



**2015**

**Proceedings of the  
7th Sacro Occipital Technique  
Research Conference**

*New Orleans, Louisiana*

*May 7, 2015*

# **Sacro Occipital Technique Research Conference**

**New Orleans, Louisiana**

**May 7, 2015**

*Hosted by:*

**Sacro Occipital Technique Organization – USA**

## **CONFERENCE PROCEEDINGS**



**Conference Chair**

**Charles L. Blum, DC**

**Research Director: Sacro Occipital Technique Organization – USA**

## **Acknowledgements:**

It is with the utmost gratitude I wish to thank all the various authors of these submitted abstracts and papers. Only with their selfless efforts can we share what we are finding in clinical practice and help build our evidence base of literature. I also wish to thank those who have donated to the Sacro Occipital Technique Organization – USA Research Fund which has helped pay for the printing of this conference's proceedings. A special thanks also goes to Pamela Woodward, DC who participated with editing of this SOT® Research Conference's Proceedings. A special thanks goes to NCMIC for supporting this research conference as well as helping to advance chiropractic and allied healthcare evidence based research.

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### **Publisher**

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# Proceedings of the Sacro Occipital Technique Research Conference

*New Orleans, Louisiana – May 7, 2015*

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# 2015 SOT Research Conference Schedule

May 7, 2015 · New Orleans, Louisiana

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<b>4:00 – 5:00 PM</b>	<p><b>Study on inducing fifth lumbar vertebra dys-relationship by M. B. DeJarnette: Historical development of sacro occipital technique</b> <i>Major B. DeJarnette, DC, DO (deceased), Charles Blum, DC</i></p> <p><b>Cerebrospinal fluid stasis and its clinical significance</b> <i>Donald Glassey, MSW, DC, LMT</i></p> <p><b>Pelvic torsion: Theoretical construct and current evidence</b> <i>Robert Cooperstein, MA, DC</i></p> <p><b>Inter and intra reliability of the heel tension test</b> <i>Karen Feely, DC</i></p>



## **Sacro occipital technique and autism spectrum disorders: A case series**

Susan Colby Allen, DC, Charles L. Blum, DC

### **Introduction:**

The prevalence of Autism Spectrum Disorder (ASD), a serious health problem with incredible societal implications, is rising exponentially. In 1975 the rate was 1:5000<sup>1</sup>; in 2010 it was reported to be 1:68 by the CDC<sup>2</sup>. Researchers at Massachusetts Institute of Technology estimated ASD prevalence rate in the US of 1:2 by 2025<sup>3</sup>. As a society we must face the debilitating costs to be absorbed by taxpayers: an estimated annual cost of \$67,000-72,000 per impacted child, a staggering \$3.2 million over a lifetime<sup>4</sup>.

The purpose of this paper is to explore how sacro occipital technique (SOT) care may improve the functional level and quality of life of children with ASD. This decreased cost of care eases the societal burden while improving the quality of life for the child with ASD and their whole family. Some doctors are exploring various methods to treat ASD giving hope for parents who want to help their child<sup>5</sup>.

Typical ASD patients' <sup>6</sup> presentations include conditions such as decreased ability to speak, high stimulation behaviors (stims) like arm flapping, repetitive movements, inability to tolerate stimulation from the environment, pre-verbal sound articulations (grunting, animal sounds, squealing, screaming), abnormal cranial formation (plagiocephaly), self-injurious behaviors (SIB's), and poor eye contact. In this case series (n=5) all children were diagnosed with autism prior to being seen at this office

While controversial, the parents of these five patients all reported a coincidental relationship between a developed regression, particularly after a severe inflammatory reaction from vaccination or a viral infection. Clinical assessment included parental subjective reporting and observations, scholastic noted improvements, ATEC (Autism Treatment Evaluation Checklist)<sup>7</sup>, as well as visual improvements in cranial appearance, including photographs, for clinical measurements.

There is a paucity of research and literature discussing chiropractic and particularly SOT cranial work for children with autism<sup>8</sup>. Clinically ASD patients have been treated in this clinic as a sub-specialty beginning four years ago and notable progress in those cases utilizing SOT therapies has been found. Theoretically SOT may add an important piece to the therapies needed to make positive changes in ASD and is especially helpful as it combines the ability to do cranial adjusting (affect supratentorial function), chiropractic manipulative reflex technique (CMRT)<sup>9</sup> affecting viscerosomatic/somatovisceral reflexes (non-musculoskeletal care), in addition to treating spinal neuromusculoskeletal imbalance<sup>10</sup>.

### **Patient #1: Case History**

This patient is a ten-year-old male. He began treatment in January 27, 2011 at the age of five. He regressed six months after a vaccine, when right afterwards he developed a viral infection in



2008. He was subsequently diagnosed with autism and acquired aphasia. He had been on DAN (Defeat Autism Now) protocols, herbalism, hyperbaric oxygen, and homeopathy, among other therapies, with limited success. He had SIB's of hitting himself in the head about ten times daily, very limited speech with attempts to say words not understandable, and was extremely hyperactive on intake. His initial ATEC on July 8, 2009 was 93. It fluctuated with different modalities done over the years prior to treatment at this office. When performed on September 2, 2011 after SOT care, it was 13.

**Treatment:** This patient presented with an almond or football shaped cranium with ridging at frontoparietal sutures and peak at the parietals. The left side of posterior aspect of this cranium had signs of plagiocephaly. His cranial distortions were first addressed. Later after a few cranial treatments he tolerated intraoral palatine spread. He received spinal manipulation and CMRT<sup>11</sup>. This patient's parents initiated an additional protocol several months after the chiropractic treatment began from Kerri Rivera's book "Healing the Symptoms Known as Autism"<sup>12</sup>.

**Results** The mother reported an increase in verbalism immediately, following the first treatment. By six months the cranium appeared normally shaped upon visual inspection by the doctor and parents. The overall gains for this child were notable, particularly the reports of his improvements at school. Once Rivera's protocol was added by the parents, further improvement was also noted. His ATEC dropped after four chiropractic treatments on February 15, 2011 to a 6, the lowest ATEC to date. After six months of chiropractic and following Rivera's protocols the patient had improved eye contact, initiated speech, and no longer had SIB's. He transitioned out of a specialized school for autism into traditional schooling on an IEP (Individualized Education Program). His hyperactivity had reduced to where he could sit patiently in the office now. He was able to go into public, eat out at restaurants and to circuses and the zoo. Currently, the patient is still working to improve his speech. The patient did experience lapses in chiropractic, cranial and visceral treatment with obvious regressions. During a time of no treatment by this office, his ATEC jumped to 29 on December 29, 2014. After resuming treatment and another detoxification protocol by the parents it returned to 9 on March 29, 2015. On April 14, 2015 he was using his finger in the air to write letters, was able to lie compliantly on the table, and followed all directions. He is trying very hard to speak, initiate speech struggling with difficulties of stuttering, though post treatment the stuttering was nearly gone.

### **Patient #2 Case History:**

A 13-year old female patient who was born premature, at 28-weeks via emergency C-section weighing one pound, five ounces presented in office with previous diagnoses of autism, failure to thrive, constipation, non-specific enterocolitis and cerebral palsy. At birth, she had liver enzyme and platelet abnormalities. At three months she was vaccinated, immediately after which she screamed and cried, and then began regression of skills she had prior to vaccinations. Strabismus developed and was surgically corrected. By eight months she was diagnosed with hydrocephaly and delayed myelination. She was hospitalized at age two for rotovirus. Chronic ear infections were problematic and she was put on antibiotics frequently for them over the years. Upon intake at this office on April 30, 2012, her medical doctor had prescribed Zithromax and Diflucan monthly. The chief complaints from the mother were that the patient screamed



and cried when urinating, constant pressure on chin was sought, and had SIB episodes. The girl wore orthotic braces, and her left leg function was minimal and with externally rotated when walking. Previous treatments included Natural Pathways, gastrointestinal specialists, DAN allopathic doctor prescribed steroids - which were somewhat helpful, and sulfur based approach was not helpful.

**Treatment:** Initial examination noted the following cranial abnormalities: parietal inferiority, especially anteriorly near coronal suture, and bulging of the occiput near lambdoidal suture. She had severe anterior head carriage, scoliosis with levorotation of the thoracic spine, and extreme limited left lower extremity use. Treatments for this patient included specific cranial adjusting including temporomandibular joint (TMJ) balancing, area 1 spread (decompressing craniofacial sutures)<sup>15</sup>, balancing sphenoid, parietals, occiput and frontal regions, spinal adjusting, extremity adjusting, CMRT, and muscle trigger points, and DeJarnette cranial sutural work to reduce cervical myofascial tension. On days when her speech is too rapid to understand, cranial treatment may be applied with the intention of creating a calming effect by working in the region of Broca's area.

**Results:** This patient is severely affected and results with her tend to vary. By her third office visit she was compliant for any treatment offered. At this time her mood is generally happy, and after the first adjustment the mother noted she was the happiest she had been in years. She does not have screaming from pain with urination that she presented with except on rare occasions. Five months after initial treatment, the parents then added Rivera's protocol. At this time the crying with urination further decreased, and her speech became understandable and increased to several word sentences. There are days her speech is very clearly understood. She continues to have vacillations of SIB's of pulling hair; however, the biting and hitting has reduced significantly. While these improvements have been noted in office, her mother and the school she attends have sent notes remarking on her behavioral improvements. Along with her social behavior improvements, her walking and muscle tone has also improved. She recently had a Botox injection in the external hip rotators at Children's Hospital. The shape of her cranium is improving and, though still narrow, the ridging and bulging is no longer present. Her social skills are improving and she looks forward to receiving chiropractic care. At this time her bowels are moving regularly. This patient shows regressions as noted by the parents as well as the autism school when time between care is inadvertently increased. A clear temporal relationship appears related to the patient's improvements and chiropractic care. Her initial ATEC in September 2012 was 101 and the most current taken was January 2014 and was 55, which represents a significant improvement in symptoms and function.

### **Patient #3 Case History:**

A 20-year-old male presented for care at this office on November 26, 2013. He circled and colored in his pain diagram himself on the intake form to head, abdomen and low back. He was born without complications. While causal and coincidental relationships between vaccination and adverse reactions are challenging to discern, according to the patient's parents he developed normally until an adverse reaction to a vaccination at nine months old from which he recovered

only partially. The parents reported that “after the nine-month shots, we stopped hearing as much babbling and gurgling attempts at speaking, and his lack of eye contact was concerning.”

At 15 months old he received a measles, mumps, and rubella (MMR) vaccination and, almost immediately following the vaccination, screamed for two days. The parents were told by their allopathic pediatrician to give him Tylenol. After that time, the parents noted that he never responded normally to spoken language again. Prior to his reaction at 15 months, the parents described, “He was responding to a lot of language, like, ‘where's your blanket’ or ‘can you get your ball?’ or ‘let's go outside.’ After the MMR, that was all gone, and the diarrhea started very shortly thereafter as well.” He began having seizures in 2010 weekly, had “pee-tox” (believed associated with a urinary detoxification process<sup>13,14</sup>), aggression and anger beginning October 1, 2013, and ongoing headaches. The parents had started their son on Rivera’s protocol September 11, 2013. He had been diagnosed by naturopath with spirochetes in live-cell blood darkfield microscopy prior to that. He had been seen by a chiropractor in 2001. His seizures appeared to be initiated when he is ill and happen following a fever spike. The seizures were so severe that one time he fell into the fireplace and was knocked unconscious. On intake at this clinic, the parents reported weekly seizures were part of his regular cycle for the past few years.

**Treatment:** On initial examination he had spinal tenderness with palpation at L4 and L5, with increased paravertebral myofascial tension. His organ scan using occipital fiber, vertebrae, and CMRT reflex assessment protocols were positive for spleen, liver, small intestine, and large intestine. He had an adverse (apprehensive) reaction to cervical foraminal compression testing (part of the orthopedic testing), which may have been due to sensitivity secondary to his chronic headaches. This patient did not show the severe head distortion (plagiocephaly) that has been noted in other patients with ASD, but imbalances were noted in the frontal, parietal and occiput cranial bones and sutures. He was treated with spinal adjusting, cranial adjustments and CMRT. This patient routinely has a frontal cranial bone imbalance and restrictions and responds well to this care. He frequently has TMJ parafunctional activity and strongly “grinds his teeth” during seizures.

**Results:** Of particular note, this patient reports immediate headache relief from adjustments with visually notable differences, seen in the photos taken. Following care when his headache subsides he demonstrates his relief by acting happy and smiling. The seizure frequency activity began changing with the first adjustment and showed increased time between episodes after nine treatments. After 26 treatments, he had a 40-day stretch between seizures, which represented a significant change in seizure activity. During the non-seizure time his TMJ function was more stable and the headaches less frequent. Although the seizures have not resolved, entirely they are less frequent and show decreased intensity. He no longer complains of low back pain, is not routinely angry anymore, and has started to like to sing more. There are certain songs he sings when happy and his mother reports he is singing more happy songs now. His speech has improved although some is still scripted repeats. Over the time of his care at this office, his eye contact improved and is now excellent. Independently the school he attends and the mother both have confirmed significant progress since the initiation of chiropractic care. His ATEC was 89 before he came to this office and has since dropped to 60. At this time his mother is more interested in keeping track of sick and seizure days than ATEC scores.



#### **Patient #4 Case History:**

A 19-year-old male presented to this clinic. His birth was a normal vaginal delivery. He did not have good sucking ability at birth and regurgitated frequently, and at two weeks he was diagnosed with microcephaly. He was breast fed for three months and was vaccinated as suggested according to the military schedule. He was constipated his entire life prior to being seen at this clinic. The patient was diagnosed with autism at age four while under the care of a neurologist for epilepsy/seizures at the Mayo Clinic. In 2007 he had sinusitis, which affected his eye, and was in the hospital for this condition. In 2011 he had surgery for sinuses, and in 2014 his wisdom teeth were extracted. This patient communicates through unique sign language with caregivers. He presented with very pale skin and thin.

**Treatment:** The frontal bone was observed to be severely sloped, appearing almost non-existent. He had parietal peaking and parietal-frontal ridging. He had marked kyphosis and scoliosis as well as anterior head carriage. He received cranial adjusting, including “area 1 spread” to improve motion at frontoparietal (coronal suture) region <sup>15</sup>, spinal adjusting, CMRT of colon and stomach, and diaphragm release on the first visit. Follow up appointments consist of cranial, spinal and organ reflex as needed.

**Results:** After the initial adjustment he had a bowel movement on his own, which was unusual for him. He also put his toys back on the bookshelf for the first time ever. By the third adjustment he was very calm after the treatment, and the mother was very surprised. By the sixth adjustment the mother reported that he was reading. The parents are trying to implement a gluten, soy and casein free diet. By the eleventh adjustment he was reported to be much more compliant, overall better, eating better, and having better bowel movements. By the twelfth adjustment a weight gain had been noted, as well as more color in his skin, causing him to appear less pale. His bowel movements were overall improved, but fluctuations do occur. He is more observant of the world around him, as reported by parents, caregivers, and his school. His eye contact has also improved. The cranial changes are improved, but abnormalities are still present. As the cranium was observed to have rounding and lifting at the frontal bone, the patient also showed improved frontal lobe emotional control and increased cognition. This patient asks to be adjusted, and he is always more calm afterwards, noted by other patients, staffing, the parents, as well as the treating chiropractor. His kyphosis is beginning to reduce along with his scoliosis. The anterior head carriage has persisted and chiropractic care is gradually being shifted to deal with this presenting condition. His beginning ATEC was 71 on intake and is 45 as of April 13, 2015. The only change during this time has been the introduction of chiropractic care. He also was reported to initiate doing dishes, including putting them in the cabinets when finished, for the first time following his last treatment. His neurologist did a repeat annual EEG and, for the first time, he showed improvement in EEG activity. The neurologist told the mother, “Please continue to do whatever treatment you are doing.”

#### **Patient #5 Case History:**

A five-year-old presented to this clinic. While he had a normal vaginal delivery, the day following his birth he had a fever and was admitted to the hospital by his allopathic pediatrician.

In the hospital a lumbar puncture was performed to assess his cerebrospinal fluid (CSF) for infections and was put on two days of intravenous antibiotics. The only vaccine he was given was the Diphtheria, Tetanus, and Pertussis combination (DTAP). The first time the DTAP was administered, the boy screamed afterward; on the second dose of DTAP, there were noted developmental regressions, such as a significant reduction in eye contact. He was talking (saying “mama”) and following directions until about one year old. By 18 months his pediatrician diagnosed him with autism. The mother did the Biomed approach<sup>16</sup> for 18 months, and then began on Rivera’s protocol. The boy had liver problems on Biomed treatments. He has “stims” of arm flapping, poor speech and delayed academics.

**Treatment:** This patient presented with good posture and a relatively normal shaped cranium however a visual plagiocephaly was noted at the lambdoidal sutural area. The adjustments administered were cranial (focused on parietals, frontal, occipital, and temporal bones), spinal and CMRT.

**Results:** After the first adjustment, the boy slept on the car ride home, which was a novel experience. At his second adjustment, he presented with less arm flapping stims while in the office. By his fourth adjustment he was very calm after care, and for the first time ever he traced a letter with a paintbrush afterward. There was greater time between the 4<sup>th</sup> and 5<sup>th</sup> office visit and some stims (arm flapping) began to return. The stims were absent about five minutes after his treatment, and he calmed completely while he waited as his mother was also treated. She kept looking at him during the treatment since it was unnatural that he was so quiet. After his fifth treatment he took a nap during the day, which is unusual. He has only been treated five times at this office due to long travel time; however, even in that amount of time he has shown a temporal relationship between care and subsequent behaviors. As of the most recent visit, overall improvements seen by the mother include spelling words and singing. He is saying 3-4 word sentences also. This boy’s ATEC went from 86 initially to 46.

## Treatment/Intervention

It is very important that the metabolic ability of an ASD patient is considered in any treatment plan. Commonly these patients have increased toxic loads and sensitivities<sup>17,18</sup> so care in each session will be limited and determined on the patient’s presentation. It is well documented that they often have a dysbiosis of their gastrointestinal system<sup>19-22</sup>, and have high ammonia levels<sup>23,24</sup>, which is theorized to be linked to parasitic infections<sup>25</sup>. CMRT<sup>26</sup> is also applied because it purportedly helps open the detoxification and circulatory pathways, and facilitates organ, as well as autonomic nervous system, function.

As a means to operationally define the cranial care rendered at this clinic, the following offers a six-step process of assessment and therapeutic application. Clinical observation suggests that ASD patients have some degree of cranial distortion or imbalance, which is noticed by both visual and palpatory analysis. Treating this imbalance is the initial aspect of care. By treating the cranial region initially, this appears to calm the patient (possibly due to parasympathetic nervous system stimulation) and develops patient trust, which is essential for children with ASD. As part of the initial office visit, visual and palpatory cranial bone and sutures are noted and



shared with the parents as they may relate to possible birth trauma and associated plagiocephaly  
27-29

Various functional assessments are utilized in order to guide care and offer metrics for parents, caregivers, and schools to monitor progress. These include, but are not limited to, pre- and post-care manual muscle testing<sup>30</sup>, assessing gait and kinesthetic body use, social cues such as maintaining eye contact, reduced agitation, increased verbal or fine tuned motor use, and other types of behaviors. The visual examination and palpation of the cranium<sup>31</sup> along with the pre- and post-adjustment functional assessments also help to guide the efficacy of care and give a rationale to the parent for the care rendered.

The initial cranial adjustment of the child is performed seated and in parts, as they often feel the need to intermittently walk around the room. Generally, after a few sessions, the patients become more compliant for adjustments and will sit or lie on the table; some eventually allow for cranial intra-oral work (pressures applied inside their mouth). Generally the cranial care (step one) focuses on adjusting the parietals with fingers contacting along the sagittal suture. If there are regions of sagittal suture tension or imbalance, or when pressure in various vectors upon the bones near a suture affects muscle strength, then the regions of symptomatology are treated using a “CSF directional technique”. This technique has been utilized in the chiropractic and osteopathic profession since the 1930s<sup>32</sup>. The pressures are generally directed from the point of imbalance along the midline towards the corpus collosum and fourth ventricle<sup>33</sup>.

Following reducing parietal bone tensions and attempting to improve CSF circulation, step two involves contact is made with one hand to the frontal bone and the other hand to the occipital bone. Each bone is assessed for balanced motion by torquing one clockwise and counterclockwise and replicating this functional motion assessment at the other bone. Ideally, balanced clockwise and counterclockwise motion is preferred. If there is unbalanced tension, the bone is held in the position it moves the easiest with gentle contacts pressing from occipital bone to the frontal bone. The goal of the gentle occipitofrontal contacts is to triangulate forces through Broca’s area towards the frontal lobe. While the contacts are at the occiput and frontal bone, the attempt is made to balance falx cerebri and periosteal dura in the region of the corpus collosum.<sup>34-36</sup>

The third step involves evaluating the temporal bones and any temporomandibular joint disorder (TMD). Commonly, ASD patients have some degree of a TMD presentation; frequently an under bite (class two) is noted. The temporals can be torqued in a clockwise or counterclockwise position to test for motion, which can be bilateral in unison or alternation, or only on one side. Many of these patients also have forward head posture as an accommodation secondary to TMD-related airway compromise<sup>37,38</sup>. To correct this, a hand contact is made to each temporal bone and they are corrected together as a means to balance any bilateral or unilateral torsion (across petrous portion of temporals) patterns. In addition, if there is any temporomandibular joint (TMJ) imbalance this is also treated to balance the muscles and joints, and to improve function.

Step four involves assessing any frontonasal compression, which clinically in this office has been found to possibly be related to seizure activity or visually-displayed headaches. To treat imbalance or increased frontonasal tension, contact is made to the frontal bone near the glabella

with very gentle anterior to posterior pressure while the nasal bones are lifted from posterior to anterior slightly inferiorward allowing the distracted tissues to relax and unwind.

While steps one through four may be all the treatment performed in the first office visit, as the patient develops trust and comfort further care can be rendered to facilitate the patient's improved function and relaxation. Step five utilizes intra-oral sphenoid balancing presented initially by Cleo Blutworth, DC <sup>39</sup>. This methodology may need to be repeated a few times in order to achieve sphenoid balance. While with an adult patient respiration assists are commonly used during the correction, in the ASD population breathing is not generally addressed.

The Blutworth cranial method <sup>39</sup> of correction uses the mastoid processes as indicators for viewing and palpation. According to Blutworth the bilateral mastoids, when they have asymmetrical width, purportedly are associated with dysfunction of adaptation due to typical head birth presentation. Usually the greater width (90% of the time) is found on the left side.

The width of the mastoid is the indicator for a starting point anterior to the soft palate. Independent of whether the occiput, temporal, and frontal are involved, the width of the mastoid will indicate the side on which to begin the correction.

The importance of treating the cranium is indicated by various tests such as: dollar/crest sign (part of SOT's category one diagnostic and treatment), visual analysis, cranial palpation, muscle testing, and other indicators which can be monitored pre- and post-testing.

Once cranial bone primary is determined then pelvic blocks are placed one at a time with the patient supine in a neutral position in between the greater trochanter and crest of the ilium. Trapezius fiber 5 (superior aspect of trapezius near midline) and 1<sup>st</sup> scalenus muscle tension is monitored as the block is vectored while monitoring ipsilateral trapezius and scalenus tension. When the tensions have relaxed, then the other block will also be placed on the opposite side using the ipsilateral trapezius and 1<sup>st</sup> rib tension as indicators. Once the pelvic regions have been relaxed then the cranial correction can continue.

While the starting contact is determined by width of mastoid, the phase of respiration is determined by anterior or posterior position of mastoid: an anterior mastoid (external rotation) is contacted in exhalation and the posterior mastoid (internal rotation) is corrected in inhalation. The first stage following block positioning is releasing the external pterygoid muscles bilaterally, and then beginning the process to determine whether occiput, temporal, or frontal is the primary site of lesion.

If the Occiput is the site of lesion (e.g., anterior left mastoid):

1. Finger contact is ¼ inch anterior to the soft palate and held on exhalation.
2. Then have the patient inhale and hold breath.



3. During exhalation, have the finger contact cross over the superior/posterior aspect of the hard palate from left to right palatine; hold as patient inhales.
4. As patient fully exhales pressure is applied to the right palatine towards the “small” mastoid

If the Temporal is the site of lesion (e.g., anterior left mastoid): correction is exactly the same but position starts ½ inch anterior to soft palate. The cross over is at the superior/mid-palate region. If the Frontal is the site of lesion (e.g., anterior left mastoid): correction is exactly the same but position starts ¾ inch anterior to soft palate. The cross over is at the superior/anterior palate region.<sup>39</sup>

In this clinic, the Blutworth protocol has been modified with autistic children. When the children’s occiput cranial rhythmic impulse (CRI)<sup>40-42</sup> does not respond with other care, then the Blutworth protocol is another cranial option utilized. Muscle testing is utilized to determine cranial therapeutic positional preferences with the patient supine and arms in a position of about 45 degrees lateral and 45 degrees anterior. Palpation of the hard palate is performed with the doctor’s index finger, noting the angle of torsion, inferiority and tension. This contact is palpated on the anterior of one side and posterior of the opposite side of the hard palate. Removing the torsion attempts to affect the sphenoid (or internal dural membranes) which is achieved by holding the frontal bone with one hand just at the edge of the frontosphenoidal suture with thumb and fourth finger as the opposite hand is intra-orally. On inspiration the intraoral finger glides gentle along the back of the hard palate to the palatine bone, which is medial to the teeth and anterior to the soft palate. This contact is held during inhalation until a release is felt at the finger contact. Then, during exhalation, the hard palate contact is maintained as it glides to the opposite side of the palatine bone and the finger slides up to this contact, which is held until it releases. If the treatment is successful, the arm strength will improve.

Often these patients present with a narrow hard palate and commonly the mandible teeth have some crowding to fit within the envelope of the upper teeth. In these cases a cranial procedure to attempt to create lateral expansion across the maxillas, palatines, and mandible (interosseous) is often performed. This procedure (step six) also purportedly helps with relaxation of the face and cranium and can improve airway space by allowing for the tongue to position more easily in the physiological rest position. Attempts are made when indicated to help relax the tongue to help with airway function and for speech improvement.

Because it is difficult for many children with autism to be still and be relaxed, the use of SOT pelvic blocks and category treatment is not always possible. The initial contacts to the cranium attempt to stimulate parasympathetic nervous system, which helps calm and sooth, the child to allow for sacral and spinal adjusting. With the patients in this study it was common to find sacral rotation patterns, and they were treated manually in order to relax the pelvis and sacrum into a balanced position. When possible, trapezius<sup>43</sup> and occipital fiber<sup>44,45</sup> analysis helped guide the location of spinal segment to be adjusted and used as a pre- and post-care assessment tool.



Often the respiratory diaphragm will need to be evaluated and treated, since imbalanced tension can complicate an already compromised airway disorder and create a low-grade discomfort that affects the patient's ability to relax. The therapeutic application attempts to relax and balance the diaphragm at its crural attachment at T11-L2 anterior vertebral body attachment, as well as at its insertion within the circumference of the lower costal margins.

In many cases there can be a non-musculoskeletal contribution to the patient's presentation, and these patients are treated with chiropractic manipulative reflex technique (CMRT) utilizing occipital fiber analysis and visceral reflex patterns to address the primary organ. Some of the most common active CMRT viscerosomatic reflex patterns in ASD patients include the liver (T8), spleen (T7), colon (L4), adrenal (T9), stomach (T5), and lungs (T3), theoretically suspected to be present due to the patient's compromised ability to detoxify their body and secondary weakened immune systems.

As a means to offer greater therapeutic responses to challenging ASD patient presentations, innovative protocols have been explored. Kerri Rivera has some provocative methods for helping patients with ASD. Rivera describes herself as not a doctor or scientist, (she recently has obtained a doctorate in homeopathy) but more as a mother with a child who has ASD and is looking for solutions. In her book "Healing the symptoms known as Autism" she outlines a diet, beginning with the crucial step of eliminating gluten, soy and dairy from the patient's diet, which is vital to recovery. It also has detailed the use of Chlorine Dioxide (CD) to oxygenate tissues and destroy and remove the overload of pathogens (yeast, bacteria, viruses, molds, and heavy metals), a low intensity non-systemic parasite protocol, and mild chelation. Finally, she describes the rebuilding benefits of hyperbaric oxygen treatments and GcMAF (Gc protein-derived macrophage activating factor) <sup>46</sup>.

Rivera's protocol uses the ATEC test, a series of questions about speech, physical health and sociality to assess a child's with ASD response to care. Though not published in the literature, Rivera claims this protocol has helped 176 children recover from autism (as defined as an ATEC score of 10 or under). Currently no other protocols have been able to replicate this success. While the chief component of Rivera's protocol, the use of Chlorine Dioxide <sup>47</sup>, or CD, has become a current hot topic of debate, <sup>48</sup> her protocol combined with SOT process described above seem to compliment each other.

Frequently the whole family may need to be considered when treating a child with ASD. While a child with ASD will be attempting to deal with his or her emotions and coping skills, the parents and caregivers also are experiencing high levels of stress and frustration that may need to be discussed and cared for as indicated <sup>49-51</sup>. Clinically, it has been found that emotional stressors for patient and family can be reduced by utilizing soothing light <sup>52</sup> and sound <sup>53</sup>.

## Results

In this study, five ASD patients had positive results, some faster than others. Patients 1, 2 and 4 presented with the most obvious cranial distortions and showed visual cranium improvement. Patient 1 showed the most improvement in all areas of improved cognition, increased daily



functioning, decreased self-stimulatory and self-injurious behaviors as well as a decreased toxic load. Patient 1 and 2 both had laboratory studies from their treating DAN allopath, which included hair and stool analysis along with allergy and blood testing prior to beginning treatment at this office. Follow up testing was not performed due to financial issues and the parents' satisfaction with their children's progress. Patient 2 has had a significant decrease in SIB's, but they have not been eliminated. Patient 3 has complications because of the seizures. While the seizures persisted, his head and body pains have subsided, and he has improved cognition, speech and gastrointestinal health. At this time the focus of care is to stabilize him to where he is seizure-free. Patient 4 has showed profound gains of self-awareness, eye contact, and initiating new behaviors as well as having his ATEC scores cut almost in half during the time of treatment to date. This parent is open to a repeat brain MRI or CT scan in the future to see any brain growth. With his frontal movement and increased cognition occurring during the same time frame, it will be interesting to see if this has any relationship to any frontal lobe brain development. He saw the neurologist a week prior to the writing of this paper, and the annual EEG that was performed on him recently was improved over the one done a year earlier. The neurologist told the mother to continue doing whatever she is doing as it is helping her son. Patient 5 was treated only a few times and showed calming and increased cognition as well as decreased stims and a drop in his ATEC scores.

In general every patient who was selected in this case study demonstrated improvements in cranial visual observation, improved gastrointestinal health, decreased SIB's and "stims," as well as an overall calming effect confirmed independently by social workers, schools, and family members.

SOT and chiropractic adjustments appear to provide an immediate benefit of calming these patients possibly by stimulation of parasympathetic (cranial<sup>8,54</sup> and sacral<sup>55</sup>) function. Long-term benefits are decreased visual cranial distortions (pre- and post-care photographs taken over time), improved verbal communication, improved cognition, improved eye contact, decreased stims and self-injurious behaviors, decreased rigidity around routines, and increased quality of life for the entire family as they become able to interact with society in a more meaningful way. Of importance is that these improvements are noted by family members, caregivers, and the school along with improved ATEC scores<sup>56</sup>.

## Discussion

The goal of cranial, chiropractic and visceral care is to improve CNS and ANS function<sup>57</sup> while also clearing pathways for elimination of waste and decreasing toxic burden to aid ASD patients in achieving an improved quality of life and activities of daily living. ASD is associated with delayed or regressed neurological development as well as gastrointestinal dysfunction and increased inflammatory markers<sup>58</sup>. The imbalance in both the PNS and SNS are apparent in this subset of patient population, which cranial adjusting, spinal manipulation, and visceral CMRT care all attempt to help improve.

While ASD has many components, the compromise of the viscera is universally problematic<sup>59,60</sup>. By adding the visceral work, it is hoped that this will help ASD patients with improved

detoxification, more normal function of the organs, and better elimination of stool as well as toxins. Fatigue of the adrenal glands that is not commonly seen in children without ASD, seems to be very common for children with ASD<sup>61</sup>, suggesting additional stressors in children with ASD. Interestingly this level of adrenal stress is found both with DAN laboratory testing as well as with CMRT protocols, and a correlation is also found as the child improves. The visceral manipulation attempts to ease the overall burden on these children which, theoretically, facilitates toxin removal, calms gastrointestinal issues, and helps improve digestive function.

Opening the detoxification pathways seems to be extremely important with ASD patients, and Rivera's first step is to get diet controlled by removing casein, soy and gluten<sup>62</sup>. The next is reducing pathogen load of viruses, bacterial overgrowth, and parasitic infection<sup>63</sup> while attempting to mobilize heavy metals to be eliminated via urine, stool or hair. It is important to note that this research is in its experimental stages, and published research to support its wide-scale usage is lacking. Consistent post-care testing of the patients who had the stool, hair, blood testing for pathogens and heavy metals would be a helpful marker for change, in addition to those assessment tools used in this study. Additionally, any tool that might aid in detoxification without overburdening the ASD patient theoretically would be beneficial.

There are various flaws to case reports, which this study characteristically has such as no control groups, no sham or placebo controlled intervention, difficulty in assessing possible regression to the mean, or ideomotor effects. Greater study and efficacy of interventions could be assessed by consistently performing pre- and post-care (at reasonable intervals) stool and hair analysis, as well as allergy and blood testing to measure toxic loads and their affect on patient presentations. It would be helpful to utilize methodology to measure cranial bone position and movement<sup>64</sup> along with qEEG<sup>54</sup> studies pre- and post-care to determine if there is a clear clinical relationship between care rendered and patient outcome.

At this time no side effect has been noted relative to the chiropractic, cranial, and CMRT care rendered to any patient in this study. It must be noted that caution is necessary when proceeding with detoxification since ASD patients are often very sensitive to toxic overloads and their bodies need to be strong enough to process various toxins being released. Therefore, working slowly and watching for patient response is crucial for a successful outcome. Rivera's protocol is still controversial and lacks sufficient evidence to recommend this option without the patient and their healthcare provider studying this methodology fully before moving forward.

## **Conclusion**

ASD is on such a rise, so developing effective low risk and low cost options are important for future care of these challenged patients. This case series discussed how chiropractic, particularly SOT and cranial care, along with adjunct procedures appeared to help these five different patients. Further research is needed to develop a pilot study with controls and greater pre- and post-care assessments to determine the value of chiropractic care for ASD patients following this treatment regimen. At this time, without greater study, no generalizations can be projected to ASD patients at large. Yet the temporal relationships of the patients' improvements as viewed by parents, caregivers, and schools suggest that further research is indicated.



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## The effect of the twin block appliance on correcting class II malocclusion and eliminating TMD symptoms: A retrospective case study.

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### Introduction

A class II malocclusion is characterized by a receding lower jaw (Fig. 1-2). Given that 66% of all malocclusions are class II, 80% of which are division I, the desire to find an appliance that successfully corrects class II malocclusion and is easy to apply by both patients as well as clinicians has led to many investigations in the field of Twin Block Appliances.<sup>1,2</sup>



Figure 1 – Profile of a patient with a receding lower jaw



Figure 2- Side view of a receding lower jaw.

The Twin Block appliance, designed originally by William Clark<sup>2</sup>, is an orthopedic appliance consisting of upper and lower bite blocks that interlock at 70° (Fig. 3-6). The appliance should be designed so that during mastication it keeps its stability and does not dislodge. The Twin Block appliance requires sufficient .09 mm ball clasps on anterior incisor interproximal area and Adams clasps on permanent molars (Fig. 5-6). The Twin Block appliance can have expansion screws (Sagittal & Schwartz) incorporated when needed. The use of labial bow on the upper part of the appliance was not originally suggested by William Clark because by retro-lining the maxillary incisor, the amount of potential skeletal change is reduced.<sup>3</sup>

Most importantly, the Twin Block appliance will help the posteriorly displaced condyle to move in a more forward and downward position in the area of the glenoid fossa. Therefore, the Twin Block appliance improves the overjet by advancing the mandible forward and corrects the overbite by guiding the molars to erupt. In addition, the Twin Block appliance achieves rapid functional correction of malocclusion by the transmission of favorable occlusal forces to inclined planes which cover the posterior teeth.<sup>4</sup>

Temporomandibular Joint Disorders (TMD) are a result of an improper relationship between the mandibular condyle and the glenoid fossa of the temporal bone (Fig. 7). Furthermore, this improper anatomical relationship may result from inadequate growth, malocclusion, and/or trauma. TMD eventually develops into a chronic disease state that worsens over time, which may influence the soft tissue, nerves, and hard tissue, ultimately destroying the articular surfaces of

both the glenoid fossa and the condyle head. The end result of TMD is pain; however muscle tension, headaches, and other Temporomandibular (TM) dysfunction may occur.”<sup>5</sup>

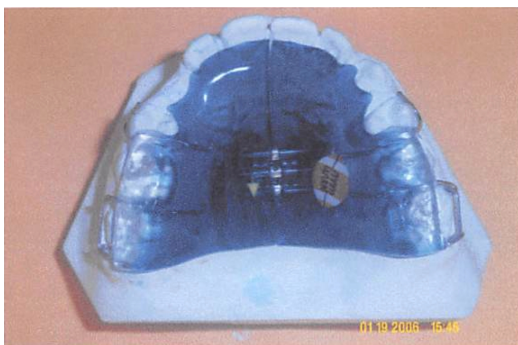


Figure 3 - Maxillary view of upper Twin Block.



Figure 4 - Mandibular view of lower Twin Block.



Figure 5 – Profile view of Twin Block



Figure 6 - Anterior view of Twin Block.

The objectives of this work are primarily to achieve a healthier condylar position by applying Twin Block appliances and secondarily to obtain an almost a perfect occlusion. In this retrospective study, 39 class II patients with one or more TMD symptoms who were treated with Twin Block appliances with the purpose of correcting their malocclusion as well as eliminating their TMD symptoms were selected for review.

### **Material and Methods**

In this study, Twin Block appliance was applied for 39 patients (22 females and 17 males; aged 8 to 16 years) for duration of 8 to 12 months (phase I Orthodontics). Every patient in this retrospective study who was treated at this private practice office paid for the services that were rendered. A written consent was obtained from the parents of all the patients along with permission to use their pictures, as is the common practice at this office. Each patient presented with one or more TMD symptoms, but all shared the common symptom of headaches. All

patients had been classified as having a class II malocclusion characterized by the clinical appearance of a retrognathic mandible and undersized lower facial height.<sup>6</sup>

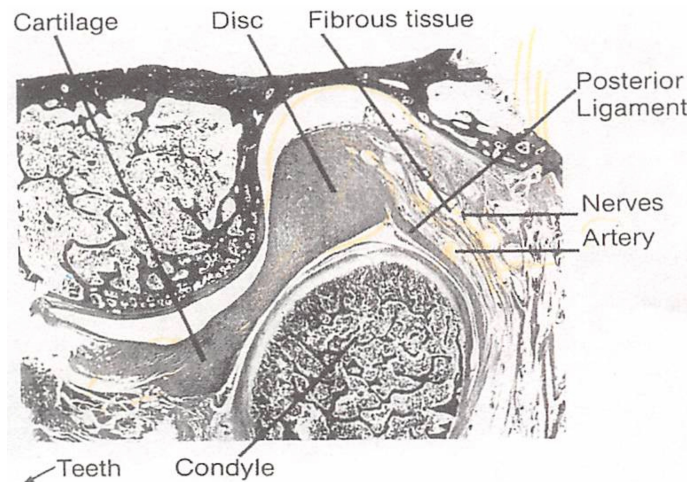


Figure 7 - Sagittal section of left TMJ.

Orthodontic records were obtained to assess the class II malocclusion. Study models, serial x-rays (Panoramic and Lateral Cephalometric), intraoral and facial photographs were taken from every patient before the initiation of the treatment. Impressions of upper and lower jaws were precisely taken with alginate material followed by a bite registration. The bite was registered with a George Gauge bite gig (Success Essentials). In this study, the intra-occlusal space was opened approximately 4 millimeter (mm). All cases were sent to Space Maintainers Laboratory (Van Nuys, CA.). Once the appliance was received, it was placed in patient's mouth and was adjusted for proper inter-occlusal space and retention.

Necessary adjustments were routinely performed thereafter. It was strongly recommended to the patients to carry the Twin Block appliance at all times, especially during mealtime. Patients were seen on a monthly basis to shave their posterior molar pads, which allowed the posterior molar teeth to erupt. Patient's TMD symptoms were checked regularly every month by means of a TMJ Health Questionnaire. Once posterior teeth were in complete interdigitation and a proper overbite and overjet achieved, the Phase I treatment was complete. Patients were then evaluated for phase II orthodontics (straight wire techniques, commonly known as "braces") to complete their treatment. All the records and questionnaires were repeated at the end of the treatment.

## Results

Thirty-nine patients suffering from class II malocclusion and TMD symptoms including significant headaches, were selected and treated for a duration of 8 to 12 months with a Twin Block appliance. Approximately one year after the treatment, the class II malocclusions of all 39

patients were corrected to class I, and their headaches secondary to TMD, were absent. In this study, three cases (Patients A, B, and C) will be presented as representative and characteristic of this case series. (Tables 1 & 2).

Patient A, a 14 years old female, had class II, division I malocclusion with overjet of 11 mm. Her chief complaint was her retrognathic mandible, and she was advised by two different surgeons to undergo jaw surgery in order to correct her bite (Fig. 8-11). She suffered from severe headaches (possibly migraines), and her family physician had prescribed analgesic medications to help relieve her pain. Aside from headaches, the patient also suffered from neck pain, ringing of her ears, jaw popping, and ocular pain. Consequently, the patient had low self-esteem. This patient was treated with a Twin Block appliance for 8 months. On her first visit, one month after placement of appliance, she reported she no longer was suffering from headaches and that the constant ringing noises she was feeling in her ears has been stopped. Phase I orthodontic treatment of Patient A was followed with braces for 12 months. At the conclusion of the treatment, Patient A was TMD symptom free and was very happy and confident. At a two-year post-treatment follow-up, Patient A was a very confident, asymptomatic young lady with a beautiful smile and a very stable orthodontic result (Fig. 12-15)

Patient	Age Year	Gender	Med Hx	TMJ Headache	Overbite	Overjet	Tx Phase	Skeletal
A	14	Female	Healthy	Severe	5	11	I & II	II Div I
B	8	Female	Asthma	Moderate	10	10	I & II	II Div I
C	12	Male	Healthy	Severe	5	0	I & II	II Div II

Table 1: Summary of Medico-dental history and treatment plan of patients representative of 3 patients before initiation of treatment.

Patient	Age Year	Med Hx	TMJ Headache	Overbite	Overjet	Tx Phase I	Tx Phase II	Skeletal
A	16	Healthy	None	1.5	11	8m	12m	Class I
B	13	Healthy	None	2.5	10	12m	26m	Class I
C	15	Healthy	None	1.5	0	8m	13m	Class I

Table 2: Summary of Medico-dental history of patients representative of 3 patients after initiation of treatment.





Figure 8 - Patient A profile before treatment



Figure 9 - Patient A frontal before treatment.



Figure 10 - Frontal view of teeth before treatment.



Figure 11 - Side view of teeth before treatment.



Figure 12 - Patient A profile after treatment with Twin Block.



Figure 13 - Patient A frontal after treatment with Twin Block.



Figure 14 - Frontal view of teeth after treatment.



Figure 15 - Side view of teeth after treatment.

Patient B was an eight year old female who was also suffering from class II, division I malocclusion with an overjet of 10 mm. Patient B's past medical history was significant for asthma and seasonal allergies. She had been using a regular pacifier for her first 3 year of life. Patient B had a retrognathic mandible, over worked facial muscles, narrow upper jaw, tight and incompetent lips, and was a mouth-breather (fig. 16-18). She suffered from TMD symptoms including headaches (perhaps tension), dizziness, pain and stuffiness of the ears.

Similar to patient A, patient B underwent treatment by Twin Block appliance with upper and lower midline screws (used for expansion) for the duration of 12 months. Her treatment was also continued by phase II orthodontic braces. As with Patient A, after orthodontic treatment Patient B was TMD symptom free, without constant headaches and her seasonal allergies and asthma have been substantially improved. The patient's parents reported that with the correction of her dental and skeletal morphology Patient B's self esteem was also significantly improved (Fig. 19-21).

Patient C was a 13-year-old male with class II, division 11 malocclusion with an overbite of 6 mm (Fig. 22-24). He had no significant medical history other than migraine headaches. Patient C also suffered from pain and ringing in his ears, dizziness, and occasional nausea and was also treated with the Twin Block appliance for the duration of 8 months followed by phase II orthodontic treatment (braces) (Fig. 25-27). Similarly, Patient C's TMD symptoms were eliminated a few days after placement of the Twin Block appliance and he has remained TMD symptom free (2 years post treatment).

## Discussion

Many orthodontic treatment modalities are capable of correcting a class II malocclusion to a class I occlusion. Functional appliances are used to correct these malocclusions by directing the movement of the mandible in a more anterior position. A successful treatment outcome depends largely on the patient's compliance. The Twin Block is a functional appliance commonly utilized in this office for the treatment of Class 11 malocclusion patients between the ages of six to 16 years. The patients (with parent corroboration) in this retrospective study reported wearing their Twin Block appliances constantly with minimum or no complaints for the total duration of their treatment.

When compared to other types of functional appliances, the Twin Block appliance is preferred by majority of patients for its comfort.<sup>7</sup> As a result, the patient appears to finish phase I of orthodontic treatment much faster and clinically appears to have more stable outcomes. The Twin Block appliance seems to help decrease the duration of phase II treatment and helps optimize the dental correction by allowing the molars to erupt<sup>8,9</sup>.



Figure 16 - Side and Frontal views of Patient B before treatment.



Figure 17 - Side view of teeth before treatment.



Figure 18 - Frontal view of teeth before treatment



Figure 19 - Side and Frontal views of Patient B after treatment.



Figure 20 - Side view of teeth after treatment.



Figure 21 - Frontal view of teeth after treatment.



Figure 22 - Side and Frontal views of Patient C before treatment.



Figure 23 - Side view of teeth before treatment.



Figure 24 - Frontal view of teeth before treatment.



Figure 25- Side and Frontal views of Patient C after treatment.

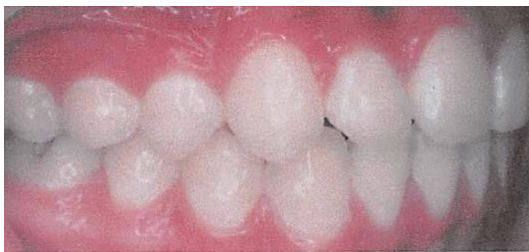


Figure 26 - Side view of teeth after treatment.



Figure 27 - Frontal view of teeth after treatment

Other authors have demonstrated similar findings of overjet reduction by application of the Twin Block.<sup>8-11</sup> Singh and Hodge<sup>12</sup> also found that the Twin Block appliance is a useful orthopedic appliance for the correction of Class II malocclusion. These authors have shown that the Twin Block appliance has a direct effect on oro-facial skeletal morphology of patients with Class II, division I malocclusion as demonstrated in Patients A and B (Fig. 8-21). Most importantly, it has been observed in this study that Twin Block appliance facilitates correction of almost all TMD dysfunction, thus reducing or eliminating its symptoms, specifically the headaches.

As demonstrated in this study, almost all patients suffering from TMD symptoms became asymptomatic shortly after placement of the Twin Block appliance. In the orthodontic literature there are numerous studies and many speculations regarding TMD and the Trigeminal-Neuro System. For instance, one of the speculations regarding TMD suggests that once the mandible is in a posterior position (class II), the condyles may also be posteriorly displaced. If the condyles are “too far back,” it could exert pressure, thus impinging the neurovascular bed, which runs in this very narrow retrocondylar space leading to inflammation of the neurovascular tissue. The chronic inflammation of the neurovascular tissue that ensues might cause hypersensitivity affecting both the limbic and hypothalamus system of the brain, which causes pain and discomfort. This “cascade effect” theoretically could be a result of the improper placement of the condyle in the fossa<sup>5</sup>

Correction of the above-described malocclusions focuses on whole body dental care, so that aside from TMD and headache symptom reduction, attaining good condylar positions and occlusion, and optimal oro-facial skeletal morphology, patient care focuses on the patients quality of life, how they feel about their “smile,” and their self esteem. The study’s results were achieved by focusing primarily on the position of mandible to the fossa, keeping proper condylar space, and eliminating any pressure or forces that are exerted on nerves and vessels in this narrow condylar region.

## **Conclusion**

Based upon this retrospective case series, it appears that Twin Block appliance can be used successfully with patients between the ages of 8-16 to help treat class II division I presentations. Along with improvement of the patients occlusion, condylar position, and dentition, secondary findings associated with positive outcomes were found, including headache reduction, improved self-esteem, and improved respiration. As with any case series without randomization, a control, or comparative group to rule out the placebo or ideomotor effect, examiner bias, regression to the mean, and other types of confounders, generalization of these findings can only be done with extreme caution. However, even with this study’s limitations, the patients’ responses to care suggest that further research is indicated.



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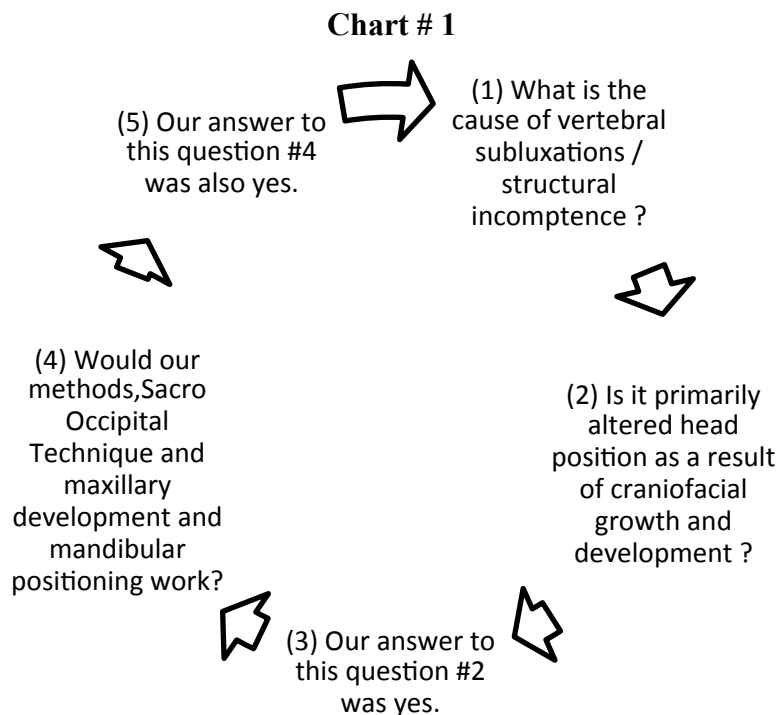
# A Review of a Commentary Published 1994: A New Management Model for Treating Structural Based Disorders: Dental Orthopedic and Chiropractic Co-Treatment.

Albert Chinnapi, Jr., DDS, Harvey Getzoff, DC

## Introduction:

The intent of this paper is to review the principles and methods outlined in the first of a series of articles published in the Journal of Manipulative and Physiological Therapeutics in 1994 <sup>1</sup>, 1995 <sup>2</sup>, and 1996 <sup>3</sup>. That article, "A New Management Model for Treating Structural-Based Disorders: Dental Orthopedic and Chiropractic Co-Treatment <sup>1</sup>", presented a management model that the authors developed over a 12 year period of time before publication. The purpose of this review by the original authors, Albert Chinappi DDS and Harvey Getzoff DC, is to examine whether those principles and methods stated in the original commentary are still valid today, 20 years later. This review reveals that the operating principles of the model as initially outlined have not changed. Methodology and techniques, especially in orthodontic materials have certainly advanced, but the underlying principles have remained constant.

In order to bring our principles from the realm of theory to a state of practicality we have utilized the following thought process, [Chart # 1] while keeping in mind the words of Ralph Waldo Emerson, "The man who grasps principles can successfully select his own methods. The man, who tries methods ignoring principles, is sure to be lost." As a result of applying these principles and methods in a significant number of patients for over 20 years, our combined model of care has been validated, with 3 cases studied over 32, 30, and 11 years.



## Principles and Methods

The initial article addresses the question of structural competence with the following statement: “It holds that the dental occlusion, as well as the spine, pelvis and cranium are determining factors in the functional health of the body. Instead of treating each as an isolated segment, the jaws, cranium, spine and pelvis are considered interdependent parts of a whole body system <sup>1</sup>.” Further along in the article we describe the principles of the co-treatment care model as that “which holds that facial-development and the resulting dental occlusion are factors in postural alignment <sup>1</sup>.” Many authors/ practitioners, Walther, Walters, Scully, Barnes, Braun, Curl and Chek <sup>4-7</sup> to name a few have written extensively about the relationship of the head, and jaw to postural dysfunction. Guyton describes the relationship of the vestibular apparatus of the head and neck proprioception <sup>19</sup>. The thoughts of some of these authors are part of the original articles. In addition to the original articles we have both published articles that further address the relationship of the head to the structures of the body. Chinappi in Inside Dentistry, “The Unity of Form and Function, The New Dental Paradigm, October 2012 <sup>7</sup> and Getzoff presented at the International Research and Philosophy Symposium 2013, a paper titled “The Relationship of Cranial Facial Growth and Development to the Sacro Occipital Technique (SOT) Category System <sup>10</sup>.”

### Philosophical Guiding Principles:

Chart # 2

The body is a functional system: not individual random parts acting independently.	We monitor functional indicators as a primary method of evaluation.	We don't treat: we facilitate change through adjustments to the system.	What we do as a clinician is either enhanced or diminished by the person we do it to.
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We share the following set of principles [Chart # 2] not only in applying the Chiropractic Dental model but also in the management of all of our patients. These principles have developed as key philosophical and clinical guides. We wrote in the initial commentary at various times about their importance and have not wavered since. As stated in the original article, “The Orthodontist is a specialist in the areas of growth and development, responsible for the correction of the results of abnormal facial growth, i.e., the malocclusion. As the Orthodontist began to work on jaw positioning and arch expansion he experienced unexpected results. He gradually converted his practice to one that places a heavy emphasis on functional jaw relationships. This applies that the diagnostic criteria are often located outside the oral cavity <sup>1</sup>.”

Also stated in the original article that simultaneously “**The Chiropractor began to look at spinal subluxations not only as a reduced or local event but as a by-product of structural deficiencies in other areas, primarily the cranium. This shift in emphasis did not minimize the role of the subluxation, but placed it within the context of a larger system.** With a greater

awareness of systematic influences the Chiropractor began to focus on the process of normal development as an initiator of structural competence or incompetence, not an isolated occurrence<sup>1</sup>.”

This model lends itself to not only a system method of care but a method of analysis based on functional indicators. As stated in the original commentary, “The co-treatment model entails analyzing each patient from a developmental and postural perspective. The Chiropractor studies the patient’s function by range of motion studies, postural observations, orthopedic tests and SOT indicators.(13) The Orthodontist analyzes developmental influences on the body of poor facial development by evaluating not only the dental occlusion but the mandibular posture. These factors are integrated with standard chiropractic and dental histories as well as lifestyle issues<sup>1</sup>.” The importance of the co-operative role of the patient in the achievement of a successful outcome can’t be underestimated. We say it this way in the original commentary: “The model demands that the patient assume a greater responsibility for the outcome<sup>1</sup>.”

**Principles of Craniofacial Growth and Development:**

**Chart #3**

<b>First Growth Site</b>	<b>Second Growth Site</b>	<b>Third Growth Site</b>
Vault and cranial base	Mid face-Maxilla	Mandible
Completed by age six	Completed primarily by age 12	Into the 20’s

Craniofacial Growth often is delineated in terms of the rate of growth of its various components. [Chart3] “The vault and cranial base develop first because of their relationship to the expanding brain. The second growth area is the mid-face or maxilla<sup>1</sup>.” Cranial bone development, the mid-face and maxilla, is both controlled by and responsive to the functional needs of all the structures and tissues involved<sup>5,9,14,18</sup>. The third growth area, the mandible, is responsive to multiple factors inclusive of the development of the mid- face and “Since maxillary growth stops earlier it seems to set the anterior limits of future mandibular growth. This, in turn, might play a significant role in the developing malocclusions<sup>1</sup>.” “The growing mandible depends on the process of intra-membrane bone formation and remodeling for the bulk of its substance. The overall mandibular remodeling and condylar growth are geared to accommodate housing for the developing teeth, to adapt to the mandibular displacement movements and to the complex growth changes occurring throughout the whole head<sup>10</sup>. Mandibular length is not predetermined genetically<sup>1,11</sup>.”



**Effects of Craniofacial Growth and Development on Structural Function:**

**Chart # 4**

Cranial/Facial function is the result of a process of growth and development	Head position is primarily a by-product of Cranial/ Facial growth and development	Altered head position affects structures throughout the system.	Clinical decisions are guided by the principles of normal Cranial/Facial growth and development.
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Much has been written about the effects that the function of the craniofacial structures have on the Structural System of the body <sup>4-7,12,14-17</sup>. The second article of our initial series traces a patient that was referred to the Chiropractor (Getzoff) from the Orthodontist (Chinappi) experiencing neck pain that showed significant improvement, both symptomatically and functionally when there was combined care <sup>2</sup>. The third article of the series illustrates a patient that was under the care of the Chiropractor for lower back pain that showed improvement, again, both symptomatically and functionally when undertaking Orthodontic care.(3) Remarkable x-ray improvement was noted and illustrated in both articles <sup>2,3</sup>. The effects of craniofacial growth were part of our commentary throughout the three articles. “If the position of the nasomaxilla complex affects the mandible, is it possible that other structures are involved as well?

Assuming the intimate anatomic relationship of the mandible to the neck and understanding the compensatory nature of the Temporal Mandibular Joints (TMJ) the mandible may act to balance the superior influences of the mid- face against the demands of the cervical musculature to set head position. Therefore, a postural change of the mandible might alter the cervical anatomy or even affect sacroiliac function <sup>1,11,12</sup>.” Our initial article cites many references referring to the influences of head position on the structures of the body <sup>1</sup>. However, as the model has evolved over the last twenty years, greater emphasis has been placed on the asymmetric development of the mandible, maxilla and mid -face and its effect on head position. This can’t be overstated, **unilateral craniofacial differences are common and proper diagnostic methods are essential.**

**Chart #5**

<b>Dental</b>	<b>Chiropractic</b>
Craniofacial Growth and Development	SOT, A Systems Method of Chiropractic
Dental Diagnosis	Basic Dental Diagnosis/Sutural Analysis
Maxillary Expansion/Mandibular Positioning	Malar/Maxillary Suture Adjusting



## **Principles and Methods of the Model of Care:**

The model of care is based on the intrinsic connection between craniofacial growth and development and structural competence.

The original paper outlined a very exact method of referring, based on acuteness, chronicity and the severity of the initial examination findings. These factors were broken down into three phases of care, preliminary, intermediate and wellness <sup>1</sup>. Referral was delayed based on the factors stated above and until certain symptomatic goals were achieved. As a result of an even greater understanding of each other's work, abilities and clinical goals, the previous method of co-treatment is seamless. [Refer to Chart # 6] The referral is made at the time of the initial patient visit. By outlining the clinical needs at the initial visit, the patient senses the urgency for combined care while placing its value at the forefront and not, in any sense, alluding to a rescue mission if done at a later time. Clinical judgments are presently based on functional needs, but symptoms are kept in mind. If symptoms remain an issue as care continues then there is greater communication between the two offices. Otherwise, functional goals have been set and continually monitored without the need for further contact unless treatment decisions require needed input. Each office refers based on functional needs even in cases where the patient presents with symptoms other than head, neck and jaw pain <sup>2,3</sup>. Both the Dentist and the Chiropractor utilize examination criteria from each other's profession. The Orthodontist utilizes both postural observation and cervical ranges of motion. The Chiropractor understands how to make initial diagnoses of dental malocclusions. Consultations, in both offices, are guided by the principles outlined in Chart # 4. It must be kept in mind that functional change of structures that have been developing and adapting for a lifetime often has some limitations and certainly can take time. In the words of Albert Einstein, "The only reason for time is so everything doesn't happen at once."

## **Combined Case Study:**

The following case study Chart # 6 illustrates the care given in each office to a 40-year old female patient. Histories, evaluation and treatment center around the Cranial Facial Growth and Development model and the structural responses throughout the body as discussed in this paper. "The model for function for Category 2 [posterior sacroiliac joint sprain] is the ability of the weight bearing structural system of the body to fully communicate through the nervous system so that maximum weight-bearing function can occur as the structural system operates within the demands of a gravitational environment. Category 2 deals with the primary neurological principle the reception of the massive sensory input (stimuli), the integration of the input and the ability of the body to respond to the input through the motor system <sup>20</sup>." Treatment and assessment of the category 2 patient is multifactorial and often utilizes pelvic blocks or wedges placed under the patient's pelvis in a supine position.



Chart #6

Present Terminology	Dental		Chiropractic		1994 Terminology
	Date	November, 11, 2010 Initial Visit	Date	November, 15, 2010 Initial visit	
History	11/11/10	<ul style="list-style-type: none"> <li>Saw 3 dentists who recommended a bite guard and made the diagnosis of a dislocating disk, needing surgery.</li> <li><b>Presented with the Magnetic Resonance Imaging (MRI) findings of closed lock. *</b></li> </ul>	11/15/10	<ul style="list-style-type: none"> <li>Pain right jaw joint,* right head (temporalis area), neck and trap area.</li> <li>Duration 20 years, more severe since August 2010. Night guard helpful initially.</li> <li>Medication (Med): Prednisone</li> </ul>	Orientation and Evaluation (Report of Findings, Referral)
Exam Findings	11/11/10	<ul style="list-style-type: none"> <li><b>Right Temporal Mandibular Joint (TMJ) closed lock with limited jaw opening of 24 mm and deviation to the right. Dental Class II malocclusion on right.</b></li> <li>Class I on left. Narrow maxilla. Right maxillary dentition, tipped to the palate.</li> </ul>	11/15/10	<ul style="list-style-type: none"> <li>Category 2, altered head position. Right, cervical restrictions, Right Leg Deficiency (RLD), left lower fossae.</li> <li><b>Cranial sutural restrictions right max. /malar, sutural release points on right.</b></li> <li>Unable to open right TMJ *</li> </ul>	Evaluation (System Analysis)
Treatment, Adjustment	11/20/10 3/22/11 3/30/11 4/20/11 12/14/11 3/20/12	<ul style="list-style-type: none"> <li>Removable Expander</li> <li><b>Cone Beam Computed Tomography (CBCT) indicates no TMJ abnormalities**</b></li> <li>Fixed Braces</li> <li>Second Expander</li> <li>Vertical Mechanics</li> <li>Braces removed</li> <li>Anterior Bite appliance for maintenance.</li> </ul>	11/15/10 Thru 1/16/11	<ul style="list-style-type: none"> <li>Category 2 blocking.</li> <li>Trap fiber 6, T8, Cervical Stairstep, Figure 8</li> <li>Sutural Technique, Right maxillary/malar, sutural release.</li> <li>Homecare.</li> <li>8 Adjustments, head righted.</li> </ul>	Preliminary (Pain Relief) and Intermediate Care (Maximum Function)
Outcome		<ul style="list-style-type: none"> <li>50% reduction in overbite.</li> <li>Jaw opening 45+ mm with no deviation, no pain.</li> <li>Significantly improved dental occlusion.</li> </ul>	1/16/11 Thru 3/26/11	<ul style="list-style-type: none"> <li>12 additional adjustments</li> <li>Complete relief, No Meds, and improvement in all findings. Now being adjusted once/month.</li> <li>No limitations in translation of right TMJ**</li> </ul>	Wellness Care (Retention and Maintenance )



\*MRI of the temporomandibular joint dated 11/10/11 impression, "Irreducible anterior displacement of right temporomandibular meniscus. The left joint was normal".

\*\*Cone Beam CT of the temporomandibular joints dated 3/22/11, "Temporomandibular joint condyles, their articular fossae and eminences exhibit good symmetry and no abnormalities.

### **Discussion:**

The period, November 2010 to March 2011, when both maxillary expansion and category 2 adjusting were making functional changes simultaneously, is when the right TM joint recaptured the disk. **Radiographic evidence illustrated the effectiveness of the therapies.**

Note that the dental and chiropractic exam findings, independently performed are similar while using different terminology. The Dentist finding a Class II malocclusion on the right while the Chiropractor found cranial sutural restriction through palpation and head position alterations also on the right.

From March 26, 2011 to present (December 22, 2014) the patient is being adjusted once per month. There is no evidence of Category 2<sup>13,20</sup> findings, no alteration of head positioning with no limitations of translation of the right TMJ. There are no reported symptoms. Thoracic 8, cervical and cranial bone and suture adjusting has continued to maintain optimum function.

We feel that this case study affirms a key statement made in the original article and questioned and commented on throughout this article. "This model of care features a high integration between the chiropractor and the functional orthodontist and assumes an intrinsic connection between facial growth and development and structural competence<sup>1</sup>."

### **Conclusion:**

*"The beginning of knowledge is the discovery of something we do not understand."*  
A P Herbert.

A mentor (Dr. Morton Amsterdam) of one of the authors (Chinappi) was fond of saying, "there are many treatment plans, but one diagnosis". The point in evidence here is that both professions need to look outside their world and understand that the body functions as a system. These systems are integrated and interrelated, inclusive of the head, spine, pelvis and dentition. Ignoring a part of it is incomplete therapy. As stated in the original article " Our purpose is not to present formal research results, but to present an alternative approach to patient management and one that has proven successful for the authors<sup>1</sup>....even 20 years later.



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## Commentary

# A New Management Model for Treating Structural-Based Disorders: Dental Orthopedic and Chiropractic Co-Treatment

This paper presents a model for treating structurally based disorders through an integrated approach to patient care. The model requires close cooperation between dental orthopedic and chiropractic professionals in evaluating and treating patients, and it demands that the patient assume greater responsibility for the outcome. It holds that dental occlusion, as well as the spine, pelvis and cranium, are determining factors in the functional health of the body. Instead of treating each as an isolated segment, the jaws, cranium, spine and pelvis are considered interdependent parts of the whole body system.

The concepts of structural and functional integration and balance are not new and have appeared throughout medical and dental literature (1-7). For example, in his textbook, *Facial Growth* Donald Enlow states, "Development is a process working toward an ongoing state of aggregate, composite structural and functional equilibrium. Any change in any given part must be proportionately matched by appropriate growth changes and adjustments in many other parts, nearby as well as distant, to sustain and progressively achieve functional and structural balance of the whole (1)."

And in his text on head, neck and jaw dysfunction, David Walther states, "Changes throughout the body, often seen on a clinical basis after making changes in the masticatory system, show how the structures within the stomatognathic system are integrated with each other, and the system is related to total body activity (2)."

Physical therapists have written widely about the relationship of the jaw to postural dysfunction. Rosemary Scully and Marylou Barnes point out that, "cervical spine disorders result in signs and symptoms that may involve not only neck but entire arm and shoulder girdle as well as head and face . . . (3)." and B.L. Braun discusses postural differences in subjects suffering from temporomandibular joint dysfunction. According to Braun, "Asymptomatic women and symptomatic women . . . show postural differences consistent with the postural theories implicating head and shoulder posture in the development or perpetuation of craniofacial pain (4)." Other theorists (5-7) maintain the belief that poor cervical posture affects the posture of the mandible and the functional demands of the stomatognathic system.

The goal of this paper is to explain the operating principles behind a working co-treatment model of care developed by the authors, a chiropractor and an orthodontist, which hold that facial development and resulting dental occlusions are factors in postural alignment. Poor facial development leads to poor occlusion and jaw position. This, in turn, results in spinal compensation, which may limit full function and health. This paper is not intended to be a definitive research study, but rather to describe one approach to patient management that has proven successful for the authors and their patients.

Since the first management principles were established over 12 years ago, the model has been modified and improved numerous times until it has reached what we believe to be its present, reproducible state. As our clinical and management skills continue to improve, the model will continue to evolve. We recognize that their interpretation of successful results may be limited or incorrect. Hence, only through an open and ongoing dialogue and further research, will the actual mechanisms be elucidated.

### Evolution of the Model

The co-treatment model represents a convergence of ideologies. The model evolved from early discussions between us regarding the management of temporomandibular joint (TMJ) problems in mutual patients. Initially, each focused on the joint as an isolated area, rather than as a subset of a very complex system. Over time, however, the focus of each began to widen to include a broader systems approach. While the orthodontist was looking to the neck and upper body for explanations of his findings, the chiropractor was discovering his answers in the cranium.

The orthodontist is a specialist in the areas of growth and development, responsible for correcting the results of abnormal facial growth, i.e., the malocclusion. Traditional orthodontic assumptions hold that jaw position is static—it stays where it is when the patient presents—and the length of the bony arches should not be enlarged or widened. Further, it is justifiable to extract teeth to correct bite positions and alter arch alignment if conditions warrant. If the resulting arches are smaller as a result of those extractions, this is believed to be of little consequence.

As he began to work on jaw positioning and arch expansion, the orthodontist experienced unexpected results. The search for explanations led to a study, first of the TM joint, and later to an analysis of the relationship of the mandible to the neck, the upper body and the rest of the spine. He gradually converted his practice from traditional orthodontics to one that places a heavy emphasis on functional jaw relationships. This implies that the diagnostic criteria are often located outside the oral cavity. This shift in emphasis began with adolescent patients and broadened to include adults as well.

Simultaneously, the chiropractor began to look at the spinal subluxation not only as a reduced or local event but as a by-product of structural deficiencies in other areas, primarily the cranium. He expanded his training and practice to include cranial manipulation based on *Sacro-Occipital Technique (SOT)* principals established by DeJarnette (8). This shift in emphasis did not minimize the role of the subluxation, but placed it within the context of the larger system. With a greater awareness of systematic influences, the chiropractor began to focus on the process of normal development as an initiator of structural competence or incompetence, not an isolated occurrence.

The chiropractor was taught that the spinal subluxation is the cause of all dysfunctions, and that identifying the subluxation and correcting it will restore health. As he practiced *craniopathy* in the context of the SOT category system (9), spinal function improved. He knew that the vestibular mechanism righting reflexes (of which the eyes are a major element) play a vital role in postural dynamics throughout the body (2, 10, 11). He also knew that the mandibular depressors are the head flexors and since head position has a dynamic effect on the mechanoreceptors of the spine, head and jaw position must be related to cervical corrections.

As the authors were developing these ideas on their own, their conversations about mutual patients led to a synthesis and amalgamation of ideas. They began to suspect that growth and development of the face and cranium are critical to the health of the spine and rest of the body.

### Growth and Development

Craniofacial growth often is delineated in terms of the rate of growth of its various components. The vault and cranial base develop first because of their relationship to the expanding brain. This growth is complete by about 6 yr of age. In close proximity to the cranial base, the second growth area is the mid-face or maxilla. The growth in width of the maxilla is 95% complete

for males and 98% complete for females by 12 yr of age (12).

The last area of focus is the mandible. Its growth activity extends well into the 20s. While the maxilla, which is associated more closely with the growth of the basicranium, is joined to the cranium by sutures, the later developing mandible is joined to the head by a bilateral joint articulation.

The growing mandible depends on the process of intra-membranous bone formation and remodeling for the bulk of its substance. The overall mandibular remodeling and condylar growth are geared to accommodate housing for the developing teeth, to adapt to the mandibular displacement movements, and to adapt to the complex growth changes occurring throughout the whole head (1). Mandible length is not predetermined genetically (13) and the condylar cartilage is a secondary, as opposed to primary, growth site.

According to Enlow, during growth, the human mandible becomes entrapped below and behind the rotated nasomaxillary complex and the upright body posture positioning of the basicranium and cervical region. Overbite and overjet, or anterior crowding, are an evolutionary and developmental means to compensate for the vulnerable positioning of the mandible and its temporomandibular joint (1).

Since maxillary growth stops earlier, it seems to set the anterior limits of future mandibular growth. This, in turn, may play a significant role in developing malocclusions. Since displacement and remodeling are the most fundamental activities of bone growth, maxillary deficiencies or excesses will tend to prevent the mandible from reaching its "correct" Class I position. The malocclusion, therefore, is the outcome of poor growth in the craniofacial complex.

### Effects of Facial Growth on Posture

If the position of the nasomaxilla complex affects the posture of the mandible, is it possible that other structures are involved as well? Assuming the intimate anatomic relationship of the mandible to the neck, and understanding the compensatory nature of the TM joints, the mandible may act to balance the superior influences of the mid-face against the demands of the cervical musculature to set head position. Therefore, a postural change of the mandible might alter the cervical anatomy or even affect sacroiliac function (14, 15).

Flexion of the head on the cervical column and flexion of the neck on the thoracic column depend on the anterior muscles of the neck. Since these muscles are located at a distance from the cervical column, they



act as a long arm of a lever (19). When these muscles act simultaneously, the mandible is lowered; but if the mandible is fixed by contraction of the muscles of mastication (the masseter and the temporalis), then the suprahyoid and infrahyoid muscles produce flexion of the head on the cervical column and flexion of the cervical column on the thoracic column while simultaneously flattening the cervical curvature. Consequently, they are very important in supporting the cervical column at rest (2, 3, 15).

According to Scully and Barnes, "The proximity of the temporomandibular joint to the pharynx and cervical region results in a uniquely interdependent relationship between these two regions. Trauma or dysfunction of one group of muscles, namely prime movers of mandible or accessory muscles such as suprahyoid or infrahyoid muscles, may adversely affect all cervical supporting musculature. Conversely, trauma to the cervical region, as in whiplash injury, may manifest as signs or symptoms of TMJ dysfunction (3)."

A person whose head is bent downward due to the contracture of the mandibular elevators must hyperextend his head to look forward, and this causes a posterior closure of the space between the occiput and atlas (16). In addition, the cervical column and thoracic column as far as T5 are flexed, resulting in a loss of the normal cervical lordosis from C3 down. In their study, Moya et al. found the use of a full-arch maxillary stabilization occlusal splint also produced significant extension of the head on the cervical spine. This, in turn, resulted in a decrease in cervical lordosis in the first, second and third cervical segments (17).

Kapandji emphasizes that the anterior apex of the anterior cervical curve is the posterior inferior border of C4. The head is in equilibrium when the eyes look horizontally (11). He describes it this way, "The head taken as a whole constitutes a lever system, the fulcrum lies at the level of the occipital condyles which is posterior to the center of gravity. A force is produced by the weight of the head applied through its center of gravity lying near the sella turcica. The posterior neck muscles are constantly counterbalancing the weight of the head that tends to tilt it forward." Kapandji further observes that the extensor muscles counteract gravity whereas the flexors are helped by gravity.

If we consider that the bite position of the mandible, i.e., the position it assumes when teeth are brought together, is relatively fixed at 10 yr of age, then it may be possible that the mandibular posture plays a role in the function of the neck. Assuming there is a relationship between the mandible and head position, how would that affect the practice of chiropractic and ortho-

dontics? This next section will explain how the authors incorporate these assumptions and observations into routine clinical practice.

#### **The Model—Patient Evaluation and Preliminary Care**

The co-treatment model entails analyzing each patient from a developmental and postural perspective. The chiropractor studies the patient's function by range of motion studies, postural observations, orthopedic tests, and SOT indicators (8). The orthodontist analyzes developmental influences on the body of poor facial development. These factors are integrated with standard chiropractic and dental histories as well as lifestyle issues, including diet.

Preliminary care patients may be in sharp debilitating pain of recent onset, or can be suffering from a long history of dull, chronic facial pain. If the pain is more chronic, then the orthodontist may delay referral until he accomplishes a complete diagnostic workup. If a patient in acute pain enters the system at the orthodontic practice, the preliminary evaluation is followed by immediate referral to the chiropractic team member. It is imperative that the dental patient learn that the immediate solution to his or her problem may lie with chiropractic, rather than dentistry, since typical dental solutions may only alleviate the pain and not address the underlying problem.

Dental solutions can be allopathic and/or invasive. The orthodontic team member tries to avoid the use of splints in the early stages of treatment. Splints work to relieve pain by changing proprioception in the craniomandibular complex but unless the splint is worn continuously the results are temporary or, in some cases, negative (18–21), and it is this need for continued use of the splint that often results in significant adverse dental changes that later render more definitive treatment difficult. It is much less invasive and more therapeutic to do good chiropractic at this point to relieve the acute distress and thereby eliminate the need for splints.

The patient entering the system through the chiropractic office, whether acute or chronic, is managed the same. The chiropractor first explains the concept of the interconnection between the jaw position and cranium, spine and pelvis. After examination, the patient is apprised of his or her basic dental needs and their effect on the body. An initial dental referral is given early in the relationship. The goal is to ascertain specific dental requisites that can be undertaken after chiropractic acute care or, if the patient is not acute, immediately. This dental analysis is shared with the chiropractic

office so the goals and/or limitations can be determined and presented.

In the preliminary phase of SOT, chiropractic treatment primarily is centered on controlling the diagnosed category (treatment protocol) and restoring cranial sutural motion (8, 15, 22). In Category II (sacroiliac weight bearing subluxation causing neural failure due to an inability of the body to maintain itself against gravity), blocking is done to close the sacroiliac weight bearing lesion and psoas stretching and iliofemoral range of motion adjustments are made. "Figure 8" and "stair-step" (23) adjustments are performed to enhance cervical ranges of motion. The spine is adjusted according to palpation, while sutural adjustments are made to specific areas identified by cranial ranges of motion (8, 15, 22).

Most, but not all, of the acute preliminary phase co-treated patients are Category II. Some are Category III (lumbar subluxation/discogenic syndrome involving nerve root compression or stretch syndrome). Those are treated to control the lumbar lesion identified by palpation, neurologic and orthopedic testing such as straight leg raise, Braggard's, Ely's, Hutching's and Goldthwaites' tests and the "step out/toe out" test. Those that exhibit no positive neurologic indicators (patella and Achilles tendon reflexes and dermatomal testing) are treated cranially in a manner similar to the Category II's, using cranial ranges of motion to identify the areas of dysfunction (8, 22) and then applying sutural techniques (8, 15).

The initial exam establishes baseline findings. On each subsequent adjustment, the chiropractor reevaluates the findings and compares them to the initial and the previous visit's findings. The goal is to maintain improvement from visit to visit. As the patient improves, the acute symptoms diminish but the adjustments are continued. Progress is monitored through the analysis of findings, not symptoms. This form of analysis helps in later communication with the dentist because he has objective measures for his treatment as well. Concerns of how far to go in dental correction often can be modulated against how the body is functioning as compared with its functional state at the beginning of treatment.

For those patients who have not made a definitive decision on orthodontic care, the end of the preliminary phase is a critical time. They now are out of pain and have been counselled by the chiropractic team in the benefits of orthodontics. They have had a dental evaluation and are aware of their dental needs. They have a sense of their own capacity for wellness and can make a decision, not based on the need for relief, but on a

desire for greater health. This is a positive, not a fear-based point.

#### **Intermediate Care**

At the point of intermediate care, the patient has accepted the management system philosophy and the acute or immediate problems have been resolved. The term "intermediate care" differentiates this level of care from the more "sickness" based level that precedes it. For it is in this phase of treatment that significant structural change occurs. It also is in this phase of treatment where the orthopedic dental changes are made, such as the maxillary and mandibular postural changes required for structural improvements. From a dental perspective, the chiropractor must continue to keep the patient healthy enough for the orthopedics to work.

During the intermediate care phase, chiropractic adjustments are continued until the findings stabilize, i.e., there is no significant improvement from the previous visits. At this point, the symptoms are under control and this information (the findings) now becomes the new baseline.

#### **Wellness Care**

From a dental perspective, this level of care is more differentiated than chiropractic. It is at this point that more traditional dental procedures are performed, including the placement of crowns, bridges and fixed braces to move the teeth if necessary. These procedures are performed now because the body has improved function and is ready for these definitive procedures. These procedures create the final occlusion that ultimately will hold the jaw in the new position established during the preceding phase of treatment. This phase creates the natural orthotic that supports the result.

In standard dentistry, this treatment phase is performed without benefit of the preliminary and intermediate phases of care. Thus, it can be argued that the body is not ready, nor in the proper alignment, to accept this level of care. This presents a conceptual departure from traditional dentistry, specifically in those cases that require a form of combined therapy. In a sense, this defines functional dentistry as the type of dentistry that requires a healthy cranium and neck prior to initiating treatment.

In wellness care, the chiropractic goal is to maintain the new established baseline of functional findings, with occasional adjustments and good lifestyle counselling. The emerging improved and stabilized occlusion helps to balance the rest of the system's function. Typically, at this point the Category II's and III's have evolved



into a Category I (cranial dural subluxation), where maintenance of primary function can be sustained.

**Treatment Goals and Objectives**

The model (Figure 1) is built on the concepts of improved function, rather than relief from pain. This implies that there are preexisting desirable outcomes that can be reached in most cases. The treatment goals are outlined below. The operating principal is that if these goals are reached, the symptoms will be diminished greatly, if not completely. Thus, efficacy is a measure of structural change and functional improvement, not symptom relief. Table I notes the respective findings from the chiropractic and dental/orthodontic points of view.

Both the chiropractic and the orthodontic office pursue a clinical model focused on maximizing function.

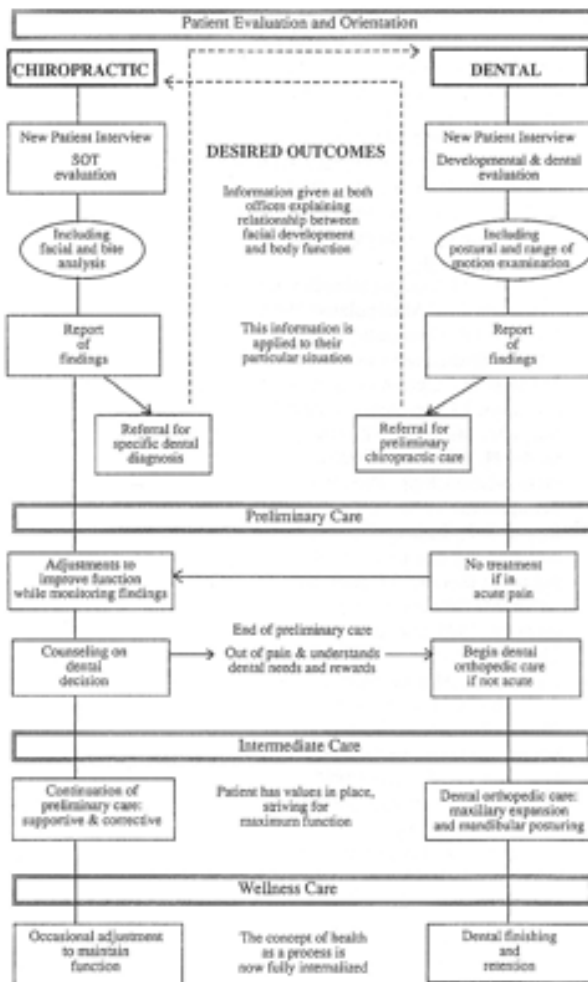


Figure 1. Co-treatment model.

TABLE 1. Respective chiropractic and dental/orthodontic points of view/findings

<b>Chiropractic</b>
Less resistance of cranial sutural motion
Improved head position
Improved cervical ranges of motion
Improvement of the lumbosacral angle with less disc compression and increased motion
Less anterior displacement of the thoracic spine
Better TM joint motion
Stability of the SOT Category II and Category III indicators
<b>Dental-Orthodontic</b>
TM joint opening, 45 mm or more
Good excursive jaw motions
Class I canine position
Full maxillary width
Corrected skeletal and dental midlines
Limited overjet and overbite

The chiropractic office uses techniques that maximize function throughout the body, while the orthodontist attempts to merge the dental correction with the chiropractic results. Often, "ideal dental goals" supported by the more traditional model may not be appropriate as overall body function improves.

Coordination often is very important to selecting the best solution for a particular problem. In these situations, the orthodontist may have to select the appropriate dental compromise. He may not have the luxury to "go by the book." Integration of care from both perspectives is more important than using blindly installed cookbook methods. The chiropractor and the dentist each work toward a negotiated result that measures its success against the improved functional findings not an idealized concept of how the mouth should look.

**Behavioral Implications**

Patient responsibility in this type of practice model is different from that in a more conventional approach. Here the patient assumes greater responsibility for the outcome and level of wellness attained. Upon achieving a predetermined goal, the patient and physician(s) may reevaluate and renegotiate a new, higher goal. It is this proactive patient/physician partnership that empowers the patient to achieve levels of wellness that often are unexpected. In this model, the patient must understand and own the concept and be aware that the co-treatment team will measure success by continually evaluating findings. The responsibility for diet, exercise and emotional well-being, including attitudes toward treatment and health, rests solely with the patient.

For patients not accustomed to taking charge of their health and well-being, this can be very intimidating. But for the clinician, this model can be liberating. The doctor becomes a teacher, a helper and no longer is cast in the role of rescuer. The doctor and team inform and



treat, while empowering the patient to share responsibility for the outcome.

This approach to patient management also facilitates the development of a team-based staff model, one that takes responsibility for itself and requires less hands-on supervision. The advantage of this style of management is that team members not only become good employees but also excellent role models. Their responsible attitudes toward patient care become a modeling experience for the patient.

The co-treatment model, casts the management team as a single team, comprising the doctors and staff of both offices, each linked by a common philosophy. Management techniques are developed at both offices through individual staff meetings and in combined meetings where the expertise of each office is shared and integrated. It is important that the patient have a similar experience at each office, and that the offices support one another. This high level of consistency is required to affirm the message. The patient begins to trust his or her body and the team's ability to help when he or she sees and experiences high levels of trust throughout the process.

#### CONCLUSION

This model of care features a high integration between the chiropractor and functional orthodontist and assumes an intrinsic connection between facial growth and development and structural competence. The degree of integration, not only in the model but also in the approach to the body, affects all levels of care and management. By working together to optimize function and foster wellness, the results have been exciting and liberating for the patients as well as the co-treatment teams.

The purpose of this commentary is not to present formal research results but to present an alternative approach to patient management and one that has proven successful for the authors. It is our hope that the concepts presented here will inspire a dialogue between other practitioners and foster an interest in controlled research studies.

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## The Dental-Chiropractic Cotreatment of Structural Disorders of the Jaw and Temporomandibular Joint Dysfunction

Albert S. Chinappi, Jr., D.D.S.\* and Harvey Getzoff, D.C.

### ABSTRACT

**Objective:** To present a case demonstrating the concept of integrated dental-orthopedic and craniochiropractic care for treating structural disorders of the jaw, neck and spine.

**Clinical Features:** A 33-yr-old woman sought orthodontic therapy for an overbite and severe crowding of the lower teeth. She reported a history of bilateral headaches and jaw popping. Orthodontic examination revealed degenerative changes in the right temporomandibular joint and restricted jaw opening. While in treatment, the patient began to experience severe temporomandibular joint pain and neck/lower back pain, which convinced her to accept chiropractic care. Initial chiropractic sacro-occipital technique (SOT) evaluation found Category II weight-bearing instability of the sacroiliac joint, specific thoracic and cervical vertebral subluxations, cranial sutural restrictions and temporomandibular dysfunction. Cervical X-rays revealed absence of the



anterior cervical curve, characterized by parallel vertebral base lines.

**Intervention and Outcome:** In addition to orthodontic treatment, the patient also received semiweekly (then bimonthly) adjustments of the spine, neck and cranial sutures. The cotreatment approach eliminated pain while improving head, jaw and tooth position.

**Conclusion:** The position of the jaw and head and neck are intricately linked. The acute symptoms experienced during the initial dental treatment phase were caused by the inability of the head and neck to adapt to maxillary and mandibular changes. Chiropractic treatments enabled the body to respond positively to the dental changes. As the mandibular position improved, further improvements were indicated by physical testing and X-rays. (*J Manipulative Physiol Ther* 1995; 18:476-81)

**Key Indexing Terms:** TMJ Syndrome, Chiropractic Manipulation, Orthodontics, Cervical Vertebrae.

### INTRODUCTION

Treating structural disorders of the jaw, neck and spine within a model of integrated care was discussed in detail in previous work (1). The model requires close cooperation between dental-orthopedic and cranio-chiropractic professionals in evaluating and treating patients. It holds that dental occlusion, as well as the spine, pelvis and cranium, are determining factors in the functional health of the body, and facial development and resulting dental occlusions are factors in postural alignment (2-5). Thus, poor facial development leads to poor occlusion and jaw position. This, in turn, leads to spinal compensation that may limit full function and health. In this integrated care model, the jaws, cranium, spine and pelvis are considered interdependent parts of the whole body system and not isolated segments. In such a model, the patient also assumes greater responsibility for the ultimate outcome of the treatment. In short, the patient becomes an active partner in the pursuit of his or her own health.

This clinical case is noteworthy in that it demonstrates how

integrated care can significantly improve the benefit to the patient. It presents a treatment chronology for a patient who began with only facial orthopedics and then later, at repeated urgings of the orthodontist, added chiropractic care. The subsequent improvements support the concept of integrated care as an aid to improving function and health.

### CASE REPORT

In November 1989, a 33-yr-old woman began orthodontic therapy to "straighten her teeth." She reported a history of years of bilateral headaches, occurring primarily in the evening, and she also complained of popping in her jaw joint. These were not her reasons for seeking orthodontic care, however.

Her malocclusion was classified as a Class II (a posterior posture of the mandible) characterized by a dental overbite and severe dental crowding of the lower teeth (Figure 1). Her temporomandibular joints exhibited a bilateral click with an opening of 37 mm (normal is > 45 mm) and her jaw opened to the right. Radiographic examination of the temporomandibular joint revealed degenerative changes in the right joint (Figure 2). Despite these findings, this patient's primary concern was with aesthetics and not with function.

Treatment began in December 1989 and was uneventful. However, by September 1990, symptoms of tightness in the neck and temporomandibular joint became sufficiently acute

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Paper submitted January 13, 1995; in revised form February 23, 1995 and March 9, 1995.



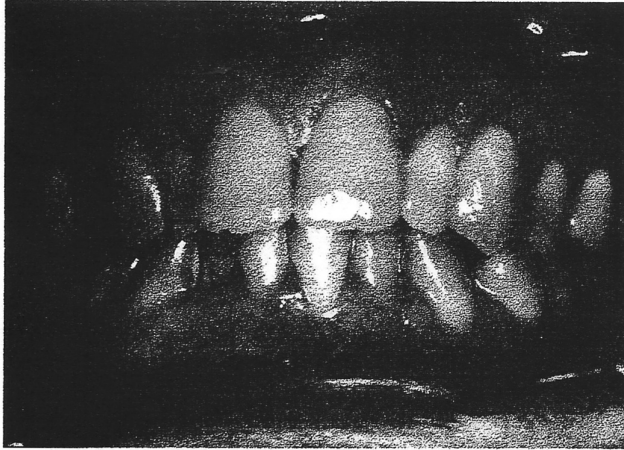


Fig. 1 Pretreatment interoral view.

that the patient accepted referral to the chiropractic member of the team. She complained of acute left temporomandibular joint pain of a 2-wk duration and the inability to open her jaw. (Contralateral pain is not uncommon when dysfunction occurs in one of two opposing joints. It seems that the body protects the damaged joint by minimizing its mobility and then compensates for that immobility through hypermobility of the opposite undamaged joint.)

The initial chiropractic sacro-occipital technique (SOT) evaluation determined that this patient was a Category II, characterized by instability of the weight-bearing sacroiliac joint, with forward head position (Figure 3). Category II also is characterized by lateral plumb line sway (6) (the body's way of compensating for the instability in the sacroiliac joint), a positive arm fossa test and left psoas muscle contraction. The arm fossa test is one of the least understood SOT procedures; basically, it involves subjecting the patient to multiple stimuli in an effort to judge the patient's pelvic stability in coordinating upper and lower motor systems. The multiple stimuli used in the arm fossa test include the resistance of the arm to externally applied pressure, an auditory command to hold the

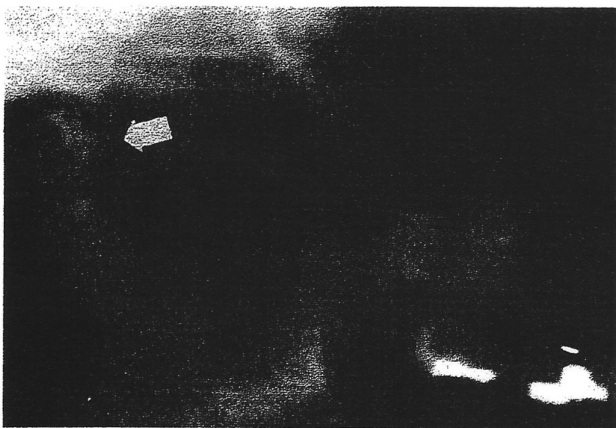


Fig. 2 Pretreatment panoramic view showing poor contour.



Fig. 3 Pretreatment, forward head position.

arm in position, tactile stimulation of the inguinal area and the patient's visual observation (7).

The initial examination also revealed cervical restrictions on the "stairstep" and "Figure 8" evaluations—primarily forward flexion and left rotation (65°). The "stairstep" test involves cervical translatory movements, whereas the "Figure 8" involves cervical rotational and lateral range of motion compressive movements. Both are conducted with the patient in a supine position.

The patient exhibited temporomandibular dysfunction, with bilateral temporal sutural restrictions and right malar-zygomatic, maxillary/malar sutural restriction. Sutural restrictions are characterized by limited relative motion when pressure is applied to specific cranial sutural areas. The chiropractor also performed trapezius and occipital fibers analyses to identify spinal subluxations and found an active occipital fiber in area 4, line 2, and a trapezius fiber 4 with a corresponding T6 subluxation (Table 1). Fiber analysis is used by SOT practitioners as a guide for quickly locating and identifying the type of subluxation. It is used as a guide for palpation. An occipital fiber along the tendon insertion of the cervical muscles at the posterior occiput, for example, will provide clues as to whether the subluxation is inferior or rotational and if it is viscerally related.

In addition to fiber analysis and palpation, the chiropractor took anterior-posterior (A-P) and lateral cervical X-rays. For the X-rays, the patient was instructed to stand and look directly at her own eyes in a mirror. The central ray was focused on the lateral transverse process of C1 (Figure 4). X-rays taken on October 23, 1990, revealed (Table 2) no apex of the cervical curve (George's Line), an anterior cervical curve angle of 0° (Jackson's Angle), and parallel vertebral base lines.

The patient visited the chiropractic office 2 times per wk for a month. After that, the frequency decreased to 2 times per month, and then, once a month. At the present time, the patient is seen every couple of months. The patient's initial treatment consisted of Category II adjusting protocol, including:

- supine pelvic blocking to position the sacroiliac joint for healing of the interosseous ligament,

**Table 1.** Physical findings

	Prefindings		Postfindings	
	10/23/90		3/27/92	9/6/94
Category	II		II	No active category
Plumb line sway	Lateral		No lateral sway	No lateral sway
Arm fossa	Positive		Negative	Negative
Psoas	Left psoas contraction		Negative	Negative
Cervical ROM	Restricted forward flexion and left rotation (65°)		ROM improved left cervical rotation (90°)	Normal ROM
TMJ	Posterior left TMJ misalignment bilateral click		No misalignment, no clicking	No misalignment, no clicking
Cranial	Bilateral temporal sutural restriction, right malar/zygomatic, right maxillary malar sutural restriction		Clear, no restriction	Clear, no restriction
Occipital fibers <sup>a</sup>	Area 4, line 2		Not tested	Not tested
Trapezius fiber <sup>a</sup>	4		4	4
Vertebral subluxation	T6 inferior subluxation		T6 inferior subluxation	T6 inferior subluxation

ROM = range of motion; TMJ = temporomandibular joint.  
<sup>a</sup> With corresponding spinal palpation.

- arm fossa test monitoring,
- cervical stairstep and Figure 8 adjustments and
- right malar/maxillary sutural adjustment, which involves applied pressure in a specific direction to create sutural motion.

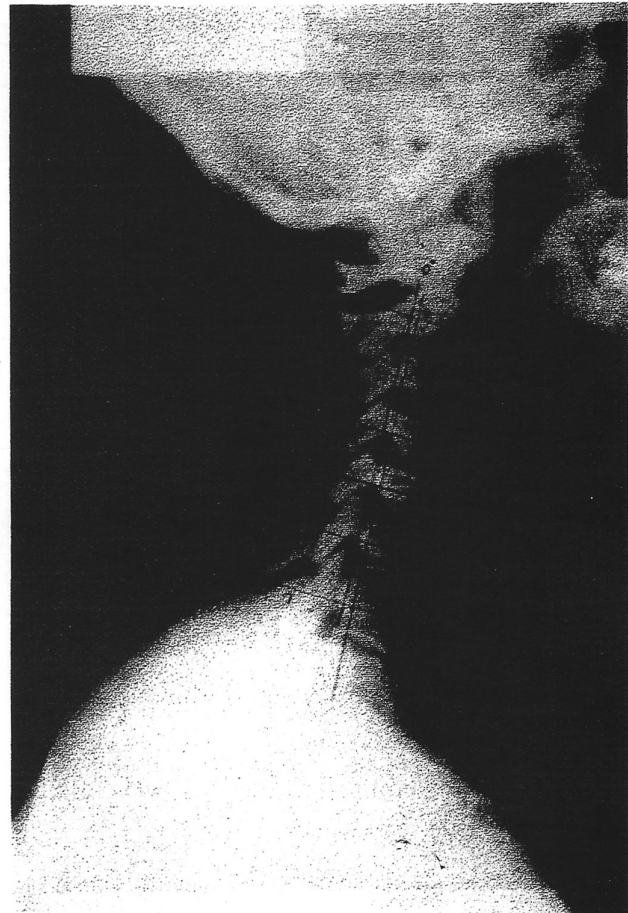
Specific spinal adjustments were directed by trapezius and occipital fibers analyses (primarily T6). The patient also received home care instructions for the cervical spine (7). Within a month, the patient was subjectively "doing great." The acute left temporomandibular joint pain and the inability to open her mouth had diminished significantly and she was able to continue her orthodontic work. Final positioning of the jaw and dentition proceeded to completion.

Within approximately 6–8 wk, all Category II indicators had diminished. There was no lateral sway on the plumb line and no arm fossa findings. Temporomandibular function improved and Figure 8 assessments produced fewer findings (Table 1). Overall cervical range of motion had improved and left cervical rotation had reached 90°.

As of her last appointment on October 18, 1994, the patient had been pain free for 1 yr. Dental examination showed a reduced overbite, symmetrical arch form and good postural position of the mandible (Figure 5). Temporomandibular range of motion had improved and both joints were quiet, with no clicking. The posttreatment X-ray of the right temporomandibular joint indicated an improved cortical contour, with a reduction of the osteophyte formation, suggesting a reversal of the earlier degenerative changes (Figure 6). Future X-rays may provide more definitive evidence of this positive reversal.

On chiropractic examination, the patient showed no weight bearing instability (no active category), improved head position (Figure 7) and the cranial findings were clear (Table 1). That is, under range-of-motion studies (8), the cranial sutures were pliable and displayed a normal range of movement. The patient's cervical range of motion was within normal limits. Only a T6 inferior scope adjustment was made, based on spinal palpation and a trapezius 4 fiber findings (Table 1). As one

would expect, in the 3-yr period of treatment, there were occasions when the Category II became active again, but the fluctuations always were within normal limits and never acute.



**Fig. 4** X-rays taken October 1990.

**Table 2.** X-ray findings

X-ray	Prefindings		Postfindings	
	10/23/90	3/27/92	3/27/92	9/6/94
Apex of the cervical curve <sup>a</sup>	No apex	C3–C4	C3–C4	C3–C4
Anterior cervical angle <sup>b</sup>	0°	11°	11°	16°
Vertebral base lines <sup>c</sup>	Parallel	Posterior converging C3/C4 base lines	Posterior converging C3/C4 base lines	Continued posterior converging C3/C4 base lines

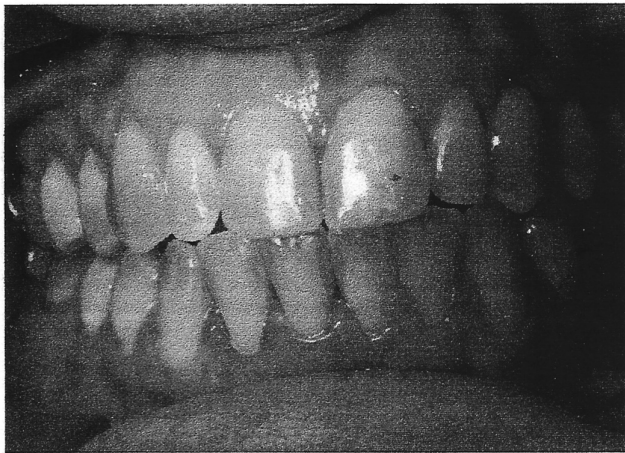
<sup>a</sup> George's Line, also known as the posterior vertebral alignment line and the posterior body line, measures the integrity of the posterior vertebral body alignment. The key is the alignment of one vertebra to a superior and inferior vertebra. If normal, George's Line also gives you the appearance of the anterior cervical curve.

<sup>b</sup> Jackson's Angle is determined by constructing measurement lines from the posterior bodies of C2 and C7. These lines ordinarily form an angle (approximately 42°) that intersects at the C4/C5 disc interspace. A decreased angle indicates hypolordosis, resulting in anterior displacement of weight bearing in the cervical curve.

<sup>c</sup> The lateral base lines are drawn through the plane of each vertebra, parallel to the inferior and superior epiphyseal plates. The lines should converge at a central point on the posterior lateral spine view. This is a qualitative analysis used by the physician to judge the relative loss, increase or normal function of the cervical curve. When a base line intersects with the next superior base line, this indicates fixed flexion of the inferior vertebra(e), whereas a base line that intersects with the next inferior vertebra indicates fixed extension of the superior vertebra(e). Fixed flexion or extension leads to biomechanical dysfunction with concomitant early degenerative changes.

X-rays taken on March 27, 1992 (Figure 8) and compared with initial films revealed apex of the cervical curve at the C3/C4 level, indicating a return of the cervical lordotic curve

(Figure 9), an increase in the anterior cervical angle from 0° to 11° and a posterior convergence of the C3, C4 vertebral base lines.



**Fig. 5** Posttreatment interoral view.

Another lateral cervical X-ray, taken on September 6, 1994, showed a greater apex of the cervical curve, an increase of the anterior cervical angle to 16° and the continued posterior convergence of the C3, C4 vertebral base lines (Figure 10), despite the fact that the patient had completed orthodontic treatment and had received only bimonthly adjustments since March 27, 1992.

**DISCUSSION**

The original dental treatment goals were first to correct the mandibular posture and then to set the dentition to that posture. This is typically accomplished by enlarging the maxilla through a process of slow remodeling, and then allowing the mandible to self-correct its posture in the face (1). This self-correction is dependent on the health of the cervical musculature and temporomandibular joint as well as the head position (6, 9, 10). The acute symptoms that the patient experienced



**Fig. 6** Posttreatment panoramic view showing improved contour.



**Fig. 7** Posttreatment, improved head carriage.





Fig. 8 X-rays taken March 1992.

during the initial dental treatment phase were apparently caused by the inability of the head and neck position to adapt to maxillary and mandibular changes. The neck exhibited a loss of the normal anterior cervical curve (flexion) with upper cervical compensation (extension).

As stated in our earlier paper, we know that

flexion of the head on the cervical column and flexion of the neck on the thoracic column depend on the anterior muscles of the neck (1). Because these muscles are distant from the cervical column, they act as the long arm of a lever (3). When these muscles act simultaneously, the mandible is lowered. But if the mandible is fixed by contraction of the muscles of mastication (the masseter and the temporalis), then the suprahyoid and infrahyoid muscles produce flexion of the head on the cervical column and flexion of the cervical column on the thoracic column, while simultaneously flattening the cervical curvature (11). Consequently, they are very important in supporting the cervical column at rest (3, 4, 10).

A person whose head is bent downward because of the contracture of the mandibular elevators must hyperextend his or her head to look forward and this causes a posterior closer of the space between the occiput and atlas (12) and often between the atlas and axis vertebrae (13). In addition, the cervical

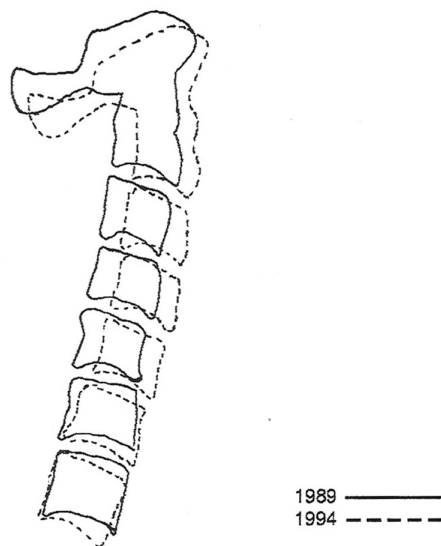


Fig. 9 Tracings of posterior vertebral body positions relative to one another at the start of treatment in 1989 and after treatment had concluded in 1994.

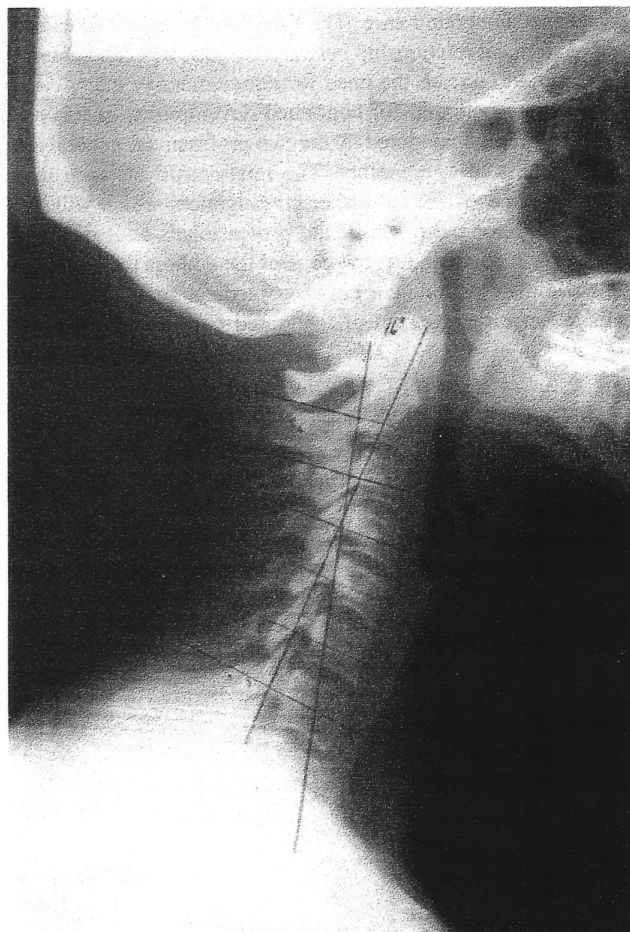


Fig. 10 X-rays taken September 1994.

column and thoracic column (as far as T5) are flexed, resulting in a loss of the normal cervical lordosis from C3 down.

In this case, the initial changes created by the maxillary appliance challenged the neck structure, mandible and cranial sutures to respond. Chiropractic adjustment facilitated the ability of the neck and cranium to accommodate the mandibular and dental changes. Once these changes were augmented and dental therapies reinstated, there were no adverse effects. Ultimately, as the mandible position improved, further positive changes were noted in both the physical testing and the X-rays. Because the maxilla was no longer controlling its placement, the mandible was free to assume a healthier position (1, 2, 14). As the mandible assumed a more balanced posture, slightly downward and forward, loading in the temporomandibular joints diminished.

As the bite was corrected and better function achieved, the significant changes were maintained. It is worth noting how well the cervical spine maintained its correction even though the patient was no longer in active orthodontic or chiropractic care.

## CONCLUSION

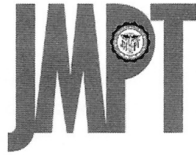
This case illustrates that orthodontic outcomes can be dependent on chiropractic intervention and gives support to the concept of integrated care. The fact that there is a functional and anatomical relationship between the jaw, head and cervical spine would indicate the need for cotreatment in many cases. To date, the potential for continued development in this area has been greatly hampered by the two professions' general lack of awareness of one another. The relationship between these two disciplines warrants further investigation, which will benefit both chiropractic and dental professionals and, more importantly, the patient. It is the hope of the authors that this work will stimulate a dialogue between medical practitioners that will advance the concept of integrated care in certain conditions.

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## CASE REPORTS



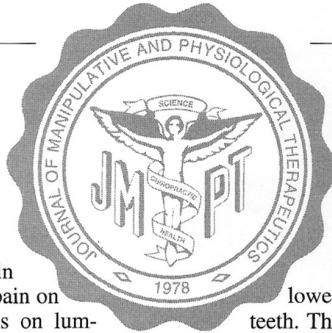
### Chiropractic/Dental Cotreatment of Lumbosacral Pain with Temporomandibular Joint Involvement

Albert S. Chinappi, Jr., D.D.S.\* and Harvey Getzoff, D.C.†

#### ABSTRACT

**Objective:** To demonstrate the concept of integrated dental orthopedic and cranio-chiropractic care for treating structural disorders of the jaw, neck and spine.

**Clinical Features:** A 33-yr-old woman sought chiropractic care for centralized lumbosacral pain that had persisted for 3 months. She exhibited pain on lumbopelvic extension and marked limitations on lumbopelvic flexion. In addition, cervical rotation and cranial sutural motion in the right malar maxillary suture were restricted. The left temporal mandibular joint also was limited in translation. Based on initial chiropractic sacro-occipital technique, she was diagnosed with Category III lumbopelvic dysfunction. X-ray examination revealed a lumbosacral angle of 39°, with sacral displacement posterior to the weight-bearing line. In conjunction with the beginning of chiropractic care, she was encouraged to seek dental-orthodontic evaluation. After 30 months of chiropractic treatment, she was still experiencing some lower back



pain and limited improvement. She finally agreed to see the orthodontist. Orthodontic evaluation revealed a Class II malocclusion with significant loss of vertical dimension, characteristic of bilateral posterior bite collapse.

**Intervention and Outcome:** Initial orthodontic treatment began in September 1991 and was followed by restorative dentistry to replace the missing teeth. This cotreatment approach, which integrated dental orthopedic and craniochiropractic care, ameliorated the pain and improved head, jaw, neck and back function.

**Conclusion:** The position of the jaw, head and vertebral column, including the lumbar region, are intricately linked. Orthodontic treatment improved the position of the mandible, which in turn enabled the body to respond to chiropractic care. (J Manipulative Physiol Ther 1996; 19:607-12).

**Key Indexing Terms:** Temporomandibular Joint Syndrome, Chiropractic, Orthodontics, Lumbar Vertebrae.

#### INTRODUCTION

In two previous articles (1, 2), we discussed a model of integrated care based on chiropractic/dental cotreatment as an aid to improving overall function and health. The first article discussed the relationship of facial growth and development to the health and alignment of the spine and the rest of the body. The second article presented a case study of a patient who initially sought orthodontic treatment to straighten her teeth and then received chiropractic intervention to complete the process and improve her overall health and function. This article discusses a case in which the patient first sought chiropractic care and then used dentistry to successfully complete the process. Our goal is to demonstrate, by way of these examples, that integrated chiropractic/dental cotreatment can improve the outcome to a far greater extent than is possible within either discipline alone.

#### CASE REPORT

In February of 1989, a 33-yr-old woman sought chiropractic care for consistent centralized lumbosacral pain that had persisted for 3 months. Chiropractic examination revealed pain on lumbopelvic extension and marked limitations on lumbopelvic flexion. The inferior spinous processes of L4 and L5 were tender to palpation. The lumbar musculature also was tender to palpation and spastic on the left. In addition, right cervical rotation was restricted to 70° (90° is normal); the left temporomandibular joint was limited in translation, and cranial sutural motion was restricted in the right malar maxillary suture (Table 1). Sutural restrictions are characterized by limited relative motion when pressure is applied to specific cranial sutural areas. The Step Out Toe Out (SOTO) test was positive for left iliofemoral restriction, with no pain in the left leg (Table 1). Sacro-occipital SOTO testing assesses the ability of the pelvis to react to leg abduction and external rotation. Asymmetrical differences are noted, along with any pain patterns such as sciatic nerve root pain.

The patient's lateral lumbopelvic X-ray revealed a lumbosacral angle of 39°, with sacral displacement posterior to the weight-bearing line. The apex of the sacrum was 3 inches from the weight-bearing line (Figure 1). The anteroposterior X-ray showed marked right rotation of the L1-L4 vertebral spinous processes. The patient was diagnosed as SOT Category III, characterized by lumbar subluxations (in this case, posterior

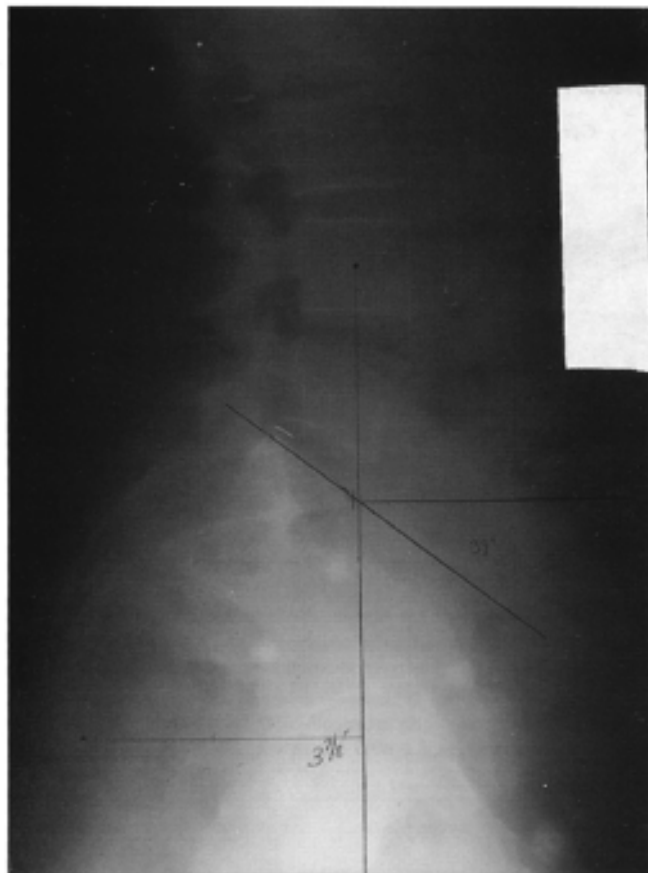
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Paper submitted March 25, 1996; in revised form May 23, 1996.





**Fig. 1** X-ray taken on February 23, 1989 that shows sacral displacement posterior to the weight-bearing line.

compression of L5 on S1, with pelvic distortion patterns but with no sacroiliac interosseous ligament damage).

Chiropractic treatment consisted of SOT Category III blocking to reduce pelvic distortion. The indicator for pelvic improvement is improved response as SOTO testing is applied every 2 min, while the patient lies prone on the pelvic blocks. SOT disc technique, a procedure that guides the lumbar vertebrae into flexion then back to a neutral position with the patient sitting and assisting, was applied to L4 and L5. SOT "stairstep" and cervical "figure 8" adjustments were used to increase the cervical right rotation. The "stairstep" involves cervical translatory movements, whereas the "figure 8" involves cervical rotation and lateral range of motion compressive movements (1). In this case, cranial sutural adjustments consisted of applying pressure in a specific direction to create sutural motion in the right maxillary/malar area. Orthodontic evaluation was recommended in conjunction with chiropractic treatment.

The patient received a total of 33 adjustments in 1989: seven in March, six in April, and five each in May, June and July. From August through December, she received five more adjustments. In 1990, she received a total of 12 monthly adjust-

ments, and in 1991, she received only six. During this time, she showed limited symptomatic improvement, as well as limited improvements in SOT findings (Table 1).

Based on her limited SOT progress and the fact that there was no improvement in the cranium or temporomandibular joint, she was further encouraged to seek orthodontic evaluation, to which she finally agreed.

Dental examination in September of 1991 revealed a Class II malocclusion with a narrow maxilla and resulting cross-bite tendency in the posterior bite (Figures 2 and 3). The Class II malocclusion is characterized by a posterior placement of the mandible in reference to the maxilla. The tendency to cross-bite is a function of the relative widths of the maxilla to mandible. If the maxilla is insufficiently wide to accommodate the mandibular dentition, the maxillary teeth do not overlap properly and can cause the mandible to shift right or left to accommodate the bite. In addition, the patient had only a limited (32 mm) range of opening in the temporomandibular joints, undoubtedly because of posterior shifting of the mandible and loading on those joints.

The maxillary right and mandibular right and left first molars had been extracted when she was young (Figure 4), which produced significant loss of vertical dimension. Vertical dimension is a measure of the distance between the upper and lower dentitions. In this case, the vertical dimension was reduced, which is characteristic of posterior bite collapse. This situation develops when posterior teeth, often on the lower arch, are lost and not replaced. Over time, the teeth posterior to the missing teeth tip and migrate forward, reducing the vertical dimension (Figures 2A, 3A and 5). The primary goal in treating these conditions is to reverse the effects of the poor facial growth as well as the results of the lost dentition.

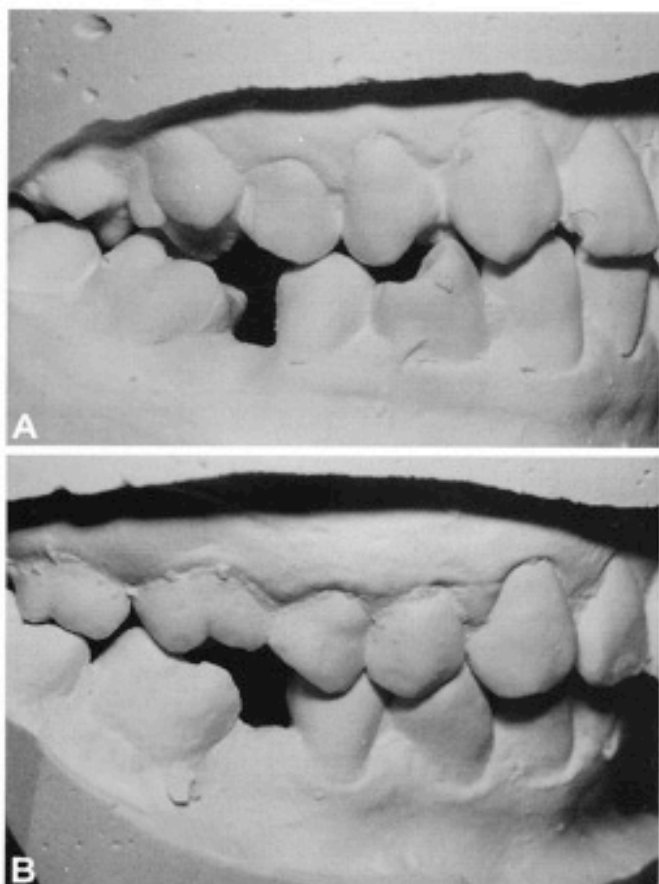
In this case, the major treatment steps were to enlarge and develop the maxilla to correct the crossbite, which allowed the mandible to reposition itself slightly downward and forward; return the teeth to their correct upright position for the bridgework (Figures 2B, 3B and 6), thereby increasing vertical dimension and reducing the stress on the temporomandibular joints; and, finally, to insert the bridgework. The orthodontic treatment spanned a period of approximately 2 yr, from September 1991 to the fall of 1993, at which time the restorative dentistry was completed.

On September 21, 1993, the patient was re-examined at the

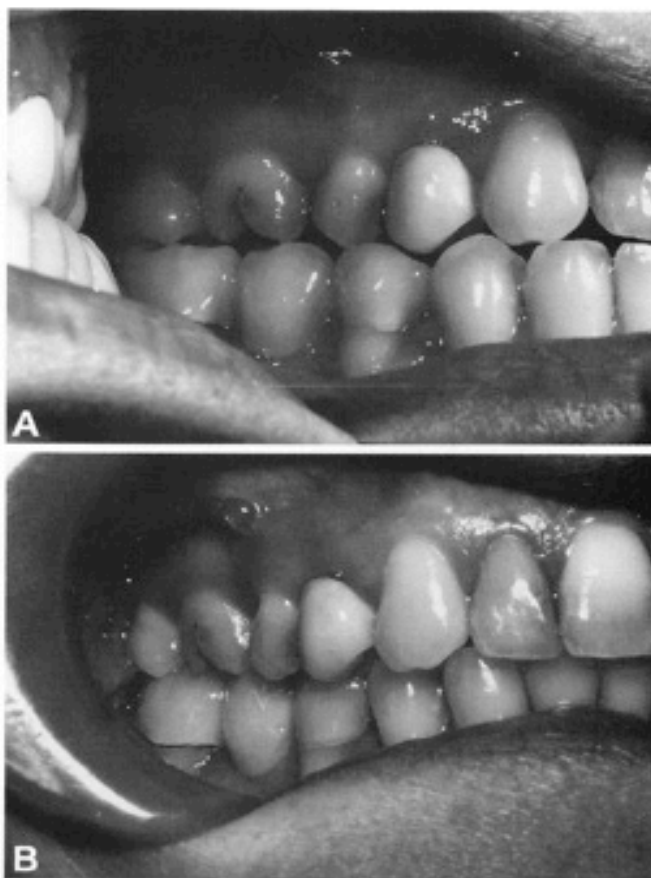
**Table 1.** Chiropractic findings

	2/23/89	7/25/89
Cervical right rotation	70°	75°
Right maxillary/malar suture	Tender and restricted	Tender and restricted
Left temporomandibular joint	Restricted in translation	Restricted in translation
Palpation L4, L5 spinous processes	Tender	Tender
SOTO - Left Iliofemoral	Restriction	Improved
	Compared with right	Same as right





**Fig. 2** A. Pretreatment study model that shows molars tipped and migrating forward. B. Post-treatment study model that shows improved bite and vertical dimension.



**Fig. 3** A. Pretreatment photo that shows posterior bite collapse. B. Post-treatment photo that shows improved bite support.

chiropractic office (Table 2) and reported that she was no longer experiencing lower back pain. Throughout orthodontic treatment, improvement was noted in all areas, especially in the cranium and jaw. The X-ray findings also showed improved sacral positioning in relationship to the weight-bearing line (Table 3; Figures 1, 7 and 8).

#### DISCUSSION

The initial chiropractic treatment goal was to eliminate the Category III indicators:

- lumbar palpatory findings;
- SOTO ilio-femoral unilateral differences; and
- positioning of the anterior sacral base under the weight bearing line.

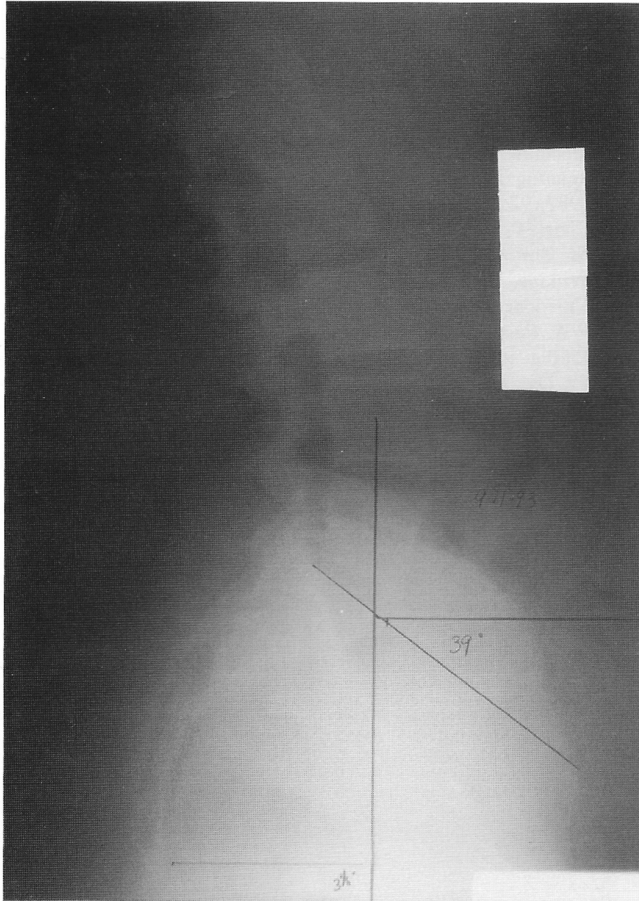
Because of their relationship to the lumbar spine, improvement in the cranium and the cervical ranges of motion were also identified as treatment goals.

We know that there are functional and anatomical relationships between the jaw, head and cervical spine, and as stated in our earlier papers, we know flexion of the head on the cervical

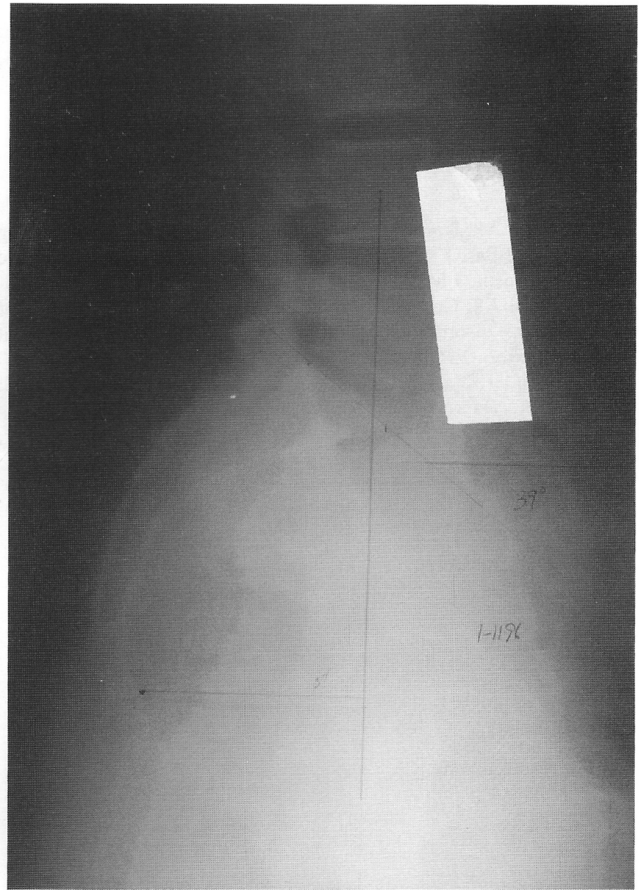


**Fig. 4** Pretreatment panoramic view. Note migration of molars.

column and flexion of the neck on the thoracic column depend on the anterior muscles of the neck (1, 3, 4). Because these muscles are distant from the cervical column, they act as the long arm of a lever (5). When these muscles act simultaneously, the mandible is lowered. But if the mandible is fixed



**Fig. 7** X-ray (September 21, 1993) that shows improvement in sacral displacement.



**Fig. 8** X-ray (January 11, 1996) that shows further improvement in sacral positioning.

and functionally (13). Head position and posture can influence the lumbar spine; thus, the whole body must be considered a unit because none of its parts function independently. In a given situation, the underlying cause may be in the mouth, which projects its deleterious influences in a caudad direction (14).

According to Dr. Burl Pettibon, D.C.,

We view the head as a vertebra. The head is the only vertebra that has neural tissue (the eyes), directing its position; therefore, it is the only vertebra that knows where it should be in three dimensional space. The head's position relative to gravity is maintained by five righting reflexes, especially those of the eyes. The righting reflexes have control over all of the other muscles of the spine; therefore, they control the position of all other vertebrae (15).

Orthodontic interventions facilitate head and neck postural positions, which may reduce the influences of the head and neck posture on the lumbar spine.

In this case, the full benefit of chiropractic treatment was limited by head, jaw and neck posture. Once orthodontic therapy was completed and the teeth restored, there were significant positive changes in both the chiropractic physical testing

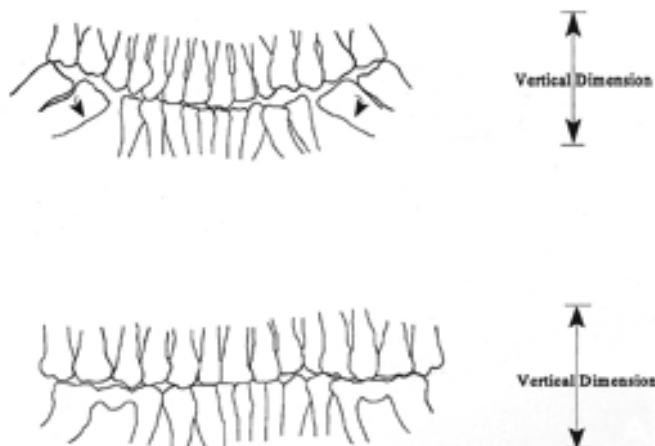
and lumbar X-rays. It is even more encouraging that 28 months after completion of orthodontic treatment and with only limited chiropractic follow-up visits, these positive changes were maintained (Table 3; Figure 8).

## CONCLUSION

This case supports the concept of integrated care, illustrating that chiropractic outcomes can be dependent on and even improved by orthodontic/dental intervention. It is possible that the patient would have followed a natural history of improvement; because 3 yr of chiropractic adjustments made no significant change and the dental temporomandibular joint problems were remarkable; however, we felt dental intervention was necessary.

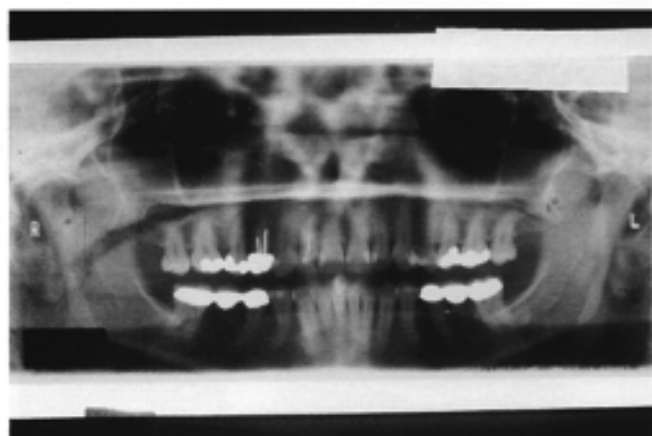
The fact that there is a functional and anatomical relationship between the jaw, head and spine suggests advantages to taking a more holistic, integrated approach in many cases. To date, progress in this area has been greatly hampered by the different health-care professions' general lack of awareness of one another. Thus, the relationship between these two and related disciplines warrants further investigation. It is our hope that our writings will prompt an open dialogue between med-





**Fig. 5** Bite before and after dental treatment. Vertical dimension increases with continuous interface of support along the arch.

by contraction of the muscles of mastication (the masseter and the temporalis), then the suprahyoid and infrahyoid muscles produce flexion of the head on the cervical column and flexion of the cervical column on the thoracic column and simultaneously flatten the cervical curvature (6). Consequently, these



**Fig. 6** Post-treatment panoramic view that shows bridgework and improved bite posture.

**Table 2.** Chiropractic findings before and after treatment

	2/23/89	7/25/89	9/21/93
Cervical right rotation	70°	75°	80°
Right maxillary/malar suture	Tender and restricted	Tender and restricted	No tenderness or restriction
Left temporomandibular joint	Restricted in translation	Restricted in translation	No restriction in translation
Palpation L4, L5 spinous process	Tender	Tender	No tenderness
SOTO - Left Iliofemoral	Restriction compared with right	Improved same as right	Symmetry maintained

**Table 3.** Lateral lumbopelvic X-rays

	2/23/89	9/21/93	1/11/96
Sacral base angle	39°	39°	39°
Weight-bearing line	Anterior-to-anterior sacral apex	Passes through anterior sacral apex	Passes through anterior sacral apex
Sacral apex to weight-bearing line	3.875 inches	3.125 inches	3 inches

muscle groups are very important in supporting the cervical column at rest (3, 5, 7).

In a deep-bite malocclusion, the resulting occlusion is an outcome of poor facial growth in the craniofacial complex (1, 8). Poor early maxillary development prevents the mandible from reaching its correct position within the face (8). With the subsequent loss of teeth, there is an additional loss of posterior vertical support. As a result, the mandible is allowed to slip farther to the posterior (Figure 5). This can cause trauma to the temporomandibular joints and affect the inframandibular muscle system, which further compromises the relationship between the mandible and cervical spine.

The importance of dentistry in these situations should not be underestimated. The first step in the dental program (i.e., enlarging and developing the maxilla) creates a space in which the mandible may assume a more healthy position (1, 8, 9). This slow maxillary remodeling and mandibular self-posturing influence the health of the cervical musculature and temporomandibular joint, as well as improving head position (2, 3, 4, 10). In addition to unloading the temporomandibular joints, the positional change of the mandible creates the space for making upright and replacing the posterior teeth (Figures 5 and 6). It is at this point that the mandible can be properly supported through more continuous contact between upper and lower dentition (Figure 6). The increased posterior vertical dimension is also more consistent with healthy muscle tonus and length, which stabilizes the entire anterior cervical musculature.

We also know that the function of the cervical spine can impact function of the lumbar spine (11). Alterations of one of the functional curves will cause reciprocal alteration in the other curves (12). Although we tend to divide the spine into regions (cervical, thoracic and lumbar), this can be a mistake, because the three units are loosely interrelated both structurally

ical practitioners with different specialties that ultimately will advance the concept of integrated care. Greater understanding and cooperation not only will benefit the health care providers but also, and more importantly, they will benefit the patient.

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## **Unity of Form and Function - A New Dental Paradigm: A Case Series**

Albert S. Chinappi, Jr., D.D.S.

### **Introduction:**

In this era of evidence-based dentistry, the profession may be limited by longstanding but unexamined assumptions that still form the framework of our diagnoses and treatment. A system of care called “functional orthopedics” seems to indicate the possibility of a different paradigm based on maxillary expansion and mandible repositioning. Exploration of the scientific literature finds support and possible explanations for the observed results.

Functional orthopedics ultimately strives to convert all malocclusions into Class I dental malocclusions prior to employing fixed mechanics. This is accomplished by using active plates and orthotics or jaw positioning appliances. Research involving using this protocol for children and adults has led to a re-examination of the basic assumptions that exist in dentistry today. In light of some novel clinical outcomes, this article will explore two of those assumptions and propose a new paradigm in which optimal function is the overriding consideration.

The first assumption, specific to orthodontics, concerns the inclination to avoid expansion in either dental arch in older children and adults. Since sutures fuse early in life, it was assumed that rapid maxillary expansion would be ineffective and unstable in patients over 12 or 13 years of age. As a consequence palatal expansion techniques were limited to younger patients.

The second assumption, common to all phases of dentistry, relates to the location of the mandible in the face. The long-held dental paradigm has been to accept the existing jaw position or to coax it posterior. However in most malocclusions, except some Class III facial patterns, the mandible may be in a compromised position. Deep bites, cross bites, and maxillary arch discrepancies likely are examples of that compromise in which the mandible hasn't been allowed to develop to its full downward and forward potential because of maxillary constriction. That altered posture, in turn, impairs the function of the cervical-mandibular musculature.

Mohl states that the role of head posture in mandibular function at least with “some of the dysfunctional problems involving the masticatory system could be in some way related to the adaptive requirements imposed by chronic or acute postural demands or vice versa.”[1] While there may be support for the relationship of dentition to mandibular location; of importance is that a main concern is the etiology. Clinical experience and published studies have noted that maxillary width is not necessarily rigid but can be altered in children and also with adults [2]. Current research suggests that chronic and acute postural dysfunctions may be related to masticatory system dysfunction. [3-5]

Therefore the basis for the paradigm of functional orthopedics is to allow the mandible to “recover” from its compensatory position affecting and being affected by postural influences. If postural influences are related to the cervicomandibular muscle complex then dental diagnosis and treatment planning should include those influences.

## **Case Report Series**

While each patient's (N=13) presentation was different from the other they all presented with dental malocclusions and reported varying degrees of cranio-mandibular dysfunction. The patient's medical histories were non-contributory. These patients were selected for this case series because post treatment the maxilla appeared to be responsible for the developmental location of the mandible and once corrected it had a profound effect on the cervical spine and head position.

### **Methods and Intervention:**

Thirteen cases are presented, 5 adolescents and 8 adults. Each was treated using the system of facial orthopedics known as functional orthopedics. Functional jaw orthopedics utilizes a philosophy that orthodontic treatment seeks to alter the shape of the bony alveolus in the maxilla and, in turn, the location of the mandible and its alveolar processes. This is accomplished along with moving teeth and re-shaping the dental arches. Functional orthopedics incorporates a style of orthodontics employing removable appliances (active plates and jaw positioning appliances) in addition to fixed mechanics. The goal of this system of treatment is to correct the pre-existing maxillary deficiency, reposition the mandible and avoid extractions and surgery if at all possible.

### **Results:**

Each of the cases presented show dramatic dento-facial changes. Full alignment of the dentition was accomplished non-extraction and non-surgical. Outcome assessment measures utilized classic dental evaluations for class II and class I positions. Diagnostic evaluations determined that pre-treatment Class II malocclusions were corrected to Class I and showed significant improvements in both the antero-posterior and vertical positioning of the mandible to a "normal" position. In other words the amount of downward and forward repositioning of the mandible was dramatic. Most significantly were changes in the adult, "non-growing" patients, changes that would only be possible with significant correction in the cranio-cervical musculature. The changes in the cervical spine were equally dramatic and quite evident in the study. One case showed changes in spinal curve simply by changing the mechanical forces used in treatment, indicating a possible advantage of this treatment philosophy.

### **Discussion:**

In the 13 subjects of this study functional changes included improvement of the cervical curve and relief of TMD type symptoms including, but not limited to, headaches and muscle spasms. If we consider the mandible and maxilla as being within a matrix of tissues and function, we are led to a new premise -- that in some instances the musculature may hold the mandible in an altered posture (compensatory position) to assure and maximize contact between maxilla and mandible dentition. Theoretically, due to the maxillary deficiency the mandible may be unable to assume its "normal" rest position, because the teeth will not fit together. The



maxillary malocclusion, be it narrow arch, cross-bite, deep anterior over-bite, or division 2 type incisor position actually create impedance inhibiting the mandible from positioning downward and forward to achieve a physiological compatible rest position. This, in turn, tends to have a significant impact upon the stomatognathic and cranio-cervical position and function.

### **Conclusion:**

The cases treated in this report demonstrate that a subset of patients with malocclusions can be the result of inadequate maxillary growth and the subsequent inability of the mandible to attain a full physiologically neutral position. At any age, when a deficiency in the maxilla is corrected and the correct arch form is in place, the mandible would logically be able to assume a more neutral position within the musculature template. The effects of maxillary expansion and mandible repositioning on stomatognathic and cranio-cervical function and its relationship functional body positioning are worthy of future research. With posture having influence on the stomatognathic system and maxillary expansion and mandible positioning likewise affecting cervicocranial posture the implications for the dental and chiropractic co-treatment can be profound.

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## Pelvic torsion: Theoretical construct and current evidence

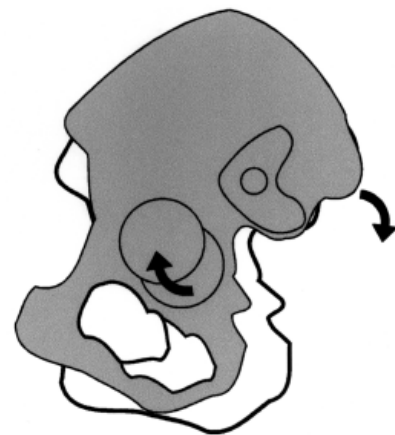
Robert Cooperstein, MA DC

### Introduction

To this author's knowledge, he has written the only review article on pelvic torsion, under the title *Pelvic Torsion: Anatomic Considerations, Construct Validity, and Chiropractic*, published in the year 2000<sup>1</sup>. That article defined pelvic torsion, reviewed the various methods by which it is detected and measured, and gathered the evidence on its clinical significance. Historically, physiotherapists and osteopaths as well as chiropractors have considered pelvic torsion to cause back pain and other conditions, either directly or indirectly by leading to poor biomechanics in other structures that are included in the sacroiliac joint's kinetic chain.

In pelvic torsion, the innominate bones rotate in opposite directions around an axis that is perpendicular to the sagittal plane. Pitkin and Pheasant<sup>2</sup>, most likely the first authors to have described pelvic torsion, stipulated that this transverse axis had to pass through the pubic symphysis. Alternative locations, such as a transverse axis through the hips or sacroiliac joints, would necessarily *luxate* the symphysis pubis. Roy Hildebrandt, in his book *Chiropractic Spinography*<sup>3</sup>, draws out the implications of these pelvic biomechanics for chiropractic technique, pointing out that some of his fellow chiropractors were fostering lumbopelvic subluxation models that were not anatomically possible. For example, many chiropractors (and

osteopaths and PTs, for that matter) to this day teach that a functional short leg is created by a posterior rotation of the innominate bone that would swing the hip anterosuperiorly, as seen in figure 1. However, was this to occur, the front of the pelvis would be luxated<sup>4</sup>. If the functional short leg does correspond to posterior ilium rotation, another model had best be found. Fortunately, other explanations based on alternations in muscle tone have been brought forward<sup>4-6</sup>.



**Figure 1. The impossible explanation of the functional short leg**

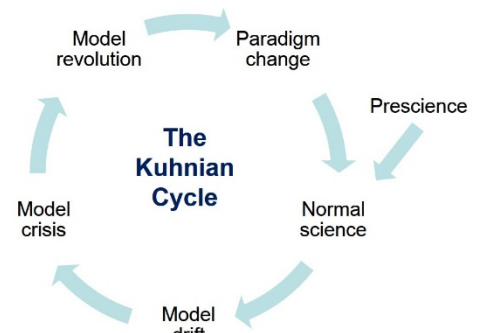
Pelvic torsion is an entirely physiological movement that occurs in a number of biomechanical situations. It is an element of the gait mechanism, with anterior rotation on the toe-off side and posterior rotation on the heel-strike side<sup>7</sup>. It also occurs when a person is standing on an unlevel surface, apparently to offset some degree of pelvic obliquity: posterior rotation lowers the sacral base on side where the surface is higher and anterior rotation raises the sacral base on the relatively lower surface side. This same pattern of adaptation occurs when there is anatomical leg length inequality, which is tantamount to always standing on an unlevel surface<sup>8</sup>. The adaptation most likely involves small changes in the sacroiliac joints in addition to changes in the orientation of the joints of the lower extremities.

When the innominate bones rotate in opposite directions, the sacroiliac joints must be able to accommodate to these movements. Relatively small translations and rotations have been measured along and around the three orthogonal axes at the sacroiliac joints. Many technologies

have evolved to produce, detect, and measure pelvic torsion, in both cadaveric specimens and in vivo. Pelvic torsion can be evoked by putting the pelvis in stressed positions, such as a one-legged stance and the straddle position. Imaging procedures, raster photography, reflective markers, and inclinometers of various sorts have been used to measure sacroiliac and interinnominate movements to some degree, but taking measurements in 3 dimensions requires more sophisticated technology. Investigators have utilized Roentgen Stereophotogrammetric Analysis (RSA), direct 3-D digitizing with skin markers, and an in-vitro optical lever system<sup>1</sup>. RSA, which involves percutaneously inserting tantalum balls into motion segments of the pelvis, followed by an RSA examination within two weeks after implementation, is generally considered the most accurate method for measuring 3-D motions of the sacroiliac joints, and thus pelvic torsion<sup>9</sup>.

The advent of RSA poses a big challenge to the manual therapy professions, by virtue of having found sacroiliac motions to be of smaller magnitudes than previously measured by lower tech methods. In a systematic review, Goode et al<sup>9</sup> report the following ranges of motion for the sacroiliac joint: X-axis rotation = -1.1 to 2.2° degrees, Y-axis rotation = -0.8 to 4.0°, and Z-axis rotation = -0.5 to 8.0°; X-axis translation = -0.3 to 8.0mm Y-axis translation = -0.2 to 7.0mm, and Z-axis translation = -0.3 to 6.0mm. The concept of pelvic torsion has thus become controversial, to the point where some authorities have concluded that it either does not occur or that the movements involved are so small that either they could not be detected or in any case would be clinically insignificant. That stated, dismissing the concept of pelvic torsion would leave so many other experimental findings without explanation that the author believes it premature to abandon the concept, and certainly not in our patients' best interests. Reports of the death of pelvic torsion may have been greatly exaggerated.

Thomas S. Kuhn wrote a seminal book in 1962 titled *The Structure of Scientific Revolutions*<sup>10</sup>. His central thesis was that scientific progress did not occur as the simple accumulation of accepted facts and theories. Rather, the discovery of facts that did not fit the dominant paradigm would lead, sometimes very abruptly and even violently, to new paradigms that better explain the phenomena under investigation. (See figure 2.) At first glance it seems that the advent of RSA and the finding of small sacroiliac motions have precipitated a paradigm shift whereby the pelvic torsion model would be upended.



**Figure 2. The Kuhnian Cycle**

Further accelerating the shift would be the clearly visible change in emphasis in chiropractic during the last few decades from static findings (misalignment) to dynamic findings (movement restriction). However, this author does not see a Kuhnian situation as having developed in the area of sacroiliac biomechanics, because the putative new sacroiliac paradigm – i.e., small sacroiliac movements are not detectable directly - creates more problems than it solves. Indeed, at the current time it cannot be ruled out that the dismissal of pelvic torsion is analogous to the pseudo-scientific proof that a bumblebee cannot fly.



It may be instructive to itemize existing experimental and observational findings that would be left without explanation were we to jettison pelvic torsion and the sacroiliac motion capabilities that would rationalize it.

- Low and medium tech measurements of SI movement in stressed positions <sup>11</sup>
- High tech measurements of SI movement in stressed positions in cadaveric specimens <sup>12</sup>
- Pelvic asymmetry detected on static palpation <sup>13,14</sup>
- Pelvic compensations for artificial and naturally occurring LLI <sup>8</sup>
- Results of studies on the block method of measuring LLI <sup>15</sup>
- Sacroiliac joint involvement in the gait cycle <sup>7</sup>
- Misalignments of the pelvis seen on imaging procedures <sup>3,16</sup>
- Results of SI motion palpation studies, given some have shown substantial reliability; e.g. <sup>17</sup>
- Patient preferences during provocative pelvic blocking <sup>18,19</sup>
- Pre-post changes in pelvic alignment associated with manual therapy <sup>20</sup>
- Patterns of delayed muscle responses seen on MMT of hip extensors/flexors <sup>21</sup>
- Sacral leg check findings <sup>22</sup>

It may seem at first glance that we stand at a crossroads where we must choose between RSA findings of very limited sacroiliac movements, and traditional manual therapy modeling of sacroiliac disorders, including pelvic torsion. However, the author would recommend for the time being a conservative reinterpretation of experimental and observational findings that could chart a path reconciling RSA and other findings. It is all too easy for manual therapists to forget that they never *really palpate osseous structures*, but rather soft tissues that overlay and attach to these structures. Therefore, it may be that positional and movement tests of the sacroiliac joint, both before and after treatment, may in reality reflect *soft-tissue changes* rather than bony re-positioning. From that point of view, the difference between typical “macroscopic” sacroiliac examination findings and RSA “microscopic” findings would be comparable to the difference between the functional and anatomical short leg – a leg that appears to be shorter than the other, but actually is equal in its length.

As examples or re-interpretable motions tests, let us look more carefully at the Gillet and sitting flexion motion tests of the sacroiliac joint. The author now believes that the apparent caudal movement of the PSIS during Gillet’s motion test on a movable sacroiliac joint most likely reflects the examiner’s thumb being carried caudally by the sacrotuberous ligament, which connects the PSIS to the ischium and the conjoined biceps femoris and semitendinosus tendons (hamstring muscles) <sup>23</sup>. In that scenario, even a minute sacroiliac dysfunction would alter hamstring muscle function, and thus tension on the sacrotuberous ligament. Turning to the sitting flexion test, the apparent difference in the degree of cephalad movement of the PSISs seen during the test could reflect an asymmetric flexion-relaxation response <sup>24,25</sup>. The erector spinae, which attach to the sacrotuberous ligament at the PSIS, may carry the palpator’s thumb more



cephalad on the side of the spine where there is a lesser degree of flexion-relaxation response, which may reflect a small sacroiliac dysfunction.

As examples of re-interpretable position tests, let us first and foremost point out that RSA measures *movement, not position*. Therefore this technology does not in the slightest refute asymmetric positions of the innominate bones. Although the interexaminer reliability of most palpatory pelvic positional tests (PSIS levels, ASIS levels, sacral sulcus depth) has been poor<sup>14</sup>, instrumented measurements of innominate rotations and asymmetric landmark positions show these actually occur. Since many studies of clinical interventions that attempt to improve symmetry confirm clinical improvement in both pain reduction and functional measures, we may hypothesize that these interventions normalize neuromusculoskeletal function, if not bone positions. It remains to be seen whether interventions using vectors contrary to those intended to improve symmetry would get equivalent results, but there is some evidence that they may not. Long et al<sup>26</sup> showed that the direction of prescribed McKenzie exercises did make a clinical difference, and the author showed that patients preferred being blocked in positions that reversed their palpable pelvic torsion pattern<sup>19,27</sup>.

It is somewhat more difficult to reconcile RSA results for the sacroiliac joint with lower tech studies (inclinometers, rasterstereography, and reflective marker motion analysis) showing changes in torsion angles. The author reviewed 9 such studies, all of which found that natural or artificially created anatomic leg length inequality resulted in pelvic torsion<sup>8</sup>. Most recently, a research project utilizing using a combination of rasterstereography of the back and frontal stereo-photogrammetry, citing this review, found this result: “The mean excursion range was 5° respective 4° for the right and left innominate exhibiting counter rotation”<sup>28</sup>. RSA findings suggest that the changes seen in these studies reflect displacements of soft rather than osseous tissue. Also needing to be reconciled with RSA is the body of literature on block methods of measuring anatomic leg length inequality. This method inserts blocks under the apparently short leg until the iliac crests are leveled, in order to compute the amount of leg length inequality. Several of the studies<sup>229-32</sup> which measured the accuracy of the block method in relation to a radiological reference standard showed a consistent undershoot. This may best be explained by assuming femoral head unleveling would consistently exceed iliac crest unleveling (due to posterior innominate rotation on the long leg side and anterior innominate rotation on the short leg side), so that block measures of anatomical leg length inequality would likely lag radiological measures. Although the use of an imaging reference standard argues against invoking soft tissue displacement to reconcile results with RSA, another possibility is that anatomical leg length inequality results in subtle changes in lower extremity joint alignment (pronation, Q angle of the knee, hip and knee flexion) that alter the iliac crest and femoral head levels as imaged.

Chiropractors and other manual therapists who, for better or for worse, have become comfortable with interpreting macroscopic musculoskeletal findings (e.g., scoliosis, TMJ syndrome, pelvic torsion) as the consequence of rather minute degrees of joint dysfunction are the least threatened by high tech methods, including but not limited to RSA, showing very small amounts of sacroiliac movement. The numbers, small as they are, are much larger than any conceivable measures cranial bone movements, which are routinely palpated and addressed by some manual therapists – again, for better or for worse. At the current time it cannot be ruled out that there is a butterfly effect in the neuromusculoskeletal system, whereby a small change in one area can

eventuate in a very large change in a remote area. Manual therapists who would explain palpatory and other results by invoking such butterfly effects are posed with a formidable challenge, since small sacroiliac dysfunctions are not yet demonstrated to exhibit such large effects. However, those who would suggest that RSA studies require us to discard the rather large body of observational and experimental findings seeming to connect such small sacroiliac dysfunctions to palpable and visible soft-tissue changes have an even more formidable task: finding alternative explanations for this rather large corpus of evidence.

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# Pelvic Torsion: Anatomic Considerations, Construct Validity, and Chiropractic Examination Procedures

**Purpose:** An overview of assessment strategies for “pelvic torsion” is presented. Various theories of dysfunction and misalignment are reviewed. Information from published literature regarding low back syndromes linked to sacroiliac dysfunction is examined. Anatomy and mechanics of pelvic structures are considered. Finally, approaches for examination of pelvic torsion are synthesized and appraised. **Method:** A qualitative literature review was conducted and supplemented by the clinical experience of the authors. **Summary:** Although pelvic torsion is an identifiable entity, its clinical significance requires further research and consideration. For example, studies have been contradictory regarding the relationship of findings of pelvic torsion to pain. It is reasonable for clinical approaches to take a biomechanical perspective to counter pelvic torsion states, however, definitive models remain to be developed. Key words: *articular range of motion, biomechanics, lumbar vertebrae, palpation, pelvic bones, physical examination, pubic symphysis, sacroiliac joint*

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## INTRODUCTION

This article “tells the story” of pelvic torsion: its definition and anatomic basis, how it has been measured, and why it may be clinically important. The analysis emphasizes, but is not limited to, chiropractic models of pelvic torsion dysfunctional states, examination methods, and developing implications and suggestions for further research.

Each of the professions that treat lumbopelvic complaints entertains various concepts of interinnominate subluxation (ie, loss of left-right positional symmetry). Some of these concepts involve translatory misalignments, such as the osteopathic “upslip” of one innominate bone, and others emphasize torsional misalignment, such as the chiropractic “anterior-superior” and “posterior-inferior” ilium listings. Although Bogduk<sup>1</sup> claims to have demonstrated that the sacroiliac joint is the pain generator in as many as 20% of low back pain cases, and the clinical entity of sacroiliac joint dysfunction syndrome is well known in the literature,<sup>2-4</sup> to our knowledge no specific type of pelvic misalignment or movement restriction has been clearly established as related to most sacroiliac complaints.<sup>5</sup>

However, there are several specific pelvic disorders that clearly explain a minority of pelvic complaints: traumatic diastases of the symphysis pubis and sacroiliac joints, fractures, relaxin-induced pelvic hypermobility in the pregnant

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*Top Clin Chiropr* 2000; 7(3): 38–49  
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and postpartum woman, sacroiliac hypermobility in a more general sense (eg, Dorman's "slipping clutch" syndrome<sup>6</sup>), and inflammatory arthritides such as ankylosing spondylitis and osteitis condensans ilii. It is not known what relation putative pelvic misalignments or movement restrictions might have relative to these specific diagnoses, whether they are distinguished from them by a matter of degree, or whether they are totally separate phenomena.

Although much has been written regarding the definition of chiropractic subluxation, traditional understanding involves a static bony misalignment. Symmetrically, the chiropractic adjustment should involve realigning the misaligned bones or joint. Therefore, in the simplest case, the purpose of detecting and measuring pelvic torsion is to identify the most appropriate vectors to be addressed. Although the subluxation theory in its most traditional form remains controversial, with many chiropractors having become persuaded that joint movement characteristics are more clinically significant than bone positions, it may be that bone positions (statics) and joint movements (dynamics) are co-determining. Unless and until clinical data are forthcoming to the contrary, it is plausible that thrusting so as to reduce the magnitude of pelvic torsion should obtain a better clinical outcome than thrusting in a direction that would increase it, whether the clinician's intention is to realign the innominate bones, increase sacroiliac mobility, or both, and whether the adjustive procedures de facto realign any pelvic structures or increase their ranges of motion.

Although it may be difficult to explain the structural or functional basis of intrapelvic joint complaints, much has been learned about their range of motion and kinematics, creating a variety of orthopaedic tests. This permits clinicians to evaluate the inherent plausibility of the various examination methods thought to identify intrapelvic dysfunction, and of possible remote effects on other parts of the body. Several orthopaedic tests for detecting pelvic torsion, despite their avowed purpose of identifying pelvic torsion per se, may be more clinically useful as pain provocative maneuvers. More often than not, a clinician should avoid manipulative thrusts that reproduce or exacerbate a patient's complaints and select vectors that ameliorate symptoms.

## DEFINITION OF PELVIC TORSION

Interinnominate subluxation exists when the innominate bones have lost superimposability in their oblique-sagittal planes as the result of translation (linear movement) and/or rotation (angular movement) of one innominate relative to the other. Uniplanar or multiplanar translation of an innominate bone does not satisfy the definition of rotation (ie, angular motion), which requires that the paths of the particles that make up the innominate bone move in relationship to an axis,

or center of rotation. The particles are said to move in a circular motion if the axis is fixed, or in more complex curvilinear paths if the axis itself continuously moves.<sup>7</sup> For the sake of simplicity, this article will assume the least complex definition of pelvic torsion: the innominate bones, in relation to one another, engage in mutually opposed rotation around a fixed axis.

## GENERAL ANATOMIC CONSIDERATIONS FOR PELVIC TORSION

The two innominate bones and the sacrum comprise a bowl of three bones and three joints (two sacroiliac joints and the symphysis pubis) in which movement at any one joint must effect companion movements in at least one of the other two joints. Obvious anatomic questions raised are: (1) Where is the location of the hypothetical fixed axis of interinnominate rotation? and (2) How do the intrapelvic joints accommodate this motion?

Although there have been several attempts to directly measure the amount of pelvic torsion, there has been surprisingly little discussion on where this axis is and how the global movement is distributed among the three joints. On the other hand, studies of these individual joints sometimes neglect to characterize intrapelvic joint movements in a global sense, in terms of the kinematic chain of events. It should be possible to connect these two bodies of data: the torsion measurements that lack anatomic detail and the detailed anatomic studies that fail to consider the global implications. Doing so, we should be able to distinguish models of pelvic torsion that respect the anatomic information from those that do not.

## PELVIC JOINT MOVEMENTS

### Sacroiliac movements and ranges of motion

Sacroiliac joint motion is a complex of coupled rotations and translations. Therefore, it may be helpful to separate the primary components of this complex into two broad categories: (1) autonomous sacral motion/subluxation with respect to one or both ilia while they remain essentially juxtaposed, and (2) motion/subluxation of the innominates with respect to each other (interinnominate movement) with sacral accommodation. The autonomous sacral movements manifest in chiropractic technique as sacral listings (eg, the anterior-inferior sacrum, posterior-inferior sacrum, rotated sacrum, and the flexed/extended or nutated/counternutated sacrum). Chiropractors usually view interinnominate movement and subluxations as torsional rather than translatory, manifesting in various innominate listings (eg, the anterior-superior and posterior-inferior ilium listings), often coupled with medial or lateral ("internal" or "external") components. Logan<sup>8</sup> reasoned that primary sacral subluxation would lead to an asso-



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**Table 2.** Pubic symphysis movements

	Walheim <sup>22</sup>	Pitkin <sup>23</sup>	Greenman <sup>24</sup>	Death <sup>25</sup>
Vertical translation	1.0 mm, males 1.3 mm, females		Occurs during one-legged standing	0.81 ± 0.74 mm (0 to 2 mm)
Sagittal plane rotation	0.3° to 0.8°	5.5°	Occurs during gait	
Frontal plane rotation	0.4°			

In 1982 Death and coworkers<sup>25</sup> proposed an alternative to the Chamberlain method for measuring pelvic ring mobility. Stress radiography was performed on 32 normal persons during the “thigh lever technique”—essentially Gaenslen’s test—which consisted of a supine patient flexing one hip while extending the other while a clinician applied overpressure to the distal femur. Average vertical mobility of the pubic symphysis was 0.81 ± 0.74 mm (0 to 2 mm). The authors also noted an average resting asymmetry of 0.66 ± 0.83 mm, with a range of 0 to 3 mm.

Two years later, Walheim and colleagues<sup>22</sup> measured symphysis motion by embedding rods into the pubic bones of four cadavers and 29 volunteers. The rods were monitored for translations and rotations during supine hip flexion and abduction, as well as during gait. The pubic bones were shown to translate vertically during gait an average of 1.0 mm in men and 1.3 mm in women; one multiparous woman exhibited translation of 3.1 mm. Sagittal and frontal plane rotations were on the order of 0.5°.

### Interinnominate movements

According to Kapandji,<sup>21</sup> translatory movements are unlikely provided the pubic ligaments are intact. Gross trauma, pregnancy, congenital hypermobility (eg, Ehler’s-Danlos syndrome), or inflammatory arthritis make such translations more feasible. Because the typical patient with low back pain is not likely to suffer from such maladies, the osteopathic “downslip” of the innominate and similar translatory concepts seem at least suspect. How feasible, by comparison, might be interinnominate torsion? Clearly, opposed rotation of the innominate bones could severely challenge the integrity of the sacroiliac and pubic joints, depending on the magnitude and location of the axis of rotation. It is important to stress that whatever the axis of interinnominate rotation, there will be an associated, but totally different, axis for sacroiliac accommodation. Few authors have commented on possible axes for interinnominate rotation.<sup>23–29</sup> Table 3 summarizes some of the evidence available regarding pelvic torsion.

Pitkin and Pheasant<sup>23</sup> describe a transverse axis passing through the center of the pubic symphysis, lying at the approximate center of a circle that is formed by continuing the

rough arc of the lower two thirds of the auriculate cartilage. They dismiss the likelihood of other axis locations: “In the presence of an intact symphysis pubis, all motions of the innominate bones about the transverse axis of the sacrum, or about the transverse axis of the hip joints, must be paired motions. Antagonistic motions of this type would rupture the symphysis and are only possible when the symphysis is relaxed or torn.”<sup>23(pp.366–367)</sup> Hildebrandt<sup>11</sup> argues the same point by opposing a common chiropractic model of pelvic torsion in which the axis runs through the hips, a model he mistakenly attributes to Gonstead, but which more properly describes the thinking of many drop-table practitioners<sup>30,31</sup> and followers of Logan.<sup>8</sup> Bourdillon and Day<sup>32</sup> also acknowledge the rationale for the through-the-symphysis model of pelvic torsion.

Sturesson et al<sup>12</sup> acknowledge that the symphysis constrains the two innominates to rotate as a unit around the sacrum, but nevertheless allows translation between the innominates. Lavignolle et al<sup>27</sup> proposed “zones” representing the average location of axes among the subjects studied. Three zones were described as: (1) right iliac displacement relative to the sacrum, (2) left iliac displacement relative to the sacrum, and (3) displacement of the iliac bones relative to each other. These zones run obliquely from posterior to anterior, intersecting at the superior margin of the pubic symphysis, the instantaneous center of rotation for antagonistic innominate motion.

### METHODOLOGIES FOR INDUCING/ INVESTIGATING PELVIC TORSION

Four principal methods have been described for producing or changing pelvic torsion angles: (1) performing cadaver studies, (2) creating temporary anatomic leg length inequality, (3) having the subject assume a “straddle” position, and (4) taking pre- and post-manipulation measurements. The numbers provided for the magnitude of pelvic torsion generously exceed those found for unilateral sacroiliac joint movements.

#### Pelvic torsion measurements in cadavers

Miller et al<sup>20</sup> studied eight pelvic dissections mounted in loading devices using motion dial gauges and an optical lever



**Table 3.** Pelvic torsion studies

Author	ROM	Subjects	Methods
Pitkin & Pheasant <sup>23</sup>	Total antagonistic ilia mobility: 11° (3° to 19°)	144 normal male college students (first year)	Inclinometer measurement of pelvic angle of inclination in neutral stance and with right and then left foot elevated
Cummings et al <sup>26</sup>	Total antagonistic ilia mobility: 2° to 6°	10 female volunteers, 19–23 years old	Infrared LEDs attached to surface landmarks measured during incremental addition of foot lifts
Lavignolle et al <sup>27</sup>	Relative antagonistic iliac displacement: 10°	3 male, 2 female adult volunteers < 25 years old	Digital orthogonal X-ray photogrammetry during supine flexion of right hip 60°, extension of left hip 15°
Drerup and Hierholzer <sup>28</sup>	At least 1.5° at each sacroiliac joint	20 mild to medium idiopathic scoliosis patients	AP full spine X-ray; standing rasterographic surface curvature analysis with one foot elevated
Smidt et al <sup>29</sup>	Composite SI oblique-sagittal motion: 9°	17 female, 15 male normal volunteers, mean 24 years old	Stance from neutral to 90% maximum straddle position measured via Metrecom Skeletal Analysis System

ROM, range of motion; LEDs, light-emitting diodes; AP, anteroposterior; SI, sacroiliac.

system. Loads up to 294 N and moments up to 42 N-m were applied to the sacrum in various directions. With both ilia fixed, mean sacral flexion was 1.31° and extension was 1.94°. For loads with only the left ilia fixed, mean sacral flexion was 2.68° and extension was 3.52°. The bilaterally fixed ilia position was not indicative of *in vivo* situations as it precluded lateral separation of the ilia from the sacrum. Unilateral left ilium fixation, allowing the sacrum and right ilium to move freely, was likened to a one-legged stance.

#### Induced temporary leg length inequality

The first investigators to induce and measure pelvic torsion by creating temporary leg length inequality in living persons were Pitkin and Pheasant.<sup>23</sup> In 1936, they took pelvic inclinometer measurements on 144 normal persons. Each person's "angle of inclination"—the angle formed between the plane of the floor and that of a line passing through the posterior superior iliac spine (PSIS) and anterior superior iliac spine (ASIS)—was measured using calipers fitted with a plumb line and a protractor scale. Measurements were taken in three positions: (1) neutral stance, (2) stance with the right foot elevated 1.5 inches by standing on a block of wood, and (3) the left foot elevated in the same manner. On the side of the "lengthened" leg, the pelvis rotated posteriorly, whereas on the contralateral side the pelvis rotated anteriorly. The average total antagonistic ilia mobility was 11° (range 3° to 19°).

In 1987, Drerup and colleagues<sup>28</sup> examined 20 patients with mild to medium idiopathic scoliosis who were presenting for

anteroposterior (AP) full spine X-ray. They used standing rasterographic surface curvature analysis to measure dimple of Venus motion when  $\pm 100$  of frontal plane pelvic tilt was introduced by having the subjects stand with one foot on an elevated block. The dimple rose as expected on the elevated leg side, but there was a systematic lag in dimple movement of up to  $\pm 1.5$  mm with respect to the pelvis. The authors theorized that this "dimple lag" resulted from pelvic torsion, although they did not opine regarding the axis. Consistent with Pitkin and Pheasant's study, the innominate on the raised leg side was found to rotate posteriorly, while the contralateral side rotated anteriorly.

In 1993, Cummings and coworkers<sup>26</sup> measured pelvic position and motion with the Waterloo Spatial Motion and Recording Technique using infrared, light-emitting diodes attached to landmarks monitored by two cameras. Ten volunteers were examined in the neutral stance, and also with incrementally increasing lifts placed under each foot. They also found that a "lengthened" leg resulted in ipsilateral posterior innominate tilt and contralateral anterior innominate. Total antagonistic iliac mobility ranged from 2° to 6°.

#### Straddle position

The straddle position involves simultaneous hip flexion and contralateral hip extension, one-legged stance being a variation on the same theme. Lavignolle et al<sup>27</sup> produced unusually large magnitudes of movement using this method. They examined five volunteers using digital orthogonal X-ray photogrammetry

during supine flexion of the right and extension of the left hips. Right hip flexion of 60° caused the right ilium to rotate posteriorly 12° and translate anteriorly 6 mm with respect to the sacrum. Left hip extension of 15° caused the left ilium to rotate anteriorly 2° and translate anteriorly 8 mm with respect to the sacrum. Relative displacement of the right ilium with respect to left was 10°, and it was accompanied by 2 mm of translation to the right. The authors described three different “zones” of localization of axes for the above motions. These zones intersect to form the instantaneous center of rotation near the superior margin of the pubic symphysis.

Smidt et al<sup>29</sup> used the Metrecom Skeletal Analysis System to measure motion during reciprocal positions of standing hip flexion and extension for 32 normal volunteers. Subjects were measured with one hip flexed to 90% of end range and the opposite hip extended to 90% of end range, a stance termed the straddle position. The composite sacroiliac joint oblique-sagittal motion between the right forward hip position and left forward hip position was 9°.

Sturesson et al<sup>12</sup> examined 25 patients with a clinical diagnosis of sacroiliac joint dysfunction. Tantalum balls were inserted into the pelvis as markers, and sacroiliac (SI) motion was measured by stereophotogrammetric X-ray during various motions of the trunk and hips. Hip hyperextension resulted in an average ipsilateral ilium anterior rotation of 2.2°, but contralateral ilium anterior rotation of only 1.7°, thus creating torsion of 0.5°. The authors concluded that assessing mobility under physiologic loading conditions cannot identify sacroiliac joint dysfunction because the motions were identical on the symptomatic and asymptomatic sides.

#### Pre- and post-manipulation changes in pelvic torsion

Cibulka et al<sup>3</sup> measured the change in pelvic torsion following one application of a high-velocity, low-amplitude maneuver (Stoddard maneuver) using an inclinometric device. Innominate tilt angles were the mean of four measurements taken by a blinded examiner. The inclinometric method had “excellent” intra-tester reliability ( $r = 0.84$ ). The mean innominate tilt angle on the manipulated side changed 5.9°, and the nonmanipulated side by 5.2° in the opposite direction. In 10 experimental subjects, the average pre-manipulative left-right innominate spread (torsional angle) of 11.2° was entirely eliminated in one manipulative procedure, unlike the control group, where very little changed. This torsional value considerably exceeds the mean values reported by some other investigators<sup>26,28</sup> but is right in line with values reported by other investigators.<sup>23,27,29</sup>

Tullberg and coworkers<sup>33</sup> used roentgen stereophotogrammetric analysis. There were no changes in the position of the sacrum relative to the innominate bone following combined high velocity, low amplitude (HVLA) manipulation and mobilization techniques, although the results of a battery of orthopaedic (“position”) tests did change. Several factors could

account for the differences between Tullberg’s and Cibulka’s findings: the exact manipulative procedure used was less competent at effecting positional change than the procedure Cibulka et al used; the latter’s inclinometric method was flawed<sup>34</sup>; stereophotogrammetric analysis is not as sensitive as one might suppose for torsion-related sacroiliac alterations; the manipulative procedures used in Tullberg et al’s experiment produced a change in the contralateral sacroiliac joint; Tullberg et al looked at sacroiliac movements and Cibulka et al at interinnominate movements; or some other explanation might best explain how the studies of Tullberg and Cibulka and their associates produced such inconsistent results.

#### ORTHOPAEDIC TESTS FOR SACROILIAC JOINT AND SYMPHYSIS PUBIS

Most of the orthopaedic tests for the pelvic joints are intended to be pain provocative. All of them involve stressing the joints in one direction or another. Examples of sacroiliac tests are the iliac compression and squish tests; Gaenslen’s sign; Yeoman’s, Patrick’s, or Fabere’s test; Laguere’s sign; straight leg raising (to a degree); and the supported Adams test. Chamberlain’s one-legged stance purports to identify pubic pain.<sup>25</sup> Many of these pelvic joint tests stress the joints in a manner comparable to that used in studies that sought to measure the pelvic ranges of motion. Most of the orthopaedic tests have limited reliability.<sup>35</sup>

#### EXAMINATION PROCEDURES FOR DETECTING PELVIC TORSION

Unfortunately, there is no established, gold standard test for pelvic torsion. When there is no accepted gold standard, we may at least temporarily accept one or more logical consequences of the target disorder and accept tests for them as providing construct validity for the target disorder.<sup>36</sup>

Several methods for detecting pelvic torsion are in common use, both within and without the chiropractic profession.<sup>3,8,11,23,30,31,37-48</sup> Some of these are direct, meaning they specifically examine the pelvis in some way, while others are indirect, meaning pelvic torsion is inferred from information gathered from a remote body location. Table 4 lists the most common of these methods.

To our knowledge, none of these methods have been established as a gold standard, but any of the direct methods, especially inclinometry and radiography, are more convincing than the indirect methods.

#### Selected tests for pelvic torsion

##### *Pelvic inclinometry*

Initially, a plumb line–based inclinometric method was used. Currently, there are measuring devices commercially available



**Table 4.** Direct and indirect examination methods for pelvic torsion

	Methods	Representative example(s)	Representative citations
<b>Direct methods</b>	radiography	eg, longer innominate bone on anteroposterior projection = posterior-inferior ilium	Herbst (37) Plaughner (38) Reinter (39), as modified by Jeffery (40) Hildebrant (11), as modified by Jeffery (40)
	pelvic inclinometry	directly measured	Cibulka (3), Pitkin (23)
		inferred from ASIS and PSIS locations, perhaps with caliper measurements	Levange (41, 42)
	static palpation and visualization	iliac crest locations, gluteal fold inspection	Herbst (37), Logan (8), etc.
	symptoms	eg, tenderness at particular aspect of SI joint implies AS or PI ilium	Herbst (37)
<b>Indirect methods</b>	leg checks	functional short leg identifies side of PI ilium	Thompson (31), Fuhr (43), DeJarnette (44), Stillwagon (30), Cooperstein (45)
		triaxial leg check	Cooperstein (46, 47)
	remote symptoms	medial knee tenderness	Thompson (31), DeJarnette (44)
	challenges	previously strong muscle indicator muscle weakens when light forces briefly applied to pelvic landmarks	Walther (48)
	isolation, pressure testing	leg length changes with provocative probing of pelvic landmarks	Fuhr

PI, posterior-inferior; AS, anterior-superior; PSIS, posterior superior iliac spine; ASIS, anterior superior iliac spine.

that replace the plumb line with either a needle gauge or a floating bubble-based level. These methods require accurate identification and equipment placement at the ASIS and PSIS.

Levange<sup>41</sup> used an alternative floor-mounted device consisting of a pointer that slides on a vertical ruler to determine the location of the landmarks in separate operations and trigonometry to determine hemipelvic tilt. She reported a very high degree of interrater correlation using her method, which involves touching the pointer to a horizontal line drawn on the thumbnail of the palpator. Levange<sup>41</sup> comments that the most commonly accepted method of measuring pelvic torsion involves (1) measuring the height from the floor (or bench if the subject is sitting) of the ASISs and PSISs, (2) computing the height differential for the ASIS and PSIS of each hemipelvis, and (3) computing the differential of the differentials. Simply stated, pelvic torsion is confirmed when lines drawn through the ASIS and PSIS on each

side of the pelvic are not parallel. Indeed, it is hard to imagine a scenario that would invalidate this assumption, other than anatomic asymmetry of the innominate bones, or of the ASIS/PSIS in particular. Translations alone could not change the relative slope of the ASIS-PSIS lines.

Sanders and Stavarakas<sup>42</sup> described how to compute pelvic tilt from vertical ASIS and PSIS measurements, provided the ASIS-PSIS distance is known from caliper measurements. A device known as the PALM (palpation meter, Performance Attainment Associates, St. Paul, Minnesota) permits such measurements to be taken simultaneously. Some authors<sup>34</sup> did not find the inclinometric-caliper method very reliable.

#### *Pelvic radiometry*

X-ray line marking in chiropractic has been surrounded by controversy. Some of the controversy involves the reproduc-

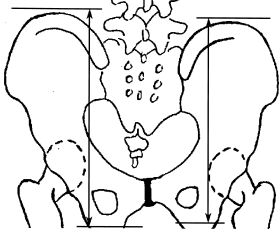
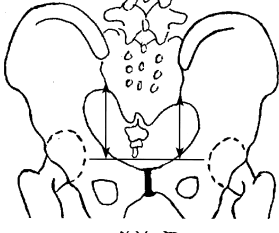
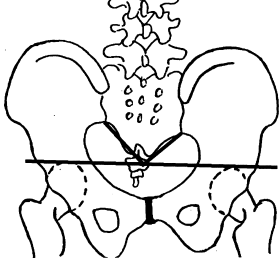
ibility of patient positioning, the interexaminer reliability of mensuration methods, the validity (the extent to which the radiographic measurements accurately proxy the physical location of bony landmarks), and questions regarding the clinical utility of knowing the information provided. As Plaughner et al<sup>49</sup> provide convincing evidence that the positioning issues are surmountable, and Harrison et al's<sup>10</sup> literature review suggests that interexaminer reliability is established for many, if not most, of the line marking methods, this article will deal with the validity issues.

It is not obvious whether inclinometry or radiography could better serve as a gold standard for measuring pelvic torsion, but it would certainly be interesting to compare results. Jeffery<sup>40</sup> characterized three general methods of radiometry to detect pelvic torsion (Table 5). Adapted versions of these methods were then used to calculate innominate tilting of a dry specimen tilted to varying known degrees and radiographed. Since Jeffery did not actually produce pelvic torsion in the dry specimen, having merely rotated the entire pelvis in the sagittal plane and applied the line marking rules to one hemipelvis, the work is not entirely satisfactory. The manner

in which torsion occurs will obviously affect the numbers. Notwithstanding this problem, Jeffery found only the Reinert and Hildebrandt line marking methods sensitive for hemipelvic rotation.

One of the authors of this article tested the validity of Gonstead line marking rule for pelvic torsion by modeling the procedure in a computer simulation.<sup>50,51</sup> Trigonometrically calculated projected changes in innominate vertical lengths were developed using experiments on a digitized pelvis, assuming a pubic symphysis axis for torsion. The left-right innominate vertical length delta was found to be a function of the magnitude of distortion, the type of radiography used (sectional or full spine), the size of the subject, the target-film distance, and the degree of pelvic tilt in the sagittal plane. The Gonstead rule (ie, the longer innominate measurement occurs on the side of posterior rotation) performed best under the following circumstances: an anteriorly tipped pelvis, full spine radiography, and a large torsional angle. On the other hand, the method was invalid using an opposite set of circumstances, so that the innominate could actually be shorter on the side of posterior rotation (flat pelvic carrying angle, sectional

**Table 5.** Radiometric methods for identifying pelvic torsion, after Jeffery<sup>40</sup>

Method	Illustration	Description	Reliability	Sensitivity
Gonstead <sup>37</sup>		Compares vertical lengths of innominates	Not satisfactory	Not satisfactory
Reinert <sup>39</sup>		Compares distance from each sciatic notch to line through the symphysis	Satisfactory	Satisfactory
Hildebrandt <sup>11</sup>		Measures angles created between lines drawn from sciatic notch to midpoint of femur head line	Satisfactory	Satisfactory

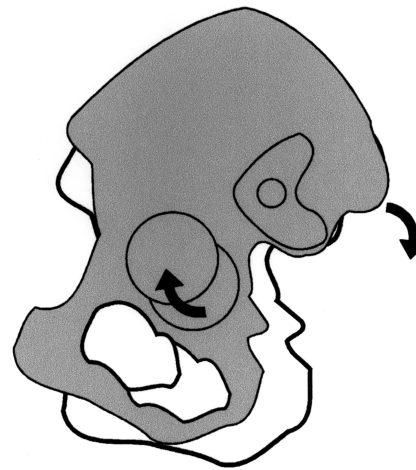
radiography). Moreover, the innominate length differential was not a monotonic function of the torsional angle, so that larger degrees of torsion eventually resulted in decreasing differentials. In effect, the Gonstead “rule” is not really a rule, since it is valid only some of the time and under certain circumstances.

**Static palpation**

The expected left-right iliac crest and PSIS height differentials for various degrees of pelvic torsion, among individuals with various pelvic sagittal tilts was also calculated assuming a pubic symphysis axis of rotation.<sup>50,51</sup> The data, which are provided in Table 6, assume 2° innominate rotations in opposite directions, well within the bounds of what the anatomists have found reasonable. The baseline “normal” pelvic carrying angle was arbitrarily defined as one in which a vertical line transects the midpoint between the ASISs and the symphysis pubis. It should be noted that: (1) the flatter the pelvic carrying angle, the greater the height differentials that are created; (2) PSIS palpation is considerably more sensitive than crest palpation; and (3) the magnitudes can be surprisingly large (ie, as much as 10.9 mm PSIS height discrepancy in a subject with a relatively flat pelvic carrying angle).

**Leg checks**

It is widely believed that a functional short leg identifies an ipsilateral posteriorly rotated innominate bone. Probably the most common explanation of the posterior-inferior ilium = short leg rule is that of a posterior swing of the innominate bone pulling the acetabulum, and therefore the lower extremity, cephalad.<sup>52,53</sup> This explanation can also be found in the physical therapy literature.<sup>54</sup> This explanation requires the interinnominate axis of rotation to be posterior to the hip, perhaps through the sacroiliac joint. However, if the hip were indeed carried cephalad by this mechanism, then so would the pubic ramus, and by a much larger amount (Fig 1). In other words, a 6-mm short leg created in this way would luxate the symphysis pubis by causing a diastasis of around half an inch.<sup>55</sup> For this reason, this explanation is not very appealing. It is unlikely that a typical patient with a quarter inch short leg has a symphysis luxation.



**Figure 1.** Symphysis pubis luxation in traditional torsion model.

A more patient friendly approach to explaining the association of posterior innominate rotation and the functional short leg invokes greater suprapelvic muscle tone on the side of posterior innominate rotation.<sup>45,56,57</sup> Relative hypertonus of the quadratus lumborum and/or sacrospinalis muscles would then elevate the ipsilateral hemipelvis and lower extremity, creating a “muscular short leg.”<sup>57</sup> Asymmetry in infralumbar ligamentous and musculotendinous resistance could play a role, perhaps even a dominant one.

The classic leg check, concerned with detecting what amounts to Y axis translation of one leg relative to the other, may be improved by adding to it elements of triaxial rotation.<sup>47</sup> A triaxial foot inclinometer was constructed, consisting of two orthogonally placed inclinometers and a compass mounted on a surgical boot, screwed to a wood “footprint” (Fig 2). This allowed measuring the tendency of the feet to assume asymmetric rotational positions in dorsiflexion-plantarflexion, internal-external rotation, and inversion-eversion. In a pilot study involving five subjects, each of whom were tested twice, a robust tendency was detected for increased external rotation, inversion, and plantarflexion to covary, on the side of apparent leg length inequality.<sup>47</sup> Ultimately, it will be necessary to demonstrate

**Table 6.** Iliac crest and PSIS differentials for 2° bilateral, opposed innominate rotation (in mm)

Pelvic carrying angle	Posterior rotation side	Anterior rotation side	Iliac crest delta	Posterior rotation side	Anterior rotation side	PSIS height delta
baseline “normal”	-2.5	2.3	4.8	-5	4.8	9.8
10° steeper	-1.4	1.2	2.6	-4.3	4.1	8.6
10° flatter	-3.5	3.3	6.8	-5.5	5.4	10.9





**Figure 2.** Triaxial foot inclinometer.

correlation of leg check results with pelvic measurements if leg checks are to predict pelvic torsion.

### Remote symptoms

Medial knee pain and/or tenderness on the side of the putative posteroinferior innominate bone is one of the most ubiquitous “rules” in chiropractic techniques, showing up in a broad array of technique systems (eg, Thompson,<sup>31</sup> sacro-occipital technique,<sup>44</sup> applied kinesiology,<sup>48</sup> Logan basic,<sup>8</sup> activator methods,<sup>43</sup> and Pierce-Stillwagon technique.<sup>30</sup> Cooperstein,<sup>45</sup> synthesizing various of the rationales presented and expanding upon them, provides a rationale based on the interaction of pelvic biomechanics and the lower extremities, which has to do with an increased valgus angle of the ipsilateral leg.

### Challenges and other reflex procedures

A broad group of chiropractic techniques (kinesiologies) based principally on the work of George Goodheart<sup>58-60</sup> attempt to identify pelvic torsion through reflex procedures such as the vertebral challenge and therapy localization.<sup>48</sup> In the vertebral challenge, a suspected line of drive is applied to a putatively subluxated bone; a weakening of a previously strong indicator muscle would indicate the appropriateness of that line of drive. For example, if a light thrust on the PSIS of a prone patient weakens the previously strong hamstring muscle, then the innominate bone is presumed to have rotated posteriorly. Activator methods chiropractic technique uses isolation testing in a more or less similar manner,<sup>61</sup> differing primarily in that the outcome measure is a change in leg checking results, rather than muscle strength. In an isolation test for pelvic torsion, “prone observations are made of straight and flexed LLs while the patient’s extremities are positioned so as to exacerbate muscular imbalance at specific spinal segments.”<sup>62(p.170)</sup> Little is known of the reliability and validity of such techniques.

## DISCUSSION AND CONCLUSIONS

Although pelvic torsion is an established fact, its clinical significance is not entirely clear. It serves as a compensatory device when standing on an unlevel surface<sup>26,28</sup> and also as part of the gait mechanism: “The horizontal axis which passes through the symphysis pubis and permits the pubis to rotate allows iliac movements in the physiology of walking.”<sup>63(p.12)</sup> Given widespread consensus that in a state of subluxation, “a vertebra or a pelvic bone has become temporarily immobilized in a position which it may normally occupy during any phase of a physiological spinal movement,”<sup>65(p.256)</sup> it would follow that pelvic torsional subluxations are likely to occur, with potential consequences. This hypothesis is not at all invalidated by findings like those of Tullberg et al<sup>33</sup>; there is no contradiction between the hypothesis that pelvic torsion is pain provocative and the experimental finding that manipulation may ameliorate sacroiliac pain without altering the sacroiliac joint bone positions. Although Levangie<sup>41</sup> did not find pain to correlate with the measures she used for pelvic torsion, Pitkin and Pheasant<sup>23</sup> did.

The musculoskeletal examination uses orthopaedic tests to rule out significant pathology (eg, a positive straight leg raise test = nerve root compression), or possibly to localize a regional pain generator (eg, a positive Gaenslen’s test = symptomatic sacroiliac joint), but not to determine an appropriate adjustment. The authors propose that a closer look at the biomechanics involved in orthopaedic tests may provide valuable information to guide the clinician in the adjustment of a given patient. Indeed, this information may augment traditional evaluation methods that determine static or dynamic “listings” in isolation from orthopaedic testing.

Gaenslen’s test may serve as example. The test is performed by putting the supine patient in the position of maximum hip flexion on one side and maximum hip extension on the contralateral side. This position moves the innominate on the flexed hip side into posterior rotation and on the extended hip side into anterior rotation, producing pelvic torsion. In a normal subject, this is painless, but when pain is elicited during this maneuver, we presume there is insufficient, excess, or otherwise faulty motion of the pelvis. Pain on either or both sides elicited with a patient’s left hip flexed and right hip extended indicates a problem with motion of the left innominate in the posterior direction and/or the right innominate in the anterior direction.

The clinician must determine, of course, whether the problems result from inadequate or excess movement in the pain provocative direction. Admittedly, this is a simple task, but that is where the statics come in: until proven otherwise, it is reasonable to suggest that a clinician should avoid adjustive procedures that would increase the degree of pelvic torsion. Apart from the obvious possibility of increasing the degree of

misalignment, such procedures might increase the abnormal stretch, however transiently, on certain contracted soft tissues, even to the point of damage; produce jamming of articular structures that are already excessively approximated, risking exacerbation of symptoms; and evoke guarding responses that diminish range of motion and delay clinical improvement (eg, pain-spasm-pain and related cyclic phenomena).

More information regarding pelvic torsion is required. The following sequence of steps is suggested: (1) establish a gold standard, probably radiometric or inclinometric; (2) determine correlation of indirect measurements (leg checks, etc) with the gold standard; (3) investigate whether torsion is more likely to occur in symptomatic or asymptomatic subjects, or correlates with or predicts any other patient characteristics; and (4) investigate the effect of chiropractic technique procedures on symptomatic subjects, structurally and subjectively. It will be interesting to determine whether changes in the torsion value can be achieved, or are even worth achieving.

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## **A clinical prediction rule for 52 patients with cranial dysfunctions and headache: A retrospective case-series report**

Scott Cuthbert, DC, Charles L. Blum, DC

### **Introduction**

George Goodheart, Jr., the son of a chiropractor and osteopath, was heavily influenced by and a life-long student of his father and his father's friend in Detroit, Major Bertrand DeJarnette. There are several important and potentially useful additions made by Goodheart (developer of Applied Kinesiology) to the unique approaches introduced into the chiropractic profession for treatment of the cranium by DeJarnette (developer of Sacro Occipital Technique). This report examines the most important of these concepts, examines its significance in cases of headache, and presents a retrospective case-series report to examine its potential usefulness.

It has been suggested by a number of cranial researchers that the extracranial muscles are the primary and most likely engine for the cranial rhythmic impulse (CRI) or cranial sacral primary respiratory mechanism (CSPRM).<sup>1-2</sup> This possibility has been supported by various researchers and shown to be a likely candidate for driving at least a part of the CSPRM.<sup>3,4</sup>

The concept of a primary respiratory mechanism (PRM) within the central nervous system was conceived over 75 years ago by William Garner Sutherland, DO. Since that time there have been many models seeking to confirm or more fully explain Sutherland's model for cranial-sacral motion. While the clinical results of cranial treatment have supported its continued use, cranial practitioners recognize that the conceptual model for the CSPRM needs to be updated.<sup>5-7</sup>

In recent years, chiropractic and manual medical research and theory have highlighted the role of muscles, joints, and nerves in the function of the neuro-musculoskeletal system. This system has been described as the Primary Machinery of Life<sup>8</sup> as it is how we, and all tissues within us, move and communicate. It is also suggested that a problem with the Sutherland model is that the amount of cerebrospinal fluid (CSF) produced per minute is too small a quantity to have the power to move the cranial sutures, and that the neuraxis does not itself have the contractile elements nor tensile strength to move itself -- and certainly not the whole cranium, its dural sleeves, nor the rest of the body. Essentially, we come down to the fact that motion in the body is likely the result of muscular action, whether striated, smooth, or cardiac.

It, therefore, may be time that a fundamental change or **addition to** the classical Sutherland model be introduced and tested – going from an 'internally driven' Primary Respiratory Mechanism, where an inherent spheno-occipital and/or “sacral boot” motion drives the CSPRM - - to an externally driven system where the muscles attaching to the entire neuraxis collectively move the bones and dura and CSF.

Cranial dysfunction (as used in this case-series report) involves a muscular weakness that is responsive to correction of the skull; that is, a section of the cranial respiratory mechanism is not moving correctly and when tested and or corrected, immediately improves muscle function. This lack of normal motion usually develops as a result of trauma to the skull or imbalanced muscular force affecting the skull. Evaluating the cranial mechanism by observing how muscles change

strength at different phases of respiration or when different pressures are introduced to the skull, makes the analysis of cranial dysfunctions easy and accurate. Challenge is utilized by mild pressure applied to various areas of the skull. These pressures will not influence muscle strength if there is no cranial fault present at that area. If there is one, there will be a temporary change of the muscle that will last long enough for the examiner to observe it.

It has also been hypothesized that the powerful muscles attaching directly to the cranial bones move rhythmically and in complex patterns, which are capable of exerting significant and constant pulls and pressures on the skull that demand a degree of resilience, flexibility and palpable motion in the sutures.<sup>1-4, 9-10</sup> Sabini and Elkowitz examined the coronal, lambdoidal, and sagittal sutures in 36 skulls and found the lambdoidal suture to be the most patent, and suggested this was due to external forces, such as the greater number of muscles affecting the lambdoidal suture when compared with the sagittal suture.<sup>10</sup>

Research has also demonstrated that cervicogenic and tension-type headaches (HA) arise from abnormalities and functional muscle inhibition and tenderness in the pericranial structures, along with sensitization of supraspinal neurons and decreased nociceptive activity from supraspinal structures – what are called *central mechanisms*.<sup>10</sup> Since patients with HA usually show an inhibition and an increased tenderness of pericranial, neck, and shoulder muscles that attach to the skull,<sup>11-13</sup> an examination of the frequency of muscle inhibition in cases of cranial dysfunctions associated with HA might be informative.

## Methods

Fifty-two patient files (48 female, four male, with an average age of 45.7 years) of patients who presented with HA to this office were included in this retrospective case analysis. The files were limited to a two-year time frame (2013-2014), and were extracted alphabetically from a patient list that met the inclusion criteria of this study. The predominance of females in this study was not intended in the search for cases. With a lifetime prevalence of 93% in men and 99% in women, headaches are undeniably and extremely common problem that afflict both sexes.<sup>14,15</sup> However, women consistently report neck pain more than men.<sup>16,17</sup>

The following symptom clusters were utilized for inclusion criteria in this retrospective case study.

- Headache pain
- Cranial dysfunction

Exclusion criteria included any patients with suspected pathologies that might contribute to their HA or be contraindicated for chiropractic manipulative treatment. As part of the practice at this office, all patients fill out a symptom questionnaire, consent form, and Visual Analog Scale of Neck and Associated Pain (VAS) assessment form before examinations and treatments are administered. (**Appendix 1**) The VAS for pain in the cervical spine has a test-retest reliability of 0.95 to 0.97, and is a common scale used to quantify pain and has also historically been used as an outcome tool.<sup>19</sup> The examination findings were recorded on the patients' first visit along with the patient filling out the assessment forms.



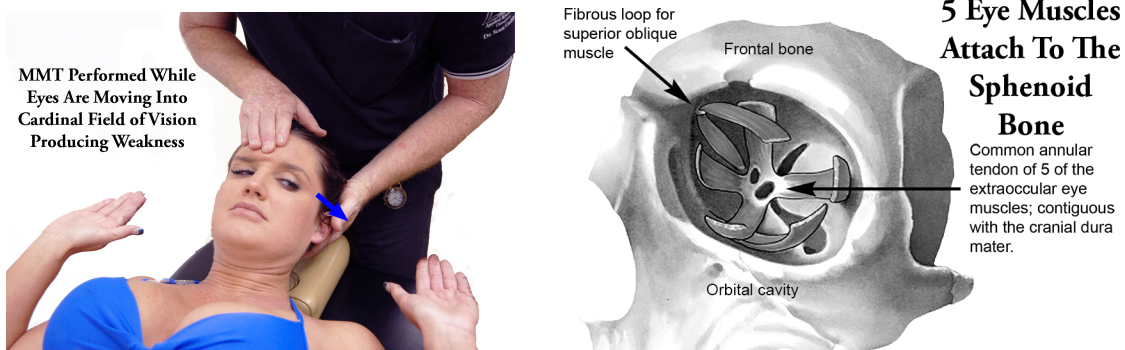
As a part of their first visit a thorough examination of postural muscle function was performed. Institutional review board exemption for this retrospective study was granted by Cleveland Chiropractic College on March 4, 2015.

## Results

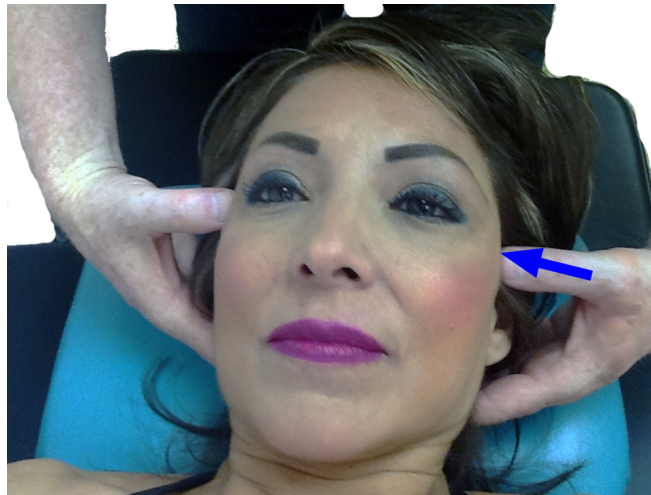
In this group of 52 patients with HA, 49 patients had cranial dysfunctions that when corrected improved all or a portion of the muscle inhibitions that were co-morbid with their HA. The three patients who did not have cranial dysfunctions, had upper cervical and/or TMJ dysfunction as the primary cause of their HA. Forty-two of these patients had sternocleidomastoid muscle inhibition on manual muscle testing (MMT), 33 patients had muscle inhibition of the deep neck flexor muscles. 24 patients had muscle inhibition of the anterior scalene muscles, 24 patients had muscle inhibition of the upper trapezius muscles, and three patients had no muscle inhibitions co-morbid with their HA at all.

Twenty-four of these patients had a positive ocular lock challenge, which in applied kinesiology (AK) testing is a sign of disturbance in the opto-kinetic reflexes.<sup>20</sup> Each of these cases was responsive to sphenoid bone cranial correction, which removed this challenge. Fifty-two of these HA patients also had a co-morbid upper cervical subluxation which also required treatment even after the cranial fault was removed. Thirty-nine of these patients had positive challenge to the temporomandibular joint (TMJ). **(Figure 1-3)**

In this retrospective case study, 40 patients who had HA and cranial and cervical dysfunctions also showed some degree of TMJ disorder. The muscular kinematic links with the mandible create a connection between temporomandibular and sphenoidal dysfunction, with influences being possible from either direction.<sup>1, 9, 17, 21</sup>



**Figure 1. Ocular Lock (Opto-Kinetic) Challenge**



**Figure 2. Left sphenoid lateral strain correction**



**Figure 3. Challenge to left TMJ with opening of the jaw**

The average Visual Analog Scale (VAS) of Neck and Associated Pain for these 52 patients was 6.75 (0 to 10 scale), and after treatment (averaging 1 to 5 sessions, with 4 patients requiring ongoing treatment to maintain their improved VAS level) the average VAS was reduced to 0.49. (Table 1 & 2, & Appendix 1)

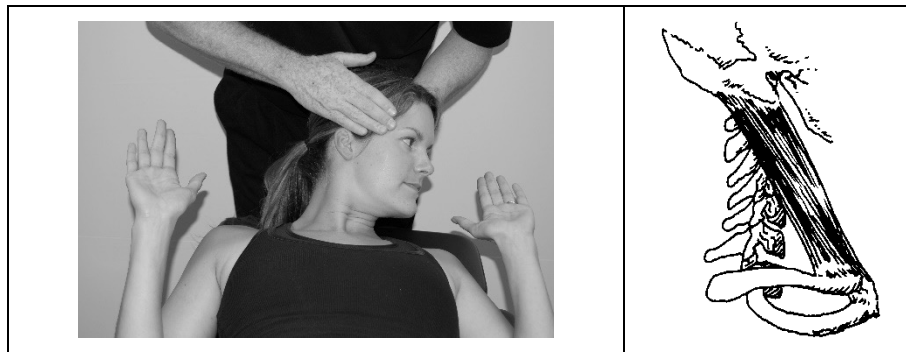
## Discussion

Sacro occipital technique (SOT) and Applied Kinesiology chiropractic technique offer a novel approach to treating head and neck pain by suggesting that manipulation of the cranial bones, sutures, meninges and related muscle of the human skull may impact whole body function. There have been some published studies that support the use of cranial techniques for the treatment of headaches and pain, though clearly more research in this arena is needed.<sup>21-23</sup>

The connective tissue matrix that binds the various cranial bones contain myelinated and unmyelinated nerve fibers that terminate as free nerve endings may be associated with pain responses caused by imbalanced myofascial compressive forces occurring at the sutures.<sup>24</sup> Some of the myelinated fibers terminate as branched free nerve-endings along the inner periosteal covering of the skull bones, and the nerve endings are believed to be pressure sensitive, producing pain sensations when under excessive force, possibly associated with muscular contractions.<sup>21</sup> According to Retzlaff et al,<sup>25</sup> if the stimulus is excessive, all of the sensory-type

receptors in the suture may produce poorly localized pain perception. Jones et al also explain that within the cranial sutures, certain nerve endings are considered sensitive to excessive pressure; when the pressure is relieved the pain is eliminated.<sup>25</sup> This relationship between nerve endings in cranial sutures and their response to pressure would be consistent with other studies suggesting a relationship between myofascial tension and headaches.<sup>26-27</sup>

Goodheart, a student of DeJarnette, stated that there is a need “to achieve zero defects both within the dura, and without.” (Figures 4-8) It is also noted that various types of muscle dysfunction underlie many different abnormal musculoskeletal presentations.<sup>28</sup> It has been hypothesized that the various powerful muscles attaching directly to the cranial bones move rhythmically and in complex patterns, and these muscles may be specifically tested and treated.<sup>9, 20</sup> In a narrative literature review by Cuthbert and Goodheart, manual muscle testing (MMT) was found to be a reliable and valid functional assessment tool,<sup>29</sup> and it is reasonable to assume that improvement of muscle function during care would be associated with improved patient outcomes.<sup>30</sup>



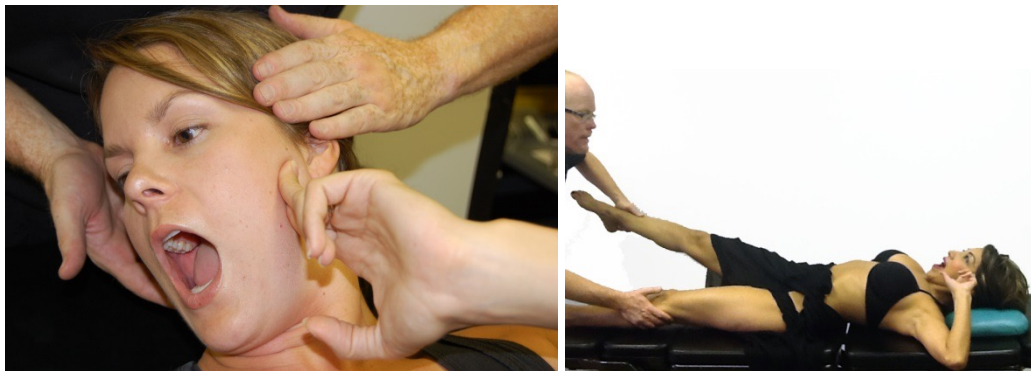
**Figure 4. Sternocleidomastoid MMT and muscle**



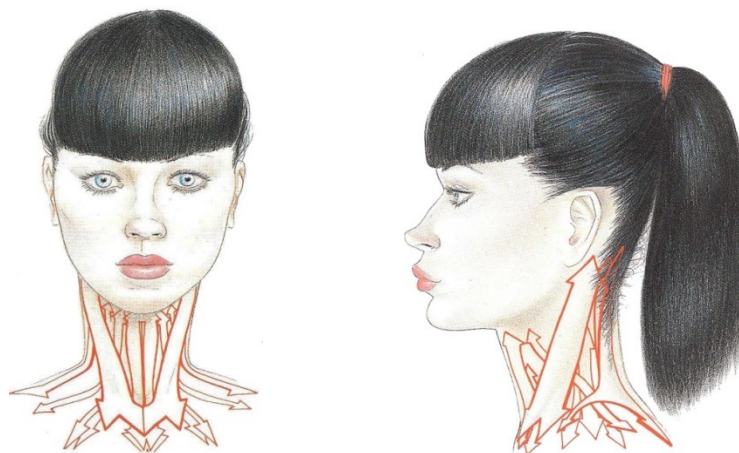
**Figure 5. Deep neck flexor MMT**



**Figure 6. Upper trapezius MMT and muscle**



**Figure 7. TMJ Challenge during MMT**



**Figure 8. Manual muscle tests (MMT) are designed to replicate the primary vector of motion of a muscle while minimizing the contribution of secondary mover muscles. There is an ideal starting position and vector of testing force that places the cervical muscle being tested as the prime mover and the synergists at a disadvantage during the test. Accurate MMT must be done with a high level of anatomical and physiological knowledge.<sup>20</sup>**

In 1920 Cyriax first described the relationship between muscle weakness (detected with a MMT) and headaches.<sup>31</sup> In 2008 an important literature review on neck muscle strength by Dvir (in a special issue of *Journal of Manipulative and Physiological Therapeutics* called “Cervical Outcome Measures: State of the Art”) confirms that “overall studies indicate that compared to normal subjects, patients suffering from neck-related disorders present with **significant reductions in cervical muscle strength.**”<sup>32-36</sup> Deficits in strength, endurance, and increased fatigability have been consistently demonstrated in the muscles that attach to the cranium in patients with whiplash-associated disorders, neck pain and headache.<sup>12, 37-39</sup>

In a recently published paper Cuthbert, Rosner and McDowall demonstrated that in a group of patients with mechanical neck pain (MNP), significantly increased MMT findings in the form of reduced strength levels were present compared to a control group (n=248).<sup>39</sup> (Table 3) This suggests that the MMT may potentially be a sensitive and specific test (a clinical prediction rule) for evaluating cervical spine muscular impairments in patients with MNP.

**Table 3**  
**Number and Percentages of Patients with Positive MMT findings, by Muscle Group**

	Control Group (100 patients)	Mechanical Neck Pain Group (148 Patients)
<b>Sternocleidomastoid</b>	<b>18 (18%)</b>	<b>61 (41.2%)</b>
<b>Anterior scalene</b>	<b>13 (13%)</b>	<b>49 (33.1%)</b>
<b>Upper trapezius</b>	<b>4 (4%)</b>	<b>64 (43.2%)</b>
<b>Cervical extensors</b>	<b>2 (2%)</b>	<b>48 (32.4%)</b>

These data indicate that the body’s reaction to injury and pain is **not increased** muscular tension and stiffness; rather **muscle inhibition is often more significant** as measured by several different methods of testing.<sup>13-14, 31-39</sup> These strength changes have been demonstrated specifically in patients with cranial bone imbalance, whiplash, neck pain and headache.

These studies suggest that the performance of the sternocleidomastoid (SCM), anterior scalenus (AS), deep neck flexor (DNF), and upper trapezius (UT) muscles are an invaluable diagnostic measurement in the evaluation of patients with headache, chronic neck pain, and chronic whiplash-associated disorders.<sup>12,40</sup> For instance, upper trapezius muscle dysfunction forces the occiput into flexion or extension and normalization of the strength and function of the muscle before treatment to the cranial base will optimize the treatment’s outcome.<sup>1,39</sup> Sternocleidomastoid muscle dysfunction forces the temporal bone into internal or external rotation, etc.<sup>1,9</sup> Changes in upper trapezius and sternocleidomastoid strength have been found in patients with cranial bone imbalance, whiplash, neck pain and headache.<sup>9, 12-14, 20, 23,39</sup>



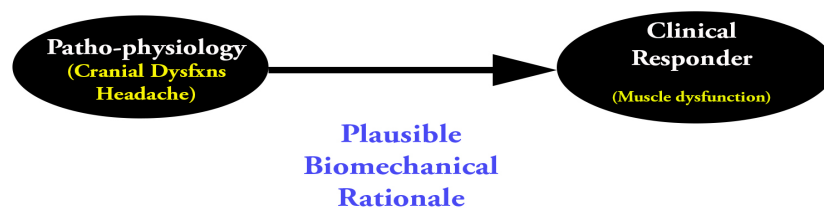
If there is a modifiable risk factor for cranial dysfunctions and headache, then it would be prudent to develop preventive strategies to help identify and target important subgroups of the population at greatest risk for these disorders so frequently confronted by SOT and AK practitioners. In this retrospective case series report, 49 of the 52 patients appeared to present with a cranial dysfunction contributing to their headache and also had a positive MMT in one or many of the muscles of the neck and head. This may mean that the MMT – and its responsiveness to cranial or cervical correction – could function as a clinical prediction rule for patients with cranial dysfunctions and HA.

Clinical prediction rules (CPRs) are derived statistically from research evidence with the aim of identifying the combinations of clinical examination findings that can predict a condition or outcome or favorable response.<sup>41,42</sup>

“CPRs quantify the contribution of symptoms, clinical signs, and available diagnostic tests, and stratify patients according to the probability of having a target disorder. The outcome of interest can be diverse and be anywhere along the diagnostic, prognostic, and therapeutic spectrum.”<sup>41</sup>

Essentially, the identification of responder sub-groups is now a treatment priority, because it appears that larger treatment effects are observed if focused manual therapy is applied to those likely to respond.

Liebenson notes that there is a profound need to translate the results of clinical and epidemiologic studies into meaningful and practical information for clinicians.<sup>43</sup> One such result could be muscle strength impairments as a modifiable risk factor in patients with cranial dysfunctions and headache. The development of clinical prediction rules (clinical examination findings that can predict the presence of a condition and its response to treatment) may link muscle strength impairments in patients with cranial faults and HA as a modifiable risk factor. (Figure 8)



## The Manual Muscle Test -- A Clinical Prediction Rule for Cranial Dysfunctions & Headache

Figure 8. The manual muscle test may be a CPR for cranial dysfunction and HA

The influence on sutural mobility of a malfunctioning sternocleidomastoid or upper trapezius muscle could be significant and sutural disturbances are a definite physiological occurrence.

Philip Greenman notes that: <sup>44</sup>

“First and foremost the craniosacral mechanism must be viewed within the context of the total musculoskeletal system. Dysfunctions within the craniosacral mechanism may be primary, secondary or of little import. Cranial dysfunction may be the result of alteration elsewhere, and, if that is not addressed, treatment of cranial dysfunction will be less than satisfactory. Conversely, continued attention to dysfunction in the musculoskeletal system elsewhere, without addressing the craniosacral dysfunction, will give less than satisfactory results.”

During an examination of cranial dysfunction, it may be of value for the physician to pay careful attention to muscular dysfunctions that cross or impact cranial suture mobility. Any attempt to normalize cranial function without appropriate attention to these muscular influences, acting directly on the sutures and, therefore, on the motion potentials of the cranium, may diminish the overall positive results of cranial manipulative therapy in cases like these.

This study attempts to emulate Flynn and colleagues, <sup>42</sup> who used a single arm design to identify demographic, historical or physical examination factors associated with a favorable clinical outcome among patients with low back pain undergoing treatment consisting of spinal manipulative therapy and range of motion exercises. While this current retrospective study has various limitations (no control, no sham intervention, not being able to rule out regression to the mean or ideomotor effect), there were five identified variables associated with a favorable treatment response:

1. Patients were female
2. Patient's ages were approximately 45 years old +/- 10 years (35-55 years old)
3. Presented with headaches with cranial dysfunction
4. Presented with upper cervical vertebral joint imbalance
5. Manual muscle testing (MMT) revealed muscle inhibition most commonly of the sternocleidomastoid and the deep neck flexor muscles, and to some degree to the anterior scalene and upper trapezius muscles.

The evaluation and treatment of the muscular strength and function in the cranial muscles may become a standard part of evaluation and therapy in headache and neck pain patients. This approach may improve our approach to, concepts behind, and outcomes with cranial therapy. The immediacy with which these muscle inhibitions (associated with headache, neck pain and jaw pain) respond to proper cranial treatment suggests how related these two basic pathophysiological problems are. In cranial treatment of this kind we ask: how is “sacroiliac pain” explained without considering the functional status of muscles that move the hip and

pelvis? Similarly, how is “headache” to be fully understood without considering the muscles that attach to and move the cranium, neck and jaw?

### **Conclusion:**

SOT (like AK, which developed from SOT) suggests that muscle dysfunctions arising from, or that are part of the etiology of cranial dysfunctions, should be recognized and corrected as part of the over-all treatment strategy. This retrospective case study suggested a relationship between muscular imbalance and associated headache pain in a selected group of patients. VAS assessments performed pre- and post-care noted an improvement from the treatment rendered. As with any case series without a control, sham intervention, randomization, or blinded gatherer of data, generalization of these findings has its limitations. Yet even with these limitations further study is indicated to determine if muscular imbalance and headaches represent a subset of patient presentations that would be predictive of having good outcomes to chiropractic care.

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**Table 1**  
**Summary of Patient Findings**  
**(n=52) Patients With Headache**

<b>SEX AND AGE</b>	<b>Positive MMT (SCM, Anterior Scalene, Deep Neck Flexors, or Upper Trapezius Muscles)</b>	<b>Positive Cranial Challenge = Strengthens Inhibited MMT</b>	<b>Positive Ocular Lock (Opto-Kinetic Reflex) Challenge</b>	<b>Positive Upper Cervical Challenge</b>	<b>Positive TMJ Challenge</b>	<b>Change in HA with TX on VAS</b>
<b>TOTALS</b>						
<b>F: 48 M: 4</b>	<b>SCM = 42 DNF = 33 AS = 24 UT = 24 None = 3</b>	<b>N = 3 Y = 49</b>	<b>N = 28 Y = 24</b>	<b>Y = 52</b>	<b>N = 13 Y = 39</b>	<b>VAS AT INITIAL CONSULTATION average = 6.75  VAS AFTER TREATMENT (1 to 5 sessions) average = 0.49</b>

**Table 2**  
**Individual Patient Findings**  
**(n=52) Patients With Headache**

<b>SEX AND AGE</b>	<b>Positive MMT (SCM, Anterior Scalene, Deep Neck Flexors, or Upper Trapezius Muscles)</b>	<b>Positive Cranial Challenge = Strengthens Inhibited MMT</b>	<b>Positive Ocular Lock Challenge (Optokinetic reflex)</b>	<b>Positive Upper Cervical Challenge</b>	<b>Positive TMJ Challenge</b>	<b>Change in HA with TX on VAS/ # of treatments</b>
<b>1.</b> <b>(F) 47</b>	Y SCM, UT	Y	N	Y	Y	8 to 1 4 TxS
<b>2.</b> <b>(F) 81</b>	Y SCM, DNF	Y	N	Y	N	6 to 0 3 TxS
<b>3.</b> <b>(F) 27</b>	Y SCM, AS	Y	Y	Y	Y	10 to 0 5 TxS
<b>4.</b> <b>(F) 52</b>	Y SCM, DNF	Y	N	Y	Y	6 to 2 5 TxS
<b>5.</b> <b>(F) 57</b>	Y SCM, DNF	Y	N	Y	N	7 to 0 3 TxS
<b>6.</b> <b>(F) 47</b>	Y SCM, DNF	Y	Y	Y	Y	to 0 5 TxS



7	(F) 44	Y SCM, DNF, AN, UT	Y	Y	Y	Y	10 to 2 Ongoing tx to reduce intractable migraines
8.	(M) 65	Y SCM, DNF, UT	Y	N	Y	Y	7 to 1 3 Txs
9.	(F) 54	Y SCM, AS, DNF	Y	Y	Y	Y	6 to 0 5 Txs
10.	(F) 15	Y AS, UT	Y	N	Y	Y	6 to 0 3 Txs
11.	(F) 61	Y SCM, UT	Y	N	Y	Y	7 to 0 5 Txs
12.	(F) 32	Y SCM, AN, DNF	Y	Y	Y	Y	9 to 0 3 Txs
13.	(F) 50	Y AS	Y	Y	Y	N	4 to 0 1 Tx
14.	(F) 64	Y SCM, DNF, UT	Y	Y	Y	Y	7 to 1 4 Txs
15.	(F) 26	Y SCM, DNF, AS, UT	Y	N	Y	Y	5 to 0 2 Txs

16. <b>(F) 54</b>	N	N	N	Y	N	6 to 0 3 Txs to I.C.V.)
17. <b>(F) 55</b>	Y AS, UT	Y	N	Y	N	9 to 0 2 Txs
18. <b>(F) 44</b>	Y SCM, AS, UT	Y	Y	Y	Y	8 to 0 3 Txs
19. <b>(F) 55</b>	Y SCM, DNF	N	N	Y	N	5 to 1 4 Txs
20. <b>(F) 48</b>	Y SCM, DNF	Y	Y	Y	N	10 to 0 5 Txs
21. <b>(F) 55</b>	Y SCM	Y	Y	Y	Y	6 to 0 4 Txs
22. <b>(F) 44</b>	Y SCM, AS, UT	Y	N	Y	Y	9 to 2 Ongoing tx to maintain 2 level HA
23. <b>(F) 23</b>	Y SCM, AS, DNF	Y	Y	Y	Y	7 to 0 4 Txs
24. <b>(F) 43</b>	Y SCM, AS, DNF	Y	Y	Y	Y	8 to 2 4 Txs
25. <b>(F) 29</b>	Y SCM, UT	Y	Y	Y	Y	9 to 0 3 Txs

26. (F) 26	Y DNF	Y	N	Y	N	4 to 0 4 Txs
27. (F) 36	Y SCM	Y	N	Y	Y	7 to 3 5 Txs
28. (F) 22	Y UT	Y	N	Y	Y	8 to 0 4 Txs
29. (F) 51	Y SCM	Y	Y	Y	N	5 to 0 4 Txs
30. (F) 43	Y SCM, AS, DNF, UT	Y	Y	Y	Y	10 to 1 6 Txs
31. (F) 49	Y SCM, AS	Y	N	Y	Y	6 to 0 2 Txs
32. (F) 58	Y SCM, UT	Y	Y	Y	Y	7 to 1 6 Txs
33. (F) 15	Y DNF	Y	Y	Y	Y	6 to 2 4 Txs
34. (M) 15	Y SCM, DNF	Y	N	Y	N	5 to 0 4 Txs
35. (F) 69	N	N	N	Y	Y	4 to 0 3 Txs



36. (F) 30	Y SCM, AS, UT	Y	N	Y	Y	7 to 1 3 TxS
37. (F) 44	Y DNF, SCM	Y	N	Y	Y	7 to 0 5 TxS
38. (F) 36	Y DNF, AS, SCM, UT	Y	Y	Y	Y	10 to 2 Ongoing tx to maintain 3 level HA
39. (F) 41	Y SCM, AS, DNF	Y	Y	Y	Y	7 to 0 4 TxS
40. (F) 56	Y SCM, AS, DNF, UT	Y	Y	Y	Y	9 to 0 3 TxS
41. (F) 43	Y SCM, DNF	Y	Y	Y	Y	7 to 0 1 Tx
42. (M) 56	Y SCM, DNF, UT	Y	N	Y	N	6 to 0 6 Tx
43. (F) 65	N	Y	N	Y	Y	3 to 0 2 TxS
44. (F) 40	Y SCM, AS, DNF, UT	Y	Y	Y	Y	10 to 0 5 TxS
45. (M) 54	SCM, AS, DNF	Y	N	Y	Y	6 to 0 4 TxS



46. (F) 51	Y SCM, DNF	Y	Y	Y	N	7 to 2 5 Txs
47. (F) 46	Y SCM, DNF, AS, UT	Y	N	Y	Y	4 to 0 4 Txs
48. (F) 47	Y SCM, DNF, UT	Y	N	Y	N	6 to 0 4 Txs
49. (F) 31	Y SCM, AS, DNF, UT	Y	Y	Y	Y	5 to 0 5 Txs
50. (F) 52	Y SCM, DNF	Y	N	Y	Y	8 to 0 5 Txs
51. (F) 60	Y SCM, AS, DNF, UT	Y	N	Y	Y	7 to 2 Ongoing tx to maintain 2 level
▪ (F) 69	Y AS, DNF, UT	Y	N	Y	Y	5 to 0 4 Txs
			<b>TOTALS</b>			
<b>F: 48 M: 4</b>	<b>SCM = 42 DNF = 33 AS = 24 UT = 24 None = 3</b>	<b>N = 3 Y = 49</b>	<b>N = 28 Y = 24</b>	<b>Y = 52</b>	<b>N = 13 Y = 39</b>	<b>VAS MAX average = 6.75  VAS CHANGE average = .49</b>



## Appendix 1: Visual Analog

# Visual Analog Scale of Neck & Associated Pain

Name \_\_\_\_\_ Date \_\_\_\_/\_\_\_\_/\_\_\_\_

Please mark on the 1 to 10 scale your involvement with pain to the following locations and situations, from no involvement (0) to maximum involvement (10). Mark the scale with a vertical line like this:

0 . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 10

1. Do you have any pain in your neck? How severe is it?

No pain 0 . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 10 Intolerable

2. Do you have any pain in the night? How severe is it?

No pain 0 . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 10 Intolerable

3. Does activity give you pain? Yes \_\_\_\_ No \_\_\_\_ If so, how much activity is required to cause you pain?

A great deal of activity 0 . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 10 Almost no activity

4. Do you use pain killers? Yes \_\_\_\_ No \_\_\_\_ If so, how much relief?

Complete relief 0 . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 10 No relief

5. Do you have any stiffness in your neck?

No stiffness 0 . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 10 Intolerable stiffness

6. Do you have pain in your shoulder and/or arm? (Mark for right and left.)

Right 0 . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 10  
Left 0 . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 10  
None at all Intolerable

7. Does your pain interfere with the use of your arm and/or hand? (Mark for right and left.)

Right 0 . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 10  
Left 0 . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 10  
None at all Not able to use it at all

8. Do you have numbness or tingling in your arm and/or hand? (Mark for right and left.)

Right 0 . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 10  
Left 0 . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | 10  
None at all Intolerable

(Over, please)



9. Do you have headaches? If so, how severe are they?  
 0 . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . 10  
 None at all Intolerable
10. How frequent are your headaches if you have them?  
 0 . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . 10  
 Infrequent All the time
11. Is your pain worse when riding in a car?  
 0 . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . 10  
 Complete freedom to ride in a car Such discomfort that I cannot ride in a car at all
12. Do you have pain when lying down in bed?  
 0 . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . 10  
 Complete comfort No comfort at all
13. What is your overall handicap in your complete life-style because of neck, head, shoulder, and/or arm pain?  
 0 . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . 10  
 Completely free to perform any task Totally handicapped
14. To what extent does your pain interfere with your work?  
 0 . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . 10  
 No interference at all Totally incapable of work
15. To what extent does your work have to be modified so that you are able to do your job?  
 0 . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . | . . . . 10  
 No adjustment to work So much adjustment that I have had to change jobs



## **Study on inducing fifth lumbar vertebra dys-relationship by M. B. DeJarnette: Historical development of sacro occipital technique**

Major B. DeJarnette, DC, DO (deceased), Charles Blum, DC

### **Introduction:**

Major Bertrand DeJarnette, DO, DC, the developer of Sacro Occipital Technique, felt that research was an essential part of being a chiropractor and essential for the future of the chiropractic profession. As early as July 1935, Major Bertrand DeJarnette was a featured speaker presenting clinical research at the 40th Anniversary Convention (1895-1935) of the National Chiropractic Association<sup>1</sup>. His attempts at research continued during his life, and in 1966 Tucker noted that “The Sacro Occipital Society is a non-profit organization set to perpetuate the advanced technics developed by Dr. M.B. DeJarnette and others in the organization. The Society is fulfilling a real need in our profession by encouraging scientific research<sup>2</sup>.”

Research was his passion, and in an interview in 1982 DeJarnette reiterated, “as far back as chiropractic college, I saw the need for a more scientific basis for chiropractic theory. My own personal physical problems had not been solved by medicine, osteopathy, or chiropractic; so I began experimenting on myself. I’m still at it, and I can see no end of the need for continuous research in chiropractic<sup>3</sup>.”

When DeJarnette began to study the assessments and treatments he had developed, he realized that if any meaningful information were to evolve from his experience, he would have to resolve it himself. DeJarnette suggested that research has to be a free agency. Basically, he saw a need and worked to fulfill that need. He realized that explaining how his discoveries evolved was more difficult than the process of developing new diagnostic and therapeutic interventions<sup>4</sup>. He said “Research is a study of what you have, and what you need to make it better, and how to make it better is the final research step<sup>5</sup>.”

“Research in Chiropractic must go on forever. Someone must do this type work, for it simply will not take care of itself. A profession cannot stand still. Momentum must constantly be generated. Chiropractic research needs many things it does not now have<sup>6</sup>.” “Sacro Occipital Technic, like all Chiropractic Technics, needs further study. We certainly do not have all the answers to all of man’s problems, and neither does any other group of people<sup>6</sup>.”

During 1941 DeJarnette concentrated his research upon the fifth lumbar vertebra. He believed that the spine must be studied vertebra-by-vertebra in order to understand the “whole.” DeJarnette decided that in order to better understand the spine as a functional kinematic structure, each part of the structure needed to be studied independently. So he undertook to do something that had never been reportedly done before in chiropractic research: he attempted to produce techniques whereby he could sublaxate the fifth lumbar vertebra even as he worked concurrently to develop techniques for the correction of fifth lumbar sublaxations<sup>6</sup>.

DeJarnette felt confident that unless a clinical researcher could actually produce distortions by sublaxating the fifth lumbar vertebra, we would never know what a fifth lumbar distortion(s) actually looked like. Ironically, he found during this following study that it was much more

difficult to willfully subluxate a vertebra than it was to supposedly correct it <sup>6</sup>. With Winsor's studies performed 20 years before (1921) as a backdrop, DeJarnette produced this following research study to see if there was a segmental relationship between the spinal dysfunction and health <sup>7,8</sup>.

## **Methods:**

DeJarnette's inclusion criteria for his study focused on acquiring subjects "who were free of lumbosacral stress symptoms <sup>6</sup>." This was determined by finding "at least two dozen subjects who could stand upright, flex forward and touch their fingertips to the floor without bending their knees, and could reverse this procedure and bend backwards without producing back or leg pain <sup>6</sup>." Subject recruitment was from DeJarnette's patient base and target ages ranged between 18 to 50 years old. Apparently over 200 subjects were examined before 18 were found that fit the inclusion criteria <sup>6</sup>. These 18 subjects apparently knew that they were part of an experiment and "consented" to be part of the study.

Once the 18 patients were enrolled in the study, he studied each subject by use of the distortion analyzer for three complete examinations on succeeding dates <sup>6</sup>. The distortion analyzer was an early attempt of maintaining stable reproducible findings by having a subject place their feet in standing foot plates and having them stand within the frame of a "box-like structure" with strings that were aligned vertically.

"The equipment consists of two arms which extend from the wall or a door casing. The arms have calibrated scales upon them, which are zeroed at the center and extended for six inches in opposite directions from center. The calibrations are in eight-inches with every quarter inch marked and numbered. The superior arm is exactly centered with the inferior arm. The zero upon each arm is in an exact gravity plane <sup>9</sup>."

"Upon each arm is fitted a plumb string carrier. This carrier is so constructed that accurate readings are made from this front cut-out. There is a locking device on both carriers so the plumb string may be set at any position for comparative readings. This plumb carrier carries two plumb strings. One is set in front of the other. These two strings attach to both arms. The strings are of different color to allow quick readings. When the carriers are moved on the plumb arms, the dual strings are carried horizontal and lateral in either direction from zero <sup>9</sup>."

The "posture foot plate is so constructed that the feet may turn laterally, but cannot turn medially past a parallel line. The back of the plate is equipped with two heel stops. When the patient is placed in the foot plate and works the feet posterior and when the heel stops are contacted the posterior surface of the heels will be exactly squared one to the other. This is very essential because by squaring the heels to a dead center, every rotative distortion will manifest itself <sup>9</sup>."

"When the foot plate is properly positioned, its exact center corresponds with the exact zero or center of the plumb arms and a plumbed string will cut through the zero on each



arm and find dead center on the foot plate<sup>9</sup>.”

While the subjects were placed in the distortion analyzer DeJarnette “would photograph the spine with a camera at a pre-focused distance. This was repeated for three consecutive days. Those films were then overlaid to see if there was a noticeable difference in the day-by-day photographs<sup>6</sup>.” Two of the 18 subjects were excluded “because their spines were too variable” with the remaining 16 subjects remaining in the study for nearly two years until completion<sup>6</sup>.

“Each of the 16 persons now received the same type adjustment, and that adjustment was designed to place a strain on the fifth lumbar that would carry the spinous to the subject’s right, this adjustment was repeated daily for four days<sup>6</sup>.” On the fifth day each of the 16 subjects were photographed while standing in the distortion analyzer. Radiographs were taken on all 16 subjects at least twice but due to equipment limitations DeJarnette was only capable of taking anterior-posterior (A-P) studies<sup>6</sup>.

Another part of this study involved attempting also to evaluate leg balance. DeJarnette measured the height of the superior iliac crests in the standing position and the femoral heads by x-ray study. Also the medial malleoli were assessed in the supine and prone positions and subjects were weighed daily on the double scales to determine bilateral weight distribution<sup>6,10,11</sup>. At the completion of the study all subjects were to have their 5<sup>th</sup> lumbar vertebra rotated back into its “appropriate” juxtaposition, by rotating the vertebra towards the left. DeJarnette was not precisely clear, but it appears that the subjects were followed for two years, after the four consecutive days of him attempting to sublunate their L5. Apparently they were followed without receiving further care and assessed for what DeJarnette presumed were health and body reactions to a 5<sup>th</sup> lumbar vertebra sublunate distortion.

## Results

DeJarnette reported, “one subject developed a severe reaction within ten minutes following his first adjustment, but within 20 minutes his discomfort subsided, so he was able to carry on with the experiment. Within ten days, all but two of the subjects showed a decided muscular groove rotation to the right. Two subjects developed a pain in their left hips on the seventh day. One complained of a stiff neck, but he had been playing ball, so that was not conclusive. Two subjects complained of mid-dorsal pain. One subject complained of cystitis. One subject complained that he had a tight band around his middle. One subject developed a one-half inch shortening of his right leg. One subject developed a severe cold. Only two subjects developed the same symptoms; i.e., right hip pain<sup>6</sup>.”

Of interest, one consistent finding was that “each of the 16 subjects developed palpatory pain over the left transverse of their atlases. None of the 16 had such pain prior to the first experimental adjustment<sup>6</sup>.” “Within four months following the last experimental adjustment to rotate the fifth lumbar spinous to the right, five of the 16 subjects suffered acute low back failure. One was hospitalized for three weeks. X-ray examination showed actual rotation in 11 of these subjects...five showed no apparent change. Two of the group that suffered acute low back pain were among those showing no rotation from effects of the experimental adjustments<sup>6</sup>.”

The most noticeable occurrence was the manner in which this experimental fifth lumbar adjustment affected the pelvis. Prior to the first experimental adjustment, only one of the 16 subjects showed any distortion of the pelvic girdle. Following the experimental adjustments, all but two of the 16 subjects developed pelvic rotation <sup>6</sup>.

Fourteen of the subjects that developed pelvic rotation, rotated exactly opposite to what he had expected. With regard to pelvic rotation a “purposeful adjustment to rotate the fifth lumbar spinous to the right <sup>6</sup>” of 16 subjects involved in the experiment found that two of those subjects developed right pelvic rotations, 11 developed left pelvic rotation, and two had no discernable pelvic rotation. Confounding the findings was that one subject would present with a right pelvic rotation one-day and a left rotation the next day <sup>6</sup>.

In the part of the study that evaluated -- leg balance, height of the superior iliac crests in the standing position and the femoral heads by x-ray, medial malleoli position in the supine and prone positions, and double scales to determine bilateral weight distribution – the findings were complex. Ultimately DeJarnette found that “those subjects with unstable sacrums showed leg deficiencies in the prone position. Those with innominate instability showed leg deficiencies in the supine <sup>6</sup>.” He noted, “The spinous would more easily rotate toward a low leg side than toward a high leg side <sup>6</sup>.” In this sample DeJarnette determined from the findings that “even in the presence of a short leg, if that short leg was on the side opposite spinous rotation, a [heel] lift might equalize the legs, but it would not change the spinous position or the pain associated with that position <sup>6</sup>.”

After two years the study concluded with 14 of the original subjects. One of the sixteen moved to California and the other was hospitalized and did not return. The 14 were carefully analyzed before attempting corrective adjusting. According to DeJarnette “many things had changed. One subject developed a severe upper dorsal scoliosis. One subject developed a migraine-type headache. One subject developed hay fever. One subject developed severe acne. One of the males developed enuresis <sup>6</sup>.” We must recognize the fact that some of the above conditions could have developed had these subjects not been given an experimental fifth lumbar adjustment. An unintentional benefit of this chiropractic research study was that DeJarnette clearly learned about the great difficulty of not having perfect control over a research subject.

DeJarnette’s experimentation concluded with each of these remaining 14 subjects received a corrective fifth lumbar adjustment. Of significance the left transverse of the atlas remained painful on each until correction was completed. However, one subject responded very poorly to the corrective technic while the others responded well <sup>6</sup>.

## **Discussion:**

DeJarnette reported he found it surprising that with the attempt to “carry the spinous to the subject’s right,” not all subjects developed a left pelvic rotation, which was exactly opposite to what he had anticipated. He assumed that by moving the spinous of lumbar five to the right, the pelvis would eventually compensate by moving the right innominate anterior and the left



posterior. However this did not happen, leaving him with multiple questions such as: “How much does the pelvis accommodate for actual fifth lumbar subluxations? Which is first, the pelvic rotation or the fifth lumbar subluxation <sup>6</sup>?” DeJarnette postulated from this study that the “lumbar subluxation will produce pelvic distortions, and pelvic distortions will produce lumbar distortions <sup>6</sup>.”

Of significance is that from the findings in this study, 16 subjects developed palpatory pain over the left transverse of their atlases, which was not found prior to the first experimental adjustment. This is consistent with the Lovett Brother phenomena <sup>12</sup> described in the literature as well as the resistance and contraction (R+C) relationship that DeJarnette later developed <sup>13</sup>.

This study by DeJarnette was performed prior to the 1970s so while patients may have understood they were part of a study and consented to participate in this study, it was not submitted for Institutional Review Board (IRB) approval. If this study were submitted for IRB approval it would not likely have been approved due to the possibility that the intervention may have caused the subjects harm.

IRBs originated after 1974 after the passing of the National Research Act by the United States congress creating the National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research. This commission created the Belmont Report: Ethical Principles and Guidelines for the Protection of Human Subjects of Research. IRB’s purpose utilizes the Belmont Report’s guidelines <sup>14</sup> to protect human subjects in research studies from any possible harm as well as to ensure research is not biased by financial interest <sup>15</sup>.

Because this study involves human subjects, to date it has not been replicated with another IRB approved study. There have been various attempts of studying this phenomenon with animals by inducing subluxations (mostly non-directional) hypomobility or spinal fixation <sup>16-24</sup>. Inducing spinal hypomobility was associated with spinal joint degeneration <sup>20-22</sup>, which could remain even after artificial fixation was removed <sup>23</sup>. Interestingly one study found that with spinal fixation in rats, this affected synaptic density and morphology in the superficial dorsal horn of the L2 spinal cord level <sup>24</sup>. Therapeutic surgical fixation on humans has been associated with degenerative changes above and below the fused segments <sup>25-28</sup>. Hypermobility of spinal segments has also been found related to segments above and below the surgical fusion <sup>29</sup>.

Ultimately this study can best be viewed as a historical inaugural attempt at performing a very challenging research study, by inducing a subluxation at L5 and assessing patients longitudinally over time to determine if this intervention had novel affects to the subjects. However, from today’s standards this study has significant limitations beyond not having IRB approval and clear consent from the patients/subjects. The examination and treatment methods are not clearly described, and it is without a sufficient discussion section. We really don’t know how much care the patients had before and during the time of evaluation, and it is unclear if anything palliative for their conditions was adopted during the two years while in discomfort. Were the subjects just treated five days in a row and no other care was ever rendered? There was no literature review or references to DeJarnette’s strong statements, which therefore lack any evidence-based support. There are many questions left unanswered which compromise this study’s findings. Yet in the 1940s, chiropractic did not have a formal research infrastructure, and DeJarnette might best be

considered as one of chiropractic's "proto-researchers"<sup>30</sup>."

Cooperstein notes "chiropractic's proto-researchers served the historical role of irreversibly formulating a new agenda for chiropractic"<sup>30</sup>." Proto-research studies such as this one lay the groundwork for our present generation to investigate and either prove or disprove whether DeJarnette's methodology in concept and practice is consistent with current science. "Yes, from today's vantage point mistakes were made, and the freedom to construct 'artful hyperbole' was much abused. On the other hand, if these clinician-scientists had not made these mistakes and thrown down the research gauntlet to the chiropractic profession of today, it is highly unlikely the chiropractic research milieu would have taken the strides that now usher the profession toward a more rational technique"<sup>30</sup>."

DeJarnette notes "Teaching and writing is like laying your soul bare before the board of the judgment society that determines your fate after you are gone. We welcome research. In reality, those doing research on our research are reaping the benefits of our research. We most often suffer the tears of failure. A technique must live by criticism and when such is well meant and constructive, it is useful. Often in the past it was totally destructive by intent. All mankind resists improvement"<sup>31</sup>."

### **Conclusion:**

This review of a historical research study performed by DeJarnette can help us better understand early stages of chiropractic research. As James A. Baldwin said, "People are trapped in history and history is trapped in them." DeJarnette didn't just teach a chiropractic method of care, Sacro Occipital Technique, but attempted to employ research methodologies to study and investigate his interventions. Due to the limitations at that time, as well as a minimal chiropractic research support, his attempt was laudable. While it is unlikely that there will be future human studies investigating purposefully causing a vertebral subluxation and studying its effect, future animal studies are promising. It is likely that if DeJarnette was still alive and vital he would be performing further research into chiropractic and Sacro Occipital Technique's affect on spinal dynamics as well as neuromusculoskeletal and non-musculoskeletal systems using today's updated research strictures.

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## **Inter- and intra-rater reliability of the heel tension test**

Karen Feely, DC

### **Introduction:**

Heel tension is considered to be a provocative test of the nervous system, a sensitizing movement that increases tension in the overall nervous system.<sup>1-6</sup> The Adverse Mechanical Cord Tension model, introduced by Brieg<sup>1,2</sup>, regards the peripheral, central and autonomic components of the nervous system as a continuum with two intimately related components: a connective tissue component and a neural tissue component. Tension in the peripheral nerve is transmitted to spinal dural mater via the perineurium which is continuous with the dural sleeves, and to the epidural tissues via the epineurium<sup>7-9</sup>.

Ankle dorsiflexion is a common sensitizing maneuver for Straight Leg Raising<sup>10,11</sup>, Braggards's, Fadjersteins<sup>12</sup> and Slump tests<sup>13,14</sup>. Chiropractors and other clinicians commonly use neurodynamic testing along with leg length equality evaluations to assess the integrity of the spine and pelvis, and involvement of the nervous system<sup>9,15,16</sup>.

Since clinical scales are based on ratings, they are prone to subjectiveness. Intra- and inter- rater reliability are important characteristics that document the potential of a scale to produce stable results within and across assessors. Test – retest reliability is a pre-requisite for scales that are to be used in a follow-up situation, such as with chiropractic care, and help to document the scale's objectivity.

The Epstein model of spinal and neural integrity relates the maintenance and improvement of spinal integrity of an individual to the interaction of communicating subsystems<sup>17</sup>. This test, as used in Network Spinal Analysis (NSA), puts tension on the Achilles tendon in the planes of flexion/extension and lateral bending. Epstein uses this test as part of an assessment package to determine neural subsystem levels of integrity and levels of potential restriction or freedom of tension and movement in both general rating of spinal and neural integrity (SNI) and specific response to intervention. Practitioners measure tension in the ankle to assess the integrity of spinal subsystems as part of the clinical exam and routine pre-adjustment and post adjustment assessment<sup>19</sup>.

DeJarnette the developer of Sacro Occipital Technique (SOT)<sup>20,21</sup> first utilized Achilles tendon tension as part of his analysis in 1970, and by 1974 incorporated what he termed "heel tension" into a method of assessing and treating pelvic torsion, meningeal tension imbalance, and CSF circulation compromise called Category One.

In his 1974 text<sup>22</sup> DeJarnette describes heel tension as follows:

"Heel tension is the common denominator of dural faults. Dural faults produce motor neuro failure. This failure may be spinal reflex or it may involve the upper motor neuron cells of Betz. Any involvement of the dural membrane, intra- or extra-cranial will always be associated with abnormal heel tension. This heel tension is tendon and ligament



tension as are all neuron abnormalities. Many neurological signs are evolved from this particular area of the human body<sup>22</sup>.”

Currently SOT utilizes Achilles heel tension to assess what DeJarnette termed a “tendon guard reflex”, which is activated when there is dural tension from craniocervical region or if pelvic torsion causes asymmetrical use of the lower extremity kinematic chain. This heel tension is believed to possibly confound leg length assessments related to pelvic torsion and/or be affected by atlas dural tension in a descending manner following along a network of fascia all the way to the calcaneus.

Reliability of the prone leg length tests<sup>23-26</sup> and other neurodynamic testing such as SLR and measures of ankle dorsiflexion have been found to be reliable<sup>27-31</sup>. We can find no peer-reviewed publication describing the specific measure of heel tension, or evaluations of the test reliability or validity. The goal of this study was to provide a first estimate of the objectivity of the test, by assessing inter- and intra-examiner reliability.

## **Methods:**

Twenty one volunteers (seventeen women and four men) were recruited from the participants in a NSA seminar conducted in Westminster, Colorado. All volunteers were asked to inform the investigators if they were currently experiencing any ankle discomfort or injury, or had in the past experienced any ankle or leg anomaly or deformity. All volunteers signed Consent to Participate in Research forms, informing them of the purpose of the study, the procedures and potential risks, and how their identities would be protected. (See Addendums)

Each person was assigned a number as they arrived to the study area. Each subject was examined by three different examiners, at two separate times. The time separating the first and second examination was approximately 3-4 minutes. The people being examined were instructed to lay prone on an adjusting table, shoes off, with their legs and ankles hanging over the end of the table. The arms were in a relaxed position with the hands resting on the hand-holds built into the table. Three adjusting tables were positioned in the room, with a distance of at least 15 feet between each table. The individuals being tested were in the prone position for an average of five minutes.

Three certified NSA practitioners, with an average of 25 years in practice, performed the heel tension tests. These practitioners are all instructors of the NSA technique. Each practitioner was paired with a person to record the data; hand signals were devised so that this communication was silent, in an effort to blind examiners to each others’ findings. The first author was on hand to monitor the measurements. No communication was allowed between the examiners and the patients or other examiners.

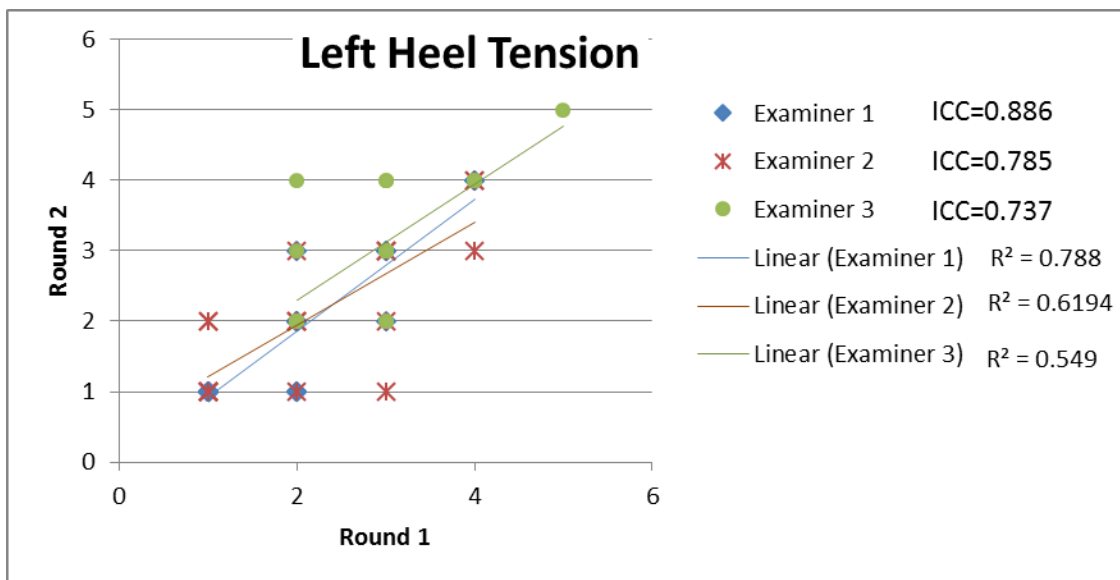
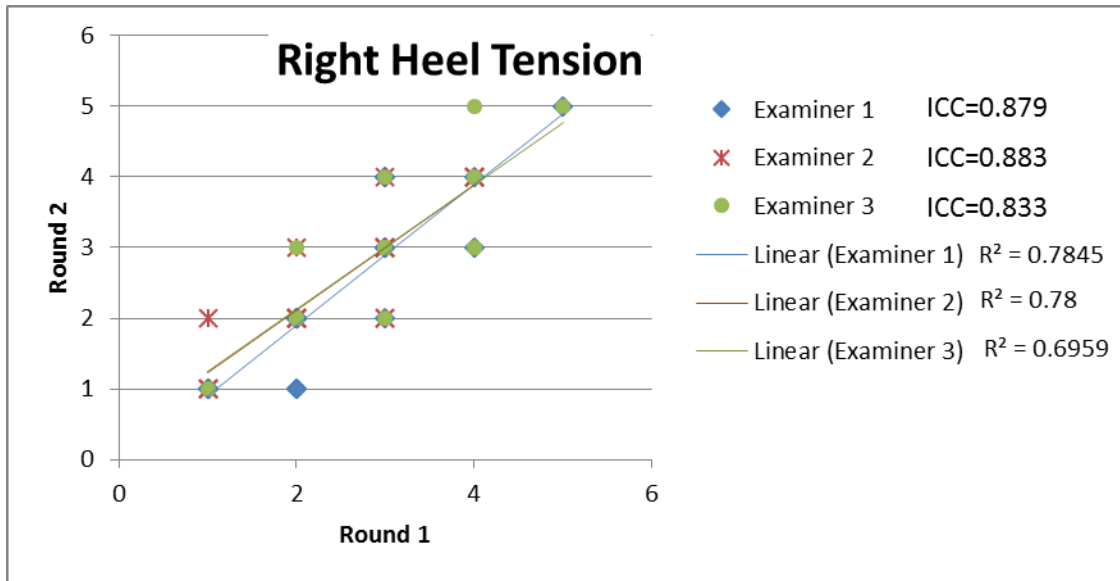
To perform this test, the individual being tested lies in the prone position, on an adjusting table, with the foot and ankle hanging free of the table. Gentle pressure is applied by the examiner at the ankle joint on both sides in the direction of flexion and extension; foot flare or eversion is removed so that the heel of the foot is in vertical alignment with the Achilles tendon, each side



was tested individually. The level of passive resistance or heel tension is then graded from 1-5, with 1 being mild and 5 very severe or strong passive tension.

**Results:**

The data was tabulated in an Excel spreadsheet for graphing and the analysis setup. We were primarily interested in calculating intra- and inter-examiner reliability for the heel tension measures. We used AgreeStat 2011.1 for Windows and Excel [Gwet KL, Advanced Analytics, LLC, Gaithersburg, MD] to perform reliability factor calculations.



## Heel Tension

The heel tension data was scaled with 5 levels (mild to severe), so we treated it as a scale variable. The inter-class correlation coefficient (ICC) is appropriate in this case for both intra- and inter-examiner reliability.

We compared each doctor's findings on the Round 1 measures to the same doctor's measure on Round 2 to assess intra-examiner reliability. The findings on the left and right sides were dealt with separately. The plots (on the prior page) graph each doctor's Round 1 data plotted against Round 2, along with the calculated ICCs. The straight lines are linear regression lines for each doctor and have accompanying R-squared regression values (a measure of how closely points fit the line; 1 is perfect).

The plots and ICCs show very good intra-examiner reliability. ICCs between 0.7 & 0.8 indicate strong agreement, while above 0.8 is almost perfect agreement. Oddly, findings on the right side are a little better than on the left. On the right side, Round 1 and Round 2 measures never differed by more than 1, and the ICCs were higher.

Notice also in the same data plots that there are offsets in the data between different doctors, which are a view of inter-examiner reliability. Indeed, the ICCs calculated between different doctors, show that inter-examiner reliability was fair to good, and somewhat lower than intra-examiner reliability.

Inter examiner ICC		
	Left	Right
Round1	0.478	0.585
Round2	0.648	0.601

ICCs in the range of 0.5 to 0.6 are considered moderate agreement, while 0.3-0.4 indicates fair agreement. In this study we saw a mix of fair and moderate inter-examiner agreement on the heel tension measure. It is not unusual to see intra-examiner measures higher than inter-examiner. It shows that doctors more often agree with themselves on repeated measurements than they do with others. The measurement seems to be a real objective phenomenon, but is subject to individual judgments and measurement error.

## Discussion:

This is the first report of the reliability of heel tension assessment technique used frequently in clinical practice by chiropractors and other practitioners. Several reliability studies of prone leg length evaluations have found good reliability<sup>23-25</sup>. Many other chiropractic clinical examinations have been tested for reliability, such as supine leg length inequality<sup>26,32</sup> and motion palpation<sup>33-35</sup> with moderate reliability

Studies on the validation for movement and increasing tension of the neural tissues using dorsi flexion of the ankle have been done with cadavers<sup>1-3, 36, 37</sup>, with healthy individuals and

correlating other functional testing such as electromyography<sup>10</sup> and ultrasound<sup>38</sup>. In the mid-1990's research revealed increased nerve conduction post-adjustment<sup>39</sup>, presumably showing evidence of decreasing neural tension allowing for increased nerve conduction. Haavik- Taylor and Murphy<sup>40,41</sup> continue to research the effects of spinal manipulation on sensorimotor integration in the brain.

Increased mechano-sensitivity and elicitation of pain are the key characteristics that are being evaluated in many clinical provocation tests. They are used by a wide variety of practitioners, chiropractors, physical therapists, and medical doctors.

As used by chiropractors, this test is part of assessment before and after chiropractic care to measure an aspect of spinal and neural integrity, specifically neural tension and how that changes over the course of care. Research to validate that heel tension changes after adjustments or other types of care is the next step. Also relevant would be to correlate heel tension to other nervous system testing, such as somatosensory evoked potentials or brain fMRI. Kent and Gentempo utilized fMRI to study voluntary unilateral ankle motion, pre- and post-adjustment<sup>42</sup>. They found that pre-adjustment there were generalized areas of activation; following adjustment, the regions of signal alteration were much smaller, and appeared to be unilateral. It was speculated that the chiropractic adjustment (entrainment) led to improved neural efficiency, evidenced by fewer and more specific foci of altered activity in the brain<sup>42</sup>. These correlations will give information and further our understanding of the effects of increased tension in the nervous system, and how the spine reflects the functioning of the central nervous system.

### **Limitations of this study**

This study did not assess the validity or clinical relevance of the heel tension test. Future research should include validation and clinical usefulness of this test. This study was a pilot study to see if further investigation is warranted. The practitioners in this study were all highly experienced – over 20 years of experience for each one. Further research might include larger number of practitioners with varying experience and larger numbers of people being assessed. It would be ideal to have subjects that represent what would be clinically representative in a chiropractic practice and also to calculate the sample size statistically before the study.

### **Conclusions**

Ankle dorsiflexion and/or heel tension assessments has been used systematically in various orthopedic and neurological tests, as well as within chiropractic technique systems such as Network and Sacro Occipital Technique. Before a test can be accepted and studied for validity, it is important to see if the test is reliable. In this study, the intra- and inter-examiner reliability of the heel tension measure used by practitioners appeared to have a level of significance for the aspect of grading heel tension. Based on the findings of this study the test for overall heel tension appears to be a reliable test. Future studies should investigate the validity of this test as it is used in various assessment methodologies.



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## Sacro-Occipital Technique (SOT) Initial Exam: Predictability of Outcomes.

Harvey Getzoff, DC

### Introduction:

The intent of this paper is to illustrate methods of utilizing certain Sacro Occipital Technique (SOT) procedures (adjustments) that enable the examiner to establish, at the initial examination, a level of predictability of patient outcomes. The patient's history and physical examination allows decisions about treatment and prognosis to be made<sup>1</sup>. The SOT initial exam is intended to primarily determine which of the three SOT Categories (Functional Systems) is most in need of adjusting<sup>4</sup>. Major Bertrand DeJarnette DO, DC, the founder and developer of SOT, writes "to bring order out of chaos SOT offers the category system of analysis<sup>2</sup>." SOT indicators determine each of the SOT Categories. Chart # 1 illustrates the key SOT indicators that are utilized to define the Category.

**Chart # 1**

Category	Key Indicators Recumbent	Plumb Line Motion Indicators
One	Heel Tension <sup>2,4,6,8</sup>	Anterior to Posterior <sup>2,4,6</sup>
Two	Arm/ Fossae <sup>2,4,6,14</sup>	Lateral <sup>2,6,15</sup>
Three	Step Out Toe Out <sup>9,11,12,14</sup>	Fixed <sup>2,6,11,16</sup>

While identifying the Category, diagnosis of the specific cause of the patient's primary concerns needs to be made. An example of this is implementing the SOT cervical adjusting protocol (figure 8 and stairstep procedures) for a patient with neck pain, within the workings of the Category 2 adjustment. Range of motion (ROM) of the cervical spine identifies the need for cervical adjusting, while SOT indicators identify the Category most in need of adjusting. In this example figure 8 and stairstep adjusting are done after the Category blocking and prior to cranial sutural adjusting as part of the Category 2 adjustment, keeping in mind that "All objects in a system both influence and are influenced by the other parts in the system<sup>4</sup>." As DeJarnette states in his 1980 book, "We begin our cervical analysis as part of all examinations to see which Category a patient is to be placed in for proper procedure<sup>2</sup>." Chart # 2 illustrates utilizing cervical figure 8 and stairstep adjusting to determine expected patient outcomes.



## Chart #2

Patient with cervical pain
Cervical rotation ROM limitations (pre)
Figure 8 and stairstep adjusting
Noted change in cervical rotation ROM (post)
Expectations: Level of Recovery

### Discussion:

The 3 SOT Categories (Functional Systems) are described as follows;

Category 1 addresses the Primary Cranial Sacral Respiratory Mechanism (PCSRM). The PCSRM is a system of harmonious functional units that allows the Central Nervous System to be nourished and protected as it regulates and coordinates function throughout the body<sup>4,8</sup>. A key aspect of the PCSRM is the tension on the dural system. DeJarnette writes that “The constant pumping of Cerebral Spinal Fluid essential to health is done by the dura<sup>5</sup>.”

Category 2 addresses the ability of the weight bearing structural system of the body, inclusive of the head righting reflexes, to fully communicate through the nervous system so that maximum weight bearing function can occur within the demands of a gravitational environment<sup>6,8</sup>. DeJarnette contended that “cranial sutural dysfunction altering head posture can be reflected throughout the entire postural system<sup>5</sup>.”

Category 3 addresses subluxations of the lumbar spine and its compensatory mechanisms in both the pelvic structures and the cervical spine<sup>4,8</sup>. DeJarnette determined that “specific cervical responses to specific lumbar subluxations enabled practitioners to make specific lumbar listings<sup>6,10</sup>”

Because of the non-invasive nature of most of the SOT procedures (adjustments) - four in this paper that fit this criterion - it seems reasonable to use them within the initial examination in order to come to conclusions as to the degree of change possible and the ability of tissue to respond. Pre- and post-adjustment findings are measured and noted utilizing a measuring instrument and observation. Calliet says it this way, that “a condition must be anatomically localized, mechanically understood and pathologically classified<sup>3</sup>.” The four main SOT procedures (adjustments) are listed below Chart # 3 along with the exam finding that dictates their use.

## Chart # 3



Symptom	Limitations and/or pain	Procedure (adjustment)
Neck pain and dysfunction	Sitting Cervical Rotation (ROM) Finding. Pre- and post-adjustment findings	Figure 8 and Stairstep Procedures*
Hip pain and dysfunction	Prone Ilio Femoral Rotation Finding. Pre- and post-adjustment findings	Ilio Femoral Goading Procedure
Back and/or leg pain and dysfunction	Supine Straight Leg Raise Finding. Pre- and post-adjustment findings	Sitting Disc Technique**
Pelvic, leg and possibly back pain and dysfunction	Step Out Toe Out Procedure Pre- and post-adjustment findings	Prone Category 3 Blocking, Repeated Step Out Toe Out Procedure (SOTO)***

\* DeJarnette notes that, concerning the Figure 8 and stairstep adjustment, “these particular cervical techniques combine analysis and corrections.”

\*\* A retrospective study of the relationship between the straight leg raise test and the sitting disc technique<sup>9</sup>.

\*\*\* Must not be done if there is an active arm/fossae finding. Also as noted in a previous paper, “Patient pain patterns and spinal patterns in conjunction with SOT’s Step Out Toe Out maneuver and the Straight Leg Raise Test can be helpful in making accurate judgments regarding the severity and the prognosis of the condition, as well as establishing and communicating an effective treatment plan<sup>12</sup>.”

Figure 8 and Stairstep Procedure: “When doing the stairstep, the doctor is seated at the head of the table with the patient supine and places a hand to each side of the patient’s skull. The index and middle finger are above the ear with the remaining two fingers below the ear. The patient’s chin and forehead must be kept level as the doctor puts inferior pressure through the cervical spine through the feet. The level where the head resist elevation is considered the subluxation and the area where the figure 8 is to be concentrated<sup>13</sup>.”

Iliofemoral Goading Procedure: “Done in the prone position by grasping the patient’s ankles everting the feet externally. The foot with the greatest resistance is the involved side. The adjustment for a left iliofemoral is to stand on the prone patient’s left and have them bend their knee to 90 degrees and grasp the patients left foot with your right hand. The doctor’s left thumb is placed against the patient’s greater trochanter. Rotate the patient’s lower leg in a wide circle. Do this motion slowly and apply pressure until better movement is noted<sup>12</sup>.”



Sitting Disc Technique: With the patient seated on a stool the doctor makes contact with their thumb just inferior to the tip of the spinous process of the fifth lumbar. The patient is instructed to move into lumbar spinal flexion by pulling their abdomen inward while arching their spine back. The doctor maintains a holding pressure in the superior direction then the patient returns the spine to a neutral position. This process is repeated three times on each of the lumbar vertebrae<sup>9</sup>.” Support for this procedure has been described in a retrospective study of the relationship between the straight leg raise and the sitting disc technique<sup>9</sup>.

Category 3 Blocking, SOTO Procedure: The SOTO maneuver is done by grasping the knee of the prone patient with one hand and the ankle with the other. Abduct patient’s leg until the hip on that side begins to elevate and/or resistance is met. Then externally rotate and dorsiflex the foot, making sure that the foot is at the same level as the pelvis. Unilateral restriction and/or provocation of pain is an indication for block placement. The blocks are placed according to the short and long leg. The block on the short leg is placed under the acetabulum pointing obliquely down. The block on the long leg is placed under the ASIS also facing obliquely downward<sup>12</sup>. This must not be done if there is an active Arm/fossae finding. Also noted in a previous paper, Patient pain patterns and spinal patterns in conjunction with SOT’s Step Out Toe Out maneuver<sup>12</sup> and Straight Leg Raise Test<sup>9</sup> can be helpful in making accurate judgments regarding the severity and the prognosis of the condition, as well as establishing and communicating an effective treatment plan.

Based upon the degree of favorable change created by these procedures (adjustment), the predictability of outcomes becomes more understandable. The level of change determines the prognosis. The chart below acts as a management guide. Patient participation in the process becomes more critical with a poorer prognosis. Chart # 4 illustrates the measured (from a Flexometer) and observed (clinically judged) percent of change comparing pre adjustment findings to post adjustment findings. The percent of change alludes to the possible patient outcome and is the basis for determining and communicating the patient’s expectations.

**Chart # 4**

Estimated Percent of Change:	Possible Patient Outcome	Management Plan: Patient Expectations
0 %	Marginal	Maintain
33 %	Guarded	Helpful
66 %	Favorable	Improved
100 %	Excellent	Corrective

DD Palmer writes that “Diagnosis is the act of recognizing disease and from its symptoms deciding unto its character, what lesions have occurred and will occur, how long it will endure and what will be its probable outcome<sup>7</sup>.” The prognosis not only establishes the predictable outcome, but it defines both the treatment and the management plans needed. Calliet remarked



that “irritated tissues must be ascertained as removable, reducible and irreversible<sup>3</sup>.” It must be kept in mind that successful outcomes can be dependent on multiple factors. Often poor patient behaviors are detrimental to a successful outcome, while supportive activities can be helpful.

### **Conclusion:**

The non-invasive nature of these procedures (adjustments) allows for a deeper understanding of not only the nature of the problem but also its level of severity. Prognosis is critical when conveying a treatment and a management plan to the patient. Telling a patient what can and can't be done to help them and what they must do is an imperative to a successful outcome. The nature and degree of tissue change can be limiting and must be taken into account. I feel that this information is critical but it does not supersede the need for proper examination techniques. Nevertheless, procedures that measure the ability of tissue to respond are necessary, not only in the initial exam but throughout treatment.

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# CEREBROSPINAL FLUID STASIS AND ITS CLINICAL SIGNIFICANCE

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We hypothesize that stasis of the cerebrospinal fluid (CSF) occurs commonly and is detrimental to health. Physiologic factors affecting the normal circulation of CSF include cardiovascular, respiratory, and vasomotor influences. The CSF maintains the electrolytic environment of the central nervous system (CNS), influences systemic acid-base balance, serves as a medium for the supply of nutrients to neuronal and glial cells, functions as a lymphatic system for the CNS by removing the waste products of cellular metabolism, and transports hormones, neurotransmitters, releasing factors, and other neuropeptides throughout the CNS. Physiologic impediment or cessation of CSF flow may occur commonly in the absence of degenerative changes or pathology and may compromise the normal physiologic functions of the CSF. CSF appears to be particularly prone to stasis within the spinal canal. CSF stasis may be associated

with adverse mechanical cord tension, vertebral subluxation syndrome, reduced cranial rhythmic impulse, and restricted respiratory function. Increased sympathetic tone, facilitated spinal segments, dural tension, and decreased CSF flow have been described as closely related aspects of an overall pattern of structural and energetic dysfunction in the axial skeleton and CNS. Therapies directed at affecting CSF flow include osteopathic care (especially cranial manipulation), craniosacral therapy, chiropractic adjustment of the spine and cranium, Network Care (formerly Network Chiropractic), massage therapy (including lymphatic drainage techniques), yoga, therapeutic breathwork, and cerebrospinal fluid technique. Further investigation into the nature and causation of CSF stasis, its potential effects upon human health, and effective therapies for its correction is warranted. (*Altern Ther Health Med.* 2009;15(3):54-60.)

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#### Disclosure

Author Donald Glassey is the owner of Cerebrospinal Fluid Technique Seminars.

In 1927, Cushing described cerebrospinal fluid (CSF) motion as the third circulation (the first and second circulatory systems being the cardiovascular and lymphatic systems).<sup>1</sup> CSF flow is characterized by both circulatory and fluctuant movement. Circulatory movement due to hydrostatic pressure gradients occurs primarily with CSF secretion at the choroid plexuses and with CSF resorption at the arachnoid granulations. The CSF also fluctuates in a rhythmic

ebb and flow in both the cranium and the spinal canal. Sutherland ascribed great significance to the CSF fluctuation, describing it as the Primary Respiration (thoracodiaphragmatic breathing being the Secondary Respiration).<sup>2,3</sup>

#### THE THIRD CIRCULATION

On average, approximately 150 mL of CSF circulates around the central nervous system at any one time, yet the total amount of CSF produced daily, approximately 500 mL, is enough to completely replace the circulating volume 3 to 4 times over.<sup>4</sup> The CSF is formed and secreted primarily by the choroid plexus of the cerebral ventricles, particularly the lateral ventricles; smaller amounts are secreted by the ventricular ependyma, the arachnoid membranes, and by the brain itself via the perivascular spaces.<sup>5</sup>

CSF secreted in the lateral ventricles flows through the inter-ventricular foramina of Monro into the third ventricle in the midbrain, between the right and left halves of the thalamus. Flow continues through the cerebral aqueduct of Sylvius into the fourth ventricle, in the area of the middle and lower brain stem. The fourth ventricle narrows to form the central canal of the spinal cord, which extends through the medulla and the entire length of the cord. From the fourth ventricle, a portion of the CSF flows inferiorly through the central canal. Most of the CSF escapes through the median foramen of Magendie and the 2 lateral apertures of Luschka into the subarachnoid space (SAS). CSF



in the SAS communicates with the cisterns at the base of the brain and percolates through the arachnoid trabeculae, diffusing superiorly around the brain and inferiorly around the spinal cord. The spinal SAS is divided into anterior and posterior compartments by the dentate ligaments, which anchor the cord laterally to the spinal dura mater. CSF circulates within the spinal canal through the SAS and potentially through the central canal. In most people over the age of 30 years, however, the central canal is probably not patent.<sup>4</sup> The central canal communicates inferiorly with the subarachnoid space at the conus medularis, at the superior aspect of the lumbar cistern, a reservoir of CSF that also contains the cauda equina and filum terminale.

Mechanisms for continuous secretion and resorption of CSF effectively maintain intracranial and intrathecal pressure equilibria. The *Monro-Kellie Doctrine*, first postulated by Alexander Monro in the 18th century, describes the cranium as a rigid box filled with the incompressible contents of brain, blood, and CSF. These 3 space-occupying components of the cranium must coexist in a state of dynamic equilibrium, wherein a change in volume in one component requires a change in volume in either or both of the other two.<sup>6</sup> Any increase in total volume of the cranial contents must result in elevated intracranial pressure. The major site of resorption of CSF into the venous bloodstream is through the arachnoid villi of the superior sagittal sinus.<sup>5</sup>

CSF is also in communication with the extracellular spaces of the brain and mixes with the extracellular fluid within perivascular extensions of the subarachnoid space, the *Virchow-Robin spaces*.<sup>7</sup> Much of the resorption of CSF may occur directly from the extracellular matrix,<sup>8,9</sup> and significant amounts of CSF may pass into the lymphatic system.<sup>10</sup> CSF crosses the cribriform plate and enters lymphatic vessels of the nasal submucosa,<sup>10</sup> and animal studies have demonstrated that some cranial CSF drains into cervical lymph nodes.<sup>10</sup> Not all of the CSF in the lumbar cistern returns to the cranium; some is absorbed into lymphatics where the spinal nerve root sleeves merge with the epineurium.<sup>10</sup> Investigators in an animal study found that 25% of all CSF resorption was from the spinal SAS.<sup>11</sup>

### Spinal Circulation of CSF

It is something of a misnomer to speak of CSF “circulation,” particularly in the spinal canal, as there is no continuous loop circulation of CSF as in the cardiovascular system. The spinal CSF fluctuates in biphasic tides of cephalic ebb and caudal flow. The fluid dynamics of CSF fluctuation in the spinal SAS are complex, and paradoxical flow patterns have been observed. Levy and Di Chiro noted that opposing flow patterns sometimes occur in the anterior and posterior subarachnoid spaces.<sup>12</sup> Radionuclide cisternography has shown that CSF follows the path of least resistance as it flows through the spinal SAS. Centrifugal forces appear to propel the flow of CSF toward the convexities of the lumbar, thoracic, and cervical curves.<sup>14</sup>

We focus upon the spinal flow or “circulation” of CSF because spinal CSF appears to be particularly prone to stasis due to the relatively high capacitance of the lumbar cistern and lower

intrathecal pressures in the distal spinal canal,<sup>12</sup> as well as the apparent absence of a strong active mechanism for cephalad flow and the gravitational effect of upright posture. The relatively high pressure pulse waves and velocities in the cranium and cervical SAS normally diminish significantly with caudal flow, with little or no flow at the system’s periphery in the relatively capacious SAS of the lumbar cistern.<sup>13</sup> In addition, the arachnoid trabeculae and denticulate ligaments likely constitute physical barriers to cephalad spinal flow, which does not benefit from the relatively strong cranial pressure pulse wave that propels caudal spinal flow. Like the venous circulation, CSF circulation depends upon indirect and passive mechanisms to propel cephalad flow. But unlike the veins, the SAS contains no valves to prevent backflow, and both caudad and cephalad flow of CSF may occur simultaneously in the spinal SAS.<sup>13</sup>

### Cardiovascular Influences on CSF Fluctuation

Calling into question the validity of the “rigid box” of the *Monro-Kellie Doctrine*, Sutherland was the first to propose that most cranial sutures do not ossify but remain mobile throughout life.<sup>15</sup> Although there is evidence for expansibility of the cranial sutures in adults,<sup>16</sup> the subject remains controversial.<sup>17</sup> The *Monro-Kellie Doctrine* remains the basis for our understanding of changes in intracranial pressure and explains how expansion of the brain drives the CSF circulation. Magnetic resonance imaging has demonstrated pulsatile motion throughout the brain, particularly in the diencephalon and brain stem.<sup>8,17,20</sup>

Sutherland correctly predicted in 1939 that rhythmic movements of the brain and associated compression of the cerebral ventricles generate the CSF pressure pulse wave; however, he described a system of spontaneous oscillations of the brain, spinal cord, and cerebrospinal fluid.<sup>2,3,15</sup> Magoun later proposed rhythmic secretion of CSF by the choroid plexus as a cause of brain motility and the CSF pulse wave.<sup>21</sup> Building upon the ideas of Sutherland and Magoun, Upledger and Vredevoogd hypothesized that the cranial sutures possess a stretch reflex, which when activated by cranial expansion feeds back to the ventricular system to reduce production of CSF, thus maintaining intracranial pressure equilibrium. Their “pressurestat” model attributed CSF fluctuation to the coordinated rhythmic movements of the choroid plexus, the cranial sutures, and central nervous system (CNS) structures.<sup>22</sup>

These hypotheses of inherent brain motility as the engine of CSF fluctuation were inaccurate. Rhythmic brain motion is not primarily endogenous but is propagated by the cerebrovascular pulse wave. The oscillatory brain movements are synchronous with cardiac systole.<sup>18,20</sup> The oscillatory brain movements extend through the length of the spinal cord with a strong caudal motion tied to systole followed by a weaker cephalad recoil.<sup>18</sup> Systolic arterial expansion causes a pulsatile expansion of the brain, resulting in a piston-like action that compresses the ventricles and propels CSF into the subarachnoid space and the spinal canal.<sup>18,20</sup> The spinal SAS thus allows for pulsatile decompression of the rigid box of the cranium with each systolic expansion. CSF aqueductal flow as well as outflow from the cranial cavity is related to systolic phase brain expansion.<sup>9</sup>



In the systolic phase, the midbrain and brainstem move caudally and medially toward the foramen magnum. In diastole, decreased arterial blood volume causes a reduction in overall brain volume, the brainstem retreats cephalad, and CSF flow reverses.<sup>13</sup>

CSF outflow into the cervical spine SAS correlates with cord motion and cardiac systole.<sup>18,19,23</sup> Caudal flow in the subarachnoid space at C2 has been measured at up to 2.91 cm per second,<sup>24</sup> but flow velocity decreases inferiorly through the spinal SAS and in the distal lumbar sac drops essentially to zero.<sup>12</sup> As the systolic pressure wave propels CSF into the SAS, the elevated fluid volume increases strain on the distal dural sac, and at the end of systole, the built-up dural tension powers a rebound pressure wave that propels the CSF cranially.<sup>25</sup> The resistance of the dentate ligaments also probably contributes to rebound motion of the cord following diastole.<sup>26</sup> Paradoxical flow patterns have also been observed in the spinal SAS, perhaps due to pulsations of the spinal arteries and epidural venous plexus that compete with cranial pulse waves.<sup>13</sup> A study on laboratory animals found that 77% of the lumbar CSF pulse wave was caused by arterial and venous pulses in the spinal canal, and 23% was caused by spinal transmission of the intracranial pressure pulse wave.<sup>27</sup> The strength of pulsations from the spinal vessels appears to provide a component of the pressure gradient required to propel cephalad flow against gravity in this low-pressure system, but cephalad flow of CSF is significantly slower than caudad flow in the spinal SAS.<sup>12</sup> Tracer substance has been detected over the medulla within minutes following lumbar intrathecal injection, but diffusion likely accounts for at least part of this result.<sup>28</sup>

#### **Respiratory Influences on CSF Fluctuation**

The systolic pulse wave is well established as the primary impetus for CSF circulation, but there is evidence that the respiratory rhythm also plays a significant role. A recent study of CSF pressure oscillations in anesthetized rats found that the strongest oscillations were coincident with ventilatory chest movement (both spontaneous and mechanically assisted) rather than arterial pulse pressure. CSF pressure oscillations were found to be only weakly entrained to heart rate.<sup>29</sup>

Maier et al observed that normal respiration may induce periodic brain stem motion as strongly as systolic phase arterial expansion. The respiratory cycle drives a low-frequency oscillation of the brain stem, in which caudal brain displacement corresponds with expiration and cephalad rebound corresponds with inspiration. The effect is more pronounced with forced respiration. This respiratory phase pulse, superimposed upon the higher-frequency cardiovascular pulse, appears to influence cerebrospinal fluid fluctuation. Modified respiratory efforts affect CSF fluctuation in peculiar ways. Valsalva maneuver quickly causes caudad and then cephalad brain stem movement. Coughing causes a cephalad impulse in CSF flow.<sup>30</sup>

#### **Vasomotor Influences on CSF Fluctuation**

In addition to pulse and respiration, vasomotor activity also appears to influence CSF fluctuation. Vasomotor waves, or

Traube-Herring Mayer (THM) waves, are normal physiologic waves that are generated by spontaneous pulsations of arterial, venous, and lymphatic vessels. THM waves are independent of the respiratory and cardiac cycles and occur at variable frequencies but with generally longer wavelengths than those of the respiratory and cardiac cycles. THM waves are mediated by the autonomic nervous system, and along with increased heart rate variability, they are considered to be markers of good autonomic balance.<sup>31</sup> THM waves of the intracranial arteries cause the propagation of waves of elevated intracranial pressure known as C waves, first described by Lundberg. Lundberg described C waves as rhythmic oscillations with a frequency of 4 to 8 per minute (most often 6 per minute) and an amplitude of up to 20 mm Hg. Because of the close association between C waves and THM waves, any effect of C waves is probably a healthy one.

#### **CLINICAL SIGNIFICANCE OF CSF STASIS**

Pathological disorders associated with disturbance of CSF circulation include hydrocephalus, intracranial hypertension (including brain edema due to trauma, infection, or other pathology), and intracranial hypotension. CSF circulation can also be impeded by space-occupying lesions, syringomyelia, and subarachnoid cysts. It has been suggested that reduced rates of CSF diffusion through the extracellular spaces of the brain may be a cause of degenerative and age-related disease.<sup>32</sup> Aging is associated with a 50% reduction in CSF production in healthy people,<sup>33</sup> and age-related pathology of the cardiovascular and cerebrovascular circulation, coupled with calcification of the choroid plexus and decreased brain tissue compliance, may also contribute to impaired CSF circulation.<sup>34</sup> Aging is also associated with occlusion of the central canal and increased damping of systolic CSF flow,<sup>4,18</sup> but causation has not been established. Rubenstein hypothesized that aging can lead to stagnation of the CSF circulation, which in turn may contribute to the development of some age-related dementias.<sup>34</sup>

We hypothesize that functional CSF stasis, a physiologic impedance or cessation of CSF flow, is also a common occurrence in the absence of degenerative changes or pathology and that CSF stasis is detrimental to health. The concept of a physiologic CSF stasis is not entirely new. Its occurrence has been suggested by Rubenstein and Perrin<sup>34,35</sup> and alluded to by Sutherland, Upledger, and Epstein.<sup>15,22,36</sup> The CSF maintains the electrolytic environment of the CNS, influences systemic acid-base balance, serves as a medium for the supply of nutrients to neuronal and glial cells, functions as a lymphatic system for the CNS by removing the waste products of cellular metabolism, and transports hormones, neurotransmitters, releasing factors, and other neuropeptides throughout the CNS.<sup>37</sup> CSF stasis may compromise these normal physiologic functions related to CSF flow.<sup>22,34,35</sup>

#### **CLINICAL ASSESSMENT OF CSF STASIS**

CSF stasis may be associated with vertebral subluxation, skin tissue drag, and biofield disturbance.<sup>38</sup> Palpation may be a useful means to assess CSF stasis. Clinically it has been observed



by Glassey that apparent changes in the coefficient of friction on the overlying skin surface create the tactile sensation of “drag” or resistance. This sensation can be detected by manual palpation with the fingertips, where Meissner’s corpuscles, which detect fine touch, are concentrated in the upper layer of the dermis. The trained practitioner palpates for the sensation of resistance on the skin surface overlying the spine and cranium. Resistance is thought to be indicative of underlying CSF stasis, and following treatment, the absence of drag may indicate that the CSF stasis has been reduced.<sup>38</sup> Fulford described a similar sensation of drag on the skin surface and attributed it to decreased flow of the human “life force.”<sup>39</sup> Toftness also described a change in tactile resistance overlying a vertebral subluxation, a phenomenon that ceased upon correction of the subluxation. He speculated that such areas of tactile resistance were associated with increased body surface electromagnetic activity.<sup>40</sup> Zhang et al partially validated Toftness’s work with their findings that low-force chiropractic adjustments can result in significant reductions in the body surface electromagnetic field, as measured by triaxial flux-gate magnetometry.<sup>41,42</sup>

It may be possible to clinically assess the effectiveness of therapies aimed at reducing impedance to CSF flow. CSF communicates with the inner ear through the cochlear aqueduct, and CSF pressure changes are reflected by changes in tympanic membrane tension. Impedance audiometry, which measures mechanical tension on the tympanic membrane, may offer a noninvasive means of measuring CSF pressure changes.<sup>43</sup> The relationship between intracranial pressure and CSF stasis is unclear. This measure has not been validated, however, and tympanic membrane tension varies between individuals, so a baseline value must be established for each patient.

#### APPROACHES TO REDUCTION OF CSF STASIS

There is a paucity of published data on the effectiveness of therapies for reduction of CSF stasis. Therapies that are thought to affect CSF flow include osteopathic care (especially cranial manipulation), craniosacral therapy, chiropractic adjustments of the spine and cranium (especially Sacro Occipital Technique and Network Care), lymphatic drainage techniques, therapeutic breathwork, and yoga. Additionally, Cerebrospinal Fluid Technique (CSFT) draws from several of the above approaches with protocols specifically intended to reduce CSF stasis.<sup>38</sup>

#### The Cranial Rhythmic Impulse

Sutherland developed the first osteopathic techniques intended to enhance the flow of CSF. He was the first to describe movements of the cranial bones at the cranial sutures, primarily at the sphenobasilar junction, and he found that he was able to palpate subtle rhythmic motions at the cranium and sacrum.<sup>15</sup> Sutherland believed that these cranial and sacral motions were associated with his Primary Respiratory Mechanism, described above. Building upon Sutherland’s observations of a craniosacral rhythm, Woods and Woods first described the cranial rhythmic impulse (CRI), an oscillation distinct from the respiratory and

cardiovascular cycles and normally occurring at a rate of 6 to 12 cycles per minute.<sup>44</sup> In 1976, Magoun named the same phenomenon “The Sutherland Wave” after its discoverer.<sup>21</sup> The CRI is thought to be related to CSF flow.<sup>44,45</sup> The CRI is measurable and is palpable throughout the body. It is enhanced in health and has been found to be depressed in numerous medical disorders.<sup>44</sup> John Upledger, trained as an osteopath and the founder of the Upledger Institute, taught that dural tension and decreased CSF flow corresponded with reduction in palpability of the CRI, conditions that could be corrected by gentle manipulation of the cranium and sacrum.<sup>22</sup>

Both Sutherland and Upledger believed that spontaneous cranial and sacroiliac articular motions exert a pumping action upon the CFS and that these motions are transmitted and coordinated by tensile forces in the spinal dura<sup>2,3,22</sup>; this concept came to be known as the core-link hypothesis.<sup>17</sup> Mitchell and Pruzzo reported evidence of spontaneous sacral motion associated with normal respiration,<sup>46</sup> but there are no other data to support the notion that spontaneous motion of the sacrum upon the ilia occurs.<sup>17</sup> Even with gross pelvic and spinal flexion and extension, physiologic sacroiliac motion is quite limited, with rotation of 3 degrees or less and translational motion of 2 mm or less.<sup>47</sup> Periodic changes in dural tension alone are thus quite unlikely to transmit sufficient force to induce articular motion in the sacroiliac joints. A skilled clinician can palpate the CRI at the sacrum and coccyx, and Zanakis et al reported a 92% correlation between perception of movement at the sacrum and in the cranium.<sup>48</sup> However, the strongest influences on cord motion are the respiratory and cardiovascular rhythms, and by all accounts, the CRI is independent of those rhythms, so the meningeal connection between cranium and sacrum does not explain the palpability of pulsations at the sacrum. Current knowledge of spinal physiology does not support the validity of the core-link hypothesis.

The relationship between the CRI and the THM oscillation serves as a more likely explanation for the perception of the CRI at the sacrum and may also be associated with pulsatile flow of CSF in the spinal SAS. The CRI has been tied to the THM oscillation, a whole body phenomenon associated with various hemodynamic metrics, notably the THM vasomotor waves referred to above. In a double-blind study, the rate of the CRI as measured by palpation was found to occur simultaneously with the THM oscillation as measured by Doppler flowmetry.<sup>25</sup> Given that the CRI and the THM oscillation are both whole-body phenomena that occur simultaneously, it seems likely that the two are actually one and the same.<sup>25</sup> The THM oscillation has been linked to minor fluctuations of intracranial pressure known as Lundberg C Waves.<sup>31</sup> The propagation of the Lundberg C Wave, palpated at the sacrum as the CRI, may cause a palpable pulse of CSF flow in the distal spinal canal.

Cranial manipulation has been shown to affect the CRI/THM oscillation.<sup>49,50</sup> Craniosacral therapy is intended to reduce tension in the dural tube and thus free the flow of CSF. Cranial and sacral manipulative techniques that enhance the CRI/THM oscillation likely enhance the propagation of C waves in the CSF.



### Autonomic Tone

“Disorder of the tone and irregularity in the rhythm are the principal causes of every illness.”

—*Sufi Master Hazrat Inayat Khan*<sup>51</sup>

Due to their close association with THM waves, we would expect that enhanced Lundberg C waves would also be a sign of autonomic balance. Balance between the sympathetic and parasympathetic nervous systems may result in frequency entrainment of multiple biological oscillators.<sup>52</sup> This state of optimal autonomic balance is consistent with increased heart rate variability, enhanced THM waves, and a strong palpable CRI.<sup>53</sup>

Osteopathic care may have profound effects upon autonomic balance. Upledger has suggested that increased sympathetic tone, facilitated segments (first described by Korr),<sup>54</sup> dural tension, and decreased CSF flow are closely related aspects of an overall pattern of structural and energetic dysfunction in the axial skeleton and CNS.<sup>22</sup> Cutler et al demonstrated reduction in sympathetic nerve activity following cranial manipulation.<sup>55</sup> In an unpublished thesis, Giles reported improvement in heart rate variability (a measure of parasympathetic activity) following manipulation of the cervical spine.<sup>56</sup>

Chiropractic care also may promote autonomic balance.<sup>57</sup> In a multisite clinical study, Zhang et al demonstrated significant increases in heart rate variability following a 4-week course of chiropractic spinal manipulation.<sup>58</sup> Like Upledger, Epstein proposed that adverse mechanical cord tension (AMCT) generates predictable patterns of segmental and plurisegmental facilitation with effects upon neural plasticity and perception.<sup>36</sup> A retrospective survey demonstrated that Epstein's Network Care was associated with numerous improvements in indicators of health-related quality of life that were suggestive of reduced sympathetic tone and enhanced autonomic balance.<sup>59</sup>

### Adverse Mechanical Cord Tension

Excessive elongation (strain) of the spinal meninges causes AMCT. First described by Brieg,<sup>60</sup> the phenomenon of AMCT and its clinical significance was popularized with the bodywork techniques developed by Epstein (Network Spinal Analysis)<sup>36</sup> and Butler (Neural Stretching Technique).<sup>61,62</sup>

AMCT may be a principal cause of CSF stasis in the spinal SAS. The spinal cord is suspended in the dural sac bilaterally by the denticulate ligaments. The dura is in turn anchored superiorly and inferiorly to the interior bony surfaces of the spinal canal and bilaterally at multiple levels to connective tissues in the intervertebral foramina. Strain of the spinal dura between points of attachment may result in strain of the spinal cord, expressed as increase in length over original length.<sup>65</sup> Cord strain occurs with normal physiologic spinal flexion; the greatest strain is sustained by the posterior aspect of the cord. In flexion the spinal cord and medulla normally stretch a total of approximately 2 to 3 cm, and at the level of the cervicothoracic junction, strain=0.24 in flexion.<sup>65</sup>

Koschorek found that in flexion, the cord elongates an average of 12 mm, while the spinal canal lengthens 28 mm on average.<sup>66</sup> Cord strain exaggerated beyond normal physiologic limits becomes AMCT

and may lead to development of CSF stasis. Deformation of the cord and meninges associated with AMCT reduces patency of the SAS<sup>65</sup> and may cause CSF stasis. Abnormal dural fixation results in transmission of tension to the cord via the dentate ligaments, especially with spinal flexion, which adds an axial component to lateral tensile forces on the cord.<sup>67</sup>

Dentate ligament strain and associated AMCT have been described in the context of cervical spondylotic myelopathy (CSM).<sup>65</sup> As the cord is displaced posteriorly by an osteophytic deformity, the dentate ligaments are stretched between their pial attachments and the dura. The resultant lateral shear stresses cause distortion and deformation of the viscoelastic tissues of the cord, accompanied by a corresponding reduction in width of the SAS, both anterior and posterior to the cord.<sup>65</sup> Because CSF follows the path of least resistance in the SAS,<sup>14</sup> flattening of the SAS is likely to reduce CSF flow, especially low-pressure cephalad flow. Anteroposterior flattening of the cord may also account for occlusion of the central canal, which is common in adults<sup>4</sup> but is probably suboptimal. Central canal occlusion may be an early sign of adverse cord tension, and patency of the central canal may be a sign of a biomechanically healthy cord. AMCT may also contribute to development of CSF stasis by means other than flattening of the SAS, including loss of capacitance due to cord tethering<sup>18</sup> or chronic dural tension.<sup>18,68</sup> Because dural tension reduces compliance and motility,<sup>18,68</sup> adverse tension may reduce meningeal capacity for stretching in response to the cranial systolic pressure wave, with a corresponding reduction in the rebound pressure wave that is caused by shortening of the dura in the diastolic phase.<sup>18</sup> AMCT may also occur in association with vertebral subluxation, the manipulable lesion ostensibly treated by chiropractors.<sup>36</sup> Sacro occipital technique, Network Spinal Analysis, and CSFT all incorporate chiropractic clinical protocols intended to reduce AMCT.<sup>36,38,69</sup>

### Lymphatic Drainage

Perrin advocates treatment of chronic fatigue syndrome by reducing CRI abnormalities due to neurolymphatic blockage. He has suggested that impaired CRI is associated with CSF stasis and a buildup of cerebral toxins, and restrictions in CSF circulation can be reduced with manual therapies intended to enhance neurolymphatic drainage. Perrin's approach consists of multiple components, including effleurage techniques directed to the cervical and thoracic lymphatics; manipulation of the spine, sacrum, and ribs; massage of the levator scapulae, paravertebral muscles, accessory respiratory muscles, rhomboids, and trapezii; and an osteopathic technique of fourth ventricle compression to stimulate the CRI.<sup>35</sup>

### Therapeutic Breathwork

Therapeutic breathwork techniques that are thought to enhance CSF fluctuation include Rebirthing, Transformational Breathwork, and Holotropic Breathwork, as well as yogic breathing techniques such as alternate nostril breathing (as taught in *Kundalini* yoga), *Shushumna* Breath, and *Kriya Yoga Pranayama*, a specific meditation technique to regulate the flow of *prana* (the life force of the breath). Expiration propels CSF caudad, while inspiration favors cephalad flow.<sup>30</sup> Due to the normal fluctuations in intrathoracic pressure



associated with respiration that favor filling and emptying of cardiopulmonary vessels, entrainment of inspiration to diastole and expiration to systole would have the effect of enhancing cerebrovascular circulation and increasing CSF fluctuation.<sup>70</sup> Chronic stress and anxiety lead to restriction of the respiration, and associated muscle and connective tissue tension may contribute to the development of AMCT by way of direct and indirect connections with the spinal dura. Therapeutic breathwork is intended to reduce chronic restrictions in the breath. Modified respiratory effort associated with certain body/mind practices such as breathwork, meditation, yoga, and relaxation therapies tend to induce deep relaxation, increased parasympathetic tone, increased heart rate variability, and an enhanced CRI and may have the effect of enhancing Lundberg C Waves.

### Yoga

The yoga practice of *asanas*, or postures, may enhance CSF flow. CSF flow appears to be related to postural changes in pressure measurements, which correspond closely with the degree of inclination of the body. In the prone position, cranial and lumbar CSF pressures are approximately equal. Standing posture reduces cephalad flow of CFS, lowers cervical SAS pressure, and increases lumbar pressure.<sup>71</sup> With cervical spine flexion, the ventral SAS narrows up to 43%, and the dorsal SAS widens up to 89%. In extension, the ventral cervical SAS increase up to 9%, and the dorsal SAS is reduced up to 17%, as compared with the neutral position. These changes are associated with changes in the sagittal diameter of the cervical cord, which is decreased 14% in flexion and increased 15% in extension, compared with neutral.<sup>72</sup> Because CSF flow appears to follow the path of least resistance,<sup>14</sup> yoga postures of spinal flexion, extension, and inversion, as well as patient positioning for structural and energetic therapies, can be expected to affect CFS flow. Alternating spinal flexion and extension may create a pumping effect that enhances CSF fluctuation. In a study involving 71 human subjects, Byrne et al demonstrated that oscillatory head tilt significantly increased the amplitude of THM variance, and the changes were apparently moderated by increased parasympathetic tone.<sup>73</sup> Yogic practices that induce what some sources refer to as *kriyas* (involuntary oscillations of the spine and or extremities) may enhance CSF flow as well. (In Sanskrit, the word *kriya* denotes action or a process that can produce a desired effect.) The somatopsychic wave phenomenon reported in recipients of Network Care may have a similar effect.<sup>36</sup>

### Cerebrospinal Fluid Technique

CSFT, developed and described by Glassey, employs a multidisciplinary approach to treatment of CSF stasis. The CSFT clinical procedure employs both low-force chiropractic techniques and massage strokes at multiple points along the cerebrospinal axis. The CSFT protocol is intended to free impedance to CSF flow around the brain and spinal cord. CSFT procedures address all the bones of the spinal column, from the first coccygeal segment up to and including the atlas. Also included are the cranial bones, which can be accessed externally. Other osseous structures that directly or indirectly attach to the spine, such as the pelvis and sternum, may also be included in the clinical protocol.<sup>38</sup>

### CSF and the Life Force

Early investigators ascribed powerful vitalistic properties to the cerebrospinal fluid. Sutherland referred to the CSF as “the breath of life” and “liquid light,”<sup>73</sup> and Randolph Stone, the founder of Polarity Therapy, called CSF “the liquid medium for the Breath of Life.”<sup>74</sup> In yoga and meditation practice, the experience of awakening the dormant power potential of the *Kundalini* has been described as a powerful flow of energy from the base of the spine to the crown of the head. On a subtle energetic level, *Kundalini* energy is said to flow up the spinal pathway (in Sanskrit the *shushumna nadi* or central pathway) in a manner similar to some aspects of the physiologic movement of CSF.<sup>38</sup> This and other peak experiences often associated with yoga, meditation, breathwork, and various structural and energetic therapies may result from enhanced CSF flow.

### CONCLUSION

There is evidence to suggest that CSF stasis may occur commonly in the absence of pathology or symptomatology and may have adverse systemic health effects. CSF stasis may be associated with adverse mechanical cord tension, vertebral subluxation syndrome, reduced cranial rhythmic impulse, and restricted respiratory function. Various structural and energetic therapies may have the effect of enhancing CSF flow, but little is known about their mechanism of action and effectiveness in this regard. Further investigation into the nature and causation of CSF stasis, its effects upon human health, and effective therapies for its correction is warranted.

### Acknowledgment

The authors wish to thank Regina-Anne Cooper, BA, for her assistance with proofreading and preparing the manuscript for submission; Cheryl Hebert, CST, for reviewing the manuscript and providing important reference materials; and Lee Carrol, DC, PhD, for her assistance with the initial literature search.

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## **Post-migraine chronic daily headache relieved with coccygeal and sphenoidal manipulation: A case report**

Jerry I. Hochman, DC

### **Introduction**

Chronic daily headache, also known as new persistent daily headache, has recently been added to the International Classification of Headache Disorders ICHD-2<sup>1</sup>. It has been proposed to develop from stress events, medication overuse, and previous migraine due to overlapping of neural circuits and cellular events, but a definite etiology has thus far elude researchers<sup>2</sup>. There is evidence that migraine headache is sometimes misdiagnosed when it presents as isolated facial pain, unlike classic migraine<sup>3</sup>. In genera, the etiology of migraine headache is often a matter of guesswork, although several factors have been implicated in the literature, including vascular changes, lowered serotonin levels and meningeal stress<sup>4</sup>. Physical stresses are no among the most common of migraine causes.

Coccyx subluxation might exist without pain, but all of the available literature on the coccyx is within the context of pain (coccydynia)<sup>5,6</sup>. Coccyx pain develops most commonly from a fall on the buttocks or from childbirth, and is treated with manipulation, injection, physical modalities, and even removal of the coccyx in extreme non-responsive cases. Manipulative treatment to the coccyx is usually done with an external contact using a cephalad push or pull, in order to decrease the degree of anterior misalignment that usually occurs when the coccyx is traumatized. An intra-rectal adjustment is also sometimes used for a more localized contact on the anterior aspect of the coccyx<sup>7,8</sup>.

The term Lovett Brother is defined as the name for a vertebra in the upper of lower spine that moves synchronously with a paired vertebra in the opposite end of the spine to maintain a balanced vertebra posture<sup>9</sup>. Blum has summarized the use of this relationship as it applies to the practice of Applied Kinesiology and Sacro Occipital Technique<sup>10</sup>. No information regarding the developmental origins or neuro-mechanical rational for the Lovett Brother idea can be found in the peer-reviewed medical literature, and scant information is available in the non-peer-reviewed literature. The idea of the relationship between the two ends of the spine may have a basis in proprio-spinal and vestibulo-spinal connections between the head and pelvis<sup>11</sup>.

Some clinicians consider the Lovett Brother of sacrum to be the occiput, an idea related to the osteopathic concept of sacral and cranial motion first promoted by Sutherland<sup>12</sup>. Anatomically, the coccyx lies inferior to sacrum and the sphenoid lies anterior to occiput. The sacrum is clinically considered to be the Lovett Brother or compensator of the coccyx.

### **Case Report**

A 32 year old male patient complaining of “chronic non stop headache with facial pain” that began in the summer of 2003 referred himself to my office in May 2010. This patient identified the two greater sphenoid wings as the location of the facial pain and reported seeing between 25 to 30 doctors over the past 7 years for treatment of these headaches. He was currently on



Cymbalta 60 mg and hydrocodone 10 mg as needed. Previous treatment included temporalis injections with lidocaine and cortisone, use of a TENS unit, acupuncture, and radiofrequency surgery on the temporalis tendon. Diagnostically he had undergone transesophageal echocardiography (TEE) and visits to an ENT specialist. A total of 28 medications had also been tried including Oxycontin and Oxycodone, all with limited or no results. Previous physical therapy and diversified chiropractic adjustment had been unsuccessful with the exception of specific upper cervical care at a local office that resulted in “taking the edge off.”

Examination revealed no positive standard orthopedic or neurologic indicators of sacroiliac or cervical dysfunction. TMJ tests were negative, including opening and closing glide, pain on palpatory pressure, or pterygoid palpation pain. Upon testing for coccyx dysfunction by having the patient squeeze the gluteal muscle together (an Activator Methods test), he exhibited immediate functional leg length discrepancy and obvious motor changes in previous strong muscles<sup>13</sup>.

Cranial motion examination, as taught and used in the SOT cranial techniques exhibited decreased S-I motion of the left sphenoid wing and an occipital base fixed in right lateral translation. Pelvic examination exhibited chiropractic proprietary indicators of minor left sacroiliac instability as used in the practice of Sacro Occipital Technique<sup>14</sup>.

## Interventions

Intervention was aimed at reducing the Activator Methods chiropractic indicator of coccyx and sphenoid dysfunction, a functional short leg appearing after contracting of the buttocks muscles. This patient was seen a total of 6 times over the course of a one month period. I administered 3 external coccyx corrections with the help of a drop pelvic mechanism, and 2 sphenoid contacts on the greater wings externally and pterygoid processes intraorally.

The coccyx adjustment is done with a coccyx base contact with the superior hand thumb pad, backed up with the heel of a stabilization hand. The pelvic piece was elevated for easy access to coccyx, and the pelvic piece was set to drop easily during a cephalad thrust. The sphenoid corrections were performed with a gloved hand contact using a sustained contact in a cephalad direction intraorally, while the greater wing contact to a sustained force in a lateral to medial direction.



## Results

After the third coccyx and sphenoid corrections, the patient reported a break in the pain. 2 visits later he reported an 80% decrease in intensity and duration of pain. 3 weeks later he still reported an 80% improvement in pain relieve. At the last visit 2 months after his initial presentation,, he reported no pain at all.

## **Discussion**

This appears to be the first report of chronic daily headache with possible coccyx-related etiology. It also appears to be the first report of a possible coccyx-sphenoid relationship in association with migraine or maxillary trigeminal neuralgia. Although anecdotal, this single case was unique in its quick resolution of symptoms that had existed for so long. The use of the Activator Methods coccyx isolation test was definitive in localizing coccyx dysfunction in this case. The author's familiarity with the relationship between the coccyx and sphenoid is believed to have been instrumental in this resolution of this case.

Familiarity with the Lovett Brother relationship between the coccyx and sphenoid was also important, since the greater sphenoidal wings were identified by the patient as the sites of the head pain.

A variety of authors have reported migraine headache with unusual manifestations such as tooth pain<sup>15,16</sup>. This patient's headache was originally classified as migraine. After discussion of the case with Dr. John Romfh, an anatomist, the possibility of maxillary trigeminal neuralgia was discussed as a possible diagnosis<sup>17</sup>. Migraines however, can become what is now classified as chronic daily headache. This transformation is summarized by Meng and Cao, and seems to be related to stress and medication overuse. Changes in neurotransmitter production and pain signaling have been proposed as the causes of chronicity. As previously stated, this patient had been on 28 different medications for several years, including Oxycontin and Oxycondone<sup>2</sup>.

## **Possible Mechanisms of Action**

### **Sutural Motion**

Cranial sutural fusion, other than at the sphenobasilar synchondrosis, is usually not complete until sometime in the 4<sup>th</sup> decade of life<sup>18</sup>. It is possible that some motion was imparted to the sacrum by force through both the greater wings and the pterygoid contacts that affected the anatomical relationship between the trigeminal ganglion, the temporal bone, the sphenoid, and the overlying dura.

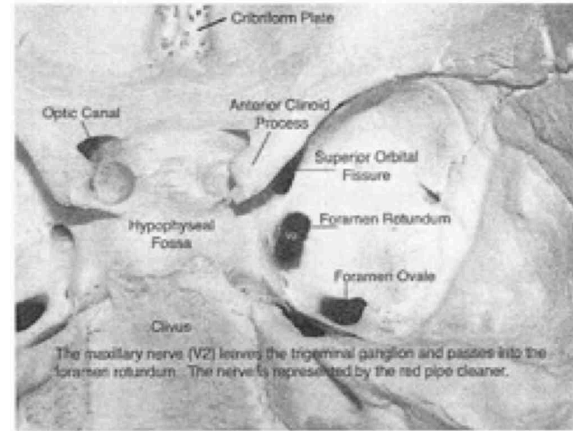
The trigeminal ganglion lies in Meckel's Cave, the dura mater covering the trigeminal impression near the apex of the petrous part of the temporal bone<sup>19</sup>. The maxillary branch reaches the trigeminal ganglion through the foramen rotundum located in the anterior medial aspect of the great wing. Cases of congenitally smaller or unusual shaped foramina rotunda have been reported causing trigeminal neuralgia<sup>20</sup>. It may be possible that the sphenoid contacts affected the sensitivity of this ganglion or the maxillary branch within the foramen rotundum to the degree that pain perception changed.



## Fascial Connection

The dura mater attaches to the coccyx via the sacrococcygeal ligament, an extension of the filum terminale <sup>21</sup>. The spinal dura is continuous with the sphenoidal dural connections, and, indeed with the entire periosteal dura of the cranium <sup>22</sup>.

Several cases of headache have been reported after accidental dural tearing during disc surgery or laminectomy <sup>23,24</sup>. The proposed etiology of the head pain is thickening of the pachymeninges and cranial cerebrospinal fluid hypotension, resulting in cranial venous swelling. Perhaps the coccyx and sphenoid contacts changed tension on the cranial dural attachments near the trigeminal ganglion, although the dural covering over the trigeminal ganglion is extremely tight <sup>25</sup>.



### Meckel's Cavity

Cleft in the meningeal layer of dura of the middle cranial fossa near the tip of the petrous portion of the temporal bone Encloses the roots of the trigeminal nerve and ganglion. (from skullanatomy.info)

## Propriospinal and Vestibulospinal Tracts

It is possible that the coccyx contact created changes in muscle tone of the head and neck via propriospinal and/or vestibulospinal influences. The lateral vestibulospinal tract descends ipsilaterally through the entire spinal cord, and is excitatory to antigravity muscles. Propriospinal neurons evidently make up the preponderance of neurons in the spinal cord <sup>26</sup>. Propriospinal connections between levels of the spinal cord allow coordinated action of the body, even to allow the head to maintain normal position in the presence of pelvic distortion <sup>27</sup>. This may be part of the Lovett Brother relationship in clinical practice. DeJarnette went so far as to use cervical muscle palpation to determine misalignment characteristics of lumbar vertebra. DeCamp has described Lovett-related methods to determine pelvic distortion <sup>14,28</sup>.

## Conclusion

This case of chronic headache relief raises several questions regarding etiology and reminds the clinician that the cause may indeed be quite far from the location of the pain, and that anatomically-based mechanical factors may play a role. The medical literature is basically non-existent regarding such an unusual case but does support, to a degree some of the possible etiological theories. A collection of similar cases from a multitude of practitioners may shed light on the most likely explanations.

## Acknowledgement

Thanks are due to Drs. Leslie Cane and John Romfh for discussing this case with me an leading me in realistic directions, and to Korey Revels for help with research and review.

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# NEUROVERTEBRAL INFLUENCE UPON THE AUTONOMIC NERVOUS SYSTEM: SOME OF THE SOMATO-AUTONOMIC EVIDENCE TO DATE -

PETER L. ROME

**ABSTRACT:** *Objective:* To present a broad overview of the literature in relation to the volume and variety of published material referring to spine-related neural reflexes upon organic symptoms, signs and conditions - the somato-autonomic influence. This presentation particularly emphasises somato-autonomic reflexes and to a degree, somato-autonomic-visceral reflexes mediated through the spinal influence of the neuraxis. It seeks to catalogue the evidence of the potential for further influence upon the *function* of internal anatomical structures - that is, other than those which may be regarded as purely musculoskeletal. The study further highlights the significant formal original neurophysiology research activities by chiropractors and medical researchers. These activities tend to explain the phenomena of this neurovertebral influence upon autonomic and internal function. *Data Sources:* Citations were extracted from a number of sources including: The Index to Chiropractic Literature, PubMed, Reference lists of previously published papers and textbooks, and two osteopathic electronic indexes. Over 500 papers were assessed and in a few cases only the abstracts were obtainable. *Data Synthesis:* There appears to be a developing interest in the influence of the autonomic nervous system (ANS) as depicted by the number of medical texts currently emerging. The most extensive work to date has been by Sato et al, where their studies correlate with spine-related concepts so pertinent to this presentation. The volume, variety and depth of material listed does not appear to have been presented previously. The inter-professional co-operative research projects are noted. *Conclusion:* It is noted that the volume of material presented tends to further define the neurological basis of the many clinical observations, and may provide additional explanation for the subjective patient reports of positive responses to manual manipulative intervention. Effectively at this stage, this both underpins and builds upon a long-established empirically based rationale.

**INDEX TERMS:** MeSH: AUTONOMIC NERVOUS SYSTEM; CHIROPRACTIC; MANIPULATION, SPINAL. (OTHER): SOMATO-AUTONOMIC REFLEX; SOMATO-VISCERAL REFLEX; ORGANIC CONDITIONS; VISCERAL DYSFUNCTION; VERTEBRAL ADJUSTMENT.

Chiropr J Aust 2009; 39: 2-17.

## INTRODUCTION

Gray's Anatomy states that the "...*function (of the nervous system) is to control and coordinate all the other organs and structures and to relate the individual to its environment.*"<sup>1</sup>

Gray's statement emphasises the all-encompassing, integrative role of the nervous system – a continuing concept effectively expounded by Sherrington in 1906.<sup>2</sup>

This paper seeks to survey the literature relating to somatic impact upon the autonomic nervous system, and the effect that has on internal organic function or dysfunction. That aim would also assess evidence relating to aberrant somatic neural input, be that stimulatory or suppressive, and in turn

assess, modify, or normalise such influences upon neural physiology and neuropathophysiology.

Various hypotheses exist on this matter of spine-related neural dysfunction. These range from involvement of massive irritation due to bombardment of noxious mechanoreceptors brought on by localised pathomechanics, to irritation and inflammatory response at the radicular level - or a combination of these various factors.<sup>3-7</sup> Carrick, in his significant original research has demonstrated,<sup>8</sup> and Terrett through an hypothesis,<sup>9</sup> have proposed concepts of neural influence at a more central level.

In reference to segmental neurospinal dysfunction, it is important to appreciate that at least for the purpose of this paper, a *vertebral subluxation* is not just a strict mechanical displacement of a vertebra. It is more accurately termed a *vertebral subluxation complex* (VSC) to encompass all the involved elements including functions and structures. A significant component in this complex is intersegmental articular mechanical dysfunction. This may comprise aberrant movement, fixation (hypomobility) or hypermobility between

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Received: 15 March 2008, accepted with revisions 18 August 2008.



adjacent facets, as well as articular muscular and ligamentous changes triggering neural firing of mechanoreceptors, proprioceptors, effectively nociceptive noxious input. The VSC would then include disturbances of these structures and their function, especially their effect upon articular physiology (function) and the integral neurophysiology. Inflammatory and circulatory disturbances of the articular environment could also be associated. It is this total pathophysiological complex that would provide the opportunity through which manual intervention by way of a vertebral adjustment may be directed in order to influence internal body physiology.<sup>10</sup> It is submitted again that *segmental dysfunction* more than osseous displacement, may be the primary physical-mechanical feature involving any associated neural aberration in this situation but, that is only one part of the complex. Only a dry skeleton could have osseous disruption without more complex involvement.

### HISTORICAL

In his 1910 text, Palmer founded what became the chiropractic profession on the basis of the importance of a neurospinal influence upon physiology. He cited the “*nervous system known as the automatic functions*”<sup>11</sup> - now known as the ANS. In 1954, Müller produced a text entitled “*Autonomics in Chiropractic*”, again highlighting the importance of the ANS to the profession. His text noted that “*The essential role of the autonomic nervous system as an integrator and controller of body functions is a fact all are agreed upon. That structure or function is disturbed, sometimes seriously, however this correlation is deranged from any cause is becoming more widely recognized by all schools of healing. It is the very bedrock upon which the premise of chiropractic is based.*”<sup>12</sup> More recent research has become much more intensive, with sophisticated studies and advanced neurophysiology research into such topics concerning the critical interaction between the musculoskeletal system and the autonomic nervous system.<sup>13-20</sup>

Interestingly, as if aware of complex neural physiology through noxious stimulation, Palmer maintained that rather than nerves being “squeezed or pinched”, neural energy was “...accelerated, (and)...the volume and force is augmented.”<sup>21</sup> It seems he was apparently aware of the bombardment of noxious impulses from disturbed proprioceptors or mechanoreceptors at that time, well before the complexities of such reflexes was appreciated as deeply as they are today.

For some 50 years early last century, the neurophysiologist Sherrington pioneered studies of neural reflexes. He stated that “To describe the action of nerve (sic) as integrative is, although true, hardly sufficient for a definition” - implying that neural influence was extensive.<sup>2</sup>

In the 1930's, Cannon addressed the issue of a relationship between the sympathetic division of the ANS with homeostasis,<sup>22</sup> and Huber and Crosby explored the “Somatic and visceral connections of the diencephalon.”<sup>23</sup> A theme followed by Sollman in Germany in 1958.<sup>24</sup>

Other early authors such as Alvarez, Breig, Pottenger, Kuntz and Sachs published significant texts for their time on the topic of neurovisceral disorders.<sup>25-29</sup> But their concepts now seem to receive less emphasis.

In Russia, Speransky conducted extensive research in neurophysiology, his text was translated and published in

1935 entitled, *A Basis for the theory of Medicine...* He cites Charcot as noting “*that not every injury to a nerve results in dystrophic lesions of the tissues, and that these lesions are connected not with the cessation of the functioning of the nerve, but with its irritation.*” He also cites Mitchell et al as stating that “*partial injury to nerves is more dangerous in this respect than complete severance.*”<sup>30</sup>

More recently, the medical specialists Bannister (1988), Korczyn (1990), Appenzeller (1995), Goldstein (2001) Jänig (2006) have made significant contributions in the field of the autonomic nervous system.<sup>31-35</sup>

Currently, there are journals based on the ANS. One entitled *Autonomic Neuroscience: Basic and Clinical*, is produced by Elsevier and edited by Geoffrey Burnstock. This was previously published under the title of *The Journal of the Autonomic Nervous System* until the year 2000. *Clinical Autonomic Research* is the official journal of the Clinical Autonomic Research Society. There are also a number of other journals on the topic of neurophysiology and neurology. To this writer's knowledge, there is no specific journal based on the somatic-autonomic-visceral complex.

Burnstock has authored and co-authored many papers on neurophysiology as listed on Pubmed (<http://www.ncbi.nlm.nih.gov/entrez/query.fcgi>). His curriculum vitae would be one of the most extensive in this respect. His discovery of a “third nervous system” - the purinergic, in addition to the adrenergic and the cholinergic, was a most significant contribution to neurophysiology.<sup>36,37</sup>

Earlier, Johnston *et al* in particular explored clinical aspects of the ANS in some depth. Their exploration of the underlying role of the ANS has been highlighted in at least two pioneering scientific texts. From the mid-1960's to the mid-1980's, they were some of the earliest to broaden the importance of the clinical aspects of autonomic dysfunction.<sup>38, 39</sup>

### SEMINAL WORK

This author is convinced however, that the most notable work in this field is that conducted by Akio Sato and colleagues in Japan. Their widely published works culminated in a text *The Impact Of Somatosensory Input On Autonomic Functions*, published over 328 pages in the *Reviews of Physiology, Biochemistry and Pharmacology* in 1997.<sup>16</sup> These extensive studies in neurophysiology conducted through the laboratories at the Department of the Autonomic Nervous System at the Metropolitan Institute of Gerontology, in Tokyo, Japan, provide a contemporary foundation for understanding clinically observed phenomena noted by manual practitioners. Sato has also been involved in the publications of numerous papers and at least two texts.

It should be noted that both familial and trauma induced *dysautonomia* (also called *autonomic dysfunction syndrome*),<sup>40</sup> usually refers to a more serious form of autonomic breakdown, as does the term *partial dysautonomia*,<sup>41</sup> or *sympathetic dysfunction* (*Reflex Sympathetic dystrophy*).<sup>42</sup> However, there can be milder versions of the trauma-induced autonomic symptoms. Gazit et al concluded that “...*autonomic nervous system-related symptoms of the patients have a pathophysiological basis, which suggests that dysautonomia is an extraarticular manifestation in the joint hypermobility syndrome.*”<sup>43</sup>



## SOMATO-AUTONOMIC EVIDENCE ROME

A number of authors have noted a connection between joint hypermobility and autonomic nervous system dysfunction (ANS/D).<sup>44</sup> ANSD usually refers to a more acute and serious clinical situation, even though it is hypothesised to involve joint proprioception.<sup>45</sup> In the manual therapies however, interest in articular integrity is normally concerned with *hypomobility* or joint fixations and its potential to affect the ANS.<sup>3</sup>

This historical section was included to show that a degree of recognition, and supportive evidence for the somato-autonomic concepts have existed for some years. But it is the more subtle clinical presentations which this paper seeks to focus upon.

### METHOD

This overview seeks to assess somato-autonomic topics in neurophysiology published by chiropractic and osteopathic researchers, and medical authors in chiropractic and other journals. (Table 1) While not a meta-analysis, this paper summarises the dates and themes of these papers, their authors' professions, and the professions associated with journals of publication. This paper is offered in a manner which would encourage the reader to view the references as an integral part of a study of the hypotheses concerned.

It has also been the intention of this study to present examples of the wide variety of areas researched, and to portray the numerical volume of published items. Consequently, an atypical format (tabular) was adopted to cover such broad factors.

Many early journals were published before the advent of the MeSH terms and the 'Key Words' adjunct. Currently, some medical as well as some chiropractic journals still do not uniformly utilise these systems. A selection of early citations have been included along with the more recent references to note the fact that a degree of relevant physiological research had been in evidence for many years although it is only chiropractors, osteopaths as well as a limited number of medical doctors and physiotherapists who appear interested in this aspect of clinical care.

In both PubMed and Google, a search was made under the terms *somato autonomic*, *somatic autonomic*, *somato autonomic visceral* and *dysautonomia*. While there were quite a number of papers on these topics, interest seems to have been renewed more recently. During this search it was noted that there was a direct interest between acupuncture and somato-autonomic-visceral reflexes - a connection also noted by Sato *et al.*<sup>107</sup>

A search of library sources revealed considerable published material concerning neurospinal-related visceral physiology and pathophysiology. In recent years more formal papers have been appearing, together with original physiological research studies which tend to clarify the rationale of these spine-related-ANS somatovisceral concepts.

In particular, three electronic avenues which were employed were,

- *The Index to Chiropractic Literature* ([www.chiroindex.org](http://www.chiroindex.org)) and,

- *The Osteopathic Index* ([www.osteopathic-research.com](http://www.osteopathic-research.com)).

- <http://ostmed.hsc.unt.edu/ostmed/index.html>

The primary source of material for this paper was from the examination of the reference lists of previously published material. Citations have been gleaned from these sources as well as PubMed (<http://www.ncbi.nlm.nih.gov/entrez/query.fcgi>), Index Medicus and textbooks. The four volumes of the Chiropractic Research Archive Collection (CRAC) index series published by the Canadian Memorial Chiropractic College between circa 1980 and 1990, were also a valuable resource of data for this purpose.<sup>108-111</sup> Copies of original papers were obtained where possible, and abstracts where this was not feasible.

The electronic *Index to Chiropractic Literature* was examined, while another electronic index MANTIS, also has an extensive electronic reference base of the manual spinal sciences, but was not drawn upon at this time - *The Chiropractic Index - MANTIS* ([www.healthindex.com/MANTIS](http://www.healthindex.com/MANTIS)) - (ex-Chirolars).

The PubMed index on CAM was found not to be of assistance on this issue. (*The CAM Citation Index (Complementary and Alternative Medicine Citation Index)* ([www.nlm.nih.gov/nccam/camonpubmed.htm#](http://www.nlm.nih.gov/nccam/camonpubmed.htm#)),

The author's own database collected over some years comprises more than 1200 citations on specified spine-related conditions. It also includes neurophysiology references on spine-related conditions. These are further divided into the different professions, and list some 127 different pathophysiological organic conditions. As an example of the volume of the material in the general literature - albeit at different standards of evidential levels, at least 21 chiropractic and 8 osteopathic papers concerning respiratory conditions have been located. In addition, there are at least a further 35 medical references also published in relation to spine-related respiratory conditions, these date from 1925 to 1995.

It also notes supportive medical neurophysiological research which has been cited in relevant papers and which report neurospinal influence upon organic function and dysfunction. (Table 2)

The nature of this presentation has been to highlight the variety, volume and depth of available evidence. It especially seeks to explicate the neurophysiological research conducted by chiropractors as well as that in chiropractic institutions and that sponsored by chiropractic research organisations. Where it is possible, it also notes inter-professional joint authorship and inter-professional co-operative research projects involving chiropractors as well as medical and osteopathic researchers in the neurosciences. However, this is not always clear in the publications.

### REVIEW

*"There is increasing evidence that manual therapies may trigger a cascade of cellular, biomechanical, neural and/or extra-cellular events as the body adapts to the external stress. Collectively (the research suggests) that spinal manipulation can alter the activity of nearby mechanical sensitive neurons...and in turn can lead to responses by the central and autonomic nervous systems...(which) may in turn*



Table 1

CONTRIBUTIONS TO SPINAL NEUROPHYSIOLOGY, NEUROANATOMY and CLINICAL OBSERVATIONS:				
PRIMARY AUTHOR	FUNCTION	ORGAN/KEYS	JOURNAL	YEAR
Bogduk N.	Cervical spine	Headaches	JMPT	1992 <sup>46</sup>
Bolton PS, <i>et al.</i>	Adrenal glands	C-Vertebral movement	Auton Neurosci	2006 <sup>15</sup>
Bolton PS, Budgell BS.	Spinal manipulation	Axial sensory beds	Med Hypotheses	2006 <sup>47</sup>
Bolton PS.	Reflex effects/PNS	Vertebral subluxations	JMPT	2000 <sup>48</sup>
Bolton PS.	Somatosensory	Neck /CNS	JMPT	1998 <sup>49</sup>
Bolton PS, <i>et al.</i>	Neck afferents/ Respiration	Sympathetic ns, Respiratory ns	Brain Res Bull	1998 <sup>50</sup>
Bolton PS, Holland CT.	Neck/CNS Mechanoreceptors	Normal afference Cervical motion	J Neurosci Methods	1998 <sup>51</sup>
Bolton PS, Tracey DJ.	Neck/sensory	Medullary relay Thalamus	Exp Brain Res	1992 <sup>52</sup>
Bolton PS, Tracey DJ.	Neck mechanoreceptors	Dorsal column nuclei/Thalamus	Brain Res	1992 <sup>53</sup>
Bolton PS, Tracey DJ.	Somatosensory Propriospinal	Spinothalamic Upper cervical cord	Exp Brain Res	1992 <sup>54</sup>
Briggs K, Boone WR.	Pupillary Changes	Somatovisceral/SMT	Exp Brain Res	1988 <sup>55</sup>
Brophy GM. <i>et al.</i>	Vestibulospinal	Lumbar parasp musc	Neurosci Lett	1997 <sup>56</sup>
Budgell BS, Bolton PS.	CSF pressure in rats	CSF	JMPT	2007 <sup>57</sup>
Budgell BS, <i>et al.</i>	Neck mechanoreceptors	Heart variable rate	Auton Neurosci	2001 <sup>58</sup>
Budgell BS.	Interspinous stimulation	Gastric Motility	J Auton Nerv Syst	2000 <sup>59</sup>
Budgell BS, <i>et al.</i>	Reflex effects	VSC/ANS	JMPT	2000 <sup>13</sup>
Budgell BS, <i>et al.</i>	Interspinous stimulation	Bladder motility	JMPT	1998 <sup>60</sup>
Budgell BS, <i>et al.</i>	Interspinous stimulation	Adrenal function	Neurosci Res	1997 <sup>61</sup>
Budgell BS, Sato A.	Cervical subluxation	Cerebral circulation	JMPT	1997 <sup>62</sup>
Budgell BS, Sato A.	Modulations/Nociception	ANS	Prog Brain Res	1996 <sup>14</sup>
Budgell BS, <i>et al.</i>	Interspinous stimulation	Cardiovascular	JNMS	1995 <sup>63</sup>
Carrick FR.	Cervical Manipulation	Brain function	JMPT	1997 <sup>8</sup>
Christian GF, <i>et al.</i>	SMT	Immunoreaction	Spine	1988 <sup>64</sup>
Cramer GD, Darby SA.	Neuroanatomy	Neuraxis/ANS	Text	1995 <sup>65</sup>
DeBoer KF, <i>et al.</i>	SMT/GI	Myoelectric activity	Man Med	1988 <sup>66</sup>
Dishman JD, <i>et al.</i>	SMT	Reflex attenuation	Spine	2000 <sup>67</sup>
Dishman JD, <i>et al.</i>	SMT/massage	Motoneuron excitability	Elect Clin Neurophys	2001 <sup>68</sup>
Dishman JD, <i>et al.</i>	Motor evoked potentials	Transcranial stimulation	JMPT	2002 <sup>69</sup>
Edwards IJ, <i>et al.</i>	Somatoautonomic reflex	Cardiorespiratory/BP	J Neurosci	2007 <sup>70</sup>
Foreman SM, Croft A.	Cervical syndromes	ANS/Whiplash	Text	2002 <sup>71</sup>
Fujimoto T, <i>et al.</i>	Cervical spine mechano	Heart rate/BP	J Auton Nerv Syst	1999 <sup>72</sup>
Giles LGF.	Vertebrogenesis	ANS Syndromes	JMPT	1992 <sup>73</sup>
Giles LGF.	Neuroanatomy	Tethered cord	Surg Radiol Anat	1991 <sup>74</sup>
Giles LGF.	Neuroanatomy	Intervertebral foramen	JMPT	1994 <sup>75</sup>
Giles LGF.	Neurovascular	Spinal canal & IVF	JMPT	2000 <sup>76</sup>
Giles LGF.	Neuroanatomy	Intervertebral foramina	Neuro-orthop	1992 <sup>77</sup>



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Grimm DR, <i>et al.</i>	Musculoskeletal injury	ANS	JMPT	2005 <sup>20</sup>
Grod JP, <i>et al.</i>	Proprioception	Neck pain	Arch Phys Med Reha	2002 <sup>78</sup>
Hack GD, <i>et al.</i>	Neuroanatomy	Dura mater/rec cap min	Spine	1995 <sup>79</sup>
Haavik-Taylor H, <i>et al.</i>	Transient modulation	Intracortical inhibition	Chiropr J Aust	2007 <sup>19</sup>
Haavik-Taylor H, <i>et al.</i>	Neck/SMT	Somatosensory evoked potential	Clin Neurophysiol	2007 <sup>18</sup>
Igarashi Y, <i>et al.</i>	Arrhythmia	SMT	Chiropr J Aust	2000 <sup>80</sup>
Kaushal B, <i>et al.</i>	Neurophysiology	Sensory convergence	Eur J Chiropr	2002 <sup>81</sup>
Kurosawa M, <i>et al.</i>	Somatosensory	Spinal cord blood flow	Auton Neurosci	2006 <sup>82</sup>
Murphy B.	Neural plasticity	SMT	ASRF	2004 <sup>83</sup>
Murphy DR.	Somato-autonomic	Cervical Neurogenesis	Text	1999 <sup>84</sup>
Niesluchowski W.	Scoliosis	Brain asymmetry	JMPT	1999 <sup>85</sup>
Ruch WJ.	Radiological	ANS, SNS	Text	1997 <sup>86</sup>
#†Sato A.	Somatosympathetic	Reflexes	NINDS/US Dept HEW	1975 <sup>87</sup>
#Sato A, <i>et al.</i>	Mechanoreceptors	Sympathetic NS	JMPT	1984 <sup>88</sup>
#Sato A.	Somatosensory/C/V G/I,G/U	Somatovisceral reflexes	JMPT	1992 <sup>89</sup>
#Sato A.	Noxious/Innocuous	Somatovisceral Reflexes	JMPT	1995 <sup>90</sup>
#*Sato A, <i>et al.</i>	Somatosensory modulation	ANS	Physiol Biochem Pharm	1997 <sup>16</sup>
#Sato A, Budgell B.	Somatoautonomic Reflexes	Multiple	In: Haldeman S (ed)	2005 <sup>91</sup>
Seaman DR, <i>et al.</i>	Neuropathophysiological	Dysafferentation	JMPT	1998 <sup>92</sup>
Watanabe N, Polus B.	Mechanical input	ANS	Chiropr J Aust	2007 <sup>93</sup>
Wantanabe N, <i>et al.</i>	Posture/autonomic regulation	Cardiovascular	Chiropr Osteop	2007 <sup>94</sup>
Whelan TL, <i>et al.</i>	Salivary cortisol levels	Stress response/ SMT	JMPT	2002 <sup>95</sup>
Wiles MR.	Electrogastrogram	Cervical SMT	JMPT	1989 <sup>96</sup>
Yates BJ, <i>et al.</i>	Vestibulo-respiratory reflexes		In: Trough CO <i>et al</i> (eds)	1987 <sup>97</sup>
Yochum TR, Rowe LJ.	Radiology	General	Text	1987 <sup>98</sup>
<b>OSTEOPATHIC</b>				
Johnson WL, <i>et al.</i>	VSC	Somatic/visceral input	JAOA	2001 <sup>99</sup>
^Korr IM.	Elect skin resistance patterns	Visceral disease	Fed Proc	1949 <sup>100</sup>
^Korr IM, Wright HM.	VSC	Cutaneous SNS patterns	J Neural Transmission	1964 <sup>101</sup>
^Korr IM.	Segmental NS	Disease processes	Text	1970 <sup>102</sup>
^Korr IM.	Neurophysiology	General	Text	1978 <sup>103</sup>
Patterson MM, <i>et al.</i>	Somatovisceral	Viscerosomatic reflexes	Text	1992 <sup>104</sup>
^Wright HM, Korr IM.	Sympathetic NS	Segmental facilitation	JAOA	1955 <sup>105</sup>
^Wright HM.	Local vasomotor disturbance		JAOA	1956 <sup>106</sup>

(Includes: original research, chiropractic authors & or chiropractic publications)

Although not a chiropractic publication, this reference makes a significant contribution and includes a mention of the complex neurophysiology of spinal manipulation.

# Sato works are directly related to somato-autonomic principles.

† The Research Status of Spinal Manipulative Therapy.

^ Neurophysiologists who worked extensively with the osteopathic profession.

JMPT = Journal Manipulative Physiological Therapeutics.

JAOA = Journal American Osteopathic Association.

(Where authors have been prolific, a limited number of their papers have generally been included).



Table 2

RELATED/SUPPORTIVE NEUROPHYSIOLOGY RESEARC			
AUTHOR(S)	TITLE KEYS	JOURNAL	YEAR
Adachi T, <i>et al.</i>	Cutaneous stimulation/Cerebral blood flow	Neuro Report	1990 <sup>112</sup>
Araki T, <i>et al.</i>	Somato-adrenal medullary reflex	J Auton Nerv Syst	1981 <sup>113</sup>
Arce A, <i>et al.</i>	Autonomic denervation/lymphocyte response	J Auton Nerv Syst	2001 <sup>114</sup>
Barron W, <i>et al.</i>	Articular receptors/cardiovascular reflexes	J Physiol	1973 <sup>115</sup>
Bolser DC, <i>et al.</i>	Viscerosomatic reflexes/spinothalamic tract.	J Neurophysiol	1991 <sup>116</sup>
Brennan TJ, <i>et al.</i>	Somatovisceral reflexes/spinothalamic tract	J Neurophysiol	1989 <sup>117</sup>
Cao WH, <i>et al.</i>	Somatosensory/c/f noxious –v- non-noxious	Jpn J Physiol	1992 <sup>118</sup>
Chiu JH, <i>et al.</i>	Sphincter of Oddi/Somatovisceral reflex	Dig Dis Sci	1999 <sup>119</sup>
Coote JH, <i>et al.</i>	Viscero-viscero sympathetic reflex	Neurosci Lett	1984 <sup>120</sup>
Coote JH, <i>et al.</i>	Somato-sympathetic/cardiac symptoms	Brain Research	1978 <sup>121</sup>
Coote JH.	Somatic afferents/muscle/joints/heart circulation	Brain Research	1975 <sup>122</sup>
Coote JH, <i>et al.</i>	Thoracic white rami/somatic/visceral excitation	J Physiol	1969 <sup>123</sup>
De Landsheere C, <i>et al.</i>	Spinal cord stimulation/angina	Am J Cardiol	1992 <sup>124</sup>
Dmitrieva L, <i>et al.</i>	Somatic afferents/somatovisceral/muscle	[Zh Evol Biokhim Fiz]	2000 <sup>125</sup>
Edney DP, <i>et al.</i>	Neck muscles afferents/neural gaze.	J Comp Neurol	1986 <sup>126</sup>
Edwards IJ, <i>et al.</i>	Somatoautonomic excitation & inhibition	J Neurosci	2007 <sup>77</sup>
Elenkov IJ, <i>et al.</i>	ANS/brain/immune system.	Pharmacol Rev	2000 <sup>127</sup>
Fujino M, <i>et al.</i>	Somatic afferent stimulation/adrenal sympathetics	Neurosci Lett	1987 <sup>128</sup>
Gilbey MP, <i>et al.</i>	Sympathetico-visceral	Baillieres Clin Endocr	1993 <sup>129</sup>
Gouveia RG, <i>et al.</i>	ANS/Cluster headaches	J Headache Pain	2005 <sup>130</sup>
Hikosaka O, <i>et al.</i>	Cervical spine/abducens motor neurones	Exp Brain Res	1973 <sup>131</sup>
Hobbs SF, <i>et al.</i>	C1/2/Propriospinal/Viscerosomatic/spinothalamic	J Neurophysiol	1992 <sup>132</sup>
Hotta H, <i>et al.</i>	Lumbar spine/Vasa nervorum	Neurosci Lett	1991 <sup>133</sup>
Hyingstrom AS, <i>et al.</i>	Neuromodulation/joint angulation	Nature Neurosci	2007 <sup>134</sup>
Jänig W.	ANS/Homeostatis	Text	2006 <sup>36</sup>
Jinkins JR.	Somato-autonomic/Neurogenic syndromes	Text	1997 <sup>135</sup>
Jinkins JR, <i>et al.</i>	ANS/Lumbar spine/disc	Am J Roentg	1989 <sup>136</sup>
Kerr FWL.	Cervical spine/trigeminal tract/solitary nucleus	Exp Neurol	1961 <sup>137</sup>
Kimura A, <i>et al.</i>	Somato-autonomic reflexes	Jpn J Vet Res	1997 <sup>138</sup>
Kimura A, <i>et al.</i>	Somatocardiovascular/Cervical cord	Neurosci Res	1995 <sup>139</sup>
Kirchner F, <i>et al.</i>	Spinal sympathetic inhibition	Brain Research	1975 <sup>140</sup>
Kiyomi K.	Somatoautonomic responses	In: Korr IM.	1978 <sup>141</sup>
Kurosawa M, <i>et al.</i>	Adrenal sympathetics/somatic stimulation	Neurosci Lett	1987 <sup>92</sup>
Lindquist C, <i>et al.</i>	Mechanical sensitivity of nerve fibres	Brain Res	1973 <sup>142</sup>
Maeda M.	Somatosensory/vestibular	Prog Brain Res	1979 <sup>143</sup>
Menetrey D, <i>et al.</i>	Somatovisceral/Tractus solitarius	J Comp Neurol	1987 <sup>144</sup>



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Nagatomi R, <i>et al.</i>	ANS/brain/immune system.	Immunol Rev	2000 <sup>145</sup>
Nash MS.	Depressed immune function	J Spinal Cord Med	2000 <sup>146</sup>
Norman J, <i>et al.</i>	Cutaneous visceral reflex/Heart rate/Vagus	J Physiol	1973 <sup>147</sup>
Norman J, <i>et al.</i>	Somatosympathetic afferents/PR/BP	J Physiol	1973 <sup>148</sup>
Ohtori S, <i>et al.</i>	Neuroanatomy/Somatosympathetic	Spine	2001 <sup>149</sup>
Ohtori S, <i>et al.</i>	Lumbar noxious stimulation/Fos/Brain	Spine	2000 <sup>150</sup>
Roca PD.	Ocular manifestations/Whiplash injuries.	Annals Ophthalmology	1972 <sup>151</sup>
Sato A, <i>et al.</i>	Gastric motility/skin nociception	Brain Res	1975 <sup>152</sup>
Sato A, <i>et al.</i>	Heart rate changes/somatosympathetic	J Auton NS	1981 <sup>153</sup>
Sato A, <i>et al.</i>	Nociception/knee/BP/PR	Neurosci Lett	1984 <sup>154</sup>
Sato A, <i>et al.</i>	Nociception/knee/Catecholamine/adrenal	J Physiol	1986 <sup>155</sup>
Sato A.	Somatic afferent stimuli/Adrenals	Adv Biophys	1987 <sup>156</sup>
Sato A.	Autonomic reflexes/somatic nociception	Masui	1987 <sup>157</sup>
Sato A, <i>et al.</i>	Modulation of visceral function	Japanese J Phys	1987 <sup>158</sup>
Sato A.	Somatosensory/ANS	Neurosci Behav Physiol	1997 <sup>159</sup>
Sato A, <i>et al.</i>	Cardiovascular/somatosensory/ANS	Neurosci Behav Physiol	1997 <sup>160</sup>
Sato A, <i>et al.</i>	Digestive secretions/motility/somatosensory/ANS	Neurosci Behav Physiol	1997 <sup>161</sup>
Sato A, <i>et al.</i>	Urinary/somatosensory/ANS	Neurosci Behav Physiol	1997 <sup>162</sup>
Sato A, <i>et al.</i>	Sudomotor/somatosensory/ANS	Neurosci Behav Physiol	1997 <sup>163</sup>
Sato A, <i>et al.</i>	Endocrine/somatosensory/ANS	Neurosci Behav Physiol	1997 <sup>164</sup>
Sato A, <i>et al.</i>	Immune/somatosensory/ANS	Neurosci Behav Physiol	1997 <sup>165</sup>
Schmidt RF	Articular Nociception/Health & Disease	Brain Res	1996 <sup>166</sup>
Sumiya E, <i>et al.</i>	Viscerosomatic inhibition	Jpn J Physiol	1997 <sup>167</sup>
Sun MK, <i>et al.</i>	Nociceptor input/CNS/Medulla	J Physiol	1991 <sup>168</sup>
Takahashi Y. <i>et al.</i>	Lumbar spinal reflex/lower abdomen	Spine	2000 <sup>169</sup>
Vaida JS.	Posture/sudomotor/sympathetic efferents	Indian J Physiol Pharm	1994 <sup>170</sup>
Wright HM, <i>et al.</i>	Segmental vasomotor variations	Fed Proc	1953 <sup>171</sup>
Wright HM, <i>et al.</i>	Vasomotor Disturbance	Acta Neuroveg	1960 <sup>172</sup>

lead to observed changes in circulating levels of various neuropeptides and regulatory proteins.”<sup>173</sup>

Studies of somato-autonomic function and dysfunction are steadily emerging with quality research which continues to be carried out. Chiropractic neurophysiologists in conjunction with medical neurophysiologists are conducting much of this. (Tables 1 & 2) Some authors may have a number of papers on a particular topic, a limited selection only was adopted in this paper.

While recognising that articular adjustments – a localised and specific form of SMT, do have potential for certain physiological effects, further substantiation of spinal manipulative influence upon visceral conditions is steadily emerging.<sup>174</sup> That is, initial clinical and anecdotal observations are being explored by more extensive and formal studies. A wider acceptance of such concepts has probably developed to the same stage as that of the evidential literature support for manipulative approaches to mechanical lumbar spine conditions of thirty to forty years ago, and now also adopted by other professions.

This growing volume of elucidating scientific research on spine-related neuro-autonomic conditions has been summarised by Slosberg when he reports:

“...that repetitive stimulation of small myelinated and unmyelinated somatic afferents can dramatically increase reflex pre- and post-ganglionic sympathetic discharge.” And notes further that “...electrically stimulated articular nerves from knee joints of anesthetized cats (led to) two sympathetic responses of different latencies in the inferior cardiac nerves resulting in increases of heart rate and blood pressure.” He states further that “...studies suggest that the alteration of afferent articular input due to joint dysfunction and nociception excitation, in conditions of noxious mechanical deformation or chemical irritation, may provoke significant changes in efferent and autonomic responses.”<sup>175</sup>

Much of this research is centred around major noxious stimulation of the autonomic nervous system from vertebrogenic (somato-autonomic) sources into the spinothalamic tract. Due to the integrative nature of the neuraxis, this is now known to fire into the tractus solitarius,



interomedial lateral cell column (IML) of the spinal cord, other spinal cord tracts, through the brain stem nuclei and into the cortical areas.<sup>72</sup> (Tables 1 & 2)

Edwards and colleagues suggest that "...the InM (*Intermedius Nucleus*) contains neurochemically diverse neurons and sends both excitatory and inhibitory projections to the NTS (*Nucleus Tractus Solitarii*). These data provide a novel pathway that may underlie possible reflex changes in autonomic variables after neck muscle spindle afferent activation." While somato-autonomic mechanisms are recognised, there is currently only limited evidence exploring the long-term neurological effects of more minor traumatic effects emanating from spinal structures under such adverse conditions.<sup>77</sup>

Jenkins further clarifies the concepts by stating that "The clinical state of neurogenic spinal radiculopathy accompanying nerve root spinal nerve, and dorsal root ganglion injury, may be associated with definite somatic and autonomic syndromes." He notes further that "The combined clinical complex includes "autonomic reflex dysfunction...and ..."generalized alterations in autonomic viscerosomatic tone."<sup>135</sup>

Medical texts vary in their depth of commitment to the concept of somatovisceral disorders. Bourdillon states tentatively that, "If autonomic reflex activity is accepted as a vehicle for many of the manifestations of joint and somatic dysfunction, then one can postulate that coronary vasospasm might be a result of somatic dysfunction and, if so, that it might respond to manual management."<sup>176</sup>

An interesting study by De Landsheere *et al* incorporating PET monitoring found that stimulating the spinal cord

(electrically), reduced exercise induced angina in patients, without conventional drugs or surgery. They found that the stimulation resulted in decreased ECG signs of myocardial ischemia, but not myocardial perfusion.<sup>177</sup>

It could be argued that if disturbances of the spine through such trauma as cervical whiplash (in its varying degrees), has recognisable neurological consequences, it is reasonable and possible to assume that normalising such a disturbed cervical spine should then also tend to ameliorate the neurological sequelae.

Whiplash injuries in particular can result in a number of neurological disturbances.(Table 3) In her text, Jackson mentions various autonomic symptoms which could result from disturbances to the cervical spine and cervical sympathetic supply.<sup>194</sup> They include:-

A sensation of exophthalmos	Blurring of vision	'Dazed and addled'
'Drop attacks'	Dysphagia	Nausea
Palpitations	Paresthesias	Tachycardia
Tinnitus	Vertigo	Vomiting
Weakness of extremities		

These citations provide evidence which tends to suggest that trauma of the cervical spine in particular, can have distinct neurological sequelae. It would seem logical that

TABLE 3

POSSIBLE CERVICOGENIC NEUROLOGICAL CONCOMMITANTS OF WHIPLASH			
Brown S.	Visual accommodation	Clin Experiment Ophthalmol	2003 <sup>178</sup>
Burke JP <i>et al.</i>	Visual system	Graefes Arch Clin Exp Ophth	1992 <sup>179</sup>
Chrisman OD, <i>et al.</i>	Otological	Clin Orthop Rel Res	1962 <sup>180</sup>
Croft AC.	Tissue injury/incl nerve	Text	2002 <sup>181</sup>
Foreman SM.	Nerve system trauma	Text	2002 <sup>182</sup>
Freeman MD, <i>et al.</i>	Whiplash associated disorders	Quebec Task Force	1998 <sup>183</sup>
Grimm DR <i>et al.</i>	ANS	JMPT	2005 <sup>20</sup>
Heikkilä H, <i>et al.</i>	Cervicocephalic kinästhesia	Scand J Rehabil Med	1996 <sup>184</sup>
Hinoki.	Vertigo	Acta Otolaryngol Suppl	1984 <sup>185</sup>
Johansson BH.	Multiple	Pain Res Manage	2006 <sup>186</sup>
Kivioja J, <i>et al.</i>	Immune response	Clin Immunol	2001 <sup>187</sup>
Mallinson AI, <i>et al.</i>	Dizziness c/f non-whiplash	Am J Otol	1998 <sup>188</sup>
May TS.	Headache	Am Acad Neurol	2007 <sup>189</sup>
Pang LQ	Otological	Laryngoscop	1971 <sup>190</sup>
Radanov BP, <i>et al.</i>	Cognitive deficits	Spine	1992 <sup>191</sup>
Roca PD.	Visual system	Annals Ophth	1972 <sup>192</sup>
Storaci R, <i>et al.</i>	Oculomotor	Eur Spine J	2006 <sup>193</sup>



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TABLE 4

**CHIROPRACTIC- RELATED RESEARCH PAPERS**  
**ASPECTS OF BIOCHEMISTRY AND PHYSIOLOGY**

Anaphylaxis <sup>200</sup>	Inflammatory cell changes <sup>215</sup>
ACTH <sup>201</sup>	Interleukin-2 <sup>219</sup>
β-endorphins <sup>201-204</sup>	Lectins <sup>220</sup>
Biophotons <sup>205</sup>	Helix pomatia agglutinin (HPA)
Blood pressure <sup>206-208</sup>	Phaseolus vulgaris leucoagglutinin (PHA-L)
Calcitonin <sup>202</sup>	Killer cells <sup>221,222</sup>
Catecholamine <sup>209</sup>	Lymphocytes <sup>223</sup>
CD 4 cells <sup>210</sup>	Macrophages <sup>224</sup>
Chemiluminescence <sup>211</sup>	Melanomas <sup>212</sup>
Conjunctival nevi <sup>212</sup>	Melatonin <sup>225</sup>
Cortisol <sup>201,213,214</sup>	Neuroimmunomodulation <sup>226</sup>
Endocrine <sup>215</sup>	Neutrophils <sup>211,227-229</sup>
Endotoxic shock <sup>200</sup>	Oxygen radicals <sup>224</sup>
Heart rate <sup>209</sup>	Phagocytosis <sup>227,230</sup>
Immune complex deposition <sup>216</sup>	Prostaglandin <sup>231,232</sup>
Immune response <sup>215,217</sup>	Respiratory burst <sup>228-230,233</sup>
Immunoglobulin M (IgM) <sup>218</sup>	Serum aldosterone <sup>234</sup>
Immunohistochemistry <sup>212</sup>	Substance P <sup>227,228</sup>
Immunoreactive ACTH <sup>201</sup>	Tumor necrosis factor <sup>228</sup>

This table demonstrate s the wider aspects of chiropractic research. (Note: Many of these studies concern an immunological response. More than one term may appear in a single paper. Papers are not necessarily related to spinal manipulation but more the broad nature of chiropractic research.)

mechanical amelioration of mechanical trauma as in cervical facet hypomobility, hypermobility and noxious sensory input from related soft tissue scarring and damage, as well as joint irritation and inflammation, may well ameliorate or alleviate at least some of the associated neurological sequelae. It would seem reasonable to extend these same principles to other levels of injury in the spine. It is reasoned here, that there are varying degrees of whiplash other than the more extreme forms of trauma, less severe mechanical insult or indeed irritation, particularly of a chronic nature which would also have neurologically noxious input, and may explain a number of different insidious signs, symptoms and conditions.

In an extensive study, Hinoko noted that whiplash disturbed ‘proprio-autonomic reflexes’, not only of the cervical sympathetic nerves, but also that of cervical and lumbar proprioceptors.<sup>195</sup> Others have also noted proprioceptive disturbance in the form of vertigo and head re-positioning aberrations following whiplash.<sup>184,196-197</sup>

Grimm and colleagues highlighted ‘interaction between cutaneous and vasomotor sympathetic neuron’ response to acute musculoskeletal injury.<sup>20</sup> They monitored “*cardiovascular modulation, baroreceptor sensitivity, sudomotor response (skin conduction) and peripheral skin temperature.*” Their findings were indicative of changes to somato-autonomic function.

The physiotherapy profession has more recently also become interested in the neurological aspects of manual therapy as a treatment of non-musculoskeletal conditions.<sup>198</sup> Grieve<sup>199</sup> acknowledges ‘autonomic nerve involvement’ in such signs and symptoms as:-

- |          |                   |                               |
|----------|-------------------|-------------------------------|
| Dyspnoea | Flushing          | Nausea                        |
| Pallor   | Pulse alterations | Reduced respiratory excursion |
| Sweating | Vomiting          |                               |

In considering neurospinal influence, it is worth noting the rather wide range of research papers which assess the chiropractic profession’s interest in biochemical markers as well as exploring connections between spinal manipulation and this measurable biochemistry. These have been monitored in a number of studies, many of which are related to the immune system. Nevertheless, they reflect rather dynamic interest in measurable biochemistry markers.(Table 4) Apart from the immunological interest in a number of these chiropractic papers,<sup>216,226</sup> a *neuroimmunological* relationship through the ANS has been recognised.<sup>127,146,165,187,235</sup>



Table 5

ANIMAL RESEARCH ON VISCERAL DYSFUNCTION, NEURAL DISTURBANCE AND THE VERTEBRAL SUBLUXATION		
AUTHOR(S)	RESEARCH/TITLE	JOURNAL/YEAR
Brennan P, Kokjohn K, Triano J, <i>et al.</i>	Immunological correlates Spinal mobility Model: Dog	Proceedings Intl Conference Spinal Manip. 1991 <sup>215</sup>
Bolton PS, Holland CT.	Vertebral displacement Model: Cat	Soc Neurosci Abstr. 1996 <sup>238</sup>
Bolton PS Holland CT.	Vertebral motion Model Cats	J Neuroscience Meth 1998 <sup>51</sup>
Bolton PS Budgell BS, Kimpton A.	Cervical vertebral movement Model Rats	Auton Neurosci 2006 <sup>47</sup>
Budgell BS, Hotta H, Sato A.	Reflex bladder motility Stimulation of interspinous tissue Model: Rat.	J Manipulative Physiol Ther 1998 <sup>60</sup>
Budgell BS, Sato A Suzuki A, Uchida S.	Adrenal function Stimulation interspinous tissues Model: Rat	Neurosci Res 1997 <sup>61</sup>
Budgell BS Bolton PS.	Cerebrospinal fluid pressure Model: Rat	J Manipulative Physiol Ther 2007 <sup>57</sup>
Burns L*, Chandler LC, Rice RW.	Pathogenesis of visceral disease VSC (vertebral lesions) Model: Rabbits	Am Osteop Assoc, (Pub) Text Chicago 1948. <sup>237</sup>
Cleveland CS.	Researching the VSC Model: Rabbit.	Sci Review Chiropr 1965 <sup>236</sup>
Crawford JP, Hickson G, Ward M.	Immune complex deposition Acute synovitis/knee Model: Rabbit	J Manipulative Physiol Ther 1986 <sup>216</sup>
DeBoer KF.	Gastrointestinal myoelectric activity VSC/vertebral lesions: Model: Rabbit	Europ J Chiropr 1984 <sup>239</sup>
DeBoer KF, Schultz M, McKnight ME.	Gastrointestinal myoelectric Spinal manipulation Model: Rabbits.	Man Med 1988 <sup>66</sup>
Deboer KF, Hansen J, Dhami M.	Interaction of oxygen radicals and macrophages/ gossypol injection for inflammatory response. Model: Rats, Hamsters	J Manipulative Physiol Ther (Abstract) 1990 <sup>224</sup>
Kaushal B Hayek R, Ali S, <i>et al.</i>	T1-T4 sensory afferents Model: Rats	Eur J Chiropr (Poster Prestn) 2002 <sup>81</sup>
Kurosawa M, Watanabe O. Maruyama H, Budgell B.	Dorsal spinal cord blood flow innocuous cutaneous stimulation Model: Rats	Auton Neurosci 2006 <sup>82</sup>
Sato A Swenson RS.	Sympathetic nervous system Spinal column stress Model: Rats	J Manipulative Physiol Ther 1984 <sup>88</sup>
Waddell SC, Davidson JS, <i>et al.</i>	Immune response/endotoxic shock Cervical sympathetic trunk Model: Rats	J Manipulative Physiol Ther 1992 <sup>200</sup>

This table reflects chiropractic researchers or animal research papers in chiropractic journals.  
(\*Dr Burns has published at length on her extensive research, particularly in the J Am Osteop Assoc and the AT Still Research Institute Bull, the most recent is circa 1953.)



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Some acknowledgement should also be placed on research into the effects of spine-related physiology, pathomechanics, and pathophysiology in an animal model. Two of the earliest studies on this topic were conducted by Cleveland (Circa 1965) and Burns et al in 1948.<sup>236,237</sup> More recent research by Brennan *et al* amongst others utilising mammalian subjects, has been particularly extensive.(Table 5)

Another paper of interest was that by Kimura and Sato entitled “Somatic regulation of autonomic functions in anaesthetised animals – neural mechanisms of physical therapy including acupuncture”, depicts extensive somato-autonomic circuits.<sup>138</sup>

A recent landmark study by Bakkum *et al.*, found that “preliminary data suggest that chronic vertebral hypomobility at L4-L6 in the rat affects synaptic density and morphology in the superficial dorsal horn of the L2 spinal cord level.”<sup>240</sup> This finding would fit within the chiropractic model of segmental fixation within the VSC.

Physical postural distortions, anomalies, and dysfunction of the spine have also been attributed to adverse influence on the function of visceral structures innervated from disturbed vertebral levels.(Table 6)

Over almost fifty years between 1905 and 1952, Goldthwaite and medical colleagues in particular, espoused the postural implications and complications of visceroptosis and vascular stasis associated with a wide range of visceral conditions. In their extensively referenced text Goldthwaite *et al.*, stated that “It is through this autonomic system that disturbances or improvements in visceral function are mediated by changes in the mechanics of the body.”<sup>245</sup> A number of mechanisms contribute to significant proprioceptive input, with direct structural influence through the centralised neural channels. This would suggest that a significant change in posture and postural mechanics may influence neuropathophysiology. Lennon *et al* summarise this aspect as follows:

*“Observations of the striking influence of postural mechanics on function and symptomatology have led to our hypothesis that posture affects and moderates every physiologic function from breathing to hormonal production. Spinal pain, headache, mood, blood pressure, pulse, and lung capacity are among the functions most easily influenced by posture.”*

*“The most significant influences of posture are upon respiration, oxygenation, and sympathetic function. Ultimately, it appears that homeostasis and autonomic regulation are intimately connected with posture.”*<sup>249</sup>

Table 6

**AFFECT OF POSTURAL ABBERATIONS ON THE ANS.**

Black FO <i>et al.</i>	1983	Vestibular <sup>241</sup>
Bouhuys A, <i>et al.</i>	1962	Gas distribution in lungs <sup>242</sup>
Bouhuys A.	1963	Asthma <sup>243</sup>
Gagey BP, <i>et al.</i>	1996	Body axis <sup>244</sup>
Goldthwait JE, <i>et al.</i>	1952	Multi (Text) <sup>245</sup>
Gökpinar E, <i>et al.</i>	1998	Non-toxic goitre <sup>246</sup>
Gooch AS, <i>et al</i>	1967	Cardiac/Posture <sup>247</sup>
Grubb BP, <i>et al.</i>	2006	Tachycardia <sup>41</sup>
Kado DM, <i>et al.</i>	2004	Geriatric mortality <sup>248</sup>
Korr IM.	1949	Sudomotor <sup>100</sup>
Lennon J, <i>et al.</i>	1994	Multi <sup>249</sup>
Lewit K.	1980	Respiration <sup>250</sup>
Martin-Du Pan RC, <i>et al.</i>	2004	Multi <sup>251</sup>
Schey WL.	1976	Multi <sup>252</sup>
Storaci R, <i>et al.</i>	2006	Oculomotor dysfunction <sup>193</sup>
Ussher NT.	1933	Multi <sup>253</sup>
Ussher NT.	1940	Multi <sup>254</sup>
Vaida JS, <i>et al.</i>	1994	Sudomotor <sup>170</sup>
Watanabe N, <i>et al.</i>	2007	Autonomic regulation/cardiovascular <sup>94</sup>
Watson DH, <i>et al.</i>	1993	Cervicogenic headaches/muscles <sup>255</sup>
Wright HM, <i>et al.</i>	1966	Skin temperature <sup>256</sup>
Wyke BD.	1979	Senile disequilibrium <sup>257</sup>



Table7

VASOMOTOR RESPONSE TO SPINE-RELATED ABBERATIONS		
AUTHOR	YEAR	JOURNAL
Adachi T, <i>et al.</i>	1990	Neuro Report <sup>112</sup>
Appenzeller O, <i>et al.</i>	1965	J Neurol Neurosurg Psychiatr <sup>250</sup>
Figar S, <i>et al.</i>	1967	Acta Neuroveg <sup>251</sup>
Figar S, <i>et al.</i>	1967	Acta Univ Carolinae <sup>252</sup>
Figar S, <i>et al.</i>	1965	Acta Univ Carolinae <sup>253</sup>
Giles LGF.	2000	JMPT <sup>76</sup>
Gongal'skii VV, <i>et al.</i>	1992	Neirofiziologija (Ukraine) <sup>254</sup>
Grimm DR <i>et al.</i>	2005	JMPT <sup>20</sup>
Hotta H, Nishijo K, <i>et al.</i>	1991	Neurosci Lett <sup>133</sup>
Knutson GA.	2001	JMPT <sup>255</sup>
Kurosawa M, <i>et al.</i>	2006	Auton Neurosci <sup>82</sup>
Mc Knight ME, DeBoer KF.	1988	JMPT <sup>256</sup>
Passatore M, <i>et al.</i>	1996	Acta Neurobiol Exp <sup>257</sup>
Potts JT.	2002	Clin Exp Pharmacol Physiol <sup>258</sup>
Potts JT, Paton JF, Mitchell JH, <i>et al.</i>	2003	Neurosci <sup>259</sup>
Potts JT, Spyer KM, Paton JFR.	2000	Brain Res Bull <sup>260</sup>
Sato A, Sato Y, Schmidt PE.	1997	Rev Physiol Biochem Pharm <sup>261</sup>
Shortt TL, Ray CA.	1997	Am J Physiol <sup>262</sup>
Sun MK, Spyer KM.	1991	J Physiol <sup>168</sup>
Wright HM.	1956	J Am Osteop Assoc <sup>106</sup>
Wright HM, <i>et al.</i>	1960	Acta Neuroveg <sup>171</sup>

In addition, cutaneous and vasomotor autonomic reflexes can provide further examples of spine-related somato-autonomic activity.(Table 7)

Wilson noted that “static contraction of skeletal muscle activates small-diameter afferent nerve fibres which evoke a reflex increase in sympathetic nerve activity and cardiovascular function.” They cite others as making the same observation.<sup>271</sup>

As highlighted by D’Aubigne in the preface to Kapandji’s text (and in the text’s title), is the term central to this subject - the term ‘physiology of a joint’. It comprises not only the cell physiology of all associated articular tissue, but also the biomechanical aspects of normal articular movements – joint physiology, structures and function.<sup>272</sup> Physiology can be defined as the “*a branch of biology that deals with the functions and activities of life or of living matter (as organs, tissues, or cells) and of the physical and chemical phenomena involved.*” Pathophysiology of a joint then is some abnormality of the function of associated tissues, including especially neural tissues and articular mechanics – a *derangement of function* or “*the physiology of abnormal states; specifically : the functional changes that accompany a particular syndrome or disease.*”<sup>273</sup>

Whatmore and Kohli define the term dysponesis and that “*most diseases consist of physiologic reactions that lead to organic dysfunction. These physiologic reactions constitute the response of the organism to some noxious agent, whether microbial, chemical, or mechanical.*”<sup>274</sup>

In another component of the subluxation complex (myopathology or myopathophysiology), Edwards *et al* proposed that autonomic variables can be influenced by afferent muscle spindle activation, particularly from the posterior muscles of the neck. Further, that cardiorespiratory variables rely on interaction between the somatic and autonomic systems, essentially somato-sympathetic reflexes.<sup>70</sup>

Hyingstrom *et al*, found further that “intrinsic electrical properties of spinal motoneurons vary with joint angle(s)...” and that “*dendrites of spinal motoneurons amplify inputs to a marked degree through persistent inward currents (PICs)...(where) dendritic amplification is subject to neuromodulatory control from the brainstem.*”<sup>134</sup>

It is submitted that if autonomic influence can be so readily disturbed locally, it would seem reasonable that associated visceral function could also be influenced, and that the material presented would tend to support that hypothesis. Inasmuch



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as the correction (vertebral adjustment) of a physically and physiologically disturbed spinal element (a VSC) may provide an acknowledged physiological mechanism to ameliorate or normalise the connected autonomic disturbance and linked organic dysfunction, that hypothesis could then be reasonably supported.

### DISCUSSION

*"The autonomic nervous system is intimately responsive to changes in the somatic activities of the body and while its connections with the somatic elements are not always clear in anatomical terms, the physiological evidence of visceral reflex activities stimulated by somatic events is abundant."*<sup>275</sup>

Central to this discussion is the fact that the autonomic nervous system "is a visceral and largely involuntary sensory and motor system (where) virtually all visceral reflexes are mediated by local circuits in the brain stem or spinal cord"<sup>276</sup> As stated, much of this activity is interceded through the spinal cord neurologically and the intervertebral foramina anatomically. If it is accepted that the ANS effectively influences all functions in the body, then there are six key elements to be addressed on this topic of external manual influence and spine-related pathophysiology. They are:-

1. Neural dysfunction. Whether within the vertebral subluxation complex (segmental dysfunction) there can be influence, irritation, interference or modulation (stimulation or inhibition) with afferent and/or efferent neural transmission - Dorlands Dictionary defines such a role as reflexogenic - *producing or increasing reflex action.*<sup>277</sup>
2. Organic dysfunction. Whether any resultant altered neural transmission can adversely alter or influence innervated structural or organic physiology;
3. The *degree* to which any neural-induced pathophysiology of viscera may take place;
4. Neural Pathophysiology. Whether subsequent manual spinal adjustment (SMT) can positively influence neuropathophysiology of neural dysfunction;
5. Organic pathophysiology. Whether manual adjustment may influence the innervated visceral dysfunction or other structures by that positive influence, and if so;
6. How that influence may be monitored and modified to best effect for a particular patient's response.

It is submitted that if a spinal, or indeed a peripheral articular adjustment does not affect, influence or have input upon the nervous system in any way, then effectively, manual manipulative therapy professions would not have a *raison d'être* in advancing such a neurospinal model. The reduction by articular adjustment of a bombardment of noxious neural stimuli from aberrant articular or associated soft tissue nociceptive<sup>152,166,270,278</sup> input, could be deemed an example of a positive influence. Clinical examples would be in the cases of resolution of the vascular component of cervicogenic headaches,<sup>65</sup> or the positive influence upon a dysfunctional lumbar spinal segment associated with PMT or dysmenorrhea.

- conditions that are a dysfunction (pathophysiological) rather than pathological.<sup>279,280</sup>

If neural disturbance (Table 8) via hyperstimulation, suppression, or irritation is present within a subluxation complex, and deliberate neutralisation or normalisation of such aberrations through a vertebral segmental adjustment takes place, then the vertebral adjustment would be deemed to have had a positive neural influence. The differentiation and degree of a VSC affecting a somatic-somatic or a somatovisceral reflex (or both at once), must be the subject of interesting future research.

Another area of research interest could involve differentiating the variation in biological response to the VSC. For example, one response might be somato-somatic and another somato-visceral, even though by definition both would have a segmental neurological factor at the same vertebral level. A more specific example would be why a C1/C2 VSC in one patient produces headaches, in another migraines, and in yet another, no headache at all - just localised facet or muscle pain.

Extensive research currently being undertaken by the chiropractic neuroscientist Bolton et al, seems to corroborate the hypothesis of definitive compromise of neural physiology due to articular facet disturbance.<sup>282,283</sup> Their research involves complex neurological aspects of both the VSC and the vertebral adjustment.

In relation to other spinal levels, there are a number of symptoms which can reflect spine-related neurological involvement.<sup>284</sup> Common examples would include pain as in vertebrogenic sciatica and brachial plexus neuropathy.<sup>285,286</sup> Symptomatically, these conditions may be associated with various other neural symptoms including paresthesias, formication, muscle weakness, hyporeflexia, hyperalgesia and hypalgesia, through to muscle atrophy and trophic changes.<sup>287</sup> In osteopathic research, Karason and Drysdale demonstrate a somatovisceral reflex involving increased cutaneous circulation at the L5/S1 level, following administration of spinal adjustments (high-velocity low-amplitude - HVLA). These were conducted 'outside the region of the sympathetic outflow.'<sup>288</sup>

Further examples would be spinogenic dyspepsia.<sup>289-292</sup> Another could be the ciliospinal reflex, which incorporates both elements of a transient basic somatovisceral reflex. Chusid and McDonald classify the ciliospinal reflex as a visceral reflex. They also note that in the presence of Horner's Syndrome which involves the T1 and T2 sympathetic segment, the ciliospinal reflex is lost.<sup>293</sup>

It may be a rudimentary example, but if it is noted that just a sharp stimulating slap on the back can affect neural activity (nociceptive, mechanoceptive) and invoke sympathetic responses such as pupillary dilation, increased pulse rate and adrenal secretion, then a somato-autonomic neural mechanism would be demonstrated. If that slap on the back can produce a generalised somato-autonomic response, then a controlled, specific, neuromechanical stimulation via a specific vertebral adjustment to a mechanically disturbed spinal segment may have the potential towards a more



localised and predictable physiological response. It is noted that other factors such as psychological aspects, may also be involved in this example.

Physical therapy techniques including exercises, and at times manual manipulative musculoskeletal techniques, have also been employed in the management of a variety of visceral conditions involving the sympathetic nervous system. These include respiratory and cardiovascular rehabilitation.<sup>294</sup>

Recognition of the existence of neural and visceral pathophysiology or physiological dysfunction are central to this model. While consideration is given to the possibility of vertebrogenic visceral dysfunction and vertebrogenic visceral symptoms, the advent of actual vertebrogenic visceral pathology needs additional research. The possibility of simulated symptoms of visceral conditions has been discussed elsewhere.<sup>295</sup>

Even with a diagnosis of a *simulated* organic condition, the patient's complaint is likely to be present in a symptomatic form. Unless the symptom is recognised as *simulation*, then previous diagnoses, treatments, or medication are likely to be based on those symptoms and not necessarily directed at the condition itself. That is, a treatment may well have been based in error on an actual organic condition, but one that is only simulated. One wonders if this could be a potential shortcoming in some Cochrane Collaboration studies, which appear to be based on the assumption of an accurate diagnosis in the first place - followed by treatment based on that diagnosis.

On the other hand there is a need for much more fundamental research to fully substantiate the spinovisceral role, even though reasonable evidence does exist. Conversely, there is a far greater paucity of evidence which would *contradict* claims by patients that they subjectively experience benefit from SMT. There seems to be a notable lack of double-blind controlled studies which *negate* positive claims regarding autonomic symptoms by patients under chiropractic care. Indeed, to justify the more recent adoption by *manipulative medicine* and *manipulative physiotherapy* of manual spinal therapy in relation to musculoskeletal conditions, there would appear to be a lack of evidential studies which provide the legitimacy for and justification of that involvement.

A connection has been discussed between mechanical spinal disturbance and resultant influence upon autonomic function.<sup>13</sup> This has been further depicted by way of highlighting sensory and mechanical disturbance from lumbar and cervical spinal facet changes (Table 1), and from whiplash (Table 3). It is also seen neurologically through the autonomic symptoms associated with migraine and other headaches,<sup>296-298</sup> and pain. (Table 9)<sup>399-410</sup> There does however seem to be only limited research into the ANS effects from the varying durations and severities of more minor chronic pain situations. Although Johnston<sup>38,39</sup> and Bannister<sup>31</sup> have discussed the finding that autonomic function, autonomic dysfunction and degrees of autonomic failure can be of varying degrees of severity. Carrick has shown that specific influence on cervical spinal structures has led to a reasonable hypothesis regarding spinal influence upon brain function, as monitored by blind-spot mapping.<sup>8</sup> Disturbance of specific aspects of the extensive autonomic network may also explain

some visceral symptoms and pathophysiological conditions of organic dysfunction as listed in this paper.

## SUMMARY

*"Health practices such as acupuncture and spinal manipulation frequently employ stimulation of somatic tissues in the treatment of visceral symptomatology. The efficacy of these practices may well be based in somato-autonomic reflexes. An understanding of how afferent input modulates autonomic function, therefore, has considerable meaning beyond its academic interest."*<sup>14</sup>

Traditionally, medical interest in neural function in man has been centred on the more serious expressions of ANS dysfunction.<sup>31,311</sup> However it is in relation to the more subtle signs and symptoms which this paper sought to illustrate – and especially, to look at the *neurospinal* connections – even in infants.<sup>312</sup>

It is a stimulating chore to attempt to differentiate between the papers mentioned. The cited extensive writings in the referenced literature by Bolton, Brennan, Budgell, Burns, Carrick, Pickar, Korr, Patterson, Swenson and particularly Sato *et al.*, do provide a deeper awareness and appreciation of neuro-vertebral concepts. Their contribution has been significant in providing greater insight into the wide influence of disturbed somato-autonomic-visceral reflexes.

Based on the indications presented, it would be fair to suggest that to date, the neurological implications of SMT may be more intricate, extensive and sophisticated than even DD Palmer may have believed.<sup>313</sup> However, more research is required for further understanding and to elucidate the complex of neurovisceral-pathophysiological phenomena. It is hoped that true scientists would thoroughly consider all material before drawing conclusions on the role of chiropractic in this somato-autonomic area.

As indicated, basic scientific evidence does exist in support of a spine related influence upon the ANS. It suggests distinctly possible vertebrogenic factors in affecting such autonomic activity in the disturbance of some forms of heart rate, blood pressure and neural activity in renal, adrenal and gastrointestinal function. The potential for a possible physical, as opposed to a chemical form of intervention, is exciting. Given the volume, variety and indeed depth of the material mentioned here, one could be regarded as ultra-conservative if one concluded meekly that there does appear to be at least some potential in support of an hypothesis of spine-related neuro-autonomic pathophysiological dysfunction. Sato *et al* stated that *"...the decreases in blood pressure and renal nerve activity during manipulation of the spine are thought to be supraspinal reflexes."*<sup>314</sup>

## CONCLUSION

*"In contrast to the impressive body of knowledge concerning the effects of visceral afferent activity on autonomic functions, there is, generally speaking, much less information available on the reflex regulation of visceral organs by somatic afferent activity from skin, the skeletal muscle and their tendons, and from joints and other deep tissues. The elucidation of the neural mechanisms of somatically induced autonomic reflex responses, usually called somato-autonomic reflexes, is, however, essential to*



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Table 8

SPINE-RELATED MODULATION OF THE ANS EXCITATORY &/or INHIBITORY		
Budgell B, Sato A.	Modulation	1996 <sup>14</sup>
Dhami MSI, Coyle BA.	Stimulatory	1986 <sup>225</sup>
Dishman JD, Ball KA, Burke J.	Excitatory	2002 <sup>99</sup>
Edwards IJ, Dallas ML, Poole SL, <i>et al.</i>	Excitatory & Inhibitory	2007 <sup>70</sup>
Fidelbus J.	Somatosympathetic reflexes	1989 <sup>226</sup>
Fujimoto T, <i>et al.</i>	Stimulatory	1999 <sup>72</sup>
Fujino M, <i>et al.</i>	Stimulatory	1987 <sup>128</sup>
Haavik-Taylor H, Murphy B.	Inhibitory	2007 <sup>19</sup>
Hinoki M.	Excitatory	1984 <sup>185</sup>
Hyingstrom AS, Johnson, <i>et al.</i>	Excitatory/Amplification	2007 <sup>134</sup>
Kirchner F, Kirchner D, Polosa C.	Inhibitory	1975 <sup>140</sup>
Lennon J, <i>et al.</i>	Modulation	1994 <sup>249</sup>
Ohtori S, <i>et al.</i>	Stimulatory	2000 <sup>150</sup>
Pickar JG.	Excitatory & Inhibitory	2000 <sup>281</sup>
Sato A.	Excitatory	1987 <sup>157</sup>
Sato A, Schmidt RF.	Modulation	1987 <sup>158</sup>
Sato A, Sato Y, Schmidt RF.	Excitatory & Inhibitory	1987 <sup>16</sup>
Sato A.	Excitatory	1997 <sup>159</sup>

*developing a truly scientific understanding of the mechanisms underlying most forms of physical therapy, including spinal manipulation and traditional as well as modern forms of acupuncture and moxibustion.” – Sato A et al<sup>315</sup>*

In essence, this has been an attempt to highlight the published literature surrounding the hypotheses appropriate to the manual manipulative therapies in general, and the science of chiropractic in particular. It draws connections between the effect upon the autonomic nervous system due to pain, postural disturbance, and the mechanical disruption of trauma, with whiplash being the most easily demonstrated. There are indications in some of the references that trauma does not have to be extreme to produce such symptoms. It has attempted further, to look at the reflexogenic effects of factors affecting the ANS. It then follows the next association - that of the effect of ANS irritation upon the physiology of structures innervated by an ANS modified by such changes, especially those regarded as spine-related.

It would seem reasonable to hypothesise that if disturbance or mechanical insult to the spine can lead to ANS-related dysfunction or symptoms, then alleviation of that disturbance or insult should also tend to ameliorate those same symptoms, and thereby encourage disturbed physiology in involved structures to return towards normal function.

The volume and variety of evidence presented in this cursory overview, would tend to suggest there should be open mindedness when considering the possibilities of manual management of a number of somatovisceral conditions. An attitude of outright rejection may tend to limit chiropractic

within a musculoskeletal field. This could deny science a whole area of opportunity, and deprive certain patients of options for a potential source of minimally invasive natural health management. Once all the available evidence is considered, and further research has had the opportunity to explain the clinically observed phenomenon of positive outcomes, proper assessment can then take place. Despite the material presented here, one is still reticent in making broad claims.

To consider the historical base for chiropractic, without the vital inherent correlations with the nervous system, is essentially to not fully appreciate chiropractic as it was originally intended - and where it is currently pioneering this natural model of health care.

Co-operation between the health professions, together with a serious, constructive and unbiased research effort into this topic, would raise the potential for a more effective, non-invasive means of influencing internal physiology and potentially, pathophysiology.

It would seem appropriate to be able to influence the nervous system and physiological dysfunction through the least invasive intervention possible and through readily accessible neural procedures. If that potential is through SMT, then it behoves the scientific community to explore that potential and develop it to its extreme. Rejecting the concept without thorough investigation is unscientific and close-minded.

While much research is currently underway, many areas remain to be explored in order to further develop the somato-



Table 9

PAIN AND THE ANS		
Benarroch EE.	Pain /ANS	2001 <sup>299</sup>
Cortelli P Pierangeli G.	Chronic pain/ANS	2003 <sup>300</sup>
Cramer GD, Darby SA.	Spinogenic pain	1995 <sup>301</sup>
Grod JP, Diakow PR.	Neck pain/proprioception	2002 <sup>302</sup>
Jönig W.	Sympthetic NS/Pain	2006 <sup>303</sup>
LeBoeuf-Yde C, <i>et al.</i>	Low back pain/Health	2003 <sup>304</sup>
Michaelis M, Janig W.	Sympathetic NS/Pain	1998 <sup>305</sup>
Nathan PW.	Sympathetic NS/Pain	1988 <sup>306</sup>
Passatore M, <i>et al.</i>	Sympathetic NS/Pain	2004 <sup>307</sup>
Rix GD, Bagust J.	Proprioception/headache/neck pain	2001 <sup>308</sup>
Sato A, Sato Y, Schmidt RF.	Somatic nociception	1997 <sup>309</sup>
Sterling M, Jull G, Wright A.	Sympathetic NS/Cervical pain	2001 <sup>310</sup>

autonomic-visceral hypothesis. To this author, the weight of the evidence so far is such that a significant neurospinal connection cannot be ignored or discounted. Beyond the basic neurophysiological research, the positive clinical indications so far suggest quite inspiring promise.

*“The human nervous system is the most complex physical system known to mankind: it consists of many billions of interactive units whose constantly changing patterns of activity are **reflected in every aspect** of human behaviour and experience.” Gray’s Anatomy <sup>316</sup>*



## References to Dr Peter Rome's

### NEUROVERTEBRAL INFLUENCE UPON THE AUTONOMIC NERVOUS SYSTEM: SOME OF THE SOMATO-AUTONOMIC EVIDENCE TO DATE -

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## **Learning ability restored in pediatric patient following co-managed chiropractic care: a case report.**

Richard White, DC

### **Introduction:**

Learning disabilities occur in about 5% of school-aged children, have life-long implications, and depend on such factors as age, medical history, family history, and intelligence quotient. “Many children who have learning problems can be classified into one of two major categories: the dyslexia group or the nonverbal learning disability group <sup>1</sup>.” Through emotional damage and strains at school and work, learning disabilities take a toll on the families of those affected, and their communities as a whole <sup>1</sup>.

Currently, long term care for learning disabilities is limited to a small number of prescription drugs. There is often no plan to get patients off their drug interventions, so it is considered a life long illness, leaving those suffering with learning disabilities little hope for long term improvement <sup>2</sup>. The drugs prescribed to manage learning disabilities have many adverse side effects, and eventually cause dependency <sup>3,4</sup>. As general (allopathic) practitioners tend to agree that it is not their role to deal with developmental disorders <sup>5</sup>, chiropractors may be able to play a part offering this underserved group of patients a low risk option, particularly with the subset of children with “minor neurological dysfunction <sup>6</sup>”.

The purpose of this paper is to investigate how chiropractic care may have played a part in facilitating improved neurological development and improving a patient’s learning capability. The paper also presents how chiropractors could play a part within an interdisciplinary care arena treating children with learning disabilities by collaboration with mental healthcare professionals.

### **Case Report:**

**Patient History:** A six-year-old female patient presented to the chiropractor’s office through referral by her neurodevelopmental therapist. The therapist refers her patients to this particular chiropractor, because she has found that, the type of chiropractic care practiced, sacro occipital technique (SOT) <sup>18,19</sup>, has consistently been found to help her patients with learning disabilities. The patient’s two siblings with developmental issues were also successfully seen previously by the neurodevelopment therapist. She referred the siblings to the same chiropractor for SOT care and they both had successful outcomes to chiropractic care and the therapist’s instruction. This patient presented with complete inability to remember numbers or letters, and had very little memories from day to day. She was left hand dominant or predominately used her left hand for function when referred to the chiropractor’s office.

### **Methods/Intervention:**

Chiropractic exam utilizing SOT methodologies revealed palpatory fixations at occiput and sacrum. The SOT analysis noted a category one (pelvic torsion with sacroiliac joint fixations and

reduced sacral nutation) with most specifically a sacral malposition listed as apex right and a rotational occipital dysfunction. The patient was treated with SOT category one protocols, until the indicators were cleared <sup>20</sup>.

The chiropractic intervention included an adjustment to correct a sacral apex right subluxation while simultaneously holding the occiput into the corrected position. The patient was only seen for only one treatment by the chiropractor. After the adjustment, the patient was referred back to her neurodevelopment therapy and began care, which included intense math and reading exercises. The neurodevelopmental therapist typically referred challenging cases, such as in this case, for chiropractic care prior to instituting her instruction methods.

### **Results:**

After the chiropractic office visit the patient appeared to have a change in hand dominance or preference that persisted and appeared to coincide with improved cognitive functioning, as noted by her parents and neurodevelopment therapist. The increase in cognitive function seemed to help the child work with the neurodevelopmental therapist's and perform the cognitive exercises. Significant differences were noted by the parents, in the child's ability to being able to remember letters or words and cooperate with the therapist, which the parents attributed to the chiropractic treatment. Within one month of the chiropractic treatment and instituting neurodevelopmental therapy the patient was reading chapter books by herself and within six months, she was actively reading and singing hymns. At the writing of this paper it has been three years since the one chiropractic adjustment and the patient's family has not seen the need to return for care. The family spoke highly of what care they did receive, attributing it to helping with their child's progress. To date, the patient continues to improve in her scholastic activities at a rate similar to other children. She is no longer under the care of the neurodevelopment therapist.

### **Discussion:**

There has been an emerging evidence base of information suggesting that chiropractic may help patients with learning or developmental difficulties can have favorable outcomes <sup>7-17</sup>. These studies often suggest that the relationship between the spine, cranium and nervous system plays an integral part in neurological development and therefore in a subset of patients affects their cognitive functions. Therefore developmental delays or compromised development may associated with patients presenting with learning disabilities, dyslexia, dyspraxia, and other related conditions.

Interdisciplinary relationships involving chiropractic care for patients with various presentations may offer better patient outcomes. Certain groups within chiropractic, in this case SOT practitioners, are already looking for ways to co-manage complex cases with other professions such as with cardiologists <sup>21</sup>, gastrointestinal specialists <sup>22</sup>, acupuncturists <sup>23,24</sup>, oral myofunctional therapists <sup>25</sup>, veterinarians <sup>26,27</sup>, oncologists <sup>28</sup>, dentists <sup>29-31</sup>, Alexander Technique Instructors <sup>32</sup>, and Tomatis auditory therapists <sup>33</sup>. There are also studies, specifically related to SOT care, investigating this care to help patients with developmental delays <sup>7,34,35</sup>.



SOT was developed by M.B. DeJarnette, DO, DC, an engineer, osteopath and chiropractor. DeJarnette attempted to give chiropractors a method of generalizing patient presentations so that methods of analysis, intervention, and outcome to treatment could be assessed and measured. To do this he used his knowledge of engineering, chiropractic and osteopathy to integrate an anatomical physiological based method of analysis and treatment.

He investigated how sustained stressors to the body created distinct retained patterns of distortion in the neuromusculoskeletal system. He ultimately used his experiences to develop methods of categorizing three specific primary body distortion patterns. DeJarnette's concepts led to the development of three specific categories of analysis:

Category One: relates to pelvic torsion, anterior sacroiliac joint fixation affecting sacral nutation and its relationship to dural tension and CSF circulation.

Category Two: relates to pelvic torsion and the posterior sacroiliac joint instability or hypermobility, with related musculoskeletal and whole body kinematic compensations.

Category Three: relates to the body's adaptation to the inability to distribute weight through the posterior sacroiliac joint with subsequent transmission to the lumbar discs and spine, commonly associated with associated sciatica and piriformis muscle syndromes<sup>18-20</sup>.

The patient presented with both cranial and sacral fixations, which through SOT assessments suggested that she fit within SOT's category one criterion. There are many symptoms and conditions related to category one patients in general, but this patient's specific presentation appeared relating to a delayed developmental syndrome and related learning disabilities. The SOT care offered the patient consisted of sacral and occipital adjustments, believed to aid balancing dural tensions and facilitating CSF circulation<sup>36,37</sup> within the craniosacral subarachnoid spaces and central canal due to improved sacral nutation.

What is particularly interesting is how is it possible that this one treatment might have had an affect on hand dominance or preference and how could this have any relationship to cognitive functioning or learning disabilities? A functional MRI study by Meier et al<sup>38</sup> investigated the effect of posterior to anterior (P/A) pressure to the lumbar spine and its affect on cortical activity. They found that "stimulation of the lumbar spinous processes revealed bilateral neural responses in medial parts of the postcentral gyrus (S1). Additional activity was observed in the secondary somatosensory cortex (S2), posterior parts of the insular cortex, different parts of the cingulate cortex, and the cerebellum<sup>38</sup>." While they concluded that using functional MRI they were able to view cortical activity due to pressures to lumbar spine to monitor "neuroplastic changes in chronic low back pain subjects<sup>38</sup>," it does illustrate that a contact to the sacrum might also likely have distal cortical effects.

The hand dominance or preference change is hard to explain as a placebo or ideomotor effect, but what is further difficult to understand is why this might have a relationship to the patient's cognitive function as witnessed by her parents. We do know that there is a variation between

hand dominant and non-dominant sides and motor unit firing delays<sup>39</sup>. Also an “association between hand dominance and the common drive of motor unit firing rates lends credence to the idea that one or more CNS sites may influence conjoint motor unit firing behavior<sup>40</sup>.” This suggests a cortical relationship between hand dominance and there is “evidence for differences in neuronal processing between the dominant and nondominant hemispheres in motor control<sup>41</sup>.” If this patient did have developmental delays causing modified hand preference it is possible, if this neurological patterning was improved following the chiropractic intervention, it may have led to improved cortical function and processing.

In a case study by Lovett and Blum they described an 8-year-old male patient who presented with learning disabilities that appeared following a fall from a “swing” on a playground. Following the fall a change in handwriting as well as academic performance was noted. The child was treated for a SOT category two (pelvic torsion with sacroiliac joint hypermobility syndrome) and cervical spine related discomfort. The patient was seen for two months at weekly intervals and a relationship seem to appear between improvement in category two findings and his improved handwriting and academic performance<sup>36</sup>.

Silver discussed the uses of controversial therapies for treating “children with learning disabilities, attention deficit hyperactivity disorder, and other neurologic disorders<sup>42</sup>.” He noted that at this time “we do not understand these relationships and there are no known treatments based on these relationships that have been shown to be clinically successful<sup>42</sup>.” Therefore while chiropractors need to educate parents about the risks and benefits of the various interventions suggested for their child’s learning disability, “parents need to ask themselves why this amazing approach is not used by everyone, and feel free to ask to see the data supporting the concept and the treatment<sup>42</sup>.”

Chiropractors need to be both responsible practitioners and knowledgeable educators so they can be able to communicate to parents how care for their child with learning disabilities or developmental delays may benefit from care. However since there is no specific explanation for how chiropractic can help with the treatment of learning disabilities, it may be necessary to focus on chiropractic care’s low risk and the evolving evidence base of literature that discusses chiropractic’s success treating children with learning disabilities and other related conditions. With complex cases it is likely that interdisciplinary care<sup>43</sup>, integrating chiropractic and neurodevelopment therapy, may represent an important low risk strategy for treating children with learning disabilities.

It is possible that the chiropractic treatment affected cortical functioning or positively affected the pelvic and upper cervical spine function which had a cascade affect helping to the child’s neurological processing and development. Along with the care offered by the neurodevelopmental therapist, that aided reading, writing, and numerical recognition<sup>44</sup> a significant change was noted by the parents and teachers as the child’s reached milestones such as reading chapter books and being able to read and sing from hymn books.



## **Limitations**

As with any case studies there are multiple limitations associated with lack of a control, inability to rule out placebo or ideomotor effects, and coincidental improvement of function not necessarily related to the chiropractic intervention. It is unclear if the child would have improved without the neurodevelopmental therapist's care or if the child would likewise have improved without the chiropractic care. Using parents to discern whether their child improved following an intervention or not, is not an infallible process.

The above factors all confound the outcomes of this case and make it difficult to attribute results to the child's improved function to normal development independent of care or to the chiropractic intervention or the neurodevelopment therapy conjointly or separately. Since from the parents' perspective the child had a good outcome to the combined chiropractic and neurodevelopmental therapist's care they decided to not bring their child back for chiropractic care. This also limits the information on this case and ability to discern whether the sacrum and occiput sustained their position and function or whether her improvement was sustained independent of sacral and occipital position or function. However, from a temporal perspective, the child's unresponsiveness to interventions prior to chiropractic care and her change in hand preference and improved cognitive function following care, suggests that the chiropractic care may have had a therapeutic effect.

## **Conclusion:**

The patient's response to chiropractic care and neurodevelopmental therapy suggests that this type of interdisciplinary care warrants greater study. However the limitations of case report suggest that further research, specifically a comparative study of patients with learning disabilities, is needed to explore the relationship between chiropractic care and learning disabilities. A comparative study could utilize four groups, with one group under only SOT chiropractic care, one group only under neurodevelopmental therapy, one group under no care, and one group under co-managed care. This type of study could help us better understand how chiropractic care can be integrated with mental health professionals and could help to delineate the relationships in types of care and the importance of co-management.

## **Acknowledgements:**

It is with great appreciation that I wish to thank and acknowledge the sharing of this case study by Jerry I. Hochman, DC, FICS for the basis of this case report. Without his willingness to help and support this project by sharing the necessary data this study could not have been written.

I wish to also thank Charles L. Blum, DC who helped review this manuscript, offered clarity and explanations about sacro occipital technique, and aided me in my goal of sharing this data in an professional evidence based manner.

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# SACRO OCCIPITAL TECHNIQUE

## RESEARCH UPDATES

*Fourth Edition*

By Charles L. Blum, DC



**T**HIS IS THE FOURTH IN A SERIES OF ARTICLES THAT WILL SHARE VARIOUS CONCEPTS OF RESEARCH WITH DOCTORS IN CLINICAL PRACTICE. THIS ONE RELATES TO CHIROPRACTIC CARE OF NONMUSCULOSKELETAL CONDITIONS. TO BETTER UNDERSTAND THE NATURE OF CHIROPRACTIC CARE FOR NONMUSCULOSKELETAL CONDITIONS, IT IS IMPORTANT TO BECOME FAMILIAR WITH THE CONCEPT OF “RISK BENEFIT RATIOS” AND HOW VISCEROSOMATIC AND SOMATOVISCERAL INTERACTIONS TEND TO BE COMPLEX AND NONDISCRETE. THE LACK OF A CLEAR UNDERSTANDING OF HOW CHIROPRACTIC CARE AFFECTS NONMUSCULOSKELETAL CONDITIONS IS A CHALLENGE OUR PROFESSION WILL NEED TO OVERCOME<sup>1-5</sup>.

The chiropractic profession has been attempting to study which subset of patients with nonmusculoskeletal conditions might respond to chiropractic care. While there is a paucity of published literature relating to the chiropractic treatment of nonmusculoskeletal conditions<sup>6</sup>, our colleges still seem to find that both student interns<sup>7</sup> and clinicians<sup>8</sup> have an interest in the treatment of these visceral related conditions.

Nonmusculoskeletal conditions may be affected by visceral related referred pain patterns associated with the: (1) convergence of visceral and somatic afferents at or near the spinal cord<sup>9</sup>, (2) dorsal spinal column<sup>10</sup>, and (3) cerebral nuclei and the brain stem<sup>11</sup>. Sato notes that some somatovisceral reflexes “have propriospinal and segmental characteristics, while others have supraspinal and generalized characteristics in their reflex nature<sup>12</sup>.” He postulates that “somatovisceral reflex responses may be functioning during spinal manipulative therapy...<sup>12</sup>” Budgell also suggests that there is a neurophysiologic rationale for the concept that aberrant stimulation of spinal or paraspinal structures leads to segmentally organized reflex responses of the autonomic nervous system, affecting visceral function<sup>13</sup>.

### Risk Benefit Ratio

The term “risk benefit ratio” can be used to help us better

understand the complex nature of chiropractic treating nonmusculoskeletal conditions. It simply means, “What is the risk of an intervention or no intervention versus its possible benefit?” As the chiropractic profession participates within the nonmusculoskeletal care arena, we would need to show that chiropractic care is a low risk intervention. “Watching and waiting” or no care is not an option for some patients. In addition, chiropractic care may indeed offer some benefit. Being able to discern when patients with these conditions need to be referred for emergency care or interdisciplinary cotreatment is essential for responsible practitioners treating nonmusculoskeletal cases.

### Treatment Becomes Part of the Diagnosis

Evidence-based care of nonmusculoskeletal conditions treated by chiropractic is slowly emerging. Due to the complex and diffuse nature of viscerosomatic and somatovisceral referred pain interactions, it is possible that chiropractic care could be seen as a relatively low-risk intervention, particularly if the cost is reasonable. If chiropractors are going to use treatment and the patient’s response as means to develop a diagnosis, then the treatment should be safe and show some response in at least two to four weeks. The challenge for chiropractors in this arena is presenting a rationale for care, utilizing care for a limited period, and then making the proper referral to an allied healthcare provider if the patient’s response does not show improvement within that time period.

The following are some studies from the SOT Research Conferences that help illustrate how chiropractic care might play a role in the treatment of patients presenting with nonmusculoskeletal conditions.

### Pediatric Nonmusculoskeletal Retrospective Survey<sup>14</sup>

**Introduction:** For the purposes of this retrospective survey,

all parents of children treated (2000-07) in a clinic by the same clinician (n=127) were sent a questionnaire. The questionnaires were part of a standard practice of this office for follow up, patient control, and management. 65/127 parents responded from this standard follow up outreach, and 37/65 of those were treated for nonmusculoskeletal presentations. In all of the cases, active chiropractic care consisted of sacro occipital technique and cranial pediatric treatments.

**Methods/Results:** Of the 37 (17 male, 20 female) nonmusculoskeletal pediatric patients, five were treated for immune function, seven for developmental delays/dysfunction, nine for birth trauma, one for seizure activity, four for learning problems, three for endocrine problems, three for migraines, two for gastrointestinal issues, two for fussiness/agitation/anxiety, and one for enuresis. 36 of the 37 patients, per their parent, reported improvement of their child's nonmusculoskeletal condition that appeared related to the chiropractic intervention

**Implication:** Since it does appear from this patient survey that nonmusculoskeletal conditions may benefit from SOT and cranial adjustive techniques, there is a greater need to investigate whether certain children with nonmusculoskeletal presentations may be candidates for chiropractic care. With its low risk options, chiropractic care may offer an option for

**Conclusion:** It is of interest to determine if the reduction of joint or body-related pains might also have a relationship with improvement of nonmusculoskeletal presentations. What needs to be determined is if this improvement of visceral function is related to either balancing of sympathetic/parasympathetic nervous system function, improvement of viscerosomatic/somatovisceral reflex activity and reduction of nociceptive signals crossing over to adjacent visceral afferents, or mechanical musculoskeletal effect on adjacent visceral structures. Parents of children with difficult conditions, such as incontinence, often consider that doing nothing is not an option, yet they are concerned about medications and their side effects. It is possible that chiropractic care might fill a low-risk intermediate option between watching and waiting and beginning a medication program.

### Insulin Resistance Case Series<sup>16</sup>

**Introduction:** High plasma levels of insulin and glucose due to insulin resistance are a major component of the metabolic syndrome. Metabolic syndrome is a group of risk factors that raises the risk for heart disease and other conditions, such as diabetes mellitus (DM) type 2 and stroke. Since some low-level

parents who feel the need to do "something" for their child. Chiropractic care may help children with nonmusculoskeletal presentations and offer their parents' confidence that they will be properly referred to allied health practitioners if a condition remains unresponsive.

### Adolescent Incontinence Case Study<sup>15</sup>

**Introduction:** A 13-year-old female presented with a prior history that included sprained right and left ankles, attention deficit disorder (ADD, inattentive type), and the rare occasion of bed-wetting at age three and four (fully toilet trained at age two). The patient's major concern was incontinence that had worsened the summer prior to the office visit following a fall from a swing into a lake that caused her to land onto her back.

**Methods/Results:** Examination and patient's presenting symptoms suggested a relationship between her incontinence (urgency) and a sacroiliac joint sprain (category two). Sacro occipital technique treatments, soft tissue balancing, and Carver techniques were used. While the patient still had some degree of incontinence during treatment, the incidence of incontinence and frequency of occurrences were significantly lessening. It was apparent to both the patient and her parent that there was a clear relationship between the reduced low back pain, second-

evidence has found that chiropractic care may demonstrate some influence in nonmusculoskeletal interactions such as in DM individuals, this study was performed to analyze any possible influence of chiropractic treatment for patients with DM and insulin resistance.

**Methods/Results:** Four patients with DM type 2 with insulin resistance were selected by an allopathic diabetes specialist to participate in this study. The treatment consisted of eight chiropractic office visits that incorporated adjustments to the spine and chiropractic manipulative reflex technique (CMRT) to balance viscerosomatic/somatovisceral autonomic reflexes. Laboratory blood tests were taken before and after the chiropractic adjustment on the second and eighth office visits. After the eighth office visit, the levels of insulin resistance, following chiropractic care, decreased significantly when compared to the levels prior to the chiropractic intervention.

**Implications:** Further research is needed in this arena to determine which subset of patients and type of chiropractic care may achieve optimal results. Since the risk is high for the various types of medications utilized for insulin resistance, and not treating this condition may lead to serious sequelae, a low-risk trial of chiropractic care could be part of an early treatment regimen to determine if a patient with insulin resistance syndrome might be responsive to chiropractic care.



There is much to learn about nonmusculoskeletal conditions that respond to chiropractic interventions. Which patients with nonmusculoskeletal presentations may respond to chiropractic adjusting, soft tissue visceral manipulative reflex care, nutritional or lifestyle counseling, and/or other low-risk chiropractic interventions? What would be a reasonable trial period to determine if chiropractic care may be assisting a nonmusculoskeletal patient? How can we assess a patient's response to care and know when and to whom it is appropriate to refer a patient that is not responding appropriately?

While our chiropractic research community is attempting to answer these questions, it may be best for "patients in need" to receive a trial period of chiropractic care (two to four weeks) to determine if chiropractic care might be an option for their nonmusculoskeletal presentation. Since nonmusculoskeletal conditions are multifactorial and complex, chiropractic care may not be an option for some patients and developing proper referral skills will be essential for optimal patient care.



Charles L. Blum, DC is in private practice Santa Monica, California, director of research for Sacro Occipital Technique Organization—USA, adjunct research faculty at Cleveland Chiropractic College and teaches the Sacro Occipital Technique (SOT) elective class at Palmer College of Chiropractic—West and Southern California University of Health Sciences.

## 8<sup>th</sup> Annual SOT Research Conference Call for Papers



Submission deadline  
January 31, 2016

Contact Dr. Blum for questions or assistance  
with submissions.  
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# Sacro Occipital Technique

## Research Updates **Fifth Edition**

By Charles L. Blum, DC

This is the fifth in a series of articles that will share various concepts of research with doctors in clinical practice. This one relates to chiropractic and dental interdisciplinary care as it relates to temporomandibular joint disorders (TMD).

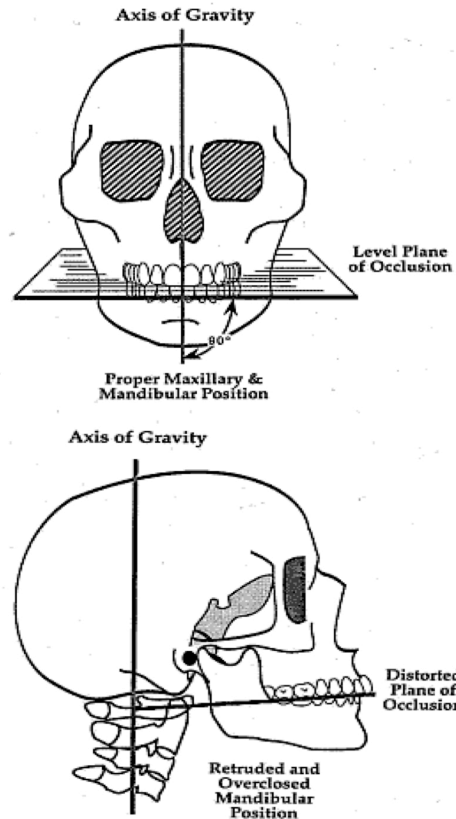
To better understand how chiropractic and dentistry often can function in an integral manner to treat patients presenting with TMD, it is important to grasp the dynamic nature of how body posture affects dental occlusion, condylar position, and airway space, and likewise how dental occlusion, condylar position, and airway space affects body posture. A couple of recent studies exemplified this relationship by showing how placing a heel lift under one shoe to affect pelvic torsion caused the teeth to contact primarily on the side of the heel lift. Likewise, changing dental occlusion had an effect on the stability of a patient's posture.<sup>1,2</sup>

The interrelationship between head and neck position and body posture is affected to some degree by the visual and vestibular righting mechanisms. What goes on below the head and neck will cause the head and neck to accommodate like a gyroscope in order to maintain a horizontal-level position to the horizon for the eyes and ears. If the head and neck are compromised and cannot properly accommodate, then the pelvis and lower spine will be compelled to modify their positions.<sup>3</sup>

Therefore, it is not unreasonable to find intertwining of body relationships with the body's kinematic chain from distally, such as between the feet or knees to the craniofacial regions.<sup>4-6</sup> Also of importance, the pelvis, spine, and TMJ have also demonstrated functional interrelationships.<sup>1,2,7</sup> An association has been found between sleep apnea, airway space, and forward head posture (FHP) that will allow dental chiropractic co-treatment to be viewed from beyond just a pain relief aspect.

While the effect of sleep apnea on public health is becoming well known<sup>8</sup>, what is not readily understood is the effect of airway space or apnea on head and neck position.<sup>9</sup>

Studies are finding that the position of the mandible<sup>10</sup> affects airway space, tongue position, and can lead to FHP. So, before chiropractors attempt to treat a patient's FHP, we may need to factor in the question: "Does this patient have TMD-related issues that might be compromising his or her airway space?"<sup>11</sup>



“Studies are finding that the position of the mandible affects airway space, tongue position, and can lead to FHP.”

The following are some studies from the SOT Research Conferences that help illustrate how chiropractic and dental co-treatment might play an effective part of interdisciplinary care of TMD patient presentations.

### SOT Cranial and TMJ therapy for unresolved BPPV<sup>12</sup>

**Introduction:** Vertigo accounts for about six million clinic visits in the US every year, and 17 to 42% of these patients eventually are diagnosed with benign paroxysmal positional vertigo (BPPV).



**Case History:** A 37-year-old female was seen for BPPV, referred by her allopathic physician for chiropractic care. The patient had two to three months of constant vertigo, unresponsive to medications, and it prohibited her from driving or walking without difficulty.

**Methods/Results:** Evaluation determined a sacroiliac joint hypermobility syndrome (category two), right temporal bone restricted in external rotation, and significant malocclusion with clenching. Category two protocols for the pelvis were applied along with cranial and TMJ therapies. Dental co-treatment was necessary to sustain the cranial and TMJ corrections. By the seventh office visit (three to four weeks of care), the patient's vertigo had resolved, her category two stabilized, and TMJ translation had improved without pain.

**Implications:** Since it is not uncommon for cranial trauma to affect cranial nerve function, it is possible that low-level sustained cranial stress or trauma could contribute to clinical presentations such as BPPV. The patient's rapid response to chiropractic and dental care suggests further investigation is warranted into this method of treatment for a subset of patients presenting with BPPV or unresponsive vertigo.

#### TMD – Chiropractic and Dental Cross-Referrals<sup>13</sup>

**Case Report:** In conditions where a chiropractor or den-

**Implications:** A main obstacle for chiropractic/dental co-treatment is the lack of awareness and knowledge of each other's professional treatment and diagnostic focus, as well as terminology. This case report illustrated a relationship between ascending/descending postural dysfunctions and TMD. It appeared that with these cases optimal outcomes appeared contingent upon chiropractic and dental co-treatment.

#### Complex Patient Presentations and Chiropractic Dental Co-Treatment<sup>14</sup>

**Case History:** A 42-year-old female presented with an unsteady Parkinsonian-type of gait diagnosed as psychogenically driven. She also was diagnosed with an atypical version of a complex regional pain syndrome called "complex pain syndrome" due to its whole body generalization as well as her history of migraines.

**Methods/Results:** Initially the patient was co-treated with a dental night- and day-time appliance, sacrotrochanter belt, and treated with SOT category two protocols, sutural cranial/temporomandibular joint (TMJ) interventions, T8 chiropractic manipulative reflex technique (CMRT), and supportive nutritional modifications to support liver function and reduce inflammation. At the first office visit with the dental appliance, trochanter belt, and category two treatment, all of her shaking stopped when standing and her pain was significantly reduced. This allowed for the patient's medications to be notably decreased.

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“The patient's rapid response to chiropractic and dental care suggests further investigation is warranted into this method of treatment”

tist has reached a therapeutic impasse with a patient's temporomandibular/cranio-mandibular disorders (TMD/CMD), co-treatment may be indicated. These two cases discuss two patients with sacroiliac joint hypermobility syndrome (category two) and cervical intersegmental restricted motion that necessitated craniomandibular balancing therapeutic interventions and dental appliance therapy. One initially was treated by the chiropractor and referred to the dentist for co-treatment, and the other initially was treated by the dentist and referred to the chiropractor for co-treatment.

**Methods/Results:** With SOT and craniomandibular therapies, along with dental appliance therapy, both cases showed a reduction of pain and improvement of TMJ function and/or symmetrical joint translation without crepitus. General relaxation in cervicocranial and craniomandibular musculature was noted by the patient, chiropractor, and dentist.

“A main obstacle for chiropractic/dental co-treatment is the lack of awareness and knowledge of each other profession's terminology and treatment”

**Implications:** It is interesting that a relationship appears to have been found with this patient's severe tremors, migratory joint pain, and migraines that appeared to be associated with her pelvis and TMJ function. The patient's tremors could be eliminated by having a trochanter belt placed around her pelvis and they would return when the belt was removed. The future challenge is developing a predictive group of tests to determine what subset of patient with severe tremors, fibromyalgia, and migraines would be responsive to this type of chiropractic and dental co-treatment.

There is much to learn about interdisciplinary care and how chiropractic and dentistry can function as partners in optimizing patient outcomes. Developing relationships of trust between our professions and knowing when referrals to one another are necessary will be an important first step.<sup>15,16</sup>



Learning each other's terminology and how we each view relationships between the stomatognathic system and body posture, as well as the far-reaching implications of sleep apnea on our patient's health, will assist chiropractors to better help patient outcomes in the future.

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# SACRO OCCIPITAL TECHNIQUE

## Its Past, Present and Future

By Charles L. Blum, DC

**S**acro Occipital Technique (SOT) is an assessment and treatment method of chiropractic developed by Major Bertrand DeJarnette, DO, DC in the late 1920s. Prior to beginning a career in chiropractic, a nineteen-year-old DeJarnette embarked on a career as an engineer within a group of elite engineering students hired by the Ford Foundry for research and development. One day not long after beginning his employment at the foundry, he was walking up the steps to his work when an explosion occurred in the building. He was thrown nearly 30 feet and barely survived his injuries, everyone else was killed.

During that era in American history, anyone involved in an explosion was considered “bad luck” by potential employers and society at large. He felt despondent about his future engineering career, confused as to why he alone survived, and in excruciating pain due to the injuries he sustained. Contemplating suicide while standing on the highest bridge in town, he felt something touch him and tell him that he had important things yet to accomplish. At the time he was not an especially spiritual person, but he was shaken enough by the experience to get down to the bridge. He walked around aimlessly until he collapsed in front of a house, exhausted. In the morning the homeowner, who fortuitously happened to be an osteopath, discovered the young DeJarnette asleep on his front steps and offered to help him<sup>1</sup>.

When the osteopath realized how injured DeJarnette was, he suggested that he attend an osteopathic college where he could learn and continue to receive care. After graduating with an osteopathic degree, he later attended chiropractic college. Upon graduating, he established his chiropractic practice in Nebraska City, Nebraska. He always felt there was a reason why he survived, and that he had a duty to make his life meaningful by improving the welfare of others<sup>1,2</sup>.

DeJarnette had a photographic memory and could read a full page, rather than a single word, at a time. His abilities likely led to why he was able to write over 140 books and articles. For DeJarnette, research was an essential part of being a chiropractor, and essential to the future of the chiropractic profession. As early as July 1935, he was a featured speaker at the 40th Anniversary Convention 1895-1935 of the National Chiropractic Association, presenting clinical research. Always,



*Photo: Major Bertrand DeJarnette, DO, DC*

research was his passion. In an interview in 1982 DeJarnette reiterated, “As far back as chiropractic college, I saw the need for a more scientific basis for chiropractic theory. My own personal physical problems had not been solved by medicine, osteopathy, or chiropractic; so I began experimenting on myself. I’m still at it, and I can see no end of the need for continuous research in chiropractic<sup>3</sup>.”

When Dr. DeJarnette began to study the treatments he rendered, he realized that if any meaningful information was to evolve from his experience, he would have to resolve it himself. He realized that explaining how his discoveries evolved was more difficult than the process of developing new diagnostic and therapeutic interventions<sup>4</sup>.

“Research is a study of what you have, and what you need to make it better, and how to make it better is the final research step<sup>5</sup>.” “Research in Chiropractic must go on forever. Someone must do this type work, for it simply will not take care of itself.



A profession cannot stand still. Momentum must constantly be generated. Chiropractic research needs many things it does not now have<sup>6</sup>.”

### Three Novel Concepts<sup>1,7</sup>

DeJarnette utilized concepts of evaluating the body's presentation as a three dimensional holograph which is affected by a matrix of integrative activities. He investigated how sustained stressors to the body create distinct retained patterns of distortion in the neuromusculoskeletal system. He ultimately used his experiences to develop methods of categorizing three specific primary body distortion patterns.

1. He factored Osteopathic principles relating to cerebrospinal fluid (CSF) circulation, dural membranous tensions, and cranial bone dynamics into chiropractic analysis and treatment.
2. He determined that there are two parts to the sacroiliac (SI) joint, a posterior weightbearing supportive hyaline structure and an anterior synovial membranous joint that allows for joint nutation.
3. From an engineering standpoint he realized that the majority of the weight or stress from structures above the SI joint rests upon the posterior SI joint, whereas inferior to the SI joint the stress is spread 50% to each hip joint.

DeJarnette's three novel concepts led to the development of three specific categories of analysis:

**Category One:** relates to the anterior synovial SI joint's nutation and its relationship to dural tension and CSF circulation.

**Category Two:** relates to the posterior SI weightbearing joint.

**Category Three:** relates to the body's adaptation to the inability to distribute weight through the posterior SI joint and its subsequent transmission (via iliolumbar ligaments and sacrospinalis muscles) to the lumbar discs and spine.

### Integrating Viscerosomatics and Cranial Biodynamics into SOT

Utilizing the categories of analysis and treatment, DeJarnette found specific ways of incorporating treatment relating to viscerosomatic and somatovisceral reflexes, and specific organ manipulation into an indicator based system of care entitled Chiropractic Manipulative Reflex Technique (CMRT)<sup>8</sup>.

Incorporating cranial, meningeal, and CSF analysis and treatment<sup>9</sup> into a systematized methodology of care was also integrated into his category system. This allowed the doctor

to use pre- and post-adjustment indicators to assess when and where care is needed and whether the care rendered was successful. His cranial system of analysis involved palpation for pain, functional assessments, and palpation of cranial compliance<sup>9</sup>. This allowed for a generalization of patient presentations into a system of analysis and care that followed a logical and reproducible progression<sup>7</sup>.

With persistent extremity imbalance due to trauma, asymmetrical function, and various other possibilities, DeJarnette developed a system of extremity analysis and treatment relating to the feet, ankle, knees, and hips as well as from the scapula, shoulder, and elbow. Since imbalanced function can be specific to a joint or factors, distal or proximal, the whole kinematic chain of influence is considered with SOT extremity analysis and treatment<sup>7</sup>.

Therefore while SOT is considered a chiropractic technique, it is more an inclusive paradigm of health that attempts to integrate whole body function, nonmusculoskeletal interrelationships, and preventative care.

Sacro Occipital Technique Organization (SOTO) – USA was formed in 1999 to disseminate the teachings of DeJarnette, and bring SOT into the evidence based chiropractic community. That involves responsibly performing research to support the findings of SOT doctors, being circumspect about our claims, and modifying SOT to fit the current research. SOTO-USA has been able to teach SOT according to DeJarnette's completed works, while bringing his work into 21st century language.

SOTO-USA focuses continuing its SOT certification program, with systematized syllabi, books, lesson plans, and certified instructors, along with written and practical SOT and cranial certification examinations. One aspect that SOTO-USA believes is important for the future of SOT is researching its clinical outcomes as well as its reliability and validity. Another crucial aspect for the future of SOT is interdisciplinary care.

### Certification Program

In 2014-15 SOTO-USA is presenting SOT and Cranial Certification Programs at the University of Western States, Palmer College of Chiropractic Davenport, Palmer College of Chiropractic Florida, Southern California University of Health Sciences, and in Northern California. Our annual SOT and Cranial Certification examinations will be given this year at the SOTO-USA Clinical Symposium May 7-10, 2015 in New Orleans.

### Research



“DeJarnette analysis and techniques helped establish chiropractic as more than just a spinal based therapy but a holistic method of spinal care incorporating cranial bone, viscera, meningeal, and extremity interrelationships.”

SOTO-USA has a three-pronged focus with regard to research publication: (1) regularly presenting research at chiropractic (ACC/RAC<sup>16</sup>, WFC<sup>11</sup>, ECU<sup>12</sup>, IRAPS<sup>13</sup>, COCA<sup>14</sup>, and ACH<sup>15</sup>) and interdisciplinary research conferences, (2) having annual SOT Research Conferences<sup>16</sup> (May 7, 2015 will be the 7th) that give doctors the ability to become familiar with submitting, preparing and presenting SOT related research in a professional and collegial manner, and (3) submitting research for publication in peer review journals.

## Interdisciplinary Relationships

Pioneering dental/chiropractic co-treatment of temporomandibular joint disorders (TMDs), SOTO-USA is a member of the Alliance of TMD Organizations<sup>17</sup>, a group of predominately dental based groups totaling 14,000 members that specialize in treatment of temporomandibular joint disorders. SOTO-USA has regularly been presenting research at the Interdisciplinary World Congress on Low Back and Pelvic Girdle Pain<sup>18</sup>, at the North American Brain Injury Conferences and John Hopkin's Integration of Complementary and Alternative Medicine into Clinical Practice Conference. Multiple papers have been presented at many chiropractic research conferences sharing how SOT care can integrate with various interdisciplinary fields such as dentistry, medicine (e.g., cardiology, neurology, gastrointestinal, gynecology, etc.), osteopathy, optometry, acupuncture, ayurveda, pediatrics, and pregnancy.

At this time, SOTO-USA is not just about furthering the work of DeJarnette, but about helping chiropractic and chiropractors move forward. This is accomplished by aiding doctors in clinical practice to share their findings in the research community, as well as sharing up to date findings from the research community with doctors in practice. Developing an understanding of chiropractic's role in nonmusculoskeletal therapies and how to integrate with allied healthcare providers, will ultimately offer patients improved therapeutic low risk options. Expanding chiropractic's role in healthcare delivery through education of

our allied healthcare partners will also facilitate care of patients with secondary head, neck and back pain conditions associated with oncology, menstrual syndromes, pregnancy, brain trauma, TMD, and other conditions/syndromes.

SOT is an inclusive chiropractic paradigm of care that easily integrates various adjusting methods and methodologies. DeJarnette's life's work offers chiropractic an indicator based system of analysis and treatment to expand and enhance any chiropractors current practice. Please consider becoming a member of SOTO-USA, attending an SOT certification series or our annual symposium May 7-10, 2015, or simply becoming more familiar with SOT by visiting the SOTO-USA website at [www.SOTO-USA.org](http://www.SOTO-USA.org).



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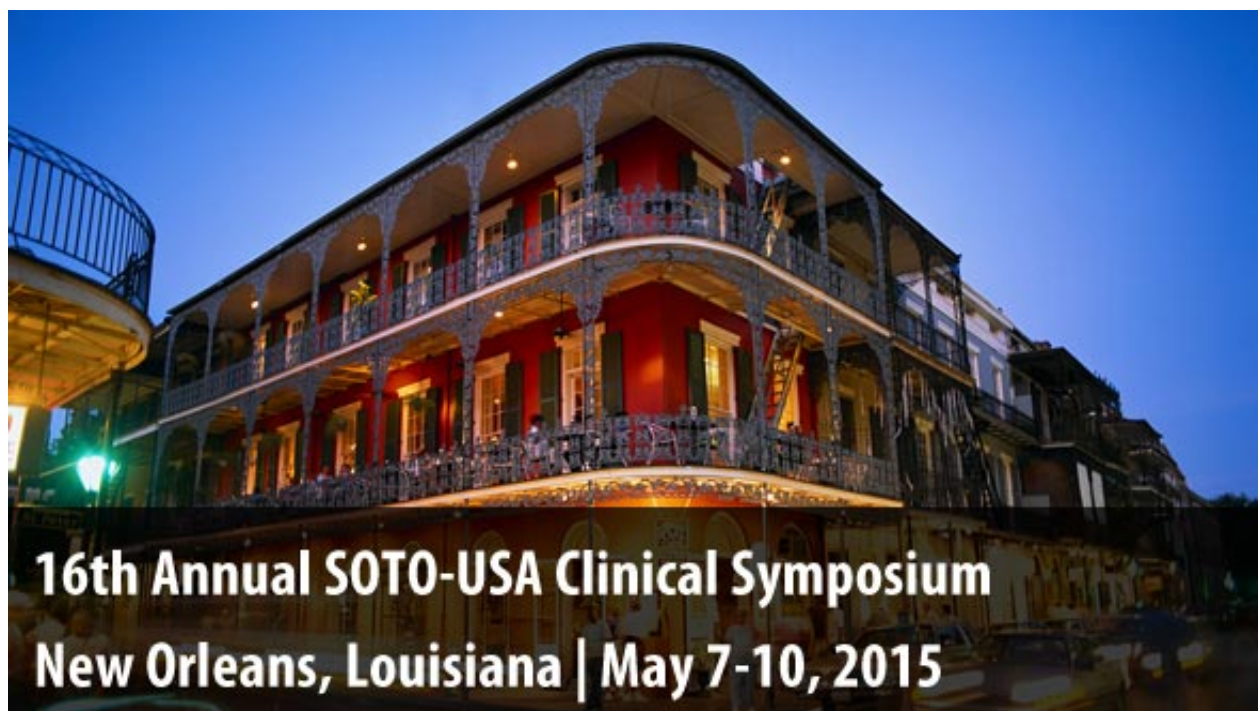
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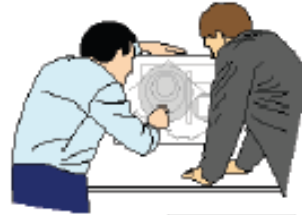
# Effective Scientific Posters: Quick Reference

George R. Hess

[<http://www.ncsu.edu/project/posters/NewSite/documents/QuickReferenceV2.pdf>]

## A poster is a visual communication tool.

An effective poster will help you ...  
... engage colleagues in conversation.  
... get your main points across to as many people as possible.



Posters serve as ...

- » a source of information
- » a conversation starter
- » a summary of your work
- » an advertisement of your work



## Tips for Effective Poster Presentations

- Get your message across with effective visual displays of data and small blocks of supporting text. Think of your poster as an illustrated abstract.
- Tell readers why your work matters, what you did, what you found, and what you recommend. Avoid excessive focus on methods – it's the results and implications that count!
- Overall appearance. Use a pleasing arrangement of graphics, text, and colors. Your poster should be neat and uncluttered – use white space to help organize sections. Balance the placement of text and figures.
- Organization. Use headings to help readers find what they're looking for: objective, results, conclusions, etc. A columnar format helps traffic flow in a crowded poster session.
- Minimize text – use graphics. Keep text in blocks of no more than 50-75 words – don't create large, monolithic paragraphs of prose.
- Text size. All text should be large enough to read from 1-2 meters, including the text in figures. Title should be larger, to attract attention from far away.
- Use color cautiously. Dark letters on light background are easiest to read. Stick to a theme of 2-3 colors. Avoid overly bright colors – they attract attention but wear out reader's eyes.
- Don't fight reader gravity, which pulls the eyes from top to bottom (first), and left to right.
- Include full contact information. You want to be found – the reader should not have to look up anything to find you.

## Clean graphs show data clearly!

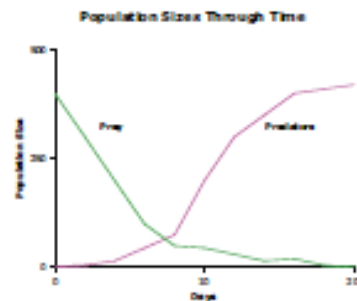
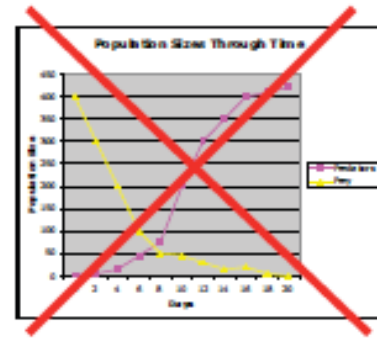
Desired message: Prey decreased as predators increased.  
Focus on relationships – exact values are usually not important.

Eliminate “chart junk” to keep focus on data.  
Grid lines, detailed ticks on axes, data markers, and grey backgrounds are not needed.

Label data directly, when possible.


Legends force reader to look back and forth to decode graph.

Message is now loud and clear!



## Sample Case Report Poster Presentation

Names of Authors and Affiliations

INTRODUCTION	RESULTS	DISCUSSION (Continued)
In the introduction section you describe the purpose of your poster presentation. Describe the importance of the topic, why the reader should bother to read this poster, and briefly summarize the poster's focus.	What was the patient's response to your treatment? Can you objectively quantify their response with outcome assessment pre and post forms? Were there pre and post laboratory, imaging, or other type of findings?	Why do you think that the patient would not have gotten better on their own without treatment or that some other treatment they received was not the reason for their response to care? What are the limitations to your study?
<b>CASE REPORT INFORMATION</b>	 <p><i>A brief caption under a picture is helpful.</i></p>	<b>CONCLUSION</b>
This is the place where you share the patient's gender, age, and any pertinent information. Why did they come to you for treatment, is there any unusual information about this patient, and any prior or current treatment they received?		Summarize your whole poster in a sentence. How could future studies be improved and how is this one a call for further research?
<b>INTERVENTION/TREATMENT</b>	<b>DISCUSSION</b>	<b>REFERENCES</b>
What treatment did the patient receive at your clinic? How long and how many treatments were rendered? Were any unusual tests performed and did they guide treatment?	Can you give a research or “evidence” basis for why you think your treatment had the purported effect on the patient discussed in this poster?	<ol style="list-style-type: none"> <li>Block SM. Do's and don'ts of poster presentations. <i>Biophysical Journal</i>. 1996; 71: 3527-9.</li> <li>Harms M. How to prepare a poster presentation. <i>Physiotherapy</i>. 1995; 81(5): 276.</li> <li>Hess GR, Brooks EN. The class poster conference as a teaching tool. <i>Journal of Natural Resources and Life Sciences Education</i>. 1998; 27: 155-8.</li> </ol>

## **May 2015 Sacro Occipital Technique Research Conference**

*New Orleans, Louisiana – May 2016*



### **Call for Scientific Submissions** **Sacro Occipital Technique Organization - USA** **8<sup>th</sup> SOT Research Conference, May 2016**

This call for scientific submissions invites the submission of original research that will promote the dissemination and discussion of new information. The categories for the 2016 conference are:

1. **Research (Integration)** integrated/integrative healthcare, integration related research topics (e.g., policy, healthcare programs, quantitative/qualitative research, etc.)
2. **Research (Basic Science)** (e.g., experimental trials, quantitative basic science research, etc.)
3. **Research (Clinical/Health Care Systems)** (e.g., experimental clinical trials, quantitative clinical research, case reports, qualitative clinical research, public health, etc.)
4. **Research (Innovative)** (e.g., experimental sacro occipital technique or cranial integrative methods assessed with reliable and valid assessment tools, etc.)

#### **Submission Requirements**

##### **1. Blinded submission for peer review - due electronically January 31, 2016**

- a. The submission must be a completed study. Incomplete work (e.g., concept proposal, a proposed idea for a research project that has not begun yet, a project has started but no data) will not be considered. If you are uncertain or have any questions about this, please contact the Peer Review Chair prior to the submission deadline.
- b. Word limit: submission may be up to approximately **2000 words** (but may be shorter). The 2000 word count allows authors to demonstrate the data/results of their findings and the scholarship quality of their completed work. One file in Word or rich text format (RTF), 12-point type font, double-spaced, maximum 2MB.
- c. Do not include author names or institutional affiliations anywhere in title or text.
- d. The submission must include appropriate sections such as: Title, Introduction (e.g. Background, Objectives, Purpose), Methods, Results, Discussion, Conclusion, and References sections. References are expected, but are not included in the word count.
- e. Due to file size limitations, it is preferred that you submit up to 2 of any combination of the following embedded in the Word/RTF document: diagrams, figures, pictures



(JPEG, TIFF or BMP), graphs or tables (e.g. one graph and one table.) Only submit these if they are essential for the peer reviewers to evaluate the proposal. Do not submit tables, graphs or pictures as separate files. Do not submit other visual aids (no videos or power point).

f. Your accepted paper will be published in the Sacro Occipital Technique Research Conference Proceedings 2012 but you will not sign over copyright to this conference and reserve the right to publish your article at another research conference or journal.

**2. Abstract for proceedings if accepted and author information - due January 31, 2016**

a. The abstract should be a structured abstract and include appropriate sections such as: Introduction (e.g. Background, Objectives, Purpose), Methods, Results, Discussion and Conclusion sections.

b. Word limit: **200 words maximum**. No pictures, tables, figures, or references are included in the abstract.

c. Do not include author information or institutional affiliations in the abstract.

d. The abstract will be published on the *SOTO-USA.org* website and within the *SOT Compendium of Peer Reviewed Literature 2010-2015* if submission is accepted.

**3. Signatures of all authors - due postmarked or faxed by January 31, 2016**

a. Signatures of all authors shall be submitted on the authorship statement form

b. Presentations of accepted works are expected. Presenting author(s) must register and attend the conference to present. Only authors may present the study. All presenters must register for the conference. We strongly recommend that funding is secured or confirmed in advance of submission. Submission is a commitment for presenting authors of accepted submissions to attend the conference and be present at the scheduled session.

**4. For studies involving human subjects – a copy of IRB/Ethics approval, expedited, or exemption letter – due postmarked or faxed by January 31, 2016**

a. All studies involving human subjects must go through appropriate IRB/ethics review and state these processes in both the blinded submission and abstract. Case reports are exempt. Any questions should be directed to your institution's IRB or Ethics Committee.

b. For studies involving human subjects research, provide a photocopy of the approval, expedited review or exemption to the peer review chair. For studies not involving human subjects, this document is not required.

**Submissions that do not meet the above requirements will be returned to the submitter.**



## **Submission Information**

All paper submissions shall be submitted electronically via email to Dr. Charles L. Blum – [drcblum@aol.com](mailto:drcblum@aol.com). A website link relating to the SOT Research Conference and registration for this conference will be posted on the website [www.soto-usa.org](http://www.soto-usa.org). The primary author is responsible for proper submission of all items. Non-authors (e.g., staff) are not allowed to submit or query about submissions.

### **Important Information:**

1. If the submission does not meet the submission requirements (e.g., not a completed research study, missing items), the SOT Research Conference Peer Review Chair will contact the authors. If however the paper cannot be accepted for this conference then notification will be sent to the submitting author. Concept proposals and incomplete works will be returned to the authors and those authors can contact Dr. Blum at [drcblum@aol.com](mailto:drcblum@aol.com) for further information.
2. It is the responsibility of the primary author to ensure that all requirements are met. The primary author will be the contact person responsible for submission of all required materials and all correspondence. Do not send communications through a third party, staff member, or co-author.
3. If the Peer Review Board confirms that there is an inappropriate submission, it will be disqualified. Examples of inappropriate submissions include but are not limited to: one that has been presented before at this conference, incomplete submissions, concept proposals, duplicate submissions, no human subjects/ethics review when one was necessary (includes expedited review), non-authors listed as authors, plagiarized work, etc.
4. Only electronic submissions will be considered. No faxed or mailed submissions will be considered.
5. Presentations of accepted works are expected. Authors must register and attend the conference to present. An author who does not register and present an accepted work will be disqualified from submitting/presenting for the following 2 years. It is the author's responsibility to find funding to register and attend the conference. We strongly recommend that funding is secured or confirmed in advance of submission. Presenter information and registration for the conference is required or the invitation to present will be revoked. Only authors may present their work at the conference.
6. Due to time and space limitations, and ability to cover poster presentations, there may be a limitation for the number of poster presentations per primary author/presenter.



All submissions will be evaluated for completeness, strength of contribution to the profession and relevance to the SOT research conference. Submissions will be reviewed by the peer review committee based upon the following criteria:

1. Practical significance
2. Originality
3. Theoretical/conceptual framework
4. Quality of experimental or descriptive design
5. Discussion/findings/results - clarity of presentation of findings
6. Conclusions, interpretation of results, implications for chiropractic education, theory, research, or practice
7. Citation of appropriate literature
8. Applicability for: the chiropractic profession, classroom use, further research, current/critical concerns, etc.
9. Completed study
10. Overall rating of the paper.

**Notification:** Primary/corresponding authors will be notified of peer review results by April 2016. If accepted, an acceptance communication and other information of the presenting author must be returned to the peer review committee. For submissions that are accepted, an author is required to register and present the work at the conference. If you have any questions or would like to request forms please contact the Peer Review Chair: Dr. Charles L. Blum at [drcblum@aol.com](mailto:drcblum@aol.com)

#### **OTHER INFORMATION:**

If accepted, the **200 word** maximum *abstract* will be printed on the SOTO-USA.org website and within the *Sacro Occipital Technique Compendium 2010-2015*. *The paper will be published within the proceedings of the SOT Research Conference 2016*. This will still allow you to publish your completed paper in any journal you wish.

Email a pdf or jpeg scan to [drcblum@aol.com](mailto:drcblum@aol.com) by **January 31, 2016** to:

SOT Peer Review Committee 2016  
Attn: Charles L. Blum, DC Peer Review Chair  
Email: [drcblum@aol.com](mailto:drcblum@aol.com)

Multiple authors involved with one submission may send their forms in separately

*The following two submission forms can all be found on the SOTO-USA website by going to [www.SOTO-USA.org](http://www.SOTO-USA.org) and clicking on SOT Research Conference Proceedings Submission box.*



***Authorship Signatures Form***  
***Sacro Occipital Technique Research Conference VII***  
***May 2016***

INSTRUCTIONS: This form must be completed, signed, and submitted by **January 31, 2016**  
**Submission title** (print):

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**By signing this form:**

1. I/We confirm that each of us qualify as an author of this submission, am/are responsible for all of its content, and give permission for: 1) its presentation if accepted to the SOT 2013 research conference, 2) the publication of the *abstract on the SOTO-USA.org* website and within the *SOT Compendium of Peer Reviewed Literature 2010-2015*, 3) your accepted paper to be published in the *Sacro Occipital Technique Research Conference Proceedings 2016* but you will not sign over copyright to this conference and will retain the right to publish your article at another research conference or journal, and 4) am/are capable of presenting/defending all of its content (for information about authorship visit [www.icmje.org](http://www.icmje.org))

2. If accepted, I/we understand that registration and presentation of this work at the conference is required and that funding should be secured or confirmed in advance of submission. Submission is a commitment for presenting. Authors of accepted submissions must attend the conference and be present at the scheduled session. I/We understand that withdrawing after acceptance may prevent us from submitting to future SOT Research Conferences.

**For studies involving human subjects – a copy of IRB/Ethics approval, expedited, or exemption letter – due postmarked or send to [drclum@aol.com](mailto:drclum@aol.com) by January 31, 2016.**

Evidence of IRB or ethics review approval/exemption is required for all research studies involving human subjects. It is recognized that projects that use human subjects are expected to follow appropriate human subjects review procedures depending on the type and nature of the research (more information about human subjects review/ethics review/IRB can be found at <http://cme.cancer.gov/c01> and [http://ohrp.osophs.dhhs.gov/irb/irb\\_guidebook.htm](http://ohrp.osophs.dhhs.gov/irb/irb_guidebook.htm)).

**Primary Author Print name Email address Signature Date**  
**Other Authors Print name Email address Signature Date**

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**If more authors, please sign and date on an additional form. If multiple authors, each may send in their completed forms separately (need not be on the same form).**



## Patient Case Consent for Publication and Presentation

Title of case study/series: \_\_\_\_\_

Author(s) names: \_\_\_\_\_

As the patient in this case study/series, I hereby give my consent for clinical information relating to my case to be reported at a scientific conference, in a conference proceedings, and/or published in a scientific journal.

I understand that my name, initials, and/or any protected health information such as my identification number, billing information, address, etc. will not be published and that efforts will be made to conceal my identity, but that anonymity cannot be guaranteed.

I understand that the material may be published in a journal, a website of a journal, and/or in products derived from the publication. As a result, I understand that the material may be seen by the general public.

\_\_\_\_\_  
Name of patient (print)

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of patient (or signature of the person giving consent on behalf of the patient if patient is a minor or deceased)

If you are not the patient, what is your relationship to him or her? (The person giving consent should be a substitute decision maker or legal guardian or should hold power of attorney for the patient.)

\_\_\_\_\_  
Why is the patient not able to give consent? (e.g., is the patient a minor, incapacitated, or deceased?)

\_\_\_\_\_  
If images of the patient's face or distinctive body markings are to be published, the following section must also be signed in addition to the section above:

As the patient stated above, I give permission for images of my face or distinctive body markings to be published and recognize that I might therefore be identifiable even though my name and initials will not be published.

\_\_\_\_\_  
Signature of patient (or signature of the person giving consent on behalf of the patient)

\_\_\_\_\_  
Date

Please keep a copy of this completed form for your records.



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NCMIC and the NCMIC Foundation continually invest in the chiropractic profession's growth and advancement.

Since 1995, more than \$13 million has been contributed to chiropractic research, education and foundations for such important projects as the International Bone and Joint Decade.\*

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\*\*A Best Evidence Synthesis on Neck Pain: Findings from the Bone and Joint Decade 2000-2010 Task Force on Neck Pain and its Associated Disorders\*

