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The Mechanism of the Chiropractic Spinal Adjustment/Manipulation: Osseous Mechanisms Part 1 of a 5 Part Series

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The Mechanism of the Chiropractic Spinal Adjustment/Manipulation: Osseous Mechanisms

Part 1 of a 5 Part Series

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A report on the scientific literature

Introduction

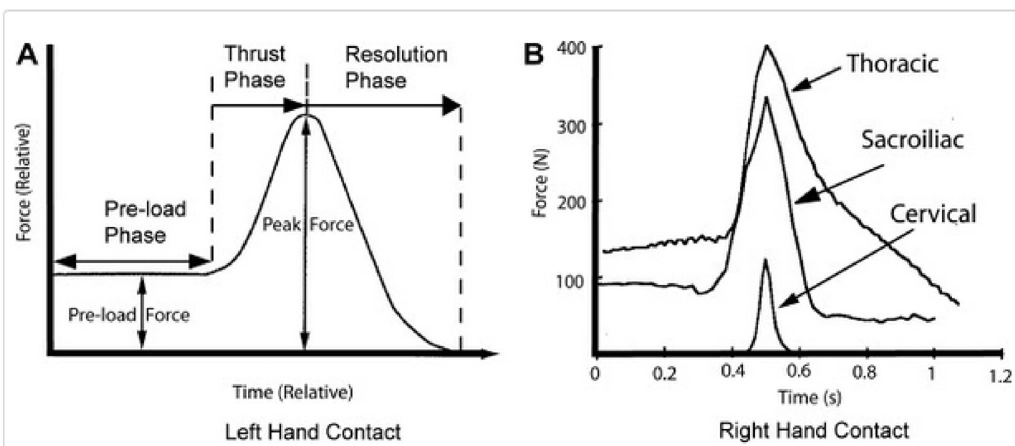
There have been many reports in the literature on chiropractic care and its efficacy. However, the reporting is often "muddled" based upon interchangeable terminology utilized to describe what we do. The etiology of the verbiage being used has apparently been part of a movement to gain acceptance within the healthcare community, but this attempt for a change in view by the healthcare community has cost us. Currently, the scientific community has lumped together manipulation performed by physical therapists or osteopaths with chiropractic spinal adjustment because all three professions perform "hands on" manual therapy to the spine. For example, Martínez-Segura, De-la-LLave-Rincón, Ortega-Santiago, Cleland, and Fernández-de-Las-Peñas (2012) discussed how physical therapists commonly use manual therapy interventions directed at the cervical or thoracic spine, and the effectiveness of cervical and thoracic spine thrust manipulation for the management of patients with mechanical, insidious neck pain. Herein lies the root of the confusion when "manipulation" is utilized as a "one-size-fits-all" category of treatment as different professions have different training and procedures to deliver the manipulation, usually applying different treatment methods and realizing different results and goals.

In addition, as discussed by Sung, Kang, and Pickar (2004), the terms "mobilization," "manipulation" and "adjustment" also are used interchangeably when describing manual therapy to the spine. Some manipulation and virtually all chiropractic adjusting "...involves a high velocity thrust of small amplitude performed at the limit of available movement. However, mobilization involves repetitive passive movement of varying amplitudes at low velocity" (Sung, Kang, & Picker, 2004, p. 115).

To offset confusion between chiropractic and any other profession that involves the performance of some type of manipulation, for the purpose of clarity, we will be referring to any type of spinal therapy performed by a chiropractor as a chiropractic spinal adjustment (CSA) and reserve manipulation for other professions who have not been trained in the delivery of CSA. Until now, the literature has not directly supported the mechanism of the CSA. However, it has supported

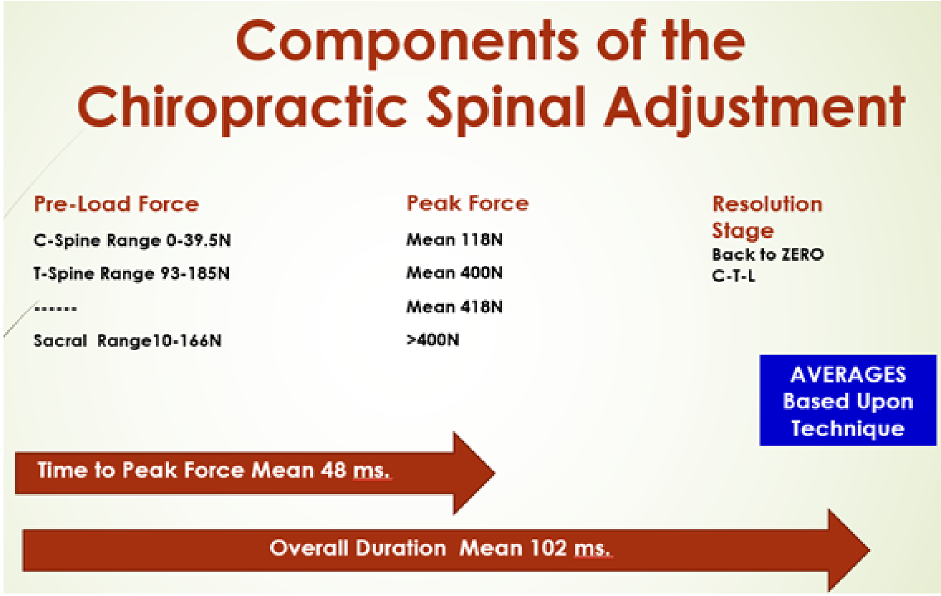
each component and the supporting literature, herein, will define the neuro-biomechanical proce of the CSA and resultant changes.
Components of the Adjustment or Thrust
Both human and animal studies have shown the tri-phasic process of the CSA and the time for th thrust duration of each phase. In addition, the timing at each phase has been shown to be integr in understanding the neurological effect of the CSA. The forces are broken into 3 phases. These a the pre-load force, which takes the tissue close to its paraphysiological limit, the peak force or thrust stage and the resolution stage.

> **Pickar and Bolton (2012) reported the following:**
> **CSA, referred to in the literature as spinal manual therapy, "...in the cervical region has relatively little pre-load ranging from 0 to 39.5 N. In contrast, the average pre-load forces during [CSA] in the thoracic region (139 ± 46 N, ± SD) and sacroiliac region (mean 88 N ± 78 N) are substantially higher than in the cervical region and are potentially differen from each other. From the beginning of the thrust to end of the resolution phase, [CSA] duration varies between 90 and 120 ms. (mean = 102 ms.). The time to peak force during t thrust phase ranges from 30 to 65 ms. (mean = 48 ms.). Peak applied forces range from 99 to 140 N (mean = 118 N, *n* = 6 treatments). In the same study with [CSA] directed at the thoracic (T4) region and applied to three different patients by the same practitioner, the mean (SD) time to peak force was 150 ± 77 ms. and mean peak force reached 399 ± 119 N. During the resolution phase, force returned to pre-[CSA] levels over durations up to two times longer than that of the thrust phase. When [CSA] was applied to the sacroiliac joint, mean applied peak forces reached 328 ± 78 N, with the thrust and resolution phases having similar durations (~100ms.). The peak force during manipulation of the lumbar spine measured by Triano and Schultz (1997) tended to be higher than during the thoracic or sacroiliac manipulation measured by Herzog et al. (1994) and the force–time profiles resembled half-sine waves with the time to and from peak taking approximately 200 ms. Peak impulse forces during thoracic manipulation approximated the >400 N peak impulse force measured by Triano and Schultz (1997). (p. 786)**



Note. **"Spinal Manipulative Therapy and Somatosensory Activation," by J. G. Pickar and P. S. Bolton, 2012, *Journal of Electromyography and Kinesiology*,*22*(5), 787. Copyright 2012 by Elsevier.**

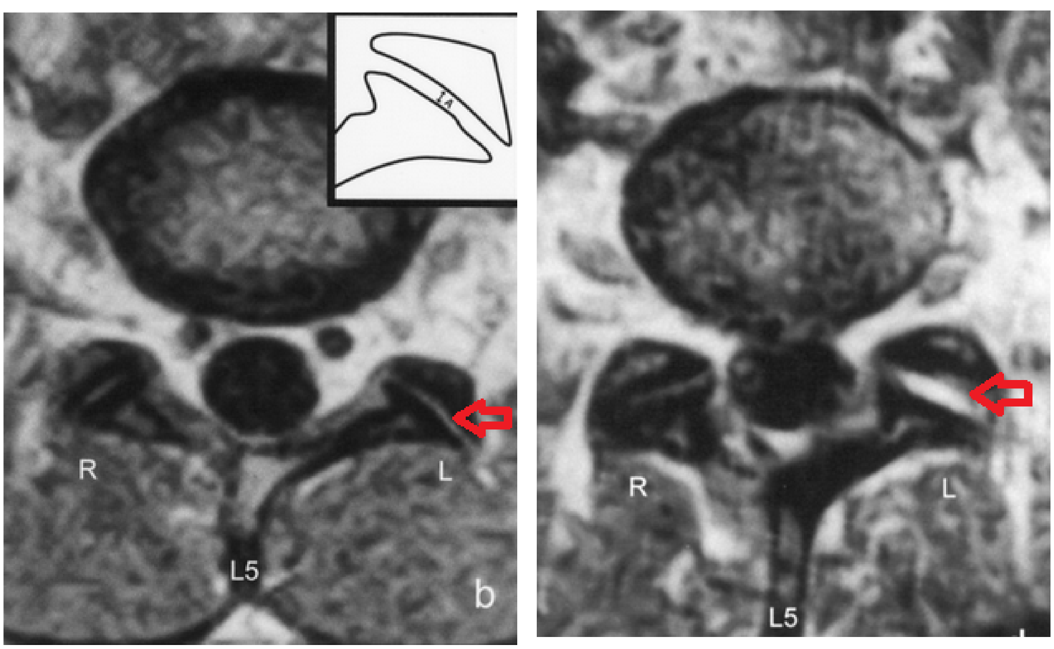
Pickar and Bolton (2012) reported that the physical characteristics of an CSA may vary based up the technique being used and the individual practitioner. However, the above scenario is an illustration and guide to the time and force for of a CSA.



Zygapophysial (Z) joints

Cramer et al. (2002) explained the following:

One component of spinal dysfunction treated by chiropractors has been described as the development of adhesions in the zygapophysial (Z) joints after hypomobility. This hypomobility may be the result of injury, inactivity, or repetitive asymmetrical movements.. one beneficial effect of spinal manipulation may be the "breaking up" of putative fibrous adhesions that develop in hypomobile or "fixed" Z joints. Spinal adjusting of the lumbar region is thought to separate or gap the articular surfaces of the Z joints. Theoretically, gapping breaks up adhesions, thus helping the motion segment reestablish a physiologic range of motion. (p. 2459)



Control subject [left] before the CSA and after [right] a CSA. The red arrows depict the increase i the Z-Joint

Note. "The Effects of Side-Posture Positioning and Spinal Adjusting on the Lumbar Z Joints: A Randomized Controlled Trial with Sixty-Four Subjects," by G. D.Cramer, D. M. Gregerson, J. T. Knudsen, B. B. Hubbard, L. M. Ustas, & J. A., 2002, *Spine,27*(22), 2462. Copyright 2002 by Lippincott Williams & Wilkins.

> **Cramer et al. (2002) found the following:**
> **...significant differences between several groups in this study, with the group that received chiropractic adjustments and remained in the side-posture position showing the greatest increase in gapping. This finding is consistent with the hypothesis that chiropractic adjustin gaps the Z joints...The Z joints were found gap during side-posture positioning, although no as much as during side-posture adjusting...The flexion that occurs during the side-posture position and side-posture spinal adjustment may allow for greater gapping during axial rotation and may account for the difference in results between the studies. However, because both the side-posture positioning group and the group that had side-posture adjusting followed by continued side-posture positioning received equal amounts of flexion the thrust given during the chiropractic procedure had the effect of increasing the gapping the Z joints. (p. 2464)**

> **The average difference between the control subjects...and the subjects that received a chiropractic adjustment and remained in side-posture position was 1.33 mm...a difference o 0.71 mm was found between the side-posture group...and the group that received an adjustment and remained in the side-posture position...It will be recalled that the Z joints a very small [and this is a considerable gap in a joint as small as the Z joint]...Another important consideration is that the term "residual," or "left-over" gapping, could be applied to the gapping measured in the adjustment group because it can be logically assumed that the Z joints gap a greater distance during the forceful loading of the manipulative procedure than recorded in this study. The tissues of the spine presumably bring the articular surfaces back toward the pre-adjustment (closed) position as the patient resumes a more typical sid posture position after the thrust of a manipulation. This "residual" gapping is what was see during the 15- to 20-minute MRI scan taken immediately after the adjustment. (2464-2565)**

What makes this significant is the residual time that occurs after the CSA. During this period, and the time that follows is the foundation for biomechanical changes in the adjacent discs and ancillary connective tissue attachments that will be discussed in the next article in the series. However, this is part of the foundation for bio-neuro-mechanical changes to the spine secondary to the CSA.

Meniscoid Entrapment

> **Evans (2002) reported the following:**
> **...on flexion of the lumbar spine, the inferior articular process of a zygapophyseal joint move upward, taking a meniscoid with it. On attempted extension, the inferior articular process returns toward its neutral position, but instead of re-entering the joint cavity, the meniscoid impacts against the edge of the articular cartilage and buckles, forming a space-occupying "lesion" under the capsule: a meniscoid entrapment. A large number of type III and type IV nerve fibers (nociceptors) have been observed within capsules of zygapophyseal joints. Pain occurs as distension of the joint capsule provides a sufficient stimulus for these nociceptors to depolarize. Muscle spasm would then occur to prevent impaction of the meniscoid. The patient would tend to be more comfortable with the spine maintained in a flexed position, because this will disengage the meniscoid. Extension would therefore tend to be inhibited. This condition has also been termed a "joint lock" or "facet-lock" the latter of which indicate the involvement of the zygapophyseal joint.**

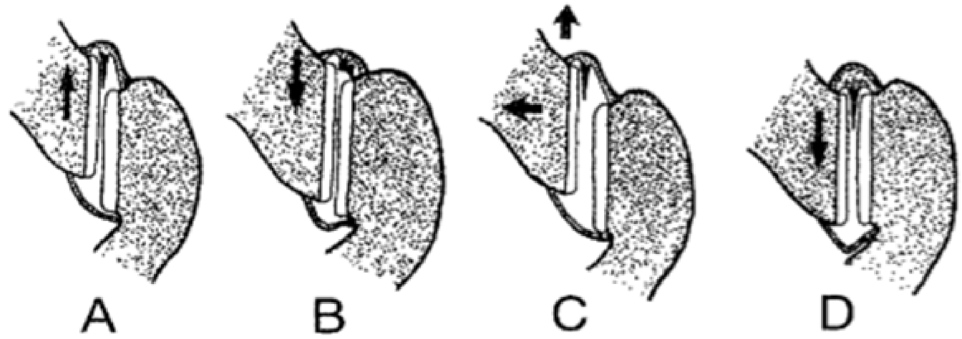
> **The presence of fibro-adipose meniscoids in the cervical zygapophyseal joints suggests that similar phenomenon might occur, but in the neck the precipitating movement would be excessive rotation. The clinical features of cervical meniscoid entrapment would be those of an acute torticollis in which attempted derotation would cause impaction and buckling of th entrapped meniscoid and painful capsular strain. Muscle spasm would then occur to prevent impaction of the meniscoid by keeping the neck in a rotated position. Under these**

circumstances the muscle spasm would not be the primary cause of torticollis but a secondary reaction to the entrapment of the meniscoid.

An HVLAT manipulation, involving gapping of the zygapophyseal joint reduces the impactior and opens the joint, so encouraging the meniscoid lo return to its normal anatomical positic in the joint cavity. This ceases the distension of the joint capsule, thus reducing pain. (p. 252-253)
Evans (2002) also explained the following:

Zygapophyseal joint gapping induced during an HVLAT manipulation would further stretch the highly innervated joint capsule, leading to a "protective" reflex muscular contraction, as shown in electromyographic studies. The most important characteristic of a manipulative procedure that will provide joint gapping, before the induction of protective reflex muscular contraction, would be high velocity...the thrusting phase of an HVLAT manipulation requirec 91 ± 20 ms. to develop the peak force. If this period is compared with the time delay between the onset of the thrusting force and the onset of electromyographic activity, which ranges from 50 to 200 ms., we can see that a force of sufficient magnitude to gap the joint can be applied in a shorter time than that required for the initiation of a mechanoreceptor-mediated muscular reflex. Furthermore, once the muscle is activated (i.e. there is an electromyographic signal), it will take approximately another 40 to 100 ms until the onset c muscular force. It therefore seems unlikely that there are substantial muscular forces resisting the thrusting phase of HVLAT manipulation. Thus, HVLAT manipulation would agai appear to be the treatment of choice for a meniscoid entrapment.

The cavitation event may not be a prerequisite for a "successful" HVLAT manipulation in the case of a meniscoid entrapment and may be an incidental side effect of high-velocity zygapophyseal joint gapping (which would be a prerequisite for success). Audible indicatior of successful joint gapping may, however, be regarded as desirable in itself as a clinical measure of "success." A clinician's perception of the occurrence of cavitation during an HVLAT manipulation has been shown to be very accurate and would therefore be a reliable measure of a '"successful" joint gapping. (p. 253-254)



Meniscoid entrapment. A) On flexion, the inferior articular process of a zygapophyseal joint move upward, taking a meniscoid with It. B) On attempted extension, the inferior articular process returns upward to its neutral position, hut instead of re-entering the joint cavity, the meniscoid impacts against the edge of the articular cartilage and buckles, forming a space-occupying "lesio under the capsule. Pain occurs as a result of capsular tension, and extension is inhibited. C) CSA (Manipulation) of the joint involving flexion and gapping, reduces the impaction and opens the joint to encourage re-entry of the meniscoid into the joint space (D) Realignment of the joint.

Note.* "Mechanisms and Effects of Spinal High-Velocity, Low-Amplitude Thrust Manipulation: Previous Theories," by D. W. Evans, 2002, *Journal of Manipulative and Physiological

***Therapeutics, 25*(4), 253. Copyright 2002 by Elsevier.**

This first part of a 5-part series covers the osseous mechanics of what the chiropractic spinal adjustment is comprised of. Part 2 will cover the ligamentous involvement from a supportive and neurological perspective. The topic of part 3 will be spinal biomechanics and its neurological components. Part 4 will be an in-depth contemporary comparative analysis of the chiropractic spinal adjustment vs. physical therapy joint mobilization. The final part will be a concise overview of the chiropractic spinal adjustment.

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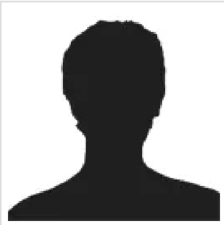

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