Perspectives on the Lateral Atlas:

A review of the literature

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Narrative: Upper Cervical Chiropractic adjusting has long revolved around the lateral atlas, but controversy has followed. Biomechanics indicates that the atlas has no lateral flexion on the axis, raising questions about the nature of the lesion.

An exploration of the literature demonstrates various reference points used, which lend themselves to various understandings and adjustments, prompting me to describe a variety of adjusting styles.

Given the preeminence of the upper cervical region granted by neurology and morphology, a clearer idea of the aim of the Chiropractic adjustment is desired.

Indexing Terms: Chiropractic; Upper Cervical; biomechanics; adjusting; technique history; lateral atlas.

Introduction

From the time of BJ Palmer's all or nothing declaration of '*hole in one*' (HIO) in 1931, (Wardwell, 1992, p. 83) various groups refined approaches to adjusting the upper cervical spine. However, a subset of skills, generally known as '*upper cervical specific technique*', has generally been a take it or leave it proposition within the profession. (Eriksen and Rochester, 2007)

... 'it has been said that specificity lies with intent. A clear understanding of how biomechanics relates to adjusting is essential to maximising the effect of the Chiropractic adjustment ...'

Adjustment of the upper cervical region is very common within all paradigms of Chiropractic, and is referred to in different ways. The *Motion Palpation Institute*, for example, has taught seated palpation of both the atlantoaxial (AA) and occipito-atlantal (OA) joints for many years, with adjustive techniques for the upper cervical region taught seated, prone, and supine (Faye and Schafer, 1989). Gonstead used a combination of knee chest toggle recoil and seated adjustive techniques, seated motion palpation, and radiographic mensuration (Herbst, 1989). In a similar fashion, Thompson adopted BJ's drop piece toggle recoil into his full spine technique without alteration, including x-ray analysis. (Hyman, 1995)

Anatomy

The anatomy of the region being morphologically distinct from the rest of the spine has been a factor in some authorities viewing the upper cervical spine as preeminent in function. Various attachments of the dura have been noted, from the occiput, C1-C3, C7/T1, and various lumbar segments, down to a low attachment at S3, finally anchoring the filum terminale at the coccyx. (Unal and Sezgin, 2021) The C1 dorsal root exits between atlas and occiput, becoming the suboccipital nerve, which supplies the muscles of the suboccipital triangle. (Williams et al, 1995, p. 1263) This may account for authors noting suboccipital trigger-points and atlas transverse process tenderness with OA restrictions, (Davies, 200, p. 313; Lewit, 1988, p. 88-89; Faye, 1989, p. 121) and with AA restrictions. (Mennel, 1960, p. 107) Occipital neuralgia is a well-recognised cause of headache, and may be related to C2 dorsal root ganglion (DRG) compression. (Williams et, 1995, p. 1263)

Nonetheless, the lesion-in-common between all the different techniques can loosely be referred to for the purposes of this paper as the lateral atlas. While there is a very plausible argument to describe Chiropractic listings in terms of motion analysis, these become unwieldy for documentation. Therefore, this author utilises static listings specifically because they succinctly indicate the line of drive by articulating position. This is also still in keeping with the 'asymmetry' in the Medicare PARTS format widely used to substantiate the need for care in the insurance world.

Many different neurologic mechanisms and effects have been reported and discussed with regard to upper cervical adjusting. Grostic (1988) postulated the dentate ligament distortion hypothesis. Thompson practitioners discuss interference with the postural centres of the reticular activating formation. (Hyman, 1995, p. 36) Lu and Ebraheim (1998) observed that the C2 DRG fills 76% of the C1/2 neural canal, and that this level is the largest DRG in the cervical spine. Furthermore, Keith (1986) notes rotation and hyperextension can pinch the C2 DRG between the atlas and axis posterior elements. The dorsal ramus of C2 branches into the greater occipital nerve, which supplies cutaneous sensation to the posterior aspect of the skull. Knutson (1997) articulates a theory of synovial meniscoid or plica entrapment.

Chiropractors have also observed a relationship between the upper and lower limits of the spine. (Blum, 2004). The occiput is said to rotate ipsilaterally with the sacrum, C1 ipsilateral with L5, and C2 ipsilateral with L4. The rest of the spine is paired, but in contralateral rotation, e.g. C3 rotates opposite L3, following superior until the centre of the process at T5 and T6. This has been referred to primarily as the *Lovett Reactor*. (Blum, 2004) Different explanations have been cited for the phenomenon, from the gait cycle to (the aforementioned) dural attachments, to tonic neck reflexes. The chief importance given to the Lovett Reactor by Chiropractors is a potential cause of compensation from a distant area.

An explanation for the Lovett reactor that has not been explored to date is that of spinal coupling patterns in the same segment. According to Panjabi and White, (1990) lumbar rotation is coupled to contralateral side-bending. In contrast, lower cervical rotation is coupled to ipsilateral side-bending. These two patterns meet roughly in the mid-thoracic spine. Interestingly enough however, the upper cervical region couples rotation with contralateral side-bending, just like the lumbar spine. This suggests the same pattern proposed with the Lovett Reactor.

Clinical assessment

Regardless of any subluxation hypothesis, assessment of upper cervical function in Chiropractic primarily revolves around three things:

- x-ray analysis
- leg length, and

- palpation, motion or static.

Numerous early Chiropractic authors noted a relationship with the short leg and atlas, as well as the pelvis. Upper Cervical Chiropractors often use a supine leg check, and feel the presence of inequality indicates a need for adjustment that day on the listing established from patient x-rays. (Eriksen and Rochester, 2007) Thompson's algorithm uses a series of manoeuvres to derive a cervical listing, including the occiput bilaterally posterior, although true atlas listings are only derived from x-rays. (Hyman, 1995) No less than Dejarnette even included the short leg as an indicator of the lateral atlas in his 1984 *Sacro-occipital Technique Manual*. (Dejarnette, 1984) It should be noted that leg length assessment is also used for pelvic assessment.

Both Thompson, (Hyman 1995) and Dejarnette (1984) note the short leg that goes long with knee flexion as a posterior ilium indicator, and the short leg that is unchanged as an anterior ilium indicator. Similarly, Gonstead felt the PI ilium was on the short leg side, and the AS ilium on the long leg side, relative to L5 body rotation, albeit measured via X-ray. (Herbst, 1989) This also coincides with Hugh Logan's statement (1950) that the body of the lowest freely movable vertebra will rotate to the low side of the sacrum.

Wiegand (1994) proposes that the gait cycle, as described by Greenman (1990) is the primary mechanism for compensation within the spine. Anterior displacement of the head must be compensated for in order to maintain balance. Offsetting body masses, such as the ribs and pelvis can effectively counterbalance this, but must be done in a fashion that the joints will tolerate. Large movements are likely to cause insult to ligaments, but the smaller sequential movements of gait would be less likely to.

When biomechanics of the upper cervical region are explored, difficulties emerge with the idea that the atlas is 'lateral'. (Panjabi and White, 1990) Up to 40% of the flexion and extension found in the cervical spine is located at the OA joints, depending on the reference. Coupled motion at the OA, as previously discussed, is found in extension, ipsilateral side-bending, and contralateral rotation, with an ipsilateral translation of the atlas. However, in contrast to the OA joints, coupled motion at the AA joints is exclusively inferior translation with rotation. Some 50% of the rotation of the cervical spine is located at the AA joints. In carefully reading the biomechanics literature, there is no side-bending or lateral translation at the AA joints.

> The most common factor among the technique systems in adjusting atlas is a lateral to medial line of drive. If this is the case, what is happening during the lateral atlas adjustment?

Biomechanics of adjusting

In the classic scenario (HIO), the patient is right lateral recumbent with the headpiece elevated to align the neck with the rest of the spine. (Hyman-Folmar, 1996) This is also performed often with a cervical drop piece. (Hyman-Folmar, 1996) Excluding any other vectors, a lateral to medial force is induced on the left atlas transverse process. According to Panjabi and White, (1990) this will create an obligatory coupled motion of the occiput, specifically the right condyle, in extension, right side-bending, and left rotation. On the left side, this will decompress the OA joint. However, a force applied to atlas will not simply affect the OA joints. A rapidly applied force may lift the C1 facet up along the surface of the C2 facet, a reversal of the coupled motion seen as AA rotation returns to anatomical position. The adjustment may therefore have the effect of decompressing the C2 DRG, in addition to decompressing the C1. This might be termed a 'multi-segmental' adjustment.

In biomechanical descriptions, there is a difference between 'upper cervical specific' and 'full spine specific' techniques. As an example of the full spine techniques, *Motion Palpation* [Institute] describes moving atlas on axis using atlas contacts, and moving occiput on atlas using occipital contacts. (Faye and Schafer, 1989) *Upper Cervical Chiropractic* however, uses the lateral atlas contact to reorient atlas under the occiput, and axis contacts to rotate axis under atlas. (Hyman-Folmar, 1996) Furthermore, Wernsing hypothesised that the atlas moves on the occiput as the rim of a circle, and likewise, but a smaller circle on axis (Eriksen and Rochester, 2007). In short, *Motion Palpation* references the joint below, and upper cervical techniques reference the joint above. What this means is that in *Upper Cervical Chiropractic*, atlas refers to the OA joint, and axis refers to the AA joint, but in *Motion Palpation* atlas refers to the AA joints and axis refers to C2/3.

Upper cervical listings classically are derived, as in Palmer, from the APOM and lateral X-ray views, into a series of 16 four letter abbreviations. (Hyman, 1995; Hyman-Folmar, 1996) More contemporary techniques may utilise degrees, referenced via the orthogonal coordinate system. (Eriksen and Rochester, 2007) To the APOM and lateral views, these techniques have added the base posterior view, which allows an axial perspective on atlas, and the nasium view, which allows an unobscured view of the occipital condyles. In either case, what is sought is a three dimensional understanding of atlas positioning.

Assisted adjustment

While HIO is generally performed with a drop piece as noted above, osseous adjusting of the upper cervical spine is generally not done in this lateral recumbent positioning. More typically, as referred to above, occipital contacts are used to 'adjust' occiput on atlas, and atlas contacts to 'adjust' atlas on axis. These are what are generally referred to as assisted adjustments, where adjustive contact motion assists motion of the segment. (Bergman et al, 1993) Most commonly, the osseous adjustments used to move occiput on atlas, done seated, prone or supine, are referred to occipital lifts. As specified, these adjustments are designed to move only one segment. (Faye and Schafer, 1989)

Resisted adjustment

There is another category however, known as resisted adjustments, where contact motion is opposite to preload of the head. (Bergman et al, 1993). Janse et al (1947) illustrate a lateral atlas osseous adjustment using a lateral to medial thrust on the atlas transverse process with the head rotated away. This adjustment is ostensibly to 'move' atlas on occiput for lateral flexion, but might be better termed 'resisted anterior to posterior rotation' by the *Motion Palpation Institute*. (Faye and Schafer, 1989) With the head rotated approximately 45° contralaterally and side-bent ipsilaterally, a thrust lateral to medial and posterior to anterior on the atlas transverse process could potentially move the the anterior occiput relatively posterior. This would create the coupled ipsilateral rotation and glide of occiput. While this can be a pisiform-transverse process contact, it could also be 2nd metacarpophalangeal-posterior arch contact.

In contrast, a resisted adjustment of the axis on atlas with the same preload works well because the coupled motion of C2/3 is ipsilateral to side-bending, locking C3 to free the axis to move better under the atlas. With atlas rotation almost locked out, a force directed to the C2 spinous process lateral to medial (L→M) and superior to inferior (S→I) may reverse the coupled motion of inferior glide, decompressing the C2 DRG.

Static description

In static terminology, a posterior atlas on the right would be relative to an anterior occiput on the right. A number of different technique systems have discussed this anterior occiput and the adjustment of it.

It would seem to be an important issue given the prevalence of forward head carriage. Gonstead positions the doctor behind the seated patient, applying anterior to posterior force to the skull. (Herbst, 1989) *Motion Palpation* believes the occipital lifts can clear all restrictions at the occiput. (Faye and Schafer, 1989) Regardless, it has been my experience that preloading exclusively for occipital flexion to result in a cavitation can be quite difficult. In contrast, *Motion Palpation* teaches a seated occipital lift which more easily preloads occipital flexion and releases it with a long axis traction vector. (Faye and Schafer, 1989)

Radiographic measurements

Upper cervical techniques assess the upper cervical spine primarily with X-ray, and use unique measurements. Among these are termed the 'upper angle' and the 'lower angle', both measured in the coronal plane. Essentially, the upper angle measures how perpendicular the central axis of the skull is to the C1 plane line, and the lower angle measures how perpendicular the C1 plane line is to the lower cervical spine. Tilting of the occiput found on the upper angle, ipsilateral to tilting of the lower cervical spine on the lower angle is referred to in Orthospinology as, '*into the kink*'. Another way of putting it, '*Into the kink*' refers to alterations in the lower angle ipsilateral to atlas laterality. (Eriksen and Rochester, 2007)

A retrospective survey of patient files compared various assessment tools, including leg checks, thermography, palpation, and postural evaluation, to x-ray analysis. The survey found that observed head tilt, '*into the kink*' had the highest Kappa agreement with X-rays. (Eriksen, 1996) This is notable because isolated OA lateral flexion would be uncoupled, forcing the head into transverse plane neutral while preventing coronal plane coupling.

Leg Length inequalities

We also know from early research in the 1960s that movements of the head produce positional changes in leg length. (Hellebrandt et al, 1962) Classic within chiropractic is the *Derifield leg check*, where rotation of the head is said to equalise or distort (depending on the circumstances) relative leg length. (Hyman, 1995) Hellebrandt et al (1962) found cervical rotation lengthens the ipsilateral leg and shortens the contralateral leg. This would be peculiar as an indication of OA restriction, given the minimal rotation at that segment; it would make more sense as an indication of limited AA rotation.

It may be observed that a reciprocal relationship exists of hyper and hypomobility between the occiput and axis. AA rotation is isolated with full cervical flexion; this locks the lower cervical spine into full flexion, and the occiput does not rotate very much, so motion is generally understood to be AA in nature (Dvorak and Dvorak, 1990). Likewise, Jirout (1979) identified that occipital flexion by means of chin retraction will isolate rotation to C2/3. This means that if the occiput is locked in flexion onto C1, more rotation will be demanded of C2/3 than usual. In a similar fashion, if C2/3 is locked into right rotation, then C1/2 begins left rotation much closer to end-range. This means that the occiput must make up the remainder of left rotation that C1/2 no longer possesses. In short, these mechanics appear to make up a reciprocal pattern of hypermobility and hypomobility between the occiput and C2.

Integration of Chiropractic technique systems

The first component in understanding the common factors different technique systems use to understand the upper cervical region is transliteration. *Upper Cervical Specific* references the joint above, (Hyman-Folmar, 1996) and full spine techniques generally reference the joint below. (Faye and Schafer, 1989)

The second component is Upper Cervical biomechanics. The atlanto-occipital joint couples extension with ipsilateral side-bending, contralateral rotation, and ipsilateral translation. The atlanto-axial joint couples rotation exclusively with inferior translation.

The biomechanics literature is clear that there is no side-bending at the atlanto-axial joint. (Panjabi and White, 1990) Therefore, the classic lateral recumbent, toggle recoil adjustment would be termed a '*resisted*' adjustment as the inferior bone is moving opposite of head motion, but only at the atlanto-occipital joint. At the atlanto-axial joint, this would be an '*assisted*' adjustment, lifting atlas superior, off the axis. In contrast, occipital lifts would be only '*assisted*', lifting occiput off atlas. (Bergman et al, 1993) This can be used for either coupled or uncoupled mechanics. It should also be noted that the superior forces would be unlikely to be limited to C0/1; most likely, atlas would also be lifted off axis, as it the toggle recoil adjustment.

Another approach to adjusting most of the cervical spine comes from Faye and Schafer. (1989) A drop piece is used with the patient prone, and the drop set for 45° cephalad. The doctor stands lateral, elbows fully extended, contacting the involved vertebrae with bilateral ulnar knife edges. Preload is provided by drawing the hands apart. The drop is delivered with a *bilateral pec toggle*. The present author uses this for the OA joints, standing opposite the posterior occiput restriction, cupping the occiput with the thumb web of the pronated hand. The pronated inferior hand closes the thumb web down over the the C2 spinous process. Tension is set with a slight counter-rotatory and distractive action to preload the occiput and C2 in opposite directions. This motion is useful for either the posterior occiput restriction or the contralateral anterior occiput (aka the lateral atlas). A similar setup can allow the same adjustment to be used for a posterior atlas, anterior lower cervical restrictions, or other posterior cervical restrictions.

James Cox, DC (2014) has developed a special table for cervical distraction, now in it's eighth version. The headpiece allows for distraction with free movement in all three degrees of freedom. Upper cervical manipulation is termed the 'f*oramen magnum pump*', and contacts the base of the skull. It is performed coupling long Y-axis distraction with ipsilateral lateral flexion and contralateral rotation. While this is low velocity, low amplitude manipulation, the table allows full relaxation for the patient, and ease for the doctor.

In both the cases of Gonstead and Thompson, they adopted BJ Palmer's toggle recoil analysis and adjusting, without modification. (Herbst, 1989; Hyman, 1995). However, I believe the biomechanics of the region suggests that both Gonstead and Thompson thought in terms of the inferior segment, and as a result the Palmer listing system was incongruent with the theoretical foundation of the rest of the system.

Pettibon and Harrison are interesting in this regard because they also began with upper cervical (personal communication from Dr Ronald Aragona, confirmed by personal communication Dr Ray Wiegand), but each of them expanded their approach to the entire spine, although using a theoretical foundation which entirely sidestepped these issues. While Harrison et al (1998) purport a very high number of coupling patterns, most authorities are consistent with Panjabi and White, which are the biomechanics used in this paper.

Conclusion

While published, peer-reviewed research is exceedingly important for scientific and cultural authority, it must be noted that this is not an even playing field. The funding for such research in medicine in a single year likely dwarfs that of all funding ever for research in chiropractic. For practical reasons therefore, other indications of good clinical practice are important.

In such a fractious and divided community as Chiropractic, it may become useful to note practices found useful by a majority of doctors. For example, both the drop piece and Derifield pelvic leg check are widely used by field doctors, present in numerous technique systems, and taught in most Chiropractic colleges, but neither are comprehensively researched.

Another example would be the muscular hypertonicity and osseous tenderness frequently noted at fixated segments. With the limited nature of Chiropractic research, the widespread nature of these practices can lend them a certain amount of deference when weighed against the non-existent alternatives. Regardless, it has been said that specificity lies with intent. A clear understanding of how biomechanics relates to adjusting is essential to maximising the effect of the Chiropractic adjustment.

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Cite: Baroody SB. Perspectives on the Lateral Atlas: a review of the literature. Asia-Pac Chiropr J. 2025;5.4. apcj.net/Papers-Issue-5-4/#BaroodyLateralAtlas

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