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A comparative analysis of Applied Kinesiology Upper Cervical Vertebral Challenge Technique and Upper Cervical radiographic examination

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Introduction: Upper cervical (UC) chiropractic has a more than 70-year history of pursuing empirical research, making many consider UC examination as the 'gold standard' for evaluating the UC spine. Applied Kinesiology utilises Vertebral Challenge Technique (VCT) as one tool to determine the presence and direction vertebral subluxation.

Objectives: The purpose of this research is to present a preliminary assessment of the accuracy of the AK VCT when applied to the UC spine by comparing it to established UC protocols, which provide an excellent reference for comparison.

Methods: Patients selected for this study underwent a normal initial evaluation, consisting of history, history based exam, manual muscle testing exam, and UC examination. Additionally, VCT was applied to the CCJ and results for atlas laterality and rotation were recorded. Pre-adjustment VCT results were compared to UC radiographic measurements to determine agreement between these two evaluation procedures and determine the accuracy of VCT when applied to the CCJ.

Results: Twenty-seven patients were included in this study. Multifactorial analysis showed that when compared to UC radiographic pre-adjustment measurements, pre-adjustment VCT showed an agreement range of 3.7%-47.6%. Post-adjustment agreement increased to 96.3%

Conclusion: The lack of agreement with pre-adjustment radiographic, orthogonal model measurements of the CCJ suggests that pre-adjustment VCT applied to the atlas may not be an effective method for determining the direction of correction to reduce CCJ misalignment. However, due to the dramatic increase in agreement post-adjustment, more investigation is warranted.

Indexing Terms: Chiropractic; Upper Cervical; Atlas Orthogonal; Applied Kinesiology; Subluxation; Manual Muscle Test, MMT; Vertebral Challenge Technique; Craniocervical Junction; NUCCA.

Introduction

The chiropractic subluxation has had many definitions over Chiropractic's history and that definition varies between organisations with modern definitions slanting toward describing a functional entity over a purely structural problem. (1, 2) Much like Applied Kinesiology (AK), upper cervical (UC) chiropractic's thought process encompasses this functional paradigm with its focus on correcting subluxation with the goal of improving overall function

> *… pre-adjustment VCT applied to the atlas may not be an effective method for determining the direction of correction to reduce CCJ misalignment…'*

and general health. UC also mirrors the AK thought processes by focusing on *when* to adjust, not just *where* or *what* to adjust. (2, 3)

UC has a rich history with its first introduction as '*Hole in One*' (HIO) by BJ Palmer at the 1931 Lyceum and later in print in 1934 in the text '*The Subluxation Specific - The Adjustment Specific*'. (2) After this introduction, a multitude of upper cervical techniques (UCT) developed with differing thought processes, methods of analysis, and corrective procedures. Despite these differences, all UCT focus on making corrections the craniocervical junction (CCJ) defined as:

> 'the junction of the base of the skull and the cervical spine including the occipital bone, surrounding the foramen magnum (occiput), C1 (atlas), C2 (axis) and the intervening tendons, and ligaments'. (2)

Today, there are two major thought processes within UC:

- the articular model which focuses on correcting misalignments relative to the articulations of the CCJ and includes Knee Chest, Toggle Recoil, and Blair techniques, and
- the orthogonal model which focuses on correcting relative misalignments of the CCJ measured in the anatomical planes and includes Grostic, NUCCA, Orthospinology, Atlas Orthogonal (AO), and Advanced Orthogonal (AdvO) techniques. (2, 4)

All UCTs have the goal of reducing the radiographically measured misalignments to improve overall neurologic function and general health. The importance of the goal of UC correction is echoed by Walther in the text, *Applied Kinesiology, Synopsis, 2nd Edition*, where, in his description of Primary Atlas Technique, he states '*Maintenance of proper upper cervical function is paramount to normal function of the nervous system*'. (3)

Included in UC's long history within chiropractic is a 70+year history of research into the theory that the CCJ misalignment is the primary misalignment that needs correction. (2) This research extends into the areas of anatomy, clinical cases, clinical trials, examination and examiner reliability, and technique and instrument development. The results of this ongoing research has led to greater understanding of the intricacies of the CCJ and the impact dysfunction of this area can have on human function, as evidenced by the myriad of case and clinical studies covering a diverse set of conditions including, but not limited to: neck pain, headache and migraine, blood pressure dysregulation, epilepsy, Parkinson's disease, Multiple Sclerosis, concussion, Menière's disease, scoliosis, and immune system function. (1, 2, 4, 5 … 13)

Mechanistic research is underway to attempt to discover why such a diverse set of conditions seem to respond a two by two grid, representing the areas palpated, and along with LLI indicate the need for radiographic examination to determine the adjusting vector and table placement. SP examination occurs before and after treatment with the expectation of a reduction in severity grade after the correction is made. (15, 16)

Radiography

UCTs utilise radiographic analysis (pre x-ray) as another tool to determine the presence and degree of misalignment of the CCJ. The use of radiographic measurement of UC subluxation has sixty years of evidence supporting its use, with investigations showing sufficient to excellent inter- and intra-examiner reliability. (2, 4)

UC radiographic analysis also utilises x-ray measurements after the adjustment (post x-ray) to measure the degree of correction and potentially alter adjustment parameters to achieve a more complete reduction of the CCJ misalignment toward an orthogonal state. Greater reduction of the CCJ misalignment is associated with better patient outcomes and fewer adjustments. (4, 15, 16) The high level of reliability makes UC radiographic analysis an excellent tool for testing the concurrent validity of VCT.

The typical series of UC radiographs include (with alternative nomenclature in parentheses):

- Lateral Cervical (Sagittal), taken to visualise the cervical spine and measure the angle, relative to level, of the atlas posterior arch and the angle of the superior facet of C2 to set the angles for taking accurate Frontal and Axial radiographs
- AP Open Mouth (Axial), taken to visualise the odontoid, C2 spinous rotation, and measure the Axial Circle.
- Frontal (Nasium), taken to make the majority of the orthogonal system measurements, including Atlas Frontal Plane Line (AFP), Atlas Cephalic Displacement (ACD), Cervical Spine Angle (CS)
- Horizontal (Vertex/Base Posterior), taken to measure Atlas Horizontal Rotation (AHR). (2, 15, 16)

For this investigation, AO and AdvO radiographic analysis was used and discussion will be focused on those procedures. In both AO and AdvO procedures, x-rays are taken in the sagittal, frontal, and horizontal planes to construct a three-dimensional measurement of the CCJ misalignment and calculate a correction vector. The measurements of note for this comparison are:

- Laterality, recorded as ACD, and is defined as the side of acute angle between the AFP and Frontal Cephalic Line (FCL)
- Rotation, recorded as AHR, and is defined by the measure of the angle, anterior (acute) or posterior (obtuse), on the side of laterality. (15, 16)

Manual muscle testing

The history of manual muscle testing (MMT) extends back to the original work of Lovett in 1915 and throughout its history, much research into MMT's validity as a diagnostic tool has been performed. Overall, this research has demonstrated that MMT showed good repeatability and good inter-examiner reliability. (3, 17) Cuthbert and Goodheart summarise this data in a narrative review that also discussed some of the challenges related to the research into the validity of MMT as it applies to AK procedures. They also present a discussion of the different types of validity that should be considered when pursuing further research. (17)

The Cuthbert & Goodheart article was reviewed by Hass et al and while that reinterpretation contained some valid points in regard to various aspects of '*search methods, inclusion criteria, quality assessment, [etc]*' (18) I think that Hass et al misinterpreted the intent of the Cuthbert & Goodheart article which seemed to have the goal of establishing that MMT was a reliable and reproducible tool to aid in the diagnostic process, of which AK procedures can be a part of. They also discuss the hurdles that plague research into AK muscle testing outcomes and AK treatment procedures in an attempt to catalyse interest into that difficult research. (17)

Vertebral challenge technique

VCT is one of the cornerstones of AK procedures, aiding the practitioner in finding the optimal contact and direction needed to correct a vertebral subluxation. According to Walther, a vertebral subluxation can be challenged by applying pressure on the spinous or transverse processes to rotate or tip a vertebra and then releasing that pressure. If the intrinsic muscles of the spine are dysfunctional, they will overreact to this stimulus making the subluxation worse. This worsening of the subluxation will *stress* the nervous system and a previously strong muscle (PSM) will weaken on subsequent testing. (3)

VCT applied to the CCJ can be complicated by high mechanoreceptor density, intricate muscle control, and complex connective tissue interactions.

Once a corrective adjustment is applied to the vertebra, the vertebra should no longer challenge with VCT. (3, 15, 16)

Methods

Patient selection

Subjects for this study were randomly selected from new patients from January 1, 2021 through December 31, 2022. Selected patients were included regardless of primary complaint and were also included if the results of the UC evaluation yielded no CCJ misalignment. All selected patients were informed of the investigation and its purpose, informed that there would be no alteration in care, and written consent to anonymously use examination data was obtained.

Pre-evaluation

Initial evaluation of patients included in this study did not differ from the normal initial evaluation for a new patient and consisted of history collection, examination based on that history, AK MMT of 48 muscles bilaterally to construct a list of facilitated (strong) and inhibited (weak) muscles to work from, and evaluation for CCJ misalignment using AO and AdvO protocols, including functional LLI via SLC and SP as described above.

For this investigation, selected patients underwent additional testing that included VCT applied to the atlas. This was a rebound style test challenged as described by Walther, (3) checking for laterality and rotation of atlas, and was performed using a previously identified strong muscle, noted in Table 1.

The order of examination procedures was purposefully designed to essentially blind the practitioner and avoid influence by the radiographic analysis results on the VCT applied to the atlas and progressed as follows:

1. AK MMT of 48 muscles and results recorded
2. Pre-functional LLI evaluated and results recorded
3. Pre-scanning palpation performed and resulted recorded
4. Pre-VCT applied to atlas and results recorded
5. Pre-radiographic analysis performed, if indicated
6. 6. Adjustment of the CCJ performed, if indicated.

CCJ adjustment procedure

The adjusting protocol used in this study followed AO and AdvO procedures, utilising a Spinalight model 310 AO instrument. (15, 16) This instrument delivers a solenoid driven, percussive impulse that imparts a mechanical wave into the CCJ at a prescribed angle to make the CCJ alignment correction. The adjusting procedure involves:

- Setting the table-mounted adjusting instrument to the appropriate Z- and Y-axis correction vector based on radiographic measurements
- Placing the patient side-lying with the mastoid supported on the headpiece
- Positioning the patient's shoulders and setting headpiece height to accommodate biomechanical factors measured on the radiograph.
- Measuring the head height angle of the patient and correcting the Z-axis vector based on this measurement. (16)
- Positioning the adjusting instrument stylus with the appropriate lead to the C1 transverse process
- The instrument is activated and the corrective impulse is delivered.

Post-evaluation

Post-adjustment examination procedures also did not differ from the normal new patient protocol, except for the addition of VCT applied to the atlas and progressed as follows:

1. Post-scanning palpation performed and resulted recorded
2. Post-functional LLI evaluated and results recorded
3. Post-VCT applied to atlas and results recorded.

I do not routinely perform post x-ray analysis, opting to use clinical findings such as not holding an adjustment, lack of change in symptoms, or side effects to indicate the need for post x-ray analysis. No patients included in this study demonstrated any indications to perform post x-rays.

Statistics

The goal of this research is to present a preliminary investigation of the accuracy of the AK VCT when applied to the UC spine by comparing it to established UC radiographic measurements in an effort to improve patient evaluation, care, and outcomes under AK procedures.

This preliminary research attempts to answer the question, *Does AK VCT provide the same listing as radiographic upper cervical analysis*? To answer this question the following null and alternative hypotheses were constructed and are presented respectively:

- *If an atlas misalignment is present and it is assessed utilising AK VCT and AO/AdvO examination procedures, then the results of those examinations will be different*
- *If an atlas misalignment is present and it is assessed utilising AK VCT and AO/AdvO examination procedures, then the results of those examinations will be the same*.

Due to the potential errors in the calculated statistical significance (α-value) that can be produced by the small sample size of this study and the preliminary nature of this investigation, α-value and p-value will not be utilised for null hypothesis evaluation. (19, 20, 21) Instead, a conceptual discussion of the data, their meaning, and the potential reasons for the outcomes will be undertaken. This discussion will be used to either accept or reject the null hypothesis.

Results

Twenty-seven (27) patients were included in this investigation and the following were recorded for each:

- Pre LLI measurement
- Pre Scanning Palpation results
- Muscle used to perform VCT
- Pre atlas VCT results
- AK indicated listing
- Radiographically measured listing
- Post Scanning P
- alpation results
- Post LLI results
- Post atlas VCT results

The pre-adjustment data collected (Table 1) indicated that, according to AO/AdvO examination standards, the presence of LLI and positive scanning palpation findings, a misalignment of the CCJ was present in 26 of the 27 patients included in this study. The one patient not demonstrating a CCJ misalignment was included in this analysis because the accuracy of VCT should be independent of the presence of an atlas misalignment, meaning if there is no atlas misalignment, VCT should be negative in all directions of challenge.

Pre-VCT results were recorded based on the direction of the rebound challenge (ie. left to right challenge indicated by L>R or left to right with anterior to posterior challenge indicated by L>RAP) with (+) meaning a PSM weakened with the challenge and (-) meaning a PSM did not weaken with the challenge. If VCT results did not definitively indicate laterality, '*Inconclusive*' was recorded because of the need to identify laterality to determine rotation in UCT. Despite this limitation, rotation was still compared when possible. '*No Listing*' was recorded if no positive challenges were obtained by VCT. Where VCT did determine laterality but rotation was inconclusive, the listing was recorded as both anterior and posterior (ie. LA&P).

Comparison of the VCT results and the radiographic measurements (Table 2) was divided into laterality agreement and rotation agreement. Agreement was classified as '*Yes*', '*No*', and '*NA*' in the case of an inconclusive VCT laterality results.

Data analysis (Table 3) showed that VCT results had poor agreement with the radiographic measurements, whether comparing the total listing agreement (*yes* for both laterality and rotation agreement), laterality agreement alone, or rotation agreement alone. The poor agreement improved slightly when the inconclusive laterality VCT results were excluded. Rotation agreement analysis was complicated by VCT that yielded anterior & posterior results.

The post-adjustment data collected (Table 4) indicates that, according to AO/AdvO examination standards, the misalignment of the CCJ was corrected in all 26 patients who initially showed CCJ misalignment. Post-VCT results were recorded in the same manner as the pre-VCT.

Comparison of post-VCT to the post-AO/AdvO examination yielded a dramatic increase in agreement where only one case showed VCT results that disagreed with the AO/AdvO examination results (Table 5), suggesting that the removal of neurologic insult at the CCJ improves the reliability of VCT.

The results of the data analysis, while not fully quantified with α- and p-values, conceptually show that pre-VCT applied to the atlas does not have enough agreement with radiographic, orthogonal model measurements of the CCJ to reject the original null hypothesis and may not be an effective method for determining the direction of correction to reduce CCJ misalignment. However, due to the dramatic increase in agreement post-adjustment, more investigation is warranted.

Table 1: Pre-adjustment test results

Pre Leg Length	Pre Scanning Palpation		Muscle Used	Pre L>R	Pre L>RAP	Pre L>RPA	Pre R>L	Pre R>LAP	Pre R>LPA
LSL 3/8"	3 3	2 2	L Middle Deltoid	+	+	+	+	+	+
LSL 1/2"	1 2	3 3	L Middle Deltoid	+	-	+	-	-	-
RSL 1/8"	2 3	2 3	R Latissimus	+	-	+	-	-	-
LSL 1/4"	0 2	1 2	L PMC	+	+	+	-	-	-
LSL 1/4"	3 2	2 2	R Serratus Anterior	+	+	-	+	-	+
LSL 3/4"	0 0	1 2	R PMC	+	-	+	-	-	-
LSL 1/4"	2 2	2 3	L Latissimus	+	-	+	-	-	-
LSL 1/4"	2 2	2 2	L Latissimus	-	+	-	+	+	+
LSL 1/4"	2 2	2 3	L Ant Deltoid	+	+	-	-	-	-
RSL 1/4"	1 1	2 2	L Latissimus	+	+	-	-	+	-
RSL 3/4"	0 0	0 0	L Latissimus	-	-	-	-	-	-
RSL 1/4"	3 3	2 3	L Biceps	+	+	+	+	+	+
E	2 1	1 1	L Latissimus	-	-	-	+	+	+
LSL 1/2"	2 2	2 3	L Biceps	+	+	+	-	+	+
LSL 1/2"	1 1	2 3	L PMC	+	+	+	-	-	-
RSL 1/4"	1 1	2 2	L Ant Deltoid	+	+	+	+	+	+
LSL 1/2"	3 2	2 3	L Latissimus	-	-	-	+	+	+
LSL 1/4"	1 2	2 3	R PMC	+	+	+	-	-	-
RSL 1/4"	1 1	2 3	R Biceps	+	+	+	+	-	+
E	1 2	2 3	L Latissimus	+	+	-	-	-	-
RSL 1/4"	2 2	2 2	R PMC	+	+	+	+	+	+
RSL 1/2"	2 1	2 3	L Latissimus	-	-	-	-	-	-
RSL 1/2"	2 2	1 1	R Latissimus	-	+	-	+	+	+
DNP	2 2	2 3	L Latissimus	+	+	+	-	+	+
LSL 1/4"	2 2	2 3	L Latissimus	-	-	-	+	+	+
RSL 1/4"	2 2	2 2	L Latissimus	-	-	-	+	-	+
LSL 1/8"	3 3	1 2	L Latissimus	-	-	-	+	+	+

Table 2: AK VCT and AO/AdvO listings with agreement results

AK VCT Indicated Listing	X-ray Measured AO/AdvO Listing	Laterality Agreement	Rotation Agreement
Inconclusive	R6 P32	NA	NA
LP	R27 P7	No	No
LP	R18 A6	No	Yes
LA&P	L10 A10	Yes	NA
Inconclusive	R 27 A6	NA	No
LP	R11 P10	No	No
LP	R6 A9	No	Yes
RP	L1 P85	No	No
LA	L2 P60	Yes	No
LA	L11 P13	Yes	No
No Listing	Not X-rayed	NA	NA
Inconclusive	L12 A9	NA	NA
RA&P	R20 P12	Yes	NA
LA&P	R7 P19	No	NA
LA&P	R32 P1	No	NA
Inconclusive	L18 A15	NA	NA
RA&P	R8 A43	Yes	NA
LA&P	L9 A17	Yes	NA
Inconclusive	L4 A3	NA	NA
RA	R19 P3	Yes	No
Inconclusive	L6 P6	NA	NA
No Listing	R3 P73	NA	NA
RP	L23 A6	No	Yes
LA&P	L12 A11	Yes	NA
RA&P	R33 P2	Yes	NA
RP	L9 P31	No	No
RA&P	L22 P1	No	NA

Table 3: Pre-VCT, Pre-radiographic listing agreement analysis

Total Listing Agreement	Total Listing Agreement w/o Inconclusive VCT	Laterality Agreement	Laterality Agreement w/o Inconclusive VCT	Rotation Agreement	Rotation Agreement w/o Inconclusive VCT	Rotation Agreement w/o A&P and w/o Inconclusive VCT
3.7% (1/27)	4.8% (1/21)	37.0% (10/27)	47.6% (10/21)	14.8% (4/27)	19.0% (4/21)	22.2% (4/18)

Table 4: Post-adjustment results

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<tr><th>Post Leg Length</th><th colspan="2">Post Scanning Palpation</th><th>Post L>R</th><th>Post L>RAP</th><th>Post L>RPA</th><th>Post R>L</th><th>Post R>LAP</th><th>Post R>LPA</th></tr>
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Table 5: Post-VCT, Post-radiographic listing agreement analysis

Total Listing Agreement	Laterality Agreement	Rotation Agreement
96.3% (26/27)	96.3% (26/27)	96.3% (26/27)

Theoretical explanations

The results of this investigation into the accuracy of VCT when compared to what could be argued as the 'gold standard' for evaluating and correcting misalignment and dysfunction of the CCJ yielded surprising data. These data should not be used to throw out VCT as a tool used to evaluate patients, rather they should provoke thought into why these results came out the way they did and foster a spirit of discovery for better methods to challenge and correct this complex area of neuroanatomy.

The lack of agreement between pre-adjustment VCT and UC radiographic analysis was quite surprising and equally surprising was the abundance of agreement between post-adjustment VCT and UC evaluation. As is the case with every individual patient, the reasons for this disagreement are numerous and likely complex. Potential reasons for disagreement found in this investigation will be divided into UCT reasons and AK reasons and will be discussed respectively.

UCTs have a history of pursuing a greater understanding of the anatomy, biomechanics, and function of the CCJ complex. That pursuit has yielded more accurate examinations, radiographic measurements, and correction vectors. Viewed through this paradigm, the reasons for disagreement between VCT and x-ray measurement are potentially found in the CCJ anatomy.

Variations of skull and UC anatomy are common and normal. Many UCTs have tools for assessing these aberrancy's and making corrections to the measurements of the CCJ misalignment for a more accurate listing and subsequent correction. There are particular normal aberrancy's that can impact the laterality determination, including variations in base of skull, variations in C1 lateral mass size and shape, variations in C1 posterior arch, variations in occipital condyle size and shape, and variations in the shape of the parietal bone that effect the measurement of the ACD. (15, 16)

Another important normal variation that is applicable to the results of this investigation is mastoid size and shape because the mastoid can be large enough to block the practitioners ability to contact the transverse process of C1, resulting in VCT that is inaccurate because the practitioner is not actually contacting C1 and is likely contacting C2 when performing VCT.

In cases of trauma or pathology damage to the *apical*, *alar*, or *transverse altantal* ligaments could alter the biomechanics of the CCJ, influencing the results of VCT and possibly requiring a modification of corrective techniques. (1)

AK also has a rich history of innovation and discovery of better ways to evaluate patients and offers numerous possibilities for explaining the lack of agreement between radiographic measurements and VCT, especially in the light of the dramatically increased agreement in the post-adjustment analysis. Walter Schmitt has presented a neurologic hierarchy thought process in his '*Quintessential Applications*' (QA) text and discussion of the AK reasons for lack of agreement between pre-adjustment VCT and UC radiographic analysis will attempt to follow that thought process. (22)

The neurologic impacts of old injuries are discussed by both Walther and Schmitt, with Schmitt placing the treatment of these injuries, through *Injury Recall Technique* (IRT), at the top of the QA rationale. Injuries seem to impact the ankle mortise joint and the upper cervical spine through flexor and extensor reflex patterns, respectively. (3, 22) This disruption of flexor and extensor reflexes may have an impact on the integration of mechanoreceptor, posture, and equilibrium afferent supply, resulting in altered efferent activity and potentially reducing the accuracy of VCT. Support for this explanation may be found in the post-adjustment data of this study with the dramatic increase in agreement once the neurologic insult of CCJ dysfunction was corrected. Additionally, the impact of old injuries on UCT patients who do not 'hold' their adjustments should also be considered by UCT practitioners.

Inappropriate acute or chronic pain can also disrupt MMT results and may have an impact on VCT. Walther describes MMT failure due to pain during the test, while Schmitt seems to suggest that any unresolved, inappropriate pain may alter MMT and AK challenges via spinal cord reflexes. (3, 22) If Schmitt is correct, then pain, even unconscious pain, from the CCJ and elsewhere would have an impact on the accuracy of VCT, reducing VCT agreement with UC radiographic measurements.

Cranial dysfunction could also alter the accuracy of VCT through the firm dural connections to the inside of the skull, foramen magnum, atlas, and axis. Altered cranial movement or misalignment could place transient or constant tension on the dura, altering the movement patterns of the atlas. Alteration of the movement patterns of atlas would likely disrupt mechanoreceptor activity, resulting in VCT challenge results that do not agree with UC radiographic measurements. Additionally, strain on the dura may result in nociceptive afferent input, from the recurrent meningeal nerve, that could further decrease the accuracy of VCT.

Fixations are described as involving two and usually three vertebra which are locked together and demonstrate resistance to individual movement. (3) This definition overlaps with the way UC practitioners think about the CCJ as a functional complex made up of three boney rings and supporting soft tissue structures. (15, 16) Disruption of the movement patterns of the CCJ through fixation phenomenon may hide the presence of an underlying subluxation or alter the results of VCT. The theorised presence of dural tension with vertebral fixation and the dural connection to occiput, atlas, and axis could also disrupt VCT. (3) Due to the direct impact on the structures of the CCJ or the supporting cervical muscles, the fixation patterns that may be most relevant when considering CCJ corrections include occipital, upper cervical, atlas-occiput flexion and extension, lumbar, sacral, and sacroiliac.

The above is not an exhaustive discussion of the potential anatomical and neurological rationale for why the data in this investigation did not support the accuracy of VCT when applied to the CCJ. Rather, it is a start to the conversation about how we can better think critically when presented with clinical challenges and build a bridge of understanding between researchers and practicing clinicians. This bridge is something that must be built so researchers don't toss aside a potentially useful tool simply because there are unsupportive findings or limited support in the current research. Researchers and clinicians must not stop at '*The evidence was limited/ unsupportive/anecdotal, so that must not work*'; instead we must ask the question '*why did that evidence turn out that way*'? and further pursue answers to difficult questions.

Conclusion

AK practitioners rely on VCT to determine the best contact to use and direction to adjust a vertebra. This comparative study of VCT application to the UC spine to what many would consider the 'gold standard' for CCJ evaluation yielded data that was not promising for the use of VCT in pre-adjustment evaluation of the UC spine for subluxation. However, the increase in post-adjustment agreement between VCT and UCT examination shows that there may be other neurological factors at play here, skewing the results of this comparative analysis.

Based on the data from this preliminary look at VCT's accuracy for the CCJ, it seems that there may be a need to consider additional evaluation procedures to accurately assess the CCJ. For the most unresponsive patients, an alteration of treatment procedures may be in order to optimise patient outcomes and the potential for referral for co-management by an UCT practitioner, to achieve clinical goals, should not be ruled out.

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