CANADIAN COLLEGE OF OSTEOPATHY

AN INTER-RATER RELIABILITY STUDY OF A PHOTOGRAPHIC REPRESENTATION OF THE VERTICAL DE BARRÉ (VERTICAL BARRÉ TEST)

JOHN SAGE

THESIS PRESENTED TO THE INTERNATIONAL JURY

OCTOBER 31, 2014

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Date: August 22, 2014

I, Glen Parsons have reviewed the thesis An Inter-Reliability Study of a Photographic Representation of the Vertical Barre Test of my student, John Sage.

By applying my signature to this form I attest that this Thesis meets the standards of the Canadian College of Osteopathy and I approve it for final presentation before a jury of CCO graduates and an international jury.

Glen Parsons

August 22, 2014
(Dated)

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THESIS ADVISOR

Glen Parsons D.O.M.P. CAT(C)

HYPOTHESIS

1. The Vertical Barré test as observed in photographs by trained osteopathic manual practitioners will produce a kappa statistic greater than 0.6 without a plumb line, when assessing the cranial versus caudal landmark differences from the midline.

2. The Vertical de Barré test as observed in photographs by trained osteopathic manual practitioners will produce a kappa statistic greater than 0.6 with a plumb line when assessing cranial versus caudal landmark differences from the midline.

3. The Vertical de Barré test as observed by trained osteopathic manual practitioners compared to the BioPrint software will produce a kappa statistic greater than 0.6 when assessing the cranial versus caudal landmark differences from the midline.

ABSTRACT

The Vertical Barré test is a standing postural observational test that is taught at the Canadian College of Osteopathy (CCO) and other health care disciplines. It is utilized during assessments to gather objective information about the patient's position in space. Theoretically, the test is an indicator of the potential primary dysfunction present in that patient's body allowing an evaluator to assess more efficiently. The purpose of this study is to define the test and to determine how reliable practitioners are when making observations of photographic postural assessments. Four human raters and a computer software program, BioPrint, were raters in the experiment. The BioPrint has been shown to be a validated measuring device that can accurately assess posture of subjects and was utilized to compare the human raters results against a quantifiable result. The results of this computer software were introduced to calculate what has been deemed a greater deviation from the midline by the individual assessments of each rater.

Eighty-four participants, aged 16 to 64, were photographed standing in the Vertical de Barré position on a manufactured board with and without a plumb line strung in front of them for visual reference. A second set of photographs was taken for the BioPrint software program to produce a report with quantifiable data on which the landmark had a greater deviation from the midline. Four manual therapists, three osteopathic practitioners, and one thesis writing osteopathic practitioner analyzed the photographs.

Inter-rater reliability between the human practitioners without a plumb line was 0.24 K coefficient with a 95% CI, while it was 0.37 K coefficient with a 95% CI utilizing a plumb line. When the BioPrint software was introduced to compare human raters to quantifiable data, K coefficients were 0.21 without a plumb line and 0.28 with one.

Finally, inter-rater reliability observational evaluation of the Vertical de Barré test utilizing photographs produces fair agreement especially when utilizing a plumb line for visual reference. The Vertical de Barré is a posture exam that can produce theoretical data but should be a small component to a complete evaluation for confirmation of findings and summation of results.

RÉSUMÉ

Le test Vertical Barré est un test d'observation postural qui est enseigné et utilisé lors des évaluations de recueillir des informations objectives sur la situation du patient dans l'espace. Théoriquement, le test est un indicateur de la dysfonction primaire potentielle présente dans le corps de ce patient, permettant à un évaluateur d'évaluer de manière plus efficace. Le but de cette étude est de définir le test et déterminer comment les pratiquants sont fiables, en faisant des observations au cours d'une évaluation posturale. Quatre évaluateurs humains et un logiciel informatique, BioPrint, ont été evalués dans l'expérience. Le logiciel est un dispositif de mesure validés qui peuvent évaluer avec précision la posture des sujets. Les résultats de ce logiciel ont été introduits pour le calcul de ce qui a été considéré comme un grand écart par rapport à la ligne médiane par les évaluateurs inter aveugle.

Quatre-vingt-deux participants, âgés de 16 à 64 ans, ont été photographiés debout dans la position Verticale de Barré avec et sans fil à plomb tendu devant eux pour référence visuelle. Une deuxième série de photos a été prise pour le logiciel de BioPrint pour produire un rapport avec des données quantifiables sur lesquels repère avait un plus grand écart par rapport à la ligne médiane. Les photographies ont été analysés par quatre thérapeutes manuels, trois praticiens de l'ostéopathie, et une thèse à écrire ostéopathique praticien.

Inter coefficient d'objectivité entre les praticiens des droits sans fil à plomb est de 0,24 K coefficient avec un IC à 95 %, alors qu'il était de 0,37 coefficient K avec un IC à 95 % en utilisant un fil à plomb. Lorsque le logiciel de BioPrint a été introduit pour comparer les évaluateurs humains à des données quantifiables, les coefficients K 0,21 sans un fil à plomb et de 0,28 avec un.

Inter coefficient d'objectivité évaluation observationnelle produit juste accord particulier lors de l'utilisation d'un fil à plomb pour référence visuelle. La verticale de Barré est un examen de la posture qui peut produire des données théoriques, mais devrait être une petite composante d'une évaluation complète pour confirmation des résultats et la somme des résultats.

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TERMINOLOGY

CCO – Canadian College of Osteopathy

EBM – Evidence-Based Medicine

CCP – Common Compensatory Patterns

COG – Centre of Gravity

K – Kappa

CI – Confidence Interval

GPR – Global Postural Re-Education

OMM – Osteopathic Manipulative Medicine

CLOG – Centre Line of Gravity

A-P – Anterior – Posterior

P-A – Posterior – Anterior

REB – Research Ethics Board

1 CHAPTER ONE: INTRODUCTION

1 INTRODUCTION

OSTEOPATHIC EVALUATION

A typical osteopathic objective evaluation would consist of general observations from head to toe, gait analysis, observational screens from the anterior, side and posterior, assessment of horizontal structures both anterior and posterior, and then moving from general to specific mobility tests. An osteopathic exam is conducted in various stages to obtain the most amount of information in an effort to maximize treatment plans and assist the patient in obtaining optimal health. The stages of the exam should progress from a subjective question process, then move to a more objective process. The observational part of the exam should move from global to specific observation and testing, contributing to conclusions of dysfunction and a diagnosis.

During both the subjective and objective processes, the therapist should maintain an open mind while gathering information of the somatic and visceral dysfunctions, as well as considering emotional components that might be contributing to the impairment.

THE VERTICAL DE BARRÉ (VERTICAL BARRÉ)

The Vertical de Barré test is a postural test taught at the Canadian College of Osteopathy (CCO) and in the Posturology discipline, as a tool to assist in the physical examination of a patient. As will be described in detail later in the document, the test requires the subject to stand upright with feet externally slightly rotated while the human observer assesses the subject's position in space. Conclusions from this test have been described as being able to provide information of postural imbalances, dysfunctions, and indicators of physiological compensations as outlined by Gagey and Weber (2004) .

The published material in North America regarding the description of the Vertical de Barré test is obscure (Appendix A), without any peered reviewed evidence even produced. Publications from Europe (Gagey & Weber, 2004; Vallier, 2012; VanTichelen, 1992) where the test was developed have some differences in its description but one common theme with all of them is standing with the feet externally rotated and using a plumb line to make observations. While many therapists use the Vertical de Barré test to assist in their observational testing, it has been observed by the author that many practitioners do not use an actual plumb line clinically to assist them to their conclusions, but rather follow their visual training and make observations of the patient's position in space.

PURPOSE OF RESEARCH

The purpose of this study was to determine if manual practitioners are able to produce a high rate of inter-rater reliability when making observational conclusions on photographs. The BioPrint software program is used as a validated measurement standard (Normand et al., 2007) and is able to produce a quantifiable value against which the rater's conclusions can be compared. Finally, the Vertical de Barré test will be described through the literature review for future reference and provide a correct definition for future students.

The methodology of the research includes utilizing photographs for inter-rater observation while the subject stands in the Vertical de Barré position. While clinically the test is done in real time with live subjects, and observations are made in three dimensional planes, photographs of an anterior view of subjects standing in the Vertical de Barré have been utilized for the research due to the high volume of subjects and multiple raters required to meet statistical power.

REASON FOR RESEARCH

This topic is important for various reasons. The CCO has limited resources on the Vertical de Barré test, and, hopefully, this paper will assist other CCO students and manual practitioners in understanding posture assessment and improve interpretation of the results.

This research is important to understand the validity and importance of the inter-rater component. As a student, observation exercises are often conducted as an education tool but little research validates its efficacy. Often, when one student or teacher makes a comment regarding an observation, it has been observed by the author that a high degree of agreement occurs amongst the group despite any quantitative measure or measuring tool confirmation. For the profession to continue to progress, it must have evidence-based medicine (EBM) for credibility and best practice. This research attempts to bring together both inter-rater validation as well as a quantifiable statistic tool.

Finally, by using photographs of subjects standing in a consistent position and a computer software program that is a validated research tool, this experiment was conducted to investigate what many experienced practitioners believe to be true: skilled manual practitioners can make many consistent accurate conclusions of the person's body and dysfunctions utilizing observational conclusions. An even more important statistic from this experiment will be on how well the raters agree on the observational conclusion.

IMPORTANCE OF RESEARCH

Inter-rater reliability research for manual practitioners is a valuable exercise to challenge what a therapist does, and it asks a practitioner to be critical of his or her skills, testing methods, and review techniques. Inter-rater research lends creditability to the profession by producing assurances as well as examples to provide confidence for the student while developing his or her observational skill set. By utilizing a computer software program that is a validated research tool, the test results can be confirmed and garner much more respect both for the test and the discipline.

2 CHAPTER TWO: LITERATURE REVIEW

2 LITERATURE REVIEW

To fully understand the importance of this research, a number of subjects must be described and previous research presented. The literature review will attempt to outline what information is presented on posture, postural assessment, the Vertical de Barré test, and what other inter-rater studies already conclude in an effort to justify the methodology of this research.

A MeSH search was conducted through the EBSCO database, the AT Still University Database and the Canadian Memorial Chiropractic College Database. Key terms included osteopathy, observation, posture, inter-rater, reliability, validity, Barré, vertical, ascending, descending, kappa, BioPrint, and gravity.

POSTURE AND PAIN

Every day, manual therapists assess patients in an effort to assist the body to return to a state of normality and optimal health. One way that therapists assess is through observation and specific logical testing strategies. Observation of a person's posture can provide much information as it is an expression of our body, our emotions, our dysfunctions, and our overall strength. As stated by Genaidy and Karwowski (1993), "The human body can adopt various types of postures. Typical examples of deviations from the neutral posture around the low back are forward and backward bending, side bending, and rotation" (p. 785). The same authors also write that deviations from the neutral posture are the most frequent form of static effort and "daily exposure to static effort over a long period may result in discomfort as well as pains and aches in the muscles, joints, tendons, and other soft tissues" (p. 785).

POSTURAL ASSESSMENT

As students, manual therapists are educated on conducting consistent structured assessments that include a subjective, objective, and analytical component in an effort to obtain the greatest amount of information to produce an efficient treatment plan. An important component of the objective portion includes the observation of the patient, beginning at the onset of meeting the person and the summation during the static and dynamic observational component.

As Kendal, McCreary, Provance, Rodgers, and Romani, (2005) state; “There must be a standard when evaluating postural alignment” (p.59). Many texts relating to general physical assessment often include a section on observation and postural assessment. Postural assessment is considered important in the information gathering part or objective stage of assessment to assisting the practitioner toward diagnosis. The purpose of this research paper is to examine the Vertical de Barré test and determine if photographic observations are consistent between various practitioners when eliminating the possibility of chance.

Fortin, Feldman, Cheriet, and Labelle, (2011) state, “Physiotherapists and physicians commonly assess posture, and current practice is based on subjective impressions that are not quantified using a reliable and valid measurement scheme” (p. 367). This subjective observation can provide bias conclusions, inaccurate assumptions by the therapist and could mislead students as they develop their clinical observational skills. It is for this reason that quantifiable postural descriptions should be utilized when educating new therapists on postural observational skills, allowing the new therapist to have instant feedback on observations being made.

When posture is defined, while the theme may stay the same, some variations can be described. A study by Luzi, Carlo, and Luzi (2011) quotes five different authors who have some slight variation on the way to describe posture. Ricciardi describes posture as "nothing but the result of a complex interaction among brain, sense organs, and emotional states; the positions we adopt on our own are a kind of topographic map of the human being; it is our way of getting in touch with reality, the physical and mental expression of neuor-vegitative system, of the actual state of mind" (as cited in Luzi et al., 2011, p. 45). Annibalidi indicates "posture, as a complex expression of the state of the nervous system, is substantially the way in which each subject reacts and rules its own body, still or in motion" (as cited in Luzi et al., 2011, p. 45).

Calandriello states, "Standing posture of every person may be represented by the spatial inter-relationship that the head, trunk, arms, and legs assume with regard to each other" (as cited in Luzi et al., 2011, p. 45). Luzi et al. (2011) also cite two articles by Messa and Kendal, describing posture as more about an expression of the physical state and the situation characterized by articulations in any given moment.

Typically posture is examined in a standing position looking at the vertical alignment. Krasnow, Monasterio, and Chatfield redefine static vertical alignment and cite Wells, who states, "While standing, posture is of little importance in and of itself, it is important as the point of departure for the many postural patterns assumed by the individual both at rest and in motion" (2001, n.p.).

Sharpe (2003) describes "Subjective Postural Vertical" as being the position of the head or body with respect to the true vertical. As a manual practitioner clinically examines postures that present during observational analysis, subjective postural vertical becomes important. While the subject thinks he or she is standing straight, compared to the true vertical, there might be significant alterations to the optimal posture.

Optimal posture is described in many different publication types. In the textbook, *Postural Assessment*, Johnson (2012) describes standard posture and standard alignments.

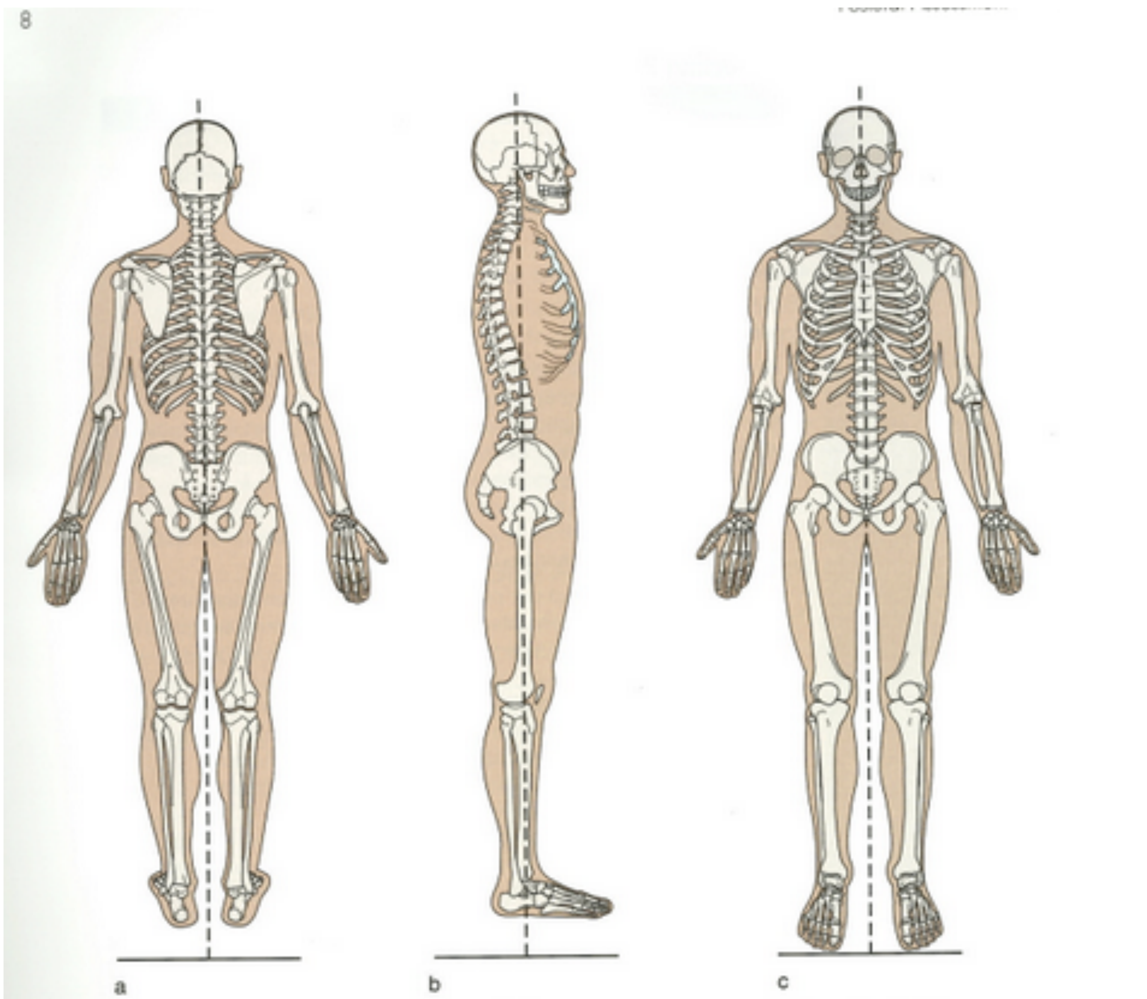


Figure 1 outlines the traditional images of the ideal posture from a posterior, lateral, and anterior view with the plumb line as a reference. Johnson also lists factors that

Figure 1: Ideal Posture with Plumb Line (Johnston, 2012)

might influence posture that includes structural or anatomical factors, age, physiology, pathological factors, and occupational factors, including recreational, environmental, social cultural, and emotional factors.

Posture is dependent on many physiological systems that contribute to the control of the body in space. Humphreys (2008), who presented a review of postural stability and balance tests, states, “It is clear that the visual, somatosensory, and proprioceptive systems of the cervical spine are paramount in controlling posture and balance against gravity” (p. 540). The author also indicates that the head is able to respect the trunk with feedback from the visual, vestibular, and cervical proprioceptive systems. “Input from the occulomotor system is important in postural control because it allows the position of the head and trunk to be fixated in space to balance the centre of mass on the body over the feet or base of support” (p. 540). Figure 2 highlights the relationship between the systems as described by Van Tichelen (1993).

The article by Humphreys (2008) is useful in that it articulates the connection between visual, vestibular, and cervical proprioceptive systems and is responsible for the orientation of the head to the trunk. While the review critiques specific tests for the assessment of sensorimotor dysfunction in patients with neck pain, it does not present testing procedures that are common amongst manual therapists.

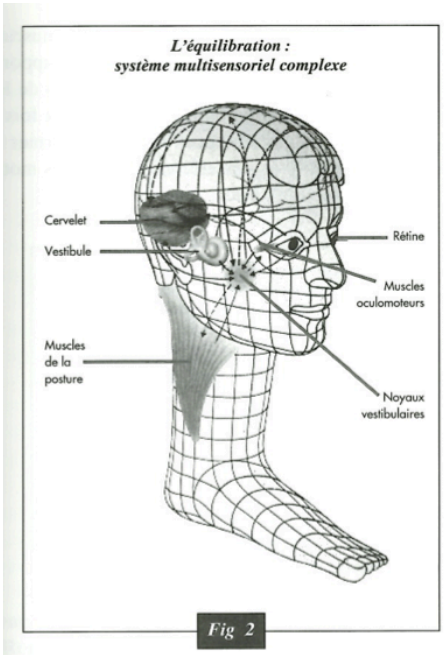


Figure 2: Equilibrium System (Van Tichelen, 1992, p. 103)

For a manual therapist, much information can be gathered utilizing posture as an observational reference. During an assessment or re-assessment along with the subjective report from the patient, a postural observation can help reinforce some of the summations already being made. Observations help us acquire information, and they can help save time, as Johnson 2012 states, “The relationships among body parts are more difficult to assess when someone is lying down to receive a treatment” (p. 10). Difficulty in assessing posture and relationships when lying down is due to the influence of gravity and weight bearing of the person. A standing postural observational test can quickly provide the therapist with a baseline of where the body is relative to a horizontal and vertical axis and what factors might be influencing his or her position.

Kuchera (2003) describes that, when doing the observational portion of a musculoskeletal examination, one should be “observed for symmetry of the body and the space around it" (p. 635). The author's description includes that notes should be made on the relationships of extremities to each other, any obvious rotational positions of body regions and paraspinal symmetry of the body. Rotations of body regions are best observed looking down on the patient from a cephalic vantage point (see Figure 15). Spinal curvatures and general appearances are best observed from the front and side for evidence of spinal abnormalities.

When assessing standard postural alignments, Johnson (2012) outlines the standard posterior, lateral, and anterior alignments. Figure 3 highlights the standard posterior anatomical observations that should be used when using a plumb line. This image clearly states and indicates that there should be symmetry on the right and left sides. When utilizing a plumb line, it should bisect the scull, run the distance to the pelvis, and sit between the two ankles and feet, where the feet are slightly externally rotated.

When conducting observations from a lateral view, the plumb line would run vertically through the earlobe, parts of the spine, and bisect the hip joint and knee to the lateral malleolus. Anterior observations should be consistently bisecting the right from the left. Figures 3, 4, and 5 are included in this publication to highlight the areas of standard postural assessment. Johnson (2012) also includes some information on the plumb line and states that it "represents the line of gravity" (p. 22).

The concept that the plumb line represents the line of gravity is important for this study, as it provides a true vertical reference that a therapist can make observations from. Some therapists may not choose to utilize a plumb line, and the purpose of part of this study is to measure the inter-rater reliability of not using a plumb line versus the plumb line observation.

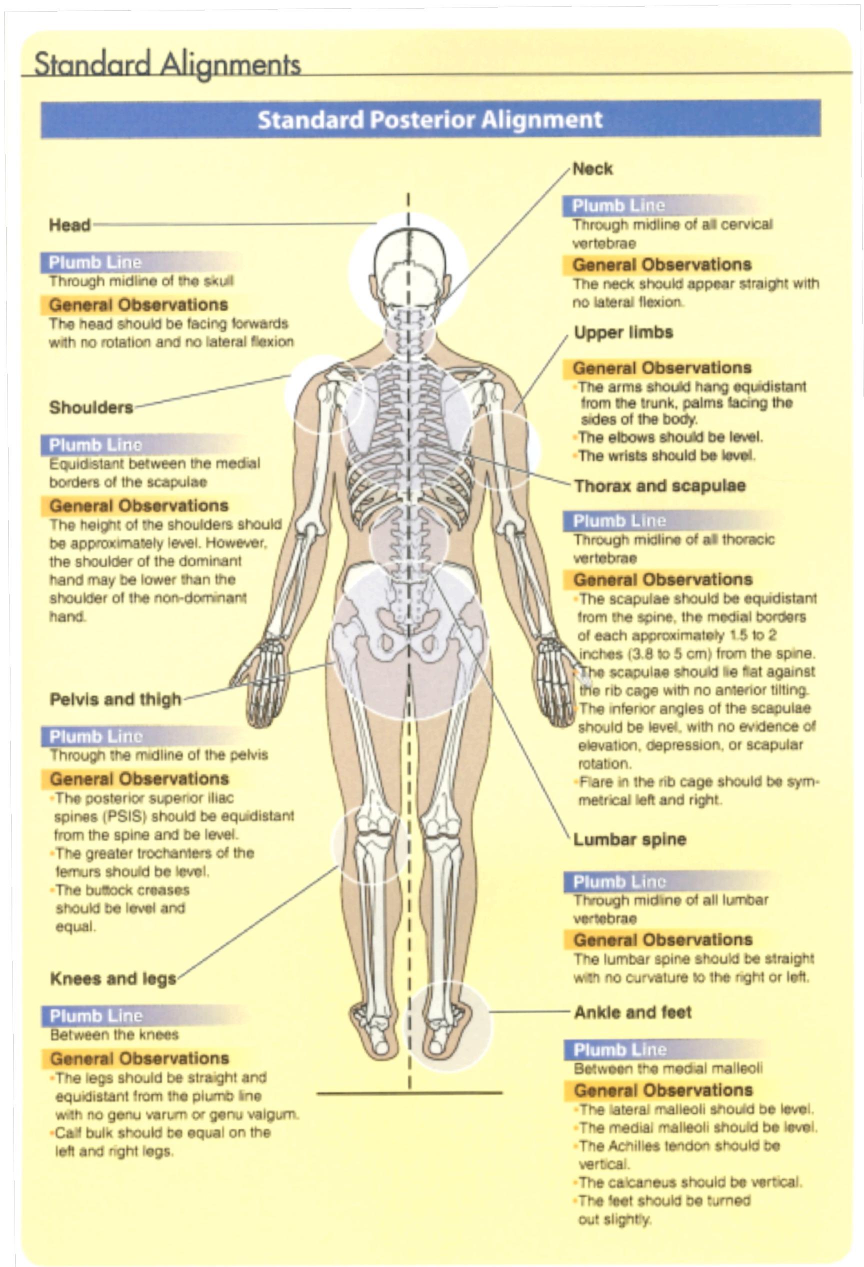


Figure 3: Standard Posterior Alignment, (Johnston 2012)

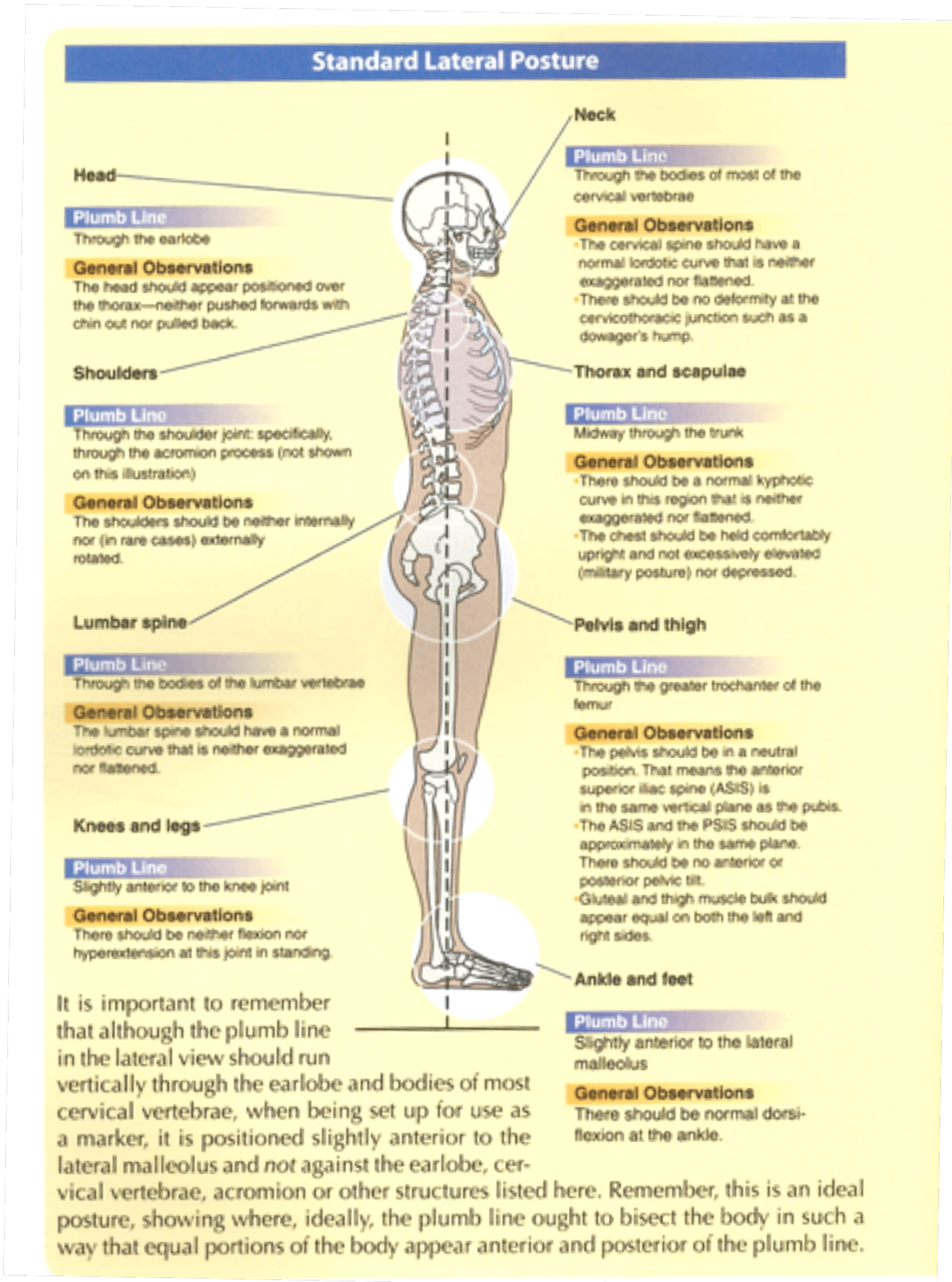


Figure 4: Standard Lateral Posture, (Johnston 2012)

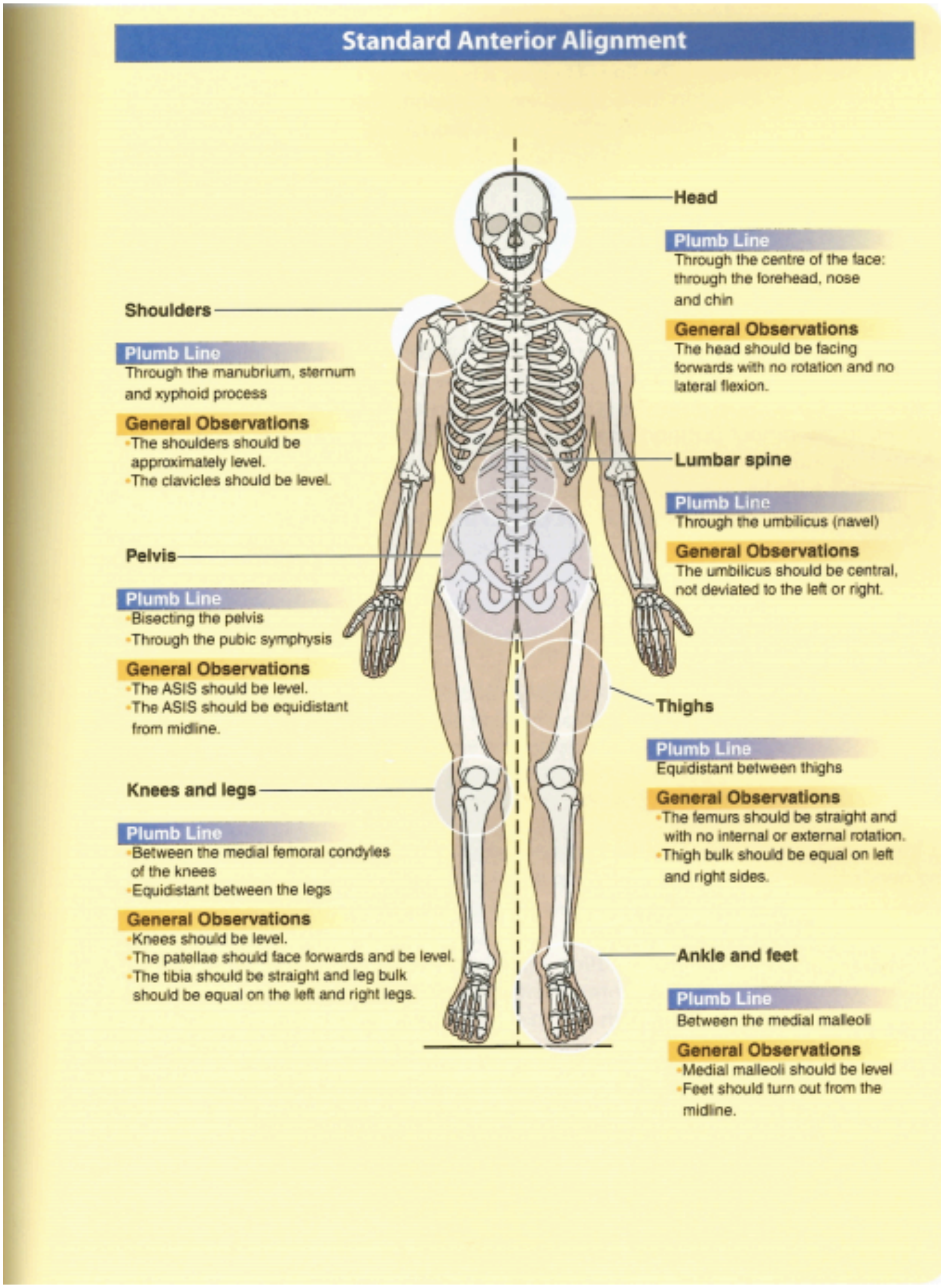


Figure 5: Standard Anterior Posture, (Johnston 2012)

When following a step-by-step process to assess the postural adaptations of a subject, it was concluded by Watson and Mac Donncha (2000) that a "high degree of reliability can be achieved when assessing posture" (p. 268), and their methodology design would produce repeatability scores in excess of 85%. Watson and Mac Donnacha (2000) utilized photographic records and a systematic assessment technique to evaluate 114 adolescent males. While the reliability scores were high and the quantitative posture scales were well designed, the rater system was subjective and did not provide quantifiable evidence to correspond to the raters evaluations.

Publications have been produced to describe protocols for postural assessment such as Watson and Mac Donncha (2000), Johnson (2012), and Tunnell (1996). In Tunnel's commentary on the assessment of posture, the author references Janda's neuromuscular system changes and Chaitow's upper- and lower-crossed systems that can be observed with postural assessment. Tunnel (1996) describes the "close interplay which occurs amongst the elements of the systems" (p. 27) and indicates any alterations in structure that can change the function. It is important to recognize the close relationships between the different segments of the body as presented by Tunnell (1996) to grasp the concepts of ascending and descending lesions and how the identification of dysfunctions can assist in effective treatment plans.

While posture studies, such as Watson and Mac Donna (2000), have shown a high degree of reliability amongst evaluators, a study by Fedorak, Ashworth, Marshall, and Paull (2003) show that intra-rater and inter-rater reliability of assessing posture utilizing photographs can be fair to poor. In this study by Fedorak et al. (2003) examining cervical and lumbar lordosis, the chiropractors (6), physiotherapists (7), physicians (10), and surgeons (5), who took part in a study, could only produce an intra-rater reliability of fair (*K*=0.5) and an inter-rater reliability of poor (*K*<0.4). What is interesting in this study is that the subjects who participated were symptomatic with back or neck pain, and a convenience sample size of 36 subjects were recruited. The sample size was much lower because the number of raters was high at 28, which would have still given the study statistical power. Higher numbers of raters equal a lower number of subjects, and lower numbers of raters equal higher numbers of subjects when using kappa statistics. Of note, this study also used a three-category scale for rater evaluation, which resembles the experimental design of this study but did not include a quantifiable measuring tool, such as a BioPrint software program, to validate the objective evaluations completed by the raters.

While reliability can be poor, postural assessment still can be valuable for many reasons as indicated by Johnson (2012) who states that postural assessment can help one to “acquire information, save time, establish a baseline, and treat holistically” (p. 9). Establishing a baseline and other information is valuable as it may provide the practitioner with information about postural habits, muscle imbalances, trauma, scars, or surgeries not mentioned in the subjective interview. Postural observation allows visualization of compensations that the body produces and provides an indicator of where the body is in space and how the subject deals with gravity. A postural observation can provide a starting point to evaluate the effectiveness of the treatment.

2.1.1 PLUMB LINE

Many practitioners will utilize a plumb line as a tool to assist in assessing posture. Johnson (2012) indicates that the plumb line “represents the line of gravity, it is a vertical line drawn from the body’s centre of gravity to within the body’s base of support” (p. 22).

As can be seen in Figures 2, 3, and 4, the plumb line should fall in respect to various parts of the body. Following these suggestions, one can infer where the subject's position relative to the vertical line of gravity is, and how they compensate against gravity versus optimal standard posture.

One study actually concluded that a plumb line is the "most useful instrument for measuring static trunk list" (McLean, Gillan, Ross, Aspden, & Porter, 1996, p. 1670) when assessing a gravity-induced trunk list. The McLean et al. (1996) also indicate that the plumb line does have some limitations with repeatability as some inconsistency in measurements can occur. This study utilized three techniques to determine the lumbar list in the subject, but only seven patients were measured using all three techniques of the twenty-seven subjects in total. Two raters were used which would lack statistical power, but it was concluded that it was possible to measure a list to within 4 mm using the plumb line. This study is positive in that it concludes that the plumb line is beneficial and can produce consistency to within 4 mm but should include either more raters or subjects in an effort to increase statistical validity.

Some practitioners see a lot of value in the plumb line while others do not. Bryan, Mosner, Shippee, & Stull (1990) concluded that when assessing observational skills the use of a plumb line did not improve raters accuracy when observing lumbar lordosis via photographs. The study used forty-eight raters, six subjects, and two sets of photographs, Set A without a plumb line, and Set B with a plumb line. All six subjects were X-rays to provide a quantifiable calculation of the degree of lordosis. Results indicated that the correct response rate was only 9.3%, but the author did note that the study was "not strictly clinical since therapists are usually assessing live patients and not a picture" (p.26). The advantage of the photographs is that raters assess the exact same posture and lordotic curve.

In a separate study by Steffen, Obeid, Aurouer, Hauger, Vital, Dubousset, and Skallie (2010), the use of a gravity line was able to produce clinical relevant information to improve postural evaluation. This study was able to conclude key parameters to evaluate posture as being the acoustic meatus and L3, but was only measuring posture in a transverse plane using a 3D construction of the spine using X-rays. While theoretically an excellent way to measure posture quantitatively, the availability of 3D radiographic technology is limited, and many therapists would not use this method as a tool to observe posture.

2.1.2 The Vertical de Barré Test

The Vertical de Barré test has been utilized as a postural observation tool/test adopted by some osteopathic institutions and the posturologie discipline. As indicated by Blanchet (2009), the test itself seems to be derived through the observations of Jean Alexandre Barré, a French neurophysicist, who studied with Babinski and later worked closely with George Guillian. The two worked during the First World War where they made many discoveries in surgical and neuroscience and eventually identified Guillian-Barré syndrome. The Vertical de Barré has three published descriptions found by this author (Gagey & Weber, 2004; Vallier, 2012; Van Tichelen, 1992), all of which describe the test with some variation.

A study by Gagey, Scheible, Bourgeois, and Weber (2006) tried to validate the Vertical de Barré test utilizing an eight- to nine-year-old population. While the study concluded that there was a significant deviation of L4 in boys as compared to girls, the conclusion indicated this could have been attributed to postural asymmetries or postural dysfunction. There was one rater to 85 subjects, and the difference between boys (37) and girls (48) was not significant when examining the deviation between C7 and L4. This attempt by Gagey et al. (2006) to validate the Vertical de Barré test is a start, but clearly more evidence-based research is necessary on the topic. Chasczewski (2010) included personal communication with Gagey (Appendix B) and indicates "he discontinued the studies to validate the Vertical de Barré due to the clinically boring nature of the test" (p.29). Gagey is one of a few authors to write about the Vertical de Barré test but has chosen to discontinue studies on the topic, which leaves this author to continue to wonder about the validity of the actual test.

Figure 6: Vertical de Barré Platform (Van Tichelen, 1992, p. 111)

Van Tichelen (1992) describes the Vertical de Barré test in *Les troubles de l'équilibre* (1992) as the following:

> Si des dysfonctions musculo-squelettiques viennent à perturbé ce systeme oscillant, apparaissent des syncinésies tonique parasites, se traduisant par des contractures, des douleurs, des modifications du schema corporel. L'observation s'effectue sur un plateau strictement horizontal, le sujet ayant les pieds ouverts à 30 degrés vers l'avant, de part et d'autre d'une cale triangulaire de 5 cm de base; des fils à plomb (Verticals de Barré) materialisent les plans medians sagittal et frontal (p. 110).

This description can be translated as standing on a platform (Figure 6) with heels 5 cm apart separated by a wedge and feet externally rotated in an open position by 30 degrees. Observations should be made from the anterior, side, posterior, and horizontal views (see Figures 6 and 7). Anteriorly observations should be made of the alignment of the umbilicus, sternum, and the nose, where the bilateral axis should be noted of the ilium, acromial, and pupils.

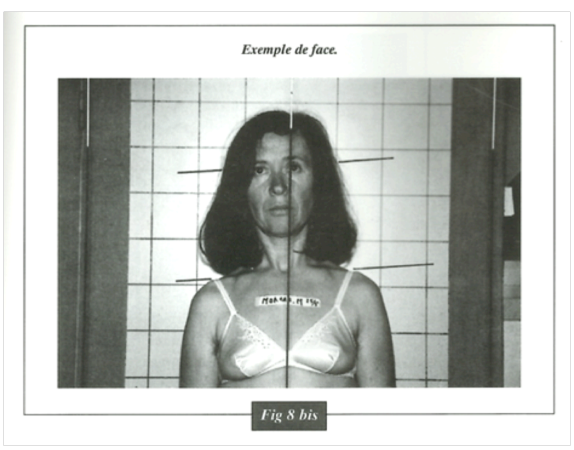
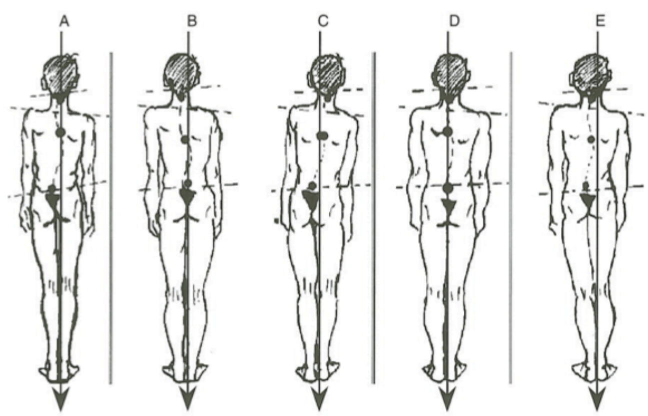


Figure 7: Vertical de Barré, Anterior View (Van Tichelen, 1992, p. 111)

Van Tichelen (1992) also notes that examination of these different frames can denote the eventual existence of abnormal postural patterns responsible for a modification of the body positioning “with a tonic muscle imbalance between the various channels, agonists/antagonists and tonic-phasic” (p. 110).

A second French reference of the Vertical de Barré is included in the book *Posturologie* by Gagey and Weber (2004). Gagey (2004) cites Van Tichelen (1992) in his reference but elaborates on the results of observations that might be made while in the Barré position. Figure 8 indicates, from a posterior view, five patterns that are likely to be seen.



A: Only L3 is skewed; it is usually a foot problem.
B: Malalignment starts from D4 / 6, often the problem is high.
C: Cross-deviation of mixed problem.
D: Compensated: risk of decompensation.
E: Systematic deviation of all points on the same side of the Vertical disharmonious syndrome (from whiplash, but not only).
Gagey and Weber (2004, p.35).

Figure 8: Vertical de Barré Observations (Gagey & Weber, 2004, p. 35)

The Vertical de Barré test as described by Gagey and Weber (2004) and Van Tichelen (1992) is a weight-bearing test that evaluates the patient. Observations should be made starting from the malleoli, tracking inferior to superior. The vertical plumb line should ideally bisect the L3 and C7 spinous processes and the vertex when observing from the posterior position. Static position and postural sway are also noted. The subject should also be observed from a sagittal view for static position and from a horizontal plane to determine axial rotation through the torso.

A third and the most recent reference has a slightly different description of the Vertical de Barré. Vallier (2012) cites Van Tichelen (1992) and describes the Vertical de Barré as the following:

> Le dispositive est formé d'une plaque au sol avec en arriere une cale afin de bloquer les talons. Au centre du plateau est positionnée une cale en coin de 30 degres. Les talons sont ecartes de 2 cm pour accroitre la stabilité selon Van Tichelen (1992) (p. 55).

Vallier (2012) suggests the observation be made from the posterior, looking for asymmetries and imbalance that can be done by using a plumb line and two horizontal lines as references. Vallier describes the postural observation being done behind the platform (see Figure 9) with a plumb line, perfectly centred on the central wedge that represents the sagittal plane. The observer aligns his eye on the plumb, the imaginary horizontal lines of reference follow the plane across the pelvis and the shoulders. The examiner notes the asymmetries in the sagittal plane. This step, while noting the imbalances of the horizontal lines, will help identify asymmetries in the frontal plane and in the horizontal as well. Of note, Vallier (2012) indicates the heels are separated 2 cm as opposed to Van Tichelen's description of 5 centimeters.

Figure 9: Vertical de Barré Board / Platform (Posturepole, 2012)

Vallier (2012) also suggests when examining the profile to note asymmetries and to introduce the Vertical de Barré with head rotation to observe gross movement from a posterior aspect. If there are no major cervical vertebral dysfunctions, the cervical spine rotation induces a slight opposite side bending to L5. For the examiner, this can highlight definite areas of dysfunction or areas of asymmetries.

2.1.3 POSTURE PATTERNS

Ascending Patterns: As described by Gagey and Weber (2004), an ascending pattern can be inferred when the pelvis is off the midline and the cranium is closer to the midline. This pattern has been used to describe an ascending dysfunction: simply stated, the problem is coming from the lower extremity. This could be a dysfunction in the foot or ankle, knee, or pelvis that can create a rotation though the pelvis, which would highlight the imbalance. Figure 10, Graphic A, represents the system in balance, while Graphic B represents that the centre of pressure is displaced creating an ascending lesion. Graphic C in Figure 10 represents a superior centre of gravity displacement creating a descending lesion.

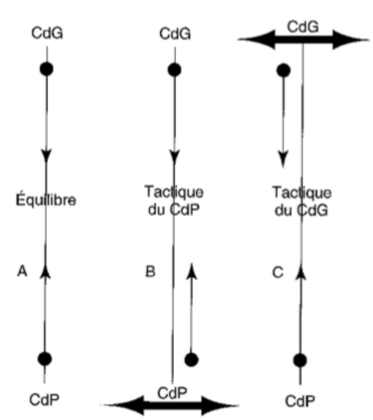


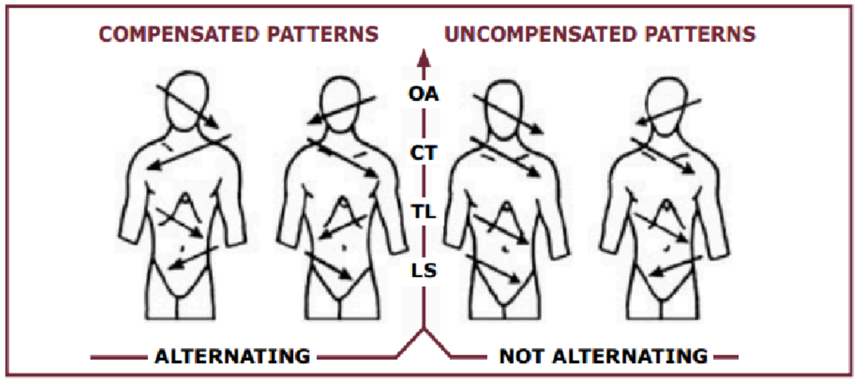
Figure 10: Stabilization Tactics (Gagey & Weber 2004, p. 16)

Descending patterns have been described as the cranium being off the midline. A neurological dysfunction, shoulder girdle or clavicle lesions, or old cranial disturbances (Liem, 2004) could create the imbalance.

Liem (2004) also describes the ascending lesion. The patient has the pelvis off the midline due to lumbar pain, dysfunctions of the foot, knee, hip, or pelvis. A third lesion is described as ascending and descending and is defined when the cranium deviates to one side and the pelvis to the other.

Compensated and uncompensated postural adaptations are described by many authors including Pope (2003). Pope (2003) cites the Common Compensatory Pattern (CCP) as described by Gordon Zink, which is a "term to describe commonly found patterns of dysfunction in the body" (p. 176). Recurrent patters of dysfunction found during observations include fascial patterns, postural imbalances, somatic dysfunctions, and disturbances in function. Pope (2003) states, "We frequently see a clinically short right leg, a cephalad pubes dysfunction on the left, a posterior ilium on the left, and an anterior ilium on the right. Patients regularly display a left on left sacral torsion with L-5, side bent left and rotated right as well" (p. 176).

Pope (2003) cites Zink's theory of fascia and fascial patterns as a probable cause of some of the common patterns observed by manual practitioners. This sheet of connective tissue or fascia may be impeding biomechanical motion due to a somatic imbalance or dysfunction usually found in transition zones of the body. These transition zones include at CO-C1: cervico-thoracic junction, thoraco-lumbar junction, and lumbo-sacral junction.



OA = occiput/axis

CT = cervical/thoracic

TL = thoraco/lumbar

LS = lumbo/sacral

Figure 11: Zink's Compensatory Patterns (Pope, 2003, p.178)

"Restrictions in these transitional zones can cause major alterations in the function of surrounding structures, and thus directly or indirectly influence the health of the body" (Pope, 2003, p. 178). Three classifications had emerged from examining these restrictions as identified by Zink during clinical observations. The ideal pattern is demonstrated by equal fascial glide, with no preference to the right or left. An alternating pattern of fascial ease is described as a compensated pattern, where "Zink reasoned that counterbalanced rotations were more adaptive, and that was why these individuals responded more favourably to stress or illness" (p. 178). Finally, in uncompensated fascial patterns, Pope (2003) indicates there is no alternating rotational pattern, which has been thought to be less healthy.

Kuchera and Kuchera (1994) state, "Zink studied posture as a clinician and though he believed that equal fascial preference for right and left rotation was ideal, he found that almost all of the people who thought that they were well had alternating fascial patterns" (p. 46). The common pattern that was described was the left right, left right pattern that most fascial restrictions present as, and it was referred to as the common compensatory problem. Recognizing these patterns when assessing posture for various reasons may contribute to an understanding of the mechanism of injury as well as assist in developing a treatment plan to balance the patient.

2.1.3.1 VERTICAL BARRÉ OBSERVATIONS

Similar to Gagey and Weber's (2004) previously mentioned conclusion, Liem (2004) states that the Vertical de Barré test can conclude a number of different physical states depending on what is observed. Dysfunctions can be classified as ascending or descending lesions, compensatory states, or unilateral hypertonus. Deviations matching Image 1 (Figure 12) indicate an ascending lesion. According to Liem (2004), the problem is from the foot, knee, or pelvis creating the deviation. Image 2 (Figure 12) would be classified as a descending lesion: a neurological problem or cranial type dysfunction. Image 3 (Figure 12) having both the head and pelvis opposite of the midline are uncompensated problems and Image 4 (Figure 12) would be a compensated pattern. Image 5 (Figure 12) has both the head and pelvis on the same side of the midline, which indicates a significant lesion with no compensation.

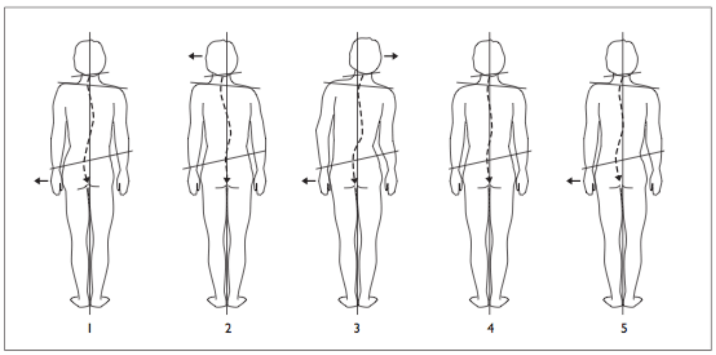


Figure 12. Barré Vertical Alignment Test (Leim, 2004, p. 340)

Barré's Vertical alignment test results (Liem, 2004)

1. Ascending dysfunction (pelvis deviates to the side): short leg, lumbar pain, dysfunction of the foot, knee, hip or pelvis.
2. Descending dysfunction (head/neck deviate to the side): cervical pain, dysfunction of the clavicle, shoulder, mandible, old craniocervical trauma, disturbance of the eyes or of vision.
3. Dysfunction ascending and descending (head/neck deviate to one side; pelvis to the opposite side).
4. Compensatory state: in this state any therapeutic intervention brings with it a risk of decompensation.
5. Unilateral hypertonus (head, upper body and pelvis deviate to the same side): central or vestibular disturbance.

2.1.4 TYPES OF POSTURE STUDIES

Ganget, Pomero, Dumas, Skalli, and Vital (2003) state “analyzing standing posture requires a precise measure of the orientation of the various body segments with respect to the gravitational vector” (p. 424). The 3D geometry of the spine and pelvis was utilized with a force place for this study that concluded that this method could be used for posture characterization. This complicated data collection set-up is an unrealistic way of conducting postural evaluations for a manual therapist. What is interesting in this study is that the resultant line of gravity had a sacral plate centre, which appeared to be the closest constant to the line of gravity with the greatest variability at the head. The images produced resemble Littlejohn’s posterior line of gravity.

Studies by Grandcolas Danis, Krebs, Gill-Body, and Sahrmann (1998); Lafond (2004); Lin, Lee, Liao, Wu, and Su (2011); Sakaguchi (2007); Schmit, Regis, and Riley (2005) all utilized force plates to determine the centre of gravity (COG) to assist in their research. Grancolas et al. (1998) examined standing feet apart and feet together, along with eyes open and closed. Interestingly in this study, the large (53 total) subject pool included those with and without vestibular dysfunction. Not surprising, when eyes were closed and feet together, both groups’ COG shifted anteriorly and notably more for those with vestibular dysfunction. While lateral translations were not noted, the authors did report that those with vestibular dysfunction “stood with more body weight shifted toward the left lower extremity during standing” (Grandcolas et al., 1998, p. 513). Theoretically, those with vestibular dysfunction may present with a descending lesion, if the head was off midline, which might be enough to create extra pressure on one foot versus another.

The studies by Lin et al. (2011) and Schmit et al. (2005) both included ballet dancers in their study. These two studies concluded that dancers who have training in posture and balance may not actually have better postural stability, perhaps, due to previous injuries. Lin et al. (2011) actually tested dancers in a number of positions, one of which was the first position. This position is very similar to the Vertical de Barré position as feet are externally rotated with heels together, and it is inferred by the author that ankle injuries may require the subject to recruit balance strategies from proximal joints (hip) instead of ankle joints due to proprioceptive systems being affected. While Lin et al. (2011) did not measure the specific direction of the centre of pressure, the ascending lesion patterns could be a factor in the poorer scores demonstrated by the injured dancers. Previous ankle sprains would affect the proprioceptive portions of the foot and ultimately create a deviation in the tested centre of pressures on the force plate.

When examining posture, a question of how consistent one's posture is during observation might arise. It has been established by Bullock-Saxton (1993) that "on a particular day, a person assumes a consistent postural alignment when asked to stand comfortably erect" (p. 28). Bullock-Saxton measured the spinal angle of the study's three pools of subjects using a clinometer and took readings on the same day as well as over three data collection days spread out with a four-day interval between. Thirteen of the subjects were followed over a long time and data was collected again at 16 months and 24 months post the initial collection. The results of this study conclude a day-to-day consistency in posture, short term and long term, is possible to maintain, unless external factors or therapeutic treatments are introduced. This conclusion could be beneficial for future postural observation studies, especially ones with multiple raters, but would be difficult due to the high volume of subjects required for statistical significance in an inter-rater reliability study such as the present Vertical de Barré study.

2.1.5 PHOTOGRAPHY AND POSTURE STUDIES

Fedorak, Ashworth, John, and Paull (2003), Fortin, Feldman, Cheriet, Gravel, Gauthier, and Labelle (2012) Harrison et al. (2008), and Harrison et al. (2007) used photographs and photogrammetric techniques to have raters determine postural positions. Of these studies, Fortin et al. (2012) state, "posture can be assessed in a global fashion from photographs" (p. 64), but results from their study still only produced a fair statistical agreement of inter-rater reliability. Carr, E. Kenney, F. Wilson-Barnett, J. Newham (1999) concluded that a photographic tool can be a "quick and simple means of collecting information" (p. 229). This study utilized four hundred and forty pairs of observations of 57 subjects in three projects in four positions after a stroke. Many variables were included in this study by Carr et al. (1999), and while it did produce acceptable levels of agreement between raters, the author reported that some raters had difficulty allocating a posture to a category and made "a best guess rather than a clear-cut decision" (p. 239). With so many observations being made and the reality of varying postures not being definitive, it would be difficult to make clear-cut decisions on every observation. While the photograph is a good tool to observe posture quickly, it can lose some context in regards to the subject's actual position in 3D space.

A literature review done by Fortin, Feldman, Cheriet, and Labelle (2011) to quantify body segment posture concluded that measuring "body angles from photographs may be the most accurate and rapid way to assess global posture quantitatively in a clinical setting" (p. 382). While this conclusion provides justification for the present

Vertical de Barré study design, it must be noted that the review done by Fortin et al. (2011) included many studies that examined a joint angle. Posture evaluation is included in the review by Fortin et al. (2011), but indicates, as with any part of an assessment and observation, that it must be "understood in a global fashion and should be specific for each person" (p. 381).

2.1.6 OTHER POSTURE STUDIES

When considering a quantifiable measure to include in this study of posture, many assessment devices were examined for the Vertical de Barré to provide a quantitative postural assessment. As indicated by Ganget et al. (2003) and Vedantam, Lenke, Keeney, and Bridwell (1998), stereoradiography and plane radiographs can be valid tools to compile research. While this method can be useful for spinal postures, the purpose of the current research is to observe the whole body in relation to a plumb line. It would not be practical and potentially unhealthy for subjects to be exposed to full-body plane radiographs.

A study conducted by Steffen et al. (2010) utilized both a force plate as well as a 3D reconstruction of the spine with bi-planar radiographs to quantify posture. Of note, Steffen et al. (2010) identified that the line of gravity should pass through acoustic meatis: T1, T4, T9, L3, S1, T4 and L3, of course, being important osteopathic pivot points. The study by Steffen et al. (2010) demonstrated that a force plate could be used to determine the COG, and be useful to determine postural sway, balance, and postural tendencies. However, the force plate, while providing information on the COG and postural tendencies, would not be able to provide a rater or observer with a specific body position in relation to horizontal and vertical axis needed to observe a static posture.

2.1.7 QUANTIFYING POSTURE

Quantifying posture and anatomical landmarks has been done in many different ways. A study by McAlpine, Bettany-Saltikov, and Warren (2009) concluded that the Middlesbrough Integrated Digital Assessment System (MIDAS) produced a high inter-rater reliability, providing an objective method for assessing posture. While the portable, cost-effective unit could have been another candidate to be included in the Vertical de Barré research, it only measures spinal posture and not a global perspective. Detailed and accurate, the unit does measure X, Y, and Z axis, but does have room for human error as markings need to be made on boney anatomical landmarks on the spine.

The BodyGaurd system was utilized by O'Sullivan, Galeotti, Dankaerts, O'Sullivan, and O'Sullivan (2011) to analyze lumbar spine posture. Conclusions by this study indicated that the device had an excellent inter-rater reliability to monitor spinal position in space, but it only measures spinal posture specifically through dynamic movements and is mainly used in industrial settings to provide feedback for the user.

Another postural analyzing system the PAS/SAPO was evaluated by Ferreira, Duarte, and Marques (2010). This study concluded that the software was "accurate for measuring corporal angles and distances and should be considered as a reliable postural assessment" (p. 680). This unit, however, is cost prohibitive for the average manual therapist and requires a great deal of space to house such a system. For these reasons, although the PAS would produce a valid quantifiable result, it was not used in this current research.

Finally, the Vertical de Barré research introduced a quantifiable posture analyzing tool in an effort to provide a validated photographic report that could easily defend or refute the observational analysis that the human raters were noting. Studies by Harrison et al. (2007), Harrison et al. (2008), and Normand et al. (2007) indicate that accurate posture measurements can be conducted using the Biotonix BioPrint system as it "has high degrees of reliability and validity" (Normand et al., 2007, p. 246). The Normand et al. (2007) study design utilized 40 human subjects who were measured utilizing the PosturePrint system, a parent version of the BioPrint, and results produced a good inter-rater coefficient indicating that a digitizer was reliable for clinical use. The study provided evidence to indicate that three experienced PosturePrint users were able to place 13 hypoallergenic reflective markers on the subjects and use the software to produce a close examiner agreement of the reports produced for each subject by each rater. The BioPrint which utilizes the same technology was chosen as an assessment tool for the Vertical de Barré research as it is a portable, cost effective, and practical tool to evaluate a subject's standing posture and produce a numeric value of head and pelvis from the midline.

2.1.8 Inter-Rater Studies

When considering the structure of this inter-rater reliability study, the terms must be defined and the expectations of the results explained. "Reliability can be defined as the extent to which a repeated test will produce the same result when an unchanged characteristic is evaluated. Validity can be defined as the extent to which a procedure measures what it is intended to measure" (Spring, Gibbons, & Tehan, 2001, p. 47).

Spring et al., (2001) explain that **intra**-examiner reliability "involves one examiner assessing single individuals at least two times to evaluate rater self-consistency. **Inter**-examiner reliability involves two or more examiners making one assessment of all subjects to evaluate rater concordance" (p. 47). Sprint et al. (2001) utilized 10 raters and 10 subjects examining the three different lumbar tests conducted by osteopathic students.

The study design of this Vertical de Barré research requires four human raters, all of whom must have a minimum of five years of manual experience to examine and requires eighty-four subjects in an effort to produce the desired statistical power to produce a valid inter-rater reliability study.

Haas (1991) reviews forty-five reliability studies and comments on various methods of statistical calculations. In this review, Haas (1991) states, "because of the uncertainty in the measurement of intra-examiner concordance and its implication of error, it is prudent to weigh inter-examiner concordance more heavily in the evaluation of reliability" (p. 201).

Kmita and Lucas (2008) indicate that "tests that lack sufficient reliability are not useful, as they do not provide a consistent measure of the variable of interest" (p. 16). The author also concludes that the reliability of diagnostic tests in osteopathic medicine is "vexatious" as many studies produce poor to slight reliability. Kmita and Lucas (2008) designed their study to evaluate the reliability of identifying anatomical landmarks of the pelvis and to compare the inter-rater results between two groups, one of experienced osteopaths and the other of inexperienced osteopathic students. Only nine subjects were tested for the study, which would have affected the kappa values obtained, perhaps contributing to their "vexatious" results.

The most important component to the Vertical de Barré study is the inter-rater reliability evaluation. As suggested by Kuchera (2011), completing inter-rater reliability studies provides validity and reproducibility to a test and to manual medicine. Kuchera (2011) advises following the 13 golden rules as presented by Remvig and Ellis (2003), which include experiment protocol training, agreement levels for the researchers to attain, and guidelines to follow when conducting research. The experimental design of this study followed the guidelines by providing training regarding the expectations and providing familiarity with the methodology in an effort to assist the raters to become comfortable with the procedure.

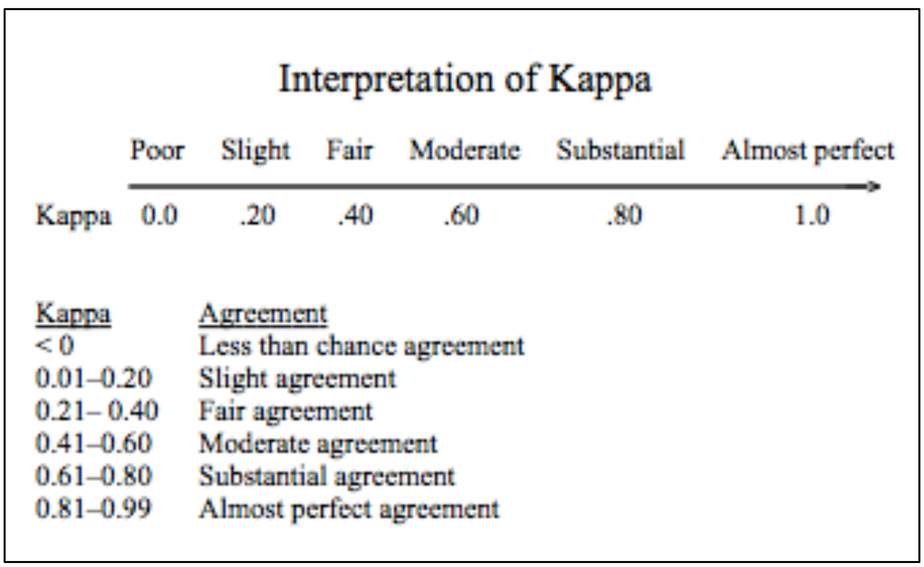
A study that utilized inter-rater reliablity by Fortin et al. (2012) also included the use of photographs to determine inter-rater reliabilty of anatomical landmarks of seventy subjects with ideopathic scoliosis. While their statistics used a different method to quantify, Fortin et al. (2012) were able to produce good reliablity of raters, and also concluded that “posture can be assessed in a global fashion from photographs” (p. 74). The benefit of the photographic image is that it is a consistent indiciation of the person’s posture, allowing mulitple raters to rate the identical posture of the subject.

Moran and Ljubotenski (2006) utilized various experience levels as part of the data and determined that “experienced” raters (5+ years) produced a higher reliability. This study seems to have met statistical significance levels as it contained twelve raters and sixty subjects when using a short video clip of each subject to assess lumbar lordosis. This study provides another tool (video analysis) to quantify posture as well as providing an osteopathic study that indicates inter-rater observations can be comparable between experience and inexperienced raters.

2.1.9 KAPPA VALUES

This study on the Vertical de Barré is attempting to measure the agreement between practitioners when examining a subject’s postural position in a photograph. As written by Haley and Osberg (1989), “Kappa is a preferred statistic to estimate inter-observer agreement for nominal or ordinal scale data” (p. 970). Viera and Garrett (2005) explain that “kappa is intended to give the reader a quantitative measure of the magnitude of agreement between observers" (p. 360), and applies to tests like radiographs as well as physical findings. Sim and Wright, (2005) state, "if used and interpreted appropriately, the kappa coefficient provides valuable information on the reliability of diagnostic and other examination procedures" (p. 258).

Sim and Wright (2005) explain the purpose of a kappa statistic is as a unit of measure of true agreement because. "It indicates the proportion of agreement beyond that expected by chance, that is, the achieved beyond-chance agreement as a proportion of the possible beyond-chance agreement" (p. 258). In Figure 13 Sim and Wright present the relationship of kappa to overall and chance agreement schematically, and provide a visual of how the numeric kappa values translate into various agreeing catagories.


Interpretation of Kappa

	Poor	Slight	Fair	Moderate	Substantial	Almost perfect
Kappa	0.0	.20	.40	.60	.80	1.0

Kappa	Agreement
< 0	Less than chance agreement
0.01–0.20	Slight agreement
0.21– 0.40	Fair agreement
0.41–0.60	Moderate agreement
0.61–0.80	Substantial agreement
0.81–0.99	Almost perfect agreement

Figure 13: Kappa and Overall Chance Agreement (Sim and Wright 2005, p. 258)

When examining what measuring the true agreement means, Vierra and Garrett (2005) explain that the perfect agreement would be 1.0 kappa (*K)* and the chance agreement would be 0 *K*. Figure 14 outlines kappa values for accepted agreement levels.

Other information that can be extracted from kappa values is the CI and the p-value. Vierra and Garrett (2005) outline the p-value in an inter-rater experiment, which “tests whether the estimated kappa is not due to chance. It does not test the strength of the agreement. Also, p-values and CIs are sensitive to sample size, and with a large enough sample size, any kappa above zero will become statistically significant” (p. 362). To determine the meaning of the kappa, calculating the CI for the obtained kappa can help. Since kappa is an estimate of inter-rater reliability, CIs can be of more interest. These points are important to consider as the Vertical de Barré research will utilize kappa to examine the rater agreement and the p-value can indicate if the results from the study are actually statistically significant.

When considering why kappa was used in this experiment versus other statistical methods, as stated by Bao, Howard, Speilholz, Silverstein, and Polissar (2009), the response was the “percentage of agreement and kappa statistic can be used for categorical posture data, the Interclass Correlation Coefficient, ICC, is used for continuous data” (p. 304). This Vertical de Barré study includes the categorical data that rates subjects into three specific categories: the head is off midline, the pelvis is off midline, or the body positions are neutral to the midline.

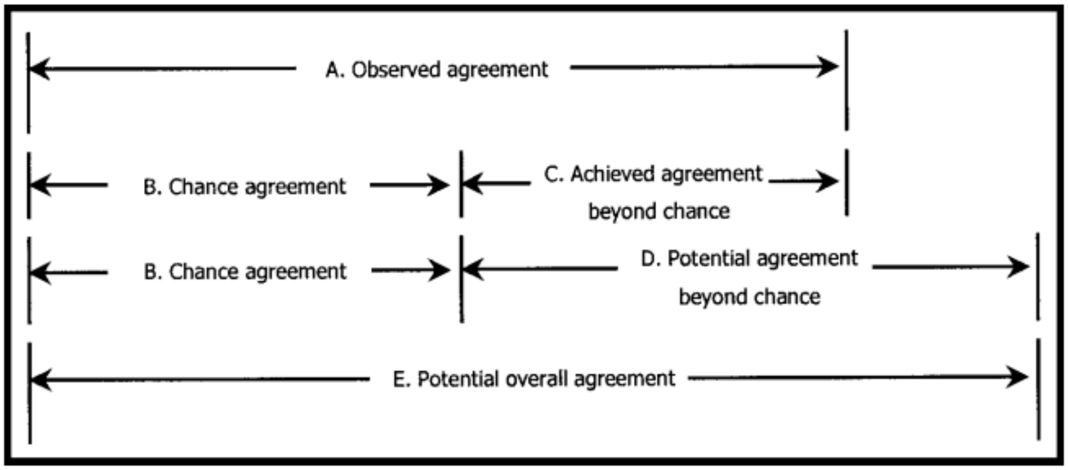


Figure.
Schematic representation of the relationship of kappa to overall and chance agreement. Kappa=C/D. Adapted from Rigby.[24]

Figure 14: Inter of Kappa: From the Measurement of Observer Agreement for Categorical Data. (Landis & Koch, 1977, p. 170)

2.1.10 INTER-RATER RELIABILITY CONCLUSIONS

This research examined a number of different reliability studies to examine the kappa values produced in inter-rater reliability studies. In an inter-rater palpation study by Kmita and Lucas (2008) researchers found that intra-examiner reliability ranged from 0.29 to 1.0 *k* when palpating anatomical landmarks of the pelvis, but concluded that overall reliability of the physical examination was generally found to be low. In a second study measuring palpation of anatomical landmarks of the pelvis again, Fryer, McPherson, and O'Keefe (2005) found that kappa was fair for palpation ranging from -0.01 to 0.28 *k*.

Other palpation studies that produced a kappa statistic for inter-rater reliability palpation studies include ones by Haneline and Young (2009); Paatelma, Karvonen, and Heinonen (2010); and Tong, Heyman, Lado, and Isser (2006). Paatelma et al. (2010) were able to produce a kappa 0.5, an acceptable level but only had 15 subjects in their study. Tong et al. completed a double-blinded study that produced a kappa value of 0.47, 0.08, and 0.32 *k* for a specific method of sacral assessment, but also found lower rates for two other methods of assessing sacral position in their study. Finally a review of inter-examiner and intra-examiner studies of static spinal palpation by Haneline and Young (2009) concluded of the reviewed 29 studies that the overall inter-rater agreement was generally low.

Postural inter-rater observation studies reviewed for this study include one by Passier, Nasciemento, Gesch, and Haines (2010), who measured deviations from neutral by degrees. They concluded that observations less than 5 degrees produced a kappa value of 0.30 but jumped to 0.51 *k* when the deviation was 10 degrees. Bao et al. (2009) state observed that posture angles of joints 30 degrees or better produced a substantially higher agreement than posture angles of joints at the 10-degree range, observing large body parts resulted in better reliability.

A study by Somers, Hanson, Kedzierski, Nestor, and Quinlivan (1997) concluded that there was "no dramatic difference in the intra-tester or inter-tester reliability between experienced and inexperienced testers, regardless of the evaluation used (p. 192). The study compared visual assessment versus goniometer measurement of the foot position and found that the visual estimation may be more reliable with an ICC of 0.81 and 0.72. There were only ten subjects observed by three raters, which would not provide enough of a sample base to produce significant statistics. The Vertical de Barré research utilized eighty-four subjects and four human raters.

Nilsson and Söderlund (2005) measured inter-rater reliability of the head position relative to the shoulder in standing by three examiners with a goniometer. The results produced an ICC of 0.95 in reliability by using the goniometer, but an ANOVA showed a significant difference between raters. This study which produced a high rater (three raters) agreement overall, utilized a tool, the goniometer, which has been shown above to produce some variability and also states a significant difference between raters. This goinimeter is a tool that was not included in the Vertical de Barré study because it could not provide an overall posture measurement, and the experience of the raters was not considered to be a significant variable for the study.

Silva, Punt, and Johnson (2010) describe in their research that observing posture is done “through the measurement of angles and distances between anatomical landmarks” (p. 491). That study showed that assessing the head posture through a four-category scale produced a kappa statistic between 0.02 to 0.19, resulting in poor reliability and validity. The study design was strong as it included ten raters and the images of forty subjects, and is another study that produces lower than expected kappa values when related to a reliability study.

A study by Perry, Smith, Straker, Coleman, and O’Sullivan (2008) found that photographic analysis of adolescent posture had fair reliability with an ICC between 0.4 to 0.75 for most measures it had captured. Twenty-two subjects were utilized and rated by four raters, with eight posture angles being measured. This experiment had concluded that using photographs is a “practical technique” for a large population, but produced an inter-rater reliability of fair to good (Perry et al., 2004, p. 74). A solid study yet again produced less than moderate inter-rater results.

The study by Fedorak et al. (2003) also measured reliability using photographs of cervical and lumbar lordosis. Mean inter-rater reliability was found to be poor at only

0.16 *k,* concluding no statistical significance. Fortin et al. (2012) utilized photographs to measure idiopathic scoliosis of youths using the global postural re-education (GPR) evaluation. Their conclusions found reliability was moderate to substantial 0.42 to 0.76 *k* for muscular chain evaluation using the GPR. Finally, the literature review done by Fortin et al. (2011) to quantify body segment posture concluded that measuring body angles from photographs may be the most accurate and rapid way to assess global posture quantitatively in a clinical setting" (p. 382). This review also highlighted the trend that most inter-rater reliability studies produce lower than expected and slight to fair kappa agreement, suggesting that either the method of studying inter-rater reliability should be reconsidered or the use of obtaining objective postural and position observations kept to a minimum.

Overall, it appears that conclusions of many inter-rater studies produce kappa and ICC values that can have great ranges but trend to a poor to moderate overall reliability. When evaluating inter-rater reliability, kappa values are rarely produced greater than 0.6 *k* falling into the substantial range.

2.1.11 Exclusion Criteria

A final subject examined throughout this literature review included exclusion criteria. Lin et al. (2011) concluded that dancers would not have greater balance or posture than other athletes, and, therefore, may not have to be excluded from posture research, as in some cases their posture and balance might be worse than the average person. For this reason, the activity level and participation in sports was not a factor to exclude subjects from the Vertical de Barré study.

Sakaguchi (2007) concluded that mandibular relationship to posture is co-related and, therefore, it suggested that persons with recent dental work be eliminated from the research. On this basis, those subjects with recent dental work, within the last 3 months, were excluded from the subject pool.

Schmit et al. (2005) excluded persons with diabetes, arthritis, vestibular disorders, dizziness, or history of falls when they examined the postural sway in dancers. Due to the kappa statistics to be utilized, other persons will be excluded if they have a diagnosed scoliosis, major head injury, or recent high trauma accident (hospital stay required) as it may exaggerate the results. A subject who presents with significant deformities from the midline will make the observations too obvious, allowing the possibility of chance to lessen, which directly affects the kappa statistic.

3 CHAPTER THREE: OSTEOPATHIC JUSTIFICATION

3 OSTEOPATHIC JUSTIFICATION

OSTEOPATHIC CHALLENGES

"The teaching of osteopathic manipulative medicine (OMM) has been traditionally based on the opinions of experts and underpinned by biomechanical and physiological models that appeared plausible in light of the evidence that was available at the time of initial development" (Fryer, 2008, p. 56). This is an interesting concept as it must marry theory with practical application. Combining faith, experience, and legitimacy, an educational institution that teaches OMM must maintain creditability by delivering the best education to their students. Inter-observational exercises and tests such as the Vertical de Barré test are an integral part of the educational process as it allows the student to develop confidence and knowledge, but the profession must have some statistical evidence to provide confidence in the process.

Inter-rater reliability and reproducibility studies can contribute to manual professions including osteopathy as the profession has increasing evidence-based expectations from governments, insurers, patients, and the public. It is the responsibility of the profession to prepare students and practitioners to "be well informed of current evidence as it relates to their discipline. In essence, the theory of EBM encourages 'best practice,' and involves the 'integration of best research evidence with clinical expertise and patient values'" (Fryer, 2008, p. 57).

Fryer (2008) also points out challenges that EBM has faced, as it was "intended to integrate individual clinical experience with the best external evidence" (p. 57), but EBM has been considered too rigid by some critics and "is applied to disease management, rather than disease cure or treatment" (p. 57). Where does this leave a student learning and experiencing OMM? It is imperative that the students are presented with as much information as possible to enable them to decipher why a test or technique is considered legitimate, and which allows them to have confidence in their treatment techniques and styles within the medical profession.

Fryer (2008) states, “It is clear that critical thinking and honest self-reflection are necessary for successful integration of EBM into practice. The implementation of EBM was never intended to be rigidly governed by the outcomes of a few randomized controlled trials” (p. 58). By considering and integrating EBM, a therapist continues to develop his or her skills and protects the public. As Green (2000) states, “Evidence-based practice, depending on one’s definition of evidence, is probably a misnomer, and the term ‘evidence-informed osteopathy’ might be a more accurate and acceptable term” (p. 22).

OSTEOPATHS AND ASSESSMENT

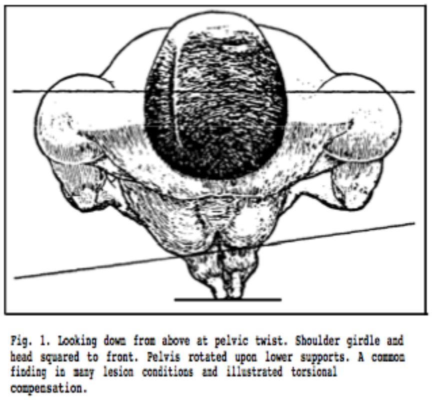
“Osteopaths and other practitioners of manual medicine employ a variety of procedures in assessing a patient in order to determine a diagnosis and subsequent treatment plan. The physical assessment generally includes visual observation, static palpation, and motion testing” (Spring et al., 2001, p. 47). Evaluation of the patient is completed in many different ways, which can begin as soon as the patient walks into the office. A detailed history, observing the patient in space as well as a complete physical exam is imperative to produce an accurate diagnosis leading to the treatment plan. A vital component of the evaluation is observation of the subject in space and time, where specifically the evaluation of the person in the Vertical de Barré position can be used.

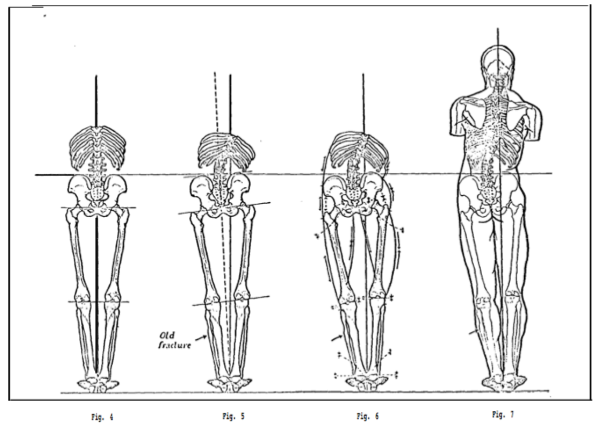
Before the physical evaluation of the patient, the education and training methods of developing manual practitioners must be examined. As stated by Mitchell (1976), "One of the ultimate objectives of the osteopathic educational program is an attitudinal one: an appreciation of the importance of manual, observational, and palpatory skills in all areas of medical practice" (p. 874). Mitchell (1976) describes visual literacy as the visual experiences and the exercise of visual perceptions in making judgments and states that perceptions may be qualitative and quantitative or both. He also indicates that the sense of vision can be subdivided in the ability to evaluate colour, shapes, and spatial orientation in relation to a horizon, along with the ability to assess movement or motion. This concept of visual perception is the basis for this inter-rater reliability study, and, while the study design might only capture a photographic image of the subject, it provides a reason to examine the visual training methods at the CCO and a basis for further research.

In a study by Woolman (2011), 98% of osteopaths interviewed in his research, included posture assessment in their initial consult when interviewing and assessing patients. A high level of importance identified in Woolman's research surrounded weight bearing in the COG and shoulder balance. For any practitioner, postural observation is conducted on a daily basis and can produce important information to assist in treatment. Considering that such a high rate of osteopaths utilize postural observation in their practice, is it assumed that all of them see the same thing when observing a subject standing? If interviewed, would these same osteopaths indicate the findings all result in the same conclusion for each patient? It is for this reason that inter-rater reliability studies continue to be conducted to provide EBM for the profession. It is also important to define postural components and the observation processes from an osteopathic perspective.

From an osteopathic perspective, proper postural balance has been described by Kappler (1982) as “a condition of optimal distribution of body mass in relation to gravity” (p. 598). Kappler describes that optimal postural balance can exist when there is perfect distribution of the body mass around the COG. In this state, ligamentous tension and pressure on the discs and muscles all have normal tone. To assess posture, Kappler describes that the patient should be observed from the back or front, making note of “symmetric right and left halves; ideally a Vertical plumb line should exactly bisect the cranium and spine and fall at a point equidistant between the patients feet” (1982, p. 598).

A historical source describing postural assessment is Schwab (1931), who describes examining one patient “standing upright with heels together” (p. 21), and also suggests that in order to recognize lateral shifts in the trunk, one must look at the patient from above. This mirrors the description from the previous section regarding the definition of the Vertical de Barré test (see Figures 15 and 16). This early description of postural assessment is an indication of how observational techniques have remained consistent over time; however, little has been published with specific descriptions such as Schwab’s (1931).





Figures 15 and 16: Postural Observations (Schwab and Kappler, 1931, p. 21)

Schwab (1931) states that "a single mechanical error or imbalance (a lesion) may affect the entire structure of an individual" (p. 21). For example, leg length discrepancies are indicated as possibly being the cause of dysfunction, and that, if structure determines function, "people who are supported by legs of unequal length always have some compensatory change in lumbar structure" (p. 21). Possible reasons for unequal leg length are unequal growth, epiphyseal injuries, fracture, weak foot, dislocations, arthritic changes, or some congenital abnormality (Schwab, 1931). This type of dysfunction is consistent with an ascending lesion pattern, creating the posture deviation of the pelvis moving away from the midline to adjust for the leg length imbalance.

Bailey (1978) describes structural abnormalities that might be present contributing to abnormal posture originating in the cranium. He states, "Disturbance of the structure-function of the cranium may demand accommodations similar to those required by asymmetry of leg length. Asymmetry of cranial function through continuity of meningeal membranes may un-level the sacral base with the same results in spinal accommodation as would result from a 'short leg'" (p. 15). This description follows the descending pattern theory of the head being off the midline as previously described by Gagey and Weber (2004).

With a cranial lesion or dysfunction, Bailey (1978) indicates that the eyes may be uneven "demanding special postural accommodation. Asymmetry of cranium may affect function of the labyrinth, confusing the integrating function of the brain (needed to maintain balance), or may cause the person to carry the head in an unusual position to pick up sound better" (p. 15). This can also be viewed as the descending lesion: a neurological dysfunction that pulls the head off the midline.

STILLS PRINCIPLES

3.1.1 STRUCTURE GOVERNS FUNCTION

If there is a structural change within the lower limbs, the upper half of the body will have to adapt, potentially altering the function of supporting musculature, ligaments, joints, and viscera.

Cathie (1983) states, "Disturbances of balance from any cause disturb weight bearing and produce joint strain and, eventually, deformity. Misalignment of the skeleton as the result of trauma is frequently accompanied by disturbances of balance. Until this is corrected, postural defects may occur. Diseases of bones and joints accompanied by productive or destructive changes are potent enemies of good" (p. 44).

3.1.2 THE BODY SERVES AS A FUNCTIONAL UNIT

Kuchera and Kuchera (1994) describe, "postural compensation in the musculoskeletal system occurs in all three planes of body motion to keep the body balanced and the eyes level" (p. 331). The nervous system relies heavily on the senses, specifically vision and the auditory system for balance functions. Normally, spinal compensation allows a person's central nervous system to correlate proprioceptive information received from the tendons and muscles with vestibular information from the semicircular canals, and to integrate this with information received from the eyes. Structural compensation allows a person to get through life and daily living in spite of musculoskeletal imbalances that place stress on the proprioceptive, musculoskeletal, and sensory systems. Due to an accumulated history of genetic, traumatic, and habitual processes requiring compensation, few patients have ideal posture.

Specific regions of the body may be affected when the breakdown of compensation is localized. This may take place in any part of the spine. The nerve distribution from the region involved will determine the symptoms produced. Consequently, anything from headaches to foot strain may be brought on as the sequelae of short lower extremity (Eggleston, 1983).

W. Kuchera and Kuchera (1994) also suggest that posture is more than just a product of joints, muscles, and ligaments; it is part of a functional unit. The authors write, "Posture is more than physical curves stacked one on another with musculo-ligamentous connectors; posture is influenced by the patient's emotional-spiritual self. Posture to a large degree is also a somatic depiction of the inner emotions. There is no doubt that posture can be considered a somatization of the psyche" (p. 359).

3.1.3 THE RULE OF THE ARTERY IS ABSOLUTE

Bailey (1978) writes, "Changes in muscle and fascial tensions may directly interfere with blood and lymph circulation. Through pressure on nerves, they may disturb reflex control of circulation or the trophic function of nerves. Change in visceral support and position may further disturb visceral function and postural imbalance is prone to limit respiratory movements" (p. 15).

3.1.4 THE SYSTEM OF AUTOREGULATION

Beckwith (1983) highlighted the importance of posture and the body's inherent adaptability. Proper assessment and treatment can help the body return to the stage of adaptability and autoregulation. Bailey (1977) writes, "The entire somatic structure of the individual, the state of development of neuromuscular patterns, and his potential at the moment to receive and integrate proprioceptive, vestibular, and ocular stimuli, and to respond with muscular activity for appropriately redistributing the masses of his parts, all influence his accommodations and the efficiency of these accommodations" (p. 15).

LINES OF GRAVITY

Postural considerations are vital in osteopathic medicine, and, as described by Kuchera (2003), "gravity is one of the major disrupters of postural homeostasis" (p. 603). He also indicates that "accurate postural diagnosis requires an understanding of both static and dynamic components of postural stress, and observations and palpation form the cornerstone of postural observation" (p. 607).

Gravity and its forces are significant because of the direct influence it can have on an individual. Imbalances in posture create strain on the various components of the body that in turn can affect the whole system. Slight rotations or side bending of the spine affect the nervous system and either the sympathetic or parasympathetics. As described by Cathie (1974), the sympathetic and parasympathetic systems affect each other, and this can result in an autonomic imbalance and have an impact on homeostasis of the body. The vagus nerve, responsible for parasympathetics complicates this further. The vagus nerve is in relation to the occiput, the cervical fascia, the pericardium, and the diaphragm. Cathie (1974) also describes the gravitational line of the body as passing through the body of the third lumbar segment to the middle of the sacral base.

Gravitation lines of force that are placed on the body can influence the resultant posture of the subject being observed, creating the altered posture and compensating patterns of posture. The central line of gravity is a combination of the anterior-posterior line of gravity (A-P) and the posterior line of gravity (P-A).

Littlejohn and Wernham (1956) describe that the anterior-posterior (A-P) line of gravity travels from the anterior foramen magnum, traveling inferiorly through the bodies of the eleventh and twelfth thoracic vertebra (T11 and T12) to the posterior portion of the fourth and fifth lumbar vertebra (L4 and L5), and through the body of the first sacral segment (S1) to the inferior tip of the coccyx (Figure 18A).

The posterior-anterior (P-A) line of gravity travels from the posterior foramen magnum down to the anterior margin of L2 and L3 and ends in the coxofemoral joints (Figure 18B). A result of these two lines is the CLOG (Figure 18 C and Figure 19).

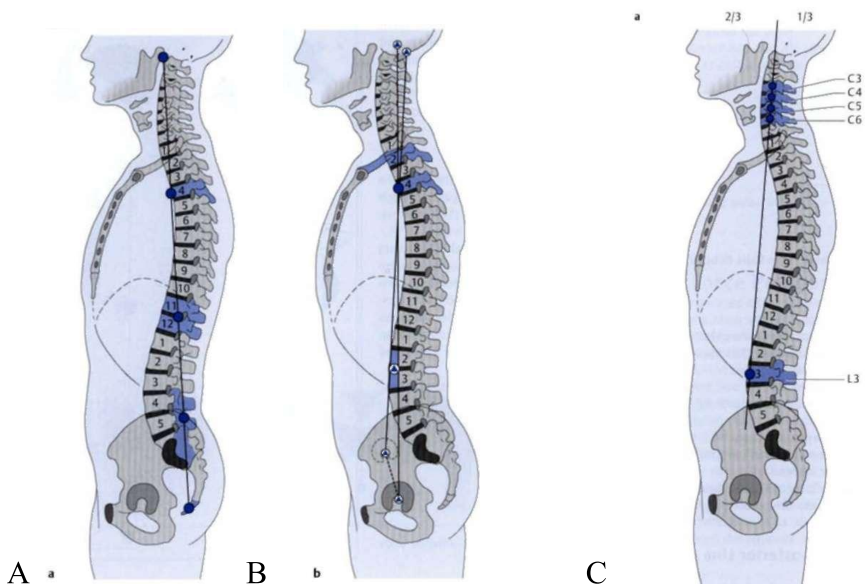


Figure 17: A-P line (A), P-A line (B), Central Line of Gravity (C), (Richter and Hebgen 2009, p. 59)

Littlejohn and Wernham (1956) describe the COG line as the axis of symmetry of the body as a perpendicular line falling between the two condyles of the occiput at the odontoid process passing through the spine at those points where the curves merge into each other. It then passes through the anterior promontory of the sacrum. Littlejohn and Wernham (1956) also indicate that all forces in movement are arranged mathematically in relation to gravity, to the COG line, and to the movement of that line especially in relation to its centre at L3; see Figure 18 (C).

The CLOG is a vertical line that travels from the vertex, through the body of L3 and through the centre of the arch of each foot. L3 is the only vertebra crossed by all three lines of gravity; it supports the entire body above, where the remainder of the body below is supported from it. L3 creates a balance of posture between these two halves leaving it prone to lesions.

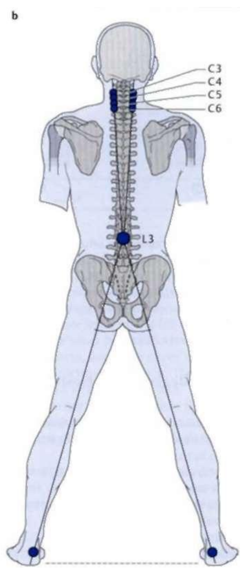


Figure 18: Central Line of Gravity, (Richter and Hebgen 2009, p. 59)

Littlejohn and Wernham (1956) wrote that both the A-P and P-A lines intersect at the level of T4 and form two triangles above and below that segment. T4 acts as a balance point between the superior and inferior triangles. Wernham (1965) states, “T4 is the centre of vaso-motion and its extension in the superficial circulation, in the correlation of the circulation in the two cavities of the body, and in the correlation of the deep and superficial circulations all over the body” (p. 31). See Figure 20 as an example of where the triangles meet, also known as the polygon of forces of the spine.

Hoover (1950) describes the influence that gravitational forces can have on the body and indicates that the body, as a structure, must comply with the laws of mechanics. Any force that creates a disadvantage on the mechanical levers of the body will change the balance of compressive force of gravity, and a counterbalance of another system or body part must occur to maintain a balanced gravitational system.

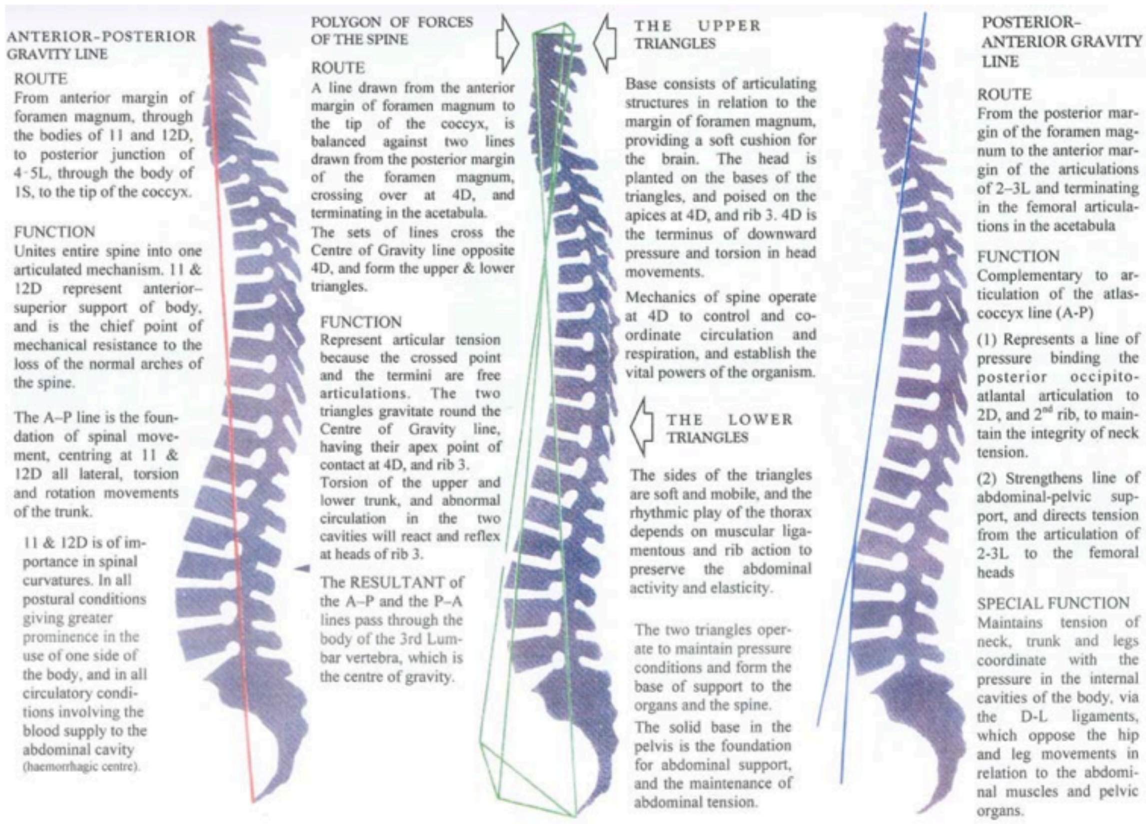


Figure 19: Littlejohn's Force Polygon as Described by Wernham (1955)

When the balanced gravitational system is stressed, each individual accommodates by producing compensatory curves. Pre-existing lesions and dysfunctions influence and limit the body's response in an individual pattern. Hoover (1950) states, "this means that patterns should not be classified exactly, and it is the reason why it is necessary to know the principles with which to fashion each piece of technique to meet the exact requirements of the individual lesion pattern" (p. 54).

POSTURAL PATTERNS

Group curves, common fascial lesion patterns, compensation patters, and classical patterns are common osteopathic theories, and they have been described in osteopathic literature. Due to the nature of the study, postural patterns and typologies must be examined to gain a better understanding of posture in general and of the associated presenting patterns.

3.1.5 POSTURE TYPOLOGIES

As indicated in Richter and Hebgen (2009) where they state that the diaphragms are important for the balance of pressure in the cavities and the anterior body line is in close contact with the diaphragms. Tensions in the thoracic area will create tensions in the abdomen area contributing to both anterior- and posterior-type pathologies (Richter & Hebgen, 2009). Numerous dysfunctions can be observed in the image below which could be due to an imbalance creating a structural change to that A-P line.

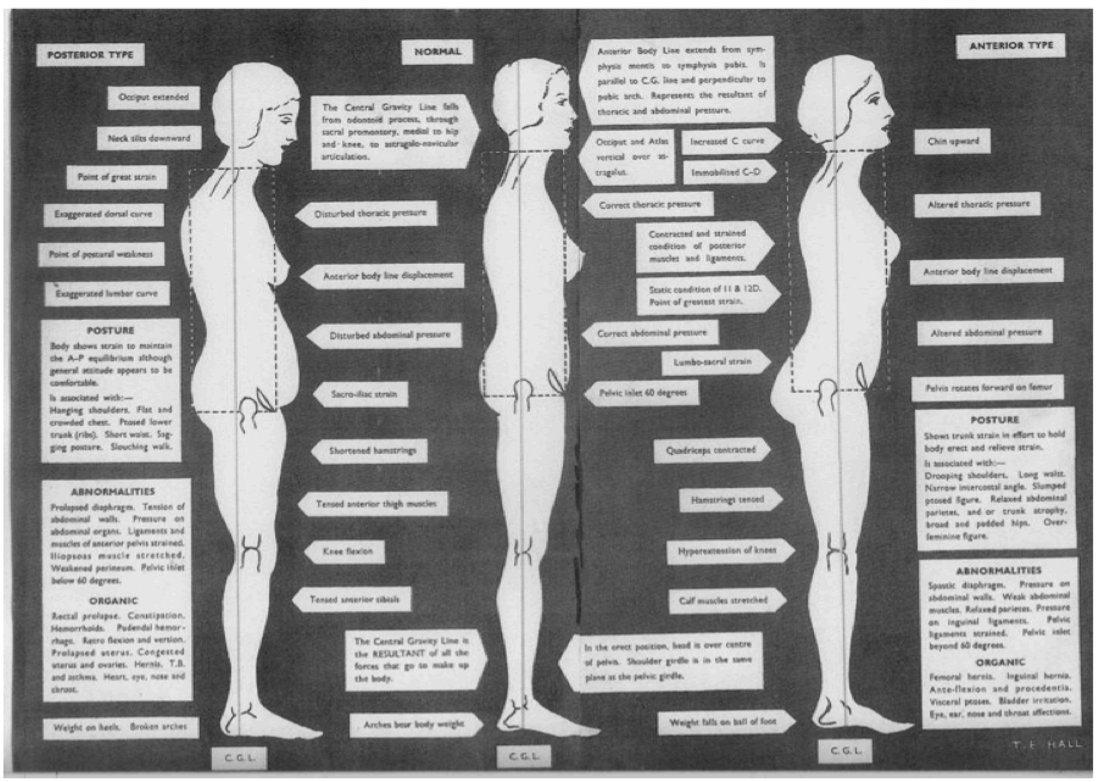


Figure 20: Postural Types (From Wernham. Mechanics of the Spine. Reprinted by the Institute of Classical Osteopathy, Maidstone, Kent, 1956 Yearbook)

Hoover (1950) describes that when any spinal segment has changed any portion of one or more of its ranges of movement, all other physiological movements of that segment are restricted. Hoover states, “the definition of an osteopathic lesion is any change in structure which interferes with function. A consideration of these principles reveals that all segments thus restricted are in lesion to the degree that their function is impaired” (p. 54). Hoover (1950) continues to describe that if any restriction is imposed, a proportionate decrease in the adaptability of the structure’s mechanism will occur and will be maintained by the forces of gravity. These altered structural capabilities are observed by manual practitioners and conclusions are drawn from these observations.

3.1.6 COMPENSATORY PATTERNS

Definition: “A compensated posture is the result of the patient's homeostatic mechanisms working through the entire body unit to maximize the function of a less than ideal situation, allowing the structure to operate more efficiently” (Kuchera & Kuchera, 1994, p. 334).

Kuchera and Kuchera (1994) describe that postural compensation in the musculoskeletal system “occurs in all three planes of body motion to keep the body balanced and the eyes level” (p. 334). During compensation, a person's central nervous system correlates proprioceptive information received from tendons and muscles with vestibular information from the semicircular canals. This process then integrates with information received from the eyes. As stated by Usatchev and Mokhov (2005), “As soon as the body deviates from the vertical, the receptors of the vestibular apparatus and proprioceptive receptors operate” (n.p.) in an effort to keep the eyes and body balanced.

When making postural observations of subjects, the clinicians and manual therapists make conclusions from the postures presented, which theoretically can assist in the treatment plan for the patient. One such postural pattern that is observed is termed a structural compensation pattern, and, as stated by Kuchera and Kuchera, "Structural compensation allows a person to get through life and daily living in spite of musculoskeletal imbalances (1994, p. 334).

3.1.7 DECOMPENSATED PATTERNS

"Decompensation occurs when an individual's homeostatic mechanisms are overwhelmed" (Kuchera & Kuchera, 1994, p. 335). Factors that Kuchera and Kuchera (1994) identify as contributing to postural decompensation include the following:

- Traumatic decompensation due to a history of macrotrauma or recurrent microtrauma that disrupts the ligamentous stability of the spine, fractures or compressions of the spine, fractures of the pelvis, or fractures of a leg that may produce sacral base unleveling or the need for compensatory changes above the area of the trauma.

- Personal conditions, activity, and aging as a cause of decompensation of the spine: Changes of body habitus which accompany pregnancy, obesity, "beer bellies," muscular weakness of aging, and poor sitting or standing habits produce postural stress and can initiate a decompensation process. Sometimes a work environment, which requires strenuous postures, may result in postural decompensation.

- Abnormal gait as a cause of decompensation: Examples of this would be the gait produced from a unilateral flatfoot problem, wearing high heels, wearing shoes with worn heels, and the gait following sprains or strains. These conditions affect the base of support and, therefore, stimulate compensatory changes in posture which, if continue indefinitely, could progress to decompensation with scoliosis, lordosis, and/or kyphosis (p. 335).

These compensated patterns create physical characteristics that can be observed by practitioners. Kuchera and Kuchera (1994) explain that postural compensation creates "cross-over points" that can irritate or facilitate spinal cord segments when the body tries to decompensate. Kuchera and Kuchera (1994) also state, "sagittal plane decompensation is often associated with extension mechanic prevalence in the craniosacral mechanism. The extension phase is often accompanied by loss of energy and psychological depression" (p. 335). This description by Kuchera and Kuchera is an example of literature that presents a theory regarding observational conclusions of the subject, but the evidence-based research regarding the subject is minimal. As previously indicated, many osteopathic theories lack scientific evidence to reinforce the conclusions drawn through experience and clinical observations.

The biomechanics behind compensated postural patterns are outlined by Kuchera and Kuchera (1994), who indicate that compensation can occur in "all three cardinal planes because spinal motions are biomechanically linked" (p. 335). Kyphotic or lordotic curves occur in the sagittal plane, while scoliotic curves are seen in the coronal plane. A rotation or torsion compensatory pattern is seen in the horizontal plane. In a clinical environment when examining posture and utilizing observation to assist in conclusions, it is important to consider all of the biomechanical planes and to examine the patient from different views. Clinically examining in all views provides more information for the practitioner. In the case of this study however, for the purpose of examining how consistent inter-rater reliability is, observations using photographs have been used in one plane only.

"Osteopaths frequently identify somatic dysfunction according to the diagnostic triad of ART, where A represents asymmetry of structure or function, R represents altered range of motion, and T represents tissue texture abnormalities (Spring et al., 2001, p. 47). Clearly and quickly identifying postural patterns in the subject can assist in the diagnosis as well as lead to efficient treatment plans in an effort to return the patient to a balanced midline position. As described by Usatchev and Makhov (2005), "the information of a deviation of the body from the vertical is absolutely necessary to the restoration of balance" (n.p.). While this inter-rater examines photographs in one plane and does not examine rotation in its evaluation, it is important to note the purpose of the research is to examine quickly and to identify asymmetries of the subject, which as stated can provide important information for the treating therapist.

FASCIA AND POSTURE

Fascia and posture are deeply connected. Kuchera and Kuchera (1994) indicate that "fascial environment influences posture. Asymmetry of posture may be a sign of fascial dysfunction" (p. 41). While a quick observation, without palpation, such as the methodology utilized in this study, may not provide much detail on the state of the fascial system, it must be considered when building a treatment plan. The fascial system is as important as the biomechanical structural changes that will influence a person's posture.

EMBRYOLOGICAL CONSIDERATIONS

As described in the literature review, Pope (2003) cites Zink to explain the CCP that is seen in almost eighty percent of the population. Pope (2003) writes that Zink theorizes the origin of the CCP could be because of the predisposition of the left hemisphere dominance. Cerebral lateralization causes right-hand and foot-motor dominance, which through repetitive use is thought to cause the common compensatory problem" (Pope, 2003, p.180). Pope also references a potential CCP, which occurs because of asymmetries within the body or is even due to the fetal development in the third trimester. This is an interesting concept to consider as many practitioners will infer that changes to a person's posture is a result of external factors; perhaps humans are genetically predisposed to postural patterns. While genetics influence a body type, this embryologic consideration must be considered when completing postural observations during a proper assessment.

4 CHAPTER FOUR: METHODOLOGY

4 RESEARCH METHODOLOGY

Approval for the study was granted by the CCO in Toronto, ON, and ethical clearance was granted by the Research Ethics Board (REB) at the Canadian Memorial Chiropractic College in Toronto, ON, Canada (Appendix C).

SUBJECTS

Ninety-four healthy (65 female and 29 male) subjects were recruited through the general public with the help of advertising in a busy sports medicine clinic, an email campaign, and postings on social media (Appendix D). The subjects were between the ages of 12 years to 71 years with no acute musculo-skeletal complaints. Ten participants were identified as falling into the exclusion (six females and four males), and their photographs were removed from the study and used for rater training purposes. All subjects gave their informed consent, and all subjects were informed of the aims of the study and the procedure that would be used. They were asked to wear shorts and sports bras or tank tops to meet their personal comfort. They were informed that they could withdraw from the study at any time.

EXCLUSION CRITERIA:

Those potential subjects who were excluded were individuals that may have presented with an obvious deviation from the midline due to a condition or trauma. Exclusion criteria pre-determined in the thesis proposal included the following:

- Any diagnosed spinal abnormality (i.e., scoliosis)
- Major trauma suffered in the last six months (hospital stay required)
- Persons with major dental work in the last six months (anesthesia required)
- Persons with diabetes, arthritis, vestibular disorders, or dizziness

- Persons with a history of falls (two or more in a year, resulting in hospital stay)

As the research includes an observational test, exclusion criteria were set for those with an increased likelihood of deviations at the cranium or pelvis. High trauma or significant anatomical deviations may make the midline deviations too obvious and potentially alter the results. It is for this reason that the history intake form included the above exclusion criteria to limit variables.

RATERS

Five raters were used for this study and recruited through personal communication from the author of the study. Three were osteopathic manual practitioners with at least ten years experience in the health care field, and the fourth was a CCO thesis writer with over six years experience in the health care field. These four conducted a blinded study. A fifth rater was introduced as well: the BioPrint postural analyzing software, which was also used as a measuring tool.

Five raters, four human raters, and the BioPrint software, along with eighty-four subjects, who were included in the methodology in an effort to produce the greatest possibility of diversity. The numbers of subjects and raters were calculated based on the work by Fleiss (1981), on the statistical methods for raters and proportions by Flack et al. (1988), and on sample-size determinations for the rater kappa statistic, which were presented by the statistician based on the calculations for statistical relevance (see Figure 22).

					No. of Raters			
	Probability				2	3	4	5
Rater Scale Options	1	2	3	4	Required Sample Size			
	0.33	0.33	0.33		142	93	72	58
	0.20	0.30	0.50		161	105	81	65
	0.20	0.25	0.55		162	106	82	66
	0.25	0.25	0.25	0.25	129	84	65	52
	0.10	0.20	0.30	0.40	152	99	77	62
	0.10	0.10	0.30	0.50	166	108	84	68
	0.70	0.80	0.25	0.60	175	114	88	71

Figure 21: Kappa Statistic Sample Size Calculation/ Number of Raters

Of note, the author of this study originally intended on being a rater, but, after processing the images and preparing the packages, withdrew himself as a rater to eliminate the possibility of bias.

BARRÉ BOARD AND PLUMB BOB

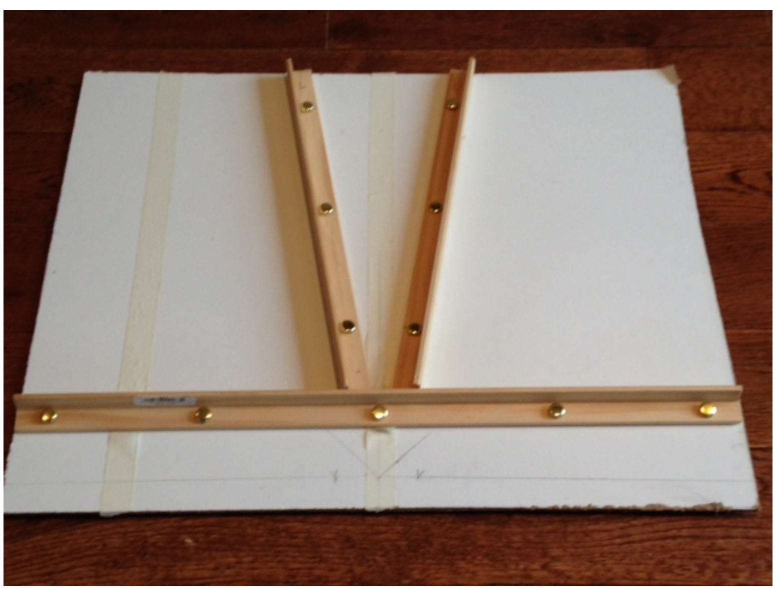


Figure 22: Vertical de Barré Board

The Barré board and plumb line was constructed out of material purchased from The Home Depot and Staples, Newmarket, Canada. White particleboard was used for the platform, L trim was used as the block for the heels. The trim was fastened to the board with 2-inch fasteners. As per Van Tichelen's (1992) description of the Vertical de Barré test and platform, angles of blocks were measured thirty degrees from midline and blocks were placed 5 cm apart. The Barré platform was validated for accuracy by Stephen Schwartz, B.Eng. The plumb bob and chain were purchased from The Home Depot and fixed to the ceiling, utilizing a hook fastened into the ceiling.

PROCEDURE

4.1.1 BACKDROP SET-UP

A BioPrint posture grid was hung on a wall and leveled with a 2-foot level. Tape was used on the floor to bisect the BioPrint grid and to allow the Barré board to be consistently square to the backdrop and repeatedly be placed in a consistent position for all three photographic positions. A piece of tape, 20 inches, was placed on the ground nine inches from the wall as per the BioPrint specifications (see Appendix E). Finally, the camera was landmarked eleven feet from the wall and a piece of tape placed where the lens would be; this position was centred by measuring equidistant numbers from the right and left side of the posture grid. The lens was measured to be thirty-three inches off the ground, and fastened on a tripod for stabilization.

The Checklist (see Appendix F) was taped to the wall to the left of the photographer to ensure consistence in procedure.

4.1.2 SUBJECT PROCEDURE

The subject entered the facility to complete his or her demographic intake form and to sign a consent for participation. The subject then drew a subject number between 0 and 100. Subjects were assigned a number at random to assist in the tracking of evaluations and the demographic data entry. Numbered stickers were placed on the left thigh of their shorts and on their intake form with their demographic information.

4.1.3 POSTURE MEASUREMENT

Subjects were asked to stand in the Vertical de Barré position, on a premade Vertical de Barré board, heels five centimeters apart, feet turned in 30 degrees of external rotation, and feet touching the wooden block to maintain a consistent position.

- The dress code required males to wear shorts and females to wear shorts and tank tops or sports bras.

Subjects were then asked to nod their heads up and down three times, inhale/exhale, and stand to their normal behavior. They were to gaze at pieces of tape in an X on the wall directly across from them.

Two pictures were taken with a Canon Rebel XS DSL camera (10.1 megapixel – Appendix G) at a distance of eleven feet from the backdrop. The first was not with the plumb line, and the second was with a plumb line, both were from an anterior ventral view (Figure 22) (Appendix I).

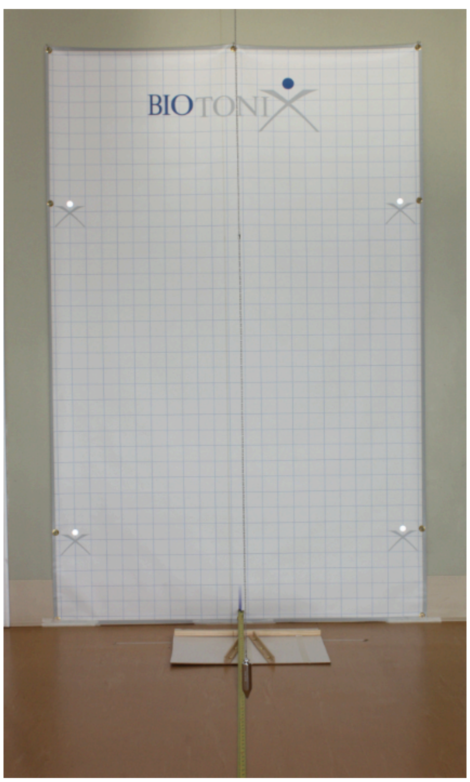


Figure 23: Vertical de Barré board, Plumb Line, and BioPrint Backdrop

4.1.4 BIOPRINT DATA COLLECTION

Thirty-two hypoallergenic reflective markers were then placed on anatomical landmarks of the subject as per BioPrint protocol (see Appendix H) by one of three research assistants, who had been trained via the BioPrint software on marker placement. Four photographs were taken utilizing the BioPrint backdrop, keeping the subject in the Vertical de Barré position. Two pictures were taken from the profile, one with the arm straight and one with the elbow bent at 90 degrees. One picture was taken from the posterior. One picture was taken from the anterior, as per the BioPrint protocol. Subjects were asked to step off the Barré board, and it was rotated 90 degrees to capture the next photo, as pictures were taken from an anterior, lateral, and posterior view (Appendix J). The Barré board was consistently placed in the same position for each photo utilizing tape markers on the floor to align the board in the proper position.

Photographs were digitized and uploaded into the BioPrint software program. The images were processed in the program. During this phase of the data collection, corrections could be made to ensure that the hypoallergenic reflective markers were placed in the correct anatomical landmark. A BioPrint report was produced which provided a quantitative value of where the subject's body was in space (see Appendix K). From the report, the forehead and pelvis measures were then highlighted and recorded on an excel spreadsheet for statistical analysis (Figure 23)

View from the Front (anterior)

How many degrees you are from horizontal

Body Segment	Elevated Side	Angle
Shoulders	Left	1.6°
Pelvis	Right	0.3°
Knees	Right	0.7°

Note: The ideal angle should be 0°.

How far are you from vertical

Reference Point on	Direction	Distance
Forehead	Left	0.3 in
Shoulders	Left	0.3 in
Umbilicus	Left	0.1 in
Pelvis	Right	0.2 in
Knees	Left	0.3 in
Toes	Left	0.3 in

Note: The ideal distance should be 0 in.

How many degrees your feet are rotated

Body Segment	Direction	Angle
Left foot	External Rotation	6.3°
Right foot	External Rotation	1.8°

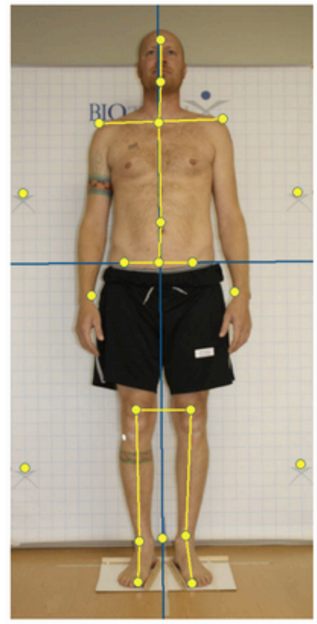


Figure 24: BioPrint Anterior View Postural Report

Of note, photographs used for the raters evaluation were taken observing the subject from an anterior view because the BioPrint report produced statistical values for the distance of the forehead and pelvis from the midline. The forehead and pelvis were the two landmarks that raters were making observational conclusions of, and the images had to be consistent with the BioPrint software report and anterior images that were produced. Traditionally, the Vertical de Barré test is thought to have been done only from the posterior view, but as stated in the literature review, observations of the test should be done from an anterior, lateral, and posterior view.

IMAGE PROCESSING

Four 5 x7 photographs of each subject standing (a) without a plumb line and (b) with a plumb line were developed at a Costco wholesale store in Newmarket, Ontario, and divided into four piles. Each photograph had a number written in a black sharpie marker on the back of the photograph, indicating the subject's randomly assigned number.

EVALUATION SEQUENCE:

4.1.5 RATER EVALUATION TRAINING

The human raters were delivered a training package included in their study envelope as suggested by Kuchera (2011). The purpose of the training package was to allow the raters to become familiar with the protocol for the experiment, practice the observation and evaluation process, and execute the scoring system.

Each of the four human raters observed photographs of the subjects standing in the Vertical de Barré position, from the anterior view, to determine if there was a greater deviation from the midline at the level of the torso, at the cranium, or if the patient was in a neutral position. The data was then analyzed to determine the reliability of his or her observations.

4.1.6 RATER EVALUATION PROCEDURE

- Raters were sent via courier, one package, containing three envelopes and one return shipping label. Raters were sent the packages off-site due to geography and the various time commitments of each rater. Raters were instructed through personal communication that they were to complete the research independently and follow the directions that were included in the envelope (Appendix L).

- Envelope One: training envelope, containing 20 photos, 10 subjects with plum line and 10 subjects without plum line, 20 + rater evaluator forms and an instruction sheet on how to proceed (see Appendix M).

- Envelope Two: containing 84 photographs of the subjects standing without a plumb line and 85 rater evaluation forms.

- Envelope Three: containing 84 photographs of subjects standing with a plumb line and 85 rater evaluation forms.

4.1.6.1 RATER PROTOCOL

- Following the Protocol Instruction Sheet, raters reviewed the photos of each subject in a random order as placed in the envelope. Using a watch or timepiece to measure time for observing the photographs at 10 seconds, the raters were asked to complete the rater evaluation form with a check mark, indicating which body segment had the greatest deviation from the midline: cranial, pelvis, or neutral.
  - First, they were asked to complete the training package.
  - Secondly, they were asked to complete the set of no plumb line pictures.
  - Thirdly, they were asked to complete the set of plumb line pictures.
- After completing the assessment of all the photographs as per the instruction sheet, the raters returned the photos and rater evaluation forms into the respective envelopes and back into the shipping package, and they were returned to the author of the research via courier.

- The rater evaluation sheets were then placed into numerical order, and the results were recorded onto an Excel spreadsheet, indicating subject number, cranium, pelvis, or neutral deviation, right/left and ascending/descending lesion present.

BIOPRINT SOFTWARE SEQUENCE

The BioPrint software was loaded onto a Lenovo 400 computer with a Windows Operating System.

- Each of the Four BioPrint pictures were uploaded separately into the subjects BioPrint profile that was created by their subject number and name as per the BioPrint software procedure.
- BioPrint software and hypoallergenic reflective sticker placement was verified using the software, ensuring accurate anatomical landmarks.
- BioPrint report was produced.
- The result summary page was printed and attached to their consent form and medical history questionnaire (Appendix N and O).
- If requested by the patient, the BioPrint report was sent to the email address that they provided on the intake form.

DATA PROCESSING AND EVALUATION

- Data from the medical history questionnaire was transferred into an Excel spreadsheet for calculation.
- Data entered included: Age / Sex / Conditions / Medications / Other Injuries / Deviation (Cranium or Pelvis) / Direction (R/L) / Type of Lesion

Identified (Ascending or Descending) / BioPrint Deviation / BioPrint Value from Midline.

- Data was reviewed and process by Dr. Jason Pole, statistician at the University of Toronto. Dr. Pole processed the numbers producing a kappa variable according to the Fleiss model, separating the results into Training, No Plumb Line, and Plumb Line categories.
- Results were compared for statistical significance using kappa statistics:
  - rater versus rater – no plumb line
  - rater versus rater – plumb line
  - raters versus BioPrint

INDEPENDENT VARIABLES:

Independent variables that were limited include the following:

- The stance position for the evaluation.
- Trained research assistants, post-secondary students who completed the BioPrint training procedure, conducted the placement of the markers.
- Photographs were taken at a specific distance of eleven feet from the backdrop.
- The raters were to observe the photographs of the subjects for 10 seconds before indicating their conclusions on the rater form.

ETHICS:

Ethical considerations for this research included the photographic images taken for comparison and the BioPrint software analysis. Subjects were asked to wear shorts and a tank top or sports bra if female, and male participants wore no tops to allow for the proper placement of markers to have pictures taken.

All personal information gathered from the subject has been protected by the Personal Information Protection and Electronic Document Act (PIPEDA), as well as the Personal Health Information Privacy Act (PHIPA), and will be applied following the PIPEDA and PHIPA compliance framework. This research paper was applied for and was granted approval from the Research Ethics Board (REB) at the Canadian Memorial Chiropractic College.

Subjects' identities have been kept confidential and digital pictures were held on a password-protected hard drive. Printed photographs that were distributed to raters for evaluation were sent via courier, wherein a signature was required to accept the collected data. Subjects were educated on the requirements, and, if they felt uncomfortable, they were able to remove themselves from the study at any time.

There was no monetary reward for participation in the study.

The BioPrint software was chosen as it had been deemed a validated research tool with a high degree of reliability in referred journals (Normand et al., 2007, Normand, Harrison, Cailliet, Blacka, Harrison & Holland, 2002). The conductor of this research has no relationship to Biotonix or BioPrint, and has zero conflicts of interest.

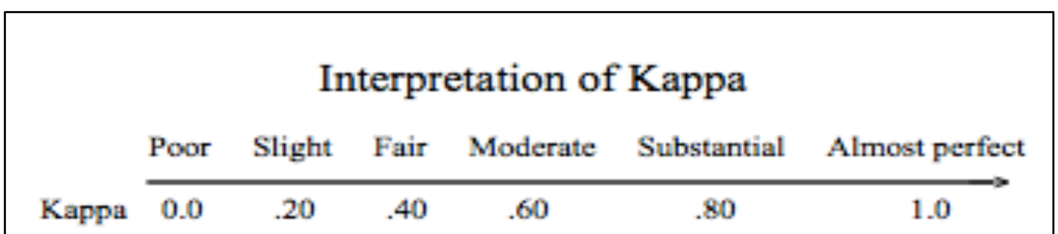
5 CHAPTER FIVE: RESULTS

5 RESEARCH RESULTS

STATISTICS

Intra-examiner reliability was determined using the generalized Cohen's kappa coefficient (*K*) for concordance as described by Hass (1991) and modified by Gwet (2012), kappa was calculated using the Standard Analysis System (SAS) version 9.3 by Dr. Jason Pole, epidemiologist/statistician at the University of Toronto. As stated by Spring et al. (2001), "Kappa values can range from -1 to 1, where positive values signify agreement better than chance, zero signifies agreement no better than chance, and a negative value signifies agreement worse than chance" (p. 50). Kappa values above zero were interpreted using the scale proposed by Landis and Koch (1977).

Stratification, which is the process of dividing members of the population into groups, was considered for this experiment. This included dividing the observations into subgroups; without a plumb line and with a plumb line, which then could be divided again according to the distance from the midline as produced by the BioPrint report.



Kappa	Agreement
< 0	Less than chance agreement
0.01–0.20	Slight agreement
0.21– 0.40	Fair agreement
0.41–0.60	Moderate agreement
0.61–0.80	Substantial agreement
0.81–0.99	Almost perfect agreement

Figure 25: Interpretation of Kappa (Landis & Koch, 1977)

Demographics of the study are observed in Table 1

Table 1: Demographics

	N	Mean	Standard Deviation
Overall	84	39.14	12.13
Females	59	38.44	11.66
Males	25	40.80	13.28

The findings of all examiners for “No Plumb Line Assessment,” “Plumb Line Assessment,” “Raters vs. BioPrint No Plumb Line,” and “Raters vs. BioPrint Plumb Line” are summarized in Table 2 and expanded in Tables 3, 4, 5, and 6 respectively.

Table 2: Inter-Rater Results Comparing Human vs. BioPrint Software Using a Plumb Line and No Plumb Line

Stratification	Raters	Kappa	95% CI	P-value
No Plumb Line				
	Raters 1–4	0.24	0.16 – 0.32	0.001
	Raters vs. BioPrint	0.21	0.16 – 0.27	0.001
Plumb Line				
	Raters 1–4	0.37	0.29 – 0.46	0.001
	Raters vs. BioPrint	0.28	0.22 – 0.34	0.001

NO PLUMB LINE ASSESSMENT

The results derived from this study demonstrate that human inter-rater reliability is of slight agreement with a kappa of 0.24 with a 95% CI ranging from 0.16 to 0.32 and a p-value $\leq$ 0.001 indicating statistical significance.

PLUMB LINE ASSESSMENT

The results derived from this study demonstrate that human inter-rater reliability is of slight agree agreement with a kappa of 0.37 with a 95% CI ranging from 0.29 to 0.46 and a p-value ≤ 0.001 indicating statistical significance.

RATERS VS. BIOPRINT NO PLUMB LINE

The results derived from this study demonstrate that human inter-rater reliability is of slight agreement with a kappa of 0.21 with a 95% CI ranging from 0.16 to 0.27 and a p-value ≤ 0.001 indicating statistical significance.

Table 3: No Plumb Line

Stratification	Raters			Kappa	95% CI			P-value
All	One	vs.	BioPrint	0.23	0.10	–	0.36	0.001
	Two	vs.	BioPrint	0.10	-0.02	–	0.22	0.050
	Three	vs.	BioPrint	0.33	0.19	–	0.46	0.001
	Four	vs.	BioPrint	0.05	-0.06	–	0.16	0.174
	Raters 1–4			0.24	0.16	–	0.32	0.001
	All			0.21	0.16	–	0.27	0.001

RATERS VS. BIOPRINT PLUMB LINE

The results from this study demonstrate that human inter-rater reliability ranged in a slight agreement with a kappa of 0.28, with a 95% CI ranging from 0.22 to 0.43, and a p-value ≤ 0.001 indicating statistical significance.

Table 4: Plumb Line

Stratification	Raters			Kappa	95% CI			P-value
All	One	vs.	BioPrint	0.22	0.09	–	0.35	0.001
	Two	vs.	BioPrint	0.12	0.00	–	0.24	0.028
	Three	vs.	BioPrint	0.22	0.09	–	0.35	0.001
	Four	vs.	BioPrint	0.07	-0.05	–	0.18	0.126
	Raters 1–4			0.37	0.29	–	0.46	0.001
	All			0.28	0.22	–	0.34	0.001

Table 5: Rater Reliability Distance from Midline No Plumb Line

Stratification	Raters			Kappa	95% CI			P-value
BioPrint ≤ 0.2	One	vs.	BioPrint	0.07	-0.31	–	0.45	0.350
	Two	vs.	BioPrint	0.08	-0.30	–	0.46	0.342
	Three	vs.	BioPrint	-0.08	-0.38	–	0.22	0.710
	Four	vs.	BioPrint	0.39	-0.04	–	0.82	0.038
	Raters 1–4			0.54	0.25	–	0.83	0.001
	All			0.37	0.22	–	0.51	0.001
BioPrint > 0.2	One	vs.	BioPrint	0.24	0.11	–	0.38	0.001
	Two	vs.	BioPrint	0.11	-0.02	–	0.24	0.051
	Three	vs.	BioPrint	0.37	0.23	–	0.51	0.001
	Four	vs.	BioPrint	0.02	-0.09	–	0.13	0.375
	Raters 1–4			0.21	0.13	–	0.29	0.001
	All			0.20	0.14	–	0.26	0.001
BioPrint ≤ 0.4	One	vs.	BioPrint	0.19	-0.02	–	0.41	0.042
	Two	vs.	BioPrint	0.06	-0.14	–	0.25	0.283
	Three	vs.	BioPrint	0.11	-0.10	–	0.32	0.147
	Four	vs.	BioPrint	0.07	-0.12	–	0.27	0.226
	Raters 1–4			0.23	0.09	–	0.37	0.001
	All			0.18	0.09	–	0.26	0.001
BioPrint > 0.4	One	vs.	BioPrint	0.25	0.09	–	0.41	0.001
	Two	vs.	BioPrint	0.13	-0.02	–	0.28	0.046
	Three	vs.	BioPrint	0.44	0.28	–	0.60	0.001
	Four	vs.	BioPrint	0.04	-0.09	–	0.18	0.262
	Raters 1–4			0.25	0.15	–	0.35	0.001
	All			0.23	0.16	–	0.31	0.001
BioPrint ≤ 0.6	One	vs.	BioPrint	0.15	-0.02	–	0.32	0.039
	Two	vs.	BioPrint	0.06	-0.10	–	0.22	0.228
	Three	vs.	BioPrint	0.25	0.07	–	0.44	0.004
	Four	vs.	BioPrint	0.08	-0.08	–	0.23	0.159
	Raters 1–4			0.21	0.10	–	0.32	0.001
	All			0.18	0.10	–	0.26	0.001
BioPrint > 0.6	One	vs.	BioPrint	0.32	0.13	–	0.51	0.001
	Two	vs.	BioPrint	0.15	-0.03	–	0.34	0.050
	Three	vs.	BioPrint	0.42	0.23	–	0.61	0.001
	Four	vs.	BioPrint	0.03	-0.12	–	0.19	0.349
	Raters 1–4			0.28	0.16	–	0.40	0.001
	All			0.26	0.17	–	0.35	0.001

Table 6: Rater Reliability – Distance from Midline with Plumb Line

Stratification	Raters			Kappa	95% CI			P-value
BioPrint ≤ 0.2	One	vs.	BioPrint	0.34	-0.10	–	0.79	0.065
	Two	vs.	BioPrint	0.08	-0.32	–	0.47	0.347
	Three	vs.	BioPrint	0.09	-0.30	–	0.48	0.318
	Four	vs.	BioPrint	0.20	-0.21	–	0.62	0.170
	Raters 1–4			0.32	0.07	–	0.57	0.006
	All			0.27	0.09	–	0.46	0.002
BioPrint > 0.2	One	vs.	BioPrint	0.20	0.07	–	0.34	0.001
	Two	vs.	BioPrint	0.13	0.00	–	0.26	0.026
	Three	vs.	BioPrint	0.24	0.11	–	0.38	0.001
	Four	vs.	BioPrint	0.05	-0.07	–	0.16	0.203
	Raters 1–4			0.38	0.29	–	0.47	0.001
	All			0.29	0.22	–	0.35	0.001
BioPrint ≤ 0.4	One	vs.	BioPrint	0.15	-0.06	–	0.35	0.086
	Two	vs.	BioPrint	0.02	-0.17	–	0.20	0.427
	Three	vs.	BioPrint	0.10	-0.10	–	0.31	0.160
	Four	vs.	BioPrint	-0.01	-0.18	–	0.16	0.445
	Raters 1–4			0.36	0.21	–	0.51	0.001
	All			0.24	0.15	–	0.33	0.001
BioPrint > 0.4	One	vs.	BioPrint	0.26	0.10	–	0.43	0.001
	Two	vs.	BioPrint	0.18	0.02	–	0.34	0.012
	Three	vs.	BioPrint	0.29	0.13	–	0.46	0.001
	Four	vs.	BioPrint	0.11	-0.03	–	0.25	0.062
	Raters 1–4			0.39	0.28	–	0.49	0.001
	All			0.31	0.23	–	0.39	0.001
BioPrint ≤ 0.6	One	vs.	BioPrint	0.18	0.00	–	0.35	0.023
	Two	vs.	BioPrint	-0.05	-0.18	–	0.09	0.244
	Three	vs.	BioPrint	0.18	0.00	–	0.35	0.022
	Four	vs.	BioPrint	0.08	-0.08	–	0.23	0.165
	Raters 1–4			0.30	0.19	–	0.41	0.001
	All			0.21	0.14	–	0.28	0.001
BioPrint > 0.6	One	vs.	BioPrint	0.29	0.09	–	0.48	0.002
	Two	vs.	BioPrint	0.32	0.13	–	0.52	0.001
	Three	vs.	BioPrint	0.29	0.09	–	0.48	0.002
	Four	vs.	BioPrint	0.07	-0.10	–	0.23	0.214
	Raters 1–4			0.48	0.35	–	0.60	0.001
	All			0.38	0.28	–	0.48	0.001

Table 7: Rater Reliability – No Plumb Line Female vs. Male Subject

Stratification	Raters			Kappa	95% CI			P-value
All	One	vs.	BioPrint	0.23	0.10	–	0.36	0.001
	Two	vs.	BioPrint	0.10	-0.02	–	0.22	0.050
	Three	vs.	BioPrint	0.33	0.19	–	0.46	0.001
	Four	vs.	BioPrint	0.05	-0.06	–	0.16	0.174
	Raters 1–4			0.24	0.16	–	0.32	0.001
	All			0.21	0.16	–	0.27	0.001
Females	One	vs.	BioPrint	0.23	0.08	–	0.39	0.002
	Two	vs.	BioPrint	0.14	-0.01	–	0.29	0.032
	Three	vs.	BioPrint	0.37	0.21	–	0.53	0.001
	Four	vs.	BioPrint	0.00	-0.12	–	0.12	0.493
	Raters 1–4			0.19	0.10	–	0.27	0.001
	All			0.18	0.11	–	0.25	0.001
Males	One	vs.	BioPrint	0.21	-0.02	–	0.45	0.037
	Two	vs.	BioPrint	0.01	-0.19	–	0.21	0.461
	Three	vs.	BioPrint	0.23	-0.01	–	0.46	0.029
	Four	vs.	BioPrint	0.17	-0.05	–	0.40	0.066
	Raters 1–4			0.39	0.22	–	0.56	0.001
	All			0.29	0.19	–	0.40	0.001

Table 8: Rater Reliability – Plum Line Female vs. Male Subjects

Stratification	Raters			Kappa	95% CI			P-value
All	One	vs.	BioPrint	0.22	0.09	–	0.35	0.001
	Two	vs.	BioPrint	0.12	0.00	–	0.24	0.028
	Three	vs.	BioPrint	0.22	0.09	–	0.35	0.001
	Four	vs.	BioPrint	0.07	-0.05	–	0.18	0.126
	Raters 1–4			0.37	0.29	–	0.46	0.001
	All			0.28	0.22	–	0.34	0.001
Females	One	vs.	BioPrint	0.25	0.09	–	0.40	0.001
	Two	vs.	BioPrint	0.17	0.02	–	0.32	0.302
	Three	vs.	BioPrint	0.32	0.16	–	0.47	0.001
	Four	vs.	BioPrint	0.04	-0.09	–	0.17	0.261
	Raters 1–4			0.34	0.24	–	0.43	0.001
	All			0.28	0.20	–	0.35	0.001
Males	One	vs.	BioPrint	0.16	-0.06	–	0.39	0.080
	Two	vs.	BioPrint	0.01	-0.18	–	0.21	0.446
	Three	vs.	BioPrint	0.01	-0.18	–	0.21	0.444
	Four	vs.	BioPrint	0.12	-0.09	–	0.34	0.136
	Raters 1–4			0.46	0.30	–	0.62	0.001
	All			0.31	0.22	–	0.40	0.001

Table 9: Rater Reliability by Age of Subject – No Plumb Line

Stratification	Raters			Kappa	95%CI			P-value
Age ≤ 38 years	One	vs.	BioPrint	0.16	-0.01	-	0.34	0.032
	Two	vs.	BioPrint	0.07	-0.09	-	0.23	0.192
	Three	vs.	BioPrint	0.31	0.13	-	0.49	0.000
	Four	vs.	BioPrint	0.05	-0.10	-	0.20	0.242
	Raters 1-4			0.24	0.12	-	0.36	0.000
	All			0.20	0.12	-	0.28	0.000
Age > 38 years	One	vs.	BioPrint	0.30	0.11	-	0.49	0.001
	Two	vs.	BioPrint	0.14	-0.04	-	0.32	0.070
	Three	vs.	BioPrint	0.34	0.14	-	0.53	0.000
	Four	vs.	BioPrint	0.05	-0.11	-	0.21	0.264
	Raters 1-4			0.25	0.14	-	0.36	0.000
	All			0.23	0.14	-	0.32	0.000

Table 10: Rater Reliability by Age of Subject – Plumb Line

Stratification	Raters			Kappa	95% CI			P-value
Age ≤ 38 years	One	vs.	BioPrint	0.18	0.01	–	0.36	0.020
	Two	vs.	BioPrint	0.13	-0.04	–	0.30	0.067
	Three	vs.	BioPrint	0.21	0.03	–	0.39	0.010
	Four	vs.	BioPrint	0.13	-0.03	–	0.30	0.058
	Raters 1–4			0.42	0.30	–	0.53	0.001
	All			0.31	0.22	–	0.40	0.001
Age > 38 years	One	vs.	BioPrint	0.26	0.07	–	0.45	0.003
	Two	vs.	BioPrint	0.11	-0.07	–	0.29	0.110
	Three	vs.	BioPrint	0.24	0.05	–	0.43	0.006
	Four	vs.	BioPrint	-0.01	-0.15	–	0.14	0.455
	Raters 1–4			0.33	0.21	–	0.45	0.001
	All			0.26	0.18	–	0.34	0.001

6 CHAPTER SIX: DISCUSSION

6 DISCUSSION

The goal of this research was to investigate the validity and inter-rater reliability of a posture observation method, the Vertical de Barré. The hypothesis of the study restated is the following summation:

1. The Vertical de Barré test as observed in photographs by trained osteopathic manual practitioners will produce a kappa statistic greater than 0.6 without a plumb line, when assessing cranial versus caudal landmark differences from the midline.

2. The Vertical de Barré test as observed in photographs by trained osteopathic manual practitioners will produce a kappa statistic greater than 0.6 with a plumb line, when assessing cranial versus caudal landmark differences from the midline.

3. The Vertical de Barré test as observed by trained osteopathic manual practitioners compared to the BioPrint software will produce a kappa statistic greater than 0.6 when assessing cranial versus caudal landmark differences from the midline.

Inter-examiner reliability using photographs of the Vertical de Barré position as a means of observing posture produced fair agreement without a plumb line (0.24 *K*) and with a plumb line (0.37 *K*). When compared to the BioPrint software, inter-rater reliability using the Vertical de Barré position as a means of observing posture produced fair agreement with (0.21 *K*) and without (0.28 *K*) a plumb line as well.

While the findings did not produce moderate agreement, producing a null hypothesis for hypotheses 1, 2, and 3 as stated above, the data does produce statistical significance as P $\leq$ values are consistently 0.001. This low p-value indicates the likelihood of the observations made by the raters had a low possibility of happening by chance, providing statistical significance of the findings.

There are a number of possible reasons why the results from this study did not meet the cut point of moderate agreement $K \leq 0.6$ when considering human vs. human reliability, with and without a plumb line, and human versus BioPrint posture analyzing software, with and without a plumb line.

A factor that might have influenced the results includes research design. In this research, observations were only concluded in the anterior view. This was done to ensure that raters observations would be comparable to the BioPrint software report, which was able to provide a quantifiable value. The research by Perry, Smith, Straker, Coleman, and O'Sullivan (2008) studied the reliability of photographic spinal posture assessment in adolescents. Their conclusions implied that it might be beneficial to examine posture in more than one position. The findings by Perry et al. (2008) also determined that inter-rater reliability ranged from poor to good, and identified many of the same variables that would have affected their results

Haas (1991) reviewed many different articles regarding examiner reliability. In his report, one thing he notes to consider is the area of observation that is being examined. Hass indicated that segmental reliability studies have different outcomes versus global reliability studies. The current research being presented made global observations where perhaps future inter-rater studies at this level could make more specific observations, for example, in estimating distance from the midline. On the other hand, future research might be interesting to see if kappa values would change if there was no direction (right/left) associated with the rater's evaluation. One would assume, if a variable is eliminated from the testing parameters, inter-examiner reliability would be higher.

When examining the cut point that was chosen for this study, it was hypothesized that reliability would expect to be substantial at 0.6 K or better. Other factors that might have limited inter-examiner reliability to not getting better agreement, include human error and the subjective nature of the observational assessment. While Zonnenberg, Van Maanen, Elvers, and Oostendorp (1996) quantified postural differences between photographs and real-time observations, the authors concluded that using photographs to assess posture is a reliable method. Zonnenberg et al. (1996) does indicate that the involvement of humans in identifying landmarks and estimating position is a subjective technique that will result in error; values and conclusions become estimates and are not measured, and, as Zonnenberg et al. (1996) indicate, a difference of interpretation can occur when no exact is identified.

Using the BioPrint system provided some checks and balances during the data entry and report-producing process as there was opportunity to alter the position of the hypoallergenic marker placement on the anatomical landmark. The observations of the subjects cranial or pelvic deviations does have a subjective component to the process, which could have been affected by the use of the photographs as opposed to real time, but due to the study's design, this was deemed a satisfactory process. The difference of interpretation of the subject's body position by the raters is what makes this current Vertical de Barré study interesting as the observational skills of each rater should be similar due to the similar training each had received; no exact direction of pelvis/cranium right and left was provided, resulting in many variations of the raters' conclusions and the low kappa results.

The chart below (Chart A) indicates the differences in kappa value observed when examining deviations from the midline. The BioPrint software is able to quantify distance from the midline to the tenth of an inch. The chart below indicates that raters had slightly better results without a plum line when deviations were only 0.2 inches from the midline, whereas raters seemed to gradually improve results when the deviation was larger from the midline utilizing a plumb line.

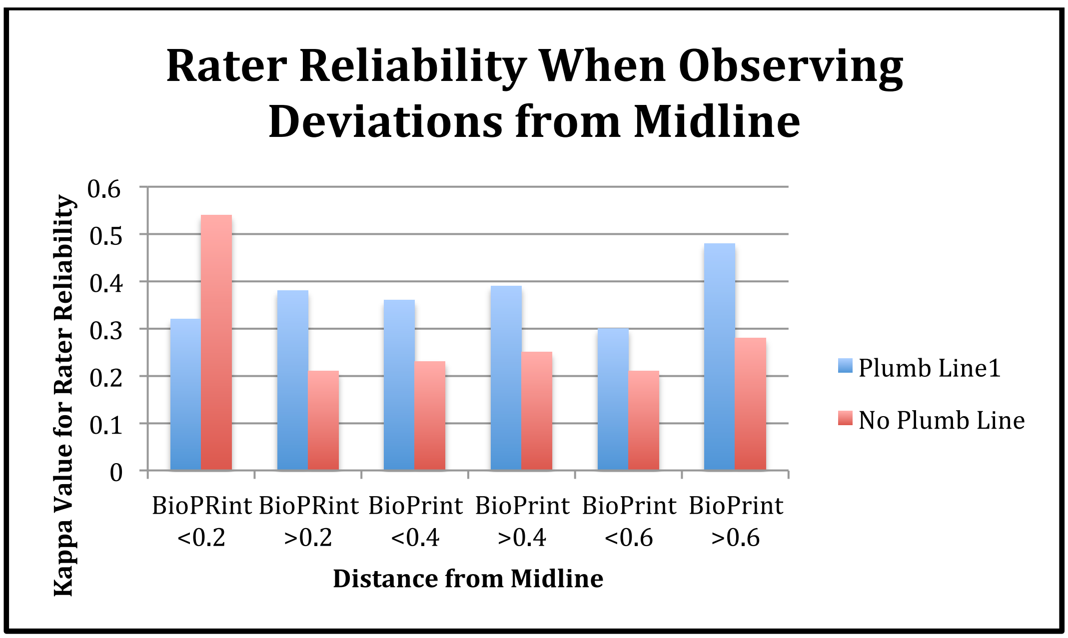


Chart A: Rater Reliability from Midline

The BioPrint software required 32 markers to be placed on anatomical landmarks on the subject in order to produce the quantitative value of position in space. While the research assistants and author of the study had adequate training, such as watching a training video and practicing placement of stickers on one subject, there is still room for error when placing the anatomical markers. In fact, when including the BioPrint software with other raters, the overall kappa decreases (Chart B). This indicates that the raters had an overall different impression of the subjects postural differences than the BioPrint reports produced. Generally, the raters had a higher rate of agreement with each other versus the BioPrint report. This could be due to several factors: an overall error in placing the hypoallergenic markers on the subjects, inconsistent report processing, a change of posture by the subject, or poor rater training.

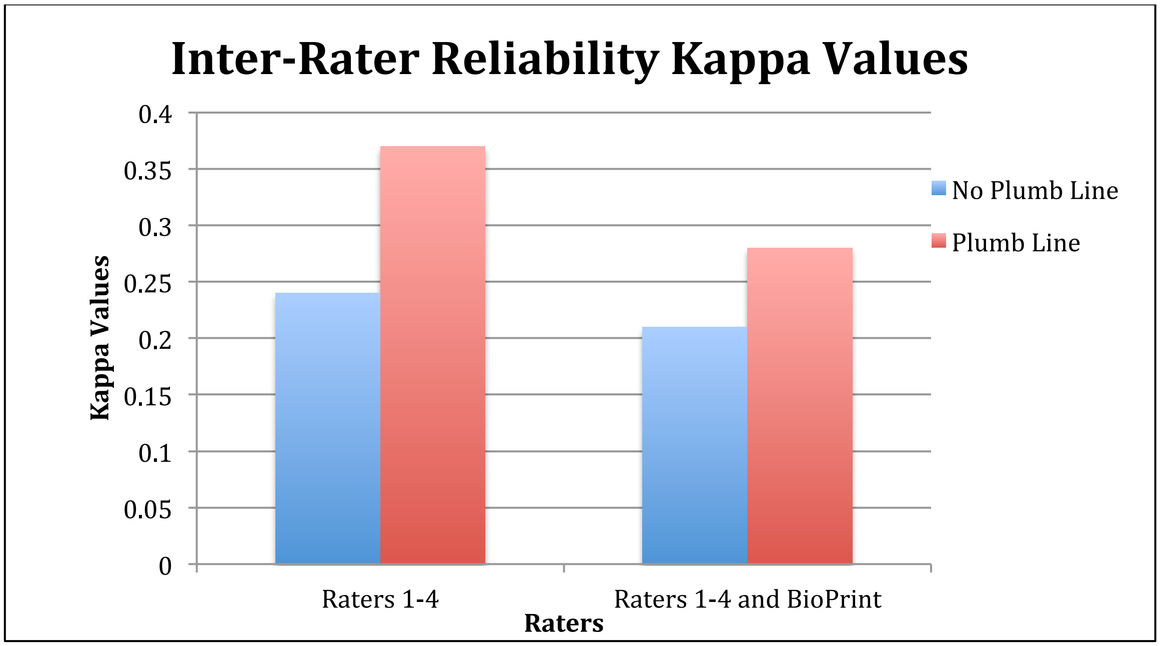


Chart B: Inter-Rater Reliability Kappa Values

Spring et al. (2001) also indicated inter-rater results could be improved by better training examiners, better land marking for data collection, and using only symptomatic patients for the research. Spring et al. (2001) also made the observation that although subjects were asymptomatic, raters in her study were still able to find asymmetries with the subjects. The same thing could be assumed in this research study. While subjects with acute injuries were excluded, the medical questionnaire did not ask specifically if the subject was symptomatic on the day of their participation. The raters in the study were not notified of the health of the subjects, yet they were still able to make conclusions of the subjects posture, indicating that a majority of observations were off midline at the pelvis or cranium.

A counterargument to Spring et al.'s (2001) observational note of using asymptomatic subjects comes from a study by Holmgren and Waling (2008), who showed that inter-examiner reliability in the asymptomatic population was just likely to have low-rater agreement as in the symptomatic population. While low-rater agreement seems to be a trend in inter-rater studies, using these studies of reliability, on symptomatic or asymptomatic subjects, is only a measure of reproducibility, not necessarily a "gauge of accuracy" (p. 55). This study used asymptomatic subjects, but perhaps future studies might consider utilizing symptomatic subjects. While Holmgren and Waling (2009) produced low inter-rater results when using palpation as a tool, perhaps observational studies may increase reliability results as deviations from the midline may be more obvious.

When examining inter-rater reliability research, an article written by Sim and Wright (2005) provides some direction for future studies. Sim and Wright (2005) suggest that prior to the development of the methodology for an inter-rater study, a sample-size calculation would be beneficial to assist in determining the state of probability to detect the statistically significant kappa coefficient. The sample size calculation to produce a CI within 95% provided a sliding scale of total raters to subjects and was completed prior to the commencement of data collection for this Vertical de Barré research. Initially two human raters were to provide observational analysis compared to the BioPrint software, requiring 142 subjects. In an effort to make the study parameters attainable, two more human raters were introduced bringing the number of human raters to four, resulting in the number of subjects required to attain the desired CI width to 82 total subjects (Appendix O).

Sim and Wright (2005) also indicate if the goal of the research is to detect a kappa value of 0.4 K or greater, it is not advantageous to use more than three raters per subject. Four human raters were used in this research, but done so to bring the subject total down. While 0.6 K was the cut point for hypotheses 1, 2, and 3, the confidence interval was still set at 95%. Sims and Wright do state that when using kappa style research, the value of the null hypothesis should be set at a higher level along with the p-value in kappa research tests whether or not the estimated kappa is due to chance. It does not test the strength of the agreement. Finally, another article by Viera and Garrett (2005) also indicates that p-values and CIs are sensitive to sample size, since with a large enough sample size, any kappa above 0.0 will become statistically significant, which has been indicated in this study. The p-values are relevant to the study as they provide strong evidence against the results occurring not by chance, and this indicates that it is unlikely that the four human raters in the study came to similar conclusions just by guessing.

When evaluating other aspects of the data collected, an article by Bao et al. (2009) contradicts data collected in this research. Boa et al. (2009) indicate in their discussion that male observers had better estimation capacity than female raters. If we look to the chart below, there is a deviation from this statement when examining the male vs. female raters from the current research. It appears that Rater 1 and 3 have stronger agreement versus the BioPrint software, where Rater 2 and 4 have consistently less agreement. Of an interesting note, when the male raters rate males, especially with the plumb line, they have extremely low kappa values.

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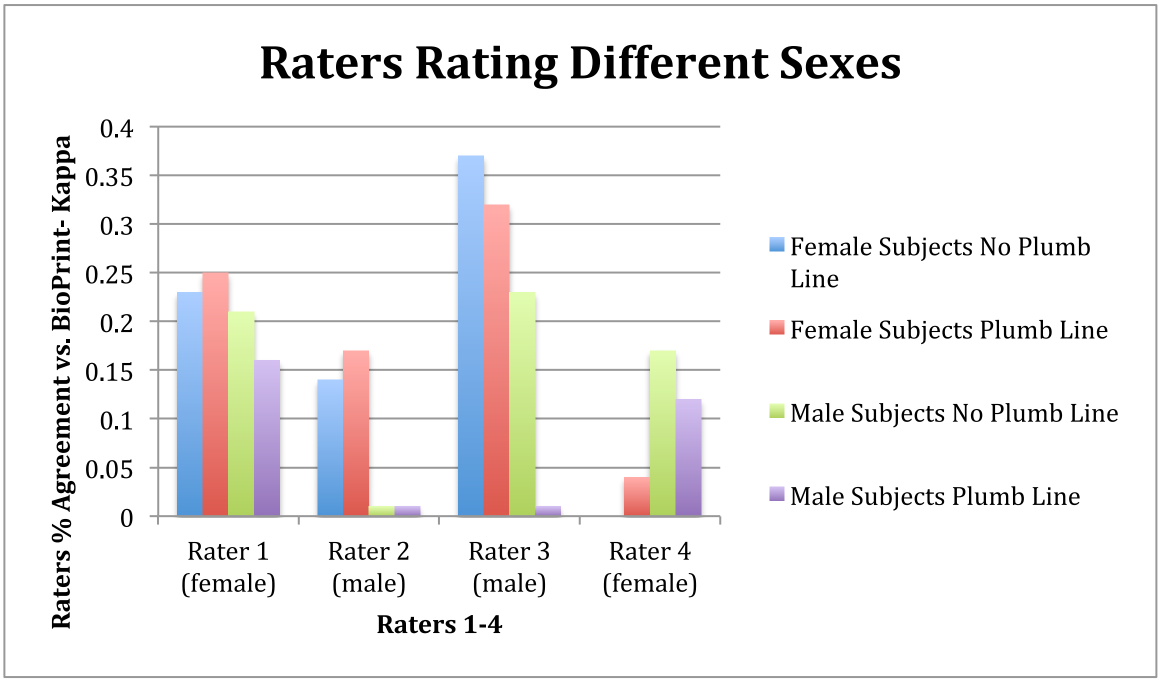

Chart C: Raters Rating Different Sexes

The process of evaluating inter-rater reliability contains many facets to be taken into consideration. Boa et al. (2009) states, “Posture observations agreement is complicated because of factors such as posture categorization strategy, rater training, rater position, and rater estimation error” (p. 304). Mitchell (1976) describes visual literacy and ponders if it changes with age and experience, and questions if accuracy and reliability of visual judgment are trainable. While this research provided some training on protocol and on the practice of evaluation, it comes in to question if there was enough training to obtain agreement amongst the raters, and if the raters developed the confidence to execute their evaluations consistently. As Mitchell (1976) asks, “Can skill in visual literacy be retrained without reinforcement and is making these judgments sufficient practice to be confident in making these conclusions consistently" (p. 883)?

Fedorak, et al., (2003) indicate that visual assessment should not be discarded simply because it has poor accuracy and reliability. Observations and inspections are an important competent of any clinical exam and could direct the practitioner to an underlying pathology. "Other assessment tools, in combination with visual assessment, should be used to improve the quality of examination overall" (p. 1859). While the Vertical de Barré test produces postural observations that may lead the practitioner to conclude the patient presents with an ascending or descending lesion, this is only a small component of information that must be gathered during an evaluation. It is through a thorough history, and a period of observation, along with an examination of the somatic, cranial, and visceral areas that an osteopathic practitioner can draw conclusions to treat the primary dysfunction.

It is clear that the purpose of the evaluation of a patient is to gather information. Although many studies conclude that inter-rater reliability is low for many testing procedures, observations are necessary to make an informed decision on how to approach a treatment plan. Tunnell (1996) states it well by saying that, after the evaluation, "appropriate treatment may then be selected which seeks to improve the whole system function. Aim is to improve well being, improve dysfunction which left untreated might predispose the patient to recurrent pain and disease" (p. 27). Joshua, Celermajer, and Stockler (2005) suggest ways to improve evaluations that include the following: acknowledge that the uncertainty inherent in the physical examination is the first step to improving it, optimize skills, be well rested, examine in the appropriate environment, try to avoid being influenced by expectations, and examine patients on more than one occasion to verify that findings will assist the process and contribute to consistent findings.

Finally, while it can be stated that inter-rater reliability research often indicates that observations, palpation skills, and testing procedures produce consistently low agreement, Hass does shed some light on these types of studies. Hass (1991) suggests that although reliability for any diagnostic procedure might be inconsistent, the final assessment must come from a synthesis of multiple studies using a broad cross section of subjects and examiners. O'Hare and Gibbons (2000) conclude, as would this research, that more studies are needed to determine why many inter-rater studies produce such poor agreement.

7 CHAPTER SEVEN: SELF CRITIQUE

7 SELF CRITIQUE

While the practice of osteopathy has a focus on anatomy, physiology, and palpation, EBM must not be overlooked or discounted. Many scientific models might not fit osteopathic practices, but the profession needs to continually progress scientifically, and inter-rater and intra-rater studies are important in the process and need to be included in the discipline.

This study was originally designed to be simple in that it set out to define the Vertical de Barré test and determine the accuracy of its conclusions. What it quickly morphed into was an inter-rater study, utilizing the Vertical de Barré test as a consistent standing postural position to collect data from. While the project progressed well and the results were satisfactory, there should be some considerations for future studies to consider if they follow this study's design.

RATERS

Of the four raters, one had consistently produced lower kappa values compared to the other three raters when comparing the raters scores to the BioPrint report. This will alter the overall kappa dropping the test reliability. The reasons why this occurred must be examined in an effort to assist future raters from making errors and affecting the overall statistics produced in a study. Perhaps, the poor rater did not understand the definitions of cranium versus pelvis being off the midline, did not feel comfortable with the amount of training provided for the task, or confused the right/left of the observer versus the subject's right/left direction.

The vision of each rater was not accounted for. While three of the raters have prescription glasses, it was not indicated in the protocol that they were or were not to utilize their spectacles during the process. As observation is the basis of this experiment, utilizing their glasses, if prescribed, should have been stated in the protocol as a necessity for observation.

PLUMB LINE

While the plumb line position and set-up should have been consistent, when processing the photographs, the author noticed that in six sets of the photographs, the plumb line was shifted either right or left to the Vertical de Barré board. This could skew the rater's observational process, altering their sense of the midline. The sets of images were kept in the study as raters were informed to watch out for set-up errors and take the shift of the plumb line into account.

RESEARCH ASSISTANTS

The research assistants were trained in sticker placement via the BioPrint training software video as well as reviewed with the marker-placement guide. All the assistants had some sort of exercise science background and were familiar with the specific anatomical landmarks. During the photo processing into the BioPrint software, it was noticed by the author that some markers were incorrectly placed or stickers were missing. The BioPrint software allowed for changes in the marker-placement positioning within the software, but placement during the digitalization process would not be as accurate as the real anatomical landmarking with palpation. Clothes worn by subjects would conceal specific anatomical boney landmarks. These images were still used in the data collection and BioPrint report statistics.

Anatomical palpation for location of the BioPrint markers could come into question, especially in light of the literature review for this study. As many studies indicate, palpation of anatomical landmarking can have a varied inter-rater reliability and has typically been found to be slight to fair agreement. Even though the research assistants were trained in the placement of the markers, some variation could have occurred and may not have been accounted for on digitization into the BioPrint system.

SUBJECTS

While all the effort was made possible to produce an absolute postural consistency amongst the subjects and their standing position on the Barré board, there still seemed to be some deviations when the subjects were placed on the board and photographs were taken. Subjects were asked to stand on the board in the Barré position, heels touching the block, producing externally rotated hips at a consistent angle, then asked to nod their head three times and take a deep breath. The author would then return to the camera and take the pictures, and sometimes the subject would shift weight or change foot position on the board. This was not initially observed when the photographs were captured, but feedback from the raters indicated two of the subjects changed position in their photographs. These images of the two subjects were still utilized as part of the study, as it was a consistent photograph each observer was viewing.

During the process, the subjects completed a medical history questionnaire to obtain a health history, and information regarding past trauma and conditions that they had been diagnosed with was requested. While there was a small exclusion criteria for certain conditions, there was no data collected to determine if they were in pain on the day of the data collection, so it cannot be determined if they were asymptomatic or symptomatic. This information could change the magnitude of deviations one way or the other and potentially the rater’s rate of agreement with the observations.

The subjects were asked to wear shorts and tank tops or sport bras as they were to be comfortable. Feedback from the raters indicates that wearing the shorts made it difficult to observe the pelvis in some photographs. This may have made the cranium more obvious and potentially led the rater to observe the cranium from off the midline more often.

LOCATION

There were two different locations used for the testing of the subjects. With the grand scale of the subjects required, it was necessary to change the location to recruit the numbers needed. The BioPrint backdrop and set-up was consistent, but the walls behind the set-up were different. This could have created a distraction and altered the rater's observation.

RATER PROTOCOL

The rater's protocol did not specify how much time was supposed to be spent between Envelope One vs. Two or even the pictures in each envelope. While instructions indicated the rater was to look at the photos for 10 seconds, they may have taken a break between the photos, envelopes, or training and practice. This delay or distraction could have affected the rater's ability to observe the images and accurately rate the subject's posture.

The images the raters evaluated were from an anterior view. This was done because the BioPrint software produces the quantitative value for the anatomical landmarks of the head and pelvis in the anterior view, and would allow the BioPrint data to be compared directly to the raters' data. As described by Gagey and Weber (2004) and Van Tichelon (1992), the Vertical de Barré test should be done from an anterior view as well as from the side profile and posterior view. Raters may have been distracted by this observational technique as their familiarity with the test is typically from a posterior view. The education of the Vertical de Barré and static postural observation should be made from an anterior, lateral, and posterior view. While raters think they were observing the subject in the Barré position incorrectly, it must be remembered that the data that is being collected is actually how consistent raters are with their evaluations when compared to other raters. The actual Vertical de Barré test has less relevance than that of the inter-rater observational data collected.

By observing the images from an anterior view, it may have altered the observer's results as the face of the subject may have distracted the rater. The raters who participated in the study were educated at the CCO in Toronto and are typically taught the test by making observations from a posterior view. They may have had a preconceived impression of the test and a bias to the subjects and the results.

PHOTOGRAPHS

Photographs were taken at eleven feet from the back drop as per the BioPrint software specifications. As days and locations had changed during the data collection, there is a chance that the zoom had changed during the set-up at each location. The BioPrint calculations may have been altered by these changes in location.

Photographs were all developed at a Costco wholesale store in Newmarket, but some were processed on separate days. Different dye lots in the photo development centre may have changed the lighting or colouring of the photographs slightly, which potentially could have had an influence on the raters' observations.

8 CHAPTER 8: CONCLUSION

8 CONCLUSION

The inter-rater reliability of the photographic representation of the Vertical de Barré test did not produce a kappa value of 0.6 or a substantial agreement between the raters. The inter-rater reliability test has slightly higher kappa values when utilizing a plumb line assessing posture in the Vertical de Barré position, producing fair agreement. Human raters have slightly better kappa values when comparing reliability amongst themselves compared to the BioPrint posture analyzing software.

While the findings did not produce moderate agreement, producing a null hypothesis for hypotheses 1, 2, and 3 as stated above, the data does produce statistical significance as $P \leq$ values are consistently 0.000.

It would be recommended to use a plumb line when utilizing the Vertical de Barré or any static postural observations since reliable outcomes would be higher. Further research is recommended to evaluate other assessment techniques to increase their validity and assist in the instruction of such tools.

Finally, throughout the literature review and conducting the research, it has become evident that there is little consensus on what makes a test reliable, on the appropriate acceptable statistical level, or on a standard number of raters required to make an inter-rater evaluation consistent. Future studies need to examine all factors mentioned, as well as the test or technique being studied to design a well-structured experiment that would produce acceptable results.

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9 APPENDICES

APPENDIX A: VERTICAL DE BARRÉ PRIMARY SOURCE SEARCH

9.1.1 EMAIL COMMUNICATION WITH POSTUROLOGIE INSTITUTE

No assistance from France.

----- Message d'origine -----
De : "John Sage" <john.sage@gmail.com>
À : <contact@institut-europeen-posturologie.fr>
Envoyé : jeudi 31 juillet 2014 13:43
Objet : Joomla: Dr. P.M. Gagey

> Hello
> I'm an osteopathic student in Canada conducting an osteopathic thesis on a test known in France as the "verticale de Barré".
> The only authors that I've found who has written about the test are Dr. P.M. Gagey and B. Weber in the their book "Posturologie Regulation et dereglements de las station debout".
> My question is, does your institution have any information on this test and if not do you know how I could contact either Dr. Gagey or Weber?
> Thanks you in advance for any help that you can offer me.

--

Hello,

I'm sorry, I can't help you..

Amer SAFIEDDINE
Orthophonie posturale et neuro-sensori-motrice
Hypnose, Thérapies Brèves
Formateur en hypnose ericksonienne
Chargé de Cours à la Faculté
Chargé de Cours à l'Ecole des Mines d'Albi
Membre de l'International Society of Hypnosis (ISH)
Formateur à l'Institut Mimethys
Ex-délégué régional de l'Association Française d'Hypnose (AFHYP)
Membre de la Confédération Francophone d'Hypnose et de Thérapies Brèves (CFHTB)
Président de l'Institut Milton Erickson d'hypnose médicale du Liban (IME-Liban)
Membre fondateur de l'Association Parole Bégaiement (APB)
Secrétaire de la Sté de Posturologie Interdisciplinaire de Midi-Pyrénées (SPIMP)
Membre fondateur de l'Institut Européen de Posturologie (IEP)

4, rue de la Barutte
31000 Toulouse
Cabinet : 05.62.89.08.00
Portable: 06.85.08.43.84

http://www.institut-europeen-posturologie.fr/
http://www.amersafieddine.com

9.1.2 BIU SANTÉ EMAIL COMMUNICATION -

Very Helpful librarian at BIU but no luck on actual description of the Vertical de Barré

I am looking for a description of the vertical de Barré test for my thesis at the Canadian College of Osteopathy in Toronto Canada.
The vertical de Barré seems to be a test utilized alot by posturolgists and some dentists.
Currently I have references, of Posturologie by Gagey, Les troubles de l'equilibre which inlcudes a reference by Van Tichelen, and Traite de Posturologie by Docteur Gerrard Vallier.
All three descriptions have some slight variations. Can you help me clarify the way that J Barré would have described it?
Thank you for your time and effort

Dear Sir,

For the moment, we didn't find the original description of this test by Barré. We found a lot of descriptions but without any reference. We looked in historical databases and in Pubmed for some review article but without any result.
Do you have any biographical information about the author of this test ? He could be the neurologist Jean Alexandre Barré (1880-1967), who was Achille Souques's student but we didn't find any reference to this test in his biography. We will look into his works and let you know if we find any information.

Best wishes,

Estelle Lambert
BIUMinfo

--

Estelle

Thank you so much for the reply.

I am under the impression that the test was authored by JA Barré but again, literature in North America is zero and I can not find any specific reference.

I really do appreciate your help.

Cheers

John

--

Dear Mr Sage,

We found an interesting reference in the book "Neurological eponyms" edited by Peter J. Koehler, George Bruyn and John M.S. Pearce, Oxford University Press, 2000. Chapter 19 deals with "The Barré and Mingazzini tests" (p. 119-126) but I'm not sure that it is the test you are looking for. It deals with finger-spread test and Barré's arm test. But perhaps these tests are they related to the vertical test ? Perhaps will you at least find a track in the bibliography ? There are notably three references from J. A. Barré :

"La manoeuvre de la jambe", *Presse medicale*, 1919, 79, 793-795 online in Medic@ : http://www.biusante.parisdescartes.fr/histmed/medica/page?100000x1919xartorig&p=797

"Le signe de l'ecartement des doigts", XXIVe Congrès des Alienistes et Neurologistes, aout 1920, *Revue neurologique*, 1920 : 942. Summary

"Le syndrome pyramidal deficitaire", *Revue neurologique*, 1937, 67 : 1 - 40.

I send you in an attached file the summary of the article "Le signe de l'ecartement des doigts" from *Revue neurologique* that we have digitized and we will soon propose online. You can download the review article "le syndrome pyramidal deficitaire" thanks to this link : http://www.biusante.parisdescartes.fr/repro/Barré.pdf

I think that you will find the book "Neurological eponyms" in the library of your College or in another canadian library : http://amicus.collectionscanada.ca/aaweb-bin/aamain/itemdisp?sessionKey=1396960769043_142_78_200_14&l=0&v=0&lvl=2&rt=1&itm=25466500&rsn=S_WWWbgaqDItBr&all=1&dt=+TW+"neurological"+AND+"eponyms"&spi

I hope that this infomation will be helpful.

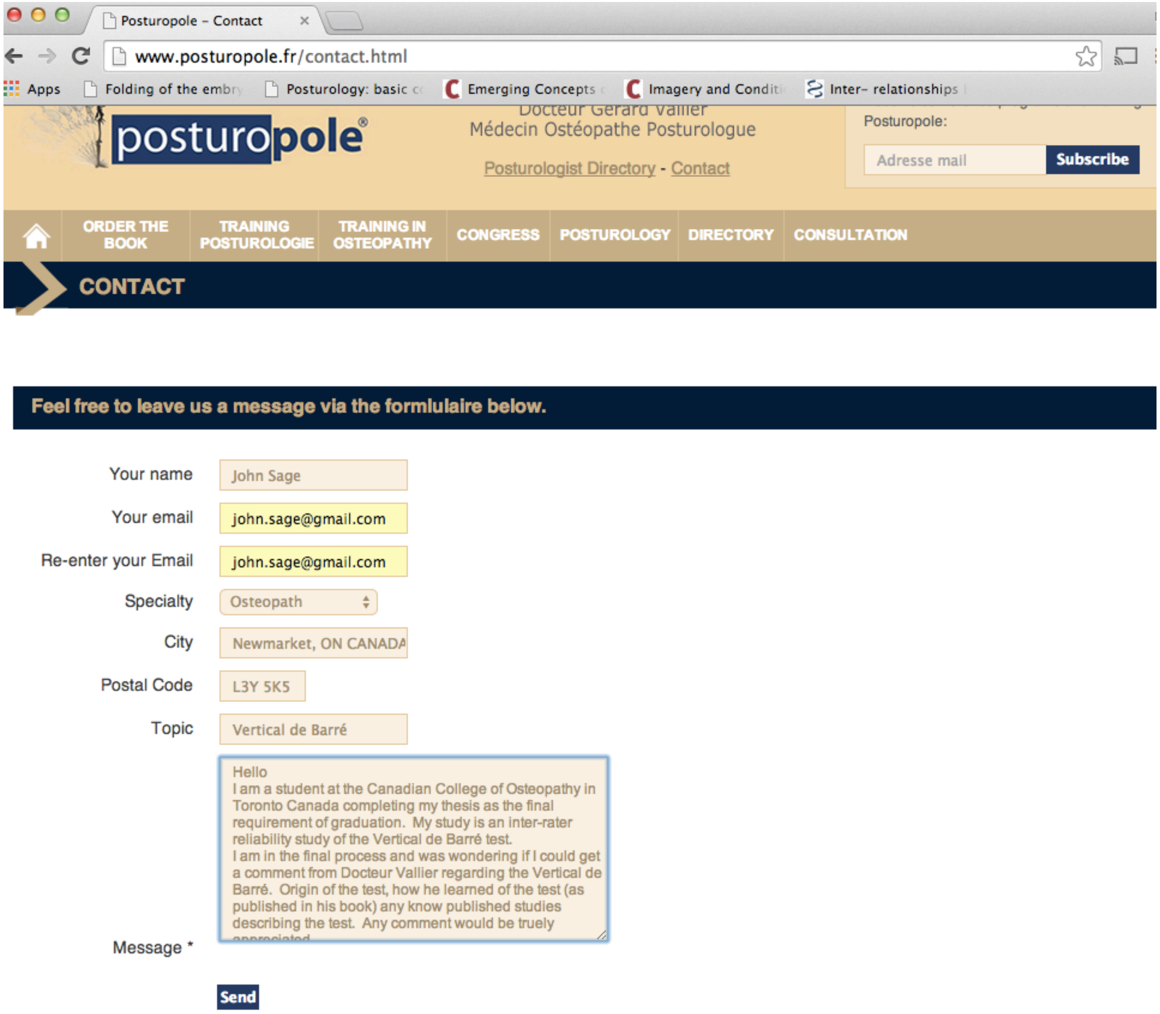
Best wishes,

Estelle Lambert
Conservatrice - Service d'histoire de la santé
BIU Santé - Pôle Médecine-Odontologie
12 rue de l'École de Médecine - 75270 Paris cedex 06
Tél. : +33 (0)1.76.53.19.75
Fax : +33 (0)1.44.41.10.20

Estelle LAMBERT estelle.lambert@biusante.parisdescartes.fr

9.1.3 EMAIL COMMUNICATION TO POSTUREPOLE FOR VALLIER

No response from Posturopole after two requests:



9.1.4 MR. GAGEY – EMAIL REQUEST – NO RESPONSE

Good day Mr Gagey

My name is John and I am currently finishing my thesis at the Canadian College of Osteopathy in Toronto. It has been suggested by my supervisors that I try to contact you to assist in my search for a primary resource describing and or validating the Vertical de Barré postural observation test.

My thesis is an inter-rater reliability study of the vertical de Barré test. I have obtained your posturolgie text and utilized it to assist in my description and analysis of the test - thank you for producing that.

I realize that published artilces describing the Barré are limited but if you could provide any suggestions they would be welcomed.

Thank you for your time and consideration in assisting me in my research

Kind regards and best in health.

--

Bonjour Mr. Gagey

I am writing you as a follow up to a previous email- I am unsure if you received the first contact. I am a student at the Canadian College of Osteopathy in Toronto and completing my thesis study which is an inter-rater reliability study of the vertical de Barré test. I have completed my first draft but my evaluator suggest I find a primary source (journal artical) describing the Barré, in order to strengthen my reference list. I have exhausted all of my resources and thought I would turn to you as source.

Do you have any suggested readings of the Vertical Barré test or any other suggestions on who to contact regarding this test?

I understand the Barré is included as an assessment tool in Posturologie (as described in your book) could you give me some feedback of your understanding on why it is included and do you actually use it as part of your clinical assessment?

9.1.5 EMAIL COMMUNICATION WITH A. T. STILL UNIVERSITY

-- December 12, 2012

John,

You have recently contacted Barb Magers at the International Center for Osteopathic History for some help about your thesis.

She asked me if I could contact you in order to get some precision about your request. I am a French osteopath and it looks like the "verticale de Barré" is used only there...

let me know how we can help you.

Best,

Rafael

--
Rafael Zegarra-Parodi, D.O. (Europe)
Research Assistant Professor
Still Research Institute
A.T. Still University of Health Sciences
800 W. Jefferson St.
Kirksville, MO 63501
660-626-2267
660-626-2099 (fax)
rzegarraparodi@atsu.edu

A.T. Still University of Health Sciences serves as a learning-centered university dedicated to preparing highly competent professionals through innovative academic programs with a commitment to continue its osteopathic heritage and focus on whole person healthcare, scholarship, community health, interprofessional education, diversity, and underserved populations.

--

Rafael

Thanks for following up - I appreciate your input.

Cranial Osteopathy - principles and practice has a blurb on Barré's vertical alignment test - it is the closest reference I have found but does not actually describe the test. One other source I have found online describes the test - Feet turned out approx 30 degrees, but I am not able to find the test description in print, which is what I would prefer for my thesis.

A book by Gagey, Posturologie - also references the Vertical de Barré but no actual description of the test?

Let me know if you can think of any other resources

John

9.1.6 EMAIL COMMUNICATION WITH AT STILL UNIVERSITY LIBRARIAN

-- December 10 2012
Barb
Thanks for the follow up.
The working thesis title at this point is:
"An inter-rater reliability study of the vertical Barré test."

Not sure what they call it in Kirksville but the vertical Barré is test is taught to us in school as a standing posture test that can provide ample information.
It incorporates Littlejohns ascending and descending theory's and some of Zink? compensation and decompensation principles.

Test will follow something like this - 2 blinded therapists assess a persons posture (from the posterior in the Barré position) to determine if person presents with ascending/descending lesion/issue and a computer software will confirm this.

I logged in last night as per your instructions but have no idea how to utilize the sources that are on website unless I have a direct reference for those journals. Is there a search tool/index of what each journal contains?

Key search terms that I am using on the Human Kinetics Library include
posture, assessment, observation, inter-rater
osteopathy, descending, ascending, Barré - produce little results so far

Thanks a bunch - let me know what you think and if you could provide me with any leads that would be great.

There is a descent chiropractic college that I will likely have to use for some of the resources but hope to utilize the ATS Universitylibrary for more of the osteopathic information.

Hope to hear from you soon, have a great weekend
John

-- December 12 2012
o'k will see what I can find.
sometimes you just have to play around with search terms before you find what you are looking for.
barb

APPENDIX B: PERSONAL COMMUNICATION (ALISON CHASCZEWSKI - GAGEY)

From: ***~aLiSoN cHaScZeWsKi~*** <achaz03@gmail.com>
Date: Mon, Feb 15, 2010 at 6:44 PM
Subject: Verticale de Barre
To: pmgagey@club-internet.fr

Bonjour Monsieur Gagey,

I am a student at the Canadian College of Osteopathy in Toronto, currently in the seconda and final year of writing my thesis. I am sorry that I am writing in English as my French is very very poor.
Through much research I have come upon quite a bit of your work on posturology and have purchased your book on Posturologie Regulation et dereglements de la station debout. The attempt to translate parts of in English has been challenging especially since my main source is Google translate.:) I have found your work very interesting and informative.

I am writing as I have been asked to validate the verticale de Barre test as it is a test that has been taught and used since year one of our program. My thesis titled "Osteopathic treatment of the Pelvis and Lower Extremity and its Effects on Upper Extremity grip strength" uses the Verticale de Barré test to assess subjects that have ascending lesion patterns to qualify for my study. As a professional and expert in this area I was hoping you may shed some light on the origin and background of the Verticale de Barré test. Any information you may share with me, would be greatly respected and appreciated.

Yours in Health,

Alison Chasczewski
Canadian College of Osteopathy Thesis Writer
Head Athletic Therapist, Durham College and University of Ontario Institute of Technology

From: **Pierre-Marie GAGEY** <pmgagey@club-internet.fr>
Date: Tue, Feb 16, 2010 at 5:46 AM
Subject: Re: Verticale de Barre
To: *~aLiSoN cHaScZeWsKi~* <achaz03@gmail.com>

I am not a great scientist about the Barré's vertical!... Barré was a French neurologist who worked in Nancy, I believe, in the beginning of the XXth century. He is especially well known by the syndrome of Barré and Liéou (1926) and the syndrome of Guillain-Barré. He was quite a lot interested in balance problems as they said at this time, and it is in this context that he promoted the test of the vertical of Barré. This test is not validated. I began a validation of the test, but I did not go beyond children 8 years olds! In fact this test is not dreadfully interesting in postural clinic...

I am sorrey that the book is not translated in English yet, but you know it is translated in Italian, Spanish, Portuguese and Russian. Nice to hear from you, I wish you a great success.

Je ne suis pas très savant sur la verticale de Barré!... Barré était un neurologue français qui travaillait à Nancy, je crois, au début du XXième siècle. Il est surtout connu par le syndrome de Barré et Liéou (1926) et le syndrome de Guillain-Barré. Il s'est beaucoup intéressé aux problèmes qu'on disait alors d'équilibre, et c'est dans ce contexte qu'il a promu le test de la verticale de Barré. Ce test n'est pas validé. J'avais commencé une étude de validation du test, mais je n'ai pas été au-delà de l'enfant de 8 ans! En fait ce test n'est pas terriblement intéressant en clinique posturale...
Je suis désolé que le livre ne soit pas encore traduit en anglais, mais sachez qu'il existe en italien, espagnol, portugais et russe.

Très amicalement

Gagey P.M., Scheibel A., Bourgeois P., Weber B. (2006) Valeurs moyennes et interprétation de la verticale de Barré chez l enfant de 8-9 ans. In Perennou D., Lacour M. (eds) Efficience et déficiences du contrôle postural. Marseille, Solal, 169-173.

APPENDIX C: ETHICS APPROVAL

Certificate of REB Approval

CMCC

Project Number 133004 **REB Approval** 1307X05

Principal Investigator Sage, John

Faculty Supervisor External Project

The project entitled An inter-rater reliability study of the verticale de barré (vertical barré).

has received CMCC REB Approval as of: 08-Aug-13

This approval expires in one year. The status of the project must be reported as of: 08-Aug-14

The investigator, or in the case where this pertains to a Student Investigative Project, the faculty supervisor, is responsible for ensuring that the work is conducted in accordance with the CMCC's Research Policy and the Research Procedure manual.

The investigator/faculty supervisor is responsible for notifying the ORA when this study is completed.

August 8, 2013

Mark Fillery, BA, CCRP
Research Administrator, Office of Research Administration

APPENDIX D: LETTER OF RECRUITMENT

Canadian College of Osteopathy

PARTICIPANTS NEEDED FOR
RESEARCH IN POSTURAL ASSESSMENTS

We are looking for volunteers to take part in a study of
reliability for postural evaluation.
As a participant in this study, you would be asked to:
Complete a medical questionnaire and have 6 photographs taken in a standing position, 4 of which will be done utilizing the BioPrint software.
We will be comparing evaluator's conclusions of a standard balance test including a computer postural analysis program. You will be required to wear shorts and a tank top for females and shorts for males, have 2 sets of photos taken while you are in a standing position, a total of 6 photographs captured.
Your participation would involve *1* session,
approximately *20* minutes.
For more information about this study, or to volunteer for this study,
please contact:
JOHN SAGE
at
416-882-5689
Email: *johnsageresearch@gmail.com*
This study has been reviewed by, and received ethics clearance
through, the Office of Research Ethics, Canadian Memorial Chiropractic College

APPENDIX E: BIOPRINT SPECIFICATIONS

Welcome to Biotonix

This guide will quickly introduce Biotonix and its product, as well as cover the necessary steps to get you up and running.
Taking almost 16 years of scientific testing and programming to develop this system enables you, the health care professional, to perform postural evaluations non-invasively and generate detailed assessments and personalized exercise correction programs. We have provided to you all of the necessary tools within this Starter Kit to prepare you to do a biomechanical evaluation. Please take a few minutes to review this Guide to familiarize yourself with the necessary materials used in performing a postural evaluation.

Equipment Specification Form

Within this booklet, on page,6 we have provided you with an Equipment Specification Form. Fill it out and return it by fax to 1-514-840-0140.
Once this form has been received in our office you will receive your USER ID and Password by E-mail, which you need to login to Biotonix.

HIPPA Compliance and Confidentiality

Be assured that when doing an evaluation on line that the patient pictures are never sent over the Internet. Only the data (coordinates of the markers) is sent to a centralized data processing centre, where detailed biomechanical analysis is then automatically generated. The system computes many fundamental biomechanical variables that allow us to determine joint compression forces, deviations from vertical and horizontal alignment, and the client's centre of gravity. Muscle function underlying these biomechanical properties as well as appropriate stretching and strengthening exercises are determined and documented in the BioPrint report.

Steps for your first evaluation

Here are the recommended steps to follow in order to do your first evaluation.

1. Fill out the equipment specification sheet and fax it back to Biotonix ASAP, at 514-840-0140. (Found in your Starter Kit)
2. Go over the Starter Kit checklist to ensure that all items are there.
3. Schedule a time to meet with your assistant to review the installation and marker placement videos, as well as the provided documentation.
4. Purchase varying sizes of tight-fitting, black exercise outfits for men and women.
5. Prepare your exam room. For details see "Prepare your exam room" below.
6. Set up your computer and install Biotonix software Page 9.
7. Review the Step-by-Step User Guide included in the Starter Kit.
8. Take four (4) pictures (2 laterals), 1 anterior, 1 posterior of the patient. For details refer to Page 12.
9. Login to Biotonix to perform an on-line evaluation.

Prepare your exam room:

1. Your room must be at least 9 feet long (8 feet between camera and Biotonix Backdrop and 1 foot to view image on the camera display).
2. Choose a flat wall that measures at least 4 feet wide by 7 feet high.
3. Install the backdrop and camera (Place a reflective silver marker on each of the **4 calibration points** (x's at each corner).

For further backdrop set-up options refer to **page 8**

4. Take note of the distance between the camera and Biotonix Backdrop, as you will be required to enter it into **YOUR ACCOUNT - INFORMATION** section of the welcome page of Biotonix, before processing your first assessment.
5. Take four (4) pictures, 2 laterals, 1 anterior, and 1 posterior of your patient.

Note: For a graphic aid of the set up please refer to Camera and Tripod sheet on page 14

Backdrop Set up Options

Here are some possible backdrop set-up difficulties that you may encounter followed by suggested solutions:

a) **If the backdrop is too wide for the wall space;**

Trim the left and right sides of the backdrop no further than the calibration points.

b) **If the backdrop does not lie flat against the wall due to baseboard mouldings;**

Measure the height of the baseboard moulding and cut the equivalent away from the bottom of the backdrop. Note: The calibration points cannot be cut away or moved. If for some reason you are unable to comply with this rule, please refer to solution c)

c) **If the backdrop can not be stuck directly to your wall, or you are unable to dedicate a fixed wall space;**

Frame the backdrop or stick it on a foam core backing (4ft x 6.2ft) to avoid having to fasten it directly to the wall, or over a baseboard. It is important to remember that the backdrop must not LEAN against the wall; it must be parallel to the wall. Consider some soft foam pads or other non-damaging material to be placed behind the upper half of the backdrop.

With this set up, you can easily relocate the backdrop to another room. Remember to measure your camera distance and blue patient marker distance when you move the backdrop to another area/room. When the camera distance changes, you will need to update by overwriting the existing measurement under Your Account Information in the Biotonix welcome page.

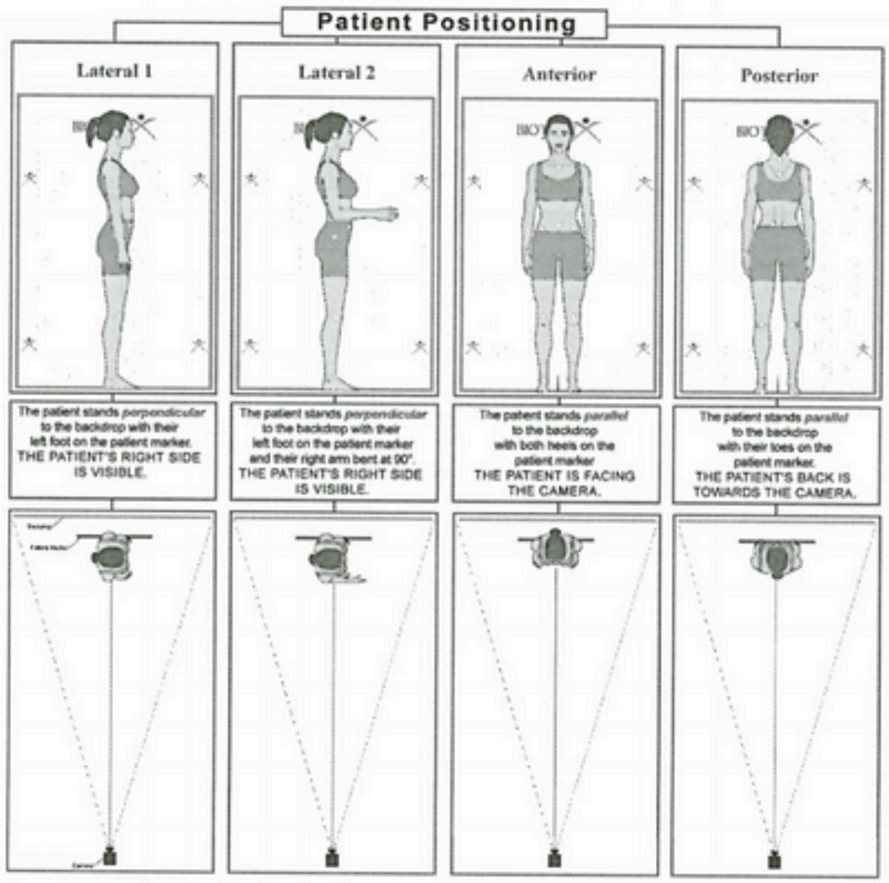
Example Reports

Example reports have been included along with a description of each report type and a costing structure. (Assessment only Report, Full BioPrint Report, Comparison Report and Pediatric Report). Please refer to page 13 of this booklet.

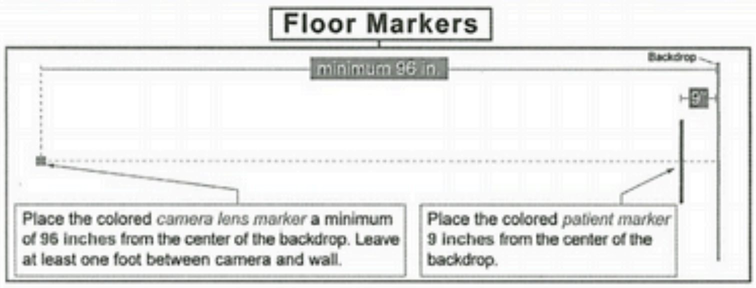
Evaluation Forms

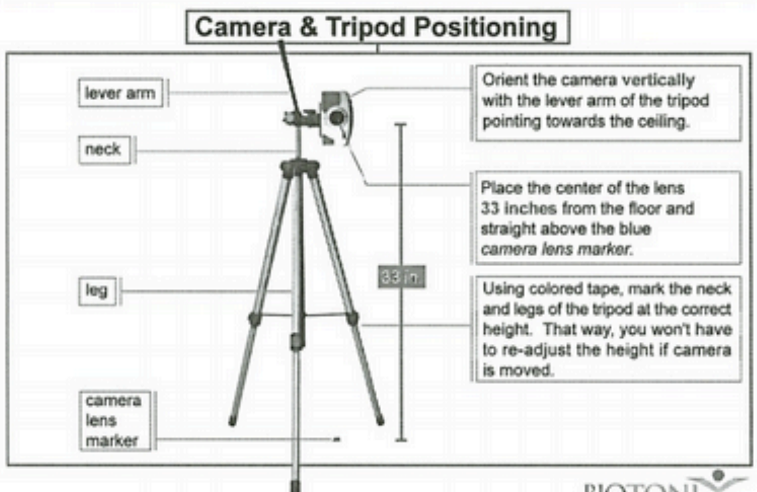
BIOPRINT EVALUATION FORM: An example evaluation form has also been included on page 15 or 16 of this booklet. It is used to record your patient information, such as height, weight and picture numbers. Booklets of these forms can be purchased, by calling your customer representative, at 1-888-866-4988

How your patient should be positioned for the pictures?



- Before you begin your BioPrint™ evaluation, make sure you have placed all markers correctly and that they are visible where appropriate (e.g., tie back hair to view C7 or tragus etc.).
- Make sure the camera/tripod and patient are correctly aligned relative to the backdrop.
- Ask your patient to step in place for five steps before taking each picture.
- Make sure the flash is "on".
- Take pictures with at least 600x800 pixel resolution.
- Assure that the backdrop and patient are correctly framed in the camera view finder.





BIOTONIX

APPENDIX F: BARRÉ EXPERIMENT CHECKLIST

Barré Study Checklist

- ❑ Age – **Height – Weight** - Signature
- ❑ Females – hair up in **ponytail**
- ❑ Subject number on thigh?
- ❑ **2 pictures – no stickers**
- ❑ Sticker application – are all of them used on the sticker sheet?
- ❑ Distance of the camera
- ❑ Is camera level
- ❑ Foot position
- ❑ Nod head up and down
- ❑ **4 Picture – stickers**

APPENDIX G: CAMERA SPECIFICATIONS

Camera Specifications

TYPE

Type:	Digital, single-lens reflex, AF/AE camera with built-in flash
Recording Medium:	SD memory card, SDHC memory card
Image Format:	22.2mm x 14.8mm
Compatible Lenses:	Canon EF lenses (including EF-S lenses) (35mm-equivalent focal length is approx.1.6x the lens focal length)
Lens Mount:	Canon EF mount

IMAGE SENSOR

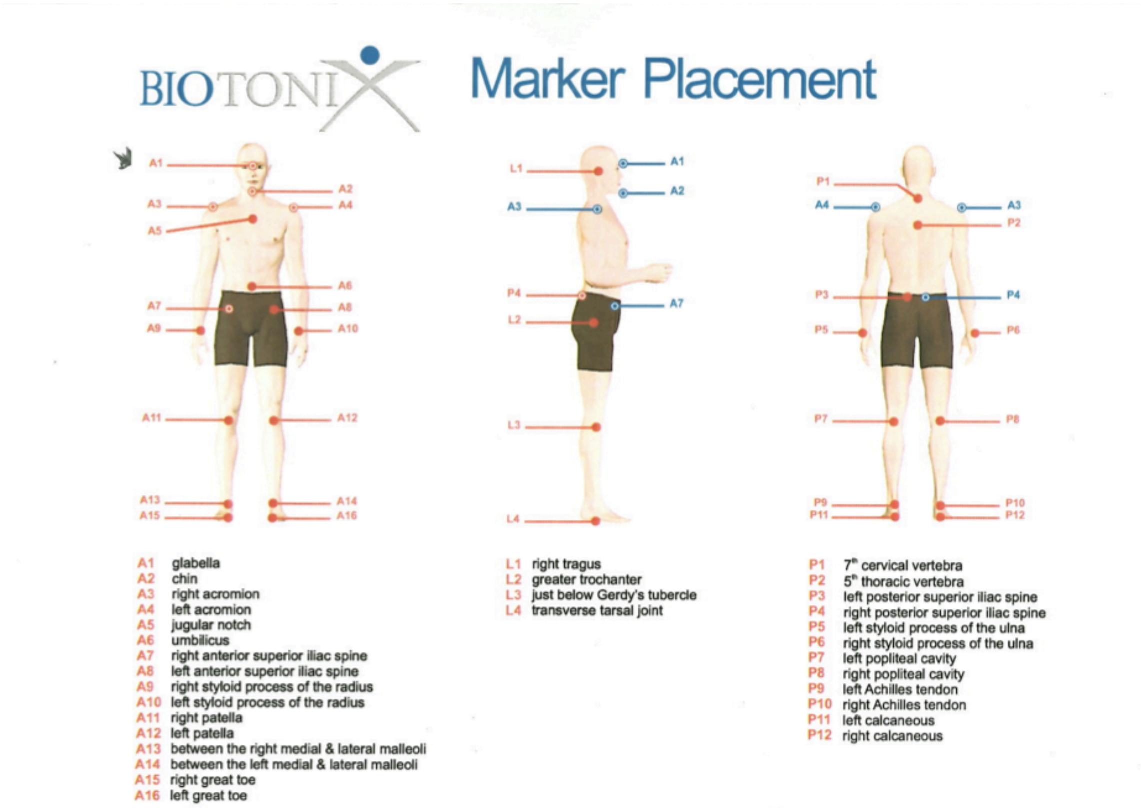
Type:	High-sensitivity, high-resolution, large single-plate CMOS sensor
Pixels:	Effective pixels: Approx. 12.20 megapixels
Total Pixels:	Total pixels: Approx. 12.40 megapixels
Aspect Ratio:	3:2 (Horizontal : Vertical)
Colour Filter System:	RGB primary colour filter
Low-pass Filter:	Located in front of the image sensor, non-removable

RECORDING SYSTEM

Recording Format:	Design rule for Camera File System 2.0

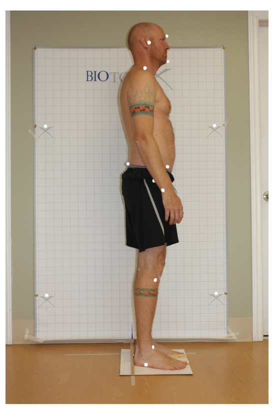
Image Format:	JPEG, RAW (14-bit Canon original) RAW+JPEG
File Size:	(1) Large/Fine : Approx. 4.3MB (4272 x 2848 pixels) (2) Large/Normal : Approx. 2.2MB (4272 x 2848 pixels) (3) Medium/Fine : Approx. 2.5MB (3088 x 2056 pixels) (4) Medium/Normal: Approx. 1.3MB (3088 x 2056 pixels) (5) Small/Fine : Approx. 1.6MB (2256 x 1504 pixels) (6) Small/Normal : Approx. 0.8MB (2256 x 1504 pixels) (7) RAW : Approx. 15.3 MB (4272 x 2848 pixels) Exact file sizes depend on the subject, ISO speed, Picture Style, etc.

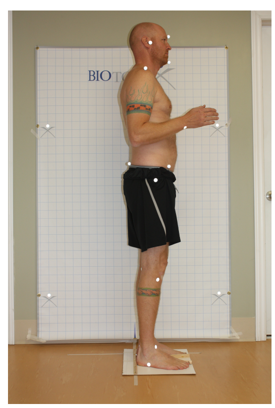
APPENDIX H: BIOPRINT MARKER PLACEMENT



APPENDIX I: SUBJECT PHOTOS FOR RATERS

APPENDIX J: SUBJECT BIOPRINT PICTURES FOR PROCESSING



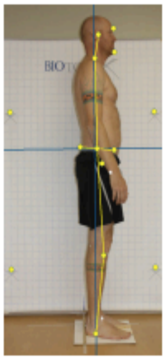
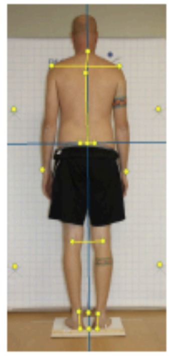
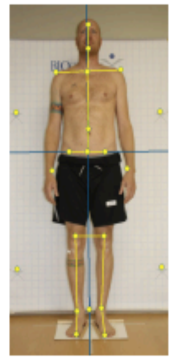
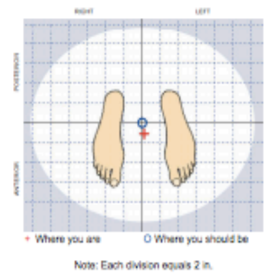


APPENDIX K: BIOPRINT ASSESSMENT TOOL SUMMARY AND REPORT

Summary

Client #	Name	Birthdate	Sex	Height	Weight	Activity Level
0035	Mark Schwarz	January 1, 1975	Male	74.0 in	195.0 lb	Moderate

Evaluator: John Sage **Clinic:** John Sage
Evaluation Date: December 2, 2013

How many degrees you are from vertical

Body Segment	Direction	Angle
Head to Shoulders	Anterior	9.4°
Shoulders to Pelvis	Posterior	1.1°
Hips to Knees	Posterior	0.7°
Knees to Feet	Anterior	6.8°

Note: The ideal angle should be 0°.

How many degrees you are from horizontal

Body Segment	Direction	Angle
Pelvis	Anterior	4.7°

Note: There is a normal forward angle between the anterior and posterior pelvic markers of 10°. Angles greater than 15° indicate anterior pelvic tilt - angles less than 5° indicate posterior pelvic tilt.

How far are you from vertical

Reference Point on	Direction	Distance
Head	Anterior	1.1 in
Shoulders	Anterior	0.3 in
Pelvis	Anterior	0.7 in
Hips	Anterior	1.8 in
Knees	Anterior	2.0 in

Note: The ideal distance should be 0 in.

How many degrees you are from horizontal

Body Segment	Elevated Side	Angle
Shoulders	Left	0.9°
Pelvis	Right	0.0°
Knees	Right	0.8°

Note: The ideal angle should be 0°.

How far are you from vertical

Reference Point on	Direction	Distance
Shoulders	Left	0.5 in
7th Cervical	Right	0.2 in
5th Thoracic	Left	0.4 in
Pelvis	Left	0.1 in
Knees	Left	0.2 in
Ankles	Left	0.1 in

Note: The ideal distance should be 0 in.

How many degrees are your feet are from vertical

Body Segment	Direction	Angle
Left foot	Supination	4.7°
Right foot	Supination	2.2°

Note: The ideal angle should be 0°.

How many degrees you are from horizontal

Body Segment	Elevated Side	Angle
Shoulders	Left	1.6°
Pelvis	Right	0.3°
Knees	Right	0.7°

Note: The ideal angle should be 0°.

How far are you from vertical

Reference Point on	Direction	Distance
Forehead	Left	0.3 in
Shoulders	Left	0.3 in
Umbilicus	Left	0.1 in
Pelvis	Right	0.2 in
Knees	Left	0.3 in
Toes	Left	0.3 in

Note: The ideal distance should be 0 in.

How many degrees your feet are rotated

Body Segment	Direction	Angle
Left foot	External Rotation	6.3°
Right foot	External Rotation	1.8°

Displacement	Direction	Distance
Left-right	Left	0.2 in
Anterior-posterior	Anterior	1.1 in
Displacement		1.1 in

Note: The ideal distance should be 0 in.

Moments of Force and Reaction Forces

Segment	Actual	Lever arm	Moment of force	Joint reaction force	Effective
Head	15.8 lb	0.9 in	1.5 Nm ↺	108.6 N	24.4 lb
Head and Trunk	112.7 lb	0.7 in	8.7 Nm ↻	675.2 N	151.7 lb

Postural Deviations and Associated Exercises

Postural Deviation	Movement to Correct Deviation	Goal of Exercise
Posterior pelvic tilt	Hip Extension (Left)	Stretch
	Hip Extension (Right)	Stretch
External rotation of the left foot	Ankle Inversion (Left)	Strengthen
	Hip Adduction (Left)	Strengthen

APPENDIX L : BARRÉ TRAINING INSTRUCTIONS TO RATER

An inter-rater reliability study of the Vertical de Barré

CCO Thesis Study

John Sage

416-882-5689

Thank you for agreeing to assist me in this study.

Enclosed find 3 brown envelops.

Envelope one

Sample of BioPrint picture used for analysis BioPrint Report

–male with white dots (FYI)

- this is Computer Software analysis your results will be compared to

10 pictures of no plumb line

10 pictures of plumb line

20 rater evaluation forms

Study hypothesis and inter-rater evaluation form – (FYI)

Envelope two

84 pictures of subjects without plumb line

84+ rater evaluations forms

Envelope three

84 pictures of subjects with plumb line

84+ rater evaluations forms

Instructions for picture analysis form completion

1. Start with envelope one – training envelope
2. Turn the two stacks of pictures face down, separate from one another
   Start with the no plumb line stack of photos
3. Complete analyzing form –
   a. Indicate subject number
   b. Indicate test 1 OR test 2
   c. Turn picture over and look at for 10 seconds
      Ask yourself – is pelvis OR cranium farther away from midline OR is their position in space neutral between the two

      Based on your observation, ask yourself if you observe the subject has a greater deviation from midline right R or left L

      PLEASE ONLY INDICATE ONE ANSWER

   d.
      i. Cranium - check mark
         1. Is it greater to right or left – circle answer
      ii. Pelvis -check mark
         1. Is it greater to right or left – circle answer
      iii. Neutral
4. Based on your observation – would you observe the subject has an ascending lesion or a descending lesion right R or left L
   PLEASE ONLY INDICATE ONE ANSWER

5. turn picture over and move to the next photo and repeat as above
6. when finished place photos and rater evaluations back into training envelope and seal with tape

Please complete all of the training images prior to moving to envelop 2 and 3

Complete envelope 2 – no plumb line picture as above

When finished place photos and rater evaluations back into envelope 2 and seal with tape

Complete envelope 3 – plumb line pictures as above

When finished place photos and rater evaluations back into envelope 2 and seal with tape

Place all three envelopes into the shipping envelope and notify me to organize pick up.

****Please note in the plumb line images, there may be a slight deviation of the plumb line from true midline, please take this into account when assessing.

APPENDIX M: SAMPLE RATER EVALUATION FORM

Rater Evaluation Form

Subject Number: ______________________________

Test 1 – without plumb line □

Test 2 – with plumb line □

Observations:

Deviation from Midline

Neutral □

Cranium □ R / L

Pelvis □ R / L

Descending Lesion □ R / L Ascending Lesion □ R / L

APPENDIX N: INFORMED CONSENT

Informed Consent

Thank you for your interest in this research project.
Title: An inter-rater reliability study of the Vertical Barré

Researcher: John Sage CAT(C),
Certified Athletic Therapist,
CCO Research Student
Tel: 416-882-5689
Email: johnsageresearch@gmail.com

For questions about your rights as a participant, please contact Mr. Mark Fillery at mfillery@cmcc.ca, or by phone at 416-482-2340 extension 267.

Objectives: To determine if the manual practitioners observe similar patterns of subjects in quiet standing, utilizing posture software to confirm findings.

Description: Standing in the Vertical Barré position, two pictures taken and are evaluated by different practitioners to determine asymmetries. Three BioPrint software pictures are taken and utilized to obtain statistical evidence of the same posture.

Benefits/Risks: By participating in this research, your posture will be analyzed by the BioPrint software and as a benefit, you can obtain the BioPrint results as well as recommended exercises to assist in optimal postural correction. There are no foreseeable risks associated with this study.

Your privacy is important to this project. Information collected within the subject chart is maintained and used in accordance with the PIPEDA. All results from this study will be used in a written study but your name will remain confidential and will not be used. All data collected during this study will be done in such a way so you remain anonymous and will be stored in a password-protected database until completion of the study. The information obtained in this study will only be used for this specific research. Upon completion of the study, photographs will be destroyed.

With signing this document, you are giving permission for pictures of you to be taken from different angles and analyzed for postural imbalances.

Your consent is required for us to perform and complete this study.

If, at any time you feel that you would like to withdraw from the study, you will be excused with no questions. The information obtained from you will be destroyed. Thank you for participation in this research project. Please let us know if you have any questions or concerns.

Please read the statement on the next page and sign should you wish to continue in the study. Please keep this page for your records and contact me at the above number should you have any questions regarding the research.

I understand that I have been asked to participate in a research study. I have received and read the information concerning this study, and I understand the benefits and risks involved in taking part. I have had an opportunity to ask questions about and discuss this study, and I know that any personal, identifying information I give will be kept confidential. I understand that I am free to withdraw from this study at any time, without need for any explanation. I also understand that withdrawing from this study will not affect my treatment in any way.

Participants name: ____

Participants signature: ____

Date: ____

Witness signature: ____

SUBJECT NUMBER:____________________________________

APPENDIX O: MEDICAL HISTORY FORM

Medical History Form

Subject Number: ________Subject Number: ________Age: _______ Height: ______
Weight:______ Male / Female

Previous Hospitalizations:(surgery, illness, falls, trauma etc.)______________________

Other Injuries:(MVA, dislocation, sprain etc.)__________________________________

For Females - are you pregnant? qor Femal

Please list any Prescription Medication you are taking:

____

Do you have or been diagnosed with:

- ❑ spinal abnormalities
- ❑ major dental surgury in last 6 months
- ❑ diabetes
- ❑ arthritis
- ❑ history of falls

Would you like to be informed of the results at the end of the study? Yes / No

Email Contact:

____

Would you like to receive an electronic copy of the research upon completion of the study? Yes / No

APPENDIX P: STATISTICAL CALCULATIONS FOR SUBJECTS / RATERS REQUIRED

Table 1 - Sample Size Estimates for kappa

	Probability				No. of Raters			
					2	3	4	5
Rater Scale Options	1	2	3	4	Required Sample Size			
	0.33	0.33	0.33		142	93	72	58
	0.20	0.30	0.50		161	105	81	65
	0.20	0.25	0.55		162	106	82	66
	0.25	0.25	0.25	0.25	129	84	65	52
	0.10	0.20	0.30	0.40	152	99	77	62
	0.10	0.10	0.30	0.50	166	108	84	68
	0.70	0.80	0.25	0.60	175	114	88	71