

Quantifying Structural Changes with the Application of Osteopathic Manual Medicine
(OMM) in Tegucigalpa, Honduras

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Abraham Billy Hardee III

(ABSTRACT)

The primary purpose of this research was to compare quantifiable structural asymmetry to changes visualized in center of pressure (CoP) and/or postural sway by the use of an Isobalance forceplate in order to introduce principles of osteopathic medicine to a Latin America culture. Osteopathic manual medicine (OMM) was used to correct structural dysfunction found in the study participants at the Baxter Institute in Tegucigalpa, Honduras. Study participants were students and staff members ranging in age from 18 to 35 and consisting of 24 males and two females. The examination period lasted a total of five weeks. During weeks one, three, and five, baseline measurements were taken prior to manipulation using .05 alpha to test significance. Measurements were repeated post OMM. An educational video was provided during each session. Pretest and posttest results demonstrated an improvement in understanding of OMM materials provided to participants. A bivariable chi-square test found that, when manipulated, those with sacrum dysfunction have an association with a positive improvement in postural sway (TIC 1 & 2) ($p < .05$). Also, the multivariable logistic regression model found that individuals who had no initial change in postural sway (TIC 1 & 2) were more likely to move to a positive improvement of time in the center of the premeasured diameter calculated by the Isobalance forceplate, than a decrease in time spent in the center (i.e. negative improvement) throughout the time of the study ($p < .05$).

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“There is neither Jew nor Greek, there is neither bond nor free, there is neither male nor female: for ye are all one in Christ Jesus.”

Galatians 3:28 (King James)

Throughout my medical school and PhD experience, I have traveled half-way around the world and have visited many people in their own surroundings. However, as much as I have been blessed to see and be a part of so many medical mission trips in these last five years, there are two individuals that I need to recognize because without their encouragement and their testimonies I may not have made it this far.

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My roommate for the last nine years is by far my biggest fan. She has always been there for me even when I was a child. We have laughed, cried, and grown older together. She is my number one fan. Even though she has not seen me during these past nine years, or watched me play football or baseball at Virginia Tech, nor seen my graduations, or my wedding; she has always listened. My grandmother has been suffering from macular degeneration for years and the Lord took her sight shortly after I moved in

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CHAPTER I

Introduction

The purpose of this study was to assess the impact of osteopathic manual medicine (OMM), structural change in Center of Pressure (CoP) and postural sway (Time in Center (TIC) 1 & 2), and the knowledge of OMM among the participants. In addition, this study led to the development and implementation of an educational packet for participants and implementation of OMM treatment at the Baxter Institute to introduce osteopathic medicine to a Latin American culture. Introducing and implementing a new healthcare option to a subgroup of individuals that has never been exposed to such a treatment could enhance the use of osteopathic medicine in Honduras.

OMM was implemented in this study to help reduce musculoskeletal discomfort and/or limitations in the range of motion (ROM). OMM was applied to individuals who had limitations in their activities of daily living (ADLs) or somatic dysfunction/s that were found via osteopathic structural evaluation to correct these problems. The change in CoP and/or postural sway was quantitatively measured by numerical change in the forceplate readings. The individuals evaluated live in Tegucigalpa, Honduras. In this part of Central America being free of musculoskeletal pain and having maximal ROM is very important because many have occupations that require physical labor. The individuals in this region travel much of the terrain by foot, especially the group studied due to their missionary responsibilities. Furthermore, the accessibility to automotive travel is limited

due to either economic hardship or poor road conditions in rural locations (Bureau of Consular Affairs “Honduras,” 2006).

Osteopathic research in developing countries like Honduras is extremely limited. However, the osteopathic philosophy is well suited for the Honduran culture because of the necessity of village self-care due to the lack of medicines. Furthermore, medicinal forms of pain management/relief are limited due to low socio-economic status among those in this region. There are great opportunities for advancements in healthcare in this region with the implementation of manual medicine complementing other forms of treatment of musculoskeletal resulting from structural changes pain and asymmetrical change due to the stresses caused by activities of daily living (ADL).

Part of the osteopathic philosophy is that the body works at its optimal capacity when structural disturbances are minimized. OMM can correct certain areas of discomfort or limited ROM, to most effectively acquire optimum movement of the musculoskeletal system. The osteopathic belief is that by using bones as levers to relieve pressure on nerves, veins, and arteries; there can be an alleviation of musculoskeletal discomfort (Seffinger et al., 2003). Treating the body as a complete unit includes the fascia and fibrous tissue that intertwines the muscles that unite the body from head to foot, enabling the body structures to reach a level of biomechanical and physiologic homeostasis (Martinke, & Dowling, 1997).

The utilization of a forceplate to measure CoP and postural sway has been previously studied in the U.S. and other countries demonstrating the viability of this approach to medicine. Furthermore, postural stability measured via a forceplate has shown trends of decreasing CoP with increasing symmetry of the body (Genthon, and

Rougier, 2005). The forceplate utilized in this study was an Isobalance forceplate, designed by Isotechnology. This machine calculates stability in two ways. First, the isobalance machine measures postural sway as a percent weight distribution in a six inch diameter circle. Second, CoP is measured by pressures placed in different quadrants on the forceplate. While there have been studies, a review of literature failed to locate research that measured level of correctable change in postural stability by manual medicine such as OMM.

Statement of the Problem

There are many reasons that substantiate the need for this research. Osteopathic manipulative treatment in past studies has been limited to outcomes such as qualitative pain relief and structural improvement. This study complements previous subjective research where data such as a pain scale or level of improvement charts are the main determinates of OMM success. Furthermore, cultural and personal preferences exist in our society regarding appropriate and inappropriate standards of care provided by a physician. As such, quantifiable data could be useful to substantiate subjective personal preference.

Osteopathic medicine is a relatively new profession having been around for about 100 years. As a result, there are fewer doctors and limited geographical and are not as well known internationally compared with the tradition Medical Doctor (M.D.). Indeed, a medical doctor, M.D. seems more widely recognized in the U.S, compared with an osteopathic doctor, D.O. (Doctor of Osteopathic Medicine). In addition to the explanation this is that the M.D. degree has a much longer history than the D.O., the number of colleges awarding M.D. degrees outnumber the colleges awarding the D.O. Currently,

there is a trend for greater acceptance of the D.O. among medical practitioners. Today, the D.O. and M.D. work alongside one another. However, there still exists a lack of knowledge, and therefore appreciation and acceptance, of manual medicine as a treatment option. There is even less research and understanding of OMM in the international setting. To address lack of understanding and acceptance, research is needed to measure the effects of OMM treatment objectively.

The specific problem addressed by this research is the lack of measurement effect of osteopathic manual medicine on structural dysfunction is limiting potential clinical treatment and acceptance in the medical community. Findings regarding OMM treatment of structural dysfunction contribute to the literature on osteopathy and have potential to relieve or reduce complications of postural instability and/or pain among the patient population in this study.

Purpose of the Study

The purpose of this study was to assess the impact of OMM on structural change as by measured CoP and postural sway, and thus, increase the level of understanding of the basic principles of OMM among the participants. Based on findings, the researcher developed and implemented an educational packet for participants and implemented OMM treatment at the Baxter Institute. As a result of the data collected in this study, the information obtained will enhance the scientific literature on OMM, provided an opportunity for investigator to evaluate the knowledge gained by the participants, alleviation of their discomforts (through OMM), and their measure of acceptance of OMM as an effective form of medicine. Additionally, this study enabled the investigator

to quantify postural sway and further evaluate how this measure was correlated to structural change via manipulation.

Research Questions

1. To what extent will the introduction of OMM lead to reduction of somatic dysfunction of individuals in the study?
2. To what extent will OMM change the measured indicators of CoP and postural sway with the utilization of the Isobalance forceplate?
3. To what extent will a particular response (positive, negative, no change, variable change) be identified by the 'outcomes' designed in this study?
4. To what extent did participants gain knowledge and accept osteopathic medicine after viewing the instructional videos presented during the study?

Research Hypotheses

The level of significance test apply to each hypothesis is $p < .05$.

1. Posttest scores will be higher than pretest scores on knowledge of osteopathic medicine after participants receive educational materials on OMM.
2. Posttest scores will be higher than pretest on acceptance of OMM among participants.
3. Posttest forceplate calculations of parameters of balance compared with pretest following OMM will show decreased postural sway, resulting from a decrease in body movement on the forceplate.
4. Posttest compared to pretest center of pressure (weight distribution) placed on the forefoot or hind foot during tandem stance will increase, thus show improvement of somatic dysfunction following OMM.

5. Somatic dysfunction measurement will decrease between week one to week five OMM treatment, thus showing improvement.

Significance of the Study

This study is significant because there is a lack of scientific evidence on the benefit of OMM treatment. Furthermore, the impact of education regarding the *complementary* benefit of OMM has not been well documented among populations not previously exposed to osteopathic medicine. While there is a general lack of research in the U.S., studies of non-U.S. cultures is even more pronounced. Manipulative treatment to correct somatic dysfunction and to evaluate the effects OMM has on CoP and postural sway is very important. Attempting to quantify how much manipulation benefits an individual is paramount in furthering the teachings of osteopathic medicine. This approach supplements and adds quantitative scientific measurements to the current predominate evidence approach to supporting OMM as a viable treatment method. Furthermore, as demonstrated in this study, educating individuals about why and how OMM works is a crucial part of evidence-based medicine. Most directly, this study has merit for relieving somatic dysfunction among the participants. In addition this baseline pilot has potential application for further study and clinical treatment application.

Assumptions

OMM has not been practiced in Honduras and other countries represented in the patient population. Therefore, it is assumed that patients included in this study had no prior experience or knowledge of osteopathic medicine. In addition, it is assumed those participating in this study have developed an understanding of the ways in which

osteopathic physicians can participate in medical fields other than traditional hospital medicine as a result of the researcher interventions.

Changes resulting from the treatment include an assessment through numerical changes on the Isobalance forceplate readings following the application of OMM. Potential measurement error by multiple raters will be eliminated, as the researcher will be the exclusive rater.

The Isobalance forceplate was designed for international applications for the military. This device is a prototype, initially designed to evaluate the effects of blast exposure on military personnel. This machine measures, but is not limited to, the following outcomes: changes in body weight distribution (CoP), postural sway, changes in body weight, and other criterion that is not relevant to this study. To ensure that the equipment worked properly it was calibrated on a daily basis according to the manufactures specifications.

The criterion used to analyze the data collected in this study was designed by the primary researcher and statistician. Current standardizations of criteria for increase or decrease in the outcomes (listed above) due to blast exposure are still in design phase according to Isotechnology. However, the use of forceplate to quantify postural stability is well documented in the literature.

Criteria for the evaluation of changes in CoP and postural sway, as it is related to OMM, have not yet been investigated for this or any other forceplate. The information gathered through this study can be used to add to a body of knowledge of how osteopathic manipulation can alter the structure and stance of an individual and manage somatic dysfunction.

Limitations of the Study

The language barrier was minimized by use of a translator and conversion of all relevant materials to the Spanish language. While the sample size of 26 may be considered small by some standards, it is sufficient for analysis in this case study approach. This study was conducted at an Institute in Tegucigalpa that has a population of approximately 75 students who come from at least ten different countries in Central and South America and the Caribbean Islands. Since the individuals studied were not all citizens of Honduras, they did not represent the Honduran population. Although the number of participants is limiting, the heterogeneity of the chosen population has implications for conclusions included in the study because of the different ethnic and regional differences of the participants. Individuals included in the study were volunteers and not randomly selected.

Somatic dysfunctions relationship to CoP and postural sway:

The study is limited by the lack of randomization of the participants. Those studied were a convenience sample. The measuring device was designed to measure CoP and postural sway, a variable of interest in this study. Measurements of somatic dysfunctions and correlates of changes in CoP and postural sway were determined by a researcher-developed protocol to guide observation and reduce potential subjective measurement error.

A review of literature failed to identify previous studies on correlations between somatic dysfunction and numerical changes in percentage weight distribution (CoP) and postural sway on a forceplate. However, the clinical application, mechanical attributes

and capacity of the device according to manufacture specification hold promise for measurement in this study and future application if successful in this pilot.

Summary

OMM has the potential to address the problem of somatic dysfunction through clinical application, thus enhancing the quality of life. Research questions and hypotheses are based on related literature to consider variables and strategies most promising to provide yield results useful to osteopathic physicians. While the parameters are limited to the sample in this study, the findings have implications for further research and clinical treatment. There is a gap in the literature on comparisons of somatic dysfunction with changes in CoP and postural sway. Educational modules on basic fundamentals of osteopathic medicine and OMM will help enhance the understanding of osteopathic manipulation among participants and serve as an introduction of OMM to the Latin American culture. The definition of terms describes key concepts in operational terms for this study. Contributions to literature on osteopathic medicine include the application of forceplate/s and correlations of changes in structural alignment to change CoP and postural sway. The next chapter will further discuss previous research that has been performed with forceplates similar to the one used in this study.

CHAPTER II

Review of Literature

In this chapter the history and background of osteopathic medicine, anatomy of the body, and prior methods of forceplate usage will be discussed. This review will build a foundation for the study and will establish the quantitative measurement for evaluating the effects of OMM on body mechanics.

The first section will explain the demographics of the population in Tegucigalpa, Honduras. Knowing more about this society will lead to a better understanding of the need for osteopathic medicine in this area, and in particular OMM for musculoskeletal pain relief. The second section will contain a discussion of the philosophy that makes osteopathic medicine a distinct practice of medicine, and an explanation of how and why manipulation works on the body. The final section of the literature review will review the types of instrumentation that are needed to measure CoP and postural sway. By understanding how CoP and postural sway is measured, one can measure structural change of the body with quantitative data points.

Demographics

In Honduras the terrain consists of mountainous areas and coastal beaches and the government is a democracy with a developing economy. The estimated population as of 2004 was 7,099,000 (Figure 1) (UNICEF, 2005).



Figure 1. Honduras is located in Central America. UNICEF.org key word Honduras.

Roughly 68% of the families in Honduras are poor and live in the rural and peri-urban areas. About 16% of the population is unemployed in 2001 and 384,832 children between the ages of five and eighteen were working (UNICEF, 2002). Many of the individuals in the rural and peri-urban areas only have a primary education.

The greatest healthcare disparities exist in the rural areas. Moises Leon, in the article “Perceptions of Healthcare in Central America,” found that the dominant form of healthcare coverage was the Ministry of Health System and Social Security (2003). The best form of healthcare available is private care, which is available only to the financially stable portion of the population. The majority of the Central American population does not fit in this group. Seventy-five percent of the Ministry of Health Hospitals (MOH) are in rural areas and they provide some services but the resources are limited (Leon, 2003). Due to the heavy financial burden that healthcare has on the family; “annual maintenance” exams are often missed. However, the MOH keeps many of the children that have access to health facilities up-to-date with pediatric vaccinations.

Osteopathic Medicine

The research available on the state of healthcare in Central America, and specifically Honduras is limited. However, what does exist points to insecurities that the people have in their country's quality of healthcare (Leon, 2003). These insecurities consist of lack of education about health maintenance, the physicians' need to perform certain procedures, and facility management. The approach toward patient education along with the osteopathic principles that will be discussed later are the reasons this practice of medicine would be beneficial for this population. The field of osteopathic medicine has existed for over 100 years and is currently growing rapidly with 20 schools in existence in 2005 and currently 28 osteopathic campuses in the United States, according to the American Osteopathic Association (AOA, 2008). The founder of this form of medicine was an allopathic physician (M.D.) by the name of Andrew T. Still. With any type of structure, mechanical or living organism, the optimal function is directly related to the balance of its components. This same idea was used by A.T. Still when he began to practice medicine with an osteopathic approach. Avoidance of alcohol, drugs, and other toxins is the basis of the holistic approach to medicine (mind, body, and spirit) (Seffinger et al., 2003).

The College of Osteopathic Medicine in Kirksville, Missouri was the first osteopathic school, and in 1953 the first four osteopathic principles were developed. These principles are as follows: the body is a unit; structure and function are interrelated; the body can self-regulate and self-heal; and the body can defend itself. Rational treatment by osteopathic physicians comes with the understanding of these basic principles (DiGiovanna, 1997). There were also two more principles added by Sprafka,

Ward, and Neff (1981) which will be discussed below. The Educational Council on osteopathic Principles study (Figure 2: as cited in Foundations of osteopathic medicine, 2003) displays the coordination of the activities of five basic body functions that are integrated by the musculoskeletal system when adapted to stressors.

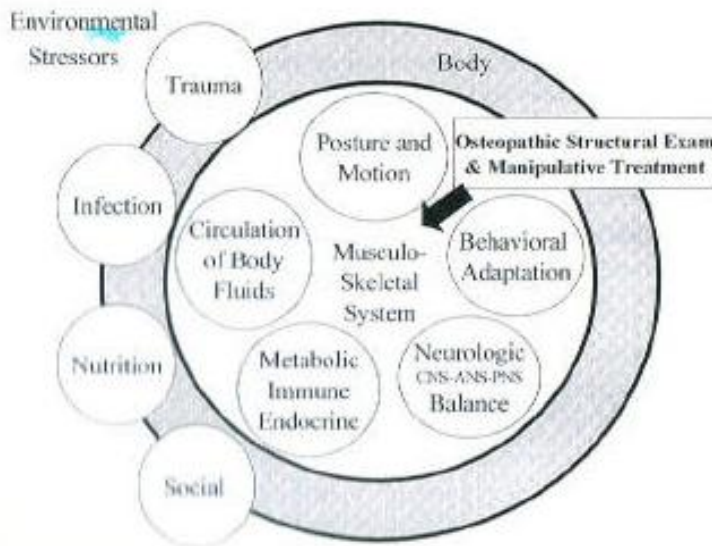


Figure 2. Foundations for Osteopathic Medicine (FOM) 2003, pp. 11.

The evaluation and treatment of the musculoskeletal system will affect the person's ability to adapt to the internal and external stressors.

The second component of osteopathy is the body's ability to self-regulate by neuronal reflexes and hormonal pathways. The neuronal reflexes are seen best in the cardiac sinuses in managing pressure placed upon the vasculature. When the baroreceptors are stimulated they respond with either an increase or decrease in the heart rate and contractility. The hormonal response is seen in many situations most noticeably in the sympathetic response, which is also known as the "fight or flight response". Furthermore, the body has the innate ability to defend and repair itself. The body can

recover from illnesses, wounds, broken bones, skin eruptions, and even regression of cancers. Healing happens when obstacles are removed that prohibit the body's optimal performance (Seffinger et al., 2003).

Structure and function principles are so important because the musculoskeletal system is intricately connected to the other systems of the body, i.e. the voluntary and involuntary nervous system. Therefore, the musculoskeletal system serves as a mirror of health and disease by demonstrating increased sensitivity and inflammation to the muscle area close to the problem organ/system (DiGiovanna, 1997). Furthermore, where mechanical disorders are palpated, manipulative medicine is introduced to the area. OMM is not just limited to the muscles and bony structures (even though these are the areas of focus in this project); the nervous system can also be affected, which in turn affects the visceral organs/structures. This enables the body to work at its optimal level, which will allow self-healing to take place.

The two additions to the four basic principles of osteopathic medicine that were drafted by Sprafka et al. (1981) state the following:

- When environmental changes overcome the body's self-maintenance capabilities, disease is more likely to exist. Therefore, if the cause can be manipulated, self-repair is a great possibility.
- Understanding the concept that the body is one component with many different parts working in concert is crucial for understanding the approach to the most effective treatment. It is also important to understand that manipulation is not the most important part of osteopathic medicine but can have major benefits in the treatment of somatic dysfunction.

Somatic dysfunction (SD) is a term that is used in Osteopathy to describe a change in function of the somatic framework (vascular, lymphatic, neural, skeletal, musculoskeletal, and arthrodiagonal). As is stated by DiGiovanna (1997), the term is too general and can apply to a wide variety of problems that may not be true somatic lesions. Not all lesions such as fractures, sprains, degenerative processes, and inflammation qualify as somatic dysfunction. Dr. Mitchell, Sr. (as stated in the text book: *An Osteopathic Approach to Diagnosis and Treatment*) stated “implicit in the term ‘somatic dysfunction’ is the notion that manipulation is appropriate effective and sufficient treatment for it.” There are specific criteria that must be met in order to have the diagnosis of a true somatic dysfunction.

The acronym that is used to help osteopathic physicians remember the criteria for somatic dysfunction is “T-A-R-T”. The “T” stands for tissue texture changes. The changes denoted here are due to soft tissue (skin, fascia, and muscle) palpable changes. In tissue texture changes, there are two major classifications that aid in determining the time period at which the somatic dysfunction has taken place. Soft tissues experience change differently due to acuteness or chronicity of the dysfunction (Table 1). “A” represents an asymmetry in the vertebral and other bones in the skeletal system. The “R” is for restriction in range of motion (ROM). There are three components that make up the barriers to full range of motion including physiologic, restrictive, and anatomical barriers (Figure 3).

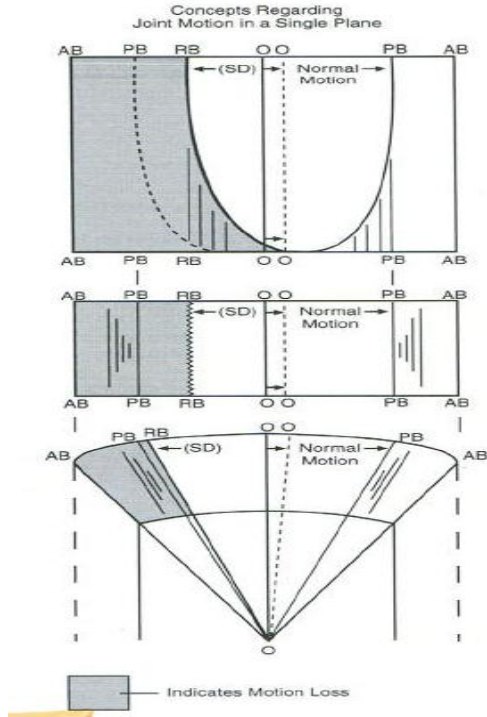


Figure 3.: The restrictive barrier (RB) is the grey shady area on the left side of the graph. This delineates the lack of movement that an individual can produce due to restriction in muscle, bone, tendon and/or ligaments structures. Foundations for Osteopathic Medicine (FOM) 2003, pp. 11

The final “T” is for tenderness experienced by the patient during palpation of the tissue in that area.

Osteopathic physicians name the restriction in movement (i.e. dysfunction) by the directions in which the body segment moves most freely. For example, if figure 3 was a cervical segment and rotation occurred around a vertical axis, the cervical unit would be rotated left and restricted in right rotation. If trying to rotate the segment opposite of the directions it is rotated (right) would produce little to no movement. Therefore, the cervical segment will rotate more freely in the left direction. Thus, the dysfunction would be called a ‘left rotation dysfunction’. There are two major types of classifications of somatic dysfunctions: Type I and Type II dysfunctions. Type I follows Fryette’s first principle of motion. This states that group curves involve one or more vertebral

segments, and rotation and side-bending of the spine are in opposite directions (DiGiovanna, 1997). Type II mechanics of a single vertebral unit follow Fryette's second principle of motion, that single vertebral units have dysfunctions in which rotation and side-bending occur on the same side. It is important to understand that Fryette mechanics only exist in the thorax and lumbar vertebra. The cervical vertebra have different anatomical structures and muscular attachments.

Some of the basic terminology of the treatment of SD needs to be understood before proceeding to the actual treatment techniques. Active techniques are those that involve a patient's voluntary muscle movement. Passive techniques call for the patient to relax and let the physician direct movement. In Osteopathy, motion classification consists of indirect and direct movements. The indirect movement involves taking the body part away from the area of restriction, while direct techniques engage the barrier of the restriction.

The major goal of OMM is to relieve pain, improve motion, and positively change abnormal conditions in the muscles and skeletal system (DiGiovanna, 1997). OMM is very important for the treatment of back and neck pain. Takala (as cited in Morken et al., 2003) found that low back pain accounted for 40% of worldwide work-related health cost and the associated musculoskeletal discomfort.

Osteopathic Techniques

When the diagnosis of the SD has been made, treatment of the specific area follows. This can be accomplished by the use of the many forms of osteopathic treatments available (Figure 4). The techniques listed below will not all be used in the treatment of individuals in Honduras with musculoskeletal complaints; however, a brief

introduction to each one will allow greater understanding of how treatments are performed. All descriptions of treatment options are taken from the DiGiovanna text (*An Osteopathic Approach to Diagnosis and Treatment*) and figures from the Ward et al. text (*Foundation for Osteopathic Medicine*).

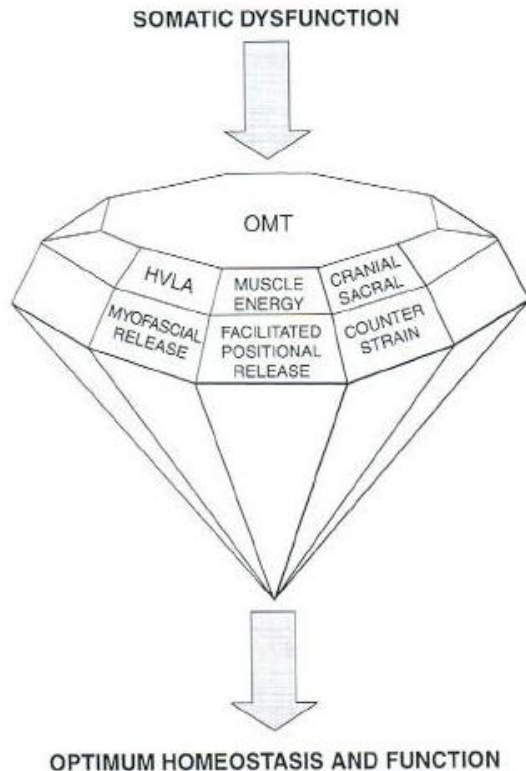


Figure 4. This picture lists the six types of osteopathic techniques that are used for the treatment of SD.

Foundations for Osteopathic Medicine 2003, pp. 1157.

Myofascial treatment is used in soft tissue areas in particular the muscle and fascia. These techniques can be active or passive. In Figure 5, the physician is attempting to find which direction the fascia moves freely. In this picture, if the fascia moved more freely to the left and a direct technique was to be applied, the movement of the physician's hand would be in the direction of the arrows (towards the right).

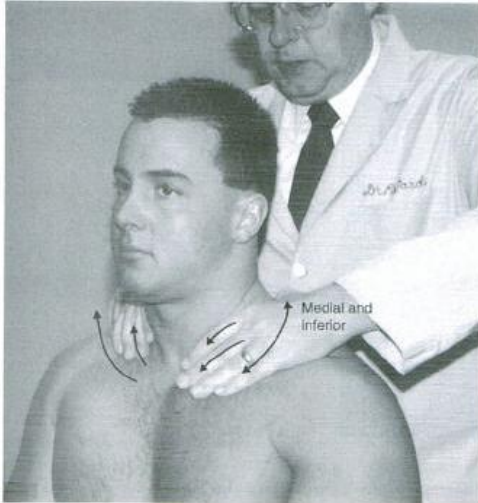


Figure 5. Direct technique. Foundations for Osteopathic Medicine 2003, pp. 956.

Counterstrain is used when tender points are located in the muscles, ligaments, and tendons. These tender points are treated by shortening the muscle involved, holding it in this position for 90 seconds and then returning the body part to a neutral position. These points can be described as small tense edematous areas of tenderness about the size of a fingertip; typically located near bony attachments of tendons, and ligaments or in the belly of some muscles. This technique is considered to be a passive indirect treatment. In Figure 6, the instructor has located a tender point on the spinous process, and he is shortening the musculature on that side by lifting the shoulder to relieve the discomfort.



Figure 6. The physician is causing retraction of the shoulder blades and decreasing the muscle length yielding to relaxation of the tender musculature.

Foundations for Osteopathic Medicine 2003, pp. 1010.

Muscle Energy is an active direct technique that engages the restriction (the body part is moved into the barrier); the patient is instructed to move in the opposite direction for three to five seconds (against resistance). This technique is repeated three or four times and the physician moves the body part further into the restricted barrier after each relaxation (Figure 7).



Figure 7. The physician is treating a posterior sacral torsion by having the left leg pushed to the floor; the patient then pushes up toward the ceiling for a count of 3-5 seconds. Each time the instructor pushes further and further

down to get through the restrictive barrier. Foundations for Osteopathic Medicine 2003, pp. 899.

Facilitated Positional Release (FPR) is very similar to that of counterstrain because the physician is placing the body part in the position of comfort (i.e. shortening the muscle length). Before the area with SD is manipulated, the practitioner places the area in question into a neutral position (this is different than counterstrain where placement into a neutral position is not achieved until after treatment) and a facilitating force is added before the segment is placed in its ease-of-motion or shortening position. The position is held for about five seconds and then the part is returned to resting position for reevaluation. The mechanism behind FPR states that placing an inappropriate amount of gain on the gamma motor neuron of the muscle spindle would result in characteristic change of the SD (Figure 8). This treatment modality was initially studied by H.W. Bailey (Foundations for Osteopathic Medicine, 2003).

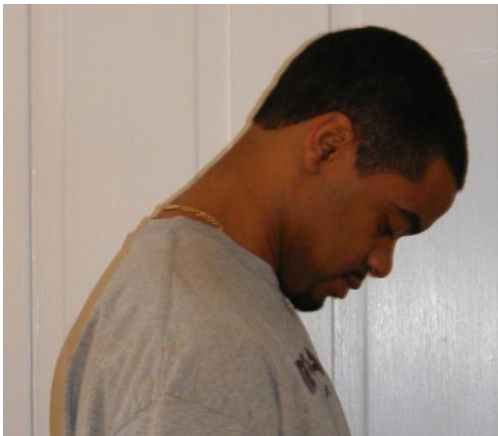


Figure 8. Demonstrates the technique of FPR by having the practitioner shorten the musculature of the trapezium, while also applying a downward pressure on the shoulder with the left hand. Foundations for Osteopathic Medicine 2003, pp. 1020.

One of the most popular and more quick techniques used by osteopathic physicians is the high velocity low amplitude thrusting maneuver (also known as HVLA). This technique involves a quick force (high-velocity) over a short distance (low-amplitude). In this type of manipulation joints are moved.

Anatomy

In the cervical spine there are seven vertebral bones, which are divided into three regions. The first region has two different names (Cervical 0 {C0} or Occipitoatlantal Joint {OA}) and is composed of two bones (cranium and the Cervical one {C1}). In this region the major motion is flexion and extension of the head. The second region is called the Atlantoaxial Joint (AA) or also called Cervical two (C2), and consists of C1 rotating on C2. The most interesting part of C2 or the AA joint is the dens, which fits into the OA joint. The third and final components of the cervical spine are the cervicals of three to seven (C3-C7). The major motion in this region of the neck is side-bending. The ROM for flexion is 45 degrees: for extension (backwards bending) 85-90 degrees. The rotation and side-bending components are 85-90 and 40-45 degrees respectively (Figure 9, 10).



*Figure 9.*Forward Bending 45 degrees. Taken by primary investigator.



Figure 10. Backwards Bending 85-90 degree.

Photo by primary investigator.

In the thoracic area there are 12 vertebral bodies and 12 ribs. As was mentioned in the earlier sections, this area is one of the regions that follows Fryette mechanics (the other is the lumbar region). Figure 11 shows the lateral view of the vertebral bodies and Figure 12 shows an anterior view of vertebral bodies with ribs attached.

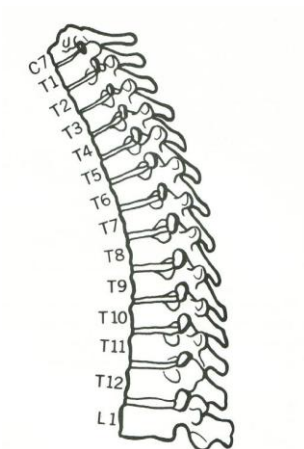


Figure 11. The Rules of three can also be seen in this picture.

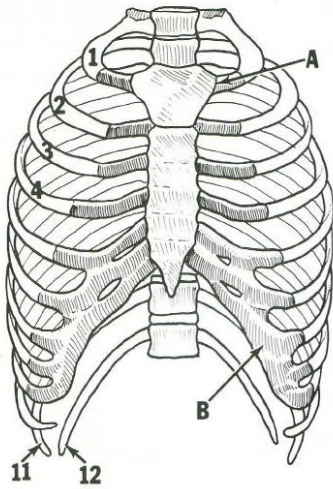


Figure 12. Thoracic cavity

The thorax can move in flexion, extension, side-bending, and even rotation (which is its most dominant motion). The rib head (circled) (Figure 13) articulates with the vertebral body. Having an understanding of the bony landmarks of the spinous and transverse processes of the spine is needed in order to evaluate and treat SD (Figure 11) (Fenton, & Phykitt, 1997). The ROM in this area as it relates to side-bending is 20 degrees, and rotation is 40 degrees.

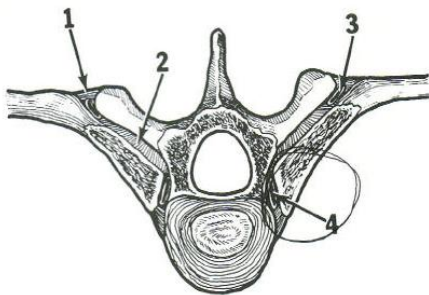


Figure 13. Single vertebrae with rib heads articulating bilaterally.

The lumbar spine (L1-L5) consists of 5 vertebral bodies, and is the site of most back complaints (L4-L5). The major motion in this section is flexion and extension.

Furthermore, when sacral pathology is present, it is appropriate to treat L5 first and then the sacrum. The ROM for the lumbar area in flexion is 105 degrees, while extension is 60 degrees. In side-bending and rotation the normal range of motion is 40 degrees.

The pelvis and sacrum unit is composed of three bones: ileum, ischium, and pubic bones. The sacrum is made of fused bones and a small piece called the coccyx bone. The pelvis is the major support of the body's weight and stance, along with the sacrum. There can be many dysfunctions found in this area yielding to improper stance and structure. Problems in this area not only lead to discomfort (muscle tightness, or SD) but can also lead to neurological problems due to the vast amount of nerves that travel through the pelvic girdle.

Postural importance

This section will list some of the situations that cause variations in posture, which can alter forceplate readings even when SD is not found during osteopathic structural evaluation. Posture is a very complex topic to cover in such a short section; however, the information below is to further aid in the comprehension of how posture distribution of the mass of an individual, and the base of support depends on the following three major conditions (Ward, 2003):

1. Energy requirements of homeostasis
2. Integrity of musculoligamentous structures
3. The compensation of structure at and/or below the skull, which has visual or balance function on the body

The postural approach to treating pain is very effective because gravity has a major responsibility in postural homeostasis. Throughout life many conditions can effect

this physiological development of normal curvature such as: anatomic short leg, scoliosis, small hemipelvis, spondylolisthesis, and wedge vertebrae (Ward, 2003). The alignment depends on the balance of the curves that are pictured in Figures 14 and 15. When there are structural changes, the resulting postural compensatory pattern often leads to pain (Kuchera, 1995).

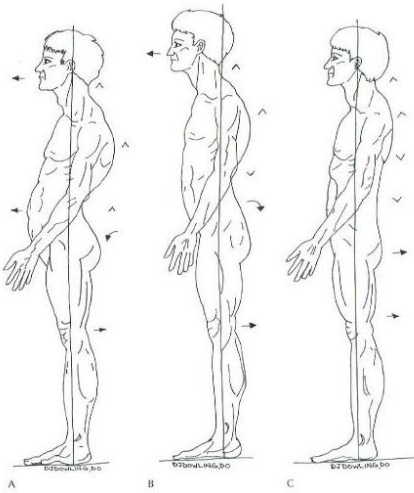


Figure 14. Postural changes that come with changing in body habitus. *An Osteopathic Approach to Diagnosis and Treatment* 1997, pp. 39.

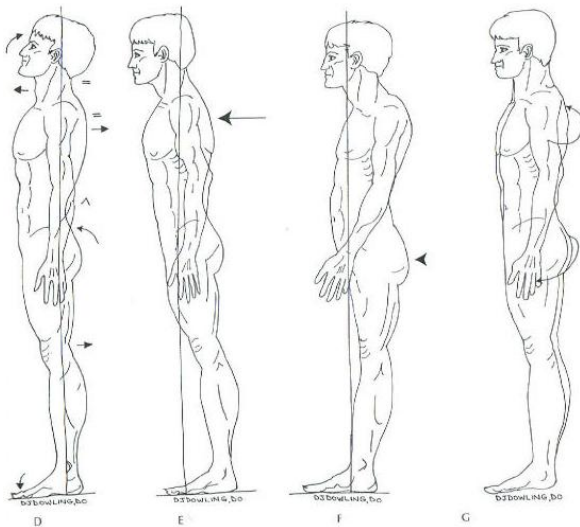


Figure 15. *An Osteopathic Approach to Diagnosis and Treatment* 1997, pp. 40.

Figure 16 demonstrates the importance of biomechanical principles at work in a negative response to gravity and poor posture acting on the body. These effects of gravity on the body cause disruptions in normal physiological group curves leading that can lead to somatic dysfunction/s. These forces are causing further delineations from normal group curves of the spine. To properly diagnose dysfunctional areas in the body, landmarks are used for locating and naming types of lesions found (Figure 17).

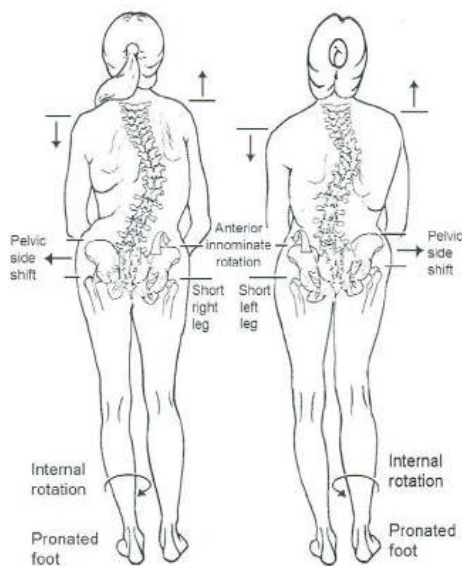


Figure 16. This schematic shows that with rotations in one area, there will be a balancing rotation in the opposite direction somewhere else in the body. The end results from a malrotated lower leg can cause upper back complications. Foundations for Osteopathic Medicine 1997, pp. 605.

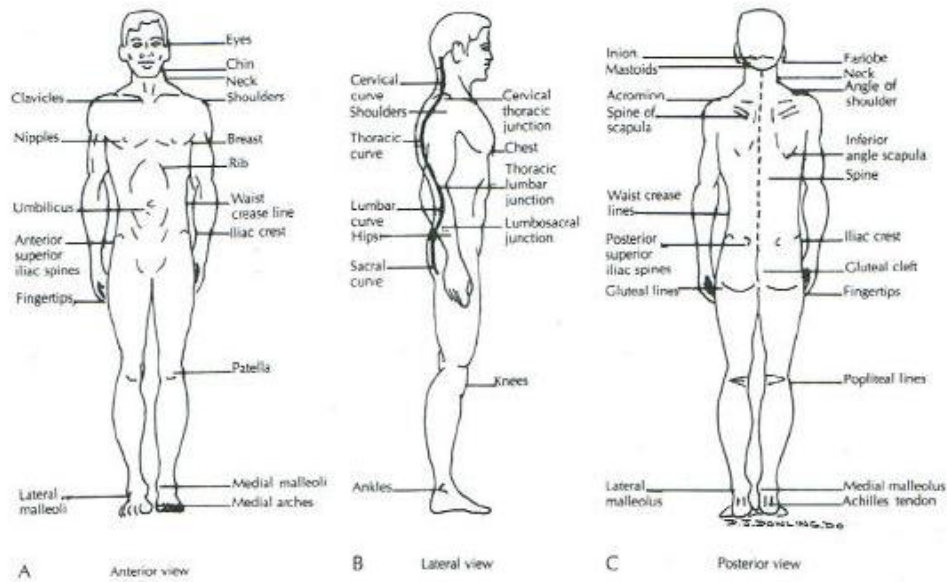


Figure 17. These landmarks are used to locate possible asymmetries in posture. An Osteopathic Approach to Diagnosis and Treatment 1997, pp. 44.

Forcplate

Barbe and Barr, (2006) were able to show that musculoskeletal disorders (MSD) not only account for a significant proportion of work injuries but also that the key to controlling the impact of such disorders is prevention or early intervention. Once again, the latter part of this equation is what osteopathic medicine can do. However, in research, most osteopathic measurement devices are qualitative. Quantitative measuring tools provide greater validity. Furthermore, objective data is more widely accepted in the scientific community.

There have been studies performed in the past that evaluated center of pressure and ground reaction forces in relationship to posture. One study performed by Takala, Korhonen, & Viikari-Juntura (1998), showed that postural sway has associations with low-back symptoms in a working population. The researchers found a small correlation of sway and low back pain when participants in a quiet stance (not moving and arms

down to the side), were compared with their eyes opened and eyes closed. Due to their inclusion of the variables eyes open and eyes closed, this study was not included in the current project, which evaluated center of pressure (CoP) change with eyes open prior to and after OMM was performed. Also, the relationship of CoP with somatic dysfunction was evaluated through questionnaires and forceplate readings.

Further studies on ground reaction forces by Jonsson, Seiger, & Hirschfeld evaluated single-leg stance. Their project was able to demonstrate that difficulties in maintaining static position are dependent on both an impairment to compensate for the disturbance of posture (caused by a weight-shifting) and weaknesses in musculature which support the body. The end result was that the first five seconds of quiet stance is the most important in maintaining posture on one leg.

More research has been conducted on sway than CoP because of the neuronal complexities. Zhang, Kiemel, & Jeka (2006) performed a study to evaluate the engagement of the musculature as it relates to sensory involvement on a forceplate with in-phase (ankle stability) and anti-phase (hip involvement). This means that the amount of sway demonstrated by the lower extremities (in-phase) was compared to that of the hip structures (anti-phase) when the patient would change sensory stimulus (finger to nose with eyes open/closed and finger to pressure testing). The results showed that increased sensory involvement (i.e. movement of arms in different directions) would yield to greater recruitment of the pelvic musculature to aid in maintenance of the upright stance compared to ankle sway. This means that with bilateral movement of the upper extremities, pelvic movement would move at great frequencies than the ankles. The study showed the importance of a longitudinal analysis to alleviate pelvic and sacral

abnormalities. Based on Zhang, Kiemel, & Jeka (2006), the research in Honduras will address the correlation between structural disturbance and improving functionality.

There is one study that has already evaluated the CoP trajectories between bilateral and unilateral stance. The conclusion of this study was that the reason that bilateral stance yields lesser movements as it relates to trajectories is because there is less surface area when bearing weight on one foot. The incorporation of arm movement distracts the central nervous system from the balance mechanism of the individual, yielding to greater instability (Hwang, Huang, Cherng, & Huang, 2006). This was a very important study because the involvement of the upper extremities decreases the CNS functional capacity, thus limiting its ability to independently focus on balance. Therefore, in Honduras the involvement of dual coordination mechanisms of the upper and lower extremities will not be performed. Direct incorporation of the nervous system will not be attempted in this project, and quiet stance (standing still) with and without manipulation was the focus of the Honduras project.

Two studies have direct implication for methodology and design of the research conducted in Honduras. The first study utilized two forceplates (in contrast to the one Isobalance forceplate machine used in Honduras) but measured the ground reaction forces upon the feet. The researchers Jonsson, Seiger, & Hirshfeld (2003) evaluated the individual in the heel-to-toe position and monitored which foot had the most movement. The conclusion was that most of the weight was placed on the rear leg and the front leg was mainly for support. Furthermore, they showed that the tandem stance in the heel-to-toe position is not the most suitable test when assessing equal weight-bearing capabilities

(Jonsson et al., 2003). This information helped limit this research to tandem stance with feet shoulder-width apart.

The study by Genthon & Rougier (2004) showed that there is an increase in energy used in an asymmetric posture, and in a simulated unequal weight distribution. It also showed that the leg that had a decrease in CoP was causing a great amount of asymmetry in the body. The study by Genthon & Rougier has direct application in the Honduran study increasing somatic dysfunction corrects a “correctable” leg length discrepancy, innominate or postural imbalance.

Summary

Of the studies that were reviewed, none considered correlating manipulative treatment with changes in postural imbalances and the effect that would have on CoP or postural discomfort. The review of literature provided important insights into methodology and background information to construct the present study. Those insights are incorporated into the methodology section and noted accordingly. Changes in CoP measured by Isobalance forceplate in concert with OMM is an important line of research. Future studies with much larger populations and random sampling will be beneficial, yet the baseline from the present study is a good place to start in Honduras. The measurements of somatic dysfunction by the use of osteopathic structural evaluation (physical pathologies that are correctable or manageable with the use of OMM) have provided data generalizable to other populations as more studies are conducted that include a wider range of representative groups. Drawing correlations between structural problems and osteopathic structural evaluation and manipulation through the Isobalance forceplate can provide fertile information for enhancement of human health with non-

invasive techniques. Using non-invasive and inexpensive techniques is an important medical advancement in countries with limited access to expensive technologies and medications. Moreover, it avoids the tendency of modern medicine to rely on prescription and invasive techniques that are expensive when a more holistic approach is available.

There is a desperate need to quantify manual manipulation as a scientifically-viable option for structural discomfort, as shown in the review of literature. The correlations of somatic dysfunction and changes viewed in the CoP will validate that structural changes present with OMM. Therefore, the effectiveness of the hands-on approach to medicine as shown in the literature review will be accepted not only by those in the medical field, but also by those in the scientific community.

CHAPTER III

Methods

This section covers the methodology, design, instrumentation, procedures, and data analysis. Detailed information about OMM and the Isobalance forceplate used to measure the participants in the study is included. There are multiple figures and some tables that will aid in understanding the procedures that took place during the examination of each individual.

Research Question

1. To what extent will the introduction of OMM lead to reduction of somatic dysfunction of individuals in the study?
2. To what extent will OMM change the measured indicators of CoP and postural sway with the utilization of the Isobalance forceplate?
3. To what extent will a particular response (positive, negative, no change, variable change) be identified by the ‘outcomes’ designed in this study?
4. To what extent did participants gain knowledge and accept osteopathic medicine after viewing the instructional videos presented during the study?

Study Variables

The two major independent variables were 1) OMM procedures, and 2) education. The dependent variables were 1) level of knowledge, 2) level of acceptance of OMM, 3) reduction of somatic dysfunctions, and 4) change in CoP and postural sway. Exclusion and inclusion criteria and positive and negative controls help guide the study. Inclusion and exclusion factors defined in specific terms how individuals were selected for the study, thus meeting IRB requirements.

Inclusion Criteria refer to the means of selecting the sample from the population. The criteria include:

- Status: Baxter Institute student, faculty/staff
- Age: older than eighteen and younger than fifty

Exclusion Criteria clearly define factors that limited participation. The criteria include potential participants who fit specific conditions:

- Distracting injuries
- Acute traumatic injury
- Inflammatory arthritis
- History of neurological disease
- Osteoporosis risk or history
- Severe atherosclerotic disease

“Patient Treatment” refers to the positive and negative controls in the study design. The positive controls were the practices performed in the study that were designed to yield positive results. 1) The participants watched a translated audio-visual program that explained osteopathic medicine. 2) Each participant received a pretest and posttest to gauge the level of understanding of musculoskeletal health and osteopathic manual medicine. 3) All osteopathic manipulations, lectures, and evaluations were conducted by the primary investigator. 4) All forceplate measurements were conducted by the secondary investigator. 5) If no somatic dysfunctions were found, the individual was asked to stand back on the machine for reevaluation and measurements.

The negative controls that were limitations in this study included: 1) Individuals with chronic dysfunction did not receive optimal benefit because the number of treatments were not sufficient to correct the many years of structural asymmetry, or because the defect/s were not correctable (i.e. innominate dysfunction caused by scoliosis); 2) Healed fractures are resistant to manipulations. 3) Limited comprehension of the pretest and posttest questions could yield incorrect answers. Comprehension was limited because of the variations in syntax across a variety of Spanish speaking countries included in the study. Similarly, some participants were unable to follow commands either due to language variations in translation of terms or the use of terms that were not translatable in their purest sense. There was a bilingual translator present for the majority of the examinations. 4) Many of these individuals participated in soccer games on the campus of Baxter, and the minor traumas that occurred on the field could reduce the effectiveness of the OMM they received.

Research Methodology

Procedures followed a case study approach. Protocols were designed to implement treatment and educational components along with pre and post-measurements. Instrumentation included equipment in the treatment that provided quantitative indicators. Additional instrumentation provided attitudinal and knowledge metrics, along with qualitative opened-ended questions to provide an in-depth assessment with explanatory power to add meaning to the quantitative indicators.

The pre and posttest (Appendices B & C) were provided via an internet website called “survey monkey”, and the scores were tabulated by percentage of correct to incorrect answers. All results from the 20-question pretest and 21-question posttest were

tabulated by comparing the number of correct to incorrect answers. Group scores as opposed to individual scores were gathered and compared to examine the knowledge gained from the group as a whole.

The following provides a chronology of events:

1. Upon arrival in Tegucigalpa (January 30th), general preparations were conducted until the second of February. These preparations consisted of testing all mechanical devices (Isobalance forceplate) and obtaining a room and audio-visual equipment (Appendix D) for initiation of the study.

On the fourth and fifth of February an introduction of the project was conducted in the general assembly area. The project's design and purpose was discussed (Protocol for Consultation). Everyone who attended received the following: A) the informed consents (Appendix E) (collected through the six to the seventh of the month), and B) the exclusion criteria.

2. At the second meeting (the 6th or 7th of February) all informed consents were collected and access codes for the pretest were given. A schedule for baseline measurements was introduced, with measurement starting as early as that day (the sixth and ending on the ninth of the month). A manipulation schedule was given so participants could start receiving their OMM on the 11th.

The baselines days included: osteopathic evaluation (Appendix F), and forceplate readings without shoes in the upright position.

3. During the third meeting (on the morning of February 11) those who signed the informed consent forms and finished the pretest started receiving manipulation. Also, participants viewed mini lectures via a pre-recorded DVD that contained the following information:

- Introduction of contents of the study
- Purpose of Study
- Definition of a “Forceplate”
- A list of different physical areas that are treatable through OMM
- Differences between Osteopathic Physicians, Allopathic Physicians, Massage Therapists, and Chiropractors
- Osteopathic Philosophy

4. First evaluation and treatment (the week of February 11). Each person’s visit consisted of the following:

- a. Measuring of CoP and postural sway on the forceplate, osteopathic structural examination, and then another measuring of CoP and postural sway.
- b. The forceplate measurements were conducted in the following manner:
 - The participants stood erect with arms crossed for 30 seconds on the forceplate (Figure 18).

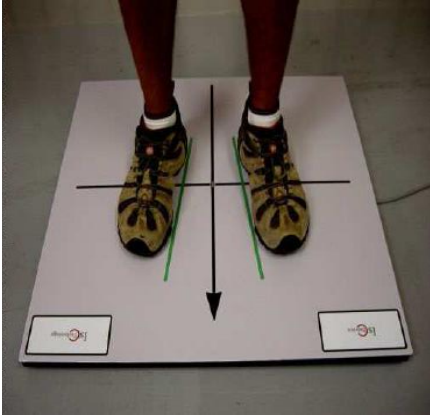


Figure 18. Isotechnology photo of forceplate used in study.

- Osteopathic evaluation and treatment consisted of:
 1. Structural evaluation
 2. Manual medicine applied if SD was found during osteopathic structural evaluation. Repeat measurements were taken for all participants whether or not manipulation was performed. Table 10 lists the procedures during the orientation week and weeks 1 through 5.
 5. All data on measurements were collected by the second investigator and placed in a locked cabinet, in a locked room, and reviewed by the primary investigator at the conclusion of the study. The second investigator tabulated the data to decrease the chances of selection bias by the primary investigator. All measuring of CoP and postural sway were performed by the computer program that comes with the Isobalance forceplate. This data was analyzed internally by the program and formatted graphically.

Population and Sample

The population included seminary students and staff at the Baxter Institute Theological Seminary in Tegucigalpa, Honduras and in residence from January 2008 – February 2008. This group of individuals consisted of 55 males and females on-site at the time of this study. These individuals are primarily from Central America, South American, or the Caribbean Islands.

From this population, volunteers were solicited to reach the final sample of 33. These individuals were selected for the study because of their availability, compliance, and accessibility. Furthermore, these individuals are educated and valued in their community because of their higher levels of education and future occupations (pastors). The participants have the potential to increase knowledge and the literacy rate, which is very low in many of the areas where they will likely work. The group of participants were chosen in part for their potential ability to influence the views of their community about physicians and the healthcare system. The minimum age requirement for participation in this study is eighteen, the maximum age is fifty. The spoken language is Spanish.

Instrumentation

There were four interventions that were utilized in this study. When the participants entered the room to receive the evaluation and/or treatment, an educational video was played. This video allowed the participants to passively learn about the osteopathic philosophy. The video was translated by a fellow classmate, Maria Dunn, a representative of the Virginia College of Osteopathic Medicine (VCOM class of 2009). This video played continuously in classroom 5 at the Baxter Institute, from the 3:00 until

5:30 p.m. Monday through Thursday of weeks one, three, and five. The video lasted 30 minutes and ran continuously during the manipulation period.

All manipulations were performed by one individual (primary investigator). During the initial stages of this project (baseline/first week of evaluation and treatment) Doctor Evelyn Parrish D.O. was present to make sure all osteopathic structural evaluations and manipulations were performed correctly. Once the initial measurements were received from the forceplate, the individual was ready for evaluation. The following photograph (Appendix G) illustrates how the room was set up for the procedures. The hands-on approach to correcting somatic dysfunction was performed in two possible ways, depending on the problem found: 1) tenderness of the area, and 2) comfort level of the individuals to receive certain treatments. The manipulations that were performed on the individuals consisted of muscle energy and/or HVLA.

The Isobalance forceplate is a machine designed to evaluate many different functions of the human dynamics of motion. The numerical information collected from the forceplate evaluated CoP and postural sway. The data was then statistically manipulated for comparison and possible relationship with OMM. This single forceplate device analyzed percent weight distribution for a given time and the amount of postural sway within a six-inch radius. CoP is the specific measurement utilized while individuals are standing in tandem stance (sometimes on two different forceplates [Appendix H] or on a single forceplate [Appendix I]).

A general knowledge pretest of what healthcare means to each participant was administered prior to the treatment and then a similar test was given at the conclusion of the study to measure the same things. Furthermore, participants were asked prior to and

after completion of the study to select, from multiple choice questions, the functions of an osteopathic physician. After participating in manipulation and attending a pre-recorded mini lecture, a posttest was used to determine new knowledge gained. There was no cronbach alpha performed in this study. The ‘outcomes’ designed for the evaluation of change in the alignment of those that participated in the study, were designed specifically for this study and have not been tested before.

Statistical Analysis

The pre and posttest answers were analyzed by comparing the percentage of questions answered correctly.

The forceplate data was analyzed via Chi-Square Goodness of Fit test to see if participants moved into any of the four outcome categories randomly or if the movement into outcomes was a result of manipulation. Bivariable Chi-Square tests and multivariable logistic regression modeling were used to evaluate the association between presence of lesion in a specific body region (ie, upper cervicals, lower cervicals, thoracic, etc.) and any of the outcomes one through four.

Summary

The methodology provided a detailed description of the procedures and related areas. This is important for those who read this study to understand the context for the investigation and for future researchers who may wish to replicate or build on the methodology in this study. The figures and tables help visualize the different positions of the participants during collection of data via the Isobalance forceplate. The proceeding chapters consist of the results (Chapter four), and a summary, conclusion, discussion, and recommendations (Chapter five).

CHAPTER IV

Results

The results of this study will be separated into three major categories. The first category which answers the first research question, provides the number of lesions found during the osteopathic structural evaluation. The purpose of the osteopathic structural evaluation, was to find trends in lesions found and body regions most frequently affected. The second category (addressing research questions two and three) makes the connection between OMM performed on an individual and structural change. This was done by monitoring CoP and postural sway via the use of the Isobalance forceplate (figure 18). The final category, 'knowledge gain,' examines the amount of material that was retained during the course of the study and answers the fourth research question. Knowledge gain was measured by comparing scores on a pretest and posttest distributed to participants in the study. The tests measured individuals' gain in knowledge of the principles of OMM and the basic importance of being actively involved with one's health. Listed below are the research questions:

Research Questions

1. To what extent will the introduction of OMM lead to reduction of somatic dysfunction of individuals in the study?
2. To what extent will OMM change the measured indicators of CoP and postural sway with the utilization of the Isobalance forceplate?
3. To what extent will a particular response (positive, negative, no change, variable change) be identified by the 'outcomes' designed in this study?

4. To what extent did participants gain knowledge and accept osteopathic medicine after viewing the instructional videos presented during the study?

Response Rate

At the initiation of the study surveys were distributed to 32 students and faculty eligible for the study. By the conclusion of the study at the fifth week, 26 surveys were distributed to the remaining individuals in the study. While 26 post tests were distributed, one participant who completed the study did not return a pretest or posttest and the TIC_Change 1 & 2 data was not taken for this individual. This identified individual missed part of the measuring on the forceplate settings and also left one session early without investigators' knowledge. This was found only at the conclusion of the study, when primary investigator reviewed the data (delay in data review was instituted in order to decrease selection bias). However, while pre and post test calculations and the TIC_Change 1 & 2 could not be made on this participant, the participant's data was included in the heel-to-toe and toe-to-heel data, along with the total count for SD lesion found per body region.

Demographic Data

Participants in the study included 24 males and 2 females. The average age of the participants was 25 – 26 years old. All participants were from Spanish-speaking countries and 77% of the individuals were from Central America. The participants were composed of first- through third-year students and two faculty members.

Findings

Osteopathic Manual Manipulation. Not all somatic dysfunctions (SD) result from a finding on the body that is amenable to manual therapy. Therefore, the particular areas of

the body that can exhibit SD and can also have OMM applied are called structural lesions. In order to tabulate these lesions correctly, a standard osteopathic structural evaluation was performed. Once found, lesions were tabulated in table 5 listed below. The average number of lesions found per manipulation setting decreased from week one to week five.

Table 1

Osteopathic Lesion

Manipulation weeks	Total # of SD found throughout the study	Average # of SD per person	Standard deviation
Week 1	37	2.74	0.90
Week 3	19	1.41	0.72
Week 5	23	1.70	0.59

The total number of SDs found throughout the study also decreased from week one to week five, as did the average number of SDs per person.

Of the 80 total somatic dysfunctions that were found during the course of this study from the 26 participants, 68% of these lesions were found in the thoracic vertebrae. The most common rotational dysfunction was a neutral component. In the thoracic vertebrae, the most common type of neutral lesion was a Right on Left (R on L) neutral lesion. The second most common rotational dysfunction that occurred in the thoracic region was Right on Right non-neutral lesion. The sacrum body region had the next highest number of SD lesions, at a total of 12%. The rotational component that occurred

most often at the level of the sacrum was Left on Left (L on L). The following body regions comprised the remaining somatic dysfunctions found: upper cervicals 8.7%, lower cervicals 6.2%, leg length 5.0%, and innominate with only 2.5%. There were no recorded lumbar lesions in this study.

Isobalance Forceplate results. The statistical analysis for each participant's percentage of time in the center and pressure on each of the four quadrants (left heel, left toe, right toe, and right heel; see figure 17) of the Isobalance Forceplate were plotted against a combination of weeks and sessions (ie, week 1 before OMM, week 1 after OMM, week 2 before OMM, etc.). A set of criteria called study 'outcomes' were designed and used to answer each research question three through five, and they are listed below:

1. Time in center change 1 (TIC Change 1): comparing pre-manipulation (week one) with post-manipulation (week five) and looking for the following responses: no change (NC), negative change (NEG), positive change (POS), and variable change (V) in the time spent in the center of the six-inch diameter circle on the forceplate (i.e. postural sway).
2. Time in center change 2 (TIC Change 2): at least two positive/negative/or no change data points on the forceplate readings during two manipulation sessions (example of three positive improvements post-manipulation: Appendix J).
3. Heel-to-toe change in quadrant pressure: a change in heel-to-toe pressure from start to finish of the study equaling CoP (example of right foot heel-to-toe change and left foot toe-to-heel change: Appendix K).

4. Toe-to-heel change in quadrant pressure: a change in toe-to-heel pressure from the first week to the final week of the study.

For the four outcomes listed above, two null hypotheses were stated and statistically tested.

1. Movement of the participants into any of the outcome categories was a totally random process. The statistical analysis used for this hypothesis was a Chi-Square Goodness of Fit test.
2. There was no association between presence of a lesion in a specific body region and any of the outcomes. This lack of association was tested using bivariable chi-square tests and multivariable logistic regression modeling. The no change (NC) category was used as the baseline of all outcomes.

Throughout the proceeding explanation of data, the above null hypotheses will be referred to as null hypothesis 1 (NH1) and null hypothesis 2 (NH2). NH1 was testing the response groups (positive, negative, no change, or variable) as they compared to the number of participants. Therefore, the results of NH1 answered the third research question. The next four tables demonstrate this by comparing response groups to the forceplate data collected from Time in the Center I and II (TIC_1 & TIC_II), heel-to-toe and toe-to-heel.

Table 2

Differences in TIC_Change 1 from week 1-6

TIC_Change1	Frequency	Percent
NC	9	36.00
NEG	7	28.00
POS	8	32.00
V	1	4.00

P value 0.1056

The data points show that from week one to week five in Table 2, the participants who had no change (NC), negative change (NEG), and positive change (POS) had little difference between them (the V = variable change). The manipulations that were performed did not prove to have an overall dependable pattern in one particular response. The responses varied to the degree that there was no significant relationship that could be deduced from the data. The greatest recurrence was NC in postural sway (Table 3).

Table 3

TIC_Change 2 no change data

TIC_Change 2	Frequency	Percent
NC	10	40.00
NEG	5	20.00
POS	5	20.00
V	5	20.00

P value 0.4318

The same conclusion can be drawn from the data of TIC_Change 2, even though there was a greater difference amongst NC and the other three responses, there was still no significance between the response data. Looking for two of any type of consistent significant change in the forceplate data as it relates to manipulation could be performed (outcome 2). The data in Table 4, demonstrates the results of change from pressure placed on the heel in the first week to pressure placed on the toe by the fifth week. Even though there was a change in pressure during the five total weeks of the study, the frequency was not enough to elicit any significant change.

Table 4

Significant change in Heel-to-Toe

Heel-to-Toe	Frequency	Percent
Changed	16	61.54
No Change	10	38.46

P value 0.3269

The data in Table 5, shows that no change was appreciated from toe-to-heel criteria. The NH1 was not disproved and is true with respect to using the Chi-Square Goodness of Fit test to show complete randomization of the persons who were manipulated and moving into any of the categories almost equally.

Table 5

Significant change in Toe-to-Heel

Toe-to-Heel	Frequency	Percent
Changed	13	50.00
No Change	13	50.00

P value	1.00
----------------	-------------

The data in Table 6, evaluated the number of participants who presented with or without SD lesions in particular body regions at least once during the course of the study. The participants had to have a palpable SD lesion that could have been manipulated via muscular energy or HVLA technique. Then the total number of individuals who had an upper cervical lesion (for example) would be placed in the lesion category, and those who did not were placed in the no lesion group. The percentage of those that had a specific lesion in a particular body region is also listed under the frequency category. The p values listed in the table are demonstrating the significance of an individual having a lesion verses not having a lesion. Some body regions had no lesions found during (ie. lumbar region) the study and other regions had lesions throughout the study (ie. thoracic region).

Table 6

Lesion in specific body regions

Body region		Frequency	Percent	P value
1.Upper cervicals	Lesion	6	23.08	0.01
	No lesion	20	76.92	
2.Lower cervicals	Lesion	4	15.38	5.33E-04
	No lesion	22	84.62	
3.Thoracic	Lesion	26	100	1.00
	No lesion	0		
4.Lumbar	Lesion	0		1.00
	No lesion	26	100	
5.Innominate	Lesion	2	7.69	1.049E-05
	No lesion	24	92.31	
6.Sacrum	Lesion	9	34.62	0.17
	No lesion	17	65.38	
7.Leg length	Lesion	2	7.69	1.049E-05
	No lesion	24	92.31	

Table 7, addresses research question two and NH2 with the utilization of a bivariable chi-square tests and multivariable logistic regression modeling. The bivariable analyses compared for example a specific body region to change noted by the forceplate. The bivariable tests measured each body region individually and compared it to each of the four outcome methods in order to determine change in indicators of postural sway measured by the Isobalance forceplate during the weeks involved in the study (i.e. if a sacral lesion was found then there would be a corresponding change in TIC_Change 1).

Table 7

TIC_Change 1 Sacrum

Body Region	Lesion vs	NC	NEG	POS	V	Total	P-value
	No lesion						
	Lesion	2	1	6	0	9	0.03
Sacrum	No Lesion	7	6	2	1	16	

There was a positive correlation between finding a sacral lesion and having a positive change in TIC_Change 1 (an increased amount of time spent in the 6 in. circle). Those who had sacral lesions at some point within the study had an improvement in postural sway. The table above is the only bivariable table listed here because out of the 27 bivariable data tables, the sacrum was the only body region that had a correlation with change in postural sway. The other bivariable data tables are located in the Table sections 9 – 36.

The results from the bivariable chi-squared analysis demonstrated that there was a correlation between change of postural sway and sacral dysfunctional lesions. Therefore,

the reference point used for the multivariable logistic regression modeling was the no change (NC) category. The sacral change was evaluated against all of the outcomes listed on pg 45. The NC was the baseline and was compared to POS and NEG change of TIC_Change1 & 2, and change in heel-to-toe and toe-to-heel. The TIC_Change 1 demonstrated that for those who had a sacral lesion there would be a movement of NC to the direction of POS change ($p \leq .04$). The odds ratios for these results showed 10.5 times likelihood if one had a sacral lesion to change from a NC to a POS in postural sway readings on the forceplate. There was no other statistically significant relationship with the other outcomes.

Pretest and posttest data. There were 26 participants in this study; however, only 25 participants responded to the pre and posttests. The participants answered a 20 question pretest before being exposed to the principles of OMM. The 20 questions included qualitative questions that dealt with the individuals' exposure to healthcare professionals and questions on how the participants manage health-related issues. After the exam, all participants were then eligible for participation in the study. During the following five weeks, the subjects were structurally evaluated and OMM was applied to the appropriate area. The informational video that covered basic fundamentals of osteopathic medicine (topics such as those mentioned in the review of literature) was presented while participants were manipulated. The video ran continuously during these sessions. At the conclusion of the study, a posttest was distributed to all participants to evaluate knowledge gained and changed ideals of healthcare.

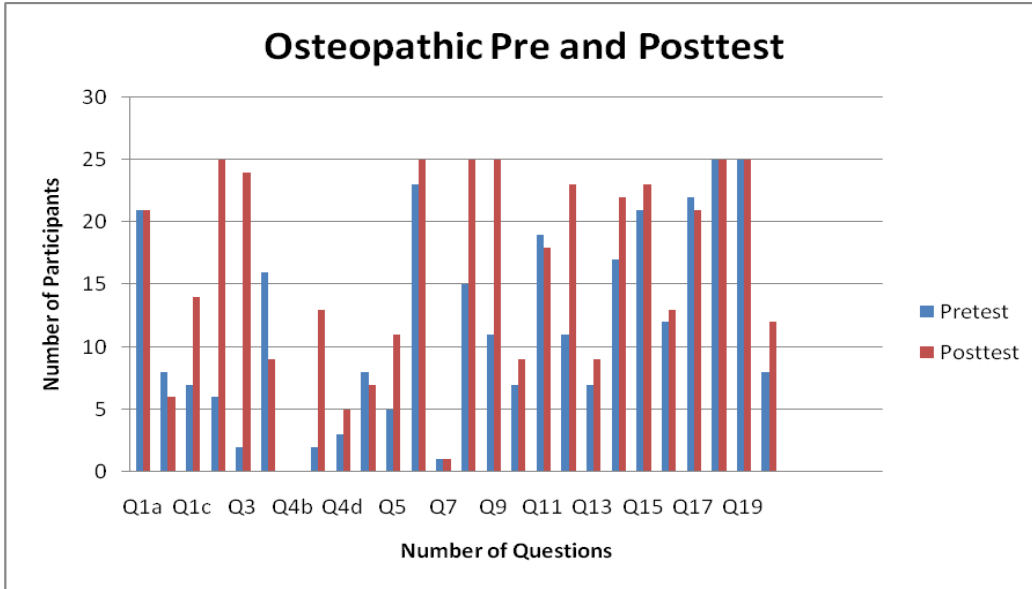


Figure 19. The above graph presents the number of questions on the pretest and posttest (x-axis). On the y-axis is the number of participants, along with the number of correct answers for those single best answer questions. The total number of person that answered the experience questions (view table 4 below) can also be found on the y-axis. The blue bars represent the pretest (before the presentation of the educational materials) and the red bars are indicative of the posttest results.

Figure 19, depicts all the answers from the pre and posttest. The questions utilized in this pretest and posttest were placed into six different categories as listed in Table 8.

Table 8

Types of questions

Type of questions	Question number	Total number questions
1) Single best answer	1, 5, 6, 7, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20	15
2) Questions showing a gain in knowledge	5, 6, 10, 12, 13, 14, 15, 16, 20	9
3) Questions answered incorrectly on the pretest or answered correctly on the pretest and incorrectly on the posttest	1, 11, 17	3
4) Multi-step questions	1, 4	2
5) Qualitative (experience) questions	2, 3, 4, 8, 9	5
6) Questions showing no change from pretest to posttest	7, 18, 19	3

Analyzing each category:

2) Single best answer:

Of the 20 total questions on the pre and posttest exam, there were a total of 15 questions that had only one correct answer. The pretest had an average of 14.5 ± 8.15 persons answering these questions correctly. After the presentation of the educational video and at the conclusion of the study, the average number of persons answering the single best answer questions correctly on the posttest was 16.9 ± 7.90 . This increase demonstrates an overall gain of knowledge. (Appendix L).

3) Questions showing a gain in knowledge:

There were a total of nine questions that demonstrated an improvement in correct answers from pretest to posttest. Question 12, "One of the osteopathic philosophies is that the body has the innate ability to heal itself given the body is free from dysfunction (homeostasis)," showed the most improvement among these nine questions (Appendix M)..

4) Questions answered incorrectly on the pretest or answered correctly on the pretest and subsequently answered incorrectly on the posttest:

There were only 3 questions that fell into this category. Question one was a multi-step question, "Which of these are components of holistic healthcare?" There was some gain in knowledge for mental health; however, there were fewer correct responses from pretest to posttest concerning spiritual health and there was no change regarding physical health. For the other two questions in this category (11, & 17), there was a slight decrease in correct responses given from pre to posttest.

For each question, 11 & 17 there was a decrease in one response from the start of the study to its conclusion (Appendix N).

5) Multi-step:

There were two multistep questions. As mentioned above, question one has only one single best answer. Question four is the other multi-step question and it falls within the experience group of questions.

6) Qualitative (experience) questions:

This group of questions could also be called the experience group of question.

This category had the most variations in results. The reasoning behind these variations will be further discussed in chapter five. There were no true single best answers to any of these questions.

7) No change from pretest to posttest:

This last category of questions were all single best answer questions that demonstrated no change from the start of the program to its conclusion in results.

Summary

The overall designs of the data collection tools enabled the study to address the research questions and null hypotheses. Information gathered from the pre and posttests demonstrated that there was knowledge gained, improvement of overall understanding of appropriate personal healthcare, and acceptance of OMM by the individuals tested. The osteopathic manipulation techniques demonstrated there was a decrease in SD lesions collectively among those in the study. Utilizing the selected outcomes in the study, the NH2 was not accepted because of the sacral rotational dysfunction and its correlation with postural sway change. However, the NH1 was accepted. There are many

possibilities that may explain why this study did not have the improvement in understanding of material anticipated by the primary investigator, as well as greater OMM correlations with postural change. Chapter five will give a summary of this pilot study and appropriately address the problems in the design and execution of the project.

CHAPTER V

*Summary, Conclusion, & Recommendations**Summary*

The purpose of this study was to assess the impact of educating an unexposed population to basic principles of osteopathic medicine, and then treating SD with the use of OMM and measuring balance changes on an Isobalance forceplate. The Project Investigator decided to attempt to increase the knowledge of this form of medical practice among a subpopulation in Central America because of the need for an alternative form of treatment of musculoskeletal pain. Furthermore, addressing the cause of pain, such as asymmetrical change due to the stresses cause by ADLs in such a mountainous territory, yielded the perfect opportunity to not only evaluate but also measure structural change following OMM on this population.

The Isobalance forceplate measures CoP and postural sway. The utilization of this particular machine for the measure of structural changes that occur during a manipulative session has not been performed before. However, the machine is built to measure the most minute changes in balance and pressure placed on the toes or heels of the feet. If there is to be a structural change made by OMM, the Isobalance forceplate will read this discrepancy as an imbalance and compare measurements to a preset reference point. The changes that were induced in each individual by manipulation and recorded by the forceplate help lead to the quantification of structural change.

Osteopathic medical practitioners take special interest in effecting change and encouraging healthier lifestyles of rural population and underserved areas in the primary care. The population chosen for this study fits into the group assessed in this project.

There was no bias in this study due to previous exposure to OMM as the population was unfamiliar with this practice. Not all abnormalities or deviations from symmetry found on the body are correctable by osteopathic manipulation. We used the term lesion to describe the structural abnormalities that could be treated by OMM. As discussed in the introduction we used the acronym T-A-R-T to help identify dysfunctions that could be manipulated and were found during the osteopathic structural examination. There are two types of dysfunctions, Type I and Type II, and these lesions were addressed with either HVLA and/or muscle energy manipulative techniques. Once the appropriate technique(s) were applied, a reassessment was performed to evaluate the structural improvement.

Previous studies of postural imbalance have been performed utilizing different types of single and dual panel forceplate machines; however, there has not been a correlation made between quantifiable asymmetrical change and correction with OMM. Of all the following areas - cervical, thoracic, lumbar, innominate, sacrum, and leg length - individuals who had sacrum lesions demonstrated improvements in postural sway (time spent in the 6 inch circle) on the forceplate ($p \leq .04$).

The individuals in this study were their own controls, and on each follow-up session before manipulation, a measurement was taken on the forceplate. This was done to test for normalization of the body to previous dysfunction prior to OMM, as well as duration of manipulation performed. Once measurements were taken, the person was manipulated and measured again for comparison of forceplate change. It was found that those who initially had no change in postural sway would develop improvements in postural sway if they had a sacral lesion ($p \leq .04$).

The education component was a video that taught basic osteopathic principles and techniques. A gain in knowledge from the video was tested by pretest and posttest answers. There was an overall increase in the number of questions answered correctly, indicating a gain in knowledge throughout the course of the study.

Conclusion

Pretest and Posttest. Of the 20 questions in the pre and posttest, 15 questions had a single best answer. The increase in correct responses to nine of these single-best-answer questions can be attributed to exposure to osteopathic principles via the video, as well as participation in the project itself. Furthermore, the range of question styles - including multiple choice, multiple answer, and true or false questions - limited the inclination to guess on each question, thereby ensuring the validity of results. In the following qualitative/experience-based questions listed below, which measure perceptions of doctor-patient relationships, there was a 38% increase in yes responses.

3. Has the doctor you visited (if you have a regular doctor) ever asked you how things are going at home or at school?

- a. Yes
- b. No

8. Do you feel your doctor communicates well with you and makes sure you understand what you can do to help yourself?

- a. Yes
- b. No

9. Does your doctor or one you have visited before explained to you what to do so you can protect yourself from future related problems?

- a. Yes
- b. No

Furthermore, by the conclusion of the study there was 96% agreement that OMM would be accepted in the participant's communities if available. There was an increase in the number of questions answered correctly on the posttest as compared to the responses on the pretest. However, since the instruments/records were not coded to track individuals and comparing individual improvement. Thus, the significance was inconclusive because instrument coding was not sufficient to track and determine results. Therefore, the following hypothesis one and two (listed below) cannot be determined with the appropriate level of statistical verification:

Hypothesis 1:

Posttest scores will be higher than pretest scores on knowledge of osteopathic medicine after participants receive educational materials on OMM.

Hypothesis 2:

Posttest scores will be higher than pretest on acceptance of OMM among participants.

Osteopathic manipulation. Regular corrections in manipulative lesions with education on what to do to decrease one's chances of injuring him or herself will lead to fewer lesions over time in the population studied. When exposing a new population to manipulation, the tendency for the body to want to revert back to its former disposition without continual conscious awareness of posturing will lead to reoccurring lesions or development of new compensatory SD.

Forceplate data analysis. Of the four different outcomes as mentioned in Chapter IV under ‘Isobalance Forceplate Results’ the TIC data (postural sway) is the only outcome that proves to have statistical significance. Only those individuals who have sacral lesions will demonstrate improvements in the amount of time spent in the six-inch circle.

Therefore, we can infer that the most important segment that needs to be manipulated to enhance balance is the sacral pelvic component to be correct in the sacral region. As a result, Hypothesis 3 is accepted.

Hypothesis 3:

Posttest forceplate calculations of parameters of balance compared with pretest following OMM will show decreased postural sway, yielding to a decrease in body movement on the forceplate is proven to be correct in the segment of the sacral region.

Hypothesis number four (stated below) could not be accepted in this study because there was no relationship in tandem stance improvement in CoP as it relates to certain areas of pressure on the feet.

Hypothesis 4

Posttest compared to pretest center of pressure (weight distribution) placed on the forefoot or hind foot during tandem stance will increase, thus show improvement of somatic dysfunction following OMM.

Research hypothesis number five (listed below) was accepted because there was a significant decrease noted in the number of somatic dysfunctions found from week one to week five.

Hypothesis 5:

Somatic dysfunction measurement will decrease between week one to week five OMM treatment, thus showing improvement.

Recommendations

Recommendation for Future Research. Designing a project that examines the effectiveness of OMM on the body is not very complicated and in fact has been performed multiple times in past studies. However, this study was unique in that it recorded the qualitative component and applied an additional quantitative component instead. There are four major parts to the project that make it revolutionary. The four components are: 1) presenting and testing foreign information to an unexposed audience, 2) drawing correlations between postural sway and CoP to an individual's post-manipulative state, 3) charting somatic dysfunctions that have manipulative components and looking for trends throughout a course of time, and lastly 4) evaluating acceptance of manipulation as a practice of medicine by an unexposed population.

The translation process of osteopathic terminology was the first major struggle that was encountered in preparation of educating the participant's involved in the study. Some words that are used in osteopathic medicine do not translate word for word in the Spanish language; therefore, learning new theories and terminology was required to fully understand the science behind manipulation. In future studies of foreign populations it is recommended that education occur not only verbally but visually as well. Learning the anatomical parts of the body, along with terminology and hands-on medicine was a new experience for the study participants.

Retrospectively evaluating the design of this study, there are areas that could have increased the effectiveness and validity of the results obtained in the study. The pretest and posttest did not have personal identifiers. This presented a major problem when trying to see if any of the information obtained from the pre and posttest was statistically significant. Without having personal identifiers in the study there were no tests that could be used to yield a p-value. The only data that could be deduced from the answers of the test were improvement in selected correct answers leading to a percentage of overall increase in selected answers, answered correctly by the group. This is a limitation because comparing a single individual's pretest with his or her posttest could not be performed. Furthermore, there was one individual who was a part of the study who did not take the pretest or posttest. There were a total of 26 persons in the study but only 25 participated in the written exams. The same individual also was missing some data from the forceplate measurements. The postural sway (TIC) data was missing from one individual yielding to a total of only 25 individuals, while the CoP data had all 26 participants involved in the study.

Listed below are additional recommendations that could help the next researcher who attempts a similar study.

1. Include a larger sample size and a population that is not just a convenient population.
2. Examine a population with more chronic issues but within the same age ranges.
3. Allow for longer courses of treatment that span months as opposed to weeks.

4. Develop more pretest and posttest questions that are worded differently to better test knowledge gained and understanding of new terms used.
5. Educate individuals who are native to the region about manipulation so that communication is not compromised by language barriers, limiting the chances of missing information.
6. Make a clear distinction between manipulation, stretching, and learned procedure in future studies. A clear delineation of these three will help further validate osteopathic medicine as an accepted science among non-osteopathic physicians (those that do not practice manipulation due to a more definite science to the manual manipulation with numbers, instead statement just as 'I feel much better').

Recommendation for Practice. As this particular study was one of the first of its kind there are further modifications of the design of the current study that will lead to a more reliable study in the future. The outcomes that were used to interpret a successful treatment are criteria that were formed specifically for this project. There are no current non-clinical guidelines for quantifying manipulations as successes or failures. Qualitative clinical measurements are the accepted norm for OMM. However, a more objective and reproducible measurement is needed to quantify the effect of OMM for inclusion in the literature of evidence-based medicine.

1. Have multiple physicians with their own subpopulations and see if results are similar with the utilization of the same measuring device.
2. Identify a device that best evaluates the changes witnessed by examiner that will yield quantitative results.

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TABLES

Table 9

Defining T.A.R.T

	<i>Acute</i>	<i>Chronic</i>
Temperature	Increased	Slight increase or decrease (coolness)
Texture	Boggy, more rough	Thin, smooth
Moisture	Increased	Dry
Tension	Increased, rigid, board-like	Slight increase, ropy, stringy
Tenderness	Greatest	Present, but less
Edema	Yes	No
Erythema test (red reflex)	Redness lasts	Redness fades quickly or blanching occurs

Note: Gives the findings that are present on palpation of someone with an acute or chronic injury. *An Osteopathic Approach to Diagnosis and Treatment* 2003, pp. 8.

Table 10

Schedule of project events

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			<i>January</i> 30	31	<i>February</i> 1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	<i>March</i> 1
2	3	4	5	6	7	8
9	10	11	12	13	14	15

Note: The table represents the schedule followed during the research in Tegucigalpa, Honduras.

Blue-grey coloring = represents the times that participants were not receiving OMM or being evaluated on the Isobalance forceplate.

Yellow coloring = represents the introduction of the study, distribution and collection of informed consents, distribution of access codes for the pretest.

Green coloring = indicates the scheduled forceplate measurements, osteopathic structural evaluation and treatment, and repeat measurements after OMM has been performed.

White coloring = these dates represent off weeks from any obligation to the study.

Table 11

TIC_Change 1 Uppercervicals

Body Region	Lesion vs	NC	NEG	POS	V	Total	P-value
	No lesion						
	Lesion	3	1	2	0	6	0.88
Uppercervicals	No Lesion	6	6	6	1	19	

Note: NC = no change in postural sway on the forceplate. NEG = Negative change in postural sway on the forceplate. POS = Positive change in postural sway on the forceplate. V = Variable change in postural sway on the forceplate.

Table 12

TIC_Change 1Lowercervicals

Body Region	Lesion vs	NC	NEG	POS	V	Total	P-value
	No lesion						
	Lesion	1	1	2	0	4	0.84
Lowercervicals	No Lesion	8	6	6	1	21	

Note: NC = no change in postural sway on the forceplate. NEG = Negative change in postural sway on the forceplate. POS = Positive change in postural sway on the forceplate. V = Variable change in postural sway on the forceplate.

Table 13

TIC_Change1 Thorasic

Body Region	Lesion vs	NC	NEG	POS	V	Total	P-value
	No lesion						
	Lesion	9	7	8	1	25	None
Thorasic	No Lesion						

Note: NC = no change in postural sway on the forceplate. NEG = Negative change in postural sway on the forceplate. POS = Positive change in postural sway on the forceplate. V = Variable change in postural sway on the forceplate.

Table 14

TIC_Change 1 Lumbar

Body Region	Lesion vs	NC	NEG	POS	V	Total	P-value
	No lesion						
	Lesion						None
Lumbar	No Lesion	9	7	8	1	25	

Note: NC = no change in postural sway on the forceplate. NEG = Negative change in postural sway on the forceplate. POS = Positive change in postural sway on the forceplate. V = Variable change in postural sway on the forceplate.

Table 15

TIC_Change 1 Innominate

Body Region	Lesion vs	NC	NEG	POS	V	Total	P-value
	No lesion						
	Lesion	1	1	0	0	2	0.76
Innominate	No Lesion	8	6	8	1	23	

Note: NC = no change in postural sway on the forceplate. NEG = Negative change in postural sway on the forceplate. POS = Positive change in postural sway on the forceplate. V = Variable change in postural sway on the forceplate.

Table 16

TIC_Change 1 Leglength

Body Region	Lesion vs	NC	NEG	POS	V	Total	P-value
	No lesion						
	Lesion	1	1	0	0	2	0.76
Leglength	No Lesion	8	6	8	1	23	

Note: NC = no change in postural sway on the forceplate. NEG = Negative change in postural sway on the forceplate. POS = Positive change in postural sway on the forceplate. V = Variable change in postural sway on the forceplate.

Table 17

TIC_Change 2 Uppercervicals

Body Region	Lesion vs	NC	NEG	POS	V	Total	P-value
	No lesion						
	Lesion	2	1	2	1	6	0.92
Uppercervicals	No Lesion	8	4	3	4	19	

Note: NC = no change in postural sway on the forceplate. NEG = Negative change in postural sway on the forceplate. POS = Positive change in postural sway on the forceplate. V = Variable change in postural sway on the forceplate.

Table 18

TIC_Change 2 Lowercervicals

Body Region	Lesion vs	NC	NEG	POS	V	Total	P-value
	No lesion						
	Lesion	1	0	2	1	4	0.63
Lowercervicals	No Lesion	9	5	3	4	21	

Note: NC = no change in postural sway on the forceplate. NEG = Negative change in postural sway on the forceplate. POS = Positive change in postural sway on the forceplate. V = Variable change in postural sway on the forceplate.

Table 19

TIC_Change 2 Thoracic

Body Region	Lesion vs	NC	NEG	POS	V	Total	P-value
	No lesion						
	Lesion	10	5	5	5	25	None
Thoracic	No Lesion						

Note: NC = no change in postural sway on the forceplate. NEG = Negative change in postural sway on the forceplate. POS = Positive change in postural sway on the forceplate. V = Variable change in postural sway on the forceplate.

Table 20

TIC_Change 2 Lumbar

Body Region	Lesion vs	NC	NEG	POS	V	Total	P-value
	No lesion						
	Lesion						None
Lumbar	No Lesion	10	5	5	5	25	

Note: NC = no change in postural sway on the forceplate. NEG = Negative change in postural sway on the forceplate. POS = Positive change in postural sway on the forceplate. V = Variable change in postural sway on the forceplate.

Table 21

TIC_Change 2 Innominate

Body Region	Lesion vs	NC	NEG	POS	V	Total	P-value
	No lesion						
	Lesion	0	1	0	1	2	0.50
Innomance	No Lesion	10	4	5	4	23	

Note: NC = no change in postural sway on the forceplate. NEG = Negative change in postural sway on the forceplate. POS = Positive change in postural sway on the forceplate. V = Variable change in postural sway on the forceplate.

Table 22

TIC_Change 2 Sacrum

Body Region	Lesion vs	NC	NEG	POS	V	Total	P-value
	No lesion						
	Lesion	2	1	3	3	9	0.34
Sacrum	No Lesion	8	4	2	2	16	

Note: NC = no change in postural sway on the forceplate. NEG = Negative change in postural sway on the forceplate. POS = Positive change in postural sway on the forceplate. V = Variable change in postural sway on the forceplate.

Table 23

TIC_Change 2 Leglength

Body Region	Lesion vs	NC	NEG	POS	V	Total	P-value
	No lesion						
	Lesion	0	1	0	1	2	0.50
Leglength	No Lesion	10	4	5	4	23	

Note: NC = no change in postural sway on the forceplate. NEG = Negative change in postural sway on the forceplate. POS = Positive change in postural sway on the forceplate. V = Variable change in postural sway on the forceplate.

Table 24

Heel-to-Toe Uppercervicals

Body Region	Lesion vs	Change	No	Total	P-value
	No lesion		Change		
	Lesion	4	2	6	1.00
Uppercervicals	No Lesion	12	8	20	

Note: Change = change seen from CoP on heel-to-toe. No change = no change seen from CoP on heel-to-toe. Data collected via outcome criteria.

Table 25

Heel-t-Toe Lowercervicals

Body Region	Lesion vs	Change	No	Total	P-value
	No lesion		Change		
	Lesion	3	1	4	0.36
Lowercervicals	No Lesion	13	9	22	

Note: Change = change seen from CoP on heel-to-toe. No change = no change seen from CoP on heel-to-toe. Data collected via outcome criteria.

Table 26

Heel-to-Toe Thorasic

Body Region	Lesion vs	Change	No	Total	P-value
	No lesion		Change		
	Lesion	16	10	26	None
Thorasic	No Lesion				

Note: Change = change seen from CoP on heel-to-toe. No change = no change seen from CoP on heel-to-toe. Data collected via outcome criteria.

Table 27

Heel-to-Toe Lumbar

Body Region	Lesion vs	Change	No	Total	P-value
	No lesion		Change		
	Lesion				None
Lumbar	No Lesion	16	10	26	

Note: Change = change seen from CoP on heel-to-toe. No change = no change seen from CoP on heel-to-toe. Data collected via outcome criteria.

Table 28

Heel-to-Toe

Body Region	Lesion vs	Change	No	Total	P-value
	No lesion		Change		
	Lesion	2	0	2	0.51
Innominate	No Lesion	14	10	24	

Note: Change = change seen from CoP on heel-to-toe. No change = no change seen from CoP on heel-to-toe. Data collected via outcome criteria.

Table 29

Heel-to-Toe Sacrum

Body Region	Lesion vs	Change	No	Total	P-value
	No lesion		Change		
	Lesion	7	2	9	0.40
Sacrum	No Lesion	9	8	17	

Note: Change = change seen from CoP on heel-to-toe. No change = no change seen from CoP on heel-to-toe. Data collected via outcome criteria.

Table 30

Heel-to-Toe Leglength

Body Region	Lesion vs	Change	No	Total	P-value
	No lesion		Change		
	Lesion	2	0	2	0.51
Leglength	No Lesion	14	10	24	

Note: Change = change seen from CoP on heel-to-toe. No change = no change seen from CoP on heel-to-toe. Data collected via outcome criteria.

Table 31

Toe-to-Heel Uppercervicals

Body Region	Lesion vs	Change	No	Total	P-value
	No lesion		Change		
	Lesion	2	4	6	0.64
Uppercervicals	No Lesion	11	9	20	

Note: Change = change seen from CoP on heel-to-toe. No change = no change seen from CoP on heel-to-toe. Data collected via outcome criteria.

Table 32

Toe-to-Heel Lowercervicals

Body Region	Lesion vs	Change	No	Total	P-value
	No lesion		Change		
	Lesion	1	3	4	0.59
Lowercervicals	No Lesion	12	10	22	

Note: Change = change seen from CoP on heel-to-toe. No change = no change seen from CoP on heel-to-toe. Data collected via outcome criteria.

Table 33

Toe-to-Heel Thorasic

Body Region	Lesion vs	Change	No	Total	P-value
	No lesion		Change		
	Lesion	13	13	26	None
Thorasic	No Lesion				

Note: Change = change seen from CoP on heel-to-toe. No change = no change seen from CoP on heel-to-toe. Data collected via outcome criteria.

Table 34

Toe-to-Heel Lumbar

Body Region	Lesion vs	Change	No	Total	P-value
	No lesion		Change		
	Lesion				None
Lumbar	No Lesion	13	13	26	

Note: Change = change seen from CoP on heel-to-toe. No change = no change seen from CoP on heel-to-toe. Data collected via outcome criteria.

Table 35

Toe-to-Heel Innominate

Body Region	Lesion vs	Change	No	Total	P-value
	No lesion		Change		
	Lesion	1	1	2	1.00
Innominate	No Lesion	12	12	24	

Note: Change = change seen from CoP on heel-to-toe. No change = no change seen from CoP on heel-to-toe. Data collected via outcome criteria.

Table 36

Toe-to-Heel Sacrum

Body Region	Lesion vs	Change	No	Total	P-value
	No lesion		Change		
	Lesion	5	4	9	1.00
Sacrum	No Lesion	8	9	17	

Note: Change = change seen from CoP on heel-to-toe. No change = no change seen from CoP on heel-to-toe. Data collected via outcome criteria.

Table 37

Toe-to Heel Leglength

Body Region	Lesion vs	Change	No	Total	P-value
	No lesion		Change		
	Lesion	1	1	2	1.0
Leg length	No Lesion	12	12	24	

Note: Change = change seen from CoP on heel-to-toe. No change = no change seen from CoP on heel-to-toe. Data collected via outcome criteria.

Appendix A

Definition of Terms

Anatomic barrier: the position to which a joint can be moved without injury: if moved beyond this point, will lead to disruption of tissue and bony structures (DiGiovanna & Schiowitz, 1997, p. 86-87).

Baroreceptors: Receptors that detect pressure of blood flow and send messages to the central nervous system to increase or decrease the peripheral resistance and cardiac output (Patterson & Wurster, 2003, p.128-129).

Center of Pressure: this term is synonymous with time in center (TIC) and represents the pressure experienced over a specific amount of time spent in a six inch radius on the forceplate machine.

Facilitating force: a compression force on a particular area. This compression of the muscle results in relaxation (Schiowitz et al., 2003, p.1017-1025).

Fight or flight response: the sympathetic nervous system's response to an outside stimulus that frightens or stresses the human body (Tortora & Grabowski, 2003, p.577-578).

Gamma motor neurons: Neurons that carry messages from the brain to the muscle spindles. These neurons are located in contractile skeletal muscle fibers (DiGiovanna & Schiowitz, 1997, p. 23, 25).

Holistic: involving the mind, body, and spirit (Martinke & Dowling, 1997, p. 4-7)

Homeostasis: an open or closed system in the living body in which a constant or stable condition is maintained (Willard, 2003, p. 150-153).

Involuntary nervous system: A response or responses to a stimulus that are not under the control of the individual (Willard, 2003, p. 90-119).

Leg length discrepancy: A condition in which one leg is shorter than the other, whether anatomically or functionally (DiGiovanna & Schiowitz, 1997, p. 210-211).

Mastoid process: the bony structure that is located lateral to the foramen magnum, to which is attached the sternocleidomastoid muscle (Anderson et al., 2002, p. 1056).

Muscle spindle: A structure that is innervated by sensory and motor neurons. The function is to send proprioceptive information about the muscle to the central nervous system, which responds to stress (DiGiovanna & Schiowitz, 1997, p. 24-26).

Musculoskeletal system: the part of the body that consists of bones and the muscles that attach to them (Wells, 2003, p.75-78).

Nervous system: A system composed of the brain and the spinal column. This system functions to relay sensory and motor information that comes from the body and the outside environment (Tortora, & Grabowski, 2003, p. 385-418).

Osteopathic medicine: A field of medicine which recognizes the impact of the neuromusculoskeletal system on an individual's health. Emphasis is placed on the complex interplay between this system and the viscera under the influence of various environmental factors and disease processes (DiGiovanna & Schiowitz, 1997, p. 1-2).

Palpation: the practice of touching the body in order to feel changes in the muscles or skeletal system (DiGiovanna & Schiowitz, 1997, p. 44-46).

Physiologic barrier: the point to which a patient can actively move a joint; its functional limit. Passive motion to the anatomical barrier is still present (Ward, 2003, p. 1232).

Prolotherapy: injection of a sugar water combination into ligaments that are too lax, to help strengthen the ligament via remodeling (Scott et al, 2003, p.497-498).

Protocol of consultation: formal guideline given in the setting of a meeting (Kelso, & Rubin, 2003, p. 1171).

Reciprocal inhibition: contraction of agonist muscle that will result in relaxation of antagonistic musculature (Enrenfeuchter, & Sandhouse, 2003, p. 883, 917).

Restrictive barrier: the limitation of the range of motion that is due to the dysfunctional process impeding motion of a joint of tissue in a specific direction. This is the barrier that osteopathic physicians move through in order to restore physiologic ROM (DiGiovanna & Schiowitz, 1997, p. 8-10).

Somatic dysfunction: impaired or altered function of related components of the somatic (body framework) system: skeletal, arthrodiar, myofascial, vascular, lymphatic, and neural elements (Jones, 2003, p. 1153-1161).

Spinous process: The bony process that is felt in the midline of the back on the spine (Hoppenfeld, 2003, p.108-109).

Tandem stance: when an individual stands on both feet at same time (DiGiovanna & Schiowitz, 1997, p. 239-240).

Tension membranes: these are ligamentous structures in the cranial vault, such as the falx cerebelli, falx cerebri, and tentorium (DiGiovanna & Schiowitz, 1997, 65-66, 71-72).

Time in center: analysis of data by comparing +/- or no change, in time spent in six-inch circle on the Isobalance forceplate.

Visceral organs: organs that are located inside the body. Dysfunctions with these organs can result in tissue changes, discernable upon palpation (Patterson, & Wurster, 2003, 127-128).

Voluntary nervous system: the part of the nervous system (brain and spinal cord) over which the individual has full control. This is in contrast to elements of the involuntary system, such as the heartbeat (Tortora, & Grabowski, 2003, p. 385-418).

Appendix B

Pre questionnaire

1. What components does healthcare cover (check all that apply):
 - 1 Physical health
 - 2 Spiritual Health
 - 3 Mental Health
2. Do you have a doctor that you visit on a regular basis:
 - 1 Yes
 - 2 No
3. Has the doctor you visited (or if you have a regular doctor) ever asked you how things are going at home or at school?
 - 1 Yes
 - 2 No
4. When you have aches and pains, what form/s of treatment do you use?
 - 1 Pill
 - 2 Surgery
 - 3 Manual Medicine
 - 4 Home remedies
 - 5 No treatment as long as you can still function without too much pain.
5. What is an osteopathic doctor?
 - 1 One who does manipulations only
 - 2 A bone doctor or specialist
 - 3 The same as an Allopathic doctor or M.D.
 - 4 A chiropractor
 - 5 A combination of an M.D. and a chiropractor

- 6 None of the above
6. Is it necessary to visit your doctor for check-ups if there is nothing wrong?
 - 1 Yes
 - 2 No
7. What is the major difference between an osteopathic physicians and Chiropractors?
 - 1 Only one can perform manipulations
 - 2 Osteopathic doctors can prescribe medicine like Chiropractors
 - 3 Osteopathic doctors go to medical school
 - 4 Chiropractors can perform surgeries
 - 5 No they are the same
8. Do you feel your doctor communicates well with you and makes sure you understand what you can do to help yourself?
 - 1 Yes
 - 2 No
9. Does your doctor or one you have visited before explained to you what to do so you can protect yourself from future related problems?
 - 1 Yes
 - 2 No
10. What are activities of daily living?
 - 1 Running 3 times a week to improve your health
 - 2 Working-out in a gym to build stronger muscles
 - 3 Activities in which you participate in during the day
 - 4 Only the parts of the day that you are walking around
11. Do osteopathic doctors only use manipulations (cracking bones) to treat patients?

1 Yes

2 No

12. Can the body heal itself?

1 Yes

2 No

13. What does the term Somatic Dysfunction mean to you:

1 Tenderness in the muscle along with some swelling

2 Abnormal posture that causes you to have scoliosis, tenderness of the back

3 Having a range of motion that is greater than normal

4 Warm muscle, painful joint, and asymmetry

5 Tenderness, asymmetry, range of motion, and tissue texture changes.

14. Which technique allows you to thrust through the barrier?

1 Direct technique

2 Indirect technique

15. When treating the nervous system can you affect the internal structures?

1 True

2 False

16. What is viserosomatic pain?

1 Pain of the muscles to the internal organs

2 Internal organs causing pain on the external organs

17. Can internal structures cause pain on the skin?

1 Yes

2 No

18. Is stretching important in musculoskeletal health?

1 Yes

2 No

19. Can having one leg longer than the other cause pelvic pain and rotation of the hips?

1 Yes

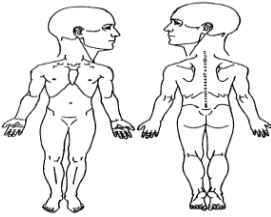
2 No

20. Is it safe for babies to receive manipulation of the head and neck?

1 Yes

2 No

21. In what area to you have the most musculoskeletal pain?



22. Do you feel that OMM will be accepted in your community?

1 Yes

2 No

TRANSLATED VERSION:

Pre cuestionario:

1. ¿Qué áreas cubre su servicio médico? (cheque todo lo que se aplica):

1 Salud física

2 Salud espiritual

3 Salud mental

2. ¿Tiene usted un doctor que visita regularmente?:

1 Sí

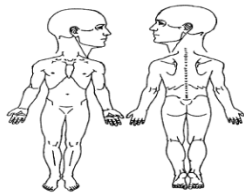
2 No

3. El doctor que usted visitó, ¿le ha preguntado alguna vez cómo le va en la escuela o en casa?

1 Sí

- 2 No
4. Cuando usted tiene dolores, ¿qué tratamiento utiliza?
- 1 Píldora
 - 2 Cirugía
 - 3 Medicina manual
 - 4 Remedios caseros
 - 5 Ningún tratamiento mientras pueda funcionar sin demasiado dolor.
5. ¿Qué es doctor osteopathic?
- 1 Uno quién hace manipulaciones solamente
 - 2 Un doctor o un especialista de hueso
 - 3 Igual que un doctor de Allopathic o un M.D.
 - 4 Un chiropractor
 - 5 Una combinación de un M.D. y un quiropráctico
 - 6 Ninguno de estos
6. ¿Es necesario visitar a su doctor para chequearse si no tiene nada malo?
- 1 Sí
 - 2 No
7. ¿Cuál es la diferencia principal entre Médicos y quiroprácticos de osteopathic?
- 1 Solamente uno que puede realizar manipulaciones
 - 2 Los doctores de osteopathic pueden prescribir la medicina como quiroprácticos.
 - 3 Los doctores de osteopathic van a la escuela médica.
 - 4 Los quiroprácticos pueden realizar cirugías.
 - 5 Ningún son iguales.
8. ¿Le parece que su doctor se comunica bien con usted y se cerciora que usted entendió lo que usted puede hacer para ayudarse a usted mismo?
- 1 Sí
 - 2 No
9. ¿Su doctor le ha explicado lo que tiene que hacer para protegerse de su problema y de futuros problemas?
- 1 Sí
 - 2 No
10. ¿Qué actividades diariamente hace usted?
- 1 Corriendo- 3 veces a la semana para mejorar su salud
 - 2 Hacer ejercicios en un gym para hacer los músculos más fuertes
 - 3 Actividades durante todo el día
 - 4 Solamente durante el día cuando hago mi rutina diaria
11. Los doctores de osteopathic son los únicos que usan manipulaciones de huesos para tratar a los pacientes?

- 1 Sí
2 No
12. ¿Puede el cuerpo curarse a si mismo?
- 1 Sí
2 No
13. ¿Qué significa el termino somático de la disfunción ?
- 1 sensibilidad en el músculo junto con un hinchazón
2 Postura anormal que le hace tener escoliosis, sencibilidad en la espalda
3 Tener una capacidad de movimiento que es mejor de lo normal
4 gusano que penetra el músculo, articulación doloroso, y asimetría
5 sensibilidad, la asimetría, la capacidad de movimiento, y la textura de la piel cambia.
14. ¿Qué técnica permite que usted empuje a través de la barrera?
- 1 Técnica directa
2 Técnica indirecta
15. Cuando uno trata el sistema nervioso, ¿ puede usted afectar las estructuras internas?
- 1 Verdad
2 Falso
16. ¿Qué es dolor viserosomático?
- 1 Dolor de los músculos a los órganos internos
2 Órganos internos que causan dolor en los órganos externos
17. ¿Pueden las estructuras internas causar dolor en la piel?
- 1 Sí
2 No
18. ¿Es el estirarse importante en la salud musculoesquelético?
- 1 Sí
2 No
19. Tener una pierna más larga que la otra, ¿ puede causar dolor en el área pélvica y la rotación de las caderas?
- 1 Sí
2 No
20. ¿Es prudente que los bebés reciban la manipulación de la cabeza y del cuello?
- 1 Sí
2 No
21. ¿En qué área tiene usted la mayoría de los dolores musculoesquelético?



22. ¿ siente usted que OMM será aceptado en su comunidad?

- 1 Sí
- 3 No

Appendix C

Post questionnaire

1. Which one of these are components of holistic healthcare? (check all that apply):
 - a. Physical health
 - b. Spiritual Health
 - c. Mental Health
2. Is it important to visit a doctor regularly?
 - a. Yes
 - b. No
3. Is social health an important component to the osteopathic practice of medicine?
 - a. Yes
 - b. No
4. Which would be your choice of treatment when dealing with aches and pains that interrupt your activities of daily living?
 - a. Pill
 - b. Surgery
 - c. Manual Medicine
 - d. Home remedies
 - e. No treatment as long as you can still function without too much pain.
5. What is an osteopathic doctor?
 - a. One who does manipulations only
 - b. A bone doctor or specialist
 - c. The same as an Allopathic doctor or M.D.
 - d. A chiropractor
 - e. A combination of an M.D. and a chiropractor

- f. None of the above
6. Having annual follow-ups are important for health maintenance.
 - a. Yes
 - b. No
 7. What is the major difference between osteopathic physicians and Chiropractors?
 - a. Only one can perform manipulations
 - b. Osteopathic doctors can prescribe medicine like Chiropractors
 - c. Osteopathic doctors go to medical school
 - d. Chiropractors can perform surgeries
 - e. No they are the same
 8. Is part of a medical visit having, your condition explained to you so that you can understand it clearly?
 - a. Yes
 - b. No
 9. Do osteopathic Doctors believe part of treatment is prevention?
 - a. Yes
 - b. No
 10. What are activities of daily living?
 - a. Running 3 times a week to improve your health
 - b. Working-out in a gym to build stronger muscles
 - c. Activities that participate in during the day
 - d. Only the parts of the day that you are walking around
 11. True or False, osteopathic doctors predominately perform manipulations as part of their practice.
 - a. True

- b. False
12. One of the osteopathic philosophies is that the body has the innate ability to heal itself given the body is free from dysfunction (homeostasis).
- a. True
 - b. False
13. What does the term Somatic dysfunction mean to you:
- a. Tenderness in the muscle along with some swelling
 - b. Abnormal posture that causes you to have scoliosis, tenderness of the back
 - c. Having a range of motion that is greater than normal
 - d. Worm muscle, painful joint, and asymmetry
 - e. Tenderness, asymmetry, range of motion, and tissue texture changes
14. Which technique allows you to thrust through the barrier?
- a. Direct technique
 - b. Indirect technique
15. When treating the nervous system can you affect the internal structures?
- a. True
 - b. False
16. What is viserosomatic pain?
- a. Pain of the muscles to the internal organs
 - b. Internal organs causing pain on the external organs
17. Can visceral organs cause pain on the skin?
- a. Yes
 - b. No
18. Is stretching important in musculoskeletal health?
- a. Yes

- b. No
19. Can having a leg length discrepancy cause your pelvis to rotate and cause pain?
- a. Yes
 - b. No
20. Are babies good candidates for manipulation of the head and neck:
- a. Yes
 - b. No
21. Was the problem area that you had in the beginning of the study treated?
- a. Yes
 - b. No
 - c. Unsure
22. Do you believe OMM as a safe and effect form of treatment options for people in your community?
- a. Yes
 - b. No
23. Would you recommend this form of pain relief to a:
- a. Friend
 - b. Family
 - c. Stranger
 - d. No one

TRANSLATED VERSION:

Pos Cuestionario

1. ¿Cuál de éstos son componentes del cuidado de salud holístico (marque todo lo que aplique)
 - 1 Salud física
 - 2 Salud espiritual

3 Salud mental

2. ¿Es importante visitar a un doctor regularmente?
 - 1 Sí
 - 2 No
3. ¿Su salud social un componente importante a la Práctica de la medicina Osteopathic?
 - 1 Sí
 - 2 No
4. ¿Cuál sería su opción de tratamiento cuando tiene que ver con dolores que interrumpen sus actividades diarias
 - 1 Píldora
 - 2 Cirugía
 - 3 Medicina manual
 - 4 Home remedies
 - 5 Ningún tratamiento mientras usted pueda todavía funcionar sin demasiado dolor.
5. ¿Qué es un doctor osteopathic?
 - 1 Uno que hace manipulaciones solamente
 - 2 Un doctor o un especialista del hueso
 - 3 Igual que un doctor de Allopathic o un M.D.
 - 4 Un quiropráctico
 - 5 Una combinación de un M.D. y Un quiropráctico
 - 6 Ninguno de lo dicho
6. Es importante tener chequeos anuales para mantener la salud
 - 1 Sí
 - 2 No
7. ¿Cuál es la diferencia principal entre Médicos y quiroprácticos de osteopathic?
 - 1 Solamente uno puede realizar manipulaciones
 - 2 Los doctores de osteopathic pueden prescribir la medicina como quiroprácticos
 - 3 doctores osteopathic van a la escuela de medicina
 - 4 quiroprácticos pueden hacer cirugias
 - 5 son iguales
8. ¿debería ser parte de una visita médica tener una explicación sobre su condición de modo que usted pueda entenderla claramente?
 - 1 Sí
 - 2 No
9. ¿los doctores de osteopathic creen que parte de un tratamiento es prevención?
 - 1 Sí

- 2 No
2 No
11. ¿Qué actividades diariamente hace usted?
- 1 Corriendo- 3 veces a la semana para mejorar su salud
 - 2 Hacer ejercicios en un gym para hacer los músculos más fuertes
 - 3 Actividades durante todo el día
 - 4 Solamente durante el día cuando hago mi rutina diaria
11. verdadero o falso- ¿los doctores de osteopathic predominadamente hacen las manipulaciones como parte de su práctica?
- 1 Verdad
 - 2 Falso
12. Una de las filosofías de osteopathic es que el cuerpo tiene la habilidad de curarse a si mismo siempre y cuando el cuerpo este libre de disfunción (homeostasis).
- 1 Verdad
 - 2 Falso
14. ¿Qué significa el termino somático de la disfunción ?
- 1 sensibilidad en el músculo junto con un hinchazón
 - 2 Postura anormal que le hace tener escoliosis, sencibilidad en la espalda
 - 3 Tener una capacidad de movimiento que es mejor de lo normal
 - 4 gusano que penetra el músculo, articulación doloroso, y asimetría
 - 5 sensibilidad, la asimetría, la capacidad de movimiento, y la textura de la piel cambia.
15. ¿Qué técnica permite que usted empuje a través de la barrera?
- 1 Técnica directa
 - 2 Técnica indirecta
16. Cuando uno trata el sistema nervioso, ¿ puede usted afectar las estructuras internas?
- 1 Verdad
 - 2 Falso
17. ¿Qué es dolor viserosomático?
- 1 Dolor de los músculos a los órganos internos
17. Órganos internos pueden causar dolor en los órganos ¿Pueden los órganos viscerales causar dolor en la piel?
- 1 Sí
 - 2 No
18. ¿es el estirarse importante en la salud musculoesquetal?

- 1 sí
- 2 No

20. Tener una pierna más larga que la otra, ¿ puede causar dolor en el área pélvica y la rotación de las caderas?

- 1 Sí
- 2 No

21. ¿Es prudente que los bebés reciban la manipulación de la cabeza y del cuello?

- 1 Sí
- 2 No

21. ¿Han sido tratados las áreas problemáticas que usted tenía al principio del estudio?

- 1 Sí
- 2 No
- 3 Inseguro

22. ¿cree usted que OMM es una forma de tratamiento efectiva y segura para la gente en su comunidad?

- 1 Sí
- 2 No

23. Usted recomendaría esta forma de tratamiento del dolor a :

- 1 su amigo
- 2 su familia
- 3 un desconocido
- 4 nadie

Appendix D

Students Watching Educational Video



Note: Baxter students watching the educational video

Appendix E

Consent

Explanation of Study:

- The purpose of this study is threefold. First, the examination of the current level of understanding about healthcare and healthcare options in the treatment of musculoskeletal pain in Honduras (and/or Central America) will be assessed. Secondly, with the introduction and implementation of Osteopathic Manual Medicine as a treatment modality, the evaluation of the degree of acceptance and understanding of the basic philosophies OMM will be studied. The final component will measure the improvements to the center of pressure (CoP) and relief of somatic dysfunction following treatment.
 - CoP is the measuring of balance on both feet when standing up without moving.
 - SD will be clarified by using the following acronym TART:
 - **T**issue texture changes (warm or cool skin)
 - **A**symmetry (when there is unevenness of a part of the body)
 - **R**ange of motion (not being able to move a particular part of the body in its usual range of motion)
 - **T**enderness (sensitive area of muscle which may be due to misalignment of the skeletal system or the muscle itself).
- During this study you will be asked to participate in one pre and post-test questionnaire, pre-recorded lectures before treatment of musculoskeletal pain and measurement of center of pressure.

Participation:

- The participation in this study is voluntary and will not be noted in the academic records. Subjects reserve the right to refuse participation in this study or to unquestionably withdraw their participation from the study at any moment. The non-participation in this study will not result in any penalty, will not be noted in academic records nor will it lead to loss of the subject benefits in any way.
- There will be no financial benefit to the subjects in the study as a result of any medical condition or discomfort following conclusion of the study.
- All subjects will be allowed to participate in the educational sessions without having to receive manipulation.
- All participants reserve the rights to disclose their participation in the study to their primary physician/s if necessary without having any information gathered during this study reviewed by anyone but the investigation team.
- The duration of the study will be from February 2008 through March 2008. A maximum time requirement of one and half hours once a week, for three weeks out of the five week test period is needed each day.

Alternative treatments:

- There are no alternative procedures that can substitute for osteopathic medicine and philosophies.

Risk:

- There is no risks of physical injury or permanent disability posed by this study. There is a mild possibility of sore muscles due to manipulation and stretching techniques.

You cannot receive manipulation if you currently have a history of any disease or condition listed in the exclusion criteria:

Exclusion Criteria

- **Acute traumatic injury:** any type of manipulation on recently injured areas due to trauma (broken bones, internal surgical procedures, ligament or muscle ruptures, etc.)
- **Inflammatory arthritis:** manipulating joint spaces in individuals with uncontrolled arthritis may lead to acute inflammatory processes
- **History of neurological disease:** working on such areas that may further deteriorate a person's condition is counterintuitive to helping the structure and function.
- **Osteoporosis risk or history:** osteoporosis and manipulation have the potential to lead to broken bones.
- **Cervical disc surgery and herniated cervical disc:** the area should be carefully manipulated be it with muscle energy or myofascial massage. The reason for this theory is that any further damage to this area may lead to paralyses.
- **History of carotid stenosis or vascular stenosis in the thoracic or lumbar area:** with the hardening of the arteries comes immobility of the vasculature in this area. Therefore, there is a potential risk of carotid shearing, stroke, vascular compromise to the head, and or death.
- **Use of anticoagulative medication:** due to the risk of uncontrolled bleeding.
- Severe conditions of cervical spondylitic myelopathy or those suffering from Down syndrome
- Older than fifty and younger than eighteen

Benefits:

- The benefits for participating in this study are an increase in knowledge of the holistic approach towards medicine. Relief of acute and chronic musculoskeletal pain.
- Increase in flexibility and range of motion; therefore, decreasing chance of injury during everyday activities (activities of daily living [ADLs]).

Compensations:

- There are no compensations that will be given to any of the participants in the study.

Confidentiality:

- The research team will only review information that is obtained during the course of this study.
- Participation or lack thereof will have no effect with any interactions with the administration at the Baxter Institute.
- All information will be placed in a locked cabinet and a locked room in the Baxter Institute administration office. The information will also be saved on the primary researcher's computer and a back-up disk, which will be accessible, only by the research team.
- All information will be destroyed by December 31, 2010.

Contacts:

If you have any questions please contact Abraham B. Hardee III via

ahardee@vcom.vt.edu.

I _____ voluntarily agree to participate in this research project.

Signature

Witness

Date

Translated version below:

Consentimiento

Explicación del estudio:

- El propósito de este estudio está explicado en tres puntos. Primero, la examinación del nivel actual del entendimiento sobre el cuidado de salud y de opciones sobre el cuidado de salud en el tratamiento del dolor musculoesquelético en Honduras (y/o América Central) serán determinadas. En segundo lugar, con la introducción y la puesta en práctica de la medicina manual de osteopathic como modalidad del tratamiento, la evaluación del grado de aceptación y el entendimiento de las filosofías básicas OMM serán estudiados. El componente final medirá el mejoramiento del centro de presión (el poli) y el alivio de la disfunción somática después del tratamiento.
 - o El poli es la medida del balance en ambos pies al estar parado sin moverse.
 - o El SD será clarificado usando las siglas siguientes TART (AGRIAS):
 - o Tissue: cambios de textura EN LA PIEL (piel caliente o fresca)
 - o Asymmetry: simetría (cuando hay la desigualdad de una parte del cuerpo)
 - o Range: variedad del movimiento (no pudiendo mover a una parte particular del cuerpo en su gama generalmente del movimiento)
 - o Tenderness: área sensible del músculo que puede ser debido al desalineamiento del sistema esquelético o del músculo sí mismo).
- Durante este estudio le pediremos que participe en un cuestionario principal y un cuestionario al final, las conferencias previas de antemano antes del tratamiento del dolor musculoesquelético y medida del centro de la presión.

Participación:

- La participación en este estudio es voluntaria y no será observada en expedientes académicos. Los participantes tienen el derecho de rechazar la participación en este estudio o de retirar indiscutiblemente su participación en el estudio en cualquier momento. El no participar en este estudio no dará lugar a ninguna pena, no será observada en expedientes académicos ni conducirá a la pérdida de las ventajas sujetas de cualquier manera.
- No habrá ventaja financiera/médica a los participantes en el estudio si tienen una condición médica o un malestar después de la conclusión del estudio.
- Los participantes podrán participar en las sesiones educativas sin tener que recibir la manipulación.
- Todos los participantes reservan los derechos de divulgar su participación en el estudio a su médico/s primario en caso de necesidad sin tener ninguna información recopilada durante este estudio revisado por cualquier persona con excepción del equipo de la investigación.
- La duración del estudio será de febrero y del marzo de 2008. El requisito de tiempo para participar en el estudio es de una hora y media cada día.

Tratamientos alternativos:

- No hay procedimientos alternativos que pueden substituir la medicina y las filosofías de osteopathic.

Riesgo:

- El riesgo a lesión física participando en este estudio no es ningún riesgo de lesión física o de la inhabilidad permanente.

Hay posibilidad de que los músculo le duelan debido a la manipulación y las técnicas de estirar los músculos.

No puede recibir la manipulación si usted actualmente tiene una historia de los criterios del exculsion:

Criterios de la exclusión

- Lesión traumática aguda:** cualquier tipo de manipulación en las áreas recientemente dañadas debido al trauma (los huesos rotos, los procedimientos quirúrgicos internos, el ligamento o el músculo rotos, etc.)
- Artritis inflamatoria:** los espacios comunes de manipulación en individuos con artritis incontrolada pueden conducir a los procesos inflamatorios agudos
- Historia de la enfermedad neurológica:** el trabajo en tales áreas que puedan deteriorar más una condición de la persona no ayudar a la estructura y a la función.
- Riesgo o historia del Osteoporosis:** el osteoporosis y la manipulación tiene el potencial de conducir a los huesos quebrados.
- Cirugía cervical del disco y disco cervical herniated:** el área se debe manipular cuidadosamente sea con energía del músculo o masaje myofacial. La razón de esta teoría es que son cualquier daños más otra a esto pueden conducir a las parálisis.
- Historia del stenosis carótida o del stenosis vascular en el área torácica o lumbar:** con endurecer de las arterias viene la inmovilidad del vasculature en esta área. Por lo tanto, hay un riesgo potencial de esquilar, del movimiento carótidas, compromiso vascular a la cabeza, y o a la muerte.
- Uso de la medicación anticoagulative:** debido al riesgo de la sangría incontrolada.
- Condiciones severas de myelopathy spndylitic cervical o de ésos que sufren abajo de síndrome
- Más viejo de cincuenta y más joven de dieciocho

Ventajas:

- Las ventajas para participar en este estudio son un aumento en el conocimiento del acercamiento holístico hacia la medicina. Alivio al dolor musculoesquelético agudo y crónico.

- Aumentación de flexibilidad y de la gama del movimiento; por lo tanto, ocasión que disminuye de lesión durante las actividades diarias (actividades de la vida del diario [ADLs]).

Remuneraciones:

- No hay remuneraciones que serán dadas a los participantes en el estudio.

Confidencialidad:

- El equipo de investigación serán los únicos que verán toda la información que se obtenga durante el curso de este estudio.
- El no participar en este estudio no tendrá efecto de ninguna manera con la administración en el Baxter Institute.
- Toda la información se pondrá en un gabinete cerrado con llave. Este gabinete estará en un cuarto cerrado con llave en la oficina de Baxter Institute. La información también se guardará en la computadora del investigador de este estudio. Las únicas personas que tienen acceso a esta información son los miembros del equipo de investigación.
- Toda la información será destruida en el año 2010.

Contacts:

Si usted tiene preguntas, por favor comuníquese con Abraham B Hardee III via ahardee@vcom.vt.edu.

Yo, _____ voluntariamente doy mi consentimiento para participar en este proyecto.

Testigo

fecha

Appendix F

Evaluation Form



LOCALIZER: Honduras, Tegucigalpa; Baxter Institute
(Location)

NOMBRE: _____

APELLIDOS: _____

Project # _____

(First)

(Last)

SEXO: Hombre Mujer

(Gender)

EDAD: _____

(Age)

Previous Injuries: _____

1. Cervicals

CO-C2

a. Neutral R on L L on R 1.

Scoliosis

C3-C7

Yes No

b. Flexion L on L R on R

c. Extension L on L R on R 2. Leg

length discrepancy

2. Thoracic

Yes No

a. Neutral R on L L on R

b. Flexion L on L R on R

c. Extension L on L R on R

3. Pelvis – Symphysis Subluxation

a. Left Right

b. Superior Superior

- c. Inferior Inferior

4. **Sacrum**

- a. Flexion/Forward L on L R on R
 b. Extension/Backward L on R R on L
 c. Unilateral: Extension Flexion Left
 Right
 d. Bilateral: Extension Flexion

5. **Lumbar**

- a. Neutral R on L L on R
 b. Flexion L on L R on R
 c. Extension L on L L on L

6. **Innomimates**

- a. Anterior L R
 b. Posterior L R
 c. Up-slipped Pelvis L R
 d. In-flare L R
 e. Out-flare L R

Appendix G

Room Set-up



Note: Second investigator is behind the desk operating the forceplate. One participant is on the forceplate and the other on the table.

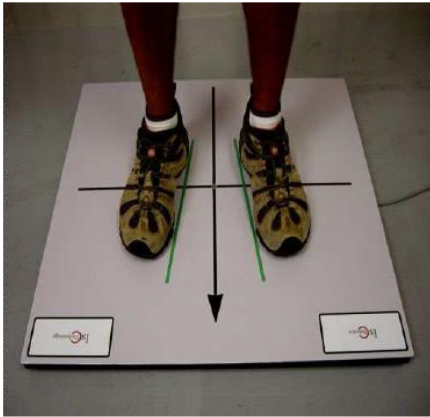
Appendix H

Schematic of a Dual Forceplate System



Appendix I

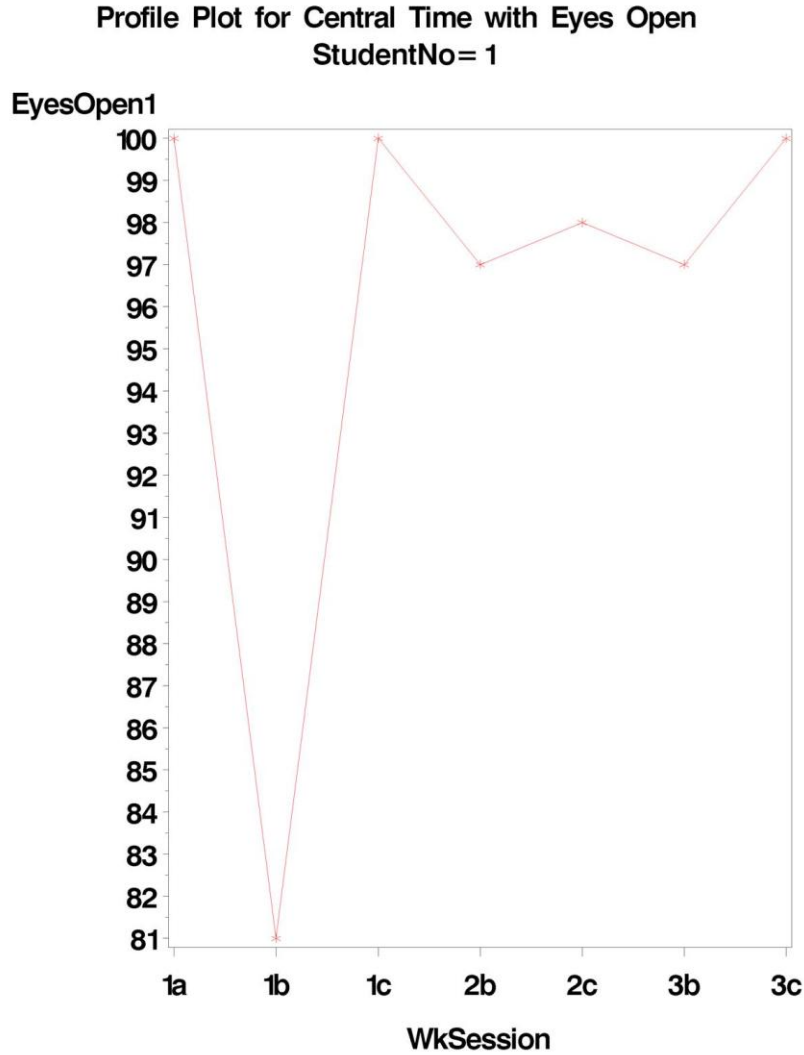
Foot placement on single forceplate



Note: Isotechnology photo of forceplate used in study

Appendix J

TIC_Change 2



Note: The above graph is an example of what the TIC_Change 1 would look like in graphic form. The x axis represents the weeks the forceplate readings and manipulations were performed. The y axis is the percent time spent within the six inch diameter circle on the forceplate. In this example you can clearly see three positive increases in percent time spent in the circle post-manipulation (1b-1c, 2b-2c, and 3b-3c). Manipulations were performed three times with one week's rest in-

1a: first baseline (data point not used)

1b: baseline pre-manipulation week 1

1c: post-manipulation week 1

2b: pre-manipulation week 2

2c: post-manipulation week 2

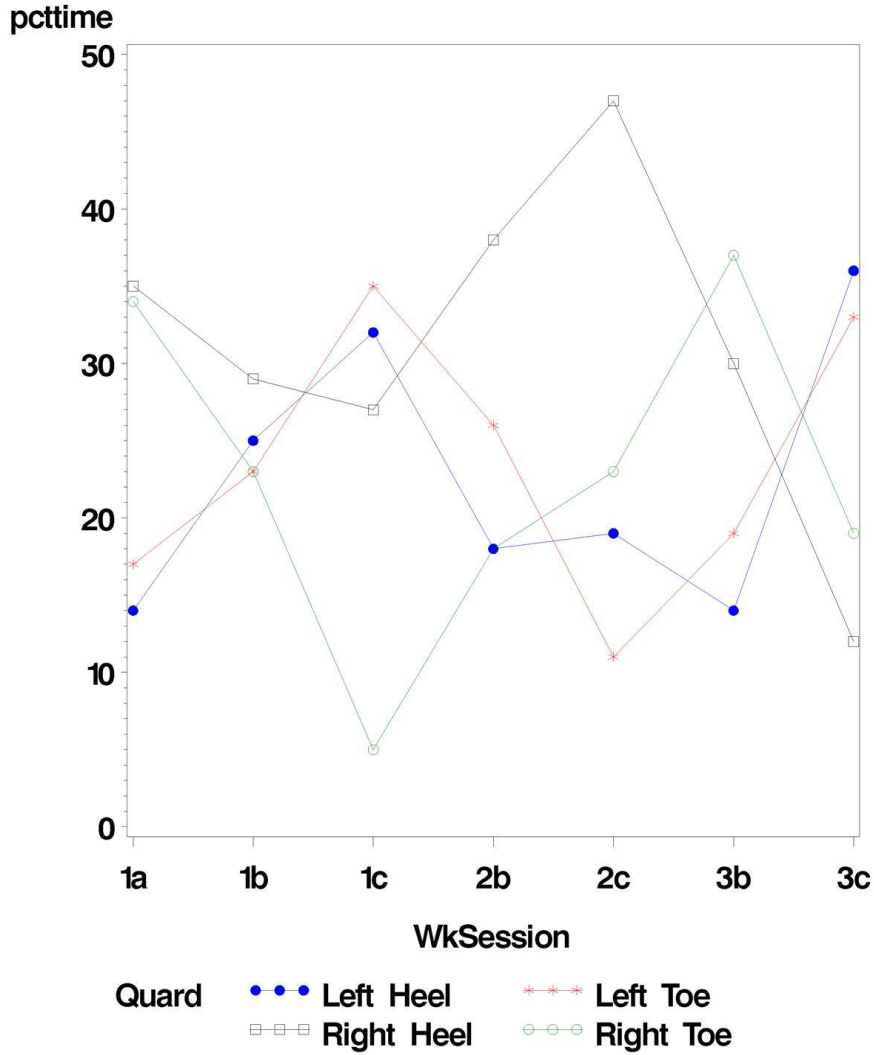
3b: pre-manipulation week 3

3c: post-manipulation week 3

Appendix K

Heel-to-Toe Change in Quadrant Pressure

Profile Plot by Quadrant for Eyes Open
StudentNo= 1



Note: This graph represents the quadrant data. As you can see the right foot has greater amounts of pressure on the heel during the first baseline week. However, by the conclusion of the study the right toe carries the majority of the weight when compared to the right heal.

1a: first baseline (data point not used)

1b: baseline pre-manipulation week 1

1c: post-manipulation week 1

2b: pre-manipulation week 2

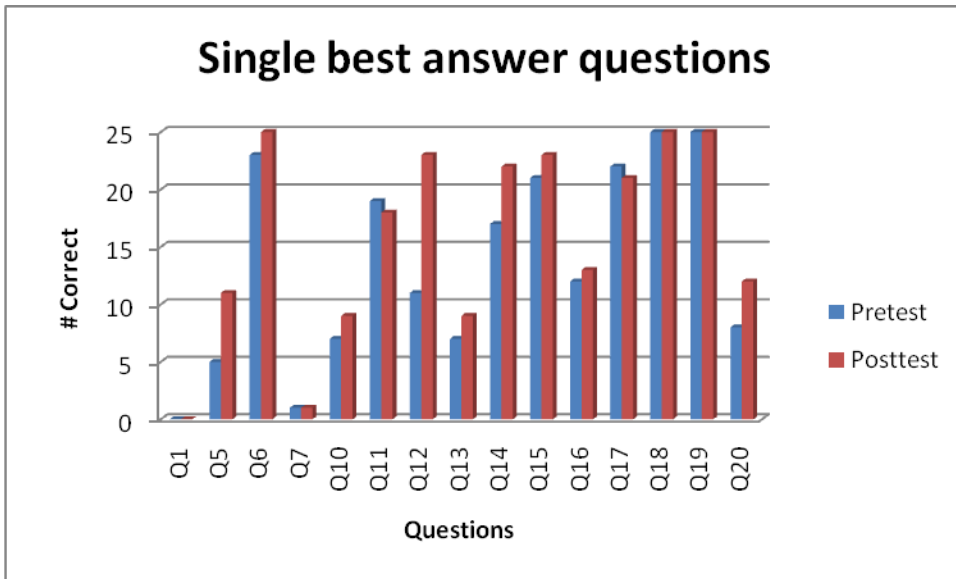
2c: post-manipulation week 2

3b: pre-manipulation week 3

3c: post-manipulation week 3

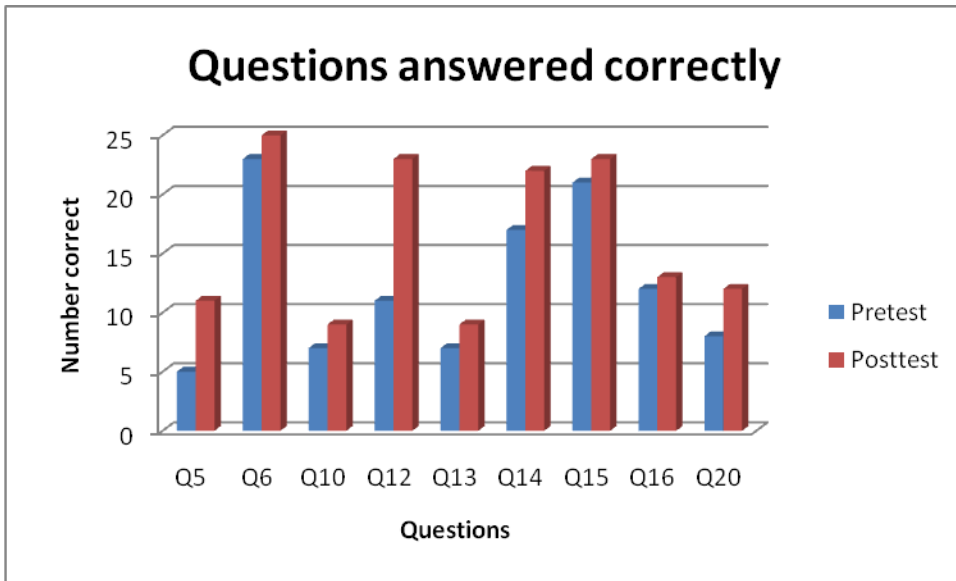
Appendix L

Single Best Answer Questions



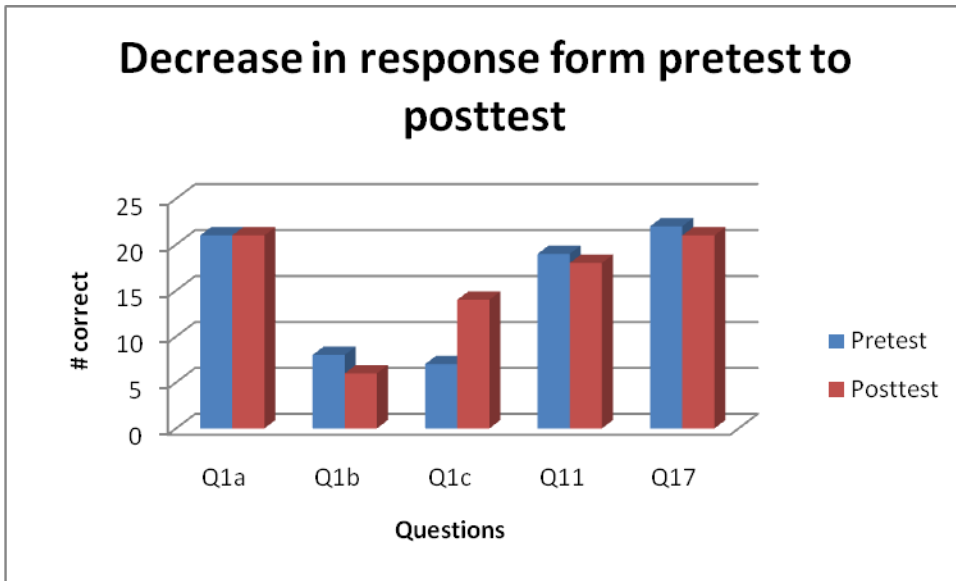
Appendix M

Questions Answered Correctly



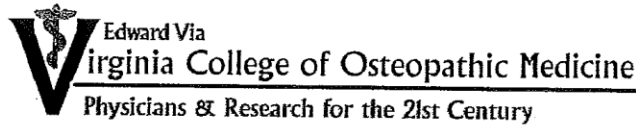
Appendix N

Question with Decrease in Response



Appendix O

IRB Approval Letter



Institutional Review Board
Dr. Hara Misra
IRB Chair
540.231.3693
hmisra@vcom.vt.edu

**VCOM Institutional Review Board
Notice of Modification Request Review**

January 22, 2008

Abraham B. Hardee III
PhD Candidate

RE: IRB#2007/044, The Introduction and Implementation of Osteopathic Manipulative Medicine in Tegucigalpa, Honduras

Dear Dr. Hardee:

On January 15, 2008 your protocol was approved via expedited procedure. On January 20, 2008 I received your request to change the term "Postural Sway" to "Center of Pressure," as well as your request to measure the subjects on the force plate in stocking feet instead of with shoes on and off. I find that these modifications to your protocol are adequately justified and that they do not increase patient risk or confidentiality. Therefore, I **approve** the above modifications to the protocol.

Please note that your continuation review remains January 15, 2009. As the PI, you are responsible for promptly reporting any injuries or adverse events or unanticipated risks to subjects, as well as any proposed changes in the research activity.

Please be advised that the VCOM IRB will be conducting routine audits as a means of ensuring compliance with VCOM and federal policies in an effort to assure the protection of human subjects. Your project may, at any time throughout the approval period, be subject to this type of monitoring.

If you have any questions or concerns, please do not hesitate to contact the IRB Coordinator, Sharon Kauffman (skauffman@vcom.vt.edu, 231-4512).

Sincerely,

A handwritten signature in cursive script that reads 'Hara P. Misra'.

Hara P. Misra, DVM, PhD
Chairman, VCOM Institutional Review Board