Efficacy of the ‘Still technique’ on dorsiflexion at the talocrural joint in patients with a history of ankle injury

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A research project submitted in partial fulfilment of the requirements for the degree of Masters of Osteopathy at Unitec New Zealand 2008
Declaration

Name of candidate: Nicholas Taylor

This Thesis/Dissertation/Research Project entitled: **Efficacy of the ‘Still technique’ on dorsiflexion at the talocrural joint in patients with a history of ankle injury**

Is submitted in partial fulfilment for the requirements for the Unitec degree of Masters of Osteopathy.

**Candidate’s declaration**

I confirm that:

- This Thesis/Dissertation/Research Project represents my own work;
- The contribution of supervisors and others to this work was consistent with the Unitec Regulations and Policies.
- Research for this work has been conducted in accordance with the Unitec Research Ethics Committee Policy and Procedures, and has fulfilled any requirements set for this project by the Unitec Research Ethics Committee.
  
  Research Ethics Committee Approval Number: **2007.706**

Candidate Signature: …………………………………………… Date:

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ABSTRACT

Background and Objectives: To determine the efficacy of an osteopathic technique (‘Still Technique’) on range of motion at the talocrural joint in individuals with a history of ankle injury. This dissertation has two sections. Section I contains a review the literature regarding investigation on range of motion at the talocrural joint. Section II consists of a manuscript of a study investigating the ‘Still Technique’ on talocrural joint range of motion.

Design: A randomised, controlled, blinded, experimental study.

Subjects: Thirty-two volunteers (19 males, 13 females; mean age=28.3 SD= 8.4) with a history of ankle injury from a university population, aged between 18 and 47 years.

Methods: Subjects with a history of ankle injury were randomly allocated to control and experimental groups. Subjects in the experimental group received three consecutive applications of ‘the Still Technique’ at the talocrural joint within a single session. Those in the control group received a sham intervention designed to mimic the ‘Still Technique’. Pre-test and post-test measures of passive dorsiflexion ROM were collected using a magnetometer.

Results: A comparison of the pre and post intervention control group (n=16) means revealed a mean change of 1.5º (p= 0.163; d= 0.10) (95% CI= -0.6 to 3.6º). A comparison of the pre and post intervention experimental group (n=16) means revealed a mean change of 3.8º (p= 0.18; d=0.34) (95% CI= 0.75 to 6.8º). The observed changes in ROM for both the experimental and control groups did not exceed the smallest detectable difference (SDD=5.9º).

Conclusion: The application of the Still technique did not substantially alter ROM at the talocrural joint in all subjects. Rather there was a range of responses, some subjects did respond to the single treatment and further investigation into the characteristics of these responsive patients could be warranted.

Keywords: Ankle joint, Still Technique, dorsiflexion, range of motion, osteopathy
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### Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>ROM</td>
<td>Range of motion</td>
</tr>
<tr>
<td>SDD</td>
<td>Smallest detectable difference</td>
</tr>
<tr>
<td>ICC</td>
<td>Intraclass correlation coefficient</td>
</tr>
<tr>
<td>SD</td>
<td>Standard deviation</td>
</tr>
<tr>
<td>$d$</td>
<td>Effect size (Cohen’s $d$)</td>
</tr>
<tr>
<td>CI</td>
<td>Confidence interval</td>
</tr>
<tr>
<td>$n$</td>
<td>Number of subjects</td>
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SECTION I - LITERATURE REVIEW
Introduction

The aim of this literature review is to provide a critical review of the literature that pertains to manual therapy applied to the ankle joint and build a platform upon which to test the application of the Still technique in an experimental study. This study appears to be the first to directly assess the efficacy of the Still technique on range of motion in a controlled setting on subjects who have a history of ankle injury. This research topic arose from inspiration at an osteopathic course that was teaching the Still technique. The course included anecdotes regarding the originator of osteopathy and his approach and this developed an interest to learn more of the techniques he used and their relevance today. Other than one published paper and a book written by Richard Van Buskirk (1996, 2000), there appears to be no previous research investigating Still technique.

Literature Selection

Literature selection for this review was undertaken using electronic databases accessed through the Unitec Library including EBSCO Host database, Academic Search Premier; AMED; CINAHL; Health Source: Nursing/Academic Edition; Medline, MANTIS, OSTMed and Science Direct using combinations of search terms such as ‘talocrural joint’, ‘Still Technique’, ‘manipulation’, ‘ankle manipulation’, ‘mobilisation’. A tabulated summary of the journal articles reviewed can be found in Appendix A.
Still Technique Model

The model of Still Technique as proposed by Van Buskirk (2000) is as follows:

1. Determine the joint position and movement and where it moves easily.
2. Move the joint or tissue into that position of ease.
3. Exaggerate the position of ease to allow the tissue to relax.
4. Introduce force vector\(^1\) (traction or compression) 5 pounds \([-2\text{kg}]\) or less.
5. Use the force vector as a lever; take the tissue through its range of motion towards and through the restriction.
6. There may be a palpable release or click.
7. The force vector is released and the tissue is returned to neutral\(^2\) and can then be retested.

Historical Background

Still Technique is the name given by Richard L Van Buskirk to a method of manipulation “discovered and used by the founder of osteopathic medicine, Andrew Taylor Still” (Van Buskirk, 2000, p. 7). Richard L Van Buskirk is an osteopath and to date has been the principal protagonist of the technique. According to Van Buskirk’s instructional text, he became interested in the methods of Andrew Taylor Still in 1989 when he was writing a paper that reviewed the books of Still and his students. During this process he came across a description of some techniques that were attributed to Still. This stimulated his interest and he decided to investigate further leading to the first article being published on the subject. Still developed his approach to

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\(^1\)The force vector here means a compressive or traction force that is aimed from the point of contact of the practitioner through the dysfunctional tissue.

\(^2\)Neutral position of a tissue is when it is in the best position for achieving maximal movement.
manipulation over the length of his professional life and was heavily influenced by his understanding of the human body. Van Buskirk describes in his book that Still did not want his students to be dominated by his technique, rather, the principles of osteopathy should be applied to techniques that they themselves developed from their understanding of anatomy and physiology. Still’s resistance to teaching specific approaches to technique may explain why so little of Still’s techniques were published or practiced after his death. The following passage from his book Osteopathy, Research and Practice illustrates Still’s view on the use of technique:

“I want to make it plain that there are many ways of adjusting bones. And when one operator does not use the same method as another, it does not show criminal ignorance on the part of either, but simply the getting of results in a different manner. A skilled mechanic has many methods by which he can produce the desired result. A fixed point, a lever, a twist, or a screw power, can be and are used by all operators. The choice of methods is a matter to be decided by each operator and depends on his own skill and judgment. One operator is right handed, the other left. They will choose different methods to accomplish the same thing. Every operator should use his own judgment and choose his own method of adjusting all bones of the body. It is not a matter of imitation and doing just as some successful operator does, but the bringing of the bone from the abnormal to the normal.” (Still, 1910, p. 29)

The following passage from Still’s autobiography emphasizes the importance he gives to understanding the philosophy as opposed to learning osteopathy and its techniques by rote:
“Osteopathy cannot be imparted by books only. Neither can it be taught to a person intelligently who does not fully understand anatomy both from books and dissection. One who does not know this preparatory branch is completely lost in our operating rooms. He does not act from reason, because he does not know enough anatomy to reason from. Therefore a treatise attempting to tell people how to treat disease by our methods would be worse than useless to every person who has not been carefully drilled in anatomy. It is the philosophy of Osteopathy that the operator needs; therefore it is indispensable that you know this philosophy or you will fail badly and get no further than the quackery of ‘hit and miss’.” (Still, 1908, p. 162)

For this reason, it appears that Still made very little written record of his techniques to pass on to students; they were expected to apply his philosophies and develop their own approach to technique. Further evidence of this is a quote from one of Still’s students Harry L Chiles:

“It was difficult to follow his hand in some of his diagnoses and treatment. There was no hesitation, for he had a clear picture in his mind of the structures he was working with. None of us had that much knowledge and no one has matched his technic, nor his success. His instructions in technic were often over our heads, but his reasoning, his deductions, and his philosophy were of the greatest value.” (Chiles in Hildreth, 1942, pp. 436-437)
Van Buskirk developed and documented these techniques after piecing together information from the manuscripts of Still and observations of his students and a 10 second film clip showing Still at work on a shoulder. He collated this information and with experimentation and modification extracted a basic model of the technique that allowed reproducible results.

**Classification of osteopathic technique**

In osteopathic medicine, techniques are often categorized as direct or indirect (Stone, 1999). Stone writes that the purpose of osteopathic technique is to remove barriers from the body and techniques are therefore aimed at these barriers. Barriers are considered to be ‘mechanical’ (i.e. altered tone, tension and texture of soft tissues or joints), ‘neural’ or ‘fluidic’. Stone describes direct techniques as those that engage a tissue barrier and attempt to work against it to cause a release of that tissue or joint i.e. thrust and articulation techniques. Thrust techniques aim to restore joint mobility to normal if dysfunction is found whereas articulatory techniques takes a joint or tissue through its complete range of motion to reduce tension and help promote drainage and decrease inflammation (Parsons & Marcer, 2006).

Indirect techniques (such as functional and balanced ligamentous tension techniques) take joints and other tissues away from a barrier and are intended to decrease the tension in the barrier. Functional techniques are aimed at avoiding barriers and following a path of ease to allow physiological mechanisms to effect a change in tissues, balanced ligamentous tension also works upon this similar process to “place the tissues in state of minimal force” (Parsons & Marcer, 2006). Van Buskirk (2000)
adds that these techniques can be global or specific and that Still Technique starts as an indirect technique and finishes as a direct one and is specific in nature. The Still technique therefore initially requires that the tissues or joint being treated needs to be placed into a position of ease such that the tissues become relaxed or balanced, a force vector is applied and then by moving through its range of motion towards the restriction the tissue tension is reduced and the barrier engaged and passed through to improve mobility. The Still technique is unique in that it employs both an indirect and direct approach within the same technique application.

**Somatic Dysfunction**

Van Buskirk makes it clear that for the technique to be effective the restricted part needs to be identified and its nature of restriction to be known. The normal range of motion of the affected part also needs to be known and without these requirements the application of the technique may be less effective. He asserts that the technique “treats specific tissues which exhibit segmental defined somatic dysfunction” and aims to rapidly “turn off the musculoskeletal effects of somatic dysfunction” (Van Buskirk, 2000). Somatic dysfunction is defined by Ward (2003, p. 1153) as being ‘impaired or altered function of related components of the somatic (body frame work) system: skeletal, arthrodial, and myofascial structures, and related vascular, lymphatic, and neural elements’. Ward (2003), Lee (2005) and Parsons and Marcer (2006) concur that to diagnose somatic dysfunction the criteria commonly used are tissue texture abnormalities, asymmetry, restriction of motion and tenderness. Parsons and Marcer make a distinction that to understand a joint dysfunction it is necessary to understand it from both a quantitative and a qualitative perspective. The
quantitative aspect identifies range of motion, whereas the qualitative considers the quality of movement through palpation i.e. a subjective assessment – does the tissue feel ‘hard’ or ‘soft’, ‘fine’ or ‘coarse’ etc? It is logical that to be able to study the effectiveness of the Still Technique will require subjects who exhibit somatic dysfunction determined by these criteria.

**Efficacy versus effectiveness**

Efficacy is defined as the biological effect of treatment under controlled conditions and effectiveness is described as the usefulness of a treatment under normal conditions (Domholdt, 2000). Domholdt states that the best way to test efficacy is by using a randomised controlled trial and that effectiveness trials are typically focussed on broader outcomes rather than single physiological outcomes. Eleven studies were found in the literature that investigated the effects of manipulation or articulation at the talocrural joint, of these eleven studies four were conducted on asymptomatic (Alburquerque-Sendín, Fernández-de-las-Peñas, Santos-del-Rey, & Martín-Vallejo, 2008; Fryer, Mudge, & McLaughlin, 2002; Nield, Davis, Latimer, Maher, & Adams, 1993; Ricketts, 2005) and seven on symptomatic individuals (Andersen, Fryer, & McLaughlin, 2003; Collins, Teys, & Vicenzino, 2004; Dananberg, Shearstone, & Giuliano, 2000; Green, Refshauge, Crosbie, & Adams, 2001; López-Rodríguez, de-las-Peñas, Alburquerque-Sendín, Rodríguez-Blanco, & Palomeque-del-Cerro, 2007; Pellow & Brantingham, 2001; Whitman, Childs, & Walker, 2005). All of these studies used dorsiflexion range of motion as an outcome measure except Alburquerque-Sendín et al. (2008) and López-Rodríguez et al. (2007) which investigated the effects of manipulation on stabilometry and are not considered further
in this literature review because the main outcome measure of interest to this review is joint range of motion rather than stabilometry.

Of the nine studies looking at range of motion, five of these examined a technique in one session under controlled conditions (Andersen, Fryer, & McLaughlin, 2003; Dananberg, Shearstone, & Guiliano, 2000; Fryer, Mudge, & McLaughlin, 2002; Nield, Davis, Latimer, Maher, & Adams, 1993; Ricketts, 2005). These studies attempted to provide controlled conditions for investigating their designated techniques. The other studies used multiple treatment sessions over multiple days and combined other modalities (Collins, Teys, & Vicenzino, 2004; Green, Refshauge, Crosbie, & Adams, 2001; Pellow & Brantingham, 2001; Whitman, Childs, & Walker, 2005). For studies that employed multiple treatment sessions over multiple days, the experimentation was controlled during each session but between each session there was possibility for influence from other variables i.e. further injury or other treatment modality altering the final results.

**Efficacy of peripheral joint manual therapy techniques**

Many studies have been undertaken in the past on the effects of manipulation of the spine but there have been few studies investigating peripheral joint techniques (Fryer, Mudge, & McLaughlin, 2002). Andersen et al. (2003) make the same observation and postulate that peripheral joints should respond similarly to spinal joints with an increased range of motion, however, no evidence is presented in this paper. Studies concerning manipulation of peripheral joints have been performed on the talocrural joint in both healthy and symptomatic populations.
Ankle anatomy

The talocrural joint, a uniaxial joint between the talus and the medial malleolus of the tibia and lateral malleolus of the fibula, is designed to accommodate the movements of dorsiflexion and plantarflexion in locomotion and the ligaments that support it are commonly injured in ankle sprain (Magee, 2002). In the United States ankle sprain is the most common injury occurring more than 25,000 per day and in the United Kingdom ankle sprains are reported in 52.7 cases per 10,000 patients (Young, 2008). In New Zealand, the Accident Compensation Corporation state that international figures report that “ankle sprains represent 15-20% of all sporting injuries, and about 10% of all presentations to accident and emergency departments” (ACC, 2008).

Measurement of ankle joint ROM

Clinically, measurement of dorsiflexion and plantarflexion is used during physical examination to determine if there is restriction in the talocrural joint (Greenman, 1996; Moseley & Adams, 1991). In line with common clinical practise most investigators use dorsiflexion as their main outcome measure.

In comparing the methods of measurement of dorsiflexion found in the literature five of the nine studies used an adapted method from the procedure developed by Moseley and Adams (1991). This method allows the application of standard torque via a spring balance applied to the ankle and the measurements are recorded on camera.

The ankle in this study is stabilized in a Lidcombe template so that the perpendicular

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3 The Lidcombe template is an acrylic footplate used to allow the application of a known torque to the ankle in the direction of dorsiflexion.
distance been the force applied and the ankle joint is constant. The technique
developed by Moseley and Adams (1991) was found to have high inter-rater and
repeated measures reliability (Intraclass Correlation Coefficient (ICC) of 0.97).

Nield et al. (1993) used the Moseley and Adams method but with the knee flexed at
90 degrees, the knee was also preconditioned three times to allow repeatable results
and the force was applied to the ankle using a load cell transducer. Repeatability of
the measurement of dorsiflexion in this study was found to be excellent (ICC 0.97).
Nield et al (1993) used five consecutive increasing torques to take the readings which
were recorded using a camera. Green et al (2001) kept the knee extended as described
by Moseley and Adams (1991) but modified the Lidcombe template with a hinge to
restrict movement only to the talocrural joint. This hinged footplate allowed
adjustment of the axis of rotation in the vertical plane. Pre trial testing found
repeatability to be excellent (ICC of 0.94). Dorsiflexion was measured using a
hydrogoniometer attached to the footplate and the angle measured when the subject
first experienced pain.

Andersen et al. (2003) and Fryer et al. (2002) also used the same modified approach
developed from Moseley and Adams (1991). Both Anderson et al. (2003) and Fryer
et al. (2002) positioned the subject in supine with the leg braced at 90 degrees with the
footplate attached, a dynamometer was used to apply equal passive torque and
preconditioning was used. Repeatability was reported by both Andersen et al. (2003)
and Fryer et al. (2002) to be excellent. The dorsiflexion angles were measured from
digital stills from video recorded during the testing procedure. Ricketts (2005) further
developed the measurement procedures using a magnetometer attached to the
footplate to measure the dorsiflexion ROM in real time. Ricketts did not precondition the ankles to avoid short-term viscoelastic change in the musculature. The measurement method of dorsiflexion ROM as used by Ricketts has been demonstrated to be as accurate as using digital video McLaughlin and Vaughan (2004).

From the nine studies investigated, four studies (Collins, Teys, & Vicenzino, 2004; Dananberg, Shearstone, & Guiliano, 2000; Pellow & Brantingham, 2001; Whitman, Childs, & Walker, 2005) used other forms of measurement including standard protractor goniometers and active knee to the wall measurements. Out of these four studies, three of the studies, Dananberg et al. (2000), Pellow and Brantingham (2001) and Whitman et al. (2005) used standard goniometers and active assisted range of motion to measure dorsiflexion. However, Pellow and Brantingham (2001) used a goniometer and measured active dorsiflexion with the subject in the prone position whereas Dananberg et al. (2000) had the subject lying supine with a cloth cord around the metatarsal heads that the subject used to pull the ankle into dorsiflexion.

Whitman et al. (2005) used a standard goniometer and measured active dorsiflexion in both sitting with 90 degree knee flexion and supine with full knee extension. However only one measurement is presented in the report and the measurements were only taken at the first session and not repeated at the two follow-up sessions. The amount of force used each time by the subjects in these studies to reach full ROM is not recorded, it could have been inconsistent and may have added error to the results.

The other study in this group of four, Collins et al. (2004) used the ‘knee to the wall principle’ and measured the distance between the wall and the second toe in millimetres and considered this more sensitive than a non weight bearing measure.
Jones, Carter Moore and Wills (2005) found the reliability of this measurement procedure to be acceptable as a rehabilitation tool when averaged over six repetitions, however, in this case only three measurements were completed at each stage. Differences in morphology (i.e. large abdomen) or flexibility (i.e. restricted movement in the hips) in some subjects may limit the ability of this technique to achieve an accurate measurement of full ROM at the ankle.

Four studies (Collins, Teys, & Vicenzino, 2004; Dananberg, Shearstone, & Guiliano, 2000; Pellow & Brantingham, 2001; Whitman, Childs, & Walker, 2005) all used a method of dorsiflexion measurement that was reliant on the visual estimation of the researcher and are therefore prone to human error in reading analogue scales. Fish and Wingate (1985) reported that photography was significantly more accurate than the goniometric method using visual estimation. Investigating goniometric error at the elbow, Fish and Wingate compared both visual estimation and photographic collection of the goniometric angles and found differences in all but one of the protocols testing the visual and photographic methods (p< 0.05). They also suggest that even inexperienced users could accurately use the photographic approach.

In summary, the method of dorsiflexion used in the literature that is most reliable is the one that uses a photographic or electrogoiometric measurement to record data and uses a known torque isolated to the talocrural joint to make pre and post measurements such as the method of Moseley and Adams (1991).
Studies reporting effects of ankle joint interventions in asymptomatic subjects

Technique effects on talocrural joint range of motion in asymptomatic subjects have been reported in three studies in the literature (Fryer, Mudge, & McLaughlin, 2002; Nield, Davis, Latimer, Maher, & Adams, 1993; Ricketts, 2005). Nield et al. (1993) were amongst the first to study the effects of a longitudinal caudal thrust manipulation on range of movement at the ankle. Their study was conducted on an asymptomatic population of 20 individuals, both male and females. The ankle was preconditioned to allow repeatable results by reducing the possible viscoelastic properties of the tissues. Different increasing torques were applied to investigate if there was any difference at end of range due to the torque, and it was found that the ROM is dependent on the torque applied – greater torques produced greater ROM. Nield et al. when performing their manipulation only considered it successful if there was a gapping in the joint or cracking sound was elicited; interestingly at least in the axial skeleton it has been shown that the pop or crack of a joint does not necessarily indicate changes have occurred in the tissues (Gibbons & Tehan, 2006; Timothy, John, & Julie, 2006). This study found that there was no change in range of motion at the ankle due to manipulation.

Fryer et al. (2002) performed a single high velocity low amplitude thrust to the talocrural joint in 41 asymptomatic male and female subjects and found that there was no significant difference in range of movement between manipulated and non-manipulated ankles. Fryer et al. considered that it was possible the measurement procedure used was not accurate enough to detect very small changes, as the mean differences in the experimental group were very small. Fryer el al. also suggests
manipulation did not affect range of movement as such but more the quality of the movement. This study found that those ankles that cracked (made a popping sound during manipulation) had a greater range of movement in the pre-test. Fryer mentioned that the manipulation might have more of a hypoalgesic effect than a biomechanical effect on improving the range of motion. This study’s use of asymptomatic individuals restricts extent that the data can be generalised to a symptomatic population.

Both Fryer et al. (2002) and Nield et al. (1993) used a direct technique, Ricketts (2005) performed a study using an indirect technique (the balanced ligamentous tension technique) on 41 asymptomatic male and female subjects. This study, although using asymptomatic subjects, only used those that had a pre-treatment range of motion difference of 6 degrees between the right and left ankle of each subject. Ricketts found normal sagittal ankle ROM was 60 degrees with a standard deviation of 6 degrees. Those subjects with a ROM on one ankle 6 degrees less than the other were considered to be restricted because it was one standard deviation away from the mean and therefore was suitable for the treatment. Ricketts kept the subjects off their feet by moving them from the testing room to the treatment room by wheelchair, which was not done in the previous studies. Ricketts did not precondition the ankles because it was considered that short-term viscoelastic effects on the tissues would influence the outcome of the technique. In addition to treatment of the ankle, Ricketts also treated the interosseous membrane. This would make it difficult to determine from the data which application of the technique had had the greatest effect on dorsiflexion. The results of the study did not show any significant increase in dorsiflexion in the experimental subjects. The aim of the experiment wasn’t to
investigate long-term effects although this would be useful, in light of the fact there weren’t short-term effects however would make this pointless. Patterson (2007) suggests that randomised controlled trials of specific techniques have limited usefulness in answering the questions posed by the practise of osteopathic manipulative therapy and it is better to look at the system as a whole, Ricketts (2005) echoes this by suggesting that to study one technique individually did not take into account its whole effect within a standard osteopathic treatment and only represented a small part of it.

As seen from the previous studies on asymptomatic individuals, no significant changes in ankle range of movement seem to occur after manipulation. It has been suggested by some authors, that range of motion may not adequately represent the desirable effect; the desirable effect might be better defined by pain or function (i.e. proprioception or gait) or a combination of the two (Andersen, Fryer, & McLaughlin, 2003; Fryer, Mudge, & McLaughlin, 2002). Nield et al. (1993) lacked adequate power to avoid statistical error due to the low number of participants in the study compared to the other two studies which had nearly twice the number. Fryer et al. (2002) considered the method of measurement of range of movement in these studies to have better reliability than using goniometric measurement or visual estimation and the authors demonstrated this in pilot work conducted prior to the main study.
Studies reporting effects of ankle joint interventions in symptomatic subjects

The following studies were conducted on symptomatic participants treated with manipulation. Three of these studies investigated inversion ankle sprain (Andersen, Fryer, & McLaughlin, 2003; Pellow & Brantingham, 2001; Whitman, Childs, & Walker, 2005). Whereas Dananberg et al. (2000) investigated ankle equinus (a structural abnormality of the ankle joint which affects dorsiflexion during walking or running).

The study by Andersen et al. (2003) used the method described by Moseley and Adams (1991) to measure ankle dorsiflexion whereas the others used goniometric measurement. Pellow and Brantingham (2001) and Dananberg et al. (2000) both found there was increased dorsiflexion in their subjects after manipulation, however, using goniometry with non standardized torque is less reliable than the study by Andersen et al. (2003) which used a dynamometer to allow consistent application of torque for each measurement. Andersen et al. (2003) used the same method of measurement as Fryer et al. (2002) but with symptomatic subjects.

Dananberg et al. (2000) and Pellow and Brantingham (2001) were both unique in that the application of torque to the ankle to measure dorsiflexion was made by the patient themselves. Dananberg et al. (2000) additionally asked the subject to pull on a cloth cord around the foot at the same time, making it an active assisted movement. This could have introduced a source of error if some subjects were to pull harder than others. These two studies measured range of motion with the patient’s legs extended.
This did not take the gastocnemius and soleus muscles off tension adding another unknown effect to the experiment.

The work of Whitman et al. (2005) was based on a case study of a female volleyball player. They did not study one specific technique, rather a range of different manipulation and mobilization techniques. This study also included home exercises in its method as part of a conventional management program. The treatments resulted in improved range of motion and decreased pain in the subject, leading the authors to suggest although not all patients needed this approach further research would be useful regarding identifying the subgroup of patients that would respond most effectively to this intervention strategy. Similar to Pellow and Brantingham (2001) and Dananberg et al (2000) the measurements of ankle dorsiflexion were taken with a goniometer but were done in both sitting and with the patient supine. The data presented did not show the two measurements for comparison and follow-up measurements were not made at the four-day and six-day follow-up periods. Whitman et al. (2005) recorded the patient’s pain experience as an outcome measure throughout the study, and found that the subject was pain free by the first follow-up session. Pellow and Brantingham (2001) also used a pain scale with their subjects and found a significant improvement in the experimental group as opposed to the control.

Other than manipulation studies, there are studies that have investigated the effect of joint mobilization on range of motion at the ankle in people with inversion sprain. Collins et al. (2004) found that utilizing Mulligan’s mobilization technique (an articulatory technique where force is applied parallel to the joint plane) on a group of 16 subjects had a significant effect in improving dorsiflexion in the initial treatment
session but decreased with each session. This study used an active weight bearing lunge measurement of dorsiflexion and the distance of dorsiflexion that the subjects could achieve towards the wall as indication of dorsiflexion range of motion. This method utilized low-tech methods rather than dynamometers and camera equipment used in other studies. The dorsiflexion movement in this case does not isolate the joint, so there was no control for application of uniform torque in each instance of measurement. This study also investigated the articulatory technique to see if it had any effect on pain thresholds. The authors report that the results were not significant and suggest that the technique has more of a mechanical than hypoalgesic effect.

Green et al. (2001) performed a randomised controlled trial to investigate an anterior-posterior articulatory technique on the talocrural joint of subjects. This was performed every second day for two weeks and also a RICE (Rest, Ice, Compression and Elevation) protocol to perform at home was prescribed. One of the important inclusion factors for this study was that subjects were required to enter the study within 72 hours of injury and only if the sprain was of sufficient severity to require assisted ambulation (i.e. use of a crutch). Those subjects in the treatment group needed fewer treatments to achieve pain-free dorsiflexion. This was the only study using the Moseley and Adams (1991) method of measurement in this review that had a significant improvement in range of motion post treatment. Pain free movement was used as an outcome measure in this experiment and the subjects were discharged from the study when they had full pain-free dorsiflexion range of movement. This experiment involved a complete treatment regimen so it is difficult to attribute the improved range of motion specifically on one technique with other variables involved. In this case the increase of ROM could be due to just a decrease in swelling.
Conclusion

A variety of methods including goniometric analysis, standardised torque with digital motion analysis and active movement have been used to assess the effectiveness and efficacy of manual therapy approaches to improving the range of motion of the ankle joint. With the exception of Green et al. (2001), the studies using the Moseley and Adams (1991) method of dorsiflexion measurement have shown that there is no significant change in the range of motion of the joint in both symptomatic and asymptomatic individuals. The Green et al. (2001) study involved multiple treatment sessions and participants with a very recent injury (less than 72 hours). It is possible that changes in dorsiflexion ROM in this study could be attributed to decreasing inflammation around the joint as a consequence of normal healing. Those studies that have used a less accurate measurement method in symptomatic individuals have shown statistically significant results (see appendix A for details of statistical analysis), however, these studies have involved treatment plans with more than one treatment session, suggesting that manipulation may successfully be combined within an overall treatment plan. In regards to other outcome measures, some of these studies have involved questionnaires regarding pain; some have shown to reduce pain whereas in others there has been no effect.

From reviewing the literature it is apparent that to perform a study on the efficacy of the Still technique requires a sufficient sized sample of subjects with ankle problems demonstrating somatic dysfunction, which will help the study achieve adequate statistical power. The subjects ankle problems could include inversion strains, ankle equinus etc. An appropriate design would include evaluation of pre and post
experimental dorsiflexion range of motion using a method of known reliability and
satisfactory error. As a preliminary study for the Still technique the focus is more on
the efficacy of the technique but this is likely to provide useful data for the
implementation of effectiveness studies at a later time.

The aim for the study reported in Section II is whether the Still Technique applied to
the talocrural joint of subjects with a history of ankle sprain can alter range of motion.
References


López-Rodríguez, S., de-las-Peñas, C. F., Alburquerque-Sendín, F., Rodríguez-Blanco, C., & Palomeque-del-Cerro, L. (2007). Immediate effects of manipulation of the talocrural joint on stabilometry and baropodometry in


Appendix  – Literature Review Table

[see next page]
<table>
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<tr>
<th>Study (Year)</th>
<th>Study Design</th>
<th>Symptomatic/Asymptomatic Subjects</th>
<th>Sample Size</th>
<th>Intervention</th>
<th>Sham. Control Procedure</th>
<th>Outcome Measure/s. Measurement Tool</th>
<th>Conclusions/Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nield, S., Davis, K., Latimer, J., Maher, C., &amp; Adams, R. (1993). The effect of manipulation on range of movement at the ankle joint.</td>
<td>RCT</td>
<td>Asymptomatic 1 ankle control the other experimental</td>
<td>20</td>
<td>Single longitudinal talocrural manipulation. Considered successful if gapping or crack heard.</td>
<td>No</td>
<td>Ankle dorsiflexion ROM measured using adapted Moseley and Adams (1991) method using Lidcombe template. Camera was used to record ankle position and simultaneous force readout. ICC 0.97</td>
<td>No change between control and experimental. (Unable to calculate effect size) Means not provided for ROM.</td>
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<tr>
<td>Dananberg, H. J., Shearstone, J., &amp; Guiliano, M. (2000). Manipulation method for the treatment of ankle equinus.</td>
<td>Non randomized, non controlled trial</td>
<td>Symptomatic Patients with ankle equinus</td>
<td>22</td>
<td>Fibular head manipulation followed by longitudinal talocrural manipulation.</td>
<td>No</td>
<td>Ankle dorsiflexion measured using a goniometer and active assisted ROM.</td>
<td>Increase in ROM of motion of all subjects following manipulation. (p&lt;0.001) 99% CI 1 degree to 17 degrees. (Unable to calculate effect size) Means not provided for ROM.</td>
</tr>
<tr>
<td>Green, T., Refshauge, K., Croddie, J., &amp; Adams, R. (2001). A randomized controlled trial of a passive accessory joint mobilization on acute ankle inversion sprains.</td>
<td>RCT</td>
<td>Patients treated every second day (maximum 2 weeks).</td>
<td>41</td>
<td>All received RICE protocol and wore tubular bandage. 3rd session all taped. Gentle oscillatory technique end of range –AP.</td>
<td>No sham, the control group had RICE Protocol.</td>
<td>Dorsiflexion: Measured using Lidcombe template with a hydrogoniometer and a spring balance to apply uniform torque. Gait: stride speed, step length, and single support time. (ICC 0.94)</td>
<td>Fewer treatments required in experimental group to gain pain free dorsiflexion than those only using RICE. Experimental (d=0.44) Control (d=0.09) (p&lt;0.01)</td>
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<tr>
<td>Study Authors</td>
<td>Study Design</td>
<td>Participants</td>
<td>Interventions</td>
<td>Outcomes</td>
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<tr>
<td>Collins, N., Teys, P., &amp; Vicenzino, B. (2004)</td>
<td>Double blind randomized controlled trial incorporated repeated measures into a crossover design. Each participant was his or her own control.</td>
<td>Symptomatic. Required grade 2 ankle sprain on average 40 days prior to testing.</td>
<td>MWM to talocrural joint 3 sets of 10 repetitions applied. Placebo: Similar to treatment condition Control: Held stance for same period of time.</td>
<td>MWM increases mobilization significantly after application. Has a mechanical effect not a hypoalgesic effect.</td>
<td>Dorsiflexion: knee to wall principle- distance 2nd toe to wall measured in mm. Pressure pain: algometry Hot and Cold thermal pain threshold: used Thermostat system.</td>
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<tr>
<td>Whitman, J. M., Childs, J. D., &amp; Walker, V. (2005)</td>
<td>Case Report</td>
<td>The patient was a 27-year old volleyball player who had suffered from an ankle sprain three weeks prior to her first visit to physical therapy</td>
<td>Manipulation mobilization techniques. Proximal fibula head manipulation. Rear foot distraction manipulation. Lateral glides.</td>
<td>Manipulation and mobilization techniques may allow quicker improvement of function and decrease in pain in patients unresponsive to conventional management. (Unable to calculate effect size)</td>
<td>Dorsiflexion, Plantarflexion, Inversion and Eversion: measured with goniometry. Foot and Ankle Ability Index. Patient Specific Functional Scale.</td>
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<td>Study</td>
<td>Design</td>
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<td>Outcome Measures</td>
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<tr>
<td>Ricketts, S. (2005). The Effect of an Indirect Technique on Range of Motion at the Ankle.</td>
<td>Randomized, controlled and blinded study.</td>
<td>Asymptomatic, students</td>
<td>40 (9 males, 31 females)</td>
<td>BLT technique to ankle complex and the tibiofibular articulations and interosseous membrane. No sham. Control group stayed for same time in the treatment room.</td>
<td>Dorsiflexion: Measured using 3DM magnetometer with standard torque applied with handheld dynamometer. BLT did not produce a significantly greater increase in dorsiflexion ROM compared to no treatment. Experimental (d=0.38) Experimental plus 30mins (d=0.43) Control (d=0.35) Control plus 30 (d=0.27)</td>
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<td>López-Rodríguez, S., de-las-Peñas, C. F., Alburquerque-Sendín, F., Rodríguez-Blanco, C., &amp; Palomeque-del-Cerro, L. (2007). Immediate Effects of Manipulation of the Talocrural Joint on Stabilometry and Baropodometry in Patients With Ankle Sprain</td>
<td>A single blind, intrapatient, placebo controlled and repeated measures study</td>
<td>Symptomatic with grade 2 ankle sprain and manual restriction of posterior gliding of the talus.</td>
<td>52 field hockey players (35 male, 17 female) Ages 18 – 49 years</td>
<td>1 distractive talocrural joint manipulation and posterior gliding manipulation over talus. Yes. Placebo. Hands placed on joint same as manipulation with no traction. Held there for 1 minute.</td>
<td>Stabilometry: Using Foot work force platform. Manipulation modified the pattern of behavior of the load support at level of the foot in athletic individuals.</td>
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Abbreviations: (HVLA) High Velocity Low Amplitude. (MWM) Mobilisation with Movement. (AP) Anterior/Posterior. (BLT) Balanced ligamentous tension. (ROM) Range of Motion. (RICE) Rest Ice Compression Elevation (ICC) Intraclass correlation coefficient. (d) effect size. (d) estimate effect size calculated by author [using $d = \frac{\bar{x}_1 - \bar{x}_2}{(sd_1 + sd_2)/2}$]
SECTION II –MANUSCRIPT

Note: The following manuscript was prepared in accordance with the Instructions for Authors for the *International Journal of Osteopathic Medicine* [see Appendix D]
Efficacy of the ‘Still technique’ on dorsiflexion at the talocrural joint in patients with a history of ankle injury
Efficacy of the ‘Still technique’ on dorsiflexion at the talocrural joint in patients with a history of ankle injury

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ABSTRACT

Objective: To determine the efficacy of an osteopathic technique (‘Still Technique’) on range of motion at the talocrural joint in individuals with a history of ankle injury.

Design: A randomised, controlled, blinded, experimental study.

Subjects: Thirty-two volunteers (19 males, 13 females; mean age=28.3 SD= 8.4) with a history of ankle injury from a university population, aged between 18 and 47 years.

Methods: Subjects with a history of ankle injury were randomly allocated to control and experimental groups. Subjects in the experimental group received three consecutive applications of ‘the Still Technique’ at the talocrural joint within a single session. Those in the control group received a sham intervention designed to mimic the ‘Still Technique’. Pre-test and post-test measures of passive dorsiflexion ROM were collected using a magnetometer.

Results: A comparison of the pre and post intervention control group (n=16) means revealed a mean change of 1.5° (p= 0.163; d= 0.10) (95% CI= -0.6 to 3.6°). A comparison of the pre and post intervention experimental group (n=16) means revealed a mean change of 3.8° (p= 0.18; d=0.34) (95% CI= 0.75 to 6.8°). The observed changes in ROM for both the experimental and control groups did not exceed the smallest detectable difference (SDD=5.9°).

Conclusion: The application of the Still technique did not substantially alter ROM at the talocrural joint in all subjects. Rather there was a range of responses, some subjects did respond to the single treatment and further investigation into the characteristics of these responsive patients could be warranted.

Keywords: Ankle joint, Still Technique, dorsiflexion, range of motion, osteopathy
INTRODUCTION

The ‘Still Technique’ is the name given by Richard L Van Buskirk\textsuperscript{1} to a method of manipulation used by the founder of osteopathic medicine, Andrew Taylor Still. Richard L Van Buskirk is an osteopath and the principal researcher of the technique to date. He became interested in the old methods Andrew Taylor Still in 1989 when he was writing a paper that reviewed the books of Still and his students. During this process he came across a description of some techniques that were attributed to Still. This stimulated his interest and he decided to investigate further leading to the first article being published on the subject.

Van Buskirk suggests that Still did not want his students to be dominated by his technique, rather the principles of osteopathy should be applied to techniques that students developed from their own understanding of anatomy and physiology. Van Buskirk developed these techniques from piecing together information from the writings of Still and those of his students, and from a 45 second film clip showing Still demonstrating his technique. Van Buskirk used this information to develop a basic model of the technique that he claimed allowed reproducible results and could be taught to others. Van Buskirk has published a book “The Still Technique Manual: Applications of a Rediscovered Technique of Andrew Taylor Still”. He has also published a chapter in a textbook\textsuperscript{2} and his initial description of the techniques and their development in a journal article.\textsuperscript{3}

In osteopathic medicine, techniques are often categorized as ‘direct’ or ‘indirect’.\textsuperscript{4} Stone writes about how osteopathy works to remove barriers from the body and
techniques are often aimed at these barriers and they can be mechanical (i.e. altered tone, tension and texture of soft tissues or joints), neural or fluidic. Stone describes direct techniques as those that engage and attempt to work against a barrier i.e. manipulation and articulation techniques. Indirect techniques take tissue or joints away from this barrier and try to decrease the tension in the barrier i.e. functional and balanced ligamentous tension techniques. Van Buskirk adds that these categories can be global i.e. directed at whole regions or the whole body or specific i.e. focussed on specific joints or tissues. Van Buskirk describes, using these categories, how the Still Technique starts as an indirect technique and finishes as a direct one. The Still technique is also specific in nature i.e. aimed a joint or muscle. The Still technique is therefore special in this regard as within the same procedure it combines both treatment approaches whereas in most osteopathic technique procedures it is either one way or the other. Cranial osteopathic technique for example can be direct or indirect but never combining both in the same treatment. Van Buskirk claims that for the technique to be effective, the restricted joint, muscle or ligament should be identified and how it is restricted to get good results. Once this restriction is known a force vector (either compression or distraction) is used to move the tissue through its ROM and finally through the area of restriction. By applying this process Van Buskirk claims the technique “treats specific tissues which exhibit segmentally defined somatic dysfunction” by turning off the musculoskeletal effects of somatic dysfunction. However, other than subjective osteopathic assessment of this in affected tissues it has yet to be confirmed formally.
The basic model of Still Technique as proposed by Van Buskirk\textsuperscript{1} is as follows:

1. Determine the joint position and movement and where it moves easily.
2. Move the joint or tissue into that position of ease.
3. Exaggerate the position of ease to allow the tissue to relax
4. Introduce force vector (traction or compression) 5 pounds \[\sim2\text{kg}\] or less
5. Use the force vector as a lever; take the tissue through its range of motion towards and through the restriction
6. There may be a palpable release or click.
7. The force vector is released and the tissue is returned to neutral and can then be retested.

The ankle joint or talocrural joint was chosen to investigate this technique, as there is relatively little research currently investigating peripheral joints. The talocrural joint is a uniaxial joint between the talus and the medial and lateral malleolus and is designed to accommodate the movements of dorsiflexion and plantarflexion in locomotion. The ligaments that support the joint are commonly injured in ankle sprain.\textsuperscript{5} In the United States, ankle sprain is the most common injury occurring more than 25,000 per day and in the United Kingdom ankle sprains are reported in 52.7 cases per 10,000 patients.\textsuperscript{6} In New Zealand, the Accident Compensation Corporation states that international figures report that “ankle sprains represent 15-20\% of all sporting injuries, and about 10\% of all presentations to accident and emergency departments”.\textsuperscript{7}
To date there have been 11 studies investigating the effects of manipulation at the talocrural joint. Of these eleven studies four were conducted on asymptomatic and seven on symptomatic individuals. All of these studies used dorsiflexion range of motion as an outcome measure except Alburquerque-Sendín, Fernández-de-las-Peñas, Santos-del-Rey, & Martín-Vallejo and López-Rodríguez, de-las-Peñas, Alburquerque-Sendín, Rodríguez-Blanco, & Palomeque-del-Cerro who investigated the effects of manipulation on stabilometry.

Although there has been no published research on the Still technique, Van Buskirk claims that in his practice of the technique it has been effective in treating dysfunction as well as other techniques. While treating 11 subjects with 1st or 2nd degree lateral ankle sprain, Van Buskirk anecdotally reports that he has seen resolution of their symptoms within one or two treatments. However, this ankle technique was used in the context of a whole osteopathic treatment where more than one isolated restriction was present and also treated.

As there has been no formal investigation of the Still technique, the purpose of the current study was to test the efficacy of the Still technique on the talocrural joint in subjects with a history of ankle injury.
METHODS

Participants

Volunteers participated in this study and were recruited from the student body at Unitec NZ. Participants were eligible for the study if they: 1) Had a history of ankle injury in the previous five years; 2) Were between 18 and 50 years of age.

Participants were excluded from the study if they were currently in pain or receiving treatment for a lower limb complaint. Participants were excluded if they: 1) Had any condition that affected the integrity of the musculoskeletal system i.e. nerves, muscles, joints etc. 2) Any other systemic disease. To give appropriate power to the study, effect size calculations were made following a group-sequential design to determine the required sample size. Sampling was stopped when further sampling was not feasible given the constraints of the project.

Study Design

The design was a randomized, blinded and controlled experiment as illustrated in Figure 1. The dependent variable was the angle of dorsiflexion and independent variable was the technique being tested. The measurement of dorsiflexion was used because clinically dorsiflexion and plantarflexion is used in a physical examination to determine if there is restriction in the talocrural joint.
**DATA COLLECTION**

**Measurement**

A hand held force dynamometer (model: Chatillon, Ametek, Inc., Largo, FL, USA) was used to apply force to a custom made acrylic footplate attached to the participant’s ankle and ROM was measured using an magnetometer (Model: 3DM, MicroStrain, Inc., Williston, VT, USA) attached to the footplate (see figure 3). The magnetometer was interfaced with a personal computer running custom written data acquisition and analysis software (LabView, National Instruments, Austin, Tx, USA). The magnetometer measures angular motion (in degrees) in all three planes simultaneously and has accuracy similar to digital video.\(^2^2\) The measurement used in the experiment was tested in a preliminary study and found to have excellent test re-test reliability (ICC= 0.975) and a smallest detectable difference (SDD) of 5.9 degrees [see Appendix B].\(^2^3\)

**Technique**

The technique applied to talocrural joint by the practitioner, is described by Van Buskirk\(^1\) as follows:

1. Ankle is grasped above the malleoli by the ‘sensing hand’.
2. Operating hand grasps the plantar aspect and calcaneus of the foot and introduces internal rotation and supination.
3. Five pounds [~2kg] of force is introduced in either traction or compression.
4. The foot is then pronated, dorsiflexed and the forefoot externally rotated a bit.
5. The force vector is then released and returned to neutral.
Sham Technique

The sham procedure involved moving the ankle through its ROM for the same duration of time as the experimental technique. There was no use of traction or compression or feeling for a release in the joint. The technique was intended to replicate the experimental technique and was conducted as follows:

1. Ankle is grasped above the malleoli by the ‘sensing hand’.
2. Operating hand grasps the plantar aspect and calcaneus of the foot and introduces internal rotation and supination.
3. The foot is then pronated, dorsiflexed and the forefoot externally rotated a bit.
4. The foot is returned to neutral.

Testing Procedure

During the data collection sessions, the practitioner was the only person aware of the group allocation for each of the subjects. The practitioner selected one of five pre-determined, randomly generated lists. The subjects were split into control and experimental groups as per Figure 1, using the randomised list generated by an online random number generator. The participants were taken into the experimental room one by one; the principal researcher performed the dorsiflexion measurements before and after each treatment. Before beginning the testing procedure 5 squats were used as a preconditioning procedure for the muscles and joints of the ankle complex. To determine whether the side with the history of injury was the most restricted side the ‘knee to the wall principle’ (see figure 2) was used as a measurement of dorsiflexion.
in weight bearing. This was done to confirm that the side with the history of injury was the most restricted and suitable for this experiment.

[Insert Figure 2]

The subject then lay supine on a standard treatment table with their leg bent up at 90 degrees and the lower leg supported by a brace. The subject was secured to the brace with straps to restrict movement only to the ankle joint and a footplate was strapped to the foot (see figure 3).

[Insert Figure 3]

The tester applied three initial dorsiflexion movements to further prepare the joint for testing and allow the ankle to adjust to the weight of the footplate. The 3DM magnetometer was attached to the footplate and the device and software was reset. The dynamometer was then used to apply force to take the ankle to full range and the amount of force was recorded (as in Figure 3). The range of motion of three successive dorsiflexion movements was recorded. The principal researcher left the room after removing the footplate and then the practitioner performed the experimental or sham technique. The intervention was performed with the leg in the braced position and performed three times in succession. The measurements were then made post intervention by the tester. The highest dynamometer force value from the three pre-test measurements was then used as the post experimental value for applying the three post-test measurements. Raw data was saved to hard drive for later analysis.
Analysis

Mean and standard deviations were calculated for the subject variables. Paired Student t-tests were used to compare the difference in the mean ROM for dorsiflexion between control and experimental groups. Cohen’s effect sizes ($d$) were calculated and interpreted according to the criteria suggested by Cohen where “anything greater than 0.5 is large, 0.5-0.3 is moderate, 0.3-0.1 is small, and anything smaller than 0.1 is insubstantial”.

Further analysis was undertaken to identify individual responses of the participants to the technique, as it was possible that some subjects may respond better to the technique than others due to the differences in morphology, restrictions at the ankle and responsiveness to manual therapy. Using the initial dorsiflexion ROM data and assuming a normal distribution, cut-offs were determined using $Z = \frac{X - \mu}{\sigma}$ to group the subjects pre-intervention ROM. The distribution was divided into thirds based on the average and standard deviation from the preliminary study [Appendix A]. Those subjects with initial ROM below 64.2 degrees were classified ‘below average’; those between 64.2 and 75.8 ‘average’ and those above 75.8 were classified ‘above average’.

Microsoft Office Excel 2000 was used to tabulate the data and calculate the means, SD and effect sizes. The data was analysed using SPSS v14.0 (SPSS Inc. Chicago, IL).
RESULTS

There was no withdrawal of participants from any stage of data collection and no subjects reported any lower limb pain or discomfort during the study (see table 1). A comparison of the pre and post intervention control group (n=16) means revealed a mean change of 1.5º (p= 0.163; d= 0.10) (95% CI= -0.6 to 3.6) (see table 2; figure 4). A comparison of the pre and post intervention experimental group (n=16) means revealed a mean change of 3.8º (p= 0.18; d=0.34) (95% CI= 0.75 to 6.8) (see table 3; figure 5).

The dorsiflexion data was also arranged into pre and post intervention categories with the predetermined cut-offs (see tables 4,5 and 6). Post hoc power analysis of the experimental group data (employing effect size d=0.34 n=16 α=0.05) revealed an observed power of 0.245.

[Insert Table 1: Subject characteristics]

[Insert Table 2: Dorsiflexion measurements from control group]

[Insert Figure 4: Dorsiflexion measurements from control group]

[Insert Table 3: Dorsiflexion measurements from experimental group]

[Insert Figure 5: Dorsiflexion measurements from experimental group]
[Insert Table 4: Pre intervention category]

[Insert Table 5: Final dorsiflexion category]

[Insert Table 6: Dorsiflexion percentage increase]
DISCUSSION

Overview

The aim of this study was to investigate efficacy of the Still technique on dorsiflexion range of motion at the talocrural joint in individuals with a history of ankle injury. There was no substantial difference between the control and experimental groups in this study, however, when reviewing individual responses, 5 of the 16 subjects demonstrated improvements in ROM that were greater than the SDD. This compares with 1 in 16 in the sham group.

Literature

In the literature it appears that this study is the first to investigate the effect of the Still Technique on talocrural ROM. There are studies focusing on other techniques used on the talocrural joint to improve ROM, ranging from thrust manipulation, \textsuperscript{9,10,12,14,17} balanced ligamentous tension (BLT), \textsuperscript{11} mobilization with movement (MWM), \textsuperscript{13} a combination of manipulation, mobilization and gliding techniques (including patient exercises) \textsuperscript{18} and a gentle end range oscillatory technique with a RICE protocol.\textsuperscript{15}

The current study used a method of measuring dorsiflexion adapted from Moseley and Adams\textsuperscript{21} that used a magnetometer to measure the angle of dorsiflexion in real time as opposed to measuring from photographs using software. Repeatability was found to be excellent (ICC=0.97 ) from preliminary testing of the experimental method. In comparing the methods of measurement of dorsiflexion in the literature five of the nine studies used an adapted method from the procedure developed by Moseley and
Adams. The repeatability of method was shown in these studies to be excellent with ICC’s ranging from 0.94 to 0.97. Green et al was the only study in this group to show substantial improvement in dorsiflexion post intervention, however it was the only study that used multiple sessions and a combined treatment.

In the other four studies, three of them used a goniometer to measure dorsiflexion ROM and one used the knee to the wall principle. None of the goniometer measurement studies calculated ICC’s for their method but quoted high reliability from previous research. Collin et al found excellent repeatability for their knee to wall measurement with an ICC=0.99. These four studies all used a method of dorsiflexion measurement that was reliant on the visual estimation of the researcher and could add error to the findings.

All four of these studies found improvements in dorsiflexion post intervention. Of these four studies three of them did not investigate a technique in isolation and involved multiple treatments, only one investigated a techniques during one session and one was a case study with only one subject.

Dananberg, Shearstone and Guiliano found an increase in range of movement in subjects with ankle equines following a manipulation to the fibular head and the talocrural joint but their study design had no control group or sham treatment and their dorsiflexion measurement was not as reliable used in the current study. Green et al also found improvements in dorsiflexion and pain behaviour during their study but they were testing a treatment procedure that lasted over two weeks of various treatment sessions and combined different treatment approaches (i.e. taping and application of RICE) as well as the oscillatory intervention and would be hard to link
that the oscillation technique was solely responsible for the results. Pellow and Brantingham\textsuperscript{17} investigated the changes in the talocrural joint over a series of treatments and found improvements but could not account for any possible variable causing changes in between sessions and there was a certain bias in the fact that all patients were chosen from a chiropractic clinic. The patients would have an expectation bias due to this being their usual treatment choice.

The findings in the current study are consistent with previous studies looking at thrust manipulation (direct technique) of the talocrural joint and its effect on range of motion in dorsiflexion.\textsuperscript{9,10,12} The findings are also consistent with those of Ricketts\textsuperscript{11} who investigated balanced ligamentous tension (BLT). The results in these studies did show small change from pre to post treatment in the experimental groups but were reported as not statistically significant, however, closer analysis of the published data indicates the typical effect sizes for manipulation and BLT range from insubstantial to moderate (0.03 to 0.44).

**Internal validity: strengths/limitations/weaknesses**

The sham utilized in this experiment was designed to closely match the actual technique. Only those familiar with the actual technique may have noted the subtle difference in intention and movements between the real and sham procedures. Although some of the participants had experience with a variety of osteopathic technique, this technique is not taught in the osteopathic school so the subjects were not familiar with it and blinding was maintained.
A ‘moderate’ effect size was observed for the change in range of dorsiflexion in the experimental group. Post hoc analysis indicates that this study was clearly underpowered and more subjects would have improved power. For a definitive study, an additional 56 subjects per group to achieve a power closer to 0.8 would be necessary, however, this scale of recruitment was not possible due to logistical constraints.

The study could also be improved by using the subject’s other ankle as a control but each ankle could have its own degree of restriction and less restricted ankle may not be non symptomatic. In setting up this experiment all steps were taken to control positioning of the leg and isolate the ankle by restricting the movement of the knee but some trivial movement remained. This was not important however in context of the other errors (e.g. biological) and also the fact that the magnetometer was able to filter out movements to specific planes. Measurements could have also been conducted on the subjects at a later time period or periods to determine if the technique had a lasting effect.

**External validity**

This study investigated the application of one technique in a controlled situation. The study is therefore a treatment study aimed at a specific target problem and not comparable to a whole treatment situation. In this case, the experiment can only show what happens to the talocrural joint at the time of experimentation. An effectiveness study on the other hand would look more at functional outcomes in the context of whole treatment sessions to determine if a treatment approach helps.
Further work

Further work in this area could investigate other outcome measures to compare them in the same protocol with ROM of the talocrural joint i.e. pain pressure threshold or proprioception. This would help to determine which measure is most influenced by the Still technique. Treatment prediction rules could be investigated also, as certain patients did seem to respond well to the technique. These rules allow clinicians to quantify the contribution of specific patient characteristics. Identifying these characteristics would allow better application of the Still technique in clinical practise.

Investigating the Still technique in an effectiveness study could also be useful to see how it applies in a real clinical setting. Following patients through a series of sessions and analysing their functional changes with a questionnaire (i.e. ability to perform certain normal tasks) after each visit.
CONCLUSION

It has been shown that the application of the Still technique did not alter substantially the ROM at the talocrural joint between the control and experimental groups on average, rather it did show a range of responses. Some subjects did respond to the single treatment and further investigation into the characteristics of these responsive patients could be warranted as well as comparison with other outcome measures.
Acknowledgments

The author thanks Lewis Wood physiotherapist and osteopathic student for his expertise in the application of manual therapy.
REFERENCES


23 Taylor N. *3DM electrogoniometer reliability study* Auckland: Unitec, 2007


SECTION III – APPENDICES
Figure 1 - CONSORT study flowchart

Assessed for eligibility (n= 33)

Excluded (n= 1)
Not meeting inclusion criteria (n= 1)
Refused to participate (n= 0)
Other reasons (n= 0)

Enrolment

Randomized

Experimental
Allocated to intervention (n= 16)
Received allocated intervention (n= 16)
Did not receive allocated intervention (n= 0)

Lost to follow-up (n=0)
Discontinued intervention (n= 0)

Analyzed (n=16)
Excluded from analysis (n= 0)

Control
Allocated to intervention (n=16)
Received allocated intervention (n= 16)
Did not receive allocated intervention (n= 0)

Lost to follow-up (n=0)
Discontinued intervention (n= 0)

Analyzed (n= 16)
Excluded from analysis (n= 0)
Figure 2 - Knee to the wall dorsiflexion measure. Dorsiflexion was measured using this method at the last point when the participant was able to keep both the knee (B) and the heel (A) in contact with the wall and floor respectively. If the heel lost contact with the floor the foot would be moved towards the wall until contact at the knee and at the heel could be maintained. The wooden bar (C) was used to align the ruler fixed (C) to the floor. The measurement (X) was then recorded.
Figure 3 - Experimental setup. Each participant was asked to lie supine on the treatment table with the leg flexed at ninety degrees and strapped into the leg brace (D) with closed cell foam inserts to prevent constriction from the straps. The acrylic footplate (B) was attached to the foot and the 3DM magnetometer (A) was attached to the footplate with hook and loop fastening fabric tape. Dorsiflexion of the talocrural joint was performed using the force dynamometer (C) and the amount of force required to get to end range was recorded.
Figure 4 - Control group results
Figure 5 - Dorsiflexion measurements for experimental group
### Table 1 - Subject characteristics

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**Notes**

SD = standard deviation
Table 2 - Dorsiflexion measurements from the control group

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Table 3 - Dorsiflexion measurements from the experimental group

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<td>-0.8</td>
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</table>

Mean | 69.3 | 73 | 5.2 |

SD | 11.8 | 10.6 |
Table 4 - Pre intervention initial category comparison for participants’ dorsiflexion ROM

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<tr>
<th></th>
<th>Subject Totals</th>
<th>Below Average ROM&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Average ROM&lt;sup&gt;2&lt;/sup&gt;</th>
<th>Above Average ROM&lt;sup&gt;3&lt;/sup&gt;</th>
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<tr>
<td>Experimental</td>
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<td>6</td>
<td>6</td>
<td>4</td>
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</tbody>
</table>

1. Less than 64 degrees.
2. Between 64 and 76 degrees.
3. Greater than 76 degrees.
Table 5 - Final dorsiflexion ROM category comparison for participants

<table>
<thead>
<tr>
<th></th>
<th>Subject Totals</th>
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<th>No change</th>
<th>ROM Increased</th>
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<tr>
<td>Experimental</td>
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<td>1</td>
<td>10</td>
<td>5</td>
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</tbody>
</table>

1. Increased range defined as ≥6°.
2. No effect defined as within +/- 6°.
3. Decreased range defined as ≤ 6°.
Table 6 - Dorsiflexion ROM percentage increase of participants

<table>
<thead>
<tr>
<th></th>
<th>% of subjects with decreased ROM.</th>
<th>% of subjects with no change.</th>
<th>% Of subjects with increased ROM.</th>
</tr>
</thead>
<tbody>
<tr>
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<td>87.5</td>
<td>6.25</td>
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<td>62.5</td>
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Appendix B – Reliability Study

Test-retest reliability of ankle dorsiflexion measurement using a 3DM Magnetometer

Introduction

Reliability of a measurement device is important because “better reliability implies better precision of single measurements and better tracking of changes in measurements in research or practical settings” (W. G. Hopkins, 2000). This study was conducted in preparation for testing the efficacy of an osteopathic technique on range of motion at the ankle and to examine the reliability of ankle dorsiflexion range of motion measurement (ROM) using a magnetometer. The 3DM magnetometer used here is a “a 3-axis orientation sensor capable of measuring: 180° of yaw heading, 180° of pitch, and 70° of roll” (Microstrain, 2008). This device has many applications in different industries but was adapted for use in this study using computer software. To the authors knowledge the magnetometer has only been used in one other study to investigate dorsiflexion ROM at the ankle (Ricketts, 2005), and because of this there is little data regarding its reliability for this purpose. Therefore the aim of this study is to determine the test-retest reliability and quantify the smallest detectable difference (SDD) in measurement of ankle dorsiflexion.
Methods

Participants

To be able to generalise the results of this study to treatment intervention studies, volunteers with a history of ankle injury were recruited for this study. These subjects were recruited from Unitec NZ. Participants were eligible for the study if they: 1) had a history of ankle injury in the previous five years. 2) Were between 18 and 50 years of age. Participants were excluded from the study if they were currently in pain or receiving treatment for a lower limb complaint. Participants were excluded if they 1) Had any condition that affected the integrity of the musculoskeletal system i.e. nerves, muscles, joints etc. 2) Any other systemic disease.

Study Design

A test-retest repeated measures design was employed. Ankle dorsiflexion of all participants was measured for three consecutive trials within the same session.

Data Collection

Measurement

A hand held force dynamometer (model: Chatillon, Ametek, Inc., Largo, FL, USA) was used to apply force to a footplate attached to the participant’s ankle and ROM was measured using the magnetometer (Model: 3DM, MicroStrain, Inc., Williston, VT, USA) attached to an acrylic custom made footplate. The magnetometer was interfaced with a personal computer running custom written data acquisition and
analysis software (LabView, National Instruments, Austin, Tx, USA). This system which measures angular motion (in degrees) in all three planes simultaneously and has been demonstrated as reliable as using digital video (McLaughlin & Vaughan, 2004).

**Procedure**

The participants were taken into the experimental room individually. Before beginning the testing procedure 5 squats were used as a preconditioning procedure for the muscles and joints of the ankle complex. Next an initial measurement was made to find the most restricted ankle. To determine whether the side with the history of injury was the most restricted side the ‘knee to the wall principle’ [see Section II, Appendix A, Figure 2 p58 for knee to wall measurement] was used as a measurement of dorsiflexion in weight bearing (Collins, Teys, & Vicenzino, 2004). If one ankle had less dorsiflexion ROM than the other ankle it was considered suitable for the experiment.

The subject then lay supine on a standard treatment table with their leg bent up at 90 degrees and the lower leg supported by a brace. The subject was secured to the brace with straps to restrict movement only to the ankle joint and a footplate was strapped to the foot [see Section II, Appendix A, Figure 3 p59 for experimental setup].

The tester applied three dorsiflexion movements to further prepare the joint for testing and allow the ankle adjust to the weight of the footplate. The 3DM magnetometer was attached to the footplate and the device and software was reset. The dynamometer was then used to apply force to take the ankle to full range and the
magnitude of force was recorded. The range of motion of three consecutive
dorsiflexion movements was recorded.

**Data Analysis**

Mean and standard deviations (SD) were calculated for all variables. Intra-class
correlation coefficients (ICC) and the smallest detectable difference (SDD) were
calculated to analyze the reliability of the measurements. The intra-class correlation
coefficient was calculated using the spreadsheet published by Hopkins (2000). The
ICC was then used to calculate the standard error of measurement (SEM) and the
SDD using the following calculations (Potter, McCarthy, & Oldham, 2006):

\[
\text{SEM} = \text{SD} \left( \sqrt{1 - \text{ICC}} \right)
\]

\[
\text{SDD} = 1.96 \times \sqrt{2}\text{SEM}
\]

Microsoft Office Excel 2000 was used to tabulate the data and calculate the mean and
SD.
Results

Thirty-two participants took part in this study (Table 1). Thirteen females (n=13) and nineteen males (n=19) aged between eighteen and forty seven years (mean age of 28.3 years SD= 8.3). The test-retest coefficient was ‘almost perfect' and SDD was 5.9 degrees (Table 2).
Table 1 – 3DM magnetometer measurement data (degrees)

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<td>72.0</td>
<td>72.4</td>
<td>71.6</td>
<td></td>
</tr>
<tr>
<td>63.1</td>
<td>59.2</td>
<td>57.5</td>
<td>59.9</td>
<td></td>
</tr>
<tr>
<td>79.5</td>
<td>82.4</td>
<td>80.6</td>
<td>80.9</td>
<td></td>
</tr>
</tbody>
</table>

Mean 70.0
SD 13.5
Table 2 – Test-retest reliability data

<table>
<thead>
<tr>
<th>Statistic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICC</td>
<td>0.975</td>
</tr>
<tr>
<td>SEM</td>
<td>2.14 degrees</td>
</tr>
<tr>
<td>SDD</td>
<td>5.9 degrees</td>
</tr>
</tbody>
</table>
Discussion

Using the descriptors for reliability described by Hopkins (2000), the test-retest reliability was ‘almost perfect’. The measurement of dorsiflexion at the talocrural joint was found to have smallest detectable difference of 6 degrees. Thus any change in range of motion resulting from an intervention in the main study with a difference of ± 6 degrees when comparing the pre and post measurements would be considered as a change beyond measurement error, that is, a ‘real change’ arising from the intervention not attributable to error.
References


Appendix C – Ethics Resources

The efficacy of a novel osteopathic technique on range of motion at the ankle in individuals with a history of ankle injury

Consent Form

This research project investigates the efficacy of an osteopathic technique on the range of motion of the ankle. The research is being undertaken by Nicholas Taylor from Unitec New Zealand, and will be supervised by Rob Moran and Dr Andrew Stewart.

Name of Participant: ……………………………………………………………………………………..

I have seen the Information Sheet dated ………………………………..for people taking part in the study, titled ‘The efficacy of a novel osteopathic technique on range of motion at the ankle in individuals with a history of ankle injury’. I have had the opportunity to read the contents of the information sheet and to discuss the project with the researcher and I am satisfied with the explanations I have been given. I understand that taking part in this project is voluntary (my choice) and that I may withdraw up until the point at which data analysis is started (approximately 10 days after the data collection session) and this will in no way affect my access to the services provided by Unitec New Zealand or any other support service.

I understand that I can withdraw from the study up until the point at which data analysis is started, if for any reason I want to do this.

I understand that my participation in this project is confidential and that no material that could identify me will be used in any reports on this project.

I have had enough time to consider whether I want to take part.

I know whom to contact if I have any questions or concerns about the project.
Nicholas Taylor (ph. 09 52476367 / romovia@hotmail.com)

Participant Signature……………………………………………………………..(date)

Project explained
by……………………………………………………………………………………

Signature……………………………………………………………………………..(date)

The participant should retain a copy of this consent form.
UREC REGISTRATION NUMBER: (2007.706)
This study has been approved by the Unitec Research Ethics Committee from 27 June 2007 to 31 December 2008. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Committee through the UREC Secretary (Tel: + 64 9 815-4321 ext 7248 or by email ethics@unitec.ac.nz). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.
The efficacy of a novel osteopathic technique on range of motion at the ankle in individuals with a history of ankle injury

Information Sheet
About this research

You are invited to take part in a research project that is investigating an osteopathic technique for the ankle joint.
This study investigates whether the technique changes the range of movement at the ankle joint (talocrural joint).

If you choose to participate you’ll need to undertake the following:

1. Meeting with the researcher for a brief initial screening to ensure eligibility for the project. (10min)
2. Signing the consent form once all information has been received.
3. Attend 1 data collection session taking approximately 20 minutes.
4. Avoid any treatment, exercise or any exercise related activity (running etc) on the day of testing, which could stress the ankle joint.

Each data collection session involves:

1. You’ll be asked to perform a ‘warm up’ by squatting 5 times.
2. Firstly ankle movements will be measured using a digital inclinometer. Participant will be asked to lie on table with knee flexed to 90 degrees, and supported in a brace. The researcher will then assess the range of movement of the ankle joint.
3. Next the osteopathic technique will be applied.
4. The ankle range of movement will be measured again as mentioned in step two.

The Researcher

The primary researcher is Nicholas Taylor
This project is being supervised by Rob Moran and Dr Andrew Stewart.

You have the right to not participate, or withdraw from this research project at any time until the beginning of data analysis. This can be done by phoning us or by telling us when we contact you that you do not want to participate.
Getting help

Please contact either one of us should you have any questions about this project.

Nicholas Taylor: Rob Moran:
Email: osteothesis@gmail.com rmoran@unitec.ac.nz
Phone: 09 524 7636 09 815 4321 ext 8642
Mobile: 021 137 1745

Information and Concerns

If you want further information about the project or if, at any time you are concerned or confused about the research project you can call or email Nicholas Taylor at the above address.

If you have concerns about the way in which the research is being conducted you can contact the following:

Health Advocates: Advocates Network Services Trust, Phone (09) 623 5799, 0800 205 555, Fax (09) 623 5798, PO Box 9983, Newmarket, Auckland.

Confidentiality

Confidentiality and your anonymity will be protected in the following ways:

Anonymity – participants will not be identified in any way connected to this research. Their names will be collected, however they will only be known to the researcher. All details will be stored either in a locked filing cabinet or password protected files; only the researcher will have access.

Data Storage – Data will be securely stored both electronically and on paper as described above. Names of participants will be separated from this data to maintain anonymity. All data will be destroyed after a period of five years in an appropriate manner, in accordance with Unitec New Zealand policy.

A copy of the final report will be available at the Unitec New Zealand library. All participants are welcome to view this. Summaries and recommendations may be published in research journals.

Finally, we would like to thank you for your valuable contribution to this research.

UREC REGISTRATION NUMBER: (2007.706)
This study has been approved by the Unitec Research Ethics Committee from 27 June 2007 to 31 December 2008. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Committee through the UREC Secretary (Tel: + 64 9 815-4321 ext 7248 or by email ethics@unitec.ac.nz). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.
Participant Information

Please circle the appropriate option or complete details in the corresponding boxes.

Name: ________________________________

Gender:  Male  Female

Date of Birth: ____________________

Ankle injury in the last 5 years:  Yes  No

Brief details of injury (i.e. ankle sprain): ____________________________

Completed by Researcher.

Height (cm): ____________________

Weight (kg): ____________________

Dorsiflexion Screen measurement:  Left  Right

Restricted Ankle (Circle):  Left  Right

Dorsiflexion Measurement Post Experimental  

Dynanometer readings (circle maximum)  

UREC REGISTRATION NUMBER: (2007.706)

This study has been approved by the Unitec Research Ethics Committee from 27 June 2007 to 31 December 2008. If you have any complaints or reservations about the ethical conduct of this research, you may contact the Committee through the UREC Secretary (Tel: + 64 9 815-4321 ext 7248 or by email ethics@unitec.ac.nz). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.
Appendix D – Instruction for authors for manuscript submission

Guide for Authors

Former title: Journal of Osteopathic Medicine

The journal Editors welcome contributions for publication from the following categories: Letters to the Editor, Reviews and Original Articles, Commentaries and Clinical Practice case studies with educational value.

Online Submission

Submission to this journal proceeds totally online. (http://ees.elsevier.com/ijom) you will be guided stepwise through the creation and uploading of the various files. The system automatically converts source files to a single Adobe Acrobat PDF version of the article, which is used in the peer-review process. Please note that even though manuscript source files are converted to PDF at submission for the review process, these source files are needed for further processing after acceptance. All correspondence, including notification of the Editor’s decision and requests for revision, takes place by e-mail and via the Author’s homepage, removing the need for a hard-copy paper trail.

The above represents a very brief outline of this form of submission. It can be advantageous to print this "Guide for Authors" section from the site for reference in the subsequent stages of article preparation.

Submission of an article implies that the work described has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the responsible authorities where the work was carried out, and that, if accepted, it will not be published elsewhere in the same form, in English or in any other language, without the written consent of the Publisher.

Types of contributions

Letters to the Editor as is common in biomedical journals the editorial board welcomes critical response to any aspect of the journal. In particular, letters that point out deficiencies and that add to, or further clarify points made in a recently published work, are welcomed. The Editorial Board reserves the right to offer authors of papers the right of rebuttal, which may be published alongside the letter.

Reviews and Original Articles These should be either i) reports of new findings related to osteopathic medicine that are supported by research evidence. These should be original, previously unpublished works. The report will normally be divided into the following sections: abstract, introduction, materials and methods, results, discussion, conclusion, references. Or ii) critical or systematic review that seeks to summarise or draw conclusions from the established literature on a topic relevant to osteopathic medicine.

Short review The drawing together of present knowledge in a subject area, in order to provide a background for the reader not currently versed in the literature of a particular topic. Shorter in length than and not intended to be as comprehensive as that of the literature review paper. With more emphasis on outlining areas of deficit in the current literature that warrant further investigation.

Research Note Findings of interest arising from a larger study but not the primary aim of the research endeavour, for example short experiments aimed at establishing the reliability of new equipment used in the primary experiment or other incidental findings of interest, arising from, but not the topic of the primary research. Including further clarification of an experimental protocol after addition of further controls, or statistical reassessment of raw data.

Preliminary Findings Presentation of results from pilot studies which may establish a solid basis for further investigations. Format similar to original research report but with more emphasis in discussion of future studies and hypotheses arising from pilot study.

Commentaries Include articles that do not fit into the above criteria as original research. Includes commentary and essays especially in regards to history, philosophy, professional, educational, clinical, ethical, political and legal aspects of osteopathic medicine.
Clinical Practice Authors are encouraged to submit papers in one of the following formats: Case Report, Case Problem, and Evidence in Practice.

Case Reports usually document the management of one patient, with an emphasis on presentations that are unusual, rare or where there was an unexpected response to treatment eg. an unexpected side effect or adverse reaction. Authors may also wish to present a case series where multiple occurrences of a similar phenomenon are documented. Preference will be given to reports that are prospective in their planning and utilise Single System Designs, including objective measures.

The aim of the Case Problem is to provide a more thorough discussion of the differential diagnosis of a clinical problem. The emphasis is on the clinical reasoning and logic employed in the diagnostic process.

The purpose of the Evidence in Practice report is to provide an account of the application of the recognised Evidence Based Medicine process to a real clinical problem. The paper should be written with reference to each of the following five steps: 1. Developing an answerable clinical question. 2. The processes employed in searching the literature for evidence. 3. The appraisal of evidence for usefulness and applicability. 4. Integrating the critical appraisal with existing clinical expertise and with the patient’s unique biology, values, and circumstances. 5. Reflect on the process (steps 1-4), evaluating effectiveness, and identifying deficiencies.

Presentation of Typescripts

Your article should be typed on A4 paper, double-spaced with margins of at least 3cm. Number all pages consecutively beginning with the title page.

To facilitate anonymity, the author’s names and any reference to their addresses should only appear on the title page. Please check your typescript carefully before you send it off, both for correct content and typographic errors. It is not possible to change the content of accepted typescripts during production.

Papers should be set out as follows, with each section beginning on a separate page:

Title page
To facilitate the peer-review process, two title pages are required. The first should carry just the title of the paper and no information that might identify the author or institution. The second should contain the following information: title of paper; full name(s) and address(es) of author(s) clearly indicating who is the corresponding author; you should give a maximum of four degrees/qualifications for each author and the current relevant appointment only; institutional affiliation; name, address, telephone, fax and e-mail of the corresponding author; source(s) of support in the form of funding and/or equipment.

Keywords
Include three to ten keywords. These should be indexing terms that may be published with the abstract with the aim of increasing the likely accessibility of your paper to potential readers searching the literature. Therefore, ensure keywords are descriptive of the study. Refer to http://www.nlm.nih.gov/mesh/meshhome.html for the MeSH thesaurus.

Abstract
Both qualitative and quantitative research approaches should be accompanied by a structured abstract. Commentaries and Essays may continue to use text based abstracts of no more than 150 words. All original articles should include the following headings in the abstract as appropriate: Background, Objective, Design, Setting, Methods, Subjects, Results, and Conclusions. As an absolute minimum: Objectives, Methods, Results, and Conclusions must be provided for all original articles. Abstracts for reviews of the literature (in particular systematic reviews and meta-analysis) should include the following headings as appropriate: Objectives, Data Sources, Study Selection, Data Extraction, Data Synthesis, Conclusions. Abstracts for Case Studies should include the following headings as appropriate: Background, Objectives, Clinical Features, Intervention and Outcomes, Conclusions.

Text
The text of observational and experimental articles is usually, but not necessarily, divided into sections with the headings; introduction, methods, results, results and discussion. In longer articles, headings should be used only to enhance the readability. Three categories of headings should be used:
• major ones should be typed in capital letter in the centre of the page and underlined
• secondary ones should be typed in lower case (with an initial capital letter) in the left hand margin and underlined
• minor ones typed in lower case and italicised

Do not use ‘he’, ‘his’ etc. here the sex of the person is unknown; say ‘the patient’ etc. Avoid inelegant alternatives such as ‘he/she’. Avoid sexist language.

Statement of Competing Interests
When submitting a Research report you will need to consider if you, or any of your co-authors, are an Editor or Editorial Board member of the International Journal of Osteopathic Medicine. If this is the case you will need to include a section, at the end of your manuscript immediately before the reference section, called "Statement of Competing Interests". Example statement, which may require editing, is as follows: {Name of author} is an Editor of the Int J Osteopath Med; {Name of author} is a member of the Editorial Board of the Int J Osteopath Med but was not involved in review or editorial decisions regarding this manuscript.

References
Responsibility for the accuracy of bibliographic citations lies entirely with the Authors.

Citations in the text: Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Avoid using references in the abstract. Unpublished results and personal communications are not recommended in the reference list, but may be mentioned in the text. If these references are included in the reference list they should follow the standard reference style of the journal and should include a substitution of the publication date with either "Unpublished results" or "Personal communication" Citation of a reference as "in press" implies that the item has been accepted for publication.

Text: Indicate references by superscript numbers in the text. The actual Authors can be referred to, but the reference number(s) must always be given.

List: Number the references in the list in the order in which they appear in the text.

Examples:
Reference to a journal publication:

Reference to a book:

Reference to a chapter in an edited book:

Note shortened form for last page number. e.g., 51-9, and that for more than 6 Authors the first 6 should be listed followed by "et al." For further details you are referred to "Uniform Requirements for Manuscripts submitted to Biomedical Journals" (J Am Med Assoc 1997;277:927-934) (see also http://www.nejm.org/general/text/requirements/1.htm)

Citing and listing of Web references. As a minimum, the full URL should be given. Any further information, if known (Author names, dates, reference to a source publication, etc.), should also be given. Web references can be listed separately (e.g., after the reference list) under a different heading if desired, or can be included in the reference list.

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State the purpose of the article. Summarise the rationale for the study or observation. Give only strictly pertinent references and do not review the subject extensively. Do not include data or conclusions from the work being reported.

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Describe your selection of observational or experimental subjects (including controls). Identify the methods, apparatus (manufacturer’s name and address in parenthesis) and procedures in sufficient detail to allow workers to reproduce the results. Give references and brief descriptions for methods that have been published but are not well known; describe new methods and evaluate limitations.

Indicate whether procedures followed were in accordance with the ethical standards of the institution or regional committee responsible for ethical standards. Do not use patient names or initials. Take care to mask the identity of any subjects in illustrative material.

Results
Present results in logical sequence in the text, tables and illustrations. Do not repeat in the text all the data in the tables or illustrations. Emphasise or summarise only important observations.

Discussion
Emphasise the new and important aspects of the study and the conclusions that follow from them. Do not repeat in detail data or other material given in the introduction or the results section. Include implications of the findings and their limitations, include implications for future research. Relate the observations to other relevant studies. Link the conclusion with the goals of the study, but avoid unqualified statements and conclusions not completely supported by your data. State new hypothesis when warranted, but clearly label them as such. Recommendations, when appropriate, may be included.

Ethical considerations
Human subjects. The International Journal of Osteopathic Medicine endorses the ICMJE guidelines, the Declaration of Helsinki and all related conditions regarding the experimental use of human subjects and their informed consent will apply. Projects that should go through approval from an ethics review board/committee or IRB should clearly include this statement in the Methods section. Manuscripts that report the results of experimental investigations with human subjects must include a statement that informed consent was obtained (in writing, from the subject or legal guardian) after the procedure(s) had been fully explained. Written informed consent for publication in both paper and electronic media needs to be obtained from patients for case reports, case series, and retrospective designs.

Patient anonymity. Studies on patients or volunteers require ethics committee approval and informed consent which should be documented in your paper. Patients have a right to privacy. Therefore identifying information, including patients’ images, names, initials, or hospital numbers, should not be included in videos, recordings, written descriptions, photographs, and pedigrees unless the information is essential for scientific purposes and you have obtained written informed consent for publication in print and electronic form from the patient (or parent, guardian or next of kin where applicable). If such consent is made subject to any conditions,
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1) Contributions to conception and design; data acquisition; data analysis and interpretation;
2) Drafting of manuscript, or critical revision for important intellectual content;
3) All authors must have given approval to the final version of the manuscript submitted for consideration to publish.

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Example of suggested format. Note the use of author initials.

AB conceived the idea for the study. AB and CD contributed to the design and planning of the research. All authors were involved in data collection. AB and EF analysed the data. AB and CD wrote the first draft of the manuscript. EF coordinated funding for the project. All authors edited and approved the final version of the manuscript.

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