Massage Therapists' Association of British Columbia

Clinical Case Report Competition

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First Place Winner

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The effects of manual and massage therapy on chronic inversion ankle sprain

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C A S E   R E P O R T

The Effects of Manual and Massage Therapy on a Chronic Inversion Ankle Sprain

Abstract

Objective: This study investigated the efficacy of specific manual therapy and massage techniques to the injured and surrounding tissues of the ankle complex. The goal of this study is a return to full ROM, decrease pain, as well as complete return to activity.

Case Selection: Individuals, males or females, between the ages of 18 and 40 with no history of an inversion ankle sprain in the past 24 months would be acceptable for this study. A 23 year old female with no prior inversion sprain in the past 36 months was used for this case report.

Methods: A protocol of five sixty minute treatments over a period of 21 days was strictly adhered to. Manual and Massage Therapy techniques were applied. The majority of each treatment was comprised of Active Myofascial Release, denoted as (AMR), and transverse frictions. The focus of the treatments was on the lateral ankle ligaments along with the tendons that cross the ankle complex. However, osseous, capsular, muscular, and superficial tissues in the area were also affected.

Results: Patient experienced an increase in dorsi and plantar flexion as well as an increase daily activities and decrease in pain in the affected limb.

Conclusion: For this patient, manual and massage therapy techniques in conjunction with hydrotherapy and rehabilitation exercises are able to return lost range of motion (dorsi & plantar flexion) to an ankle in the chronic stage of an inversion sprain injury. However, further research needs to be compiled to derive the efficacy of the protocol used on the pathology rather than the patient.

Background

There may be no more commonly injured area of the body than the ankle complex and 85 percent of ankle injuries are sprains. (New Choices in Naturally Treating Sprains, 1995) Conversely, it can be speculated that there is no part of the athletic human body that is afforded less respect in both its immediate care and its rehabilitation in the return to activity than the injured ankle. It can be speculated that many ankles get a little more treatment than a bit of ice and tape or brace. Even with substantial rest, ice and bracing is not sufficient to achieve the end goal in the rehabilitation; a pain-free return to competition. A thorough understanding of ankle sprain

mechanics is required for effective treatment and proper recovery period are essential for reaching this goal.

An inversion ankle sprain is defined as an uncontrolled supination movement usually accompanied with plantar flexion in the talocrural and subtalar joints; however, the distal tibiofibular joint may also be involved. This motion often occurs in conjunction with a loss or partial loss of balance. Corresponding injury to the Lateral Ankle Ligaments and surrounding musculature is common. Inversion ankle sprains can occur at any time while weight bearing or jumping. This common pathology can occur equally in both men and women of any age.

The primary objective of this case report is to investigate the efficacy of specific manual and massage therapy techniques to the injured and surrounding tissues of the ankle complex. The goal of this study is a return of full ROM, a decrease in pain, as well as a complete return to activity.

Anatomy

To comprehend the complexity of the ankle, a comprehensive understanding of the surrounding joints and structures is required.

The talocrural is a uniaxial, modified hinge joint created by the medial malleolus and distal articular facet of the tibia, the lateral malleolus of the fibula, and the talus. (Norkus & Floyd, 2001) On the superior and medial aspects, the tibia and medial malleolus articulate with the trochlea of the talus, whereas on the lateral aspect, the lateral malleolus of fibula articulates with the lateral aspect of the trochlea. Specifically, the concave distal articular facet of the tibia articulates with the trochlea of the talus, which is the convex superior articular surface. (Dixon, 2003) The talar mortise is wide anteriorly, gradually narrowing posteriorly. To accommodate this, the distance between the malleoli is greater anteriorly than posteriorly. The stability and function of the ankle joint is dependent upon the reliability of the ankle mortise. The strength of the mortise is provided not only by the joint shape but also by the medial and lateral ligaments, the tibiofibular syndesmosis, and the tendons that interlace the articular surfaces. (Mabee & Mabee, 2009)

Depending on the position and the stresses placed on the talocrural joint, the bones and ligaments alternate as primary and secondary stabilizers. (Norkus & Floyd, 2001) Weight bearing increases talocrural bony stability. When dorsiflexed, the ankle is in its most stable position, or *close packed,* since in this position is the most bony articulation. (Dixon, 2003) Here, most of the mortise is occupied by the talus, and contact is maximized between the articulating surfaces.

A large part of how the talocrural joint articulates properly is due to the articular capsule and three groups of ligaments (medial, lateral, and syndesmosis). The articular capsule surrounds the joint and inserts into the borders of the articular surfaces of both malleoli proximally as well as to the distal articular surface of the talus. (Netter, 1991) Anteriorly, the capsule is broad, thin, and membranous, whereas posteriorly, the capsule is thin and consists mostly of transverse fibers. The lateral aspect of the capsule is thicker than the anterior and posterior. (Norkus & Floyd, 2001)

The deltoid ligament is the broad, pyramidal shaped ligament on the medial aspect of the ankle/foot. Four ligaments make up the deltoid; the anterior tibiotalar, the posterior tibiotalar, the tibiocalcaneal, as well as the tibionavicular. (Magee, 2006) The deltoid ligament is regarded as the strongest of the ankle ligaments and, functions to restrict eversion at the subtalar joint. The anterior portions of the deltoid ligament help to resists lateral rotation of the talus. (Norkus & Floyd, 2001) To aid the deltoid in limiting eversion, the lateral malleolus of the fibula extends further distal than the medial malleolus and, as a result, it provides a bony restriction. (Singer, Jones, & Taillon 1995)

Three lateral ligaments aid in preventing excessive inversion at the subtalar joint. The anterior talofibular ligament (ATFL), the posterior talofibular ligament (PTFL), and the calcaneofibular ligament (CFL) make up the lateral collateral ligaments of the ankle. The ATFL restricts anterior and medial glide of the talus as well as posterior translation and lateral rotation of the fibula. (Norkus & Floyd, 2001) The ATFL is the taut primarily in plantar flexion. Conversely, the PTFL holds the talus posteriorly and helps to limit lateral rotation of talus as well as medial rotation and anterior translation of the fibula. (Norkus & Floyd, 2001) The ATFL and PTFL both help to prevent lateral talar tilt. The CFL functions to restrict lateral tilt of talus, predominantly when the ankle is in neutral stable position and the ATFL is relaxed. (Singer et al., 1995) The wedge shape of the mortise allows for a snug fit between the malleoli and talus when the foot is in a neutral or slightly dorsiflexed position. (Mabee & Mabee, 2009) Conversely, during jumping, the foot naturally assumes a plantar flexed and inverted position. This places the ATFL in a vulnerable position. The stability of the ankle mortise in plantar flexion is decreased and relies on the already taut ATFL and CFL as well as the surrounding tendons. If injuring forces continue beyond tearing of the ATFL, the CFL and PTFL have been shown to sustain injury in succession. Additionally, since the ATFL is an extension of the joint capsule, injury to this ligament may also result in a capsular tear. (Mabee & Mabee, 2009)

As mentioned, the leg musculature and tendons also provide an important measurement of dynamic compressive stability via their multiple insertions on the foot. The most important in regards to talocrural stability are the Peroneus Tertius and Peroneus brevis which insert on the base of the fifth metatarsal. Tibialis Posterior, Tibialis anterior and the Peroneus Longus insert, amongst other locations, on the base of the first metatarsal and medial cuneiform. (Norkus & Floyd, 2001)

The subtalar joint lies directly inferior to the talocrural joint and is the articulation of the posterior calcaneal facet of the talus with the posterior facet of the superior aspect of the calcaneus. The subtalar joint is a synovial gliding joint, with stability being given by an articular capsule and by anterior, posterior, lateral, medial, and interosseous talocalcaneal ligaments. (Singer et al., 1995) Important movements of the subtalar joint include inversion and eversion.

A third articulation in the region of the ankle and lower leg is between the tibia and fibula named the distal tibiofibular joint. This syndesmotic articulation, between the convex surface of the distal fibula and the concave distal tibia, helps to maintain distal integrity between the tibia and fibula. (Dixon, 2003) The stability of this articulation is integral in allowing for proper functioning of the ankle and lower extremity. (Norkus & Floyd, 2001) The ligaments that stabilize this joint are the anterior inferior tibiofibular ligament (AITFL), the posterior inferior tibiofibular ligament (PITFL), and the interosseous ligament. (Singer et al., 1995) The distal fibula is firmly attached at the fibular notch of the tibia by several syndesmotic ligaments. The one most related to inversion biomechanics is the AITFL. The AITFL is a broad, robust ligament. It originates from the longitudinal tubercle on the anterior aspect of the lateral malleolus, and its fiber direction is superiomedial, attaching on the anterolateral tubercle of the tibia. (Wang, Whittle, Cunningham, & Kenwright 1996) In addition to binding the fibula to the tibia, the ITFL restricts excessive fibular movement and thus, also helps to limit lateral rotation of talus. (Norkus & Floyd, 2001)

The interosseous ligament is the third ligament of the distal tibiofibular joint. The interosseous ligament is a thickening of the distal aspect of the interosseous membrane. It extends from the anteroinferior portion of the medial aspect of the distal fibular shaft to the lateral surface of the distal tibia. (Norkus & Floyd, 2001) In 2001, Norkus and Floyd state that the interosseous ligament acts as "spring," allowing for slight separation between the medial and lateral malleolus during dorsi flexion at the talocrural joint.

Kinesiology

Primary motions of the ankle (talocrural joint) are dorsi flexion and plantar flexion. The typical ankle displays 20° of active dorsi flexion and 50° of active plantar flexion. (Magee, 2006) Other actions occurring at the talocrural joint are 35° of inversion and 15° of eversion. (Dixon, 2003) As a functional movement including the incorporation of surrounding joints that contribute to the same action, ROM can be further increased.

Pathophysiology

The sprained ankle is a common musculoskeletal disorder occurring at an estimated rate of 1 per 10,000 persons per day. (Mabee & Mabee, 2009) In fact, 85% of lower leg injuries are sprains, of which approximately 85% of ankle sprains result from inversion injury of the plantar flexed foot. (Mabee & Mabee, 2009)

Using clinical criteria, most ankle sprains are graded I, II & III with respect to increasing severity. Generally speaking, a grade I sprain has 1-20% ligament fibre loss, where as a grade II has 21-70% and a grade III is 71% and above.

In the ankle, a Grade I is a mild injury with minimal tenderness and swelling, nearly no functional loss, and negative to ankle special testing. There is a presumed partial tear of the ATFL; however, patients are capable of performing their normal daily activities with only mild discomfort.

Grade II is a moderate to severe injury with noticeable local swelling and tenderness, moderate functional loss, with possible positive special testing for ankle instability. It can be speculated that in most cases, there is a partial to complete ATFL tear, and possibly partial tear to CFL. Patients are usually unable perform normal activities, and there is moderate to severe pain with weight bearing.

Grade III is a severe injury with significant swelling and tenderness, significant functional loss, with major instability when ankle special testing is performed. There is often a complete tearing of the ATFL; CFL and PTFL may also be moderately or severely torn, and the patient is completely unable to bear weight or continue with activity. Avulsion fracture of the peroneal muscles can occur and fracture of the distal fibula and or tibia is another complication.

Case Introduction

The case study participant is a 23 year old female student. She is a very active right hand/foot dominant individual, normally playing volleyball, basketball, and running several times per week. Her mechanism of injury was landing awkwardly on an opponent's shoe while jumping in a basketball game. When jumping, the patient’s foot/ankle was in the typical plantar flexed and inverted position. Patient heard many snapping and popping sounds and was completely unable to weight bear. All forms of ROM were extremely painful. Immediate acute treatment was a bag of ice. The patient could not bear weight for three days and was limping badly for several weeks.

At the start of the trial, all of these ADLs (Activities of Daily Living) were compromised. After exercise and activity, her pain in her ankle felt "throbbing" and "pinching" and could reach as high as a 9/10 on an analog pain scale. Patient had experienced neither an inversion ankle sprain to the same ankle nor any other significant injury to her left leg for a period of 3 years. Patient had no lasting effects (pain or loss of ROM) from her previous inversion sprain.

Patient's current complaints are pain at the lateral aspect of her left ankle as well as posterior to her left medial maleolus. Patient gets relief from heat, ice, and rest; she finds that inclines and running exacerbate her injury as well as it feeling worse in the morning. Patient is not seeking any other medical treatment during this trial. Patient is also currently not taking any medications; however, she occasionally takes Advil for pain. Patient's goals are to regain strength and stability, increase ROM in her ankle, and be able to play basketball again. First treatment on the patient was conducted 73 days post injury.

Literature and Research Review

Derived from Western medicine and scientific thinking, Mechanotransduction and mechanosencing is clinically exciting and relatively new to medical theory. The process of converting physical forces into biochemical signals and integrating these signals into the cellular responses is referred to as mechanotransduction. (Huang, Kamm, & Lee, 2004)

Mechanotransduction is made possible by Integrins, a classification protein embedded in the phospholipid bilayer of the cellular membrane that connects the extracellular matrix to the internal structure of the cell, the cytoskeleton. Research shows that integrins stabilize muscle and other tissue and provide not just a link but communication between the matrix and cytoskeleton.

$\alpha^7\beta^1$ Integrin joins laminin proteins in the extracellular matrix with the cellular cytoskeleton and therein, a protein within the normal cytoskeleton mediates transduction of mechanical forces into chemical signals. (Boppart, Burkin, & Kaufman, 2006) Stress induced changes in the extracellular matrix alter integrin structure and lead to activation of a plethora of secondary messenger pathways within the cell. Activation of these pathways leads to altered regulation of genes that synthesize and breakdown extracellular matrix proteins as well as alter the timing and rate of cell division. (Silver, 2004) In addition, the application of mechanical forces to cells leads to the activation of growth factor and hormone receptors even in the absence of ligand binding. This means that individual cells can respond to muscle contraction or stretch by initiating repair, growth, or even proliferation even without systemic hormonal intervention. (Boppart, Burkin, & Kaufman, 2006) and (Silver, 2004)

The role of mechanotransduction in exercise-induced cell signalling and skeletal muscle repair is supported through much research.

Application of mechanotransduction happens when Integrins imbedded in the cellular membrane of a cell are put under a stress via the application of pressure and movement. Pressure applied from the externa through the skin and multiple tissue layers in conjunction with movement of the structure or tissue layer intended on being treated causes a mechanical stress to that cellular layer. The mechanical signals which are converted into biochemical signals through mechanotransduction stimulate an increase in nucleic and ribosomal activity specific to secreted proteins and collagens. (Kahn, 2008)

The functional concept of mechanotransduction applies to both muscular, connective, and even nervous tissue. (Kahn, 2008)

It can be concluded that integrins have a protective role in maintaining muscle and tendon structure and function.

Application and measuring of the principles and effects of mechanotransduction has only been concluded on rodents and has not yet emerged into the realm of practical application for the manual therapist. Active Release and Active Myofascial Release Techniques have inherently applied the general guidelines of mechanotransduction by using pressure and movement to achieve health benefits.

Treatment Protocol

This report uses several manual and massage techniques on specific structures on or surrounding an injured ankle to measure their efficacy. Five treatments, beginning 73 days after injury and concluding 94 days after injury, were sixty minute, nearly identical. The majority of each treatment consisted of AMR and transverse frictions along with hydrotherapy. Joint mobilizations, PNF, and Swedish were applied as accessory techniques. The frictions were applied to the build-up of fibrotic tissue at the sites of the ATFL, CFL, and the PTFL. The AMR was applied to (in order) Tibialis Anterior, Peroneus Brevis, Peroneus Longus, Tibialis Posterior, Flexor Digitorum Longus, and Flexor Hallicus Longus along the tendons and musculotendinous junctions. Please see Appendix A for details of Treatment Protocol.

Remedial Exercise

Walking exercises such as 10 steps with inverted ankles, everted ankles, on heels, and on toes were to be completed on alternating days. Static stretching was to be completed on alternating days to the Peroneals, and Tibialis Posterior. A graded balance program was given to the patient to be completed on alternating days. This program escalated in difficulty from standing on 2 feet to standing on 1 foot with eyes closed.

Hydrotherapy

Patient was asked to apply ice in a slow circular pattern, not exceeding 10cm diameter, twice a day for 10 minutes on the days of treatment, after treatment. This was to help control the inflammation caused by the AMR and transverse frictions.

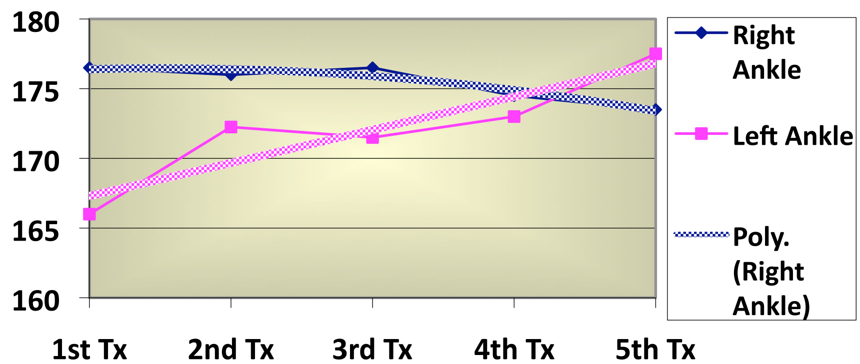
Results & Analysis

Case study participant showed a substantial increase in range of motion in both dorsi and plantar flexion through the goniometric measurements.

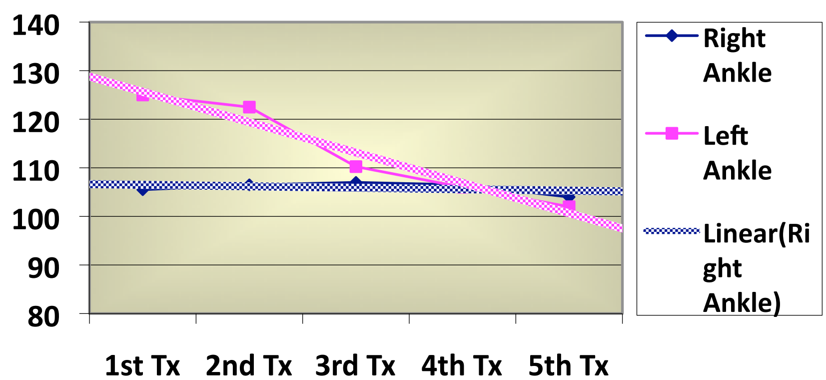
Over the 21 day trial, the patient went from 166° of plantar flexion in the injured ankle to 178°. Comparatively, the patient`s dorsi flexion improved from 126° to 102°, over the same period of time. These results represent an increase of 12° of plantar flexion and 24° of dorsi flexion, equating to 36° total ROM increase. More substantially, both of these ROM increases equated to 100% of lost ROM when compared to the contralateral ankle. The graphs below represent the ROM in both ankles throughout the 5 treatments. The shaded lines are statistical averages for the values. It is clearly evident that the right ankle did not change ROM within error while the left ankle improved greatly.

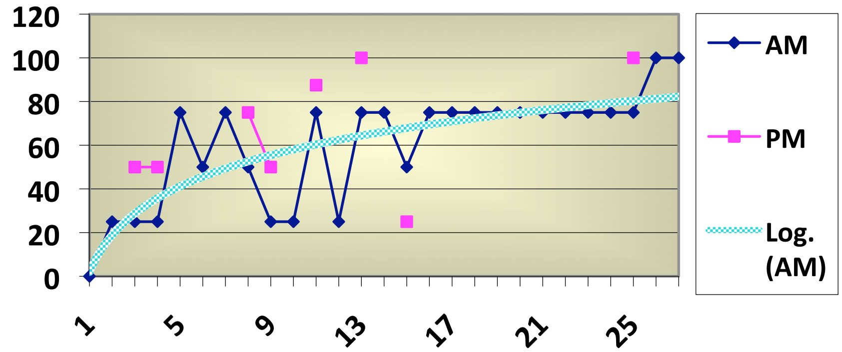
The graphs below represent how the patient’s left ankle felt in percentage. The first and second graph comfort level throughout the trail time, the second includes a statistical logarithmic average. The third graph is a comparative analysis of perceived comfort in the left ankle in regards to time after each treatment.

Plantar Flexion:



Dorsi Flexion:





<u>Values for Data Points</u>

Painful	0
Stiff/achy	25
No Comment	50
Good/better	75
Really good	87.5
Great	100

Discussion

For this patient, manual and massage therapy techniques in conjunction with hydrotherapy and rehabilitation exercises were able to return lost range of motion (dorsi & plantar flexion) to her left ankle in the chronic stage of an inversion sprain injury. The use of a more effective pain scale would have made the patient diary more admissible and statistically relevant.

Conclusion

The primary objective of this case report was to investigate the efficacy of specific manual and massage therapy techniques to the injured and surrounding tissues of the ankle complex. This paper is insufficient to make any claim as to the efficacy of the pathology. A single case is not enough to validate the protocol used or the individual techniques that comprised it. Further research with similar patients along similar timelines with a similar protocol is required to for validation in regards to the efficacy of manual and massage therapy techniques in the treatment of a chronic inversion ankle sprain. This case report cannot answer if this protocol was effective for the condition; however, it can be concluded that the protocol used was effective for this individual patient.

The goal of this study was to return the injured ankle to full ROM, decrease pain, as well as a complete return to activity. In the case of the patient, these goals were met. However, further research needs to be compiled to derive the efficacy of the protocol used on the pathology rather than the patient.

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