



2007

An Outpatient Physical Therapy Non-Operative Management and Intervention for an Older, Athletic, Professional, Caucasian Male Patient with an Acute Gastrocnemius Medialis and Lateralis Muscle Rupture

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**AN OUTPATIENT PHYSICAL THERAPY NON-OPERATIVE MANAGEMENT
AND INTERVENTION FOR AN OLDER, ATHLETIC, PROFESSIONAL,
CAUCASIAN MALE PATIENT WITH AN ACUTE GASTROCNEMIUS MEDIALIS
AND LATERALIS MUSCLE RUPTURE**

by

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Bachelor of Physical Therapy
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May, 1978**

**A Scholarly Project Submitted to the Graduate Faculty of the
Department of Physical Therapy
School of Medicine
University of North Dakota**


in partial fulfillment of the requirements for the degree of

Doctor of Physical Therapy

**Grand Forks, North Dakota
December, 2007**

This Scholarly Project, submitted by Thea Loy Pallansch in partial fulfillment of the requirements for the Degree of Doctor of Physical Therapy from the University of North Dakota, has been read by the Advisor and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.


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PERMISSION

Title An Outpatient Physical Therapy Non-Operative Management
and Intervention for an Older, Athletic, Professional,
Caucasian Male Patient With an Acute Gastrocnemius
Medialis and Lateralis Muscle Rupture

Department Physical Therapy

Degree Doctor of Physical Therapy

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ACKNOWLEDGEMENTS

A special thank you to my husband John for his enduring patience and moral support. Thank you to my daughters Karie and Jennifer for helping me get better acquainted with computer technology and for their constant cheerleading. I appreciate and thank my friend and co-pilot Connie Bacon, PTA, for pushing and keeping me at my best. Thank you to Chuck Bacon for all of his help, serving his country, and for his fine cooking skills. I acknowledge Gilbert "Gibbs" DeSpiegler for acting as my coach and Jacki Hoven for keeping me organized. A heartfelt thank you goes to Tammy Block for her computer skills and to TLC's office staff, Laurie Bergman and Darcy Mammenga, for rescuing me. To all of my friends, family, and patients living in Northeastern South Dakota, thanks so much for believing in me and giving me the courage to take this jump in my education and career. I thank the Faculty and Alyson White at the University of North Dakota's School of Medicine Department. Your inspiration and guidance during this educational endeavor has been absolutely overwhelming. Finally, I thank the Lord for allowing me this opportunity and guiding me through every step of the way.

TLP, PT

ABSTRACT

Description: The gastrocnemius muscle is a two joint muscle originating on the femur and inserting into the calcaneus through the Achilles tendon. The gastrocnemius spans the knee and ankle joint providing important stabilization and movement functions in walking, running, and jumping activities. Rupture of the Achilles tendon is one of the most common tendinous injuries. Non-operative, conservative treatment of the acute Achilles tendon rupture demonstrates comparable results to surgical intervention. Non-operative management promotes patient tolerance, low cost, and positive clinical outcomes. Previous studies have supported the concept of functional bracing as a conservative, alternate treatment for an acutely ruptured Achilles tendon. Physical therapy modalities and exercise interventions are a common occurrence after Achilles tendon injuries. The purpose of this case report is to describe the use and outcome of non-operative treatment including functional bracing, physical therapy modalities, and exercise interventions after an acute gastrocnemius medialis and lateralis muscle rupture in one patient. Procedures/Methods: The proposed study will utilize the physical therapy examination, evaluation, and intervention as a representative case report to augment the knowledge currently available for the topic of gastrocnemius and soleus ruptures. Evidence based research will be utilized to identify current best practices in the area of Achilles tendon and gastrocnemius rupture and repair.

Results: Through the application of evidence based examination and intervention, the results of this project should improve client outcomes for physical therapy services. This case report may stimulate future research comparing non-operative management and intervention of acute gastrocnemius medialis and lateralis muscle rupture with operative management and intervention.

CHAPTER I

INTRODUCTION

The gastrocnemius muscle is a two joint muscle originating on the femur and inserting into the calcaneus through the Achilles tendon. This tendon complex is subject to a variety of pathologies.¹ The triceps surae muscle includes the gastrocnemius medial and lateral heads, which originate from the posteromedial and posterolateral femoral condyles, respectively, and the soleus. Distally, the gastrocnemius aponeurosis merges with the aponeurosis of the soleus muscle to form the Achilles (calcaneal) tendon. The plantaris muscle and tendon course adjacent to the medial head of the gastrocnemius muscle and calcaneal tendon and insert into the medial one third of the posterior calcaneus.¹

The gastrocnemius spans the knee and ankle joints providing important stabilization and movement functions in walking, running, and jumping activities. Rupture of the Achilles tendon is one of the most common tendinous injuries.^{1,2} Injuries of the Achilles tendon are classified by anatomical location, occurring at either the non-insertional area (Zone 1) or at the insertional area (Zone 2). A third zone (Zone 3) involves injuries to the proximal musculature of the Achilles tendon complex, but these occur much less frequently than Zone 1 and 2 injuries. "Tennis leg" injuries, those involving strains of the medial head of the gastrocnemius muscle, and plantaris tendon ruptures occur in Zone 3.¹

Achilles tendon injuries typically occur at an age when many individuals are reducing their level of sporting activities.³ In a review of the epidemiology, etiology, and

mechanisms of rupture, the Achilles tendon appears to be predisposed to spontaneous rupture from minor trauma.⁴ Age related changes such as avascularization along with collagen degeneration and disruptions are conditions most responsible for etiology of a rupture. Alternating exercise with inactivity could produce the degenerative changes seen in tendons.⁴ Sports, in addition to daily activity, places additional stress on the Achilles tendon, leading to the accumulation of trauma. Athletes or individuals who resume physical training after a period of rest are particularly susceptible to rupture of the Achilles tendon. A rupture of the Achilles tendon is more common in males who are in the 3rd or 4th decade of life, work in a white-collar profession, and play a sport occasionally. For younger individuals, most ruptures of the Achilles tendon occur during sports activities.⁴

There are three different mechanisms of rupture.⁴ The first mechanism involves pushing off with the weight bearing forefoot while extending the knee. This movement is seen in sprint starts and jumping in sports such as basketball. The second category involves sudden, unexpected dorsiflexion of the ankle, such as that occurring when the foot slips into a hole or the individual falls downstairs. The third category involves violent dorsiflexion of a plantar flexed foot occurring after a fall from a height.

Achilles tendon injuries are the most common overuse syndrome of the lower leg.^{1,2} Arriving at an accurate diagnosis and creating an effective treatment plan requires a detailed injury history, a thorough knowledge of anatomy and biomechanics, and, often, advanced diagnostic imaging. Early intervention is necessary to provide an individual with the best chance of promptly returning to activities and avoiding repeated injury.¹ Some controversy still exists concerning surgical versus non-surgical treatment

of acute Achilles tendon ruptures.¹⁻⁴ Open primary repair of an acute Achilles tendon rupture is often the treatment of choice in the young, healthy individuals, although a recent study advocates conservative care may be as effective.^{1,3} The results of operative and non-operative treatment for an acute Achilles tendon rupture were equivalent. Non-operative care, however, may increase the risk of intratendinous calcification.¹ Cetti et al² reported in a review of literature that all athletes with Achilles tendon rupture should be treated operatively and only non-athletes or older patients should be considered for non-operative treatment. The study concluded that operative treatment using end-to-end suture is preferable, while non-operative treatment is an acceptable alternative. At the same time, treatment should be individualized according to the concerns and health of the patient.⁴ If optimum performance is necessary, operative management is probably the treatment of choice. Operative management should be used in athletes and patients who have a high level of physical activity. Non-operative treatment should be reserved for older patients who are unlikely to derive any major benefits from an operative procedure and for a physician and patient who view an operation as an unnecessary risk.

Wallace et al³, through a therapeutic level IV study, developed a combined conservative and orthotic treatment protocol for acute ruptures of the Achilles tendon. This regiment combined the advantages of a removable orthosis with those of traditional non-operative therapy. Non-operative, conservative treatment of the acute Achilles tendon rupture demonstrated comparable results to surgical intervention. Non-operative management promoted patient tolerance, low cost, and positive clinical outcomes.

Physical therapy, incorporating modalities and exercise intervention, is a common occurrence after Achilles tendon injury. Treatment protocols for Achilles tendon injuries include acute treatment of the inflammatory condition with PRICEN: Protection, Rest, Ice, Compression, Elevation, and Non-steroidal anti-inflammatory drugs.¹ Deep transverse friction soft tissue techniques and ultrasound may stimulate collagen synthesis. Finally, taping of the tendon in a plantar flexed position may allow return to play in mild cases while a unctinal orthosis and heel lifts that address a biomechanical fault (such as hyperpronated rear foot complex) may be useful in the rehabilitative and return to play phases of recovery. Poor flexibility of the gastrocnemius soleus complex should be addressed with an appropriate stretching regime of the rehabilitation program.

Only a few instances of non-operative treatment of acute gastrocnemius medialis and lateralis muscle rupture have been reported.¹⁻⁴ The purpose of this case report is to describe the use and outcome of non-operative treatment including functional bracing, physical therapy modalities, and exercise intervention after an acute category 2, Zone 3 gastrocnemius medialis and lateralis muscle rupture in one patient.^{1,4} The case study utilizes a physical therapy examination, evaluation, and intervention as a representative case report to augment the knowledge currently available for the topic of gastrocnemius and soleus ruptures. Current evidence based research comparing randomized trial studies and literature reviews will be utilized to support and augment the concrete example of a case report.

It is anticipated that the completed case study will be implemented in the care of current and future clients with acute gastrocnemius medialis and lateralis muscle

rupture. Through the application of evidence based examination and intervention, the results of this project should improve the client outcomes for physical therapy services. This case report may stimulate future research comparing non-operative management and intervention of acute gastrocnemius medialis and lateralis muscle rupture with operative management and intervention.

CHAPTER II

CASE DESCRIPTION

Examination, Evaluation and Diagnosis

Patient/client history: A self-referred 64 year-old male who was athletic, professional, Caucasian, and an avid hunter had injured his right knee while pheasant hunting two days prior to the physical therapy examination and evaluation. Previous medical intervention consisted of an appointment with a general practitioner physician two days after injury. The physician had prescribed over the counter anti-inflammatory pain medication, non-weight bearing of the right lower extremity, and a follow up magnetic resonance image (MRI) if there was no improvement in a couple days. The patient wanted to deer hunt in two weeks and did not want to wait a couple days. Past medical history revealed medical allergies to penicillin, previous surgeries of appendectomy, bypass and hernia repair, previous orthopedic injuries including left ankle fracture (1975) and a right ankle fracture (1993). The patient tolerated current over-the-counter anti-inflammatory medication. Social history was negative for alcohol and tobacco abuse. He was married, a healthcare provider, avid hunter, and hiker. Review of systems from the subjective past medical history was positive for sinus infection, hearing loss, kidney stones, thyroid disease, heart problems, and high blood pressure. The patient reported no familial history of the aforementioned subjective review of systems.

The patient's chief complaint was a right lower extremity injury while hunting. The patient reported stepping into a badger hole with the right lower extremity in

extreme dorsiflexion at the foot and extension of the right knee. Immediate right mid gastrocnemius pain and inability to bear weight on the right lower extremity occurred. The initial physical therapy examination was performed two days after the initial injury. The patient reported right mid-gastrocnemius pain and displayed an antalgic gait while ambulating without an assistive device. The patient was wearing tennis shoes when initially evaluated and stated he wears tennis shoes during hiking, hunting boots during hunting, and for work and leisure he wears cowboy boots. He was unable to wear cowboy boots because of the right lower extremity edema. Edema was apparent in the right mid gastrocnemius. Ecchymosis and bulging were prevalent along the right gastrocnemius medialis and lateralis origin tendons. The patient was tender to palpation in these areas as well. The numeric pain scale was utilized during evaluation of the patient's pain, 0/10 (0 represents a lack of pain and 10 is the most severe pain possible).^{5,6} When the patient's right knee was flexed at 90 degrees and the ankle plantar flexed at 10 degrees the pain level was 2/10. Palpation of the right gastrocnemius medialis and lateralis in the mid right gastrocnemius produced a pain level of 7/10. The patient was unable to simultaneously dorsiflex the right ankle and extend the right knee without complaining of right mid gastrocnemius pain of 10/10. This was most notable while the patient tried to bear weight during ambulation just prior to heel off.

Active range of motion (AROM) measurements of the right knee and ankle were performed using a standard goniometer.⁷ An objective manual muscle test was not obtainable because of the acute injury. Right knee AROM measurements, when the right ankle was plantar flexed at 10 degrees the right knee's AROM was within normal

limits; and the patient reported minimal right mid gastrocnemius pain of 2/10. For AROM measurements of the right ankle, the patient's right knee was placed at 90 degrees of flexion. With the right knee at 90 degrees of flexion, the patient tolerated the right ankle measurements. The left ankle was measured for a comparison. (See Table 1)

Table 1. ROM measurements at initial evaluation of a patient with leg pain.

AROM	Left	Right
Plantar Flexion	50 degrees	50 degrees
Dorsiflexion	0 degrees	-10 degrees
Inversion	20 degrees	20 degrees
Eversion	5 degrees	5 degrees

The knee examination appeared normal with no positive meniscus or ligament deficits.⁵ The Childress Test for evaluating meniscus and ligament lesions and the Pivot Shift Test for evaluating lesions of the anterior cruciate ligament weren't performed secondary to the patient's functional stance intolerance. The Lachman Test and the Anterior Drawer Sign were used to evaluate lesions of the anterior cruciate ligament (ACL). First Steinmann Sign, Apley's Compression/Distraction Test, McMurray's Test, and joint line tenderness were performed for evaluating lesions of the meniscus.

Pookarnjanamarakot et al⁸ and Malanga et al⁹ studied common orthopedic knee tests used to evaluate meniscus lesions. The Childress sign was the most sensitive and accurate. The First Steinmann Sign and Apley's test were the most specific (100%). The McMurray Test was specific but had a low sensitivity. Joint line tenderness had a

fair sensitivity but lacked specificity.^{8,9} Malanga et al⁹ and Ostrowiski et al¹⁰ reviewed and studied the accuracy of common orthopedic tests for cruciate ligament lesions. The evaluation procedure for the cruciate ligament consisted of the Lachman's Test, which was best overall for positive and negative likelihood ratios. The Pivot Shift Test was high in negative likelihood ratio. The Anterior Drawer Test was mediocre in negative and positive likelihood testing.^{9,10}

Physical therapy intervention began 48 hours after initial injury. Examination findings revealed agreement between the patient's clinical presentation and the WHO's ICDH disablement model classification and the model for orthopedic dysfunction.¹¹ In this case the stimulus was the physical trauma to the right lower extremity as demonstrated by an internal tissue response of connective tissue dysfunction. Impairment of the anatomical and physiological components of the musculoskeletal system at the right knee, ankle, and gastrocnemius resulted in decreased range of motion, increased pain, and decreased muscle performance. Functional disability impairments were manifested by the inability to perform a normal range of activities of daily living (ADLs). The handicap was the limitation in the fulfillment of the individual's normal rate (task), the inability to perform the rate (task) of hunting. Using the *Guide to Physical Therapist Practice*, a physical therapy diagnosis of 4D: impaired joint mobility, motor function, muscle performance, and range of motion associated with connective tissue dysfunction were assigned.¹² ICD-9-CM codes of 844.9 leg sprain and 729.1 myofascial pain were consistent with the physical therapy diagnosis.

Prognosis and Plan of Care

The long term goal for this patient was the optimal level of functional improvement to allow for ambulation with or without an assistive device using a functional, orthotic brace in two weeks for deer hunting. The anticipated short-term goals and outcomes addressed the pain response. The pain would be less than 2/10 in the right gastrocnemius muscle during ambulation with or without an assistive device using a functional orthotic brace within one week of physical therapy treatment.

Intervention

After the physical therapy examination and evaluation of the patient, Phase 1 of the physical therapy intervention was implemented. The patient was instructed in a home program of rest, ice, compression, and elevation (RICE).¹³⁻¹⁵ (see Appendix for details) The right lower leg was wrapped with four-inch disposable, elastic pressure support wrap (Coban, 3M Healthcare, Neuss, Germany). Instruction in non-weight bearing ambulation with crutches was provided to the patient. Based on the results of the physical therapy examination/evaluation, it was determined that the extent of the gastrocnemius medialis and lateralis muscle origins rupture required further examination by an orthopedic surgeon. The scope of practice of physical therapy was discussed with the patient along with choice of an orthopedic physician. A local orthopedic clinic was notified via telephone for an immediate appointment. The patient agreed to an appointment with the orthopedic surgeon of choice immediately after the physical therapy examination/evaluation.

The patient returned the next day for a second session of physical therapy, Phase II of physical therapy intervention. The orthopedic surgeon's medical diagnosis was right gastrocnemius rupture, flexor tendon intact. The physician's referral consisted of hot packs (HP), ultrasound (US), phonophoresis (PH), massage (mass), gradual gait training in a few days, gentle stretching, and range of motion as tolerated. The patient stated the orthopedic surgeon was quite surprised that the patient did not injure his medial collateral ligament (MCL) or his anterior cruciate ligament (ACL). The patient was quite pleased with the initial physical therapy examination/evaluation and referral to the orthopedic physician. An ankle-foot orthosis (AFO) walking boot had been recommended by the orthopedic surgeon. The patient declined purchasing or obtaining the walking boot at the orthopedic clinic and ordered the boot via his place of employment. As a temporary intervention, until the AFO (walking boot) arrived, the patient was measured and fitted with an over the counter cushioned, full-length, shoe insert (Spenco Medical Corporation PolySorb Cross Trainer insole, Waco, Tx), and a 3/8-inch heel lift. Goniometric measurement of right plantar flexion after the fitting of the over the counter insert and the 3/8-inch heel lift was 20 degrees. The patient ambulated with crutches, weight bearing as tolerated, gentle heel strike, mid-stance, and toe off with 0/10 pain on the numeric pain scale.^{5,6} Roberts et al¹⁶ described conservative dynamic casting in gravity equinus and also described recent attention to the use of customized splinting for the treatment of Achilles tendon rupture. Wallace et al³ described the concept of functional bracing as an alternative conservative treatment. Sekiya et al¹⁷ suggested non-operative treatment requires mobilization in maximal ankle plantar flexion and that immobilization of the knee may not be necessary for

tendon edge opposition. With casting and/or functional orthotic splinting non-operative treatment in mind, verification for ankle plantar flexion angle is described by Li et al¹⁸ and Robon et al.¹⁹ Both studies stated that a relationship exists between the gastrocnemius (knee flexor) and ankle plantar flexors including the soleus. The ankle plantar flexors are involved biomechanically in knee and ankle moments.¹⁹ Li et al¹⁸ stated the gastrocnemius is a bi-articular muscle and is most likely influenced by the biomechanical moments of both the knee and the ankle joints. The gastrocnemius muscle acts as a stabilizer across the knee and ankle joint angles.^{18,19} Twenty degrees of plantar flexion changed the ankle/knee angle or moment enough to decrease the patient's right gastrocnemius pain level to 0/10 during weight bearing as tolerated with crutches. At the same time, heel strike, mid stance, and toe off stages of the gait cycle were normalized.

Ultrasound (OMNISOUND 3000C, ERA: 5.0 cm², and BNR: 2.75:1, Topeka, KS) was implemented to minimize acute inflammation, decrease pain, and promote healing. Ultrasound therapy is the most widely available and frequently used electro-physical agent in physical therapy.²⁰ It is the physical modality used for the treatment at the beginning of soft tissue injuries and the bio-stimulation of tissue repair.^{21,22} The duty cycle of 25% pulsed ultrasound, frequency at 1 MHz, intensity 1.5 W/cm², and 10 minutes duration was used during five physical therapy sessions. Warden et al²⁰ reported that for acute conditions, therapists predominately use pulsed wave ultrasound at an intensity range of 0.51 to 1.5 W/cm². The study found when applying ultrasound at their selected dosage to acute conditions, therapists aim to reduce inflammation and

decrease pain. Given these aims, therapists apparently endeavor to promote the non-thermal effects of ultrasound.²⁰

Leung et al²³ described ultrasonic frequencies along with low and high intensities. Common frequencies used in physical therapy for treatment of ligamentous sprains, muscle strain, bone, and joint conditions range from 0.5 to 5 MHz. Intensity can be divided into two classes, low intensity 0.125-3 W/cm² and high intensity > 5 W/cm². Low intensity ultrasound is often used for stimulating the normal physiologic response to injury or accelerating percutaneous drug absorption through the skin. There are thermal and non-thermal effects in ultrasound. The thermal effect is usually associated with high intensity and continuous mode of application, whereas the non-thermal effect is often associated with ultrasound applications of low intensity and pulsed mode. The thermal effect is induced by oscillation of particles about their mean positions when ultrasonic energy is absorbed by the tissue. The non-thermal effect includes cavitation and micromassage, which are caused by rapid compression and rarefaction cycles of the sound wave pressure in the transmission medium.²³ The therapeutic effects of ultrasound are to control inflammation and regulate blood flow in the acute phase of injury, to stimulate fibroblastic actions and collagen formation in the active repair phase, and to improve collagen alignment and, thus, extensibility of mature collagen, such as in the scar tissue during scar remodeling phase.²³ Another study by Baker et al²⁴ reviewed the biophysical effects of ultrasound. Thermal effects are those due to heating and are accepted as including increased metabolic activity and blood flow and an analgesic effect on nerves. An additional claim is that thermal ultrasound increased collagen extensibility.²⁴ Non-thermal effects are those usually

associated with cavitation and its associated effects.²⁴ There is no direct evidence that any clinical benefits of ultrasound are due to altered membrane permeability; however, another study has suggested that increases in protein synthesis, mast cell degranulation, growth factor production, uptake of calcium, and fibroblast mobility could account for their changes in improved tissue repair following ultrasound therapy.²⁴

Ultrasound usage occurs despite a lack of supportive scientific evidence for a beneficial affect or a biophysical affect of ultrasound.^{20, 24-26} Although understanding the physiological effects of interventions does not justify their use, it is often helpful for clinicians. Alleged physiological responses to the biophysical effects of therapeutic ultrasound have been pivotal in the widespread adoption of ultrasound even in the absence of clinical studies.²⁴ However, Leung et al²³ compared the affects of different intensities and treatment durations of pulsed ultrasound at 25% in the early period of injury using a rat ligament model. The study indicated that ultrasound can stimulate an inflammatory rather than an anti-inflammatory affect. In a study by Klaiman et al²¹, ultrasound was found to reduce pain and pressure sensitivity in selected musculotendinous conditions. According to Koeke et al²² a pulsed ultrasound at 25%, frequency 1 MHz, and intensity at 0.5 W/cm², demonstrated an efficient method to accelerate the bio-modulation of the inflammatory process; thus, promoting a tendon repair process.

Hydrocortisone (10%) was used for the topical anti-inflammatory agent for phonophoresis. Klaiman et al²¹ and Koeke et al²² describe the concept of phonophoresis as a specific type of ultrasound application in which pharmacological agent such as corticosteroids, local anesthetics, and salicylates are introduced. Koeke

et al²² stated there are some indications that ultrasound induced transdermal penetration of hydrocortisone at 10% (phonophoresis) presented the best results and the most efficient treatment in tendon repair.

The orthopedic physician had ordered hot packs, ultrasound, and phonophoresis. A hot pack unit was not available in the clinic; but an interferential current electrical stimulator in combination with the pulsed ultrasound and phonophoresis was available. As stated previously, ultrasound with phonophoresis was used to minimize acute inflammation, decrease pain, and promote healing. Interferential current electrical stimulation was utilized for the same goals of minimizing acute inflammation, decreasing pain, and promoting healing. The treatment parameter for the interferential electrical stimulation combination consisted of the following: The electrical stimulation unit (OMNISTIM 500, Topeka, KS) provided the interferential current. The purpose of interferential current therapy is to provide deep tissue treatment, which is not generally obtainable with conventional electrotherapy approaches. The primary application is in the reduction of pain and in the stimulation of increased blood flow in the deeper tissues and muscles.²⁷ The interferential mode of the OMNISTIM 500 contains five pre-programmed modes. The analgesia nerve block acute local mode was chosen; carrier frequency: 500 HZ, vector: off, treatment time: 10 minutes, auto intensity: 20%. The OMNISTIM 500 electrostimulator connected to the OMNISOUND 3000C ultrasound unit via the combination therapy interconnect cable. An appropriate lead wire from the OMNISTIM 500 electrostimulator was selected and the two tip pins were separated. The positive (red) tip pin inserted into a 7 cm electrode (900 STF series TENS/NMES, EMPI, St. Paul, MN). The 7 cm electrode was chosen, which was larger than the 5 cm

transducer head of the ultrasound OMNISTIM 3000C machine. This allowed the 5 cm transducer of the ultrasound machine to remain as the active electrode. The negative (black) tip pin inserted into the black pin to banana adaptor. The banana adaptor inserted into the interconnect port of the OMNISOUND 3000C. The OMNISOUND 3000C transducer head received the designated output from the electrode stimulator (calibrated July 2005). The conduction medium was Dynagel (Dynatronics, Salt Lake City, UT). The conduction gel was placed in the area of the right gastrocnemius medialis and lateralis muscle tendons. The 7 cm electrode was placed in the area of the right soleus muscle. As stated previously, the duty cycle of 25% pulsed ultrasound, frequency at 1 MHz, intensity 1.5 W/cm^2 , and 10 minutes duration was the parameter of the ultrasound. The interferential parameter was the pre-programmed, analgesic nerve block acute local mode. Intensity of the electrical stimulation was to tolerance for the patient. Twitch of the muscle was noted at the gastrocnemius trigger points. Hou CR and colleagues²⁷ studied the mechanism of interferential therapy. The mechanism of interferential electro-stimulation relates to directly applied electrical current with a stronger intensity on the involved muscle enhancing muscle circulation, reducing muscle spasms, eliminating muscle pain, and increasing muscle strength.²⁷ Electric nerve stimulation has been used successfully to treat acute and chronic pain conditions. Interferential current therapy has a suppressing effect on the sympathetic segment of the autonomic nervous system to reduce severe pain and a stimulating effect on blood circulation to improve tissue oxygen supply and to rapidly eliminate toxic metabolic products.²⁷ In their study of cervical myofascial pain, Hou CR and colleagues²⁷, investigated electro-stimulation to cervical myofascial pain and found no effect of

electro-stimulation alone on myofascial trigger points. A combination of interferential and myofascial release therapies resulted in more pain relief, suppression of myofascial triggerpoint sensitivity, and an increase in cervical range of motion.²⁷

Besides the ultrasound and phonophoresis/interferential current electrical stimulation combination, the patient was given myofascial release techniques with a cryo-ointment to the right gastrocnemius muscle. Research studies have found myofascial pain decreased with myofascial release techniques.²⁷ Pain relief from the myofascial release technique may result from breaking the limitation of muscle or connective tissue around the joint, from stimulating the mechanoreceptor, from increasing the blood flow and neuron conductance, or from local or systemic relaxation.²⁷ Myofascial release is a highly interactive stretching technique that requires feedback from the patient to determine the direction, force, and duration of the stretch and to facilitate maximum relaxation of the tense tissues. This technique recognizes that a muscle cannot be isolated from the other structures of the body so all muscle stretching is actually the stretching of myofascial units.²⁷ Thereby, the purpose of myofascial release is to move superficial tissues over the underlying structures to improve their mobility and to relieve subcutaneous tightness of panniculosis.²⁷ Hou CR and colleagues²⁷ found that the compression therapy technique with quantified pressure and duration provides alternative treatments by using either the pressure of pain threshold with a long duration of 90 seconds or the pressure of the average of pain threshold and pain tolerance with a duration of 30 seconds. Immediate pain relief and reduced myofascial trigger point sensitivity can result from manual therapy techniques for cervical myofascial pain. The Gam et al²⁶ study confirmed the Hou CR and

colleagues²⁷ study. The Gam et al²⁶ study concluded that ultrasound gave no significant pain reduction, but massage and exercise reduced the number and intensity of myofascial pain. The Hou CR et al²⁷ study concluded a combination of hot packs, active range of motion (AROM), interferential current, and myofascial release techniques were more effective than any single modality for relieving myofascial pain and improving range of motion.

The patient was given myofascial release techniques with a cryo-ointment, counter irritant, and Biofreeze (Performance Health, Inc., Export, PA) to the right gastrocnemius. Biofreeze was utilized by the patient in conjunction with his home exercise program (HEP). Moore RA²⁸ reviewed the effectiveness and safety of topical non-steroidal anti-inflammatory drugs (NSAIDs) in acute and chronic pain conditions. Topical non-steroidals were significantly more effective than placebos for pain relief. Mason et al²⁹ determined the efficacy and safety of topical rubefacients containing salicylates in acute and chronic pain. The Mason et al²⁹ study suggested that rubefacients containing salicylates may be efficacious in acute pain and moderately to poorly efficacious in chronic arthritis and rheumatic pain. Topical salicylates have higher validity than the counter irritant such as Biofreeze. For chronic pain; however, topical NSAIDs have a higher validity.

Progressive AROM, stretching, and strengthening of the knee and ankle were implemented and instructed to the patient throughout the physical therapy sessions.(see Appendix) Werd MB¹, Roberts et al¹⁶, and Wallace et al³ studied the non-operative management and intervention of acute Achilles tendon ruptures. The review and both

studies found ongoing progressive AROM, stretching, and strengthening techniques were effective adjunct treatment protocols.

After the fourth day, status post patient injury and the second session of pulsed ultrasound, 10% phonophoresis/interferential electrical stimulation treatment, a change in color of the ecchymosis area of the right gastrocnemius medialis and lateralis muscle was observed. The color changed from a dark purple to a light green and yellow. The ecchymosis seemed to travel from the right gastroc medialis and lateralis muscle tendons inferiorly down to the right mid gastrocnemius, soleus, and Achilles tendon. The patient complained of less pain during AROM exercises, stretching, and gentle strengthening exercises.

Outcomes at Discharge

After six visits, the patient was ambulating 100 feet with a diminished level of pain to 0/10 when weight bearing on the affected extremity. Ambulation was non-antalgic with the over the counter insert and 3/8-inch heel lift in the right tennis shoe. The patient felt he didn't require the AFO walking boot and cancelled the order for an AFO walking boot. A pair of TED hose (Kendall Co., Manfield, MA) was implemented after the third session of physical therapy and continued throughout the remainder of the treatment time. Biofreeze was utilized throughout his treatment sessions as an adjunct treatment with his home exercise program. The patient was discharged with a HEP consisting of closed chain plyometric exercises related to deer hunting and continued use of the TED hose and Biofreeze.^{30,31}

The closed chained plyometric exercises consisted of lunges, squats, and side steps. The patient was instructed to monitor his perceived level of exertion and tolerance. He monitored pain, shortness of breath, and balance during each exercise technique. Two distinct kinetic profiles are associated with the performance of normal squat and chair squat activities in older men and women.³⁰ The normal squat activity primarily recruits the knee extensors and ankle plantar flexors as evidenced by the relatively large peak moments, powers, impulses, and total work produced at the ankle and knee joints. The chair squat activity primarily recruits the muscles surrounding the hip joint, generating comparatively greater hip extensor kinetics. The results of this study indicate that in older adults the chair squat places greater demand on the hip extensors; whereas, the free-standing squat places greater demand on the knee extensors and ankle plantar flexors.³⁰ Squatting activities may be used within exercise programs to preserve physical function in older adults.³¹ Wang MY³¹ studied repeated measures comparison of kinematics and kinetics associated with forward step-up and lateral step-up activity. The lateral step-up resulted in greater maximum knee flexion and ankle dorsiflexion. Peak joint moments were similar between exercises. The forward step-up generated greater peak hip power and total work. The lateral step-up generated greater impulse work and power at the knee and ankle. In older adults, the forward step-up places greater demand on the hip extensors while lateral step-up places greater demand on the knee extensors and ankle plantar flexors. The forward step-up is recommended for maintaining or improving hip extensor performance; whereas, the lateral step-up is recommended when targeting the knee extensors and ankle plantar flexors.³¹

Gastrocnemius and soleus standing and sitting stretches were continued. The patient utilized the NuStep TRS 4000 Recumbent Cross-Trainer (NuStep, Ann Arbor, MI) at a local fitness center to condition himself for a deer hunt in one week. The NuStep exercise machine is a low impact, total body workout seated stepper. The focus of the home exercise program and the NuStep was to provide aerobic strengthening and conditioning in addition to an overall muscle training range of motion. If there were any complications the patient was instructed to contact the outpatient physical therapy clinic. The patient's exercise protocol correlated with the exercise protocol as implemented in the Werd MB¹ review, Wallace et al³ study, and the Gam et al²⁶ study. The review and both studies confirmed the importance of active exercise positively affecting patients with pain.

The patient continued to monitor his perceived level of exertion and tolerance by monitoring pain, shortness of breath, and balance during his HEP. He was satisfied with the physical therapy interventions and outcomes. The patient was contacted six months after the injury. The patient reported successfully completing a deer hunt including shooting a deer. The patient finished the year of 2005 shooting his deer along with pheasants, turkey, and geese. He had no problem with pain or using the over the counter cushioned shoe insert and 3/8-inch heel lift with his right hunting boot. The patient had returned to using cowboy boots. He used tennis shoes while walking with his wife and hunting boots when he hunted. (See Table 2).

Table 2. Ankle measurements six months s/p gastrocnemius medialis and lateralis muscle rupture, tendon intact

AROM	Left	Right
Plantar Flexion	50 degrees	50 degrees
Dorsiflexion	0 degrees	0 degrees
Inversion	20 degrees	20 degrees
Eversion	5 degrees	5 degrees

CHAPTER III

DISCUSSION/REFLECTION

This case study describes the acute injury of a 64-year-old avid hunter. The patient injured the right lower extremity by stepping in a hole while hunting. After interviewing and examining the client it was decided to proceed with physical therapy intervention by incorporating a functional orthosis and heel lift, modalities and exercise. Over the course of six intervention sessions, the patient received ultrasound, phonophoresis, interferential electrical current, manual myofascial soft tissue techniques with a cryo-ointment, counter-irritant, compression wrap and hose, and graded exercise. After completing physical therapy interventions the patient successfully returned to hunting without any limitations.

Acute inflammation is usually of sudden onset, marked by the classical signs of heat, redness, swelling, pain, and loss of function, and in which vascular and exudative processes predominate.³² Acute treatment of an inflammatory condition should begin with PRICEN: Protection, Rest, Ice, Compression, Elevation, Nonsteroidal anti-inflammatory drugs.¹ In this case study PRICEN was the initial treatment. Ultrasound, phonophoresis, interferential electrical current, myofascial release techniques, and compression taping and hose were methods used to control or resolve inflammation. Ultrasound, interferential electrical current, and myofascial release techniques with a cryo-ointment, counter-irritant stimulated healing and decreased pain. A functional orthosis and heel lift, in conjunction with a graded exercise program improved function and recovery.

The treatment in this case study was successful due to early intervention. Early intervention provided the patient with the best chance of promptly returning to the activity of hunting. A detailed injury history, knowledge of anatomy and biomechanics, and an accurate diagnosis created an effective treatment plan.

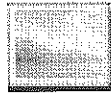
If a clinometric/functional outcome scale had been used for evaluating lower extremity functional clinical change, the lower extremity functional scale (LEFS) would have been selected. It demonstrates high rigor and reliability, validity, and sensitivity, and is efficient to administer and score.³³ However, further investigation into the utilization of the LEFS tool for Achilles tendon ruptures is required.

The direct costs were reasonable based on insurance, patient billing, and the number of visits, which amounted to 6 total visits. Indirect cost versus benefit revealed no time lost from work. There were minimal effects of impairment with no significant disability or handicap. The patient returned to hunting as he planned. The compared cost effectiveness of the over the counter inserts and heel lift with a functional orthotic brace (walking boot) reflected the most cost benefit.

Based on the research from this study, modification in modality usage may be applicable. Ultrasound may not be a future treatment of choice for acute myofascial pain; however, ultrasound may be a treatment intervention for musculotendinous lesions. Ultrasound usage occurs despite a lack of support of scientific evidence for a beneficial effect or a biophysical effect of ultrasound.^{20, 24-26} Alleged physiological responses to the biophysical effects of therapeutic ultrasound have been pivotal in the widespread adoption of ultrasound even in the absence of clinical studies.²⁴ Recent research supports cold, moist heat, interferential current, myofascial trigger point

release techniques, topical analgesics, and exercise as treatment of choice for acute myofascial injuries. Research has supported ultrasound usage for acute musculotendinous injuries. Utilization of ultrasound should be considered in a case-by-case situation especially involving musculotendinous lesions.

APPENDIX



cold packs 1st page.jpg



cold packs 2nd page.jpg



ankle exercises.jpg



forward lunge.jpg



step downs.jpg



gastroc-soleus str.jpg



step ups.jpg



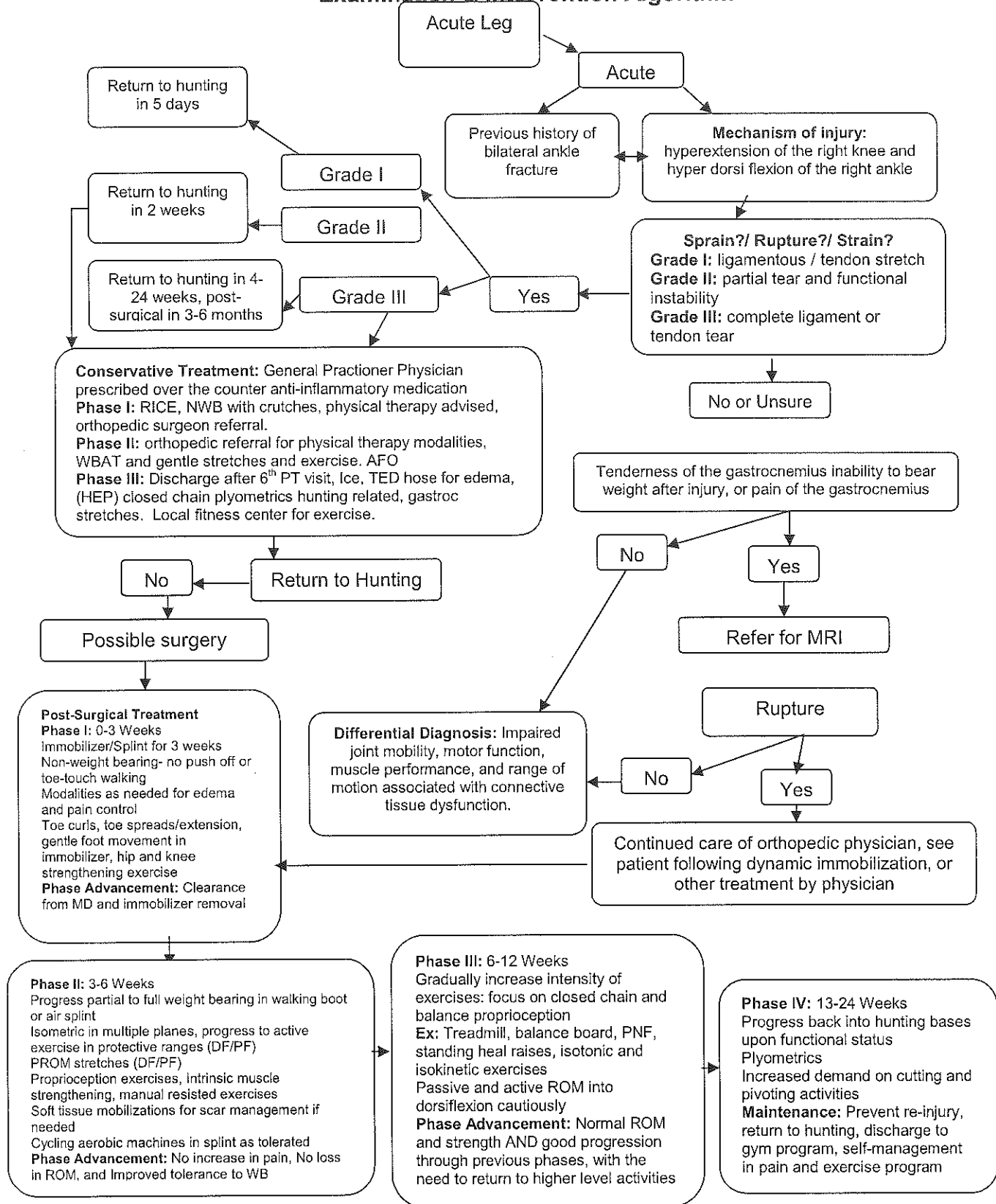
heel rise.jpg



wall slides.jpg

Appendix A

Examination & Intervention Algorithm



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