The Result of Monochromatic Infrared Light Energy Therapy and Traditional Physical Therapy in Decreasing Pain on a Middle Aged Woman Following Talar Fracture and Detached Cartilage:

A Case Report

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Abstract

Purpose: The purpose of this case study is to examine outcomes following a therapy program and monochromatic infrared energy on a middle aged woman status post talar fracture. Case Description: A 44 year old woman sustained a left talar fracture fourteen months prior to arriving in physical therapy. Her goal for physical therapy was to decrease her left ankle pain. At initial evaluation, she demonstrated increased swelling, decreased range of motion (ROM), and decreased strength. She had difficulty walking and standing for greater than 20 minutes which impacted her ability to work and perform daily activities. Methods: The interventions included moist heat and ultrasound, therapeutic exercise for strength and ROM, home exercise program and monochromatic infrared light therapy. Treatments were provided two times per week for eight weeks. Outcomes: Throughout the course of treatment the participant saw great gains in the strength and range of motion and small improvements in swelling of the ankle. She continued to have difficulty with standing and walking and was not able to return to work. Our observations show that in this particular case, MIRE was only minimally effective in decreasing chronic pain following a talar fracture. Discussion: A treatment program including modalities, therapeutic exercise, and MIRE was minimally effective in decreasing pain, but very effective in increasing ROM and strength in a middle aged female experiencing chronic pain following a talar fracture. Even though her general pain ratings did not decrease, she was able to tolerate more therapeutic exercises allowing her to make gains in ROM and strength. It is possible that MIRE played an indirect role by decreasing inflammation and allowing her to exercise more. More research is required to determine if MIRE is beneficial in decreasing chronic pain.

Background and Purpose

Talar fractures comprise 3-5% of all fractures in the foot, and of those fractures a reported 36% involve the talar processes. Talar fractures can be particularly difficult to manage in some cases due to the position and function of the talus in the foot and lower leg. The talus articulates superiorly with the tibia and the fibula and inferiorly with the calcaneus and navicular. When the foot is dorsiflexed the talus pushes up into the tibia and fibula, causing the bones of the lower leg and foot to "lock" into place. The locked position is very stable and allows for heel strike to occur during walking. When the foot transitions into plantarflexion, the talus moves inferiorly to the tibia and fibula and the lower leg and foot become "unlocked." The unlocked position allows the foot to conform to the ground beneath it. The ability of the talus to lock and unlock the foot makes it crucial in being able to walk over uneven surfaces and distributing weight evenly throughout the foot.[1]

The problem with fractures of talar processes is that they can be difficult to view on radiographs and therefore may go undiagnosed.[2] Proper diagnosis is vital when treating a talar fracture since an incorrect diagnosis can lead to inappropriate treatment and have devastating chronic affects. A person that is not treated correctly may end up with long term arthritic and chronic pain. This problem is exacerbated because the talus plays such a crucial role in ambulation.[3]

When a talar fracture is diagnosed, surgery is often performed to realign and stabilize the bones. Unfortunately, even with surgery, people with talar fractures often experience complications long after the initial injury. It has been suggested that those more likely to experience complications are people that have had a greater degree of displacement at the time of injury. People with no displacement are much less likely to have complications

following surgery. Complications include avascular necrosis due to poor blood supply, non-union or malunion, arthrofibrosis and arthritis.[4] One research study examined 80 patients following surgery for a talar fracture and found, 50 that of them had pain after sports or long walking long distances, 9 had talar necrosis, and 53 experienced arthrosis in either the ankle joint, the subtalar joint, or both. In addition, 11 patients required arthrodesis of the ankle or subtalar joint due to persistent pain, arthrosis or necrosis.[5]

Oftentimes, a more conservative approach is taken. When the radiographs show the bones are not misaligned surgery may not be necessary. In these cases, the doctor may recommend 6-8 weeks of non-weightbearing on the injured side in order to allow time for the bone to heal.[6] Following the rest period the doctor may suggest physical therapy in order to regain strength and range of motion (ROM) in the ankle joint.[3]

Limited blood supply is of great concern with a talar fracture. This can be a concern whether it has been repaired surgically, or if it is left to heal on its own. Limited blood supply is such a big concern because lack of blood can lead to talar avascular necrosis and possible bone collapse.[7] The talus has a very limited blood supply, so when a fracture occurs, the displacement of the bone may cause full or partial occlusion of the surrounding arteries. Decreased blood supply can lead to slower healing times and eventually, without correction, bone death and possible collapse.[8]

Swelling and edema are common during any acute fracture. Edema can cause pressure on the surrounding nerve fibers sending a message to the brain which is then perceived as pain. Edema can also increase pressure on the surrounding capillaries. The capillaries are key in bringing oxygen and other nutrients, such as nitric oxide, to the injured tissue to assist with the healing process. With increased pressure on the capillaries, nutrients

are unable to reach the tissue as effectively and the tissue is unable to heal properly. Current theory suggests that monochromatic infrared energy (MIRE) therapy may be able to reverse this process in order to decrease pain and improve healing time.[9]

MIRE is a therapy device that was approved by the FDA in 1994 for increasing circulation and decreasing pain. The MIRE system consists of eight flexible pads containing 60 superluminous Gallium Aluminum Arsinide diodes. These diodes emit monochromatic near infrared light at a wavelength of 890nm, which is the most effective wavelength for absorption by human tissues. Due to the nature of monochromatic light, the light cannot be seen or felt by the person, but can penetrate the skin causing changes in the deeper tissues. These changes include vasodilation, decreased inflammation, decreased muscle spasm, decreased muscle tension and tightness, increased lymphatic drainage, and increased venous dilation.[10]

Vasodilation is the key physiological change which can result in a decrease in pain. MIRE causes vasodilation because as the light penetrates the skin it causes nitric oxide to be released from hemoglobin in the red blood cells passing through that area. Nitric oxide is a molecule which acts as the strongest vasodilator in the body. When nitric oxide is released into the body it relaxes the smooth muscle tissue of the vascular system causing dilation of the blood vessels, and allowing more oxygen to flow to the injured area. Oxygen helps decrease pain by allowing the injured tissue to heal more quickly. Without oxygen present the tissues cannot heal and pain will persist.[9]

There is currently a lack of research concerning how MIRE can affect pain and healing following acute injuries. Most of the research conducted thus far has concentrated on the effects of MIRE on sensory loss from diabetic neuropathy, neuropathic pain, and wound

healing. These studies have shown that MIRE can help to improve lower extremity sensation following diabetic neuropathy,[11-15] decrease neuropathic pain,[14,16] and cut down wound healing time.[17,18]

Although these studies do not focus primarily on the effects MIRE in relation to their effects on chronic pain due to a musculoskeletal problem, the physiological concepts behind healing and perception of pain should still apply. As previously mentioned the key to healing is the release of nitric oxide. Faster healing times observed in the studies on the effects of MIRE on wound healing may be a result of the release of nitric oxide into the bloodstream. These principles could also apply to fractures. Following the fracture, if proper healing does not occur and pain persists, MIRE could help to decrease pain. If MIRE treatment pads are placed over the area where the fracture occurred, nitric oxide should be released in the area causing vasodilation, just as is observed in people with chronic wounds and neuropathy. In the case of a fracture, the vasodilation should help heal the damaged tissues in the area and also decrease pain by decreasing muscle spasm and swelling in the area.

The purpose of this case report was to document the outcome of MIRE, in addition to therapeutic exercise and modalities, on chronic pain following a talar fracture. The hypothesis is that the use of MIRE will help decrease pain in a 47 year old female status post talar fracture.

Methods

Case Description

The participant of this case report was a 44 year old female diagnosed with chronic pain following a left talar fracture. The fracture occurred 14 months prior to the physical therapy initial evaluation, when a drawer from a filing cabinet fell on her foot. She received

physical therapy five months prior to the current evaluation for left ankle pain and was discharged because her pain was eliminated. She returned to physical therapy on this day since the pain returned. She was wearing a walking boot for six weeks, which was discharged by the MD one day prior to beginning physical therapy. Past medical history includes cholescystectomy and c-section. She was employed as a professor of nursing at a local college and also as a hospital supervisor. Both of her jobs require her to stand and walk for long periods of time. She was out of work for two weeks at the time of evaluation. Her diagnosis places her into Preferred Practice Pattern 4G: Impaired Joint Mobility, Muscle Performance, and Range of Motion Associated with Fracture in *The Guide to Physical Therapist Practice*.[19] Human subject's approval was obtained from The Sage Colleges' Institutional Review Board.

Examination

The physical therapy examination took place 14 months following the initial injury. She was currently out of work, but hoped to be able to return to work within two weeks. She had also received physical therapy five months prior to the current evaluation for left ankle pain. At that time physical therapy included hot packs, therapeutic exercise, manual passive range of motion, ultrasound, transcutaneous electrical stimulation, ice, and a home exercise program. She also received physical therapy two months prior for low back pain, most likely secondary to walking with an antalgic gait from her ankle pain. During her previous course of treatment the participant received transcutaneous electrical stimulation (TENS) and ultrasound (US), two modalities that are traditionally used in physical therapy practice for decreasing chronic pain.[20, 21]

Physical therapy examination on this date showed that the participant had significant impairments in the left ankle. Left ankle active range of motion and muscle strength was considerably limited when compared to the right. See Table 1 for specific range of motion and muscle strength measurements.

Girth measurements were taken to determine if there was any swelling accompanying her current pain. Measurements showed no increase in swelling on the left side for figure eight and mid-arch measurements when compared to the right. Figure eight measurements were 21 cm on both the left and right sides. The mid-arch measured 10.5 cm on the left and 10.4 cm on the right. Standard special tests for the ankle were performed in order to rule out other diagnoses. Special tests were negative for the Anterior Drawer Test, Thompson Test and Homan's Sign. Special tests with positive results were the Posterior Drawer Test and Talar Tilt. The participant described her pain as a sharp, constant pain that varied from 7/10 to 10/10, depending on position and activity. She reported having the most difficulty with standing, lifting and carrying objects, and ambulating greater than 30 minutes. She reported to the clinic on this day with an antalgic gait, using no assistive device. She reports she was able to ambulate community distances, however she required increased rest breaks.

Outcome Measures

Outcome measures chosen for the participant were pain as measured by a visual analog scale, active range of motion, and manual muscle testing. Pain measurements were taken prior to each treatment session. Range of motion and manual muscle tests were reevaluated every two weeks.

Subjective reports of pain were taken to assess improvement. Prior to each treatment session the participant was asked to rate her pain on a scale of zero to ten, zero being "no

pain at all" to ten being "the worst pain you could possibly imagine." She was asked only to report what her pain was at that exact moment and reminded each time that her rating should only reflect the pain in her ankle. Visual analog scales have been shown to have excellent intra-rater reliability for measuring pain (ICC=.97).[22]

Active range of motion measurements were taken for all four motions of the ankle: plantarflexion, dorsiflexion, inversion, and eversion. Measurements were performed each time by a therapist with two years of experience in the outpatient setting, with a standard goniometer using the methods described by Reese and Bandy.[23] The participant was positioned in sitting with the knee flexed for all measurements. She was then instructed to actively move the joint as far as possible. When she had achieved maximal range, measurements were taken and recorded. When the correct procedures are followed, goniometric measurements for ankle plantar flexion and dorsiflexion have been shown to have excellent intra-rater and inter-rater reliability (ICC=.86-.98, ICC=.47-.99) No data was found on assessing the reliability of goniometric measurements for inversion and eversion.[24]

Muscle strength measurements were also taken for all four motions of the ankle. Measurements were taken using the methods described by Hislop and Montgomery.[25] For each motion the therapist applied direct pressure to the foot in the opposite direction of the muscles being tested, while stabilizing with the opposite hand on the lower leg. The verbal directions given to the participant were, "hold your foot where it is, do not let me move it." Scores were based on a zero to five scale where zero represents no muscle contraction and five represents a maximal contraction held for at least five seconds. In their 2007 review of literature on the reliability and validity of manual muscle testing, Cuthbert and Goodheart[26] found that inter-rater reliability of manual muscle testing varies from moderate to excellent

(ICC=.63-.98), depending on the research methods. However, research consistently shows that more clinical experience and expertise, significantly increase the degree of consistency in the examiner's scores.[26]

Evaluation/Prognosis

Left ankle pain probably led to her active range of motion and strength impairments. Equal bilateral girth measurements at the ankle indicate that all acute swelling had been resolved. However it was still likely that there was some internal inflammation in the area which would account for her increased pain. Pain, decreased strength, and decreased range of motion caused her to walk with an antalgic gait and limited her ability to stand or walk for prolonged periods of time. Since she would not stand or walk for prolonged periods, she was unable to work. Although the participant had positive results for the Posterior Drawer Test and Talar Tilt Test, which test for ligament laxity in the ankle, it is unlikely that the participant had an ankle sprain. Due to the mechanism of injury and past medical history it is more likely that the participant had positive results on these tests because the tests require the physical therapist to move the ankle joint into a range that was beyond the participant's current range of motion.

We determined that her prognosis to meet her goals was fair. On the positive side she was extremely motivated to improve so that she would be able to return to work as quickly as possible. She had the cognitive abilities to follow directions and perform her home exercise program as it was prescribed. She also had been in physical therapy before with positive results, which lead us to believe that she might have positive results again with this course of treatment. Unfortunately, we felt that her prognosis was limited because she had been experiencing this pain for over a year, and although physical therapy had decreased her pain

previously, her pain did return. Also, although it has been suggested the MIRE can be utilized to decrease pain, there is very limited documented research on it's efficacy, therefore we were unsure of how effective the MIRE therapy would be.

The participant's long term physical therapy goals were as follows: 1. The participant will achieve active range of motion of the left ankle within five degrees of normal limits, 2. The participant will achieve 4+/5 strength on a MMT for all motions, 3. The participant will return to work without limitation, 4. The participant will report 0/10 pain on VAS.

Plan of Care

The plan of care consisted of treatment in the clinic two to three times per week for four weeks and a home exercise program, which was to be performed by the participant at home on the days she was not treated in the clinic.

TENS and US were successful in decreasing her pain the first time around however, since her pain returned a few months later it was determined that these modalities were unsuccessful and a different course of treatment was needed. Ultrasound was used again, however this time it was used in combination with moist heat, therapeutic exercise and MIRE. Ultrasound was used since it had been successful in decreasing her pain temporarily in the past and the literature shows that ultrasound is successful in decreasing chronic pain.[20] The hope was that the MIRE would be successful in permanently decreasing her pain.

Each treatment began with a hot pack to the left calf and ankle in order to increase blood flow to the area in preparation for exercise. The hot pack was followed by the ultrasound which was applied to the left medial ankle at a rate of 1.3 w/cm^2 for eight minutes. Following the ultrasound she received her MIRE treatment.

The participant was in the supine position with her lower leg elevated while receiving her MIRE treatment. During traditional MIRE treatment four pads are utilized. Two of the pads were placed on the medial and lateral malleoli. The other two pads were placed in a "T" pattern on the bottom of the foot, with one pad placed horizontally at the ball of the foot and the other placed perpendicular to the first, along the longitudinal arch. The pads were strapped securely into place with Velcro straps. This pattern was chosen since the target area was completely surrounded with the pads in this position. Treatment lasted for 15 minutes at a strength of 9 bars, which is less time than recommended by the manufacturers.[27]

Following the MIRE treatment she performed therapeutic exercises. The participant displayed significant loss in strength and ROM at initial evaluation, therefore treatments were focused on increasing muscle strength and ROM, however the number and variety of exercises were extremely limited secondary to patient tolerance. Dorsiflexion and plantarflexion strengthening with a theraband, plantarflexion/dorsiflexion rockerboard, single leg stance, and sheet stretches into dorsiflexion, inversion and eversion were attempted, but were not tolerated by the participant. The exercises that were included in the treatment program can be seen in Table 2.

The home exercise program consisted of ankle range of motion and strengthening exercises, and lower leg stretches to be performed twice daily. The participant was instructed in how to perform these exercises correctly and was then required to perform them properly without any verbal cues before she was allowed to perform them at home. This was a safety measure taken to ensure that she was not doing anything that could increase her pain. She was also sent with a handout that had pictures and descriptions of each exercise as reminders.

Due to her limited range of motion at examination simple range of motion exercises were included in the home exercise program in attempt to improve her range of motion. She was asked to perform the alphabet with her foot, and to perform plantarflexion and dorsiflexion ankle pumps. Since she had been in a walking boot for six weeks prior to coming to therapy some stretches for the lower leg were also included. She was asked to perform standing gastrocnemius and soleus stretches each for ten seconds. She also performed a stretch for the Achilles tendon and plantar fascia by hanging her foot over the edge of a stair and allowing her heel to drop down. Finally, she performed toe scrunches with a towel to improve the strength of the intrinsic muscles in her foot.

Outcomes

Active range of motion, muscle strength and girth measurements were re-evaluated every two weeks. It was felt that it might take up to two weeks for the participant to see any significant change from the MIRE treatment. Subjective pain measurements were recorded prior to every treatment. This information was recorded during every session to help determine the treatment that day.

The participant's active range of motion was significantly limited in all motions at initial evaluation. Throughout the course of treatment active range of motion measurements improved for all motions at the ankle. Refer to table 3 for specific values. Manual muscle testing also showed significant improvement throughout treatment, as strength improved in all motions of the ankle. Refer to table 4 for specific values.

Although girth measurements were equal on the left and right sides during initial evaluation, these measurements were taken throughout treatment to ensure that treatment was not causing increased swelling in the joint. Girth measurements at initial evaluation were 21cm, bilaterally for the figure eight measurement, and 10.5cm on the left and 10.4cm on the

right for the mid-arch measurement. After one month using the MIRE treatment, figure eight measurement had decreased to 19.8cm on the left side, suggesting a small decrease in swelling. Girth measurements remained constant throughout the remainder the treatment.

Subjective reports of pain remained relatively constant throughout the course of treatment. At initial evaluation participant reported her pain level at 7/10. At her last treatment her pain was still rated at 7/10. Refer to table 5 for specific values throughout treatment. Participant reported that she noted slight improvement in the ability to stand and walk for extended periods of time. However, these increases were not significant and still did not allow her to function appropriately at her job.

Discussion

The purpose of this case report was to determine the effectiveness of monochromatic infrared light therapy on chronic pain following a talar fracture. Throughout the course of treatment the participant saw great gains in the strength and range of motion and small improvements in swelling of the ankle. She was able to meet the goals for strength and ROM that were set forth at the beginning of treatment; however goals for pain and function were never achieved. Our observations show that in this particular case, MIRE was only minimally effective in decreasing chronic pain following a talar fracture.

The changes seen in strength were significant. Over the course of treatment strength improved from 3-/5 to 5/5. It is unlikely that these changes are due to a direct effect of MIRE, but instead, are most likely a result of the therapeutic exercises that were included in the program. The exercises the participant performed are commonly used for people with a wide range of ankle injuries to help increase strength.[28] However, it is possible that improvement in strength could be a secondary cause of the MIRE. It could be that by

decreasing her pain, she was able to tolerate more therapeutic exercise, which, in turn, improved her strength.

There were also considerable improvements in the participant's ROM. Before treatment began the ROM in her left ankle was significantly decreased when compared to her right ankle, but by the end of treatment measurements on the left and right were comparable. As we saw with her improvements with strength, it is unlikely that her improvements in ROM were directly related to the MIRE therapy. Once again, the exercises she was performing were specifically designed to help increase her ROM and are likely the cause of most of her improvements. However, it is possible that the MIRE therapy also played an indirect role in increasing her ROM. Inflammation and swelling in a joint can restrict a person's motion in that area.[28] Working through a greater ROM requires more strength, therefore, her decreased inflammation may also help to explain her increases in strength. A decrease in girth measurement was noted throughout her treatment indicating that she likely had swelling and local inflammation at the start of treatment which could have be restricting her ROM. As the swelling dissipated it may have allowed the join to move more freely, consequently allowing her greater ROM.

Changes in the girth measurements were very minor, however they may be contributed to the use of MIRE. As previously mentioned, one of the suggested uses of MIRE is to decrease swelling and inflammation causing vasodilation to the local tissues, which brings more oxygen and nitric oxide to the area, allowing the tissues to heal more quickly.[9] Ice was also incorporated as part of the participant's daily treatment. By restricting blood flow to an area of the body, ice can work as an anti-inflammatory. This means that the ice treatment could also have played a role in the decreased girth measurements. However,

the participant reported that she was using ice regularly before beginning physical therapy treatments. This leads us to believe that the ice alone was not enough to decrease her inflammation. Therefore, we believe that the decrease in girth measurement could be secondary to the MIRE treatment.

It should also be noted that ultrasound was being used in conjunction with the MIRE treatment. Ultrasound has historically been used by physical therapists to help decrease pain and inflammation. We included ultrasound in our treatment because the participant had used ultrasound in the past and experienced decreased pain. Therefore, it is possible that some of the decrease in pain and swelling could be a result of the ultrasound rather than the MIRE. However, there is also research suggesting that ultrasound may not effective in decreasing pain or inflammation.[29]

Very minor changes were seen in the participant's pain ratings following the implementation of MIRE therapy. Before MIRE therapy was implemented the participant's pain ratings were consistently rated at 5/10 or greater. Following the implementation of MIRE the patient still reported pain levels greater than 5/10 at times, however she also rated pain levels less than 5/10 on some days. Pain ratings were very inconsistent which leads us to believe that the MIRE treatment was only minimally effective, it at all. Research has shown that if MIRE is going to be effective, the participant will notice a significant decrease in pain within twelve treatments.[27] If no significant change has been seen by the twelfth treatment it is likely that MIRE will not be an effective treatment. Our participant was treated with MIRE on seventeen occasions and still did not see a significant decrease in pain. Since the participant had not seen any significant changes in pain, she requested that the MIRE therapy be discontinued at this time. It should be noted that although the participant did not see a

decrease in pain, she was able to tolerate more exercises at the same pain rating as therapy progressed, which indicates improvement.

One possible reason that the MIRE treatment may not have been effective in decreasing pain is that it is suggested that MIRE be used for 30 minutes three times per week in order to be effective.[27] Due to time and monetary constraints our participant was only able to receive MIRE treatments for 15 minutes, two times per week. Since she was not receiving the recommended amount the MIRE may not have had the same effect it would have, had it been used for the suggested time and frequency.

One of the major limitations of this study is that there is no proof of cause and effect. Since we were unable to control for other impacting factors it is difficult to determine if the MIRE therapy was the cause of her changes or if it was due to other factors. We also were not able to control for what the participant was doing in her outside life. Since she was a nurse, a college professor and a mother she spent a lot of time on her feet, which did not allow time for swelling to decrease. This may have impacted the effectiveness of the treatment.

Another limitation is that during the course of treatment it was also discovered that the participant had detached cartilage in her foot in addition to the talar fracture. It is unknown whether or not the detached cartilage is related to the initial injury, however the pain she was experiencing from the detached cartilage could have impacted the results of the MIRE. Physical therapy was discontinued after four months for the participant to have cartilage surgically repaired.

There are also some limitations to the outcome measures that were used. Use of a goniometer may only be accurate within a few degrees, which could have caused changes in

the results. Also, using participant report for pain and function may not have been completely accurate. Although use of a goniometer and patient report for pain may not yield the most accurate results, at this time they are the standard of care in PT practice. In order to minimize error it is important to perform goniometer measurements as outlined in the books and to measure the same way each time. For pain, it is important to document other subjective information such as changes in gait, facial expressions, and other reports from the patient to help minimize error.

A number of changes are recommended for clinicians doing similar research in the future. Using standard tests to measure quality of life, functional independence and occupational satisfaction should be considered. These assessments would allow us to see how the person's pain is impacting their overall life and if the treatment has been effective in making improvements in these areas. Possible suggestions for standardized tests that could be used are the Quality of Life Questionnaire, the SF 36, the Canadian Occupational Performance Measure. Other suggestions include isolating MIRE therapy from other treatment methods, and following the suggested time and frequency protocols for MIRE therapy.

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Table 1. Ankle Range of Motion and Manual Muscle Test Measurements

Ankle Movement	Left ROM	Right ROM	Left MMT	Right MMT
Dorsiflexion	-5°	0-15°	3-/5	5/5
Plantarflexion	5-40°	0-65°	3-/5	5/5
Inversion	0-20°	0-26°	3-/5	5/5
Eversion	0-10°	0-14°	3-/5	5/5

Table 2. Exercise Log

Exercise	**Week 1**	**Week 2**	**Week 3**	**Week 4**	**Week 5**	**Week 6**	**Week 7**	**Week 8**
Dorsiflexion Stretch with towel (seated)	10x10sec	10x10sec	HEP	HEP	HEP	HEP	HEP	HEP
NuStep	XX	3 min.	5 min.	5 min.	8min.	10 min.	10 min..	12 min.
Wobble Board (Seated) (CW,CCW)	XX	10 ea dir.	20 ea dir.	20 ea dir.	20 ea dir.	25 ea dir.	25 ea dir.	30 ea dir.
Dynadisc (Seated) (PF,DF, Ev, Inv	XX	10 ea dir.	20 ea dir.	20 ea dir.	20 ea dir.	25 ea dir.	25 ea dir.	30 ea
K.A.T. (Kinesthetic Ability Trainer)	XX	XX	XX	XX	XX	1 min.	2 min.	2.5 min.

CW=Clockwise, CCW=Counter clockwise, PF=Plantarflexion, DF=Dorsiflexion, Ev=Eversion, Inv=Inversion

Table 3. Active Range of Motion

Ankle Movement	7/8/09	7/20/09	8/19/09	9/25/09	10/28/09
Dorsiflexion	-5º	-4º	0º	0-12º	0-5º
Plantarflexion	5-40º	0-40º	0-50º	0-55º	0-44º
Inversion	0-20º	0-22º	0-20º	0-35º	0-20º
Eversion	0-10º	0-11º	0-25º	0-15º	0-5º

Table 4. Manual Muscle Test

Ankle Movement	7/8/09	7/20/09	8/19/09	9/25/09	10/28/09
Dorsiflexion	3+/5	3+/5	4/5	5/5	5/5
Plantarflexion	3+/5	3+/5	4/5	5/5	5/5
Inversion	3+/5	3+/5	4/5	5/5	5/5
Eversion	3+/5	3+/5	4/5	5/5	5/5

Table 5. Pain Rating

	7/8/09	**7/20/09**	**8/10/09**	**8/19/09**	**9/8/09**	**9/25/09**	**10/6/09**	**10/28/09**
Pain Rating	7/10	5/10	0/10	9/10	3/10	7/10	6/10	9/10