The Effects of Physical Therapy Interventions in the Treatment of a Patient with Total Ankle Arthroplasty

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Veronika Bellezza, SPT       Date: 5/01/10
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Abstract

Background and Purpose: The purpose of this case report is to identify interventions that were successful in treating a patient status post a right total ankle arthroplasty.

Case Description: 72-year-old female with end stage ankle arthritis underwent a right total ankle arthroplasty. Six weeks following surgery the patient reported minimal pain and had moderate swelling. Impairments were found in range of motion, strength, and function. Initial post surgical protocol included immobilization and non weight bearing until bony in-growth occurred at six weeks. Interventions focused on decreasing ankle pain and swelling, increasing active range of motion, strength and flexibility, and improving function. The treatment program included hydrotherapy, cryotherapy, active range of motion exercises, manual stretching, proprioceptive training, progressive resistive exercises, and gait training.

Outcomes: After 17 treatment sessions the patient had decreased right ankle pain and swelling, increased range of motion and strength and was ambulating with a single point cane. She returned to driving and camping and was performing ADL’s with minimal difficulty. The patient continued to complain of ankle stiffness and minimal pain.

Discussion: Post surgical physical therapy treatment initiated six weeks status post a total ankle arthroplasty in a patient with post traumatic end stage arthritis may result in decreased pain and improved functional performance. Due to the patient’s premature discontinuation of physical therapy treatment it is unknown if abolishment of ankle pain and ambulation without an assistive device could have been achieved.
Introduction

The ankle joint (talocural joint) is made up of the talus, medial malleolus of the distal tibia, and the lateral malleolus of the distal fibula. It is a uni-axial, modified hinge, and synovial joint (freely moving connection between skeletal bones covered by articular cartilage and a synovial membrane and separated by a joint cavity) and is responsible for the sagittal plane (dorsiflexion and plantar flexion) movement that occurs between the ankle and foot. It is stabilized by the interosseous membrane, anterior and posterior tibiofibular and collateral ligaments. The ankle is more prone to secondary osteoarthritis (arthritis caused by a trauma) versus primary osteoarthritis (arthritis caused by degenerative joint disease as a result of aging) in comparison to the other weight bearing joints i.e., knee and hip. Numerous factors such as anatomy, biomechanics, and cartilage properties have been recognized as the reason for this phenomenon. The articular cartilage of the ankle can preserve its tensile stiffness and withstand fracture stress better than the hip or knee. In terms of anatomy the knee is a relatively unstable and incongruent joint whereas the ankle is a more stable joint with incongruent articulations at light loads (with incomplete and separate contact areas) but congruent articulations at high loads. The high loads cause the transition from incongruence to complete congruence thus allowing the ankle joint to withstand larger forces and remain more stable. The congruence variation also results in a beneficial effect on lubrication and cartilage nutrition which may also explain the ankle joints relative resistance to Primary Osteoarthritis. It is important to note that the ankle is exposed to greater forces per unit surface area during walking than the knee which also is in an indicator that the ankle’s intrinsic properties protect it from the higher compressive loads.
Arthrodesis (talocural joint fusion) has been the widely accepted and is the surgical
treatment of choice for relatively young patients with end stage or post-traumatic arthritis
of the ankle for more than a century.\textsuperscript{2} Arthrodesis provides pain free weight bearing and
improved stability while sacrificing mobility. In order to ambulate with a stable joint
patients who undergo Ankle Arthrodesis lose the majority of their ankle motion mainly
dorsiflexion (angle decreases between foot and leg) and plantar flexion (angle increases
between foot and leg). Post surgical range of motion depends on how the ankle was
fused. Research indicates that a patient’s functional ability and/or compensations after
surgery are dependent upon the position in which the ankle was fused. Consequently this
loss of motion changes the biomechanics of the lower extremity resulting in gait
abnormalities and/or the permanent use of orthotic and/or assistive devices.\textsuperscript{1,2,9} In a study
by Walters et al., 10 patients who underwent an ankle arthrodesis frequently had
difficulty walking on uneven surfaces and climbing stairs and experienced a decreased
gait velocity of 16\%, an increase oxygen consumption of 3\% and a 10\% decrease in gait
efficiency. This is important to note if an arthrodesis is being considered for an elderly
patient who may not tolerate the increased physiological demand because of other
medical conditions.\textsuperscript{20,24}

Short term clinical outcomes indicate that fusion is achieved greater than 90\% of
the time but varies with the number and location of joints fused, the extent of
preoperative deformity and the underlying pathology. Patients have also reported short
term and long term pain relief. Some long term research has shown ankle arthrodesis to
have high failure rates and patient dissatisfaction. Reasons for this include complaints of
pain, infection, mal-unions, non-unions, excessive limb shortening, lasting gait
deviations, permanent shoe modifications and decreased functional ability e.g., with stairs, inclines and difficulty driving. Research studies with a 7-22 year follow up period have indicated that almost all patients have gait abnormalities s/p an arthrodesis, and even if shoe modifications are used (i.e., heel lift or rocker soles) fast walking is usually the highest activity level that patients can expect to achieve. An overwhelming number of studies have reported increased compensatory motion in surrounding joints secondary to elimination of ankle motion at the talocrural joint leading to degenerative changes and increased incidence of arthritis.

The limitations of ankle arthrodesis (i.e., decreased mobility, increased complications and risk of arthritis in surrounding joints), and moderate dissatisfaction, combined with the success of hip and knee arthroplasty led to the development of Total Ankle Arthroplasty (TAA) as an alternative treatment for end stage or post-traumatic ankle arthritis.

TAA is a replacement of the ankle joint with a prosthetic device. It was introduced in the early 1970’s and claimed to offer some advantages over ankle arthrodesis including increased ROM, better functional mobility (i.e., faster walking velocity), and a reduction in stress in the surrounding joints decreasing the potential of developing arthritis. Ankle arthrodesis and arthroplasty have both been indicated for decreasing pain.

As with total knee and hip replacements, ankle arthroplasty is considered only when conservative physical therapy has been attempted with no improvement. Today there is still no consensus on indications for total ankle arthroplasty and many surgeons continue to perform ankle fusion on all patients with disabling ankle arthritis who have
not improved with conservative management. However the number of ankle arthroplasty's being performed today is increasing as surgeons continue to gain more experience with modern techniques thus increasing surgical confidence with the outcomes.\textsuperscript{1,3,7}

Indications that have been discussed in the literature include; severe and persistent pain particularly during weight bearing; compromised functional mobility as the result of advanced osteoarthritis (primary or secondary), rheumatoid arthritis, or juvenile rheumatoid arthritis; avascular necrosis of the dome of the talus secondary to trauma e.g., broken bone (fracture) or dislocated joint.\textsuperscript{7} It is also an option for patients with bilateral ankle involvement where ankle fusion on both ankles is not practical and would dramatically restrict functional mobility such as getting up from a chair or ascending and descending stairs. TAA is typically most appropriate for older patients (i.e., 50 years and older) who engage mainly in low-impact activities. Young, active individuals are not ideal candidates secondary to the high demands placed on the prosthesis and associated risk for failure. Other criteria for a TAA include sufficient integrity of ankle ligaments which is needed for ankle stability and a flexible deformity that can be passively corrected to neutral, or no more than 5° or hind-foot valgus.\textsuperscript{7,4}

The contraindications to TAA include active or chronic infection of the ankle, severe osteoporosis, impaired vascular supply of the lower extremity, avascular necrosis of a sizeable portion of the body of the talus, marked ankle instability, a varus or valgus deformity of the hind-foot greater than 20° (a varus deformity is when the heel appears inverted and valgus is when the heel appears everted), less than a 20° total arc of dorsiflexion and plantar flexion, peripheral neuropathy resulting in decreased sensation
and considerable weakness, and imbalance of ankle and foot musculature. In addition it is not appropriate for patients less than 50-60 years of age who are physically active or obese.  

There are different types of TAA prosthetic devices that have changed in design over time. The early designs were made of cement and provided a constrained (no movement allowed at the ankle joint) or an unconstrained feature. Constrained designs offered greater stability at the ankle joint but decreased mobility while unconstrained designs offered greater mobility while compromising stability. Outcomes of these early TAA designs were fraught with failures and abandoned near the beginning of the 1980’s due to a high incidence of infection, non-anatomic or mal-constrained designs, poor cement technique, excessive bone resection, loosening implants, poor functional outcomes and patient dissatisfaction. By the early 1990’s improvements in prosthetic designs coupled with better surgical techniques (better soft tissue balancing and ligament reconstruction) led to the development of un-cemented semi-constrained devices or second generation designs which provided more natural movement at the ankle joint. The development of semi-constrained designs resulted in a better understanding of the biomechanics of the foot and ankle with the goal to allow more natural movement (i.e., dorsiflexion, plantar flexion, internal and external rotation) to occur at the ankle joint. The goal was to have a prosthetic device that maintains normal ankle movements in order to prevent bone and implant shear, ligament failure, component loosening, migration, and accelerated wear. These designs led to the revival of TAA as a more accepted and successful treatment. It is hopeful that the semi-constrained devices would help prevent the high failure rates associated with constrained designs. The range of motion available
in modern day second generation prosthetic designs mimics that of a normal ankle. According to numerous sources these newer designs permit at least 5° to 10° of dorsiflexion, 20° to 25° of plantar flexion adequate for functional activities, and a small degree of medial/lateral rotation of the foot on the tibia to reduce stresses on the implants.\(^7\) It is important to note there has also been a need for different types of prosthetic designs guided by anatomical necessity. The ankle joint contains articulations between three different bones (talus, tibia, and fibula) and some prosthetic devices are designed to resurface all articulations while others are designed to resurface part of the articulations depending on the patient’s need. The more articulations resurfaced the more complicated the procedure thus the need for a variety of prosthetic designs.\(^1,2,3,7,13,19\)

Today in the United States there is only one second generation ankle prosthetic that has been approved for use by the FDA, “Agility Ankle Replacement,” made by my Depuy Orthopedics Inc., a Johnson and Johnson company. This implant allows a flexion-extension arc of 60 degrees. The distal tibia and fibula are fused together (syndesmotic fusion) and a portion of each of each is removed in addition to the top of the talus. The syndesmotic fusion allows even load transfer to the tibia and the fibula. A two component prosthetic device is then added, one piece to replace the top of the talus and the other to replace the distal part of the tibia. This design incorporates 20 degrees of external rotation into both components to allow the device’s axis of rotation to approximate the inter-malleolar axis. Theoretically the patient will be more stable in dorsiflexion than plantar flexion because the talar component is slightly wider anteriorly than posteriorly.\(^3,4,13,25\)

While few long term studies exist to determine the effectiveness of TAA, short term research indicates that patients can expect good function with the first five years of
A 5 year follow up study of TAA performed on 100 patients between 1984 and 1993 with the Agility ankle replacement indicates positive results in terms of pain, ROM, function and overall satisfaction. Outcomes are based on 82 patients (85 ankles) because 12 patients had passed away (14 ankles) and there were 5 revisions and 1 resection of an implant followed by an arthrodesis. The average age of the patients in this study at the time of the procedure was 63. At the 5 year follow up 55% of the ankles were not painful, 28% were mildly painful, 16% moderate pain and there were no reports of severe pain. In terms of function of the eighty two patients 45% reported that they were not able to climb stairs as well as they hoped; 27% blamed the ankle and 73% attributed it to other problems i.e., age, other joints. A total of 79% reported that they were extremely satisfied with the results and at the opposite end of the spectrum 4% were indifferent. The majority of the patients did not need an assistive device post-operatively; however 68% of patients reported that they felt more comfortable ambulating in a walking shoe with a small elevated heel. In terms of ROM at the follow up only 56 ankles were assessed because the other 29 completed detailed written and telephone questionnaires. Of the 56 patients the average ROM achieved was 36º (range 10º-64º) in the sagittal plane. In a study by Kopp et. al., intermediate term clinical outcomes for ROM and patient satisfaction were also promising. Ankle arthroplasty was performed on 40 ankles between 1998 and 2002 with the Agility ankle. At the roughly 4 year follow up 30 ankles with the agility ankle had a preoperative ROM restriction in the sagittal plan of less than 15º and post-operatively there were no ankles with less than 15º. Pre-operatively 7 ankles had 15 to 29 degrees and post-operatively 22 ankles had this range. Lastly, 3
ankles pre-operatively had 30° or more and post-operatively 18 ankles achieve a ROM of 30° or more. Overall 85% of ankles had increased ROM in the sagittal plane.  

A systematic review of the literature in 2007 by Haddad et al provides a quantitative comparison of the results of ankle arthrodesis versus TAA. Efficacy outcomes were determined and broken into categories of excellent, good, fair and poor. For TAA the results were excellent in 38%, good in 30.5%, fair in 5.5% and poor in 24% of the patients. In the arthrodesis group the outcomes were excellent in 31%, good in 37%, fair in 13% and poor in 13% of the patients. In looking at either end of the spectrum while TAA had better ‘excellent’ results versus ankle arthrodesis i.e., 38% versus 31% respectively, TAA had a higher percentage of ‘poor’ results versus ankle arthrodesis i.e, 24% versus 13% respectively. The following statistics show TAA results in regards to implant survival, revisions, and conversions to arthrodesis. The five and ten year implant survival rates for TAA were 78% and 77% respectively. A revision during the follow up period was necessary in 7% of the patients and the most common reason for revisions was loosening and/or subsidence (prosthetic component sinking into the softer bone of the tibial bone, often laterally), 28%. A below-the-knee amputation had to be performed in 1% of patients treated with TAA. Five percent of the TAA’s had to be converted to an arthrodesis mainly due to loosening and/or subsidence. In the arthrodesis group nonunion occurred in 10%, 9% underwent revisions mainly because of nonunion and 5% underwent a below-the-knee amputation.\textsuperscript{6,18} 

There are few standardized guidelines in the literature for the optimal physical therapy management s/p a TAA. The protocols that do exist vary significantly with regards to length of postsurgical immobilization, and when to initiate weight bearing and
AROM exercises. More long term research is needed in order to determine the most effective physical therapy treatment protocol for patients who undergo a TAA. The purpose of this case report is to identify interventions that were successful in treating a 72 year old diabetic female patient with post traumatic end stage ankle arthritis after a TAA.

**Case Description**

**Patient description**

The patient, Rita, is a 72 year old female who was referred to outpatient physical therapy status post a right TAA. Her ankle was replaced with the Agility Total Ankle System (Depuy, inc.) an un-cemented, semi-constrained, 3 component design.\(^{13,12}\) It is also important to note that Rita experienced a spontaneous syndesmotic fusion as a result of previous trauma. Rita is a retired teacher and lives with her husband. She enjoys camping with her extended family and walking for exercise. Rita’s past medical history is significant for Diabetes Mellitus type II (NIDDM), HTN (hypertension), three right ankle surgeries including two fracture repairs, and tarsal tunnel surgery secondary to tarsal tunnel syndrome. Tarsal tunnel syndrome occurs when there is abnormal compression of the tibial nerve (nerve that supplies all the muscles of the posterior leg and sole of the foot). Surgery is performed to release the flexor retinaculum or tarsal tunnel (dense band of fibrous tissue which the tibial nerve and other soft tissue structures pass through). The tarsal tunnel is formed by the medial malleolus, calcaneus, talus on one side and the tibiocalcaneal ligament on the other.\(^9\) Rita’s other pertinent past medical history includes left carpal tunnel surgery and a left rotator cuff repair/decompression. Her current medications include Glucophage, Glipizide, and Avandia for management of her NIDDM, Toprol-XL, Hydrochlorothiazide and Avapro for her HTN, Lipitor to control
her cholesterol levels, Trazodone for depression, and Nexium as needed for her unspecified gastric problems (as per the patient.)

Rita reported that she wore an AFO (ankle foot orthotic) as needed for three years prior to her TAA secondary to ankle instability and weakness. She also suffered from persistent ankle pain and difficulty performing ADL’s (activities of daily living). Rita’s goals for therapy were to decrease her ankle pain, and achieve better functional mobility in order to return to recreational activities i.e., taking walks in the neighborhood with her husband camping without difficulty. Today, treating patients’ s/p TAA is not a common occurrence in an outpatient physical therapy setting which is why Rita was chosen as the patient for this case report.

**Examination**

Rita was first seen for physical therapy approximately 6 weeks and 5 days after her surgery. Upon examination she was WBAT (weight bearing as tolerated) ambulating with a walking cast and using a walker as an assistive device. Rita’s gait was moderately antalgic with decreased heel strike and stance time throughout her right lower extremity. She was performing ADL’s (e.g., dressing, bathing, grooming) with minimum assistance and independent with activities of daily living (IADL’s) (e.g., grocery shopping and housework) with minimum-moderate assistance Rita was not able to drive at the time of the initial evaluation. Rita had moderate swelling around the ankle joint and foot and reported 2/10 pain on the Visual analog scale (VAS scale) and described her pain as, “constant and achy.” She also reported increased ankle stiffness. The visual analog scale is a numerical pain scale with zero representing no pain and ten being the worst pain. Rita was using an ice pack and prescription pain killers to help decrease her symptoms of
ankle pain and stiffness secondary to surgery. Post surgical radiology reports indicated that her prosthesis was in good alignment and that bony in-growth had occurred. No paresthesia’s (numbness or tingling) were reported in bilateral lower extremities. Light touch sensation and reflexes were grossly intact throughout bilateral lower extremities. Integumentary examination revealed small cuts throughout her right lower leg with scab formation indicating proper healing. The incision site was healing well without any erythema (redness), drainage, or signs of infection. Tenderness to palpation was noted over the incision site i.e., mid-sagittal axis over dorsum of foot, and over the anterior lower leg at the level of bilateral malleoli. Right ankle AROM was dorsiflexion 0°, plantar flexion 0-15°, inversion 0-10°, and eversion 0-5°. Normal ankle AROM measurements are dorsiflexion 0-20°, plantar flexion 0-50°, inversion 0-35°, and eversion 0-15°. Strength testing revealed 3-/5 in all motions e.g. dorsiflexion, plantarflexion, inversion and eversion within available range.9

**Evaluation**

Prior to her TAA Rita was experiencing disabling pain and a decrease in her ability to perform functional and recreational activities without difficulty. Her initial PT examination revealed right ankle pain and stiffness, increased swelling, decreased AROM, strength, balance and an antalgic gait secondary to a TAA. Rita required the use of a walking cast and an assistive device for assistance when performing ADL’s and IADL’s.
**Diagnosis**

Rita’s history of repeated right ankle fractures and tarsal tunnel syndrome resulted in a diagnosis of post traumatic end stage ankle arthritis by her primary care physician. As a result she underwent a total ankle arthroplasty on 4/10/08 and was then referred to physical therapy for the post surgical management of her right ankle. According to the Guide to Physical Therapy Practice Rita falls under preferred practice pattern 4H; Impaired Joint mobility, Motor Function, Muscle Performance, and Range of Motion Associated with Joint Arthroplasty.14

**Prognosis**

Rita was prescribed 12 weeks of physical therapy treatment 2-3 times per week by her doctor. It was expected the TAA and physical therapy treatment would help decrease Rita’s ankle pain and improve her strength and functional mobility. It was anticipated that she would be able to return to performing ADL’s and IADL’s without pain and difficulty Rita was an appropriate candidate for a TAA procedure because she is 72 years old, suffered from instability and severe and persistent pain during weight bearing, experienced compromised functional mobility as the result of post traumatic arthritis and fell into the low to moderate physical activity level category.

**Plan of Care**

Rita’s plan of care included 17 visits of treatment with each session lasting 30-60 minutes. The interventions performed included; hydrotherapy, cryotherapy, scar massage, AROM (active range of motion), PROM (passive range of motion), progressive resistive exercises, gait training, proprioceptive exercises, and a home exercise program (HEP). Her short term goals were established for 3 weeks and long term for 6 weeks.
Short Term Goals:

- The patient will increase right ankle AROM by 5° in all planes.
- The patient will increase right ankle strength from 3-/5 to 3+/5 in all directions within available range.
- The patient will tolerate ambulating in a walking cast and the use of a single point cane for 100ft.
- The patient will adhere to and be independent with a (HEP).

Long Term Goals:

- The patient will increase right ankle AROM by 10° in all planes in order to perform ADL’s and IADL’s without difficulty.
- The patient will increase right ankle strength from 3+/5 to 4-/5 in all planes in order to remain with her base of support during ambulation.
- The patient will tolerate walking 100ft without the walking cast or an assistive device in order to return to functional without difficulty.
- The patient will report 0/10 ankle pain according to the VAS in order to return to performing recreational activities without difficulty.

Short and long term goals were reassessed at the 10th and 14th visits. The patient unexpectedly canceled her remaining visits due to a death in her family and therefore was not reassessed at her last treatment session, the 17th visit.

Interventions
Interventions were focused on decreasing Rita’s right ankle pain and swelling, increasing AROM, strength, and flexibility and on ambulating without an assistive device. A HEP was implemented on Rita’s first visit and included the following: seated toe curls, AROM exercises (i.e., plantar and dorsiflexion, inversion and eversion) and long arc quads (knee extension) with the involved lower extremity and bilateral seated hip flexion. Rita was encouraged to practice these exercises 2-3 times per day and perform 2 sets of 20 reps. The plan for Rita’s gait training program was to transition her from weight bearing as tolerated (WBAT), walking cast and walker to full weight bearing with a single point cane. The ultimate goal was for Rita to ambulate independently. Rita’s surgery was performed on 4/10/08. Status post surgery she wore a hard cast to keep the joint immobilized, was non-weight bearing (NWB), and used a walker as an assistive device. By week four she continued to ambulate with a walker and was NWB but was switched to a short leg plastic cast which continued to keep the ankle immobilized. Week six was Rita’s first physical therapy session. At that time she was WBAT ambulating in a walking cast and a utilizing a walker as an assistive device. She reported that she had not performed any exercises for her involved ankle since before surgery. Interventions to increase her ROM and flexibility included manual stretching, and AROM exercises of the ankle in all directions (i.e., plantar and dorsiflexion, inversion and eversion). The AROM exercises were performed by Rita in a seated position and included ankle pumps, circles, alphabets and toe curls using a towel placed on the floor. By the third visit Rita was progressed to performing AROM exercises on a BAPS board (Biomechanical Ankle Platform). The platform offers 5 different adjustable hemispherical attachments/levels which can provide different ROM challenges. Rita began performing BAPS AROM
exercises in a seated position at level one and as her ROM improved throughout the 17 visits she moved up the levels and by her last visit advanced to level four. Scar massage was also performed during every session to help loosen adhesions formed between the scar and adjacent tissue and to prevent/decrease scarring. At the beginning of the first three visits Rita complained of stiffness in her ankle so it was decided by the treating therapist for Rita to begin her sessions with Hydrotherapy i.e., whirlpool treatment to help increase ROM and improve overall performance during treatment sessions. The whirlpool treatment was added to Rita’s program at the beginning of the fourth visit and discontinued by the 10th secondary to increased AROM and the treating therapist’s decision to focus Rita’s interventions elsewhere with the time allotted. Cryotherapy, using a cryocuff, was applied to Rita’s ankle at the end of every session for ten minutes to decrease inflammation, and complaints of soreness. A cryocuff is a sleeve that wraps around the patient’s ankle and is filled with 50-70°F water. The sleeve is inflated to provide the simultaneous application of cold and compression. The focus of Rita’s strength program was to increase her right ankle and bilateral lower extremity strength in order to improve her performance during functional and recreational activities. Rita’s strength program began on the first visit and included short long arc quads (knee extension performed with bolster under bilateral knees) performed supine on the plinth and seated hip flexion without ankle weights. Seated hip flexion exercises were ultimately progressed to standing hip flexion in the parallel bars with three pound ankle weights. Half squats and hamstring curls were also performed in the parallel bars. By the fifth visit Rita was using the single point cane in place of the walker 100% of the time. On the eleventh visit the treating therapist began weaning Rita off the walking cast and
had her utilizing a single point cane. This was initially only implemented when Rita was 
at the clinic to make sure she was ambulating safely. Once Rita demonstrated the ability 
to ambulate safely she was instructed to walk around her house with the assistance of her 
cane and without the walking cast for a couple hours every day. This process was 
continued until Rita was able to ambulate 100% of the time without her walking cast. By 
the end of her treatment Rita was ambulating safely without the walking cast but still 
required the single point cane for assistance. Once Rita was FWB and had increased 
strength and range of motion she began her sessions with a 5-10 minute warm up on the 
NuStep (seated cardiovascular exercise machine) with the resistance set at level one. Rita 
also walked on the treadmill using the hand grips to practice safe return to walking for 
exercise and help increase AROM. Additionally proprioceptive exercises were initiated 
on the 13th visit and included double leg toe raises, and single leg toe raises and single leg 
stance on a hard surface. These exercises were performed in the parallel bars and required 
Rita to maintain her stability by not falling outside her base of support. By the 14th visit 
Rita’s HEP program was progressed to performing ankle AROM exercises using a level 
one theraband (elastic band meant to provide resistance) and ultimately progressed to a 
level two theraband by the 17th visit.

**Outcomes**

Outcome measures and all data used for the purposes of this paper were collected 
from the 17 visits for which Rita was seen for post surgical management of a right TAA. 
It was recommended by the treating therapist and Rita’s physician to continue physical 
therapy after the 17th visit however Rita discontinued her treatment after the 14th visit
because of a death in her family. The last objective measures assessed on record were at Rita’s 14th visit and included ROM, strength, and pain.

By the end of her treatment Rita achieved all of her short term and the majority of her long term goals. She increased ankle ROM and strength and decreased pain and was full weight bearing and ambulating with a single point cane with a mild antalgic gait. Rita did however report that her ankle continued to feel stiff when she walked and did housework. She returned to driving by the 17th visit but continued to perform most ADL’s and IADL's with minimal difficulty. Rita reported constant but minimal pain at the beginning of physical therapy treatment rating it as 3/10 on the 10 point VAS scale. She reports that her pain never increased and became more intermittent. The treating therapist was unable to obtain Rita’s ankle ROM measurements prior to surgery. At the initial examination after her TAA Rita’s right ankle ROM measurements were as follows; dorsiflexion 0, plantar flexion 0-15°, inversion 0-10°, and eversion 0-5°. By the end of her treatment Rita’s ROM improved in all motions; dorsiflexion 0-10°, plantar flexion 0-25°, inversion 0-25° and eversion 0-9°. Rita achieved the expected mobility with the Agility Ankle replacement and achieved all her long term ROM goals with the exception of ankle eversion. As mentioned earlier in this report the newer prosthetic designs allow at least 5-10° of dorsiflexion and 20-25° degrees of plantar flexion in order for patients to be able to perform functional activities. Rita was able to achieve these ranges after her TAA and physical therapy treatment. Rita also showed improvements in ankle strength from 3-/5 at the initial examination to 4-/5 in all motions within her available range by the end of her treatment. Despite the premature discontinuation of physical therapy Rita met the majority of her treatment goals.
Discussion

The effectiveness of arthrodesis versus TAA continues to be a largely debated issue. Ankle arthrodesis remains a common treatment option for post traumatic end stage ankle arthritis with positive outcomes, including decreased pain and improved function. However it also results in arthritis in the surrounding joints and greater gait deviations and higher complication rates than TAA. As the number of long term studies documenting successful outcomes with second generation designs is on the rise TAA continues to gain recognition as a viable alternative for patients with end stage ankle arthritis providing better mobility and overall function. TAA short and long term clinical outcomes in terms of ROM, pain, function and overall satisfaction are very positive. However, while much progress continues to be made with TAA there are still barriers that must be overcome including lack of surgical experience, the technically challenging procedure secondary to the complexity of soft tissue structures surrounding the ankle joint, complication rates, ineffective component materials (i.e., osteolysis has been reported in the Agility ankle as a result of polyethylene failure) and a plethora of prosthetic designs. These obstacles may take some time to resolve due to the complexity of the ankle joint anatomically and biomechanically. Other characteristics of the ankle joint that have an affect on TAA and its complications rates include, poor bone strength, increased compressive forces distributed across the joint secondary to the longer level arm of the foot and the limited size of the talus which after resection increases the load on the joint. It is important to note that the future success of TAA may not be solely contingent upon improving some of the barriers mentioned previously but rather on refining the criteria and determining the patient’s needs and goals in order to establish
whom would most benefit from a TAA versus an arthrodesis. It is important to mention that the literature was not clear on the appropriate age for indication of an arthrodesis. It was recommended for relatively young patients with no specific age range provided. However, the literature for TAA provided a more specific age range i.e., patients over sixty years of age. 1,2,3,4,6,18

The focus of this case study was to determine what specific interventions were successful in treating a 72 year old female patient after a TAA secondary to end stage arthritis. The interventions that resulted in positive clinical outcomes for the patient, Rita included hydrotherapy, cryotherapy, AROM, manual stretching, progressive resistive exercises and proprioceptive exercises, scar massage, and gait training. Rita’s post surgical protocol of maintaining immobilization, non weight bearing, and withholding AROM open chained exercises of the involved extremity until bony in-growth occurred also resulted in positive clinical outcomes. Overall Rita reached a better functional level than she had before the surgery. Her TAA and physical therapy treatment resulted in decreased pain, increased ROM, stability, and strength. While Rita accomplished the majority of her treatment goals she still continued to have minimal pain and stiffness, and was ambulating with an antalgic gait and utilizing a single point cane at the time her treatment ended. Due to the fact that Rita discontinued her treatment before being discharged by the treating therapist it is unknown if continued therapy would have lead to the abolishment of her ankle pain and stiffness, increased strength and ROM, improved functional performance, and the ability to ambulate without an assistive device.

The literature did not provide a specific time frame for physical therapy treatment s/p a TAA. Patients are typically discharged once they have attained the expected range
of motion, demonstrate independence and adherence to their HEP (home exercise program) and have returned to functional activities without pain or difficulty.\textsuperscript{1,2,4,7}

There is no systematic approach to rehabilitation following a TAA secondary a lack of consensus with length of immobilization period and when to initiate weight bearing and exercises. This can be attributed to a myriad of prosthetic designs and the patient’s pre-existing conditions resulting in surgical procedure variances. Most sources indicate non-weight bearing immobilization must be followed until satisfactory bone-in growth occurs to ensure implant stability and prevent any potential future complications. Bony in-growth into the prosthetic components can range anywhere from 3-6 weeks after surgery depending on the type of component metal. Once bony in-growth and/or fusion has been determined by radiograph images weight bearing is initiated.\textsuperscript{1,2,4,7} However there are some conflicting opinions from other sources regarding when weight bearing should be initiated. Hasselman et. al., suggest that weight bearing can range from a maximum of 40 pounds right after surgery to non-weight bearing for three weeks or more.\textsuperscript{21} A study by Carol Smith feels weight bearing and non weight bearing AROM exercises should be initiated by the 2nd week. Martin et al, also implement non-weight bearing exercises in the 2nd week. Research indicates that it is still unknown as to whether discontinuing immobilization and initiating AROM and weight bearing exercises in the involved ankle before bone in-growth will lead to prosthetic failure. It is also unclear as to whether early open chained AROM exercises in the involved ankle result in better ROM outcomes or if it also is harmful to implant fixation or wound healing.\textsuperscript{7} Further controlled trials are needed to determine if immediate post surgical motion results in better final range or if it impairs implant fixation.
Six weeks after the surgery the patients is expected to have a follow up visit with their physician and begin physical therapy treatment. Typically once a patient weight bearing status has been established by the physician they begin with weight bearing as tolerated and typically require the utilization of an assistive device to help gain back balance control and confidence in their functional mobility. As the patient’s gait improves on level surfaces they are progressed to ambulating over elevated/uneven surfaces e.g., inclines, stairs. As with many post op orthopedic procedures progression to full weight bearing depends on the patient’s tolerance and may require the continued use of an assistive device as needed after surgery. According to most sources typically 3-6 weeks after the surgery and once bony in-growth has occurred the patient is expected to be able to resume normal functional activities with minimal limitations. After 3 months it is expected that the patient will have 80% of the range of motion determined by the surgeon in the operating room and that by 6 months all of the expected motion should return. The expected range of motion after a TAA with the second generation designs is 5-10º dorsiflexion and 20-25º of plantar flexion.\textsuperscript{7} For patients that have no motion prior to surgery as a result of joint space collapse or osteophytic abutement gaining any motion is considered a success. For these patients 20 degrees of painless motion is an improvement.\textsuperscript{1,2} Saltzman et al., report that physical therapy interventions are only indicated in patients who do not regain their intra-operative determined range or have difficulty with functional mobility specifically with balance and strength. They reported that roughly 20% of the patients they have treated with a TAA require physical therapy interventions to achieve adequate postoperative progress.\textsuperscript{2} It could be argued that all patients would benefit from physical therapy treatment s/p arthroplasty in order to reach
their functional goals in a more effective, timely and safe manner. It is also important for the patient to be educated on how to maintain mobility and strength in order to prevent future injuries and/or complications.

Martin et al., also provide specific physical therapy interventions implemented after the six weeks which include; active inversion and eversion, aggressive manual stretching and mobilization with an emphasis on dorsiflexion, progression to weight-bearing, progressive resisted exercises for the involved ankle and foot including proprioceptive exercises e.g., weight bearing toe and heel raises.\(^1\) Kisner and Colby provide different phases of rehabilitation post surgical ankle arthroplasty. The first stage is the, “maximum protection phase,” which lasts 6 weeks and focuses on maintaining ROM in the proximal joints or any other arthritic joints, improving strength in the non operated lower extremities and in the upper extremities with progressive resistive exercises, and increasing strength in the operated lower extremity with isometric exercises, and regaining AROM in the operated ankle in all motions once wound healing is sufficient and it is permissible to remove the immobilizer. The second phase is the “minimum protection phase,” and begins with the exclusion of the immobilizer for weight bearing activities as long as there is no delayed bony in-growth, union or soft tissue healing. It is expected in this phase that the patient should achieve 100% of the range of motion observed intra-operatively which is done by continuing or initiating AROM exercises of the operated ankle and foot and stretching the plantarflexors and dorsiflexors (i.e., towel stretch or with patient standing on a wedge). Improvements in strength and muscle endurance can be achieved with low-intensity, high repetition resistive exercises in weight bearing and non-weight bearing positions. Proprioceptive
exercises can help the patient achieve unrestricted weight bearing. Improvements in aerobic capacity and cardiopulmonary fitness and lower extremity muscular endurance can be implemented with a cycling, elliptical or treadmill program. The patient can be progressed by manipulating the speed, distance and/or intensity level. Additionally it is important to educate the patient on avoiding quick stop and go activities and instead to participate in low-impact activities for joint protection.\textsuperscript{7}

This case report has some limitations that may have affected clinical outcomes and effectiveness of PT treatment. One limitation of this case study was failing to obtain the patient’s pre-operative objective measurements i.e., strength, AROM, PROM (also post-operative) and the need for a more formal assessment of her functional abilities. The physical therapist was not aware of Rita’s TAA procedure until after the surgery when she came in for the initial evaluation. This is important to note because the treating therapist may have gained greater insight into the effectiveness of the surgery and physical therapy interventions with a pre-operative assessment. Suggestions for appropriate pre and post operative functional assessment tools include the Lower Extremity Functional Scale (LEFS), Ankle Joint Functional Assessment Tool (AJFAT) and a performance test protocol and scoring system to evaluate functional outcomes after ankle injury developed by Kaikkonen and colleagues. The LEFS is a 20 item assessment filled out by the patient at the initial visit which lists a combination of ADL and IADL activities for which the patient is required to rate their ability to perform the activities on a 0-4 scale with 0 being the most difficult to 4 being no difficulty. A score of 80 indicates the highest functional level. Examples of activities include, “getting into or out of the bathtub, walking between rooms, walking two blocks, going up or down one flight of
stairs, lifting an object, and lifting a bag of groceries from the floor.” The LEFS is typically used with arthroplasies of the hip and knee thus perhaps could be an appropriate assessment tool for ankle arthroplasty. It has been found to be a highly reliable test, is easy to administer and score and is helpful in making clinical decisions for individual patients. The AJFAT is a twelve item questionnaire that asks the patients questions based on a comparison of their uninvolved ankle with their involved ankle rating their answers on a scale of 0-4 with 0 being, “much less than the other ankle,” and 4 being “much more than the other ankle.” The highest score obtained on this assessment tool is 48 indicating the highest level of functional instability associated with functional limitations. Examples of items the patient is required to rate include e.g., ankle pain, swelling, ability to walk on uneven surfaces, descend stairs, overall feeling of stability, and ability to sense a “rollover” event.” The AJFAT has been found to be an effective measurement tool for identifying functional limitations associated with ankle instability. This could have also been an appropriate tool to use with Rita secondary to her reports of the need for the utilization of an AFO for 3 years prior to her TAA secondary to ankle instability and weakness. The performance test protocol and numeric scale for the evaluation of ankle injuries developed by Kaikkonen and colleagues encompasses subjective and objective assessment. The subjective items include; “assessment of the injured ankle,” with 0 being severe symptoms and 15 equal to no symptoms of any kind; “Can you walk normally,” with no being 0 and yes worth 15 points. Examples of objective items include; “raising on heels with injured leg,” with 0 being fewer than 30 times and 10 points being more than 40 times;” “dorsiflexion range of motion of the injured leg,” with 0 being less than five degrees and 10 points being greater than ten
degrees. A score of excellent is worth 85-100 points and poor is less than or equal to 50 points. It is a quick and easy test to administer, and has shown excellent reproducibility. This test performance protocol is highly effective in evaluating functional recovery after an ankle injury and therefore could be an appropriate assessment tool in determining Rita’s functional level before and after physical therapy treatment.\textsuperscript{26}

It is clear from the literature that more long term research is needed to determine the effect of TAA on clinical outcomes i.e., pain, ROM, function and patient satisfaction. It is also apparent that more long term research is needed to determine the effectiveness of a more specific physical therapy protocol for TAA with a two component second generation design. However, it has become apparent through points stated in this study that certain aspects of the existing protocols may need to continue to remain different based on the myriad of component designs necessary based on patient need in addition to the patient’s pre-existing conditions. It may be more beneficial for future research to determine clinical outcomes using one type of design in order to get an accurate understanding of the effectiveness of specific interventions for treating an s/p TAA. In addition there may be a need for utilizing a formal functional assessment tool for monitoring functional improvements pre and post surgically. Thus more short and long term research studies providing the effectiveness of specific physical therapy interventions s/p a TAA with the agility ankle prosthesis are needed.
References


