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Total Knee Arthroplasty Rehabilitation: Case Report

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Total Knee Arthroplasty Rehabilitation: Case Report

by

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This Scholarly Project, submitted by Allen Kennedy 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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Date 7/7/2016

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Abstract:

Background and Purpose: Osteoarthritis (OA) of the knee is a common problem in the world population and total knee replacement has become the gold standard for repair when the OA becomes severe enough. Total knee replacement, however, is not the complete answer to knee OA. Without rehabilitation these patients may struggle to be fully functional. The purpose of this case study was to describe the rehabilitation of a geriatric patient who underwent TKA and benefited from the use of hydrotherapy in his recovery.

Case Description: This report will look at the rehabilitation of one 73-year-old male patient and interventions used to help him return to being functionally independent. The patient had undergone right total knee arthroplasty and had previously undergone bilateral total hip replacement. Interventions included manual therapy, hydrotherapy, therapeutic exercise, interferential current and cryotherapy.

Outcomes: The main outcome measures used in this case were strength, range of motion, pain and the Outpatient Physical Therapy Improvement in Motion Assessment Log Instrument. The patient was eventually able to make a full return to make a full return to his activities despite not regaining the complete range of motion expected after total knee arthroplasty.

CHAPTER I

BACKGROUND AND PURPOSE

Amongst the many musculoskeletal disorders that people develop during the aging process, osteoarthritis (OA) is the leading cause of disability.[1] All aspects of the joint may be affected by OA including subchondral bone, tendons, muscles, synovium and articular cartilage.[2] While the etiology of OA has many different factors, two unchangeable factors are female gender and aging. Alterable factors that have shown a positive correlation with increased risk of OA are obesity, race, joint instability, and joint trauma.[1,2] One particularly troublesome joint with regards to OA is the knee. Studies have indicated that people ages 45-49 have a prevalence rates for knee osteoarthritis of 8% in men and13% in women.[1] Those numbers skyrocket for people over the age of 80, to 22% for men and 55% for women.[1] A separate study determined that the overall lifetime risk for OA is 44.7%.[3] OA of the knee is multifactorial like osteoarthritis of other joints. In the case of the knee joint mechanical stress is the key factor both in initiating and progressing OA. Obesity, trauma, congenital defects, and other factors may all lead to increased mechanical forces and further the disease process.[1] Symptoms of knee OA may include stiffness, joint pain, tenderness and locking.[2] The high prevalence of OA in the knee has led to a need for medical intervention in order to keep patients who are suffering from this pathology functional.

Nonsurgical options for treatment of knee osteoarthritis focus on treating the symptoms of OA. Included in this group are pharmacological treatments, corticosteroid injections and physical therapy.[4(Ch.92)] Physical therapy is considered a good option for nonsurgical intervention due to its lack of side effects and favorable risk-benefit ratio. Techniques associated with physical therapy for knee OA include therapeutic exercise, stretching, range of motion (ROM) exercises, strengthening exercises, aerobic conditioning, hydrotherapy, bracing, assistive device training, heat modalities, interferential current (IFC), cryotherapy and other interventions.[4(Ch.92)]

In terms of surgical repair options, Total Knee Arthroplasty (TKA) is a fast growing surgical procedure used to relieve pain in patients who suffer from joint degeneration and OA.[3] There are many factors that go into an orthopedic surgeon deciding that TKA is the appropriate intervention including age of the patient, activity level, and most importantly the degree of joint damage. The knee joint is subdivided into three compartments: medial, lateral and patellofemoral. If the damage is severe and more than one compartment is involved, TKA is the treatment of choice. Presently, TKA is considered the gold standard of surgical repairs for knee osteoarthritis.[4(Ch.107)] In 2008, over 600,000 TKA surgeries were performed in the United States. This number is expected to grow by 673% by the year 2030.[3]

Once TKA has been determined as the best intervention for the patient, the surgeon has the option of either a cemented implant, or a porous ingrowth. Although the cemented implant has been the trusted option for many years, there are some advantages to the porous ingrowth. These advantages include easier revision if and when required, as well as shorter surgery times.[4(Ch.107)] These advantages are more important in the younger

subset of the patients undergoing TKA who often are more active individuals and are more likely to require revision; since their implants have to last longer and will be subjected to more lifetime wear.[4(Ch.107)] Success rates for ten year survivorship of the two types of fixation, are staggeringly different with cemented fixation achieving a 92% success rate and porous ingrowth a 61% success rate.) Long term outcomes of TKAs are generally outstanding with a 90% survivorship for either fixation technique at twenty years.[4(Ch.107)] The aforementioned surgical success, however, may not tell the whole story. Dr. Richard Scott suggests that success of TKA should be determined by being able to answer the following three questions: Are you glad you had the operation? Did it fulfill your expectations? Would you do it again? [5] Within one year 90% of patients will answer yes to all three questions. While this is not the most scientific means of determining success, it does give a strong reflection on patient satisfaction.

ROM expectations following surgery are slightly below anatomical norms for the knee. A healthy knee may be expected to achieve 0° of extension and upwards of 140° of flexion. Post TKA ROM expectations are different, with 0°of extension to 110° of flexion ROM being considered successful result.[6]

Potential complications of TKA include deep infection, poor wound healing, limited ROM, and deep vein thrombosis. Deep vein thrombosis is exceptionally concerning because it arises in half of unilateral TKA surgeries and three quarters of bilateral surgeries if prophylaxis is not implemented.[4(Ch.125)]

With so many patients undergoing this surgery, there is a real need for effective physical therapy interventions to help them reach their maximum rehabilitation potential. This need has driven a wide variety of research to be conducted on which treatment

methods are effective. Typical physical therapy treatment for TKA patients may include but is not limited to early mobilization, supervised therapeutic exercise, continuous passive motion machines, manual therapy, cryotherapy, and IFC.[4(Ch.92), 7,8,9] Manual therapy may be incorporated to improve ROM; manual therapy techniques that may be utilized include myofacial release, patellar mobilizations, stretching of the hamstrings and transverse friction massage.[7, 10] Therapeutic exercises, including early mobility, also promotes ROM, but has the added benefit of being able to promote strengthening of weakened musculature. Common therapeutic exercises associated with TKA rehabilitation can be seen in Table 1. Effective options for pain relief in patients include cryotherapy and IFC.[11, 8]

Table 1. Common Therapeutic Exercises for TKA

Bedside (early) Exercises	Post Operative 1-4 weeks	Post Operative 4-12 weeks
• Ankle pumps • Quadriceps sets • Gluteal sets • Heel slides • Terminal knee extension with bolster	• Quad sets • Straight leg raises • Gluteal sets • Progress from hook lying to bridging with gluteus maximus exercises • Standing terminal knee extension with theraband • Recumbent bike • Heel slides • Continue exercises • Hip AROM • Clam shells • Strengthening exercises • Ambulation • Functional transfer training	• Progress previous exercises to tolerance • Bridging • Short arc quads • Open kinetic chain extension exercises • Hip adduction and abduction exercises • Proprioceptive neuromuscular facilitation patterns of the hip • Progress ambulation • Balance training with appropriate progression • Lateral movement exercises • ADL training

Hydrotherapy is also commonly used with TKA patients because it provides a reduction in weight bearing, beneficial physiological effects from the temperature of the water, and resistance to promote strengthening. The thermal effects of water in particular can increase blood flow and thus help the healing process.[12] Other beneficial physiological effects are increased peripheral circulation, sedative effects on nerve endings, and muscle relaxation.[4(Ch.92)] Additional properties of water that hydrotherapy takes advantage of are resistance, buoyancy and hydrostatic pressure.[11] The resistance provided by the water allows the patient to strengthen his or her weakened muscles. Buoyancy allows for the TKA patient to take weight off of their compromised knee joint and allows for exercise with less pain and strain to the surgical area. Additionally, hydrostatic pressure helps to increase the resting muscle blood flow, which can also increase the rate of healing.[11] All of these effects help the patient to regain strength as well as improve ROM.

Several studies have been conducted to validate the use of hydrotherapy in TKA patient's. One study conducted by Allison Harmer[13] compared two groups of post TKA patients; one group performed land-based exercises and the other group performed aquatic exercises. They found that aquatic programs and land-based programs both had similar outcomes including changes in functional measures, ROM improvement, and pain reduction.[13] A separate study conducted by S. Giaquinto et al.,[14] came to this same conclusion, but extrapolated on the positive effects of hydrotherapy on a patient's mood and attitude.

The purpose of this case study was to describe the rehabilitation of a geriatric patient who underwent TKA and benefited from the use of hydrotherapy in his recovery.

CHAPTER II

CASE DESCRIPTION

The patient in this case report was a 73-year-old male. For the purpose of this case report his name has been changed to Steve Rodgers. Steve was referred to physical therapy following a right TKA secondary to OA of the right knee. Due to Steve's age and weight bearing as tolerated (WBAT) status post surgery, it was assumed that the cemented fixation procedure was used for his surgery.

Steve was first seen one day post-surgery as an inpatient; his immediate complaints were of pain and stiffness in his right knee. His only known comorbidity, was high blood pressure. He had been prescribed Lisinopril (an ACE inhibitor), Metropopol (a beta-blocker), and Amplodipine (a calcium channel blocker) for hypertension. He was also prescribed Allopurinol to decrease his levels of uric acid. Additionally, he was prescribed painkillers following surgery. During one visit, the physical therapy staff learned that he was noncompliant with taking the pain medications prescribed by the orthopedic surgeon due to the gastrointestinal side effects, specifically constipation. Upon learning about this issue, the physical therapy staff contacted the orthopedic surgeon. The orthopedic surgeon then decided to prescribe a pain patch instead of a pill. This patch was effective at both controlling Steve's pain and did not have the constipation side effect that has caused him to be noncompliant with the oral medication. He was also taking

Warfarin as a preventative measure for DVT, a precaution that was merited by his past medical history.

Steve's surgical history included bilateral total hip arthroplasty. He stated that both of these procedures went well. It is noteworthy that he did have an issue with a DVT following the left hip replacement. This was a major factor in some of the clinical decisions during his therapy, which will be discussed in the interventions section. Overall, his body responded well to physical therapy for both of those surgeries and now his chief complaint is his right knee.

Steve had retired from his career in law enforcement before his surgery. He lived alone in his home without any stairs. Steve was independent in all of his activities of daily living (ADLs), and instrumental activities of daily living (IADLs) prior to surgery, but was experiencing significant knee pain. Steve was not open about details of his leisure activities. In order to maintain his independence, Steve was required to ambulate community distances. He also mentioned that he spends the winter months in Las Vegas. Steve's goals reflected his desire to be able to return to independence and be ready for the winter in Las Vegas.

Examination, Evaluation and Diagnosis

Steve's diagnosis fell under the American Physical Therapy Association's Adapted Practice Pattern 4H: Impaired Joint Mobility, Motor Function, Muscular Performance and Range of Motion Associated with Joint Arthroplasty. The ICD-9 Diagnosis code is V43.65 and the ICD-10 code is Z96.659. Steve's presentation was typical for someone with this diagnosis. At the time of his examination, his main problems were determined to be ROM, strength deficits, and pain (see Table 3 for

values). These factors contributed to his difficulty with bed mobility, ADLs and IADLs including community ambulatory distances. He used a front-wheeled walker as an inpatient in the hospital and was discharged still using the walker. Functionally a key issue was with transfers, specifically getting his legs into the car or into a bed without assistance, he required minimum to moderate assistance to transfer. He had been unable to drive. His incision site was red and swollen. Palpation revealed that he had significant tightness in his quadriceps muscles on his right side.

Steve's limitations made it difficult for him to participate in his usual activities of shopping and taking care of his home. They also made it difficult for him to be able to participate in outpatient physical therapy, as he required assistance in order to be transported to the facility. In order to be able to go home he arranged for a friend to stay with him to provide the assistance he needed.

In terms of a system review, mentally he was healthy and orientated times four. His only cardiopulmonary issue was the high blood pressure that was being treated pharmacologically as described earlier. With the exception of the surgical site his integumentary system did not present with any issues.

Overall, the patient was a great candidate for physical therapy. While he did have high blood pressure, it was pharmacologically controlled. Ultimately the patient's prior surgical history, his willingness to work, his age, and his postoperative status made him a great candidate for physical therapy.

The main outcome measures chosen to monitor the severity of Steve's limitations were goniometric measurements, a Numerical Pain Scale (NPS), manual muscle testing (MMT) and the Outpatient Physical Therapy Improvement in Motion Assessment Log

Instrument (OPTIMAL Instrument). Goniometric measurements were used to measure ROM. Goniometric measurements were chosen because they have been commonly used in physical therapy and have shown acceptable reliability and validity when care is taken to perform them correctly (See Table 1).[15]

The NPS pain scale was used to monitor the patient's subjective pain levels. It was administered by showing the patient a scale which included the Wong-Baker pain faces and asking where he would rate his pain on the scale 11 point from 0 to 10 with 0 being no pain and 10 being worst pain he had ever experienced.

MMT was used to monitor the patient's progress in terms of strength. MMT was performed according to standard positioning and used the "don't let me move you command".

All of the measures to this point are commonly used in the field of physical therapy; the OPTIMAL Instrument, which was used to track Steve's functional progress, on the other hand is not as widely used.[15] A study of the OPTIMAL Instrument had shown that it has sufficient construct validity and responsiveness to changes over time (see Table 2). [16] This has lead to it being used as a means of reliably tracking functional outcomes in a wide variety of patients. The OPTIMAL was administered in a one-on-one session with the therapist asking how difficult it was for Steve to perform each activity listed on the index. Answers included able to do without difficulty, able to do with little difficulty, able to do with moderate difficulty, able to do with much difficulty, unable to do or not applicable (see appendix for OPTIMAL Form).[16] The therapist was responsible for determining which fields were not applicable. Each response corresponded to a

numeric value that was used to calculate the percentage of disability demonstrated by the patient.

Table 2. Reliability and Validity of Outcome Measures

Measure	Minimal clinically significant change	Construct Validity	Effect Size	Con-current Validity	Correlation Coefficient for Validity	Test Retest
Goniometry	6° for Lower Extremity [15]				r=.98-.99 ICC=.98-.99[17]	
Numerical Pain Scale	35% change[18]		.86 [15]			
MMT				P<.001[19]		
OPTIMAL Instrument		Chronbach's Alpha score for the LE= . 95 [16]	For more information on psychometrics and statistics of the OPTMAL see "Development and Testing of a Self-report Instrument to Measure Actions; Outpatient Physical Therapy Improvement in Movement Assessment Log (OPTIMAL)"[16]			
WOMAC		Chronbach's Alpha score .7-.95 [20]				Inter-class cor-relation coef-ficient >.7 [20]

Table 3. Examination Measurements

Goniometric Measurements	3° to 40° of Flexion
NPS	10/10
OPTIMAL Instrument Score	66%
Manual Muscle Test of right quadriceps	3+/5

In order to maintain the expected time frame of 8 to 12 weeks for Steve's recovery, short term and long term goals were established. His short-term goals included the following: increase strength in the right lower extremity to 4/5 to help with gait, achieve 110° of passive range of motion (PROM) flexion in the right knee to allow for functional activities and decrease pain to a 5/10 on the NPS pain scale within four weeks. His long-term goals were to be pain free and independent in all transfers, have 120° of AROM flexion in the right knee, and to reduce his pain levels to a 2/10 at worst during activities to be completed in 8-12 weeks. The patient's discharge criteria were gaining 120° of ROM, having a 2/10 pain rating at worst, and being below 20% on the OPTIMAL Instrument.

Prognosis and Plan of Care

Mr. Rodgers had a good prognosis. He was in fair health for his age and responded well to both of his total hip arthroplasty surgeries. He was expected to be able to recover within the usual 8-12 week post surgical protocol for TKA.[7] Being retired he did not have a high level of activity before the surgery and was expected to return to or exceed his prior level of function. Examination findings coincided with the previous clinical impression that the patient was a good candidate for physical therapy intervention. Particular concern was given to the issue of potential DVT. His plan of care included therapeutic exercise, manual therapy for ROM, a home exercise program, IFC for pain and hydrotherapy once his wound has closed.

Intervention

The patient's interventions began one day post surgery when he was still an inpatient in the facility. Initial interventions included bed ROM exercises such as those

seen in table 1 and early mobility. Repetitions were generally 10-30, but were limited by patient's tolerance to pain. He was instructed to perform these same exercises throughout the day to promote ROM, as well as to reduce the risk of DVT. Steve received gait-training instructions with a front-wheeled walker (FWW) and patient education on how to use the Iceman cooling machine he was provided. Steve responded well to verbal instructions and did not require visual aids. Steve ambulated using the FWW and stand by assist (SBA). Over time, the distances he ambulated were increased depending on his pain tolerance; initially the distance was around 100 feet and it progressed to around 600 feet before he left the hospital. Steve did well with his inpatient program and after discharge was accepted into the outpatient physical therapy program.

One of the first interventions Steve received in outpatient physical therapy was a compression stocking. This was due to his previous DVT history and some edema that was observed in his calf. In order to provide Steve with a compression stocking, his orthopedic surgeon was consulted for a prescription. Steve was given an off the shelf variety of compression stocking.

During Steve's initial outpatient visits, the exercises he could perform were limited due to pain. He would start sessions using a recumbent stepper to promote ROM. This was progressed by moving the seat closer and by adding more time. His early interventions for strength included short arc quads (three sets of ten repetitions), quad sets (three sets of ten repetitions), and reduced gravity squats on a total gym at 25° for three minutes. The total gym is a piece of equipment that allows the patient to perform squats or other exercises on a wheeled platform set on rails. The therapist can make the exercise more or less difficult by altering the angle of the rails. A full list of Steve's exercises can

be seen in Table 4. He was assigned short arc quads, quad sets and heel slides as a home exercise program. Steve also received ice pack and IFC interventions simultaneously for fifteen minutes to help him with his pain levels.

Table 4. Therapeutic/Aquatic Exercises

Early Land-Based Exercises	**Later Land-Based**	**Aquatic-Based Exercises**
Short arc quads	Long arc quads	Seated heel slides
Heel slides	Heel slides	Squats
Total Gym partial weight squats	Total Gym partial weight squats	Forward and reverse walking
Recumbent stepper	Recumbent stepper	Long arc quads
	Stationary bike	Hamstring curls
		Step up and down

Once Steve's pain was more manageable, he was really able to progress his exercise regimen. He added more repetitions and increased the duration of his previous exercises. Steve also added long arc quads and the stationary bike to his workout. A focus on promoting ROM was evident throughout the rehabilitation process. When Steve was six weeks post surgery, his incision had healed enough to allow him to start aquatic therapy. The pool was kept at a therapeutic 92°. This allowed Steve to exercise in a warm reduced weight-bearing environment. Steve would typically spend forty-five minutes in the pool and would perform the exercises seen in column three of table four.

Other interventions Steve received included manual therapy to help promote ROM. Several different manual therapy techniques were used over the course of his treatment. These techniques included PROM, stretching of his quadriceps, transverse friction massage of his quadriceps muscle, soft tissue mobilizations to his quadriceps and hamstrings, trigger point release to his quadriceps, patellar mobilizations, and

proprioceptive neuromuscular facilitation (PNF) stretches to his quads. These techniques were performed for ten to twenty minutes each session for the first six weeks of his rehabilitation program.

Outcomes

Changes to Steve's outcome measures were monitored periodically throughout his rehabilitation. During the first six weeks, goniometric measurements were taken during each session. As his ROM was progressing slowly (see Table 2 for values). Ultimately, ROM was Steve's most limiting factor during his rehabilitation. Steve was unable to reach his goal of 120° of flexion, which had been achieved by previous patients in the same clinic who had been operated on by the same surgeon. Steve, on the other hand, was only able to reach 105° by the time he left therapy. While this was short of his goal, it was still close to the 110° that is considered a successful outcome according to literature.[6]

In terms of Steve's pain levels he made a lot of progress during his time in physical therapy. Initially, Steve's pain ratings were quite high ranging from 8/10 to 10/10. These high pain levels meant that Steve needed minimal to moderate assistance to get on and off of equipment. It also caused him to stop interventions early. As time progressed, Steve's pain ratings gradually decreased, and he was able to tolerate treatment better. A major factor in his improvement was the change in his medications mentioned earlier. Following the switch to the pain patch, Steve was able to tolerate interventions better and was able to limit his use of IFC and cold pack treatments allowing more time for therapeutic exercise. When Steve left physical therapy, he rated his pain level at 0/10.

The third outcome measure used to track Steve's progress was MMT (see table 5 for values). Steve's strength gradually improved throughout his rehabilitation and although he was not formally MMT between intake and discharge he demonstrated improvement through increased exercise tolerance.

The best measure of functionality among Steve's outcome measures was the OPTIMAL Index measure. It helped to show that he was functionally limited at the time of examination, but steadily improved over time. Steve was evaluated every tenth visit by retaking the OPTIMAL Index questionnaire. By the time of his 20th visit, he was down to a 14% disability exceeding his long-term goal. He had become independent in all transfers, was driving again, and ambulating community distances without experiencing high pain levels. A progression of all of Steve's outcome measures can be seen in Table 5.

Table 5. Outcome Measures

Outcome Measure	**Initial**	**3 weeks**	**5 weeks**	**8 Weeks**	**Discharge**	**Normal post TKA[6]**
Goniometric	3° to 40° of flexion	0° to 70° of flexion	0° to 80° of flexion	0° to 95° of flexion	0° to 105° of flexion	0° to 110° of flexion
Pain	10/10		Not available		0/10	0/10
MMT	3+/5 for knee extension		Not available		5/5 for Knee extension	5/5
OPTIMAL Index	66% Disability			14% Disability	Not available	

Steve responded well to all the interventions he utilized with the exception of some early ROM exercises, which he could not complete due to pain. Overall, Steve was

adherent in regard to following PT instructions. He wore his compression stocking until the orthopedic surgeon cleared him to. He also was compliant with the home exercise program he was given and the use of his IceMan cold pack. The only compliance issue Steve had was with his pain medication.

The risk reduction interventions that were taken to prevent DVT were overall successful. Steve had no issue with DVT during his rehabilitation and as mentioned earlier he was compliant with the compression stocking. Another risk reduction aspect of Steve's rehabilitation was holding him out of the aquatic portion of the program until his surgical incision had healed. While it is impossible to predict if using the pool earlier may have lead to infection, it was a facility policy to not have patients with open wounds in the treatment pool to guard against infections.

CHAPTER III

DISCUSSION

Due to the massive amount of TKA surgeries performed every year there is a great deal of research done on patients who have undergone this procedure. This made for an excellent opportunity to compare aspects of Steve's rehabilitation to research conducted on those aspects. Noteworthy aspects of Steve's case included the use of hydrotherapy, factors that may have limited his ROM, and the outcome measures selected.

One of the more interesting comparisons that can be made between an aspect of this case and research is that of hydrotherapy. Literature suggests that a positive mood boost can be seen with the use of hydrotherapy.[14] Steve's mood did seem improved while he was in the hydrotherapy portion of the program; however, he was not given any assessment that could have confirmed that a positive effect on mood had occurred.

In terms of outcome for TKA patients who utilized hydrotherapy, studies such as the one conducted by Allison Harmer et al.,[13] have shown that many of the outcomes of rehabilitation are similar whether the patient performs land-based or water-based exercises. Measures they used to compare their results included, the Visual Analog Pain Scale, the 6 Minute Walk Test, ROM, and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Steve's outcomes seem to follow the

conclusion of this study, as they would be considered good but not superior to a patient who had performed solely land-based exercises.

Despite Steve's case having a similar outcome the Harmer study,[13] there were some differences in his treatments and treatments of the patients in the study. One factor that was significantly different between the two was the treatment pool temperature. At the facility Steve attended therapy the pool was kept at 92° in order to provide enough heat to get the physiological responses that literature predicts, while still allowing the patients to exercise comfortably. The pool temperature in the study done by Allison Harmer and her colleagues was 77°F (25°C), which they acknowledged as one of the limitations of their study.[13] Theoretically, an increased temperature should have allowed Steve a better opportunity to regain ROM by increasing blood flow to the area to promote healing and also promote relaxation of the skeletal muscle.[12, 21] Yet, when Steve left physical therapy, he was still 5° short of the 110° ROM which has been determined to be a good outcome for TKA.[6] Another key difference was when hydrotherapy interventions were initiated, Steve was held out of aquatic therapy till his incision had healed where the patients in the Harmer study started their aquatic treatment immediately with the aid of waterproof dressings.[13]

There are many factors that could have affected Steve's ability to regain his ROM. Frank Lampe et al.,[22] analyzed factors to see which one were significant in predicting flexion ROM post TKA. They found that the surgically modifiable factors of flexion gap difference, femoral rotation, and extension gap size on the medial side; as well as the patient specific factors of pre-operative flexion, body mass index (BMI) and body height were all statistically significant in predicting ROM for TKA patients.[22]

Unfortunately objective values for those factors in Steve's case are unavailable, thus it is not possible to compare him directly to this study. Of the above factors, the one that may have applied to Steve would have been weight.

The primary limitation in the data collected for Steve's case study was the choice of outcome measures. In terms of a functional scale, the OPTIMAL Index was easy to perform and gave clinicians a percentage of disability; however, there is not a lot of research available on the reliability or validity associated with OPTIMAL.[16] Other studies referenced in this case report chose different functional assessments that may have been more applicable and valid. Amongst those assessments are the WOMAC and the 6 minute walk test.[13] The use of either of these two tests could have provided valuable information that could have been used to compare Steve's outcome to other studies, and may have provided a better depiction of his functional status.

The WOMAC was developed specifically to track changes in OA symptoms.[23] This makes it more specific to Steve's case than the OPTIMAL Instrument. In fact, some of the items in the physical function subscale of the WOMAC were Steve's major impairments post surgery. One particular item that was on the WOMAC and not the OPTIMAL Instrument was "getting out/in of car".[16, 20] This was a very specific limitation for Steve and could have been tracked more thoroughly if the WOMAC had been used. As noted in Table 1, the WOMAC also has more information available on its reliability and validity than the OPTIMAL Instrument.

Another test that could have been conducted was the six-minute walk (6MW) test, as it is a predictor of 30 minute walking distance. This means the 6MW test can be a predictor of long distance ambulation, such as community ambulation. Community

ambulation was one of Steve's major limitations; if the 6MW test had been used it could have given the therapy department a more objective way to determine the Steve's status in community ambulation, rather than just relying on the patient's subjective feedback.

Additionally this case, as well as the Harmer study,[13] was limited in that it did not track exercise intensity.[13] One of the concepts of hydrotherapy is that the reduced weight bearing allows the patient to work at higher intensity levels.[11] Using a rate of perceived exertion scale could have allowed for some more insight into changes in Steve's exercise tolerance with the use of hydrotherapy.

In terms of future research there are three main changes that could be done in future hydrotherapy studies to provide clinicians with valuable information. One is conducting hydrotherapy studies in pools that are heated to the appropriate temperature associated with rehabilitation protocols. This may cause significant changes to some studies. The second area would be to add rate of perceived exertion scales to hydrotherapy studies to verify if patients are indeed able to exercise at higher exertion levels with hydrotherapy than with land-based programs. The third area would be to incorporate a psychological assessment to examine the effects of aquatic therapy on mood. Most information provided on the influence of aquatic therapy on mood is subjective and if there was more objective information on a positive effect on mood it could further validate the use of aquatic therapy.

Reflective Practice

When reflecting on Steve's rehabilitation I contemplated how Steve would have answered the three questions posed by Dr. Richard Scott that were mentioned in the introduction.[5] I feel like Steve would have said yes to only one of the questions. I believe

the surgery did meet his expectations and he would have said yes to that particular question; However, if he was asked if he was glad he had the operation or if he would do it again, I believe he would say no. Steve was displeased with the amount of time that the TKA surgery took to recover from. He expressed multiple times that his total hip surgeries had been much easier and that the TKA was more painful and difficult. He also verbally stated that he would not want to have the other knee done.

When asked which program he preferred between the land-based and aquatic based programs, Steve verbally expressed that he preferred the aquatic based program. He admitted that starting the aquatic program later on in his recovery after his pain levels had already subsided significantly might have biased some of that preference. He was satisfied with the results of his program to the point that he stopped attending therapy before he was formally discharged. Steve discharged himself from therapy after he had gone on a vacation and felt that he no longer needed to rehabilitate his knee.

Although Steve did not manage to meet his discharge criteria for ROM, he did manage to meet his criteria for strength, pain and functional ability. He did benefit from hydrotherapy, which seemed to provide Steve with an effective mood boost. Overall Steve's rehabilitation went well, but there are also a few aspects that I feel could have been improved. First, I feel like his history was incomplete in that we didn't get a great depiction of when his knee pain started and how it progressed. Part of that was due to him having previously attended therapy at the clinic for his hip rehabilitations. Other staff members knew Steve from those visits and may have had more extensive knowledge about his history than I had, so some questions were not asked. One question I think

could have shed a little light on Steve's background that wasn't asked was "Why did you decide to have a knee replacement?"

In terms of examination procedures that I would change the main change I would make would be to use the WOMAC instead of the OPTIMAL Instrument. As described earlier in the discussion section the WOMAC is more specific to OA and its reliability and validity have had more research conducted on it.

In terms of changes to Steve's plan of care there are a few small changes that could have been made. One change that may have proved beneficial would be to start hydrotherapy earlier. Some of the research studies mentioned in this report had patients enter the pool much earlier than the six weeks post surgery point that Steve entered the pool. Taking advantage of that partial gravity environment provided by water may have helped Steve to perform more exercises earlier in his program when pain was a limiting factor. This however was not an option as the facility policy was not to have open wounds in the treatment pool.

In terms of evidence based practice I feel that most of Steve's interventions could be validated through evidence. The one exception to this would be the use of ICF, which I feel I could use some more evidence on before I used it again.

One of the great aspects of the clinic that this case study was conducted in was the interdisciplinary communication. The orthopedic surgeon had an office in the same hallway and had developed excellent report with the physical therapy department. When he was contacted for the compression stocking and the pain medication issue in this case he was very prompt in responding. In the case of the pain medication he came to the physical therapy clinic before Steve had even completed that days session to discuss the

problem. Additionally the physical therapy staff was involved in conversations with the surgeon in regard to the need for Steve to have a manipulation under anesthesia. Ultimately, it was determined that this would not be necessary. Due to this communication, and an absence of problematic symptoms I do not feel like any further referrals would have been necessary.

I really enjoyed working with Steve, and I feel that benefited from the use of hydrotherapy. Due to my experience with Steve and the data I collected in this report, I would use a similar rehabilitation procedure with another TKA patient.

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APPENDIX