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TOTAL KNEE ARTHROPLASTY
REHABILITATION CASE REPORT

A Dissertation
Submitted to the Faculty
of
University of North Dakota
by
Abby R. Brenner

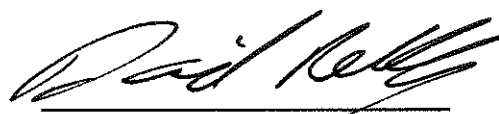
In Partial Fulfillment of the
Requirements for the Degree
of
Doctor of Physical Therapy

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This Scholarly Project, submitted by Abby Brenner 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.



(Graduate School Advisor)



(Chairperson, Physical Therapy)

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ABSTRACT

Background & Purpose Total knee arthroplasties (TKAs) are the most commonly performed elective surgery in the United States. Osteoarthritis (OA) is the most common diagnosis treated with a TKA, which aims to restore an individual's functional ability by improving joint biomechanics and decreasing pain. The purpose of this case report is to describe the progression of physical therapy rehabilitation for a patient status post total knee arthroplasty.

Case Description The patient was a 64 year old male who underwent a TKA surgery to resolve the complications from severe osteoarthritis (OA) of his left knee. He presented to physical therapy with deficits in range of motion, strength, and functional activities.

Outcomes The patient responded well to the physical therapy interventions, which included manual therapy, therapeutic exercise, and vasopneumatic treatment. He returned to his prior level of function and resumed independent exercise at the wellness center.

Discussion The patient underwent rehabilitation following his TKA and achieved favorable outcomes. His results align with other research studies conducted for similar cases. Intervention procedures that can be utilized for TKA rehabilitation in the future include preoperative exercise and functional squatting symmetry.

CHAPTER I

BACKGROUND AND PURPOSE

Total knee arthroplasties (TKAs) are the most commonly performed elective surgery in the United States, with over 719,000 TKAs performed annually.¹ Over 56% of TKA procedures in the United States are performed on patients aged 65 years or older and are performed more often in females than males.²

Osteoarthritis (OA) is the most common diagnosis treated with a TKA. OA is the most prevalent type of arthritis, impacting over 38% of individuals aged 65 years or older and the leading cause of functional disability.³ This disease occurs most often in the knee joint and is characterized by damage to the articular cartilage. OA may eventually cause changes in the surrounding bones, ligaments, muscles, and nerves as it progresses. Symptoms of knee OA include pain, stiffness, and functional disability. Pharmaceuticals are one treatment option for OA, which may lead to more rapid progression of the disease due to increased loading of the knee joint because of decreased pain symptoms. Foot orthotics, braces, and muscle strengthening are other interventions used to create a biomechanical advantage for the knee and slow the progression of OA.⁴ There is not a known cure for OA, but total knee arthroplasty (TKA) is the gold standard for treating the deteriorations resulting from the OA disease process.

Indications for a TKA include severe degenerative changes in joint structure due to a disease process such as arthritis, knee deformity, and chronic swelling. Patients may also consider a TKA if the moderate to severe pain is unalleviated by other treatments and interferes with daily function. Smoking, obesity, diabetes, osteoporosis, and infection are precautionary factors to consider when proceeding to a TKA.⁵

Factors considered when choosing the TKA surgical approach and components include ligament integrity, fixation, component mobility, and gender specific biomechanics. One major factor considered is the cruciate integrity of the patient. The cruciate-sparing approach is used when the patient has both an intact anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL). However, if the PCL is not intact, the tibial component of the implant has a posterior post to prevent posterior translation of the tibia on the femur.⁶ There is currently debate over the best functional outcomes of prosthesis fixation when comparing cemented, cementless, or hybrid. Research has been inconclusive, but cemented fixation is considered to be the gold standard by most surgeons.⁷ The mobile bearing TKA approach allows for slight rotation on the polyethylene tray, which serves the same purpose as an intact meniscus, and it decreases the impact stresses of the components.⁸ Fixed bearing TKAs do not allow any rotational movement, and there is debate of which approach is more effective. There are also gender specific components due to biomechanical alignment differences at the knee joint. Females typically have wider hips than males, thus making them more susceptible to genu valgum and extra stress on the medial compartment of the knee. One study found that preoperative varus is more common in males (64.5%) when compared to females (55.2%). The study also concluded that preoperative valgus is more common in females

(18.6%) when compared to males (8.2%).⁹ The patient and surgeon make the decision for the most appropriate surgical approach based on a multitude of personal factors.

The goal of a TKA is to restore degenerated knee biomechanics surgically and regain function through rehabilitation.¹⁰ Physical therapy is a crucial aspect of rehabilitation after a TKA surgery is performed. Individuals receive physical therapy after a TKA in the hospital/acute care setting, where home exercise programs are prescribed and further interventions are utilized in the outpatient setting. Some patients require extra assistance at a transitional care unit or nursing home. The therapeutic approach is individualized for each patient based on a multitude of factors, including activity level, protocol, age, patient goals, and pain levels. The typical physical therapy rehabilitation process focuses on knee strength and range of motion, especially terminal knee extension, which is essential to normalize gait and perform stair ambulation.⁴ Due to the prevalence of knee OA and TKAs, it is important to study the results of these surgeries and the associated rehabilitation process.

Outcomes for TKAs are typically favorable. About 85% of all TKAs last for twenty years, with the speed of deterioration dependent on activity levels.¹¹ The average protocol for physical therapy treatment spans 12-16 weeks. Discharge criteria include pain reduction, normal gait, return to functional activities, independence in home exercise program, adequate strength, and achieve knee range of motion 0-120 degrees.¹² According to Westby et. al., individuals reported increased activity levels and quality of life one year following a TKA.¹³ The purpose of this case report is to describe the progression of physical therapy treatments for a patient status post TKA.

CHAPTER II

CASE DESCRIPTION

The patient was a retired 64 year old male who underwent a TKA surgery to resolve complications from severe OA of his left knee. The surgeon used the cruciate ligament-retaining, cemented knee prosthesis because the patient had a sufficient anterior cruciate ligament (ACL) and posterior cruciate ligament (PCL). This approach included metal femoral and tibia components, polyethylene articular surface, and patella button resurface. According to the surgical reports, the patient was given a left femoral block anesthetic, tourniquet, and a spinal anesthetic. There were severe, grade 4 degenerative changes in all 3 compartments of the knee, with more significant wearing of lateral than medial tibial plateau and lateral patellar facet. The patient tolerated the procedure well and was discharged from the hospital two days later.

Past medical history for this patient included right knee arthroscopy, left knee arthroscopy, and right TKA. He had severe knee OA, which led to both his right and left TKA. At the time of evaluation, the patient presented with controlled hypertension and hyperlipidemia. His current medications included an opioid pain medication (Hydrocodone), non-steroidal anti-inflammatory drug to reduce pain and swelling (Ibuprofen), and hypertension medication (Lisinopril). He was taking all of these medications as prescribed by his medical doctor. He did not have any family health

history or behavior risk factors reported or documented. He wore a compression stocking, iced his knee, and performed his prescribed exercises as instructed by the physical therapists in the hospital.

The patient reported to physical therapy ten days status post left total knee arthroplasty. Upon initial evaluation, he reported 8/10 on the VAS pain rating scale (0=no pain, 10=worst pain). A review of systems was not performed because it was not deemed necessary due to his past medical history and prior surgical reports. He used a front wheeled walker for walking, noted difficulty with stair ambulation, and required upper extremity use with transfers. The patient was a married and retired salesman. He lived in a one-story home within five miles of the clinic. He had very supportive family and friends that helped him attend therapy sessions. His prior level of function included no difficulty with any daily activities, including walking, curb negotiation, and rising from a chair or toilet. His recreational activities included daily walking without an assistive device, independent exercising at the wellness center, downhill skiing, and hiking. He was motivated to return to these activities, with goals of pain-free living and returning to his prior level of functional.

The overall clinical impression revealed that the patient was appropriate for physical therapy interventions. He responded well treatments that addressed his pain, range of motion deficits, strength deficits, and functional limitations. The initial evaluation objectively addressed these deficits and assisted in further intervention decisions. The patient was the center of the care, and he offered his input to promote his adherence to the program.

Examination

The objective measurements used during the examination included goniometry, circumferential measurements, patient specific functional scale (PSFS), Lysholm Knee Scoring Scale, Visual Analog Scale (VAS), joint play, and palpation. **Table 1** addresses the psychometrics of each examination measurement. **Table 2** displays the objective measurements for the patient at initial evaluation and discharge compared to normative values.

Goniometric measurements were used to assess range of motion (ROM). The measurements for knee flexion and extension were gathered using standard goniometry protocol with the patient lying supine. Active ROM measures the impairment of body function and mobility at the selected joint.¹⁴ The patient presented with decreased range of motion in his left knee.

Knee swelling was calculated using circumferential measurements with a vinyl tape measure for supra-patellar, mid-patellar, and infra-patellar sites on bare skin while the patient was lying supine. Circumferential measurements are considered clinically significant if there is >1 cm difference of swelling compared to the contralateral knee.¹⁵ Monitoring swelling in the surgical knee is important to help detect any signs of infection and to ensure that swelling will not hinder range of motion progressions. The patient had notable swelling of his left knee but did not display any signs of infection.

The patient specific functional scale (PSFS) was used for subjective reporting of independent walking. The PSFS was scored on a scale where 0 means unable to perform the activity and 10 means able to perform without difficulty. The patient rated his

independent walking as 0/10 because he was using a walker for ambulation.

Unfortunately, there is a floor effect observed for patients with knee dysfunction because there is no rating on the scale to demonstrate regression or deterioration.¹⁶ The PSFS was useful in the clinic because it was easy to administer, and it helped the patient identify his progress. The patient was asked to assess his independent walking on the scale at least once per week.

The Lysholm Knee Scoring Scale questionnaire was administered for a subjective reported functional assessment. The questionnaire contains 8 different categories regarding symptoms and function by which the patient identifies the most pertinent description. These categories include limp, using a cane or crutches, locking sensation in the knee, giving way sensation, pain, swelling, climbing, and squatting. The patient scored 13/100 on the questionnaire, where scores <65 are considered poor. The Lysholm Knee Scale was originally designed for cases of knee ligament surgery, but the assessment is now used for diagnosis such as total joint replacements.¹⁷

The visual analog scale was used for the patient to identify his level of pain on a continuum from 0 to 10. The patient gradually decreased and discontinued the use of his pain medications so this was a very important scale to use throughout treatment. Knee strength manual muscle testing and functional squatting were deferred at the time of examination due to pain and swelling.

Joint play and palpation were performed at a subsequent session. The patient had restrictions with tibiofemoral glides. He was very tender upon palpation along the knee

joint line and incision. Proprioception was never formally assessed but was addressed as per typical protocols.

Table 1: Validity and reliability of examination procedures

	Intrarater Reliability	Interrater Reliability	Validity	Minimum Clinically Important Difference
Goniometry	0.85 ¹⁴	0.98 ¹⁸	0.97-0.98 ¹⁸	9 degrees ¹⁸
Circumferential Measurements	0.82-1.0 ¹⁵	0.72-0.97 ¹⁵	---	1.7-2.0 cm ¹⁵
Patient Specific Functional Scale (PSFS)	0.84 ¹⁶	---	---	1.2 points ¹⁶
Lysholm Knee Scoring Scale	0.90-0.95 ¹⁹	0.70-0.93 ¹⁷	0.54-0.57 ¹⁹	---
Visual Analog Scale (VAS)	0.79-0.95 ²⁰	---	0.80-0.88 ²⁰	1.5 points ²⁰

Table 2: Objective measurements at initial evaluation, discharge and accepted normative/ideal values.

	Initial Evaluation	Discharge	Normative/Ideal Values
Left Knee ROM	5-84 degrees	0-118 degrees	0-120 degrees ²¹
Swelling	2 cm	No notable swelling	No swelling
PSFS Independent Walking	0/10 (Unable)	9/10	10/10 ¹⁶
Lysholm Knee Scoring Scale	13/100	70/100	Excellent=95-100/100 ²²
Pain (VAS)	8/10	1/10	0/10 ²⁰
Functional Squat	Deferred	90+ degrees at knee	---

Evaluation, Diagnosis, and Prognosis

The patient presented as the APTA Guide to Physical Therapy Practice Pattern 4H: Impaired joint mobility, motor function, muscle performance, and range of motion associated with joint arthroplasty was applicable for this patient;²³ he displayed all these criteria and reported painful daily activities. The ICD-10 code for a left total knee

arthroplasty is Z96.652. The patient reported pain localized to the knee and had been unable to exercise at the gym or walk outside due to the surgery.

The patient presented to physical therapy with left knee pain, swelling, and decreased range of motion. These factors were inhibiting his functional activities of independent walking, stair ambulation, and pain-free living. He was unable to participate in exercising at the local wellness center and taking walks with his wife. His knee swelling and pain level were measured each session. The PSFS was administered once per week, and the Lysholm questionnaire was completed every 6th visit.

This patient had a good prognosis as he was motivated to return to his prior level of function and enjoyed exercising. His plan of care was developed, and it was determined that the patient would attend therapy sessions until his goals were met. The patient's goals were to decrease the swelling in his left knee and improve his knee motion. He wanted to increase his strength in order to resume his former workouts independently at the gym. Ultimately, the patient desired to return to downhill skiing and hiking.

The rehabilitation goals established with this patient were to return to his prior level of function. The short term goals were to decrease pain levels, independence with his home exercise program, and active knee extension to zero degrees to achieve normal gait pattern. The long term goals for the patient were to remain pain free with achieve left knee motion, functional lower extremity strength, independent stair and community ambulation. The patient goals for discharge were to be independent with his exercise program at the YMCA and independently manage his symptoms.

The patient was appropriate for therapeutic exercises promoting range of motion,

strength, and proprioception of the left lower extremity. He also benefitted from manual therapy mobilizations to promote terminal knee extension and scar mobilizations to prevent adhesions at the incision site. Vasopneumatic treatments was used to decrease swelling and manage pain. The patient was appropriate for physical therapy interventions and was adherent to the plan of care.

Interventions

The patient was seen in the physical therapy gym twice per week for 45 minutes each session. The patient assisted in determining the plan of care and agreed to the treatment plan. He was treated with therapeutic exercise, manual therapy, gait training, and vasopneumatic device (**Figure 1**). He was provided a demonstration and a written document of all exercises for his home program. He always performed at least 2-3 repetitions of each exercise with supervision before he was instructed to perform an exercise at home. The patient was progressed to functional tasks and movements according to patient tolerance and response. Once the patient was able to achieve functional exercises, the previous and more basic exercises were excluded. Overall, the patient was adherent to his home exercise program and was eager to learn about exercise progressions. The surgeon was contacted periodically if there were any questions regarding the plan of care. Otherwise, the patient had follow up appointments with the orthopedic surgeon and had no restrictions.

Therapeutic Exercise. All therapeutic exercises were performed to increase range of motion, strength, and functional movements. Initially, the patient performed isometric quadriceps sets, isometric hamstring sets, heel slides, and straight leg raise as per the surgeon protocol. At the initial outpatient physical therapy session, the home

exercise program he received from the inpatient physical therapists was reviewed, and he was able to demonstrate each exercise with proper technique. Warm-ups were performed on the Nustep, progressing to the recumbent bike and eventually the elliptical once pain was managed and ROM allowed for a full revolution with the recumbent bike seat adjusted properly. By the third week, forward and lateral step ups were performed with a 4 inch step, progressing to 6 and 8 inch steps in later sessions.

The patient performed mini squats and progressed to squats with a theratube around the thighs once he achieved sufficient knee motion. He also performed forward lunging, sidestepping/partial squat with red band, and monster walks with the theratube around the thigh. The theratube around his thighs promoted hip abduction strength, which is essential for proper gait and alignment of the knee joint. He could use a railing if needed for any of these exercises but rarely used it for support or regaining balance. Seated leg press, seated leg extension, and seated leg curl weight machines were utilized. He was able to increase weight periodically, and he was eventually able to adjust the seat, back rest, and weights in order to perform his exercise independently. All the strength training exercises addressed the deficits that were limiting his stair ambulation, rising from a low chair, and jogging.

The patient's balance was challenged when he performed single leg stance while tossing a two pound ball at the trampoline and deep squats on foam pad. Agility ladders were used with various patterns (grapevine, centipede or 2 in: 2 out, and river-dance or in-behind-and-out) and directions (forwards and sideways) to challenge his lateral movements and hip-knee-ankle strategy. Patient performed stair ambulation instead of step ups once he was able to perform it safely and independently. He was instructed that

he could use the railing if needed.

Manual Therapy. Manual therapy was administered to improve knee flexion and extension. A grade 3 distraction force was applied to the tibiofemoral joint in conjunction with Grade 3 and 4 posterior and anterior glides. Patellofemoral mobilizations superior, inferior, medial, and lateral were also applied. The patient was also treated with soft tissue mobilization along his incision to reduce scarring and adhesions. The patient responded well to manual therapy treatment.

Gait Training. Gait training therapy was administered to review the patient's step sequencing with the front wheeled walker. The patient was able to achieve corrected gait pattern. He initially required verbal cuing to walk with a bend in his knee and manual cuing to assist weight shifting. The patient used a cane for two weeks but then walked independently without an assistive device by the second week of therapy.

Vasopneumatic treatment. The vasopneumatic treatment (GameReady) was administered to decrease edema and pain. The unit was set to the appropriate parameters and the cuff was placed over the left knee joint with both legs elevated on a bolster. The patient tolerated each treatment well and requested to end all his sessions with the vasopneumatic treatment.

Range of motion	Heel slides Straight leg raise	Nustep & recumbent biking	Quad & hamstring stretching	
Strengthening	Quad, Hamstring, & Glut sets; Sidelying clamshells	Step ups (4"- 8") & stair ambulation	Leg press, leg extension, & seated leg curl	Squats & sidestepping with theraband
Balance	Agility ladders in various patterns & directions	Single leg stance with ball toss	Squats to ~90° knee flexion on foam pad	
Manual Therapy Mobilization	Soft tissue scar mobilization & cross friction massage to scar	Grade 3 tibiofemoral distraction with ~80° knee flexion	Grade 3-4 posterior & anterior tibiofemoral glides	Patellofemoral mobilizations (superior, inferior, medial & lateral)
Gait Training	Step sequencing with front wheeled walker	Manual cueing with cane ambulation	Manual cueing for independent weight shifting	Stair ambulation with railing as needed
Vasopneumatic Treatment	15 min medium compression & mild cooling	15 min maximum compression & mild cooling		

Figure 1: Physical therapy interventions overview and progression.

Outcomes

The outcomes of the patient's left TKA were favorable. His motivation and adherence to the plan of care contributed to his positive rehabilitation results. He was treated in therapy for 12 visits over a 7 week time frame. He was also seen by his orthopedic surgeon twice throughout the course of physical therapy treatment, and the surgeon was pleased with the patient's progress. The patient's outcome measurements are displayed in **Table 2**. The normalized ROM contributed to the progression to rehabilitation with functional activities, such as stair ambulation and rising from a low

chair. Circumferential knee measurements were equal bilaterally without any detectable swelling. He was able to walk safely and independently without gait deviations. He reported only mild difficulty walking and ambulating stairs due to pain. The patient experienced pain reduction while he performed stair ambulation in his home and community, exercised at the gym independently, and walked outside with his wife. At the time of discharge from physical therapy, the patient was able to drive without restrictions, get up from the floor if needed, rise from a low chair, and attend yoga classes. The patient renewed his membership at the wellness center and continued his exercises independently. The patient was educated on identifying any adverse reactions to the exercise and was informed to contact the surgeon or physical therapy with any questions. Overall, there were no activity restrictions that the surgeon implemented for this patient, so he was able to resume activities based on pain tolerance. The patient was extremely satisfied with his progress and was impressed that his left leg was now “better” than his right. He enjoyed being so involved in his rehabilitation process and was pleased to watch his knee progress over time.

CHAPTER III

DISCUSSION

The data collected and outcomes measured for this patient who underwent physical therapy rehabilitation after a TKA are essential to assess functional activity and community participation. The patient's outcomes for the TKA, rehabilitation, sit to stand training, and abduction strength training will be discussed in comparison to other research studies.

The patient had positive outcomes after his TKA, which is consistent with other research studies. Results from a randomized controlled trial concluded that TKAs are superior to conservative non-surgical treatments for osteoarthritis. The patients who underwent total knee replacements followed by nonsurgical treatment experienced greater pain relief and functional improvement after 12 months than did the nonsurgical treatment group alone. Furthermore, 26% of the individuals who completed the conservative treatment received a TKA within the following year.²⁴ Therefore, it is important to note that this patient was an excellent candidate for a TKA and was able to achieve therapy goals. Approximately 80% of patients that underwent a TKA were satisfied with their surgical and rehabilitation outcomes.²⁵ Similarly, the patient had favorable outcomes for his right TKA five years prior, and upon discharge, his left knee function exceeded his right.

According to a research study conducted by Matei et. al., rehabilitation following

a TKA is superior to the standard care control group. The patients in the rehabilitation group experienced decreased pain levels, increased functional outcomes, and less difficulty performing activities of daily living. Overall, the patients in the rehabilitation group were more satisfied with their TKA. These patients performed better than the control group with 6-minute walk test, ROM measurements, and SF-36 questionnaire.²⁶ The results from this study support the decision to treat patients in physical therapy with a rehabilitation program. The patient in this case report experienced similar outcomes and was satisfied with his functional progress.

Sit to stand (STS) or rising from a chair is a functional movement that was used as a rehabilitation exercise for the patient. He needed to achieve this for independence in toileting, transfers, driving, and household activities. According to a study conducted by Boonstra et. al., TKAs improve the loading symmetry of the lower extremities during a STS transition when compared to pre-surgical performance and the control group. Furthermore, maximal knee angular velocity increased, which is essential to build the momentum necessary to counteract gravity and lift the body into a standing position.²⁷ The ability to rise from a chair with loading symmetry of the lower extremities is important to address to prevent weakness on the surgical knee and also further deterioration on the contralateral leg if unequal loading exists. The patient in this case report was able to perform STSs with functional loading symmetry.

Hip abduction strengthening is a very important aspect of rehabilitation after a TKA. According to a study conducted by Piva et. al., hip abduction strength was a higher determinant of return to physical function than quadriceps strength, anthropometrics, and demographics.²⁸ Unfortunately, abduction strengthening is easily overlooked in the

rehabilitation process. Maintaining hip abduction strength is necessary to keep knee alignment and biomechanics optimal.²⁹ The patient in this study strengthened all his lower extremity muscles, including his abductors via side-lying clam shells and side stepping with theraband. He was able to achieve strength necessary to participate in all his functional activities.

Physical activity is highly encouraged after a TKA. Rehabilitation in younger and more active individuals focuses on return to prior level of athletic performance.³⁰ The patient in this case report desired to return to jogging and downhill skiing. The patient was educated by the orthopedic surgeon and physical therapists that these higher impact activities may wear out the prosthesis components more rapidly than low impact activities. Patients are cautioned when beginning a new, high impact sport after a TKA; but because the patient was a veteran downhill skier, the surgeon decided it was acceptable to return to this activity.

Reflective Practice

Overall, my clinical instructor and I were very pleased with the evaluation procedures and interventions chosen for this patient. The evaluation procedures were appropriate for the patient's condition and effectively measured progress over treatment. The measurements revealed the limitations in strength, range of motion, swelling, and functional participation. Therefore, the evaluation procedures assisted in composing the plan of care, interventions, and rehabilitation goals. He responded very well to therapeutic exercise, manual therapy, and vasopneumatic treatment.

After researching other options treatment options for a TKA, there are other interventions that could have been appropriate and beneficial for this patient or other

patients in the future. Some of the evidence based interventions that I will consider in the future are preoperative exercise and functional squatting symmetry. Preoperative exercise and education is a very important aspect of surgical rehabilitation to consider. A study conducted by Jordan et. al. concluded that combining preoperative education with post-operative treatment is effective in reducing medical costs and enhances return to function.²⁵ Functional squatting symmetry is another objective intervention that I can utilize in future practice. A study conducted by Rossi et. al. concluded that the squatting movement is an accurate clinical marker of function after total knee arthroplasty. Overall, individuals placed significantly less body weight over the involved or operated limb at initial evaluation. Greater symmetry during a squat was correlated with positive functional movements.³⁰ I could have used the Biodex machine that was available at the clinic or even use a scale under each foot to measure symmetry during a squat.

Study Limitations

Limitations of this case report include that I had no follow up with the patient after formal discharge. My clinical instructor was able to contact him and his surgeon, but I do not have access to these records. It was also difficult to remember some of the patient history without looking at his medical records while writing this report. Future research needs to be conducted using experimental and control groups to compare the efficacy of each intervention used.

Conclusion

The patient who underwent a TKA to resolve complications from severe OA of his left knee had positive outcomes following physical therapy rehabilitation. This case report discusses the use of therapeutic exercise, manual therapy, and vasopneumatic

treatment following a TKA. The patient was able to return to his prior level of function after the rehabilitation process. His results from this episode of care for his TKA are similar to literature cited in this article.

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