2014

Effectiveness of Physical Therapy Intervention following Partial Medial Meniscectomy: A Case Report

Alexa Risan
University of North Dakota

EFFECTIVENESS OF PHYSICAL THERAPY INTERVENTION FOLLOWING PARTIAL MEDIAL MENISCECTOMY: A CASE REPORT

by

Alexa Risan

A Scholarly Project Submitted to the Graduate Faculty of the

Department of Physical Therapy

School of Medicine

University of North Dakota

In partial fulfillment of the requirements for the degree of

Doctor of Physical Therapy

Grand Forks, North Dakota

May, 2014

This Scholarly Project, submitted by Alexa Risan 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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ACKNOWLEDGEMENTS

I would like to express my gratitude to Mark Romanick, PT, PhD, ATC for his valuable and constructive suggestions during the development of this case report. His input of time, effort and esteemed knowledge is respected and much appreciated. I would also like to thank the UND physical therapy department faculty and staff for fostering my professional growth and development by providing me with great educational opportunities and a positive learning environment. Finally, I wish to thank my loving family for their support and encouragement throughout my educational journey.

ABSTRACT

Background and Purpose. Partial meniscectomy is a very commonly performed surgical procedure and many cases are uncomplicated and successfully treated with home-based exercise programs. However, some patients experience more significant problems following surgery and require rehabilitation services. Research is limited regarding physical therapy (PT) effectiveness in the post-operative management of such complicated cases. This case report aims to evaluate the effectiveness of PT treatment of a 34-year-old male with significant impairments and functional limitations following partial medial meniscectomy.

Case Description. Examination and evaluation included ROM/flexibility and strength measurements as well as functional assessment. PT included therapeutic exercise which was aimed at quadriceps and hip musculature strengthening and also incorporated soft tissue and joint mobilization. A home exercise program (HEP), patient education and modalities for pain modulation were also utilized.

Outcomes. Outcomes following approximately one month of PT treatment revealed decreased pain ratings and increases in range of motion, strength and functional abilities. However, at one month post-surgery the patient still demonstrated quadriceps fatigue with prolonged ambulation and had not yet reached his previous level of function.

Discussion. After PT intervention this patient had decreased impairments and functional limitations. Further research involving large sample sizes needs to be gathered in order to determine PT effectiveness in complicated cases following partial meniscectomy.

CHAPTER I

BACKGROUND AND PURPOSE

The menisci are crescent-shaped fibrocartilaginous structures which sit on the tibial plateaus. They consist mainly of circumferentially oriented fibers which make them very good at absorbing and dispersing compressive forces, as well as resisting anterior and posterior shear forces. Also, a small number of longitudinally arranged fibers are present which add to the function of sustaining tensile forces placed upon the menisci in weight-bearing positions. Water makes up 70% of the menisci composition and this contribution assists with the structure's capabilities of shock absorption, joint lubrication and nutrition transmission that occur during weight-bearing. Water loss often occurs with age, leading to degenerative changes and increased risk of injury.[1]

Meniscal lesions are the most common knee injury with an incidence of 23.8 cases per 100,000 persons per year.[2] Injury to the medial meniscus usually occurs via one of two mechanisms. Acute injury to the meniscus often occurs traumatically in conjunction with an anterior cruciate ligament (ACL) tear sustained during athletics. Such injuries are usually sustained during a rotational moment about a flexed knee when the foot is fixed on the ground. This commonly happens when quickly changing directions during running or squatting activities. The other main mechanism of injury to the meniscus occurs following degenerative changes and these lesions are often more complex than the acute, traumatic tears mentioned above.[3] Symptoms of a meniscal injury usually include pain along the joint line, swelling, loss of range of motion (ROM) and catching, locking and giving away of the knee joint.[1]

The patient who has sustained a meniscal injury has the option of conservative treatment or more invasive measures such as partial meniscectomy, total meniscectomy, or meniscal repair. Treatment choice is determined based on patient age, health, and activity level, as well as lesion location and severity. Conservative treatment is indicated for lesions of the peripheral, well-vascularized third of the meniscus and often consists of PT which is aimed at pain modulation, edema management, strengthening and functional training.

Partial meniscectomy is the surgical removal of a fragment of torn meniscus and is the most common surgical procedure performed by orthopedic surgeons. It is often chosen for those individuals who are less active and who have suffered lesions of the inner, avascular third of the meniscus because repairs to this area typically do not heal well. Lesions to the peripheral, vascular third of the meniscus usually respond well to meniscal repair, which is associated with better patient-reported long-term outcomes and less radiologic degeneration at ten years or greater following surgery.[4,5]

Partial meniscectomy has been found to have a short-term reoperation rate of 1.4% whereas meniscal repairs have a reoperation rate of 16.5% in the first 4 years following initial surgery. At long-term follow-up after the first ten years following initial surgery, partial meniscectomy has been found to have a reoperation rate of 3.9% whereas meniscal repairs have a reoperation rate of 20.7%.[5] Although partial meniscectomy is associated with poorer long-term outcomes, research has shown that it has a lower re-operation rate and results in less pain and a quicker recovery following surgery.

While many partial meniscectomy cases are uncomplicated and successfully treated with home-based exercise programs, some patients do experience more significant problems following surgery and require rehabilitation services. Following a systematic review, Goodyear-Smith and

Arroll[6] suggest that such a subgrouping of partial meniscectomy patients may include those of older age, those who are less motivated for participation in recovery and those who also have an ACL injury or degenerative change of the knee joint. They propose that this subgroup may benefit from outpatient PT services vs. receiving only a home-based exercise program. Research is limited regarding PT effectiveness in the post-operative management of complicated partial meniscectomy cases and this case report aims to evaluate the effectiveness of PT for the treatment of such a case.

When rehabilitation is indicated for patients with substantial impairments following partial meniscectomy, it includes pain and edema management as well as restoration of knee joint ROM and strength of the lower extremity to normalize forces about the knee and decrease abnormal dispersion of stresses to the joint's articular surfaces. Neuromuscular re-education consisting of resistive exercises, closed-chain activities, and proprioception/balance training should also be incorporated 3 to 4 weeks after the surgical procedure.[7] One study included in the systematic review performed by Goodyear-Smith and Arroll found that although benefits did not carry over into significant functional improvements, PT was effective for decreasing pain and restoring muscle strength following arthroscopic meniscectomy.[6] Another study, performed by Ericsson et al[8] found that arthroscopic partial meniscectomy patients had significant dose-related improvements in one-leg hop distance and quadriceps endurance following 4 months of supervised neuromuscular training.

CHAPTER II

CASE DESCRIPTION

Examination, Evaluation, and Diagnosis

The patient included in this case report was a 34-year-old male with significant impairments and functional limitations following partial medial meniscectomy. He was suffered a left medial meniscus tear and had a partial medial meniscectomy performed four days prior to initial PT evaluation. The patient was selected for case report inclusion due to the atypical severity of his impairments and limitations following this surgical procedure which indicated that he may benefit from PT treatment. He was also a good candidate because he had no contraindications to intervention and his past medical history was relatively uncomplicated with no previous knee injuries or surgeries.

The patient's knee pain occurred with insidious onset upon waking up one morning approximately three months prior to his surgery and initial PT evaluation. He had no previous history of significant knee pain, injury or surgery but did break both ankles on separate occasions during his teenage years. His knee pain temporarily decreased with the use of anti-inflammatory medication but eventually returned to initial intensity levels and led him to visit his medical doctor. He was medically diagnosed with a tear of his left medial meniscus and had a partial medial meniscectomy performed four days prior to initial PT evaluation.

At initial evaluation, the patient was able to ambulate without the use of an assistive device but his subjective pain rating (on a scale of 0-10 with 0 equaling no pain and 10 representing worst imaginable pain) was 1/10 during rest and 4/10 with activity. He was taking

Naproxen, a nonselective NSAID, to decrease inflammation and pain. He was able to perform 1 flight of reciprocal stairs but with difficulty and pain, especially when ascending; this posed a problem as he had recently returned to work where much ambulation and stair performance was required. He was also functionally limited when rising from a seated position and was unable to run, descend to the floor to play with his young children, and ambulate for prolonged periods of time. The patient smoked on a daily basis and lived a sedentary lifestyle but wished to become more active and resume running for leisure. He was the sole provider for his wife and young children and they lived in a single-story home. The patient's and family's goals were for him to return to all previous activities, including playing with his children, rising from seated position and running, without pain and dysfunction.

Systems review performed during examination revealed no cardiovascular or pulmonary concerns. Observation of the patient's left knee revealed moderate edema both superior and inferior to the patella. The incisions were still covered with tape but surrounding skin integrity and color appeared to be normal. The patient's range of motion at initial examination was assessed in supine position on a plinth by using a 14-inch universal goniometer and is demonstrated in the following table.

Table 1. Initial Knee ROM Measurements (in Degrees)

	Left Knee	Right Knee
Active flexion	133	144
Active extension	0	0
Passive flexion	135	148
Passive extension	0	0

Range of motion measurements performed on peripheral joints have been found to demonstrate good-to-excellent reliability. A significant clinical change can be shown with a difference of at least 5 degrees between measurements.[9,10] Manual muscle screening of the patient's lower extremity was included to assess strength and included actions of hip flexion, extension, abduction and adduction. It also included knee flexion and extension as well as ankle plantarflexion and dorsiflexion. At initial evaluation, the patient's right lower extremity strength was graded as 5/5 throughout. His left lower extremity strength was measured as 5/5 except for knee extension which was found to be 4-/5. No special tests were performed due to knowledge of the injury and surgical procedure. During palpation, the patient was tender at the medial joint line of the left knee and peripatellar edema was noted.

These examination findings were not highly unexpected following partial medial meniscectomy—patients who undergo this surgical procedure often exhibit impairments including limited range of motion, strength deficits, edema and pain immediately following surgery. Specifically, medial meniscectomy has been associated with "joint-line tenderness, effusion, and joint laxity."[11]

The patient's deficits in quad strength were as to be expected; a study performed by Glatthorn et al[12] found significantly decreased quadriceps strength on the involved side during isometric and concentric contraction at 6±1 month following arthroscopic meniscectomy. Electromyelogram (EMG) activity of the vastus lateralis and medialis was decreased after this surgical procedure and this weakness was "accompanied by significant side-to-side asymmetries in muscle activation." These findings suggest a decreased neural firing to these muscles during maximal isometric and concentric contraction.

After evaluation of the examination findings, the patient's PT diagnosis was established as pain in joint, lower leg and tear of cartilage or meniscus of the knee. His problem list included pain, swelling and inflammation, limited mobility, and limited stability. It also included difficulty sleeping and impaired functional capacity with performing reciprocal stairs (especially when ascending), rising from a seated position, kneeling on the floor to play with his children, and prolonged walking.

Prognosis and Plan of Care

Based on the patient's history and examination findings and according to the second edition of the Guide to PT Practice, this patient fell into the practice pattern of 4I: Impaired Joint Mobility, Motor Function, Muscle Performance, and Range of Motion Associated With Bony or Soft Tissue Surgery. His predicted prognosis of recovery ranged from 1 to 8 months following 6 to 70 supervised PT sessions.[13] The patient had excellent rehabilitation potential and was predicted to have absent edema, report no pain at rest and only minimal levels with activity upon re-examination after 4 weeks of treatment. He was also anticipated to regain normal range of motion, eventually increase quad strength of the left lower extremity to 5/5 and return to functional activities by that time.

Patients are usually able to fully weight-bear within 4 to7 days post-operatively and achieve at least 90 degrees of knee flexion and full extension by the 10th post-operative day.[7] This patient had achieved these milestones by the initial PT visit on post-operative day 4. However, this patient exhibited prolonged edema and substantial functional limitations beyond what would be considered normal. Due to the recent surgical procedure, inflammation was most likely present in the patient's left knee joint and this reasoning is supported by the fact that NSAID medications seemed to temporarily relieve his pain. This inflammation was most likely contributing substantially to his pain and thus, addressing it was a key component in the plan of

care. The patient's observable and palpable swelling very likely played a role in his limited range of motion and decreasing this was also included in the treatment plan. The plan of care also aimed to improve joint mobility through the utilization of range of motion and stretching techniques as well as patellofemoral glides. Strengthening was incorporated into the treatment plan as well with areas of focus being about the hip and knee for improved stability during functional closed-kinetic chain activities including ambulation, stair performance and rising from a seated position. The plan of care also included a HEP, patient education and modalities as indicated for pain modulation.

Short-term goals for the patient (to be achieved within 3 weeks) included initiation of a HEP, increased left knee flexion to 140 degrees, increased bilateral hamstring flexibility to 50 degrees, decreased pain with a rating of no greater than 2/10 with activity and increased quad strength on the left by a half grade so that he would be able to perform reciprocal stairs with less difficulty, tolerate walking without rest for 30 minutes and rise from a chair with more ease. Long-term goals for the patient (to be achieved within 6 weeks) included independence with a progressed HEP, normal range of motion and decreased pain with a rating of no greater than 1/10 so that he would be able to kneel on the floor to play with his children and run for 15 minutes without being limited by knee pain.

CHAPTER III

INTERVENTION

The patient was seen for a total of 10 visits over the course of 5 weeks. During the first and subsequent sessions, treatment began with soft tissue massage to his left peripatellar region and distal quadriceps in order to promote increased circulation and decreased local swelling. Superior and inferior patellofemoral glides (grades II and III) were then performed to his left knee in order to decrease pain, improve patellar mobility and subsequently increase possible knee flexion. Passive stretching of the patient's hamstrings, iliotibial band and piriformis was performed bilaterally for 5 minutes and passive knee flexion and extension ROM was performed to the left knee for an additional 5 minutes. These joint mobilization techniques were continued throughout the remainder of the course of treatment and were followed by therapeutic exercises.

Isometric quadriceps contractions (quad sets) and quad sets with straight leg raise (SLR) were initiated as a starting point for quadriceps strengthening and were performed in supine. Quadriceps activity has been found to be highest in open-kinetic chain exercises when the knee is close to full extension, thus confirming the importance of incorporating such exercises when aiming to strengthen these muscles.[14] Because strength of hip musculature has an enormous effect on the biomechanics at the knee joint by establishing proximal stability and because many persons demonstrate weakness at the hip, isometric hip adductor contractions (add sets) and bridges were included and performed in supine to strengthen hip adductors and extensors, respectively. Active assist heel slides were also incorporated in order to improve knee flexion ROM and were performed by the patient while long-sitting.

Following the strengthening exercises, the patient performed a standing hamstring stretch followed by full revolutions on a stationary bike without resistance for 5 minutes in order to further improve joint mobility. Performing early active ROM on a stationary bike under the supervision of a physical therapist has been found to produce significant improvements in subjective measures of gait when compared to not receiving supervised exercise.[15]

Arthrogenic muscle inhibition (AMI) is an ongoing neural inhibition cycle which results in the inability to fully activate a muscle or group of muscles. It most often occurs in persons with arthritis or following traumatic injury or surgery and has been observed in patients who have undergone meniscectomy. AMI, which can be caused by pain, swelling, inflammation, or damage to afferent joint receptors, may be effectively reduced with the use of cryotherapy.[16,17] The patient was instructed on the importance of icing his knee for 15 minute increments per hour and of elevating his knee when possible at home to minimize further inflammation, swelling, and possible AMI.

The patient was given a HEP which consisted of quad sets with and without SLR, add sets, and bridges. All of these exercises were to be performed 2 to 3 times per day and in supine position as they were during his PT treatment. The isometric contractions were to be held for 10 seconds and all exercises were to be performed for 10 reps. The patient was also instructed to perform a standing hamstring stretch for 3 reps of 30 second holds.

Therapeutic exercises performed during the 2nd treatment session were the same as listed previously but bridges and heel slides were advanced by having the patient perform them on a Swiss ball. Core stabilization exercises were incorporated in order to promote increased stability of the pelvis and hip joint and consisted of isometric abdominal contractions, isometric hip external rotator contractions (clams) against manual resistance from therapist, isometric gluteal

contractions and isometric abdominal contractions performed while squeezing Swiss ball on stomach between contralateral arm and leg. These exercises were all performed in supine and isometric contractions were held for 10 seconds per rep. Calf raises were added to strengthen the gastrocsoleus complex which in turn promotes increased dynamic stability at the knee joint and mini squats were incorporated to initiate closed-kinetic chain strengthening of the quadriceps. Closed-kinetic chain exercises have better functional carry-over and were thus utilized more frequently as the patient's course of treatment progressed.

Therapeutic exercises remained the same as noted above for the 3rd and 4th treatment sessions. During the patient's 5th visit, single-leg stance on foam was added to improve hip abduction strength and proprioceptive abilities. Lateral gait was also added with TheraBand placed above his knees to apply resistance to his hip abductors and thus promote strengthening and increased proximal stability. At the 6th treatment session, the patient was able to tolerate the addition of 4 inch anterior step-ups and hip extension on multi-hip machine. Mini squats were advanced to wall squats on Swiss ball in order to promote improved posture and to engage the abdominal musculature. The patient continued the above-mentioned exercises throughout the remainder of his treatment sessions with progressions made in reps and intensity as tolerated. Apart from communication with the patient's physician, no collaboration with other medical disciplines was utilized in the care of this patient.

CHAPTER VI

OUTCOMES

Because the author left the clinic prior to this patient's discharge, final outcome status was unknown. However, re-evaluation was performed at the 8th visit which occurred approximately one month following the initial treatment session and is used to demonstrate clinical outcomes for this patient. The procedure for re-examination included history-taking, which involved subjective measures of pain levels and functional limitations, as well as repeated measurements of knee ROM. It also included palpation, MMT and functional lower extremity strength assessment through the performance of wall squats. The same student physical therapist (SPT) performed the re-evaluation and the patient was again placed in supine for ROM assessment, with measurements taken via 14-inch universal goniometer. The patient's active and passive knee extension had remained at 0 degrees and repeated knee flexion ROM measurements are listed and compared with initial measurements below.

Table 2. Knee ROM Measurements (in Degrees) at Initial vs. 8th Visit

	Initial Evaluation		At 8th Visit	
	Left Knee	Right Knee	Left Knee	Right Knee
Active flexion	133	144	140	145
Passive flexion	135	148	142	148

As observed above, the patient's active as well as passive knee flexion improved with a clinical significance of greater than 5 degrees. The patient's hamstrings were still limited but had

gained 5 degrees of mobility bilaterally since initiating therapy. Re-assessment of strength was performed via MMT which revealed an increase in knee extensor strength on the left to 5/5. Assessment of functional strength showed that the patient was able to perform 2 sets of 10 reps of wall squats with no pain and minimal quad fatigue. Despite quadriceps fatigue with prolonged walking, the patient reported no pain at rest and minimal pain when performing exercises. The patient was no longer tender to palpation at the medial joint line and slight peripatellar swelling was still noted, although this had decreased substantially from initial evaluation. He stated that he was now able to descend to the floor to play with his children and was also able to perform greater than one flight of stairs at work. However, the patient had not yet attempted to run since his surgical procedure.

At re-evaluation, a progress note was issued to the patient's physician as well as to third-party reimbursement which reported the afore-mentioned improvements as well as remaining deficits to request allowance for more visits. Although the SPT working with this patient left the clinic prior to his final discharge, knowledge was gained that the patient received approval for 4 more visits and utilized 2 of them with discharge occurring on his 10th visit.

The patient's overall response to intervention was positive, despite initial aggravations of pain and most likely inflammation. At the beginning of the 2nd treatment session 3 days after initial evaluation, the patient had increased pain to the extent that he experienced it while ambulating. This increased pain could theoretically be explained by his increased activity at work and performance of HEP.

The patient was seen a week later for his 3rd PT session at which time he reported pain levels that had continued to increase. He stated that his week-long absence from PT was due to the fact that his physician advised him to take a break from exercises until his pain levels

subsided. Upon observation, the swelling about his left knee had increased and he was tender to palpation at both medial and lateral joint lines. Despite increased swelling, the patient was able to perform all exercises from the prior session and reported that he would resume them at home as well.

At the 4th treatment session the patient was still experiencing pain with ambulation but stated that he had been performing exercises regularly at home as well as stationary biking for 15 minutes per day. Over the next 2 treatment sessions the patient's edema began to visibly decrease and passive knee flexion was within normal limits (WNL) and pain-free at the 6th visit.

The patient accomplished his short-term goals of initiating a home exercise program and achieving hamstring flexibility to 50 degrees bilaterally within three weeks of initial evaluation. At re-evaluation, the patient had achieved his short-term goals of improving left knee flexion to 140 degrees and increasing strength of the left knee extensors to 5/5 so that he was able to perform reciprocal stairs with less difficulty and rise from a chair with more ease. At this time, he had been able to increase his ambulation duration to 30 minutes but did experience quad fatigue and slight pain when doing so. He had reached his long-term goals of independence with progressed home exercise program and being able to descend to the floor. ROM of his left knee was still limited when compared to the right but significant gains had been made and this deficit did not appear to be affecting him functionally. The patient had yet to attempt his long-term goal of being able to run and therefore his ability to do so for 15 minutes without experiencing limiting pain could not be assessed at this time.

There were no known compliance issues with this patient as he reported that he performed exercises outlined in his HEP as instructed. He voiced his satisfaction with PT intervention at re-evaluation, emphasizing that he had made significant changes in function since

initiating treatment. Along with his improvements in functional activity performance at home, the patient was able to resume his normal duties at work which required much ambulation as well as stair performance.

CHAPTER V

DISCUSSION

There is limited research establishing (PT) effectiveness in the post-operative management of meniscectomized patients. Perhaps more emphasis should be placed on the evidence which argues the lingering effects that may be present following partial meniscectomy. Roos et al[18] found significant disability with functional activities and decreased quality of life 3 months following this surgical procedure in patients who had received a HEP alone. Another study performed by Malliou et al[19] found that post-meniscectomized patients who received PT for only the first 3 days following their surgery had decreased proprioception and functional abilities of their operated vs. their non-operated leg 1 to 2 years later. At 4 years following this surgery, significant reductions in isokinetic quadriceps strength, single-leg rise ability and self-reported function and quality of life have been identified.[20] These studies may suggest the need for supervised PT following post-meniscectomy to quickly initiate and monitor intensive muscle strengthening and neuromuscular training in order to restore muscle coordination and proprioception for increased dynamic stability and proper distribution of forces at the knee.

This particular patient's impairments may have been exacerbated by the fact that he was initially very fearful of activity and hesitant to perform exercises in an attempt to avoid re-injury. Also, the time-line of his improvement in outcomes may have been shortened had he not had the flare-up of pain and inflammation leading to a week-long absence from exercise performance.

Although complications following arthroscopic partial meniscectomy are rare, Kinsella and Carey have reviewed the problems that may occur prior to, during, and after this procedure. Several of these problems that could result in continued symptoms and no clinical improvement

following surgery include recommendation of this treatment when osteoarthritis (OA) is the actual source of pain, failure to exclude other sources of pain, not identifying or resecting all unstable parts of a meniscal tear, poor portal placement and damage to articular cartilage during surgery.[21] The odds that this patient had suffered any of these difficulties are rare but may have been taken into consideration had his symptoms not started to resolve with PT intervention.

The improvements that were observed in this patient over the course of his treatment are not surprising considering that a systematic review performed by Goodyear-Smith and Arroll found that PT interventions were effective at decreasing pain and restoring muscle strength following meniscectomy.[6] A systematic review with meta-analysis published by Dias et al. identified 3 randomized controlled trials (RTC) which found that PT with HEP was more effective than HEP alone for persons who had undergone partial meniscectomy. Patients receiving supervised PT had greater gains made in knee flexion ROM, had greater patient-reported knee function scores and were able to return to work more quickly.[22]

As mentioned above, the presence of edema or pain following knee injury may be significant enough to cause quadriceps dysfunction.[16,23] Therefore, management of pain and edema was incorporated in this patient's plan of care in an attempt to minimize further loss of strength and functional limitations. Rightly so, these impairments decreased as expected over the course of treatment.

Soft tissue massage and joint mobilization techniques were utilized in the treatment of this patient and re-evaluation results revealed significant gains made in ROM. Intervention techniques aimed at strengthening the quadriceps and hip musculature were employed with observable gains made in knee extensor strength over the month-long course of treatment. This increase in strength along with decrease in pain levels was followed with improved functional abilities including his eventual ability to perform reciprocal stairs, lower himself to the floor with appropriate quadriceps control and ambulate without limiting pain or fatigue.

It cannot be confirmed that this patient would have experienced more permanent or severe limitations had he received a home program alone; however, he did have decreased impairments and great improvements in self-reported and observed function following PT which included soft tissue and joint mobilization, therapeutic exercise, modalities as indicated and patient education. These outcomes suggest that such interventions may be effective at reducing pain and edema and improving ROM, strength and functional abilities in more complicated cases following partial medial meniscectomy procedures.

Recommendations for future studies include further research into the immediate effectiveness of supervised PT vs. a home program in the post-operative management of more complicated cases of meniscectomized patients. Randomized controlled trials should be utilized if possible due to the fact that this is the gold standard and in order to maximize evaluation of treatment effectiveness. Also, more research should be done to investigate if incorporating very intensive PT aimed at restoration of strength and neuromuscular function would have significantly different long-term outcomes when compared to less intensive therapy and HEP alone. Lastly, more research needs to be performed on very long-term outcomes with regards to self-reported impairments, functional abilities and quality of life as well as osteoarthritis rates following supervised PT vs. home program after partial meniscectomy.

Reflective Practice

When treating similar cases in the future, it will be important to include lower extremity girth measurements to objectively monitor changes in edema which may play an important role in ROM and strength limitations about the knee. While volumetric measurement using water displacement is considered the “gold standard”, some clinics may not own the equipment needed to perform this procedure. Circumferential measurements taken with a tape measure may be used instead as they have been found to be reliable as well as quick and fairly simple. Measurements taken using a non-elastic tape measure at 1 cm proximal to the base of the patella have an intra-

tester reliability of 0.99 which is slightly greater than inter-tester reliability (0.98-0.99).[24] While these high values support the relative reliability of repeated circumferential measurements, absolute reliability findings suggest that measurements of a patient be taken consistently by the same physical therapist to most accurately monitor for changes in edema. It is also imperative to use the same landmarks/sites for every measurement, take measurements at the same time during every treatment session (i.e. always taken initially, before soft tissue massage or therapeutic exercise), and have the patient in the same position for each measurement. It will also be important to include hip strength assessment to have an objective measure of such and also to evaluate the effects that weakness in this area may be having on the patient's entire lower extremity function.

A clinometric scale was not used during the treatment of this patient but should have been; the Lower Extremity Functional Scale (LEFS) could have been utilized to measure improvements in function over time. This functional assessment meets sensibility criteria for this patient in that it can be carried out in an outpatient orthopedic setting and includes almost all his stated limitations. This standardized measure consists of 20 questions, has understandable directions and evidence of scientific rigor as demonstrated by test-retest reliability R=0.94. Minimal detectable change and minimal clinically significant difference is 9 scale points (90% CI).[25] If this clinometric assessment had been used, the patient would have most likely achieved at least a 9 point difference from initial evaluation to re-evaluation based on his stated and observed changes in functional activities.

I would not refer similar cases to other disciplines in the future due to the fact that this patient's limitations could be effectively improved with PT intervention. However, referral would be indicated for these patients if significant comorbidities or red flags were present, if they

did not make gains as expected or if their analgesic medications were not properly managing pain.

The mean cost per PT session for this patient was $123.46 which was reasonable considering that his impairments and functional limitations were significantly affecting his ability to perform work-related duties and PT intervention may have contributed to his earlier return to work vs. had he received a home program alone. Costs to the patient could have possibly been reduced by having him come in once instead of twice per week but this frequency of visits was warranted by the importance of monitoring his edema and pain during exercises.

This case report has influenced my professional development goals in that I have gained an increased interest in studying the effects that weakness about the hip may have on knee biomechanics and arthrokinematics as well as related long-term outcomes. It has allowed me to reflect upon my practice, making note of effective strategies and techniques as well as determining what I will do differently in the future.

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