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Conservative Treatment of a 58 Year-Old Male Referred to Physical Therapy with a Knee Sprain and Knee Osteoarthritis

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CONSERVATIVE TREATMENT OF A 58 YEAR-OLD MALE REFERRED TO PHYSICAL THERAPY WITH A KNEE SPRAIN AND KNEE OSTEOARTHRITIS

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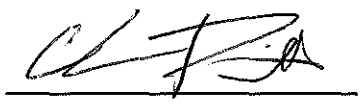
Signature 

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TABLE OF CONTENTS

LIST OF TABLES

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Thanks to family, friends, and mentors who believe in me and continually challenge me to improve.

ABSTRACT

Background and Purpose: Knee osteoarthritis (OA) is a common condition in people over 50. Although there may be an association between acute knee injuries and knee OA later in life, the occurrence of acute knee injuries in patients with existing OA is less clear. The purpose of this case study is to evaluate the effectiveness of an impairment based therapy program in an individual with an acute knee injury and knee OA.

Case Description: This case follows a 57 year old male referred to physical therapy with an acute knee sprain and tri-compartmental knee OA. Treatment lasted 7 sessions spanned over 4 weeks.

Intervention: Intervention was impairment and function based and emphasized strength, balance, range of motion, manual therapy, and functional training.

Outcomes: Improvements were seen in strength, balance, range of motion, and function. The improvement seen were relatively small as the individual presented with good strength and limited range on the affected side.

Discussion and Conclusion: In addition to patient outcomes, strengths of this case study are individualized therapy interventions and emphasis on balance and lower extremity strengthening. Some limitations to this study are an initial patient presentation with minor impairments, a lack of full reassessment at completion of treatment, and a short therapy intervention. Impairment based physical therapy is

an effective means for treating older individuals with acute knee injuries and concomitant knee OA.

CHAPTER I

BACKGROUND AND PURPOSE

Physical therapists treat patients with a variety of pathologies. According to Urwin et al,[1] the three most common areas treated as reported by physical therapists are the back, knee, and shoulder. Although injuries to these areas are treated across the lifespan, certain pathologies become more prevalent with increasing age. For example, Woolf and Pfleger[2] suggested that common pathologies occurring in an older population are osteoarthritis (OA), rheumatoid arthritis, osteoporosis, and back pain.

The prevalence of OA is high in older individuals and is estimated to occur in 60% of men when over the age of 65.[3] Despite such high occurrence there isn't a clear association with degeneration found through imaging and the symptomatic presentation of OA.[4,5] Hannan et al[4] found that of 319 patients with radiographic OA, only 47% reported pain.

The amount of traumatic knee injuries occurring within this population is more unclear. Gage et al[6] estimated that of 6.5 million knee injuries between 1999 and 2008 In the United States, 43% were diagnosed as a sprain or strain. Also found within this study was a significant increase in the rate of traumatic knee injuries in individuals over the age of 45. The actual occurrence rates are still unclear in the older population however.

A causal relationship has been suggested between knee OA and knee sprains. It has been proposed that knee sprains can lead to an increased risk of developing OA later in life. In a study by Gelber et al,[7] 141 young adults with injuries were reassessed after 36 years. The incidence of knee OA in individuals who had a knee injury was 13.9%, whereas it was only 6% in individuals with no injury. Each pathology, knee OA and knee sprains, will be discussed further.

Knee Osteoarthritis

Osteoarthritis, or degenerative joint disease, is a slowly evolving articular disease of joint cartilage which affects the bone, soft tissue, and synovial fluid.[8] Physical presentation can vary amongst individuals with OA and symptoms most commonly reported are joint stiffness, joint pain, and movement restriction.[9] Stiffness is usually worse in the morning and following periods of inactivity. Joint pain is usually insidious with slow progression, worse with joint use and impact, and relieved by rest. Other common signs are swelling, crepitus, joint line tenderness, and joint deformity. In addition to these findings, Zhang et al[10] suggests that as a result of self-reported instability and quadriceps weakness, there is an increased risk of falls in individuals with OA.

There is a large body of research investigating the benefits and limitations of physical therapy intervention for knee OA. Evidence supports that patients with knee OA receiving exercise interventions prescribed by and performed with a physical therapist have better pain resolution and Western Ontario McMaster Osteoarthritis Index (WOMAC) scores than patients performing exercise at home.[11] A recent meta-analysis by Fransen and McConnell[12] also found high to

moderate quality evidence for land based physical therapy improving pain and function in knee OA patients.

Resistance training has also been shown to be beneficial for individuals with knee OA. One possible explanation for improvements is that thigh muscle weakness has been associated with symptomatic OA.[13,14] Lun et al[15] compared the effects of a hip based strengthening program and a thigh based strengthening program in individuals with knee OA. Results showed significant improvements in pain and function in both groups with no statistical differences between groups. Similarly, Singh et al[16] showed that in comparison to standard physical therapy a 6 week hip strengthening program significantly improved WOMAC scores, 6 minute walk scores, and hip strength.

Balance has also been shown to improve with physical therapy interventions. A meta-analysis by Mat et al[17] examined the effects of different therapy interventions on balance and fall risk. Analysis found that improvements in balance were significant for strength based, Tai Chi based, and aerobic based interventions. It was also found that a significant reduction in falls risk resulted from each of the different interventions.

The benefits of manual therapy in knee OA is less clear. Although not completely understood, Deyle et al[18] proposed that the increase in inflammatory markers in OA can lead to the development of capsular restrictions in the affected joint. In the same study, effects of a combination therapy program involving manual therapy and exercise was compared to a home based exercise program in patients with knee OA. Results showed that individuals receiving both

manual therapy and exercise in clinic had greater improvements in outcomes as measured by the WOMAC than those performing the same exercise at home. These results should be interpreted cautiously. The true difference between groups may not solely be due to manual therapy but exercise performed under the supervision of a physical therapist. However, the extent of improvement in the manual therapy group was nearly identical to a previous study[19] performed by the same author.

Although several forms of physical therapy intervention have been shown to be beneficial in knee OA, one specific intervention has not been shown to be more beneficial than others. Improvements resulting from the various therapy interventions are generally related to pain, function, and quality of life and there seems to be no clear evidence that exercise alters disease progression in symptomatic individuals.

High occurrence rates of OA in the geriatric population could mean that large numbers of patients will present to physical therapy with a primary diagnosis of OA. In addition, it is likely that older individuals referred to physical therapy for other pathologies will also present with symptomatic OA. This highlights the importance of understanding the management of OA as well as how treatment might be affected with an additional injury.

Knee Sprains

Two of the more common knee sprains involve either the anterior cruciate ligament (ACL) or the medial collateral ligament (MCL). Shimokochi et al[20] reported the most common mechanisms of injury for non-contact ACL sprains

involve deceleration or acceleration movements combined with an increased quadriceps contraction and a reduced hamstring co-contraction. The authors also found the ACL to be loaded more during internal rotation of the knee, valgus of the knee with internal rotation, and valgus of the knee during weight bearing movements. The MCL provides medial stability to the knee and it has been reported that the most common mechanism of injury involves a direct blow to the lateral side of the knee, forcing it into excessive valgus.[21]

The PCL provides the primary restraint for posterior tibial translation and aids in providing stability to tibial external rotation. The most common mechanism of injury involves trauma that results in excessive posterior force to the tibia (dashboard injury) and the second most common injury involves falling on a flexed knee with the ankle in plantarflexion.[22] Injuries to the LCL usually involve excessive varus forces to the knee.

Meniscal tears have been reported to account for 14% of all knee injuries.[23] Usually the menisci are damaged when combined compression and rotation occurs at the tibiofemoral joint, such as when cutting or pivoting.[24] However injury can occur during activities of daily living, such as when squatting.[25] Degenerative meniscal tears in the elderly population are common and according to Englund et al,[26] occur in as many as 32% of males between the ages of 50 to 90 and in 56% of males between 70 to 90.

Patients with the varying types of acute ligament sprains may present similarly. The *Journal of Orthopedic Sport & Physical Therapy* (JOSPT) published clinical practice guidelines[27,28] on knee sprains and meniscal tears.

The journal reported typical signs and symptoms associated with ACL sprains are hearing a "pop" at the time of injury, hemarthrosis in the knee 0 to 2 hours after injury, reports of instability or giving way, loss of end range extension, and positive Lachman's and Lateral Pivot Shift tests. In regards to MCL sprains, typical symptoms are palpable tenderness along the MCL fibers as well as pain and increased laxity with valgus stress in 30 degrees of knee flexion. Patients presenting with acute PCL tears reported abrasions on the anterior tibia, posterior knee pain during kneeling, and a positive posterior drawer test.

Meniscal tears can present similarly to acute ligament sprains. The JOSPT clinical practice guidelines[28] on meniscal tears reported signs and symptoms of injury are a tearing sensation, delayed effusion (6-24 hours post-injury), a history of "catching" or "locking," pain with forced hyperextension and with maximum flexion, pain or click with McMurray's test, joint line tenderness, and discomfort or catching in the knee at the joint line during the Thessaly test.

There is no clear consensus on whether physical therapy or surgical management is better for acute knee injuries in the population over 50 years old. Lim et al[29] and Krych et al[30] found conservative treatment to be effective for individuals over the age of 50 with meniscus damage, demonstrating equal long term functional gains when compared to surgical repair. In regards to ACL sprains, Ahn et al[31] and Figueroa et al[32] found both conservative and surgical intervention can be effective in individuals over 50. However literature comparing surgical to conservative treatment for ACL ruptures is limited within this population.

Potential problems with the research regarding conservative treatment of knee injuries in older adults is that physical therapy intervention is either standardized across all groups or protocols are not clearly presented in the studies. For example, results from Lim et al[29] supported conservative treatment for degenerative meniscal tears; in the study, all patients performed the same set of exercises twice a week for 8 weeks. The physical therapy protocol described was passive and active stretching, general lower extremity strengthening, and aerobic conditioning on a cycle ergometer.

Similarly, the exact type of physical therapy intervention was unclear in studies that showed more favorable outcomes for surgical intervention. Ahn et al[31] reported that a conservative treatment group received pain medication, physical therapy, and strengthening exercises in comparison to a meniscal repair group, but no detail was offered about the exact physical therapy interventions or about the post-surgical activity protocols.

One challenge with research translating into clinical practice is the need for consistency, objectivity, and reliability in order to produce a quality study. The actual type of interventions performed in conservative care more than likely expand beyond general exercise and protocols and are specific to patient needs. Although not the highest level of evidence, case studies allow for a presentation of an episode of care that is tailored to one patient's needs. Needs that may involve additional comorbidities that can overall effect physical therapy intervention.

Purpose

Most research regarding conservative care for knee injuries in a geriatric population is either unclear on the type of intervention performed or a standardized therapy program is used for research design purposes. While this is appropriate for research, physical therapy treatments performed in a clinical setting can be individualized to match body structure and function limitations, activity limitations, and participation restrictions found during an examination. Therefore, the main purpose of this study is to describe a conservative treatment program for an acute knee injury in a 57 year old male that is centered on specific patient needs identified through the ICF model. A secondary purpose is to evaluate the effectiveness of the physical therapy interventions on an individual with an acute knee injury and a secondary diagnosis of tri-compartmental knee OA.

CHAPTER II

CASE DESCRIPTION

This case follows a 57-year-old male receiving physical therapy treatment for a right knee sprain. He lost his footing while walking down a graded embankment, forcing his right knee into hyper-flexion. Immediately following the injury he had pain, inability to bear weight, and significant swelling. X-rays ruled out any fracture, but did show tri-compartmental arthritis. The primary care physician diagnosed an acute knee sprain and referred the patient to physical therapy for conservative treatment.

The patient worked for the city water department and his daily duties included bending, lifting, carrying, and walking on even surfaces. Prior to his fall, he had mild stiffness and discomfort in both knees, but not to the extent experienced after the injury. He lives with his spouse in a single story home and does not participate in physical activity outside of work. His main goals for physical therapy were to decrease pain and return to his prior level of function with work duties before the injury.

One week after the injury the patient began physical therapy. The only medical history was a meniscectomy of the right knee 30 years ago. Per observation, he was slightly overweight. He walked with a limp and wasn't using an assistive device. Increased pain and instability was noted with weight bearing

activities including: carrying objects, walking, squatting, getting in and out of a car, and walking on uneven surfaces. Pain was relieved by rest, ice, and 800mg of Ibuprofen.

As this individual was referred to physical therapy without any severe system pathologies and the physical therapist's investigation confirmed their absence, a thorough physical examination of the knee was performed. The examination was directed towards ruling out severe ligamentous injury, identifying musculoskeletal impairments, and observing movement patterns.

CHAPTER III

EXAMINATION

History and observation revealed right knee pain rated 5/10 on VAS and moderate effusion in the right knee. The patient's gait was abnormal demonstrating shorter step length on the left and decreased stance phase on the right, consistent with a right sided antalgic pattern. No formal measure of effusion was taken and no other gait assessment was performed.

Knee range of motion was measured by goniometry and differences were compared to the unaffected side (see Table 1). Goniometry has been shown as a reliable tool for measuring joint motion.[33-35] Extension was measured with patient supine and flexion in prone. Active range of motion of the right knee revealed decreased extension by 11 degrees and flexion by 10 degrees. No passive range of motion was performed.

Table 1. Initial Active Range of Motion (in degrees)

	Right	Left
Extension	172	183
Flexion in Prone	88	98

Manual muscle testing was graded on a 0 to 5 scale and in standardized positions as described by Ost.[36] The intra-rater reliability of manual muscle

testing is fair, with less inter-rater reliablity.[37,38] Testing revealed weakness with right sided knee extension, knee flexion, hip abduction, hip external rotation, and hip internal rotation (see Table 2). Strength testing also revealed weakness with left sided hip abduction. Diffuse right knee pain was elicited with knee extension, hip flexion, hip external rotation, and hip internal rotation strength testing. Popping was noted with knee extension.

Table 2. Initial Strength (MMT grades 0-5)

	Right	Left
Knee Extension	4	5
Knee Flexion	5	5
Hip Flexion	4	5
Hip Abduction	4	4
Hip IR	4	5
Hip ER	4	5

Orthopedic special tests were performed in order to examine joint integrity and attempt to identify damaged structures. Special tests performed with the patient in supine included knee varus stress test, knee valgus stress test, Lachman's test, Thessaly's test, and McMurray's test. All ligament stress tests showed no increased laxity or pain when compared bilaterally.

The Thessaly's test was performed with the patient standing on one limb grasping the therapist's forearms for support and was tested in 5 and 20 degrees of knee flexion. There was a reproduction of the patient's pain symptoms but no

other clicking or popping was reported in both angles of knee flexion. Based upon the pain reproduction, at the time of evaluation a positive test was recorded. McMurray's test showed no pain reproduction or clicking when performed bilaterally.

There is variability in the diagnostic accuracy of the tests performed and details of each tests accuracy can be found in Table 3. The Lachman's test appears to be the most valid special test of the knee and a strong predictor of ACL rupture. Recent literature demonstrates relatively poor accuracy in detecting meniscus involvement with special tests. Goossens et al[43] further showed that sensitivity and specificity values did not significantly improve with the combination of the McMurray's and Thessaly's test.

Activity limitations and participation restrictions were assessed by balance testing, squat performance, and completion of a self-reported functional assessment. Single limb stance is a common test performed to assess general balance in the lower extremity and although there is little research evaluating its reliability, Springer et al[47] predicted norm values based upon age. The age predicted norm for a male in the 50-59 age range is 41.5 seconds.

Single limb stance was performed by instructing the patient to place his hands on his hips and raise one leg off the ground. He was unable to maintain balance on either side for greater than 5 seconds. He also demonstrated poor lower extremity control with increased femoral internal rotation and lateral trunk flexion bilaterally.

Upon performing a squat, the patient was unable to reach 90 degrees of knee flexion, had increased trunk flexion, and had increased knee valgus bilaterally. Audible knee joint popping and crepitus was heard by the therapist during the patient's movement. The patient also reported increased pain bilaterally in both knees during the descent and ascent phases of the squat.

The LEFS has been shown to be a reliable measure with reliability reported to be as high as 94%.[48,49] The patient's LEFS score at initial evaluation was 28/80 indicating severe lower extremity functional impairment.

Palpation was performed with the patient seated on a treatment table and both knees relaxed in about 90 degrees of flexion. There was tenderness along the medial tibial plateau, lateral tibial plateau, superior pole of the patella, inferior pole of the patella, and the posterior aspect of the knee.

In summary, examination results indicated right sided knee pain, swelling, decreased range of motion in the right knee, and decreased knee and hip strength bilaterally with the right more affected than the left. Activity limitations included antalgic gait pattern, poor balance bilaterally, pain with squatting, and overall severe functional impairment as indicated by the LEFS. Participation restrictions were focused towards work as he reported an inability to complete all tasks involving walking, bending, carrying, and lifting objects from the ground. He also reported significant pain throughout the work day.

Table 3. Special Tests Diagnostic Accuracy

	Sensitivity	Specificity	Positive LR	Negative LR
Valgus Test				
Kastelein et al[39]	.91*	.49	1.8	.2
	.78**	.67	2.3	.3
Harilainen[40]	86%	-	-	-
Lachman's Test				
Benjaminse et al[41]	85%	94%	10.2	.2
Mulligan et al[42]	70%***	97%	20.17	.32
Thessaly Test				
Goosens et al[43]	64%	53%	1.37	.68
Snoeker et al[44]	51-66%	38-43%	.91-1.07	.88-1.12
Blyth et al[45]	.66	.39	1.08	.87
McMurray's Test				
Goosens et al[43]	70%	45%	1.27	.67
Meserve et al[46]	.55	.77	-	-
Blyth et al[45]	.58	.56	1.33	.74

* - When identifying laxity
** - When identifying pain
*** - Performed in a prone position

CHAPTER IV

EVALUATION, DIAGNOSIS, AND PROGNOSIS

Physical examination results showed signs and symptoms consistent with meniscal damage and knee OA. However there wasn't a clear indication of which tissue was the main contributor in this patient's injury as symptoms could have been related to either pathology or a combination of the two.

Although moderate effusion in the right knee was noted during examination, the timing and amount of swelling immediately following the injury was unclear. The patient's subjective report was vague indicating that swelling did occur shortly after the fall, however the exact time frame and extent was unable to be recalled. The timing of effusion onset can help to dictate meniscal or ligament damage, with delayed swelling (6-10 hours post-injury) being more specific to meniscal tears and immediate effusion being more specific to ligament tears.[27,28]

It is unlikely that severe ligament damage occurred with this injury. The absence of pain and laxity with a valgus stress test and no palpable tenderness along the MCL fibers helped to rule out its involvement. The patient did demonstrate some extension loss on the affected side, consistent with ACL sprains, however the absence of laxity and the presence of a firm end feel with Lachman's test helped to rule out ACL involvement.

Loss of active range of motion was found bilaterally, with more limitation in the right knee. The presence of swelling could have been the main limiting factor regarding range of motion however decreased range bilaterally could have been caused by OA. Knee flexion limitation also could have been because of tight musculature, such as rectus femoris. End feels could have more clearly indicated what tissue or structure was limiting range, however they were not performed.

Special tests were exclusively negative, except for Thessaly's test on the right. As previously noted in Table 4 the diagnostic accuracy of the Thessaly test low. It is also possible that the pain felt during the test was due to patellofemoral compression in an arthritic joint.

The patient's injury was the result of a fall at work. Results of a single leg balance test revealed an inability to maintain balance for 5 seconds on both legs and poor control from the trunk down to the ankle. These findings are consistent with strength deficits found in the hip and knee musculature, specifically hip abductor weakness bilaterally.

Palpation revealed diffuse knee tenderness especially at the tibial plateaus. Tenderness in both tibial plateaus are consistent with meniscal damage and symptomatic OA. In addition to palpable tenderness, the presence of edema indicated an inflammatory response was present, which could have increased the sensitivity in the area.

Diagnosis

As examination results didn't support specific tissue involvement the physical therapy diagnosis for this individual was impaired muscle performance,

range of motion, mobility, and balance. The interaction between the acute knee injury and OA could have been the main reason for impairments. Symptomatic OA prior to injury could have decreased muscle performance, range of motion, and balance, putting this individual at an increased risk for falls. Addressing all limitations were implemented in an attempt to prevent the reoccurrence of a fall. Accepting this patient for care was based upon the presence of musculoskeletal impairments that were affecting activity and participation as well as the absence of severe pathology.

Goals for therapy were centered on patient symptoms, physical examination results, and his desire to return to his prior level of function with work duties. Improvements were anticipated in all major areas including pain, strength, range of motion, balance, and functional movements. Since the patient presented with signs of knee OA bilaterally, it was anticipated that pain would decrease to a level similar to pain felt on the unaffected side. This was due to the presence of OA and the patient's report of knee pain and irritation prior to the injury.

Prognosis

Based upon the patient's presentation the prognosis for achieving stated goals was good. It was very likely that physical therapy interventions would address limitations, activity limitations, and participation restrictions and improve most, if not all, to some extent. The extent of improvement was limited to the patient's prior level of function, as the OA seemed severe enough to affect the

patient pre-injury. Therapy was scheduled for 2 treatment sessions per week for 4 consecutive weeks, anticipating 8 total visits at discharge.

CHAPTER VI

INTERVENTION

The patient was seen for a total of 7 therapy visits in 4 weeks. He was unable to attend one session due to work responsibilities. Therapy was performed in a standard gym, using primarily body weight resistance or resistance band resistance for strengthening exercises. Interventions were focused on muscle strengthening, balance, manual therapy, and functional training. All types of exercise were centered on impairments found within the examination.

The primary aim of resistive exercises was to increase the strength of the knee and hip musculature. As noted in the examination the primary impairments of muscle strength included knee extension and all motions of the hip. A full list of exercises implemented to target these impairments can be found in Appendix 1. Progression was based upon patient's subjective reports and therapist observation during the activity. Increases in repetitions were introduced first followed by increases in resistance via resistance band. Initial resistance band resistance for exercises was purple.

To improve balance, exercises were performed with a single leg stance while on a Dyna-disc®. Initially the patient was instructed to perform the exercise with eyes open and using external hand support as needed for 2 sets of 60

seconds on each leg. This was followed by performance of the exercise with eyes closed and using hand support as needed for 2 sets of 60 seconds on each leg. The patient was instructed to perform the exercise with a slight knee bend and reminded to keep the knee over the toes during the exercise.

Manual therapy was performed initially to decrease the patient's pain and later to improve knee range of motion. Initially grades 1-2 mobilizations were performed to the knee joint in the posterior direction as well as a traction force. The patient was in a seated position oscillations were performed for 30 seconds for 3-4 repetitions in both directions. Each repetition was followed by end range passive stretching into both flexion and extension with 20-30 second holds at end range. Once pain had decreased, grade 3-4 mobilizations were performed in the posterior direction and a grade 3 traction force was also performed. All mobilizations were performed with similar times and repetitions and were followed by end range stretching as previously described.

To prepare the patient to return to his previous level of work duties, functional training emphasized movements similar to those of work requirements. Education was provided to ensure proper lifting technique and exercises involved lifting from a downslope or upslope, carrying from a downslope or upslope, and setting down objects while on a downslope or upslope. The patient also carried and lifted objects while on a side slope. All was done on a grassy hill to try and recreate the patients work environment and main responsibilities.

CHAPTER VII

OUTCOMES

Treatment resulted in improvement in several limited areas previously described during examination. Outcomes were measured through range of motion testing, strength testing, and a self-reported functional assessment. The patient subjectively reported excellent satisfaction with therapy as noted with a clinic specific satisfaction survey. Range of motion and strength measurements were performed at the beginning of the patient's 7th and final session of therapy.

As previously noted the patient displayed decreased knee range of motion on the right side compared to the left at examination. - After intervention the patient had improvement in both flexion and extension to nearly equal the uninvolved knee. Flexion improved by a total of degrees 8 while extension improved by 6 degrees (see Table 4).

All strength measurements were performed through manual muscle testing in a seated position except for hip abduction, which was measured in side lying. The patient showed increases in all weak areas noted during examination including knee extension, hip flexion, hip external rotation, hip internal rotation, and hip abduction. Although most measurements were equal to the uninvolved extremity hip flexion and hip external rotation were weaker on the injured side (see Table5.

At the end of the patients last session the LEFS was filled out to measure functional mobility. The patient recorded a score of 42/80, an improvement of 14 points from baseline. The minimal score to detect change in the LEFS has been reported as plus 9 from the initial score.[48,49] Although the patient had a significant improvement the final score still showed moderate impairment.

Table 4. Discharge Range of Motion (in degrees)

	Right	Left
Extension	179	183
Flexion in Prone	96	98

Table 5. Discharge Strength (MMT grades 0-5)

	Right	Left
Knee Extension	5	5
Knee Flexion	5	5
Hip Flexion	4+	5
Hip Abduction	5	5
Hip IR	5	5
Hip ER	4+	5

CHAPTER VIII

DISCUSSION

The purpose of this case study was to evaluate the effectiveness of an impairment based physical therapy program in a 57-year-old male with an acute knee injury and symptomatic OA. This patient demonstrated minor improvements in strength and range of motion at the end of treatment. Despite minor objective improvements, the patient's overall function was significantly improved as noted with the LEFS and satisfaction reports.

The patient presented with several signs and symptoms consistent with meniscal damage and knee OA. It is possible that the patient had some meniscal damage as a result of his injury, however due to the diagnostic accuracy of meniscal special tests as well as joint line tenderness being indicative of OA, it's very difficult to say if there actually was new damage. Thigh muscle weakness, poor balance, instability, joint line tenderness, audible crepitus, and reports of pain prior to the injury all support the presence of knee OA as found via imaging.[22,23]

Lower extremity strengthening targeting the quadriceps has been shown beneficial in individuals with knee OA.[28] This patient showed improvement in quadriceps strength as measured by knee extension manual muscle testing at the end of treatment. In addition to quadriceps strength, hip strength may play a role in pain and function improvement in knee OA.[28-29] A large portion of

treatment emphasized hip abduction strength in hopes to improve knee stability and overall balance. This patient showed improvements in hip abduction strength bilaterally similar to gains reported in the literature.

Strength increased only slightly. One possible reason for this is the amount of time needed for muscle adaptation in response to resistance training. For muscle hypertrophy to occur it has been reported that a minimum of 16 sessions of progressive resistance exercises is needed.[50] Strength gains seen in this client was more than likely due to improved motor performance of the targeted muscles.

Another possible explanation for limited strength gains is that the magnitude of deficits at examination was quite small. The patient had at least good strength in all muscles of the hip and knee initially. Therefore, the improvement seen would be relatively small to achieve normal strength. The patient's initial strength could also have been affected by pain causing muscle inhibition, thereby undershooting the actual strength at examination.

All muscle groups with impairments at examination had some amount of improvement at the end of intervention. Two muscle groups that demonstrated limitation at the end of treatment were hip flexion and hip external rotation. This could be due to manual muscle testing accuracy but also a lack of addressing those weaknesses through strengthening exercises.

Range of motion improved to be equal to the uninvolved side, but again the improvements made were small. Similar to strength gains this could be due to small deficits noted in the examination. The interventions that targeted range

of motion limitations were passive stretching and joint mobilizations performed by the therapist and through exercise, such as the wall squat and terminal knee extension exercises. Although there is some literature suggesting manual therapy can improve pain and function in knee OA,[31,32] it is less clear if range of motion can be increased as a result of mobilizations. It's possible that improvements in range could have been the result of reduction in swelling and acute irritability.

Although there was in increase in range, the overall amount of knee flexion present was still limited when measured in a prone position. In addition to quadriceps tightness there could have been a motion loss due to OA. No imaging was performed on the uninvolved extremity, but the patient reported similar subjective pain before the injury in both knees and at the end of treatment, suggesting possible symptomatic knee OA bilaterally.

Balance improved as a result of intervention. Although there was no formal reassessment the patient was able to maintain balance with eyes closed while on a stable surface and with eyes open on a Dyna-disc® (with hand support as needed). He was able to maintain balance for greater than 5 seconds, but did need to put his feet down several times throughout minute long holds. This was a significant improvement from his baseline. Improvements are consistent with findings by Mat et al,[30] demonstrating that in individuals with knee OA balance training is effective and can result in a reduction in fall risk. As this individual presented to therapy as a result of a fall and he demonstrated single

leg balance below age predicted norms, it was important to address these areas through interventions.

Perhaps the largest improvement was seen in the patient's function as measured through the LEFS. The change between pre and post treatment was 14 points. However, the end score of 42 is still within the moderately impaired range for function. Look at the scale now and see where he was at the end of treatment and areas that still were impaired. Such improvements in function are similar to outcomes reported in patients with knee OA receiving physical therapy.[24,25,28,29,31,32]

One potential problem with research performed evaluating conservative and surgical care is the standardization of rehab protocols.[17-19] This case study represents a conservative treatment that is patient specific rather than a general protocol often used in randomized control trials. As a result of treatment, this patient had improvements in multiple impairments and function. Because every patient seen in physical therapy is examined by a physical therapist, it is likely that many rehab programs follow a similar procedure. Case studies that reflect this type of physical therapy should also be considered when evaluating the effectiveness of conservative care.

The exact structures affected in this patient as a result of his injury was unclear. He did however, present with knee OA as identified through radiographs and several signs and symptoms consistent with knee OA. Despite being unable to identify any other structures that were compromised, this case study showed

that an impairment based therapy program can be effective for an individual over 50 with a co-existing knee injury.

Limitations

One limitation of this case was the accuracy of examination findings and the extent of improvement at the end of treatment. The patient demonstrated minor strength and range of motion limitations when compared to the unaffected side at initial examination. Therefore, measuring response to treatment can be challenging as changes were likely to be small. The inclusion of more functional measures of strength testing at initial and final assessment could have given a better assessment of strength capacity in certain muscle groups rather than traditional manual muscle testing. More research is needed on the effect of impairment based treatment in individuals with greater deficits at initial examination when comparing affected to unaffected limbs. A patient with more severe impairments may have a greater response to physical therapy treatment.

Another limitation was a lack of reassessment throughout treatment and at the end of treatment. For example, a formal balance reassessment wasn't performed at the end of the treatment. In addition, therapy only lasted 7 sessions that spanned across a 4-week period. Although the patient had improvements, a longer therapy program could have better represented the benefits or limitations of conservative care.

Reflective Practice

As a result of reflecting on the care given with this patient there are several areas that could have been improved. Most of the suggestions I would

give to myself are related to the examination and reassessment of the patient. A few things I would reconsider in these areas are the use of passive range of motion during assessment, the use of more objective strength measures, the use of more standardized tests specific to this population, the use of a written functional assessment specific to knee OA, and better education surrounding anticipated results of therapy.

Passive range of motion findings can help to identify structures that may be damaged through the use of end feels. According to Cyriax[51] abnormal end feels are commonly associated with pain or restricted movement and occur earlier than expected during the movement. Examples of abnormal end feels are muscle spasm, capsular, bone on bone, empty, and springy block. Muscle spasm can occur early or late during ROM and both are the result of the body attempting to protect an injured joint or structure. Capsular end feels can be either hard or soft and are related to capsule tightness limiting range. Bone to bone end feels are often associated with osteophyte formation and empty end feels are limitations due to pain without mechanical restriction. Springy block end feel is similar to a tissue stretch but are found in joints with menisci. A rebound effect can also be felt is usually due to internal derangement of the knee.

Assessment of passive range of motion as well as end feels would have helped to identify what structures may have been limiting knee flexion and extension range within this patient. It also would have been beneficial to identify what was limiting flexion range on the unaffected side. The results of passive range assessment may not have given any additional information or changed

treatment but it could have helped to piece together what structure was affected and given another objective measure to assess throughout treatment.

Because there were such small differences from side to side in muscle strength of the hip and knee, more functional testing could have given a better representation of strength. Therapists often perform repetitions to fatigue as a measure of strength. For example, in this patient hip abductor strength could have been assessed with repeated side lying hip abduction to fatigue on both sides. Other examples are repeated single leg bridges and calf raises. Results can be recorded and then compared to reassessment at the end of treatment.

There are a variety of functional tests often performed in the older population. These offer objective measures of not only strength but balance, coordination, and endurance. One test that could have been beneficial to this patient was the Mini-BESTest. The Mini-BESTest is an overall measure of dynamic and static balance, and coordination. It can be used as a tool for identifying individuals at risk for falls. This would have been helpful to perform for this patient as his injury happened because of a fall. Falls have also have been linked to knee OA.[23] Literature often reports aerobic activity as an important part of an OA intervention[25] so it could have been beneficial to do a 6 minute walk test or 2 minute step test as well. This would have offered myself a chance to educate about the importance of aerobic exercise in the long term maintenance of knee OA.

The LEFS is an appropriate written functional test,[48,49] however there are several specific to knee OA. One measure I found as a result of research is the

WOMAC. This assessment is performed in most of the research surrounding interventions with knee OA. The WOMAC is inclusive of pain and stiffness instead of solely measuring the performance of functional tasks. Even though the LEFS has been shown to be reliable for a geriatric population[49] there are several questions that aren't specific to many over 50. For example, some questions on the LEFS are related to running, jumping, and cutting. All activities that this patient was not capable of doing and when scoring those items low has the potential to misrepresent the actual functional limitations of the patient.

I believe the inclusion of these tests and measures would have given me a better representation of the patient's capacity at initial examination and more insight into his prognosis. It seemed that knee OA was going to be the long term pathology affecting this individual's function. It has been shown that pain benefits from therapy in individuals with knee OA are lost after 6 months, most likely due to the cessation of formal exercise.[25] Inclusion of a better education program about the long term maintenance of strength, aerobic, and balance exercises would have been beneficial for this patient to ensure long lasting benefits.

Conclusion

This case study showed that physical therapy focused on body structure and function limitations, activity limitations, and participation restrictions can be effective in older individuals with an acute knee injury and concomitant knee OA. Future case studies could include more objective measures performed throughout the course of care to evaluate impairment based therapy effectiveness within this population.

APPENDIX

Resistance Exercises

Partial Squats with a Ball	Patient performed a mini squat against the wall with the trunk supported by an exercise ball. Instruction was given to go to the point of discomfort and return to standing.	3 X 10
Resistance band Hip Circuit	A purple resistance band was placed around the patients ankles. Instruction was given to keep tension in the band while stepping sideways, forwards, and backwards. -Sidestepping Knees Bent -Sidestepping Knees Straight -Wide Forward/Backward Stepping -Standing Star Variation	2 X 30 ft (30ft each direction)
Side Lying Hip Variations	Patient was instructed to begin in side lying and perform each variation one following another. -Straight Plane Hip Abduction -Clam -Floating Hip IR – hip held in slight abduction and repeated IR of the hip was performed -Floating Hip Flexion – hip held in slight abduction and repeated marching was performed	1 X 10 for each leg

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