PHYSICAL THERAPY CASE REPORT ON A PATIENT WHO SUSTAINED A LATERAL TIBIAL PLATEAU FRACTURE

A Doctoral Project
A Comprehensive Case Analysis

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DOCTOR OF PHYSICAL THERAPY

by

Gabriel M. Bonifacio

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Abstract

of

PHYSICAL THERAPY CASE REPORT ON A PATIENT WHO SUSTAINED A LATERAL TIBIAL PLATEAU FRACTURE

by

Gabriel M. Bonifacio

A retired 65-year-old female patient who sustained a left lateral tibial plateau fracture was seen for physical therapy treatment for 14 sessions for outpatient physical therapy. Under the supervision of a licensed physical therapist, treatment was provided by a student physical therapist.

The patient arrived at the clinic with a front-wheel walker and presented with decreased stride length of the right lower extremity, decreased knee flexion of the left lower extremity, and decreased confidence with balance. The Five Times Sit-to-Stand, Berg Balance Scale, Dynamic Gait Index, Knee Injury and Osteoarthritis Outcome Score, and Lower Extremity Functional Scale were used to evaluate the patient and form a plan of care. Problems identified included decreased strength, decreased active range of motion, increased pain, gait deviations, impaired stair climbing ability, and decreased recreational/athletic ability. The goals set for the patient included increasing left lower extremity strength in knee flexion, knee extension, hip abduction, and hip external

rotation to a 5/5 manual muscle testing grade. The goal for the patient's range of motion was 120º for knee flexion and 0º for knee extension. The goal regarding pain was for the patient to decrease pain levels to 0/10. The goal for the patient's gait was to have an even stride length bilaterally. Lastly, the goal for the patient by the end of treatment was to improve stair climbing ability and return to recreational and athletic activity. The patient's treatment consisted of land-based and aquatic strengthening, range of motion, balance, functional mobility, aerobic, and plyometric exercises. The patient was discharged to live independently at home and had met or exceeded all goals.

_____, Committee Chair
Edward Barakatt, PT, PhD

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Chapter 1

General Background

Each year, 10.3 per 100,000 people suffer from a tibial plateau fracture worldwide.[1] Overall, tibial plateau fracture makes up 1% of all fractures annually[1]. Tibial plateau fractures are more common in men compared to women.[1] Men under the age of 50 are more likely to sustain an injury through a high energy mechanism such as trauma, and women over the age of 70 tend to sustain tibial plateau fractures because of a fall.[1] The mean age of those who sustain tibial plateau fractures is 52.6 years.[1] Lateral tibial plateau fractures are more common than medial tibial plateau fractures, as the medial tibial plateau bears 60% of the knee's weight and is a thicker and stronger structure.[1] The most common cause of a lateral tibial plateau fracture is a blow to the knee.[1]

Pathoanatomically, tibial plateau fractures occur due to axial loading and either a varus or valgus force.[2] Tibial plateau fractures with no associated damage to adjacent structures such as nerves, vasculature, ligaments, and menisci are typically treated non-invasively and conservatively.[1] More involved fractures are treated with surgical procedures such as circular frames, percutaneous screw fixation, open reduction/internal fixation, and arthroplasty.[2]

The extent of the injury is classified based on the Schatzker Classification system: Schatzker I: lateral split fracture, Schatzker II: lateral split-depressed fracture, Schatzker III: lateral pure depression fracture, Schatzker IV: medial condyle fracture, Schatzker V: bicondylar plateau fracture, and Schatzker VI: metaphyseal-diaphyseal dissociation.[1] Classifications I, II, and III are pure tibial plateau fractures caused by low-energy

mechanisms.[3] In contrast, classifications IV, V, and VI are fracture-dislocations of the knee which typically include extensive tissue damage and are more severe.[3] Prognostically, fractures identified as lower Schatzker levels will respond well to conservative treatment with early mobilization and suspension of weight-bearing, and will heal faster and more completely with decreased need for surgical intervention.[3]

Prognostic factors leading to an individual experiencing a positive outcome or shorter healing time include being under 21 years old, being a non-smoker, receiving an earlier surgery (if indicated), being athletic, and receiving hospital treatment within 12 hours.[4] Prognostic factors leading to an individual experiencing a negative outcome or longer healing time include being a smoker, receiving a later surgery (if applicable), being non-athletic, and receiving delayed hospital treatment.[4] Patients with valgus malalignment of 5º or greater and articular depression more than 2 mm are more likely to develop osteroarthritis.[5]

Chapter 2

Case Background Data

Examination – History

The patient was a 65-year-old female who sustained a left lateral tibial plateau fracture two months prior to her initial evaluation when her dog ran into her knee. The next day, the patient's knee was wrapped by a physician at urgent care, but no brace was provided, and the patient was instructed to be non-weight bearing on her left lower extremity. One week later, the patient had a CT scan which confirmed a left comminuted lateral tibial plateau fracture. After the CT scan, the patient started wearing a hinge brace until 1 week before the first session. The patient was initially wheelchair bound and was then cleared for partial weight bearing and transitioned to ambulation with a walker. The patient then transitioned to a single point cane and was cleared to be full weight bearing 1 week before the first therapy session. However, the patient reported to the first physical therapy session ambulating with a walker because she did not feel confident ambulating without it. The patient started physical therapy 2 months after the injury. The patient opted not to disclose surgical history when filling out intake form.

The patient's chief complaints were left knee pain, stiffness, and swelling. Pain was located at the knee joint, was intermittent, and minimally severe and irritable. Aggravating factors included movement such as walking, standing up, and climbing stairs. Easing factors included icing and rest. The patient felt stiff at the knee joint and swelling was evident in the patient's lower leg. However, the patient reported progressive improvement since the initial injury. The patient had been assigned quad sets and ankle

pumps by her physician but had not participated in any physical therapy. Further conservative symptom management which included icing, elevation, and compression. In her premorbid condition, the patient had enjoyed running, hiking, walking recreationally, and occasionally playing golf. The patient never smoked or drank alcohol and described herself as athletic. The patient's goals included returning to walking, climbing stairs, jogging, and hiking without pain or stiffness. Furthermore, the patient wanted to feel more confident with balance.

Systems Review

The patient's cardiopulmonary system was impaired with a blood pressure of 140/104, which was hypertensive. She had been prescribed Diovan and Maxzide to control her blood pressure but had not taken her medication recently. The patient's urogenital and gastrointestinal systems were unimpaired according to patient self-report. The integumentary system was unimpaired according to patient self-report and observation. The patient's musculoskeletal system was impaired because of decreased active range of motion and strength as objectively measured by goniometry and manual muscle testing (MMT), respectively. Furthermore, the patient had decreased stride length, use of front-wheel walker for ambulation and balance, and difficulty with step climbing. The patient's neuromuscular system was unimpaired according to patient self-report and intact sensation. The patient's communication, affect, cognition, and learning were unimpaired. The patient's preferred language was English.

Examination - Medications

Table 1

Medications[6]

MEDICATION	DOSAGE	REASON	SIDE EFFECTS
Potassium Chloride	20 mEq	Increase potassium levels to treat/prevent hypokalemia	Nausea, vomiting, diarrhea, gas, stomach pain
Diovan	160 mg	Decreases high blood pressure	Headaches, dizziness, tiredness, flu-like symptoms, coughing, back pain, joint pain, diarrhea, stomach pain
Maxzide	37.5/25 mg	Decreases high blood pressure	Headaches, dizziness, tiredness, diarrhea, upset stomach. constipation
Aspirin	81 mg	Reduces inflammation	Upset stomach, heart burn, drowsiness, mild headache
Magnesium	250 mg	Maintains nerve and muscle function, immune system, and regulate glucose levels	Diarrhea, bloating, gas, upset stomach, nausea, vomiting, light headedness, fainting, warmth, tingling, erythema
Estradiol	0.05 mg	Treats menopause symptoms such as hot flashes and prevents osteoporosis	Nausea, vomiting, diarrhea, stomach cramps, mood changes, insomnia, cold symptoms (stuffy nose, sinus pain, sore throat), weight gain, headache, back pain, breast pain, thinning of scalp hair, vaginal itching/discharge
mEq = milliequivalent; mg = milligram			

Chapter 3

Examination – Tests and Measures

The categories of the International Classification of Functioning, Disability, and Health (ICF) Model were used to distinguish the patient's measurable deficits according to the body structure and function, activity, and participation levels.[7,8] Goniometry, MMT, the Numeric Pain Rating Scale (NPRS), and observation of gait were used to assess the patient's body structure and function impairments. The patient's activity limitations were assessed by using the Five Times Sit-to-Stand (FTSTS), Berg Balance Scale (BBS), Dynamic Gait Index (DGI), Lower Extremity Functional Scale (LEFS), and Knee Injury and Osteoarthritis Outcome Scale (KOOS). Patient self-report on golf participation was used to assess the patient's participation restrictions. The BBS was used as a prognostic measure to determine the patient's fall risk.[9] The Ottawa Knee Rules were used as a diagnostic clinical prediction rule to determine whether the patient required further imaging.[10]

Using a 6-point ordinal scale, MMT is used to assess muscular strength where a 5 indicates that a muscle's contraction is unbreakable by the test administrator and a 0 indicates that the muscle has no palpable contraction.[11] According to a literature review, the Minimal Detectable Change (MDC) is 1 grade.[12]

Goniometry was used to measure the patient's active range of motion in degrees.[13] The minimal detectable change with a 95% confidence level (MDC_{95}) of knee flexion is 5.8º and knee extension is 2.6º.[14]

The NPRS is a 0 to 10 self-reported rating scale used to measure the patient's pain where a 10 indicates the worst possible pain and a 0 indicates no pain.[15] The NPRS has an MCID of 1 point[16] and MDC_{95} of 2 points.[17]

Observation of over-ground gait in the sagittal and frontal planes was used to identify potential gait deviations.

The FTSTS was used to measure the patient's functional mobility and has excellent test-retest reliability with an intraclass correlation coefficient (ICC) 0.89.[18] Based on the ICC and standard deviation reported in the article, the MDC_{95} was calculated to be 5.7. The test requires that the patient stand up and sit down five times as fast as possible and is timed, where the longer a person takes, the more at fall risk the patient is considered.[18] The cutoff for whether a patient is at fall risk is >12 seconds in community dwelling elderly.[18]

The DGI assesses a patient's dynamic balance in the presence of external demands. The MDC_{95} has been reported to be 2.9 points and the MCID was reported to be 1.9 points in community dwelling adults.[19,20] The test consists of eight items scored from a scale of 0 to 3.[21] Items on the test include walking with head turns, walking and turning around, walking with changes in speed, stepping over and around obstacles, and climbing stairs.[21] A score of >22 indicates that the patient is a safe ambulator.[21]

The KOOS was used to assess the patient's quality of life and ability to perform activities of daily living and recreational activities.[22] The KOOs consists of five dimensions: pain, symptoms, activities of daily living (ADL), sport and recreation, and quality of life.[22] The pain section consists of pain frequency and extent of pain under

different scenarios.[22] The symptoms section includes questions asking about joint stiffness, swelling, and noises produced by the knee during movement.[22] The ADL section includes questions about the patient's ability to perform activities such as sitting, standing, walking, and lifting.[22] Each question is scored from a scale of 0 to 4 where a 4 indicates higher dysfunction.[22] For athletes, the MDC_{95} was reported to be 6.1, 8.5, 8.0, 5.8, and 7.2 for the pain, symptoms, activities of daily living (ADL), sport/recreational, and quality of life sections of the KOOS, respectively.[22]

The LEFS assesses the patient's ability to perform ADLs.[23] Each question on the LEFS is scored from 0 to 4 where 0 indicates that the patient has extreme difficulty or is unable to perform the activity and a 4 indicates no difficulty with the activity.[23] Questions include activities such as walking, sitting, standing, lifting, squatting, and running.[23] The MDC_{95} has been reported to be 9 points and MCID has been reported to be 9 points in patients with various lower extremity injuries.[23]

The Ottawa Knee Rules are a clinical prediction rule consisting of five yes-or-no questions used to determine if the patient requires imaging to determine if the patient has sustained a fracture.[10] According to the Ottawa Knee Rules, individuals with one or more of the criteria should be radiographed.[10] The following criteria are considered to determine if imaging would be required: age >55 years, isolated patellar tenderness without other bone tenderness, tenderness of the fibular head, inability to flex the knee to 90^{o}, and inability to weight bear immediately after injury.[10] Based off published specificity and sensitivity, the positive likelihood ratio (LR+) was calculated to be 1.92 indicating a negligible shift in the pre-test probability.[10]

The BBS is a prognostic test that can be used to predict fall risk in community dwelling elderly.[9] Based off the published sensitivity and specificity for non-specific populations, the negative likelihood ratio (LR-) was calculated to be 0.74, indicating a negligible shift in the pre-test probability given a negative test with a cut-off of a score of less than or equal to 54.[9] The pre-test probability of sustaining one fall is 42%. Given a negative test, the post-test probability that a patient will sustain a fall is 35%

Table 2

Examination Data

BODY FUNCTION OR STRUCTURE		
Measurement Category	*Test/Measure Used*	*Test/Measure Results*
Muscular strength	Manual muscle testing	• Knee Extension: 4/5 (L), 5/5 (R) • Knee Flexion: 3+/5 (L), 5/5 (R) • Hip Abduction: 4/5 (L), 4/5 (R) • Hip External Rotation: 3+/5 (L), 4/5 (R)
Active range of motion	Goniometry	• Knee Extension: -8^{o} (L), 0^{o} (R) • Knee Flexion: 0^{o}–97^{o} (L), 0^{o}–132^{o} (R)
Pain	Numeric pain rating scale	• At Worst: 3/10
Gait	Observation	• Decreased stride length on right LE • Decreased knee flexion on left LE during swing phase • Decreased stance time on left LE • Use of FWW for support
FUNCTIONAL ACTIVITY		
Measurement Category	*Test/Measure Used*	*Test/Measure Results*
Functional mobility	Five Times Sit-To-Stand	12:07 Above cut-off indicating further testing for fall risk
Static balance and functional mobility	Berg Balance Scale	55/56 Low fall risk
Dynamic balance and functional mobility	Dynamic Gait Index	23/24 Safe ambulator without FWW
Sport and recreation / ADL	Knee Injury and Osteoarthritis Outcome Score	Symptoms: 60.7 Pain: 55.6 ADL: 73.5 Sport/Recreation: 0 QoL: 50
Activities of daily living	Lower Extremity Functional Scale	37/80 Severity/Complexity Modifier: 40-<60% impaired
PARTICIPATION RESTRICTION		
Measurement Category	*Test/Measure Used*	*Test/Measure Results*
Recreational participation	Self-report on ability to participate in golf	Self-Report: Patient is unable to participate in golf matches
L = Left; R = Right, LE = Lower Extremity; FWW = Front-Wheel Walker; ADL = Activities of Daily Living; QoL= Quality of Life		

Chapter 4

Evaluation

Evaluation Summary

The patient presented with decreased muscular strength, active range of motion, and observable swelling of the left lower extremity. Furthermore, the patient presented with impaired gait mechanics (decreased stride length on the right side without FWW), an NPRS worst pain intensity rating of 3/10, and decreased life participation as evident in the inability to participate in golf matches. The patient appeared to be a safe ambulator and not at fall risk as evident by DGI and BBS scores without FWW, but also self-reported decreased confidence with balance.

Diagnostic Impression

The patient's presentation was consistent with the medical diagnosis of left lateral tibial plateau fracture which resulted in decreased lower extremity strength and active range of motion, knee pain of the involved side, and decreased stride length of the opposite lower extremity. The patient's impairments at the body structure and function level limited her ability to run or climb stairs. The patient was also restricted in golf participation, family outings such as hiking, and vacations. The patient's body structure and function impairments, activity limitations, and participation restrictions resulted in a decreased quality of life.

Prognostic Statement

The patient's positive prognostic factors included Schatzker I level injury, being a non-smoker, being athletic, absence of knee valgus malalignment of greater than 5º, and

absence of articular depression greater than 2 mm. The patient's negative prognostic factors included, age over 21 years old and delayed hospital treatment (treatment not within 12 hours). The patient was motivated and expected to be compliant with her home exercise program. Given these positive and negative prognostic factors, the patient was expected to return to normal activity no later than 3 months from her injury date[24] and return to sport no later than 7 months from her injury date.[25]

G-Codes

Current with modifier: Mobility (Walking and Moving Around) G8978-CK (40 to <60% impaired) – Assessed by LEFS

Goal with modifier: Mobility (Walking and Moving Around) G8979-CI (1 to <20% impaired) – To be Re-assessed by LEFS

Discharge Plan

The patient was to be discharged to continue to live independently at home with a home exercise program (HEP).

Chapter 5

Plan of Care-Goals and Interventions

Table 3

Evaluation and Plan of Care

PROBLEM	PLAN OF CARE		
	Short Term Goals (Anticipated Goals) (3 weeks)	Long Term Goals (Expected Outcomes) (9 weeks)	Planned Interventions Interventions are Direct or Procedural unless they are marked: (E) = Educational intervention
BODY FUNCTION OR STRUCTURE IMPAIRMENTS			
Muscular strength	Increase MMT scores: -Knee Extension: 4+/5 (L), 5/5 (R) -Knee Flexion: 4/5 (L), 5/5 (R) -Hip Abduction: 4+/5 (L), 4+/5 (R) -Hip External Rotation: 4/5 (L), 4+/5 (R)	Increase MMT scores: -Knee Extension: 5/5 (L), 5/5 (R) -Knee Flexion: 5/5 (L), 5/5 (R) -Hip Abduction: 5/5 (L), 5/5 (R) -Hip External Rotation: 5/5 (L), 5/5 (R)	Stationary Bicycle: 5 minutes at the beginning of every session addressed aerobic and muscular endurance (start week 4) Interventions that addressed knee extension weakness: • Progression: quad sets→ short arc quads → aquatic squats → short arc quads with weight → terminal knee extension → over ground squats → lunges • Quad sets: 3 x 10 isometric contractions for preliminary quadriceps strengthening (start week 1) • Short arc quads: 3 x 10 for end range knee extension and quad strengthening (start week 2) • Aquatic squats: 3 x 10 for partially unweighted quadriceps strengthening and functional training (start week 3) • Short arc quads with 3 lbs. weight: intensity progressed (start week 4) • Terminal knee extension: 3 x 10 to train quadriceps to be stimulated when knee is forced to buckle (start week 6) • Overground squats: 3 x 10 for quadriceps strengthening and

			functional training (start week 7) • Lunges: 3 x 10 for strengthening quadriceps and functional training (start week 9) Interventions that addressed knee flexion weakness: • Progression: hamstring sets and heel slides → aquatic knee flexion → aquatic squats → over ground squats → lunges • Hamstring sets: 3 x 10 isometric contractions for preliminary hamstring strengthening (start week 1) • Heel slides: 3 x 10 concentric contraction of hamstrings through available range of motion (start week 1) • Aquatic knee flexion: 3 x 10 partially unweighted hamstrings strengthening (start week 2) • Aquatic squats: 3 x 10 for partially unweighted hamstrings strengthening and functional training (start week 3) • Overground squats: 3 x 10 for hamstrings strengthening and functional training (start week 7) • Lunge: 3 x 10 for strengthening hamstrings and functional training (start week 9) Interventions that addressed hip abductor weakness: • Progression: Aquatic hip abduction and aquatic sidestepping → clamshells and sidelying straight leg raises → karaokes on grass

			• Aquatic hip abduction: 3 x 10 partially unweighted hip abductor strengthening (start week 1) • Aquatic sidestepping: 3 x 10 partially unweighted and low impact functional abduction strengthening (start week 1) • Clamshells: 3 x 10 for hip abductor strengthening; progressed with more difficult bands (red → yellow → green) as exercise became easier for patient (start week 3) • Sidelying straight leg raises: 3 x 10 for hip abductor strengthening (start week 3) • Karaokes on grass: higher functioning athletic/plyometric activation of hip abductors (start week 8) Interventions that addressed hip external rotator weakness: • Clamshells and squats with lateral approximation of knee • Clamshells: 3 x 10 for hip external rotator strengthening; progressed with more difficult bands (red → yellow → green) as exercise became easier for patient (start week 3) • Squats with lateral approximation of knee: 3 x 10 to encourage use of external rotators to prevent valgus during squat (start week 7)
Active range of motion	Increase active range of motion -Knee Extension: -4^{o} (L) -Knee Flexion: 0^{o}–105^{o} (L)	Increase active range of motion -Knee Extension: 0^{o} (L) -Knee Flexion: 0^{o}–120^{o} (L)	Interventions that addressed decreased knee extension range of motion: • Quad sets: 3 x 10 isometric contractions for end range knee extension (start week 1) • Hamstrings stretch: 3 x 30 seconds to decrease stiffness of knee extensor antagonist (start week 3) • Terminal knee extension 3 x 10 concentric contractions for

			end range knee extension (start week 6) Interventions that addressed decreased knee flexion range of motion: • Heel slides: 3 x 10 concentric contractions to end range knee flexion (start week 1) • Quadriceps stretch: 3 x 30 seconds to decrease stiffness flexor antagonist (start week 3) Interventions that addressed both decreased knee extension and flexion range of motion: • Bilateral knee flexion and extension rolling large gym ball in supine 3 x 10 (start week 1)
Knee pain	Decrease pain level -NPRS: 3/10	Decrease pain level -NPRS: 0/10	Modalities performed every session as requested • Pump massage: 10 minutes to reduce knee swelling • Cryotherapy and TENS: 10 minutes concurrently; instructed to ice at home 10 minutes as needed for pain relief
Impaired gait	-Increase step length on right LE -Walk without walker or cane	-Equal step length bilaterally -Increase knee flexion range of motion on left LE during swing	All interventions mentioned above addressed impaired gait (E) Patient instructed to set grip height of cane to the height of greater trochanter. Patient encouraged to walk without use of cane and not use uninvolved side to compensate. Patient instructed to take longer step on right side to even step length and step duration. As gains were made in knee flexion range of motion on the left LE, patient was instructed to bend the left knee more during the swing phase of gait.
ACTIVITY LIMITATIONS			
Sport and recreation / activities of daily living	Increase KOOS sport/recreation and ADL scores - ADL: 77	Increase KOOS sport/recreation and ADL scores -ADL: 82	All interventions that addressed the patient's body structure/function impairments addressed the inability to run, hike, and climb stairs.

	-Sport and recreation: 3 Increase LEFS score: -40/80	-Sport and recreation: 6 Increase LEFS score: -46/80	Interventions that addressed the inability to run: • Aquatic sidestepping: 3 times forward/backward for lower impact exercise (start week 1) • Aquatic walking: 3 times forward/backward for lower impact exercise (start week 1) • Aquatic marching: 3 times forward/backward for lower impact exercise (start week 1) • Aquatic buttocks kickers: 3 times forward/backward for lower impact exercise (start week 1) • Stationary bicycle: 5 minutes no-impact aerobic activity (start week 3) • Aquatic double leg hops: 3 x 10 decreased impact light plyometric exercise (start week 7) • A-skips: 2 times forward/back on lawn in front of clinic to simulate exaggerated running motion (start week 7) • Double leg hops: 2 x 10 light plyometric exercise • C-skips: 2 times forward/back on lawn in front of clinic to simulate exaggerated running motion (start week 8) • Karaoke: 2 times forward/back on lawn in front of clinic for light weight bearing aerobic activity (start week 8) Interventions that addressed the inability to hike: • All treatments intended to address the inability to run • Aquatic single leg stance: 3 x 30 seconds each side (start week 2) • Aquatic tandem Stance: 3 x 10 each side (start week 2) • Overground single Leg Stance: 3 x 30 seconds each side (start week 3)

			• Step-ups/step-downs: 3 x 10 (start week 4) • Sidestepping over imaginary Object: 3 times forward/back in hallway (start week 4) • Imaginary tightrope exercise: 3 times forward/back in hallway (start week 4) • BOSU ball balance: 3 x 30 seconds to simulate perturbations during activity (start week 4) • Balance board: 3 x 30 seconds to simulate perturbations during activity (start week 4) • Stair climbing: 10 times up and down 5 four steps; step-to pattern with rail → alternating steps with rail → alternating steps without rail (start week 5) All interventions intended to address the inability to run and inability to hike addressed the inability to climb stairs (E) Patient was initially taught to go upstairs with the non-involved side first and then the involved side following. The patient was also instructed to go down with the involved leg first and then with the non-involved leg. The patient was taught to use the railing until the railing was no longer needed for balance or confidence. The patient was taught not to go into valgus while climbing stairs, walking, sitting down, or squatting.
PARTICIPATION RESTRICTIONS			
Restricted in golf participation Restricted movement during family outings or vacations	Capable of playing Wii golf simulation Capable of going to the mall with family (self-report)	Capable of participating in golf matches (self-report) Capable of going to Lake Tahoe with family (self-report)	Interventions that addressed the patient's body structure/function impairments and activity restrictions was intended to improve the patient's ability to participate in golf and comfortably go on family outings and vacations
MMT = Manual Muscle Testing; LE = Lower Extremity; LEFS = Lower Extremity Functional Scale; L = Left; R = Right			

Plan of Care – Interventions

Overall Approach

The plan of care was an impairment-based approach which emphasized the principle of progressive overload of the FITT variables (Frequency, Intensity, Type, and Time). Interventions first involved strengthening of specific muscle groups, increasing the patient's active range of motion, and decreasing baseline pain levels. The FITT variables were progressed over the treatment periods as follows. Frequency of exercise was increased from 4 times a week to 6-7 times a week including HEP. Strengthening exercises were increased in intensity by adding resistance bands or weight (5-10% increase) once the patient was able to 2 more repetitions more on their final set of 3 sets for 2 sessions straight (2 for 2 rule).[26] The time component for balance exercises was manipulated; first held for less than 20 seconds, then progressed to 30 seconds. Most exercises were started with 1 or 2 sets when first introduced and then were progressed to 3 sets.

The plan of care also followed the SAID Principle (Specific Adaptations to Imposed Demands).[27] Once impairments were addressed, the type of treatment shifted towards an emphasis in task specific functional mobility such as stair climbing. Later treatments were more specific to the recreational and athletic goals of the patient such as jogging laps around the clinic building. The plan of care also followed the overload principle.

PICO question

For a patient with knee pain (P), is aquatic therapy or land-based exercise (I) more effective than treatment without exercise in (C) decreasing pain and improving the strength of a patient's involved lower extremity (O)?

Lund et al.[28] conducted a single-blind, randomized controlled trial with blinded assessment (experimental group $n_{aquatic} = 27$, experimental group $n_{land} = 25$, control group $n = 27$) (Sackett level of evidence: 1b) investigating different intervention protocols for patients with knee osteoarthritis which consisted of traditional land-based and aquatic exercises. The control group was not provided with any exercise program. All participants were instructed to continue with their regular exercise routine while participating in the study. Both protocols included the same exercises. Each protocol consisted of a 10-minute warm-up, 20 minutes of strengthening/endurance exercises, 10 minutes of balance and stabilization exercise, 5 minutes of lower extremity stretching, and a 5-minute cool down. Sessions lasted 50 minutes. Each participant partook in 16 sessions spanning 8 weeks.

The inclusion criterion was patients with primary osteoarthritis as a definite diagnosis by their general practitioners. The mean age was 68 years (age range 40 – 89 years) and all participants were women. The exclusion criteria for participants were the following: hydrophobia, incontinence, wounds, language or intellectual problems, a history of periarticular knee fracture, total knee replacement, inflammatory joint disease, heart or lung condition, other medical diseases with possible contraindication of exercise

and/or pool therapy, secondary knee osteoarthritis, and participation in other clinical or exercise trials.

Outcome measures used in the study were the KOOS, a visual analogue scale (VAS) to measure pain intensity, evaluation of standing balance using the Balance Master Pro, and isokinetic dynamometry of the hamstrings and quadriceps at 30º/sec, 60º/sec, and 90º/sec.

Results showed that only the land-based exercise program yielded significant improvements in pain compared to the control (non-exercise treatment) group after a three month follow up. There were no significant improvements in KOOS scores in the pain, symptoms, ADL, sport and recreation, and quality of life subscales in either group compared to the control group. There was a significant improvement in muscle strength in the land-based group and decrease in muscle strength in the aquatic group versus the control group at 8-week and 3-month follow-up. There were no significant improvements in standing balance compared to the control group. Increased pain was reported in 44% of the patients in the land-based treatment group versus 32% of patients in the aquatic exercise group. Three of the patients in the land-based group who experienced pain claimed they had swollen knees and stopped exercising during the session. Three patients in the aquatic exercise group who experienced increased pain continued exercising. No patients in the aquatic exercise group dropped out. Therefore, there were significantly higher adverse effects in the land-based exercise treatment group compared to the aquatic exercise treatment group ($P = 0.012$). Participants in the land-based group were 6 times more likely to have an adverse effect compared to the aquatic group participants.

Regarding applicability, session duration, frequency of visits, and length of time of the episode of care was consistent with the expected treatment parameters of the patient. Although the patient did not have osteoarthritis, the patient had general knee pain status post tibial plateau fracture. The patient was the same age as the mean age of the study participants. The patient was a woman, similar to all participants in the study. None of the exclusion criteria applied to the patient except for the history of knee fracture.

This article was selected because a therapy pool was available on site. A traditional land-based physical therapy program would be more effective than an aquatic based program. However, beyond the patient's body structure and function impairments, activity limitations, and participation restrictions, the patient also suffered from decreased confidence with balance and exercise after sustaining her injury. The study showed that aquatic therapy had fewer adverse effects than land-based therapy. Therefore, aquatic therapy was thought to be useful in increasing the patient's confidence and comfort with exercises that she would eventually be doing on land.

Chapter 6

Outcomes

Table 4

Outcomes

OUTCOMES				
BODY FUNCTION OR STRUCTURE IMPAIRMENTS				
Outcome Measure	Initial	Follow-up (DC)	Change	Goal Met?
MMT	-Knee Extension: 4/5 (L), 5/5 (R) -Knee Flexion: 3+/5 (L), 5/5 (R) -Hip Abduction: 4/5 (L), 4/5 (R) -Hip External Rotation: 3+/5 (L), 4/5 (R)	-Knee Extension: 5/5 (L), 5/5 (R) -Knee Flexion: 5/5 (L), 5/5 (R) -Hip Abduction: 5/5 (L), 5/5 (R) -Hip External Rotation: 5/5 (L), 5/5 (R)	-Knee Extension: 1 grade (L), 0 grades (R) -Knee Flexion: 2 points (L), 0 grades (R) -Hip Abduction: 1 grade (L), 1 grade (R) -Hip External Rotation: 2 grades (L), 1 grade (R)	-Knee Extension: Yes -Knee Flexion: Yes -Hip Abduction: Yes -Hip External Rotation: Yes (MDC = 1 point)
Goniometry	-Knee Extension: -8º (L), 0º (R) -Knee Flexion: 0º–97º (L), 0º–132º (R)	-Knee Extension: 0º (L), 0º (R) -Knee Flexion: 0º–130º (L), 0º–150º (R)	-Knee Extension: 8º (L), 0º (R) -Knee Flexion: 33º (L), 18º (R)	Yes (120º knee flexion and 0º knee extension for left LE functional mobility)
NPRS	3/10	0/10	3 points	Yes (MCID 1.7)
Independent Gait (Observation)	-Decreased stride length on right LE -Decreased knee flexion on left LE during swing phase -Use of FWW for support	-Stride length normal bilaterally -Knee flexion normal bilaterally -No assistive device required for ambulation	No gait abnormalities or deviations noted	Yes
ACTIVITY LIMITATIONS				
Outcome Measure	Initial	Follow-up (DC)	Change	Goal Met ? (Y/N)
Five Times Sit-To-Stand	12:07 seconds	7:05 seconds	5:02 seconds	Yes (Cutoff <12 seconds for fall risk) No (MDC 5.7 seconds)
KOOS	Symptoms: 60.7 Pain: 55.6 ADL: 73.5 Sport/Recreation: 0	Symptoms: 89.3 Pain: 100 ADL: 100 Sport/Recreation: 95	Symptoms: 28.6 points Pain: 44.4 points Sport/Recreation: 95 points	Yes (MDC_{95} 6.1, 8.5, 8.0, 5.8, and 7.2 for the pain, symptoms, ADL, sport/recreational, and quality life sections of

	Quality of Life: 50	Quality of Life: 93.75	Quality of Life:43.75	the KOOS respectively)
LEFS	37/80	80/80	43 points	Yes (MDC_{95} = 9)
Running and Hiking	Unable to run and hike	Able to run and hike	Ran 10 minutes and hiked 30 minutes	Yes
PARTICIPATION RESTRICTIONS				
Outcome Measure	Initial	Follow-up (DC)	Change	Goal Met? (Y/N)
Golf Participation	Unable to participate in golf matches	Able to participate in golf matches	Participated in golf 6 holes of golf	Yes
Family Vacation Participation	Unable to go on vacations with family	Able to go on vacations with family	Participated in 1-week trip at Lake Tahoe with family	Yes
DC = Discharge; L = Left; R = Right; MMT = Manual Muscle Testing; LE = Lower Extremity; NPRS = Numeric Pain Rating Scale; FWW = Front-Wheel Walker; MCID = Minimally Clinically Important Difference; BBS = Berg Balance Scale; DGI = Dynamic Gait Index; KOOS = Knee Injury and Osteoarthritis Scale; ADL = Activities of Daily Living; MDC = Minimal Detectable Change; LEFS = Lower Extremity Functional Scale				

Discharge Statement:

The patient was seen 10 weeks after sustaining a lateral tibial plateau fracture. The patient was treated at an outpatient orthopedic physical therapy clinic for 14 visits spanning 9 weeks. By the end of the episode of care, the patient's MMT scores for the involved (left) side improved from 4/5 to 5/5 in knee extension, 3+/5 to 5/5 in knee flexion, 3+/5 to 5/5 in hip abduction, and 4/5 to 5/5 in hip external rotation showing overall improvement in lower extremity strength. The patient's goniometry measurements on the involved side increased from -8º to 0º degrees (knee extension) and 97º to 130º showing improvement in active range of motion. The patients NPRS scores improved from 3/10 to 0/10 indicating a complete elimination of pain. By discharge, the patient no longer had any gait deviations.

The patient's FTSTS time improved indicating that the patient was below the cutoff time for being at fall risk for community dwelling adults. The patient showed improved ability to perform ADLs, ability to perform sport/recreational activities, and quality of life as evident with increases in KOOS and LEFS scores. The patient was able to resume recreational and social activities including golfing, running, hiking, walking without an assistive device, family outings, and family vacations symptom free. The patient was discharged to continue living at home independently.

DC G-Code with

Goal with modifier: Mobility (Walking and Moving Around) G8980-CH (0%) Assessed by LEFS

Chapter 7

Discussion

During the initial encounter, the patient presented with gait deviations and dependence on a front-wheel walker for stability. The patient lacked confidence with balance, and her FTSTS indicated she was at increased fall risk. However, she scored high in the Berg Balance Scale and Dynamic Gait Index, indicating that she was low fall risk. Therefore, it appeared that the patient may have been higher functioning than she had initially appeared during her initial visit. A lack of confidence was preventing her from walking without a front-wheel walker and returning to athletic and recreational activities. An outcome measure that would have been useful in determining the patient's lack of confidence would have been the Activities-Specific Balance Confidence Scale. The information provided may have guided goal setting and treatment selection more directly towards the patient's needs.

The goals set for knee flexion and knee extension active range of motion were modelled after the typical amount of range of motion patients achieve following total knee arthroplasties for functional purposes rather than only considering an MDC. The goal set for the FTSTS was based on a cutoff score indicating whether the patient needed further balance testing for fall risk rather than an MDC as well. However, the patient was not at fall risk (as indicative by her BBS and DGI scores) and rather likely had a slow FTSTS time due to decreased muscular endurance from disuse. Regardless, the cautious approach was taken and the BBS and DGI were conducted.

One of the five Ottawa Knee Rules criteria applied to the patient: over the age of 55. However, the Ottawa Knee Rules were used during the initial evaluation to determine the severity of the injury and if the injury was healing properly, rather than to determine the need for further radiographing. If five of the five criteria had applied to the patient, it would have warranted a referral back to the patient's physician and a request for new radiographs.

An outcome measure which informs the therapist and patient when return to sport is appropriate may have been useful.[29] One such example is the single limb hop test.[29] The patient may have been able to have started higher impact or plyometric exercise earlier if the patient had been assessed earlier. Furthermore, it would have given the therapist a clear indication when the patient would have been prepared to start jogging, hiking, or playing golf again.

As mentioned in chapter 5, the patient's condition was excluded from the Lund et al study. However, there is a lack of evidence regarding treatment effectiveness of patients with tibial plateau fractures. No specific written protocols, such as available for total knee arthroplasty, have been studied for treating tibial plateau fractures.[30] Therefore, the patient's treatment was impairment-based and emulated a population with general knee pain or total knee arthroplasty, which proved to be effective because of the vast improvements made by the patient. Furthermore, the justification for using aquatic therapy in the study's osteoarthritic population also applies to any population with a knee injury, including tibial plateau fracture, in that aquatic therapy has less adverse effects than land-based therapy as concluded in Lund et al. The decreased risk of adverse effects

with aquatic therapy may help a patient with their confidence or decrease a patient's fear of exercise, maximizing session productivity and acting as a gateway into more therapy. Therefore, various exercises, especially exercises that would have been high impact on land, were performed first in the pool and then progressed to the gym.

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