ACUTE CARE PHYSICAL THERAPY FOR A PATIENT WITH TOTAL KNEE ARTHROPLASTY

A Doctoral Project
A Comprehensive Case Analysis

Presented to the faculty of the Department of Physical Therapy
California State University, Sacramento

Submitted in partial satisfaction of
the requirements for the degree of

DOCTOR OF PHYSICAL THERAPY

by

Cristy Givens

SUMMER
2015
ACUTE CARE PHYSICAL THERAPY FOR A PATIENT WITH TOTAL KNEE ARTHROPLASTY

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by

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Edward Barakatt, PT, PhD

Department Chair

Date

Department of Physical Therapy
Abstract

of

ACUTE CARE PHYSICAL THERAPY FOR A PATIENT WITH TOTAL KNEE ARTHROPLASTY

by

Cristy Givens

A patient with advanced osteoarthritis status post total knee arthroplasty on June 16, 2014 was seen for physical therapy treatment for seven sessions from June 16, 2014 to June 19, 2014 in an acute care hospital. Treatment was performed by a physical therapy student under the supervision of a licensed physical therapist.

The patient was evaluated at the initial encounter with goniometry, manual muscle testing, and mobility screening to assess joint range of motion, strength, and functional mobility respectively, in order to establish a plan of care. Primary goals for the patient were to increase range of motion, muscular strength, and functional mobility. The main interventions used were therapeutic exercise and task-specific training for functional mobility. The patient achieved the following goals: increase in joint range of motion, increase in muscular strength, and an increase in bed mobility. The patient was discharged to a skilled nursing facility.
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Chapter 1

General Background

The American Rheumatism Association recognizes 13 groups of arthropathies which are categorized as either non-inflammatory joint disease or inflammatory joint disease. ¹ Osteoarthritis (OA), also known as degenerative joint disease, is the most prevalent non-inflammatory joint disease. There are two classifications for OA, primary OA and secondary or idiopathic OA. Idiopathic OA has no known risk factors. Secondary OA is usually metabolic, anatomic, traumatic, or inflammatory in nature.¹

Common risk factors for OA include increasing age, obesity, previous joint injury, overuse of the joint, weak thigh muscles, and genetics.² Both men and women have OA, but before the age of 45 it is more common in men; after age 45, it is more common in women.³ Both types of OA have the same pathologic characteristics consisting of degeneration and erosion of the articular cartilage in synovial joints, sclerosis of the subchondral bone caused by the bone being left unprotected by the degenerating cartilage, and the formation of osteophytes which alter the normal contour of the bone and also cause joint surface enlargement.¹ Osteoarthritis is usually characterized by radiographic changes such as joint narrowing, presence of osteophytes, and bony sclerosis accompanied by symptoms of pain, stiffness, and swelling.⁴ The most commonly affected joints are the distal metacarpals, thumbs, neck, lower back, knees, and hips.³ It is estimated that approximately 27 million people in the United States have clinical OA of at least 1 joint.⁵ Clinical OA is defined as the characterization of a person as having OA by an examiner, based on symptoms and physical examination findings.⁵
People who suffer from severe peripheral joint OA have generally poor outcomes with high levels of physical disability, anxiety, depression, and often have high levels of healthcare resource use, such as joint replacement, drugs, and walking aids.\(^6\)

Osteoarthritis of the knee affects about 10 percent of adults older than 60 years.\(^6\) Radiologic progression is common, with 25 percent of osteoarthritic knees initially having normal joint space then showing major damage after 10 years.\(^6\) Total knee arthroplasty (TKA) is the most frequently performed joint arthroplasty.\(^7\) According to the Center for Disease Control, in 2004 there were 454,652 total knee replacements performed, primarily due to arthritis related complications.\(^4\) The greatest improvements in functional recovery typically occur in the first 12 weeks after TKA, with slower improvements continuing to occur from 12 weeks to 26 weeks after TKA, and little improvement occurring beyond 26 weeks after TKA.\(^8\)
Chapter 2

Case Background Data

Examination - History

The patient participating in this study was a 70 year old male immediately status post (s/p) right TKA (June 16, 2014) with a history of advanced OA, moderate genu varus deformity, and a moderate flexion contracture of his right knee. The patient was referred to physical therapy by his surgeon to improve function of his right knee and to improve his overall mobility. His relevant medical history includes type II diabetes mellitus, class II obesity (BMI=36), coronary artery disease s/p multiple stent placements in December 2012 and s/p triple coronary artery bypass graft placement in March 2013, essential hypertension, depression, history of myocardial infarction, and peripheral neuropathy. His OA had resulted in progressive bilateral knee pain and increasing genu varus deformity. His OA had been managed for an extended period of time with conservative treatment and intermittent steroid injections. Conservative treatment with intermittent intra-articular steroid injections had been helpful in the beginning, but the disease progressed and conservative treatment was no longer providing pain relief or functional improvement for the patient. Radiographs prior to surgery found advanced degenerative changes in the knee joint with bone-on-bone articulation suspected in the medial joint compartment. The radiologist’s impression was that the patient had advanced degenerative joint disease in the knee suggesting a chronic internal joint derangement. Due to his coronary artery disease he was not a candidate for non-steroidal anti-
inflammatory agents. Due to his progressing pain and disability, and the eventual failure of conservative treatment, it was decided that a TKA would be performed.

The patient’s wife was supportive and acted as the patient’s primary caregiver. She was a retired nurse and was available 24 hours a day, 7 days a week to provide care for her husband while he was recovering from his TKA. The patient and his wife lived in a one story home in a rural area. There were four steps at the front entrance that had hand rails on both sides, which the patient had to be able to ascend with assistance upon entering the house. There were no steps inside the home, and all rooms were accessible to him. The bathroom had a tub/shower combo and there were no grab bars, but the wife was able to assist him as needed.

Systems involved include the musculoskeletal and neuromuscular systems. The patient’s cardiovascular system is also of concern due to his hyperlipidemia, hypertension, and CAD.

The patient’s primary goals are to regain his strength and ROM, reduce his knee pain, and improve his mobility.

**Examination – Medications**

The patient was prescribed Januvia (100 mg/day) and Metformin (1000 mg/day) for the treatment of Diabetes mellitus type II, to decrease his blood sugar levels. The patient was also prescribed Lipitor (40 mg/day) to treat his hyperlipidemia, and Plavix (75 mg/day) to treat his CA. The patient was prescribed Carvedilol (25mg bid) to treat his hypertension. In addition, the patient was prescribed Norco (10mg) every 4-6 hours as needed to treat his pain.
<table>
<thead>
<tr>
<th>MEDICATION</th>
<th>DOSAGE</th>
<th>REASON</th>
<th>PT SIDE EFFECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lipitor</td>
<td>40 mg per oral (p.o.) daily</td>
<td>Hyperlipidemia</td>
<td>Gastrointestinal (GI) upset, joint pain, forgetfulness or memory loss, confusion, muscle pain, tenderness, or weakness, lack of energy, chest pain, extreme tiredness, weakness, unusual bleeding or bruising, pain in the upper right part of the stomach, flu-like symptoms, rash, hives, itching, difficulty breathing or swallowing, swelling of the face, throat, tongue, lips, eyes, hands, feet, ankles, or lower legs, hoarseness</td>
</tr>
<tr>
<td>Plavix</td>
<td>75 mg p.o. daily</td>
<td>Coronary Artery Disease</td>
<td>diarrhea, itching, nausea, or stomach pain</td>
</tr>
<tr>
<td>Januvia</td>
<td>100 mg p.o. daily</td>
<td>Diabetes Mellitus II</td>
<td>Headache, diarrhea, pain in the upper left or middle of the stomach that may spread to the back, nausea, vomiting, loss of appetite</td>
</tr>
<tr>
<td>Carvedilol</td>
<td>25 mg p.o. twice per day (b.i.d.)</td>
<td>Hypertension</td>
<td>extreme thirst or hunger, frequent urination, blurred vision, tiredness, weakness, lightheadedness, dizziness, headache, GI upset, vision changes, joint pain, numbness, burning, or</td>
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<tr>
<td>Metformin</td>
<td>1000 mg p.o. b.i.d.</td>
<td>Diabetes mellitus II</td>
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<tr>
<td></td>
<td></td>
<td>GI upset, heartburn,</td>
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<td></td>
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<td>headache, flushing of the skin,</td>
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<td>nail changes, muscle pain, chest</td>
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<td>pain, extreme tiredness, weakness,</td>
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<td></td>
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<td>discomfort, deep rapid breathing,</td>
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<td>shortness of breath, dizziness,</td>
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<td>lightheadedness, abnormally fast or</td>
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<td></td>
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<td>slow heartbeat, feeling cold</td>
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<tr>
<td>Norco</td>
<td>10 mg every 4-6 hrs as</td>
<td>Pain</td>
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<td>needed</td>
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<td></td>
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<td>drowsiness, dizziness, nausea,</td>
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<td></td>
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<td>depressed respiration, restlessness,</td>
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<td>muscle and bone pain, insomnia,</td>
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<td></td>
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<td>diarrhea, and vomiting.</td>
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</table>
Chapter 3

Examination – Tests and Measures

For this case study, test and measures for body structure or function impairments, activity limitations, and participation limitations were utilized. For body structure or function goniometry was used to assess range of motion (ROM) impairments, manual muscle testing (MMT) to assess strength deficits, and a numerical pain rating scale (NPRS) to measure the patient’s pain levels. The level of assistance needed during bed mobility, transfer, and gait were used to assess activity limitations due to mobility impairments. The Lower Extremity Functional Scale (LEFS) was used to assess the patient’s participation limitations. Psychometric characteristics of the tests and measures used in this case study are as follows:

- Goniometry is used to assess ROM by measuring an individual’s total amount of motion available at a joint. Goniometry is classified in the body structure or function category of the ICF. Goniometry is commonly used to measure joint position and motion in the clinical setting.\(^\text{10}\) Goniometry is a quick and simple test that gives valuable information regarding ROM that can be re-measured easily to show progress. Using a universal goniometer to measure knee ROM has high intra-rater (intraclass correlation coefficient (ICC)= 0.86-0.97) and inter-rater (0.91-0.94) reliability.\(^\text{11}\) This means that goniometry had a high reliability when the measurements for knee ROM were taken by the same person or when taken by different people.\(^\text{12}\) For patients following TKA intra-rater (ICC= 0.89 to 0.97) and inter-rater (ICC=0.81 to 0.96) reliability was high, other than for
passive extension (ICC=0.70-0.72). The minimal detectable change (MDC) ranged from 4.5° - 6.6° (intra-rater), and 5.8° - 15.7° (inter-rater).

- Manual Muscle Testing is a standardized assessment of muscle strength. Manual muscle testing is the most commonly used method for documenting impairments in muscle strength. Manual muscle testing is classified in the body structure or function category of the ICF. MMT scores are graded on a 0-5 scale, with 0 representing no muscle activity, and 5 representing normal muscle activity. In individuals with OA, the standard error of measure (SEM) is 1-2% when using a hand held dynamometer, and the MDC is 4%. MMT has excellent test-retest reliability with ICC of 0.97-0.98. MMT has low sensitivity (0.35), high specificity (0.90), and a positive likelihood ratio of 3.5. A systematic review published in 2007 found that a change greater than 1 grade must be obtained to be confident that a true change in strength has occurred.

- The Numerical Pain Rating Scale is used to obtain a subjective measure of the amount of pain an individual is experiencing. It is an 11 point scale from 0-10, with 0 representing no pain, and 10 representing the most intense pain imaginable. The NPRS is classified in the body structure or function category of the ICF. The test is easy to administer and takes less than 1 minute to complete. Sloman et al found that determining the percentage of improvement in pain was more meaningful than the change in score. For example, a patient with a 2 point change in score from 8 to 6 would have only a 20% improvement and still have a significant amount of pain, whereas a patient with a 2 point change in score from
a 2 to 0 would have a 100% improvement in pain. Converting the pain score reduction to a percentage of improvement allows the problems of equivalent magnitudes of pain reduction occurring at various locations in the pain range spectrum to be addressed. The MCID was determined using scores concurrently obtained from the NPRS, a verbal rating scale for the amount of perceived relief in pain levels (VRS-PR), and the numeric rating scale of satisfaction with the level of pain relief (NRS-S). In post-operative patients the MCID was determined in percent change, a 35% reduction had a rating of “minimal relief”, a 67% reduction had a rating of “moderate relief”, a 70% reduction had a rating of “much relief”, and a 94% reduction had a rating of “complete relief”. In healthy populations, experiencing experimentally induced thermal stimuli, the NPRS was found to have excellent inter-rater reliability (100%), and excellent concurrent validity with the Visual Analogue Scale \( (r = 0.86) \), Verbal Descriptor Scale \( (r = 0.88) \), 21-point Numeric Rating Scale \( (r = 0.87) \), and Faces Pain Scale \( (r = 0.80) \).

- The level of assistance needed during bed mobility, transfer, and gait was recorded as either supervised (S) (no assistance, only supervision), minimum assistance (min A) (less than 25% assistance provided by the care giver), moderate assistance (mod A) (25-50% assistance provided), maximum assistance (max A) (50-75% assistance provided), or dependent (D) (more than 75% assistance provided). Level of assistance needed is classified in the body structure or function category of the ICF. There are no psychometrics available for level of
assistance, but this is a standard measure that was required at the hospital where this case study took place. Using level of assistance is helpful in documenting how much assistance is needed and is generally accepted as having the ability to show change.

- Functional ability of the lower extremity may be assessed with LEFS. The LEFS is classified in the activity and participation categories of the ICF. The test takes less than 5 minutes to administer. The LEFS is a questionnaire containing 20 questions about a person’s ability to perform everyday tasks. Each question is worth up to 4 points with a maximum score of 80. The patient is asked how much difficulty they have performing everyday tasks such as getting into or out of the bath, putting on socks and shoes, squatting, etc. Scoring for each question is as follows: 0= extreme difficulty or unable to perform, 1= quite a bit of difficulty, 2= moderate difficulty, 3= a little bit of difficulty, and 4= no difficulty. The LEFS has excellent test-retest reliability (r=.94). Correlations between the LEFS and the SF-36 physical function subscale and physical component score were r =.80 and r =.64, respectively. There was a higher correlation between the prognostic rating of change and the LEFS than between the prognostic rating of change and the SF-36 physical function score. The potential error associated with a score on the LEFS at a given point in time is ±5.3 scale points (90% CI), the MDC90 is 9 scale points, and the MCID90 is 9 scale points. The LEFS is reliable, and construct validity was supported by comparison with the SF-36, and the sensitivity to change of the LEFS was superior to that of the SF-36.
Table 2

Examination Data

<table>
<thead>
<tr>
<th>Measurement Category</th>
<th>Test/Measure Used</th>
<th>Test/Measure Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range of motion (ROM)</td>
<td>Goniometry</td>
<td>5°- 40° active knee flexion</td>
</tr>
<tr>
<td>Strength</td>
<td>Manual Muscle Testing (MMT)</td>
<td>3-/5  gross strength for right lower extremity (knee flexion, knee extension, hip abduction, hip extension) left lower extremity and bilateral upper extremities: &gt;4/5 throughout.</td>
</tr>
<tr>
<td>Pain</td>
<td>Numeric Pain Rating Scale (NPRS)</td>
<td>2/10 pain lying in bed 4/10 pain after treatment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measurement Category</th>
<th>Test/Measure Used</th>
<th>Test/Measure Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bed Mobility</td>
<td>Bed mobility assessment</td>
<td>Minimum Assistance (min A)</td>
</tr>
<tr>
<td>Transfer</td>
<td>Transfer status assessment</td>
<td>Supervised (S) with Front Wheel Walker (FWW) and Full Weight Bearing (FWB)</td>
</tr>
<tr>
<td>Gait</td>
<td>Gait assessment with FWW</td>
<td>Min A with FWW and FWB</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Measurement Category</th>
<th>Test/Measure Used</th>
<th>Test/Measure Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased Participation</td>
<td>Lower Extemity Functional</td>
<td>8/80</td>
</tr>
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</table>
Chapter 4

Evaluation

Evaluation Summary

Prior to surgery, the patient presented with chronic pain that was progressive in nature. The patient’s problems included increased pain and decreased ROM, strength, and functional mobility. All of these deficits caused limitations in the patient’s ability to perform activities of daily living. The patient also had numerous co-morbidities including diabetes Mellitus type II, coronary artery disease, essential hypertension, history of cardiac infarction, obesity, gastroesophageal reflux disease, depression, and peripheral neuropathy. The patient underwent a cemented right TKA, including the tibiofemoral and patellofemoral joints. Post surgery the patient presented to physical therapy with pain and decreased strength and ROM consistent with typical findings post TKA.

Diagnostic Impression

Upon completion of the initial evaluation of this patient, body structure and function impairments and activity limitations were consistent with what is expected for a patient s/p right TKA performed due to OA. A review of the patient’s medical history and current procedures further supports a physical therapy diagnostic impression of reduced ROM, strength, and function s/p TKA due to advanced OA.

Physical Therapy Guide Practice Pattern

- PT Guide practice Pattern 4H: Impaired Joint Mobility, Motor Function, Muscle Performance, and Range of Motion Associated With Joint Arthroplasty.
**G-Codes**

Using the patient’s score from the Lower Extremity Functional scale, the following g-codes were assigned to the patient to show level of functional limitation.

- At evaluation- G8978 CM (90%)
- Discharge goal- G8979 CL (61-79%)
- At discharge- G8980 CL (68%)
### Chapter 5

**Plan of Care – Goals and Interventions**

**Table 3**

**Evaluation and Plan of Care**

| PROBLEM | **PLAN OF CARE** | **Expected Outcomes**<br>(3 days) | **Planned Interventions**
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>BODY FUNCTION OR STRUCTURE IMPAIRMENTS</strong></td>
<td></td>
<td></td>
<td><strong>(C) = Coordination of care intervention</strong>&lt;br&gt;<strong>(E) = Educational intervention</strong></td>
</tr>
<tr>
<td>Decreased knee active ROM:&lt;br&gt;5°- 40° flexion</td>
<td>Increase active ROM to:&lt;br&gt;0°- 90° of flexion&lt;br&gt;(Goal is very optimistic, but was set by surgeon)</td>
<td>Continuous Passive Motion (CPM) 4-5 hrs./day&lt;br&gt;Heel slides 1/10, 2 times (2x) per day&lt;br&gt;Quad sets with heel roll 1/10, 2 x per day&lt;br&gt;Seated knee flexion 1/10, 2 x per day&lt;br&gt;Extension hang 3 min, 2 x per day&lt;br&gt;Ankle pumps 1/10, 2 x per day</td>
<td></td>
</tr>
<tr>
<td>Decreased Strength&lt;br&gt;3-/5 throughout right lower extremity (knee flexion, knee extension, hip abduction, hip extension)</td>
<td>Increase Strength (&gt; 1 grade)&lt;br&gt;4/5 throughout right lower extremity (knee flexion, knee extension, hip abduction, hip extension)</td>
<td>Quad Sets 1/10, 5 second hold, 2 x per day&lt;br&gt;Short arc quads 1/10, 2 x per day&lt;br&gt;Straight leg raises 1/10, 2 x per day&lt;br&gt;Hip adduction/abduction 1/10, 2 x per day&lt;br&gt;Long arc quads 1/10, 2 x per day&lt;br&gt;Gluteal sets 1/10, 5 second hold, 2 x per day</td>
<td></td>
</tr>
<tr>
<td>Increased Pain&lt;br&gt;2/10 – laying in bed&lt;br&gt;4/10 – with activity</td>
<td>Decrease Pain to a level of moderate relief (67% reduction)&lt;br&gt;0/10- laying in bed&lt;br&gt;1/10 – with activity</td>
<td>(E) Breathing exercises&lt;br&gt;Cryo-cuff 1-2 hrs as needed, following PT sessions</td>
<td></td>
</tr>
<tr>
<td><strong>ACTIVITY LIMITATIONS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Decreased Bed Mobility:&lt;br&gt;minimum assistance&lt;br&gt;Decreased ability to transfer:&lt;br&gt;Supervised with Front Wheel Walker (FWW) and FWB</td>
<td>Increase Bed Mobility Independent&lt;br&gt;Increase ability to transfer:&lt;br&gt;Modified independent with FWW and FWB</td>
<td>Bed mobility training- rolling, supine→sitting on edge of bed (EOB), sitting on EOB→supine&lt;br&gt;1-2 times, 2 x per day&lt;br&gt;Transfer sit→stand from bed&lt;br&gt;Transfer sit→stand from chair/commode&lt;br&gt;1-2 times, 2 x per day</td>
<td></td>
</tr>
<tr>
<td>Decreased ability to ambulate: 60° with minimum assistance, with FWW and Full Weight Bearing (FWB)</td>
<td>Increase ability to ambulate: 150° with supervision, with FWW and FWB</td>
<td>Gait training in room and hall- distance determined by patients tolerance- 2x per day</td>
<td></td>
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</tbody>
</table>

| **PARTICIPATION RESTRICTIONS** | **Decreased participation in Activities of Daily Living as measured by the LEFS- 8/80** | **Increase participation in ADLs (S) as measured by the LEFS- goal of 17/80** | **Strength training (see above) ROM exercises (see above) Mobility training (see above)** |
Prognostic Considerations

Positive prognostic factors for this patient were receiving physical therapy treatment immediately following surgery, receiving a posterior cruciate ligament (PCL) sparing surgery, having a good support system at home, and a high level of function prior to surgery as he was independent in all activities without the use of an assistive device. The PCL sparing surgery helps the patient retain function, maintain anatomically correct femoral rollback, and increased knee stability. Research shows that patients with a high level of function prior to surgery have better functional outcomes than patients who do not. Since it has been reported that the greatest improvement occurs in the first 12 weeks after TKA, the patient was expected to make significant progress at this stage of his rehabilitation process. Negative prognostic factors for this patient are his numerous co-morbidities and his obesity (BMI = 36). Obesity is an independent risk factor for poor recovery in TKA. Severe obesity (BMI >35) is a risk factor that predicts worse pain and functional recovery. Patients with a BMI over 35 are also at higher risk for complications post op, including infection which increases their reoperation risk over their lifetime. Diabetes mellitus is associated with a increased rate of postoperative and wound complications following TKA. Diabetes mellitus and heart disease are associated with a longer length of stay following TKA. Diabetes, heart disease, and depression all have significant association with moderate to severe pain levels after TKA. Despite the patients numerous comorbidities the patient had a fair prognosis for achieving his physical therapy goals and having a good functional outcome.
Since the patient was living in an optimal environment with good social support, and 24 hour care from a caretaker with a nursing background, his was expected to be discharged to his home with a home exercise program.

**Plan of Care- Interventions**

See Table 3.

**Overall Approach**

The treatment strategy used task specific training concentrating on tasks meaningful to the patient. The patient had limitations with all aspects of mobility. Task specific training focused on bed mobility, transfers, and gait to increase the patient’s ability to perform these activities independently. Treatment also focused on therapeutic exercise for strengthening and joint mobility as these impairments directly affected the patient’s functional mobility. Strengthening and ROM treatments were made to be challenging to the patient and progressive in nature. Treatments used high repetitions to increase motor learning. Treatment also included modalities to reduce pain, increasing the patient’s cooperation. Because intervention in the acute care setting is limited to three days, the patient was to be discharged with a home exercise program focused on reducing impairments, functional limitations and participation restrictions. The home exercise program was to be performed twice daily. Interventions included:

*Inpatient Treatment*

- Mobility training was provided 2 times per day for approximately 15 minutes per session.
o Bed mobility training - The patient was given bed mobility tasks of rolling in bed, sitting up in bed, and sitting at the edge of the bed. The patient was educated on the best ways to achieve tasks. Verbal cues and assistance were given as needed.

o Transfer training - The patient was given transfer training tasks of sitting on EOB to stand, sit to stand from a chair, and sit to stand from a commode, all using a front wheeled walker to assist in transfer. The patient was educated on the best ways to achieve tasks. Verbal cues and assistance were provided as needed.

o Gait training - The patient received gait training in his room and halls of the hospital. The patient was instructed in the use of a front wheeled walker, educated on proper gait mechanics, provided verbal cues, and given assistance as needed. Distance goals were set, and distance was increased as tolerated.

- Therapeutic exercises were provided twice per day for approximately 15 minutes per session.

o Strengthening - The patient was provided instruction on strengthening exercises which were performed in bed, and at the EOB. Initially, each exercise was performed for one set of ten repetitions (1/10), with plans to increase repetitions as tolerated. Exercises performed were:
  - Quad Sets, 5 second hold
  - Short arc quads
  - Straight leg raises
• Hip Adduction/Abduction
• Long arc quads
• Gluteal sets, 5 second hold

○ Range of motion - The patient was provided instruction on ROM exercises which were performed in bed. Initially, each exercise was performed for one set of ten repetitions (1/10) with plans to increase repetitions as tolerated.

Exercises performed were:

• Heel slides-1/10
• Quad sets with heel roll- 1/10
• Seated knee flexion- 1/10
• Extension hang- 3 minutes (increase as able)
• Ankle pumps- 1/10
• Pursed lip breathing exercises with shoulder flexion (B) 1/10 for relaxation and pain relief

○ Continuous passive motion (CPM) device – A CPM was placed on patient 4-5 hours daily. Initial settings were set at -8° of knee extension and 40° of knee flexion. CPM will be progressed by increasing knee flexion by 5° per session, with patient increasing the flexion angle as tolerated during the treatment

• Modalities

○ A Cryo-cuff was used to help decrease pain and inflammation, and to increase patients comfort and satisfaction. It was applied immediately following surgery, and following each physical therapy session for 1-2 hours, as needed,
• Patient Instruction
  o The patient was instructed in a home exercise program. He was instructed to start out slow, with no weights 1/10 each, 2x per day, progressing to 2/10, then 3/10. He was to progress the program by adding light ankle weights when his leg muscles grew stronger, and he could perform the exercises with ease.
  ▪ Quad sets 1/10, 5 sec hold
  ▪ Glut sets 1/10, 5 sec hold
  ▪ Heel slides 1/10
  ▪ Short arc quads 1/10
  ▪ Long arc quads 1/10
  ▪ Straight leg raises 1/10
  ▪ Kitchen Sink Exercises 1/10
    ▪ Hip flexion (with knee flexion)
    ▪ Hip extension
    ▪ Hip abduction
    ▪ Hip adduction

**PICO Question**

For a patient with advanced OA status post total knee arthroplasty (P), is using continuous passive motion along with therapeutic exercise (I) more effective in reducing pain and increasing ROM and function (O) than with therapeutic exercise alone (C)?

Three articles were identified that address this PICO question. The first is a Cochrane Review (Level of evidence: 1a). In this systematic review 14 randomized
control trials were included. Results favored the use of CPM plus physical therapy when compared to physical therapy alone. Treatment with a CPM combined with physical therapy was found to significantly increase active knee flexion and decrease length of stay, as well as decrease the need for post-operative manipulation. Treatment with the CPM did not significantly improve passive knee flexion, passive or active knee extension, or function.26

The second study was a randomized controlled trial (Level of evidence: 1B; PEDro score: 7/10).27 The effectiveness of CPM combined with physical therapy following TKA was compared to physical therapy alone following TKA. The authors concluded that combining CPM with physical therapy provided significant improvements in ROM, pain, short term mobility, and muscle strength in the first two weeks following surgery, and led to an immediate decline in post operative pain compared to the control group.

The third study was a prospective randomized controlled trial (Level of evidence: 1B; PEDro score: 6/10).28 A sample of 147 patients were assigned to 1 of 3 treatment groups: CPM from 0° to 40° and increased by 10° per day, CPM from 90° to 50° (early flexion) and gradually progressed into full extension over a 3-day period, and a no-CPM group. At day 5 of the intervention, the early flexion group had significantly more range of flexion than both the standard and control groups. The authors concluded that early CPM improved ROM in the short term, but the effect didn’t last in the long term.
## Outcomes

### Table 4

<table>
<thead>
<tr>
<th>OUTCOMES</th>
<th>BODY FUNCTION OR STRUCTURE IMPAIRMENTS</th>
<th>Goal Met (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Outcome</strong></td>
<td><strong>Initial</strong></td>
<td><strong>Follow-up</strong></td>
</tr>
<tr>
<td>Range of Motion (Active)</td>
<td>5°- 40° flexion</td>
<td>13°- 67° flexion</td>
</tr>
<tr>
<td>Strength</td>
<td>3-/5 strength throughout right lower extremity</td>
<td>3/5</td>
</tr>
<tr>
<td>Pain</td>
<td>2/10 - in bed 4/10 – after treatment (tx)</td>
<td>4/10- in bed 7/10 – after tx</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ACTIVITY LIMITATIONS</th>
<th>Outcome</th>
<th>Initial</th>
<th>Follow-up</th>
<th>Change</th>
<th>Goal Met (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bed Mobility</td>
<td>Minimum Assistance (Min A)</td>
<td>Supervised</td>
<td>↓ by one assistance level</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Transfers</td>
<td>Supervised with Front Wheel Walker (FWW)</td>
<td>Min A with FWW</td>
<td>↑ by one assistance level</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Gait</td>
<td>60’ with minimum assistance, with FWWand Full Weight Bearing (FWB)</td>
<td>7 Steps with Min A, with FWW and FWB</td>
<td>50’ ↓ in gait distance</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PARTICIPATION RESTRICTIONS</th>
<th>Outcome</th>
<th>Initial</th>
<th>Follow-up</th>
<th>Change</th>
<th>Goal Met (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decreased participation in Activities of Daily Living (ADLs)</td>
<td>Lower Extremity Functional Scale (LEFS) score of 8/80</td>
<td>LEFS score of 25/80</td>
<td>17 point increase in LEFS score</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>
Discharge Statement

The patient was seen in an inpatient acute setting from June 16, 2014 to June 19, 2014 for a total of 7 physical therapy sessions. The patient made progress toward his goals, but has had numerous setbacks including anemia due to blood loss during surgery, elevated white blood cell count due to the development of a urinary tract infection, and falling out of bed during the third night of stay in the hospital which made the patient fearful. Progress was also limited due to severe pain. Continued physical therapy is needed for the patient to meet his goals. Due to the patient’s increased pain, lack of progress the last few treatment sessions, and his fear avoidance following a recent fall the patient was discharged to a skilled nursing facility to continue his recovery.
Chapter 7

Discussion

The patient who participated in this study was referred to PT with a medical diagnosis of s/p R TKA due to advanced OA. The patient's clinical presentation supported the medical diagnosis, and an evaluation of the patient and a review of his health history further supported the physical therapy diagnostic impression of reduced ROM, strength, and function secondary to OA s/p TK. The patient underwent an uncomplicated cemented TKA surgery. The patient made good progress for his first few PT sessions, ambulating 50 feet on the same day as surgery, but progress began to decline as the patient developed severe pain. He also developed medical complications including anemia due to blood loss, a urinary tract infection (UTI), followed by a fall. Following the fall, the patient was very sore and became very fearful that he would fall again. Following these events the patient's rehabilitation progress declined significantly. While strength, ROM, and bed mobility continued to improve, the rate of change slowed significantly. Improvements were made in mobility (transfer and gait distance) initially but function regressed due to the above circumstances.

The patient did well during his first treatment session while still on the morphine pump. During the second session he had an increased need for assistance due to an increase in pain following discontinuance of the morphine pump and a switch to oral pain medications. During this session the patient was awaiting a blood transfusion for his anemia that developed following surgery. Following his blood transfusion, his third
therapy session went well with a decreased need for assistance and the patient increased his ambulation distance 60 feet to 75 feet. During his fourth therapy session assistance levels increased again. From this point on there was an even greater need for assistance and a decrease in function. At this point the patient developed an elevated white blood cell count and it was determined he had a urinary tract infection. On the third night in the hospital he became confused and fell out of bed. He was not injured but was moderately sore. Following the fall, the patient was very reluctant to get up; because he was afraid he would fall again. Anemia, infection and increased pain can have an adverse effect on strength. The malaise that accompanied the UTI may have contributed to his disorientation and fall. Given these adverse developments, I am unaware of anything else I could have done to help produce a better outcome.

The patient’s goals were realistic for the inpatient setting. Although the patient had numerous comorbidities which led to a guarded prognosis, the patient did very well during his first PT session, and his goals were set based on his progress during the evaluation. The patient’s comorbidities put him at increased risk for infection, postoperative complications, increased pain, and poor functional recovery Over the course of treatment the patients comorbidities contributed to medical complications slowing his recovery. Once the patient’s medical status began to decline, so did his function, At that point is was appropriate not to advance due to the severity of pain and the medical complications he was experiencing. It was then determined that the patient would be sent to a short term rehab facility to continue his recovery under direct medical supervision due to the complexity of his medical needs at discharge.
For my next patient with a similar clinical presentation, I will focus on using more evidence based measures. I will use a 10 meter walk test (MWT) as an outcome measure to show improvement in mobility rather than relying on the standard levels of assistance. The 10 MWT gives valuable data that is helpful in predicting fall risk. The Wells clinical prediction rule (CPR) for deep vein thrombosis (DVT) may also be used in the future. Development of a DVT is a common complication of TKA, and the Wells CPR for DVT is an excellent diagnostic measure that can be used to improve diagnostic accuracy of DVT. It is quick and easy to use, and could save a patient’s life.

The Wells CPR for DVT is a diagnostic measure for diagnosing probability of DVT. The test consists of 9 clinical features, each of which can earn a score of 0 or 1 except for the last feature which can earn a score of 0 or -2, for a total possible score -2 to 8. Earning a score of 3 or more puts you at high risk (75% probability of DVT), 1-2 points moderate risk (17% probability), and less than 1 point low risk (3% probability) of developing a DVT (95% confidence interval (CI))

The 10 MWT assesses walking speed in meters per second (m/s) over a short distance. The 10 MWT is associated with the Activity ICF category. 10 MWT is commonly used to predict fall risk. The patient is instructed to walk the set distance of 10 meters while being timed. Three trials are performed and the average time in seconds is divided by the distance to obtain a score in m/s. Fall risk is obtained using the following scores: less than 10 seconds = low risk for falls, 13.5 and higher seconds = high risk for falls, more than 30 seconds = requires assistive device to ambulate; dependent in activities of daily living. No psychometrics are established for OA/TKA. In a geriatric
population the standard error of measure (SEM) is 0.06 m/s, and the MCID is reported to
be 0.05 m/s for a small meaningful change and 0.13 m/s for a substantial meaningful
change.\textsuperscript{30}

The presentation of this patient was very typical for his diagnosis. He had
decreases in strength, ROM, and mobility, accompanied by pain and weakness. He had
swelling that was typical for having a major musculoskeletal surgery. His development of
anemia following surgery also seems to be a somewhat typical occurrence following
surgery. His response to pain may have been somewhat atypical. He seemed to have a
heightened reaction to pain, which may have been associated with his comorbidities.

The outcome measures used on this patient are appropriate for similar patients.
There were no special considerations applied to this situation. It is standard in patients
recovering from TKA, in an acute care setting, to measure ROM, strength, and mobility.
All tests used for this patient are standard tests that are accurate and able to measure
change. Although I did not use any diagnostic tests and measures on this patient, the
Wells CPR for DVT and 10 MWT are appropriate for this patient population and I would
use them in the future. The use of CPM can also be applied to patients in this population.
Although long term improvements have not been found, the use of CPM following TKA
has been shown to provide significant short term improvement in pain, ROM, and
functional mobility.

In a study that analyzed costs and benefits of CPM it was found that CPM is
effective in increasing short-term knee flexion ROM and decreasing the need for knee
manipulation following TKA, without increasing costs.\textsuperscript{31} Based on the results of the
study, approximately 10% of the patients who did not receive CPM (control group) as part of their treatment ended up needing knee manipulation. None of the patients who received CPM (treatment group) as part of their treatment needed knee manipulation. Knee manipulation cost approximately $10,000 per patient. When the cost of knee manipulation was averaged across the whole control group, costs averaged approximately $940 per patient who did not receive CPM. With the average cost of CPM rental being $60 per day, it was shown that CPM following TKA is a cost effective treatment when compared to the costs associated with knee manipulation.\textsuperscript{31}

In future cases, I believe it would be of interest to explore the use of proprioception training in patients following TKA. It has been reported that there is a steady decrease in joint position sense of the knee in the aging population, and that degenerative changes further decreases proprioception.\textsuperscript{32} Elderly patients who undergo TKA due to OA are likely to have impaired proprioception not only because of their age and OA, but also due to the tissue trauma associated with surgery. Evidence on the need to include proprioceptive training in TKA treatment, and what setting that training is most appropriate (outpatient vs. acute care rehabilitation), is lacking and could, potentially, accelerate return to maximum function.
References


