

---

## Physical Therapy Interventions Following Total Knee Arthroplasty for Two Patients with Different Medical Complexity Levels: A Case Report

**Mario Baker\***

Board Certified Geriatric Clinical Specialist, Department of Physical Therapy, University of Findlay- Findlay, Ohio, USA

\***Corresponding author:** Mario Baker, Board Certified Geriatric Clinical Specialist, Department of Physical Therapy, University of Findlay- Findlay, Ohio, USA. E-mail: [mario.baker@findlay.edu](mailto:mario.baker@findlay.edu)

**Received:** May 10, 2022; **Accepted:** May 21, 2022; **Published:** June 03, 2022

### Abstract

**Background and Purpose:** More than 3 million total knee arthroplasties (TKA) are projected annually by the year 2030 [1]. Given the prevalence of elective TKA, physical therapists are working towards the most effective treatment interventions. The goal of this case report was to describe interventions for two geriatric patients with different levels of medical complexity.

**Case Description:** Two geriatric patients with different levels of medical complexity were seen following right TKA. Both patients presented with deficits in body structure and function, activity limitations, and participation restrictions.

**Outcomes:** Both patients received the same interventions to address deficits in range of motion (ROM), balance, gait, and strength. Despite different levels of medical complexity, the outcomes were similar. Outcome measures used included the Numeric Pain Rating Scale (NPRS), Range of Motion (ROM), Timed Up and Go (TUG) test, Five Time Sit to Stand Test (FTSTST), and Six-Minute Walk Test (6 MWT). At discharge, both patients reported no pain. Patient 1 right knee ROM was 0-125 degrees flexion, her FTSTST was completed in 10 seconds, she completed 487.68 meters during a 6 MWT, and a TUG score of 8 seconds. Patient 2 right knee ROM was 0-128 degrees flexion, her FTSTST was completed in 4.38 seconds, she completed 530.50 meters during a 6 MWT, and a TUG test in 6 seconds.

**Discussion:** When comparing the patients with varying medical complexities both patients demonstrated improvements in all of the outcome measures regardless of medical complexity following TKA.

**Keywords:** Total knee arthroplasty; Medical complexity; Outcome measures

## **Introduction**

Total knee arthroplasties (TKA) are often performed as a result of end-stage knee osteoarthritis (OA) [1-4]. By the year 2030 more than three million TKA are projected annually [1]. TKA for knee OA prevalence is increasing as much as 17 percent per year [2,5]. The most common reasons individuals undergo TKA are to reduce pain, [6,7,9-13] return to their prior level of function with Activities of Daily Living (ADL) [9,12,14] and to get back to an active lifestyle when conservative interventions to address knee OA have failed [8,9-11].

Physical therapy (PT) interventions have been shown to be effective in helping patients regain functional independence following TKA [3,9,11,15,16]. Individuals who participate in physical therapy have demonstrated improvements in function up to a few months after surgery [6,16].

A literature review failed to produce studies comparing outcomes of geriatric patients with differing levels of medical complexity. Age and co-morbidities related to levels of medical complexity may result in less effective interventions with some patients who have undergone TKA [10]. The goal of this case report was to describe the interventions that were used with two geriatric patients with different levels of medical complexity.

## **Case Description: History and Review of Systems:**

### **Patient 1:**

Patient 1 was a 72-year-old female status post right TKA after failed conservative and pharmacological interventions. Her medical history was remarkable for right knee OA. Review of systems was positive for shortness of breath with activity, bilateral lower extremity muscle weakness, arthralgia, gait problems, and a right knee surgical incision with no signs of infection. Vital signs were within normal limits (WNL). Her body mass index (BMI) was 30.30 kg/m<sup>2</sup>.

Activity limitations included gait with a rolling walker, supervision assistance with sit to stand transfers, an inability to drive, inability to perform shopping, difficulty with household chores, and difficulty with stair ambulation at her prior level of function. Participation restrictions included an inability to take care of her mother and her husband. This patient would be categorized as moderately complex, which by definition is 1-2 comorbidities that impact the plan of care, an examination addressing three or more elements from the ICF model, and a clinical presentation with changing characteristics over time [20]. Comorbidities that impacted the plan of care included dyspnea on exertion and anxiety. The examination revealed the need to address functional strength, ROM, and gait. The clinical presentation was determined to be evolving secondary to the comorbidities.

### **Patient 2:**

Patient 2 was a 74-year-old female status post TKA after failed conservative and pharmacological interventions. Her medical history was remarkable for right knee OA. The review of systems was positive for right knee pain, a right knee surgical incision with no signs of infection, bilateral lower extremity muscle weakness, and gait deficits. Vitals were WNL. Her BMI was 30.40 kg/m<sup>2</sup>.

Activity limitations included an inability to drive secondary to knee pain and gait marked by an antalgic pattern with no assistive device required. These limitations resulted in an inability to function at her pre-morbid independent prior level of function with gait and driving. Participation restrictions included an inability to attend musical performances as a result of the need to sit for a prolonged period of time. Her husband was able to assist with driving, shopping, and household chores. This patient was categorized as a low complexity patient, which by definition is no comorbidities that impact the physical therapy plan of care, an examination addressing 1-2 elements from the ICF model, and a clinical presentation that is stable [20]. There were no comorbidities that impacted her plan of care, the examination revealed the need to address gait and ROM, and her clinical presentation was stable.

### **Clinical Impression 1:**

At the time of physical therapy assessment, patient 1 was status post 2 weeks and patient 2 was status post 1 week following TKA after physical therapy in the inpatient and skilled nursing facility. Both patients presented with deficits including right knee pain, bilateral functional lower extremity muscle weakness, right knee ROM limitations, decreased activity tolerance, and gait abnormalities. Patient two presented with these deficits one week after surgery. Patient one was status post two week following surgery with a presentation of general deconditioning and difficulty ambulating up and down stairs in addition to the deficits that both patients had in common.

### **Examination**

#### **Measures used and Findings:**

The Five Timed Sit to Stand Test (FTSTST) was used to measure functional strength and assesses transfer skills. The test-retest reliability was 0.982 indicating this test has minimal random error with a 95% confidence [21]. The PT examination for patient 1's FTSTS test score of 13.71 seconds and 7 seconds for patient 2 (Table 1).

The Timed Up and Go (TUG) was used as an examination measure to assess mobility, balance, and walking ability. The minimal detectable change (MDC) using a 95% confidence interval for the TUG test is 2.27 second among patients that underwent TKA [22]. Patient 1 completed the TUG test in 11.94 seconds and patient 2 completed the test in 12.09 seconds (Table 1).

The 6MWT assesses activity tolerance. The MDC calculated from the standard error of measurement (SEM) was 58.21 meters for geriatric patients [23]. The mean distance for community dwelling elderly female patients was 471 meters for the 6 MWT [24]. Patient 1 completed the 6MWT with 396.24 meters covered and patient 2 completed the test with 365.76 meters covered (Table 1).

A long arm goniometer was used for both patients in sitting as it is considered a gold standard with well-established reliability [25,26]. The ICC for inter-rater reliability was noted at .996 and the intra-rater reliability was noted at .993, which are both excellent [27]. ROM for the right knee was noted at 4-94 degrees active flexion for patient 1 and 2-95 degrees active flexion for patient 2 (Table 1).

The Numeric Pain Rating Scale (NPRS) was used to assess pain in the right knee for both patients. The NPRS mean value for patients receiving a total joint replacement is around 7.9/10 with a standard deviation of 1.7 point [28]. The minimum clinical improvement accepted requires a pain reduction of 20% and the least clinically significant difference is 1.58 points on the NPRS [28]. Patient 1 reported pain at 3/10 on the NPRS and patient 2 reported 6/10 pain (Table 1).

Patient 1 activity limitations included an inability to care for her husband. Patient 2 was unable to attend musical performances. Participation restrictions for patient 1 included supervision level stair ambulation, whereas patient 2 required modified independence to negotiate 4 steps (Table 1).

**Table 1:** Examination and Outcome Findings.

Key examination elements	ICF category	72-year-old initial findings	72-year-old outcome findings	74-year-old initial findings	74-year-old outcome findings
Five times sit to stand (FTSTS) test	Body structure/function	13.71 seconds	10 seconds	7 seconds	4.38 seconds
Timed up and go (TUG) test	Body structure/function	11.94 seconds	8 seconds	12.09 seconds	6 seconds
Six-minute walk test (6 MWT)	Body structure/function	396.24 meters	487.68 meters	365.76 meters	530.50 meters
Range of motion	Body structure/function	4-94 degrees	0-125 degrees	2-95 degrees	0-128 degrees
Numeric Pain Rating Scale (NPRS)	Body structure/function	3/10	0/10	6/10	0/10
Gait	Activity limitation	Straight cane with modified independence	Complete independence with no assistive device	No assistive device with modified independence	Complete independence with no assistive device
Stair ambulation	Activity limitation	Up and down 4 steps with supervision assistance	Up and down 4 steps with modified independent assistance	Up and down 4 steps with modified independent assistance	Up and down 4 steps with complete independence
Activity of daily living	Participation restriction	Unable to care for her mother and husband.	Able to care for her mother and husband.	Unable to attend musical performances	Able to attend musical performances

**Clinical Impression 2:**

Examination findings for both patients revealed deficits in functional strength, pain, balance as a result of the TUG, gait speed in addition to endurance, and ROM at varying levels. Each examination finding resulted in activity limitations, participation restrictions, and inability to perform ADL at their premorbid level of function with varying degrees between patients. Goals were established to address deficits (Table 2).

**Table 2:** Physical Therapy Goals.

<b>72-year-old physical therapy goals (Patient one)</b>	<b>74-year-old physical therapy goals (Patient two)</b>
Short-term goals:	Short-term goals:
1. Pt. will be modified independent with gait using no assistive device on even and uneven surfaces within 4 weeks.	1. Pt. will be independent with gait using no assistive device on even and uneven surfaces within 4 weeks.
2. Pt. Will perform gait up and down 4 steps with modified independence to enter and exit her home within 4 weeks.	2. Pt. Will perform gait up and down 12 steps with independence to negotiate stairs in her home within 4 weeks.
3. Pt will improve right knee active range of motion to 0-110 degrees for improved gait, transfers, and stair ambulation within 4 weeks.	3. Pt will improve right knee active range of motion to 0-115 degrees for improved gait, transfers, and stair ambulation within 4 weeks.
4. Pt. Will improve her Timed up and go score to 8 seconds or less to improve gait stability and speed within 4 weeks.	4. Pt. Will improve her Timed up and go score to 8 seconds or less to improve gait stability and speed within 4 weeks.
5. Pt. Will improve her Five times sit to stand test to 8 seconds or less to improve functional strength and muscular endurance for improved performance with activities of daily living within 4 weeks.	5. Pt. Will improve her Five times sit to stand test to 5 seconds or less to improve functional strength and muscular endurance for improved performance with activities of daily living within 4 weeks.
6. Pt. Will improve her Six-minute walk test score to 487.68 meters to improve gait speed and activity tolerance for improved community ambulation within 4 weeks.	6. Pt. Will improve her Six-minute walk test score to 406 meters to improve gait speed and activity tolerance for improved community ambulation within 4 weeks.
Long-term goals:	Long-term goals:
1. Pt. Will report no pain at rest and 1-2/10 pain at worst with activity using exercise and cryotherapy as needed by discharge.	1. Pt. Will report no pain at rest or with activity using exercise, electrical stimulation as needed, and cryotherapy as needed by discharge.
2. Pt. Will be independent with a home exercise program to maintain gains made in therapy prior to discharge from physical therapy services.	2. Pt. Will be independent with a home exercise program to maintain gains made in therapy prior to discharge from physical therapy services.

**Table 3:** Exercise Interventions.

<b>Exercise</b>	<b>Intensity</b>	<b>Frequency range</b>	<b>Durations</b>	<b>Rule for progression</b>
Recumbent bike	Level 3-Level 5 resistance	3 time a week	10-20 minutes	Patient report of minimal work to complete the task.
Wall squats	5-15 reps, hold 5-15 seconds each	0-3 times a week	5-10 minutes	Patient reports of minimal work to complete the task.
Lunges	2 sets, 10 reps	0-3 times a week	5-10 minutes	Patient reports of minimal work to complete the task.
Balance level surface tandem stance	2 sets of 30 second holds	0-3 times a week	2-3 minutes	Patient reports of minimal difficulty with the intervention.
Balance training foam (uneven) surface	Romberg (1 set with 1-minute hold) and modified tandem stance (2 sets of 1-minute holds)	1-3 times a week	3-5 minutes	Patient reports of minimal difficulty with the intervention.
Balance training rocker-board surface	Anterior posterior and medial lateral board placement eyes open and closed 3 sets of 1-minute holds	0-3 times a week	5-10 minutes	Patient reports of minimal difficulty with the intervention.
Single leg stance on a step (eyes open or closed)	2-4 sets of 1-minute holds	0-3 times a week	5-10 minutes	Patient reports of minimal difficulty with the intervention.

### **Interventions**

Balance training on even and uneven surfaces with eyes open and closed to work on proprioception and righting reactions, and reaching out of their base of support tasks were included. Each patient participated in balance training 9 to 12 sessions over a thirty-day period for 10-25 minutes per session (Table 3). Progression from level surface, to foam cushion, and to the rocker-board surfaces was based on the patient’s self-reported ability to perform the activity.

Gait training addressed deficits that each patient was experiencing including symmetry, increasing step length, increasing step height, normalizing cadence, and using the least restrictive assistance device to no assistive device. Each patient participated in gait interventions nine to twelve sessions over a 30-day period for an approximate time frame of 10-25 minutes per session. Progression from even to uneven surfaces was based on each patient's stability and comfort.

Strength training was performed using progressive resistive exercises (PREs) to improve LE strength. Each patient participated in 20-30 reps at moderate intensity as defined by the patient report of minimal, moderate, and maximum ease of exercise completion. The objective was to improve general strength using specific weight-bearing activities including wall slides, squats, heel-raises, and lunges. In addition, seated and standing PREs were used to address specific muscle groups to improve functional mobility. Strength training took place 9 to 12 sessions over a 30-day period for 10-15 minutes per session (Table 3).

Progressive knee ROM exercise using manual therapy techniques for quad and hamstring stretches and Proprioceptive Neuromuscular Facilitation (PNF) stretching techniques to improve knee ROM were used nine to twelve sessions over a 30-day period for 10-15 minutes each session. Progression was determined by the patient's self-reported tolerance to stretching.

Aerobic exercise was performed with the lower extremity recumbent cycle at the start of treatment ranging from 10-20 minutes at moderate intensity 9 to 12 sessions over a 30-day period to warm-up, stretch the right lower extremity, and to improve ROM. Progression of resistance was based on the patient working at a moderate intensity with the ability to maintain 50-60 steps per minute (Table 3). A written Home Exercise Programs (HEP) included knee flexion and knee extension stretches, standing lower extremity exercises, and cryotherapy for pain management (Appendix 1).

**Appendix 1:** Home exercise program for both patients.

<b>Exercise</b>	<b>Parameters</b>
Supported squats	30 repetitions (reps), once per day
Standing hamstring curls	30 reps, once per day
Standing supported hip flexion	30 reps, once per day
Standing supported hip abduction	30 reps, once per day
Seated knee extension stretch with quad set	10 reps holding 5 seconds, once per day
Standing supported heel raises	30 reps, once per day
Standing knee flexion stair stretch	10 reps holding 10-15 seconds, once per day

## **Outcome**

Patient 1 with moderate medical complexity met all her goals in the 30-day period of time. Pain was reduced from 3/10 on the NPRS to no pain. Right knee ROM was improved from 4-90 degrees to 0-125 degrees. The patient's TUG score improved from 11.94 seconds to 8 seconds, which exceeds the MDC using a 95% confidence interval of 2.27 seconds for the TUG. Her FTSTS test improved from 13.71 seconds to 10 seconds. This improvement has an absolute and relative MDC of 2.5 seconds for patients aged 70-87 years old [29]. Lastly, the 6 MWT improved from 396.24 meters to 487.68 meters. The improvements met the MDC of 58.21 meters for geriatric patients [23] and the mean distance for community dwelling elderly female patients of 471 meters [24] (Table 2).

Patient 2 with low medical complexity met her goals in the 30-day period of time. Pain was reduced from 6/10 on the NPRS to no pain. Right knee ROM was improved from 2-95 degrees to 0-128 degrees. The patient's TUG score improved from 12.09 seconds to 6 seconds, which exceeds the MDC using a 95% confidence interval of 2.27 seconds for the TUG. Her FTSTS test improved from 7 seconds to 4.38 seconds. This improvement has an absolute and relative MDC of 2.5 seconds for patients age 70-87 years old [29]. Lastly, the 6 MWT improved from 365.76 meters to 530.50 meters. The improvement exceeded the MDC of 58.21 meters for geriatric patients [23] and the mean distance for community dwelling elderly female patients of 471 meters [24] (Table 2).

## **Discussion**

The goal of this case report was to describe interventions that were used with two geriatric patients with different levels of medical complexity. This case report compared the 2 geriatric patient's outcome measures after undergoing similar PT interventions following TKA.

Both patients were highly motivated to improve their functional mobility, had good family support, and were compliant. The difference between the 2 patients was the medical complexity level.

In conclusion, it is difficult to make generalizations regarding outcomes based on two cases. Both patients reported continuing their HEP and expressed satisfaction with their physical therapy outcomes. Future studies using a larger sample size of patients would be beneficial. Future studies could investigate how standardized interventions affect geriatric patients with varying medical complexity levels in order to identify if different interventions are necessary for different levels of medical complexity. Future research could examine ways to identify appropriate goals based on varying medical complexity levels.

## **REFERENCES**

1. Piva SR, Schneider MJ, Moore CG, et al. Effectiveness of later-stage exercise programs vs usual medical care on physical function and activity after total knee replacement: a randomized clinical trial. *JAMA Netw Open.* 2019; 2: 190018.
2. Sattler LN, Hing WA, Vertullo CJ. What is the evidence to support early supervised exercise therapy after primary total knee replacement? A systematic review and meta-analysis. *BMC Musculoskelet Disord.* 2019; 20: 42.

3. Domínguez-Navarro F, Igual-Camacho C, Silvestre-Muñoz A, et al. Effects of balance and proprioceptive training on total hip and knee replacement rehabilitation: A systematic review and meta-analysis. *Gait Posture*. 2018; 62: 68-74.
4. Schache MB, McClelland JA, Webster KE. Does the addition of hip strengthening exercises improve outcomes following total knee arthroplasty? A study protocol for a randomized trial. *BMC Musculoskelet Disord*. 2016; 17: 259.
5. Wylde V, Artz N, Marques E, et al. Effectiveness and cost-effectiveness of outpatient physiotherapy after knee replacement for osteoarthritis: study protocol for a randomised controlled trial. *Trials*. 2016; 17: 289.
6. Artz N, Elvers KT, Lowe CM, et al. Effectiveness of physiotherapy exercise following total knee replacement: systematic review and meta-analysis. *BMC Musculoskelet Disord*. 2015; 16: 15.
7. Fransen M, Naim L, Bridgett L, et al. Post-Acute Rehabilitation After Total Knee Replacement: A Multicenter Randomized Clinical Trial Comparing Long-Term Outcomes. *Arthritis Care Res (Hoboken)*. 2017; 69: 192-200.
8. Han AS, Naim L, Harmer AR, et al. Early rehabilitation after total knee replacement surgery: a multicenter, noninferiority, randomized clinical trial comparing a home exercise program with usual outpatient care. *Arthritis Care Res (Hoboken)*. 2015; 67: 19.
9. Bruun-Olsen V, Heiberg KE, Wahl AK, et al. The immediate and long-term effects of a walking-skill program compared to usual physiotherapy care in patients who have undergone total knee arthroplasty (TKA): a randomized controlled trial. *Disabil Rehabil*. 2013; 35: 2008-2015.
10. Madsen M, Larsen K, Madsen IK, et al. Late group-based rehabilitation has no advantages compared with supervised home-exercises after total knee arthroplasty. *Dan Med J*. 2013; 60: A4607.
11. Simpson AH, Hamilton DF, Beard DJ, et al. Targeted rehabilitation to improve outcome after total knee replacement (TRIO): study protocol for a randomised controlled trial. *Trials*. 2014; 15: 44.
12. Fleischman AN, Crizer MP, Tarabichi M, et al. Insall Award: Recovery of Knee Flexion with Unsupervised Home Exercise Is Not Inferior to Outpatient Physical Therapy After TKA: A Randomized Trial. *Clin Orthop Relat Res*. 2019; 477: 60-69.
13. Henderson KG, Wallis JA, Snowdon DA. Active physiotherapy interventions following total knee arthroplasty in the hospital and inpatient rehabilitation settings: a systematic review and metaanalysis. *Physiotherapy*. 2018; 104: 25-35.
14. Hammett T, Simonian A, Austin M, et al. Changes in physical activity after total hip or knee arthroplasty: A systematic review and meta-analysis of six- and twelve-month outcomes. *Arthritis Care Res (Hoboken)*. 2018; 70: 892-901.
15. Medical Advisory Secretariat. Physiotherapy rehabilitation after total knee or hip replacement: an evidence-based analysis. *Ont Health Technol Assess Ser*. 2005; 5: 1-91.
16. Lenguerrand E, Artz N, Marques E, et al. Effect of group-based outpatient physiotherapy on function after total knee replacement: The ARENA randomised controlled trial. *Arthritis Care Res (Hoboken)*. 2019.
17. Doma K, Grant A, Morris J. The Effects of Balance Training on Balance Performance and Functional Outcome Measures Following Total Knee Arthroplasty: A Systematic Review and Meta-Analysis. *Sports Med*. 2018; 48: 2367-2385.
18. Husby VS, Foss OA, Husby OS, et al. Randomized controlled trial of maximal strength training vs. standard rehabilitation following total knee arthroplasty. *Eur J Phys Rehabil Med*. 2018; 54: 371-379.

19. Adie S, Kwan A, Naylor JM, et al. Cryotherapy following total knee replacement. *Cochrane Database Syst Rev.* 2012; 12: CD007911.
20. Evans WK. The keys to effective documentation. *PT in motion.* 2016; 8: 8-12.
21. Mirapeix FM, Fernandez IV, Canizares JL, et al. Five times sit to-stand test in subjects with total knee replacement: Reliability and relationship with functional mobility tests. *Gait and Posture.* 2018; 59: 258-260.
22. Whitney SL, Wrisley DM, Marchetti GF, et al. Clinical measurement of sit-to-stand performance in people with balance disorders: validity of data for the Five-Times-Sit-to-Stand Test. *Phys Ther.* 2005; 85: 1034-1045.
23. Yuksel E, Kalkan S, Unver B, et al. Assessing minimal detectable changes and test-retest reliability of the timed up and go test and the 2-minute walk test in patients with total knee arthroplasty. *J Arthroplasty.* 2017; 32: 426-430.
24. Perera S, Mody SH, Woodman RC, et al. Meaningful change and responsiveness in common physical performance measures in older adults. *J Am Geriatr Soc.* 2006; 54: 743-749.
25. Steffen TM, Hacker TA, Mollinger L. Age- and gender-related test performance in community-dwelling elderly people: Six-Minute Walk Test, Berg Balance Scale, Timed Up and Go Test, and gait speeds. *Phys Ther.* 2002; 82: 128-137.
26. Schurman DJ, Rojer DE. Total knee arthroplasty: range of motion across five systems. *Clin Orthop Relat Res.* 2005; 430: 132-137.
27. Dos Santos RA, Derhon V, Brandalize M, et al. Evaluation of knee range of motion: Correlation between measurements using a universal goniometer and a smartphone goniometric application. *J Bodyw Mov Ther.* 2017; 21: 699-703.
28. Hancock GE, Hepworth T, Wembridge K. Accuracy and reliability of knee goniometry methods. *J Exp Orthop.* 2018; 5: 46.
29. De Luca ML, Ciccarello M, Martorana M, et al. Pain monitoring and management in a rehabilitation setting after total joint replacement. *Medicine (Baltimore).* 2018; 97: e12484.
30. Alcazar J, Losa-Reyna J, Rodriguez-Lopez C, et al. The sit-to-stand muscle power test: An easy, inexpensive and portable procedure to assess muscle power in older people. *Exp Gerontol.* 2018; 112: 38-43.