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RESEARCH ARTICLE

POST-OPERATIVE REHABILITATION OF A RIGHT SIDED TOTAL KNEE ARTHROPLASTY PATIENT- A CASE REPORT

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Abstract

Background and purpose: Osteoarthritis(OA) is a progressive degenerative condition resulting from the cartilage wear and tear that leads to knee joint deformities and functional limitations. Total knee arthroplasty (TKA) has become the gold standard treatment for surgically managing knee osteoarthritis, but physical rehabilitation after surgery is critical for returning function to pre-surgery levels. The purpose of this case report is to describe the effectiveness of physical therapy intervention and report outcomes following a right TKA.

Case Description: The present case report describes the 12-week outpatient physical therapy rehabilitation of an 86-year-old woman who underwent right-sided TKA. She suffered from knee pain and limited ambulating speed since three years. During outpatient rehabilitation patient received treatment for improving functional mobility, ROM, strength, and gait training.

Outcomes: During course of 12 weeks of physical therapy rehabilitation improvement was seen in pain from 2/10 to 0/10 on NPRS, flexion ROM from 110degrees to 130 and strength from 3-/5 to 4/5 on MMT. Additional outcome measures that showed improvement includes Time Up and Go Test (TUG) for mobility from 16.5 to 14.97 seconds and gait speed 0.6 m/s to 0.78 m/s. She was able to accomplish both short-term and long-term goals.

Discussion: This study supports that early mobilization and therapeutic exercises in post knee arthroplasty can improve functional outcomes and help patient to return to the prior level of function. Although, it is recommended that further research is needed to be done on a larger population to establish its effectiveness.

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Introduction:-

Osteoarthritis also known as Degenerative Joint Disease leads to the pain, inflammation and damage to the joint, often occurring in elderly people.¹ Joint replacement surgery is a safe and effective procedure to relieve pain, correct leg deformity, and help patients resume normal activities.² Approximately 80% of adults of over 55 years shows evidence of OA on an X-ray. Per one statistical estimate, over 240 million adults show OA symptoms with post-menopausal women having a higher chances of getting OA as compared to men.² Due to severe damage to the joint, patients usually suffer from limited mobility and difficulty in participating in activities of daily living.³ Initially conservative treatments are considered to manage symptoms, but when they fail, total knee replacement surgery is suggested to be a great alternative.

Around one million knee replacement surgeries are performed each year in the United States which makes it one of the conventional orthopedic procedures performed in today's time. Another statistical projection shows that there will be up to 673% rise in the knee replacement procedures by 2030, making it to 3.5 million surgeries per year. Interestingly, around 60% of all knee replacement surgeries are done on women.⁴

Common issues following TKA includes gait speed impairments, reduced quadriceps strength and range of motion deficits. Physical therapy rehabilitation has proven to benefit with long-term strength gains in turn improving the functional outcomes.⁶ Therefore, it is recommended to provide adequate treatment for maximizing the physical function following TKA.⁵ Targeting major muscles of lower extremity and providing progressive resisted exercises and other high intensity exercises has shown greater long-term improvement in strength and function.⁶ Due to huge benefits of the exercises in improving the functional outcomes, the purpose of this case study was to provide therapeutic exercises, manual therapy, gait and balance training to the patient to reach prior level of function post TKA.

Patient History and Systems Review

An 86-year-old woman residing at an independent living facility presented to an outpatient physical therapy two weeks after total knee arthroplasty. Pre-operative x-ray revealed severe osteoarthritis(OA) of the right knee with complete loss of the medial joint space, appearance of bone spurs and knee valgus. During the surgery, the valgus deformity was corrected, after which the patient ambulated with a rolling walker for two weeks.

Post arthroplasty, an examination of various systems was performed as part of the initial evaluation(Table 1). In the initial outpatient visit she presented with pain 2/10 on Numerical Pain Rating Scale(NPRS), range of motion(ROM)110 degrees of flexion and -10 degrees of extension, muscle strength -3/5 on Manual Muscle Testing(MMT), and impaired gait with little to no flexion while ambulating.

Comorbidities included: OA, atrial fibrillation, atrial-flutter, hypertension, left breast cancer, increased fracture risk.

The goals from physical therapy were to ambulate independently without pain, restore muscle strength so as to return to the recreational activities with minimal to no discomfort.

Clinical impression 1

The subjective information presented here mentions primary complaints of the patient after TKA that includes pain during walking and knee bending, reduced flexibility in the muscles, weakness and inability to achieve complete knee flexion during walking. The system review results supported the above impairments.

As discussed in the systems review few tests and measures were conducted to get the detailed information like: MMT, girth measurement, ROM via goniometry, NPRS for pain, gait speed measurement and TUG test were used to assess the mobility. Baseline measurements were used to plan goals for the therapy.

Based on the results of the tests and outcome measures, physical therapy post TKA is an appropriate intervention in order to improve muscle function, strength and mobility in order to reach the prior level of active function. It can be determined that the patient was a good candidate for this case report due to similarity in the symptoms with other candidates with OA who can resume prior level of activities and strength by doing early physical therapy intervention.

Examination

After the initial evaluation, tests and outcome measurements were taken for further and detailed examination that assisted in goal setting. Tables 2 and 3 provide additional findings from these tests and outcome measures.

Manual Muscle Testing

One study conducted by R W Bohannon revealed that MMT and dynamometer measures are greatly correlated to measure muscle strength ($r = 0.768$; $P < 0.001$).⁷ Both lower extremity muscles were tested, including hip flexors and knee extensors (quadriceps) in a seated position and knee flexion (hamstrings) in a prone position. Gross right operated hip, quadriceps and hamstrings strength was 3-/5. Gross left lower extremity strength was 4-/5.

Goniometry

A goniometer was used to measure the patient's active and passive range of motion. As a result, active knee flexion was 110degrees and extension was -10degrees, while passive knee flexion was 115degrees and extension was -8degrees. A study conducted by P PGogia, et al. found the goniometer has high intertester reliability ($r = .98$; ICC = .99) and validity ($r = .97-.98$; ICC = .98-.99). Therefore, measurements taken from goniometer at the knee joint are reliable and valid.⁸

Girth Measurement

The knee circumference measurements are generally reliable for assessing the intra-articular effusion (ICC > 0.8).⁹ Three repeated measurements of an operated knee were taken in supine position at the center of the knee and around the joint line. An average of these measurements was taken into consideration. The right knee measured 19.5 inches, and the left knee measured 16 inches. Left knee measurements served as a baseline.

Palpation and Scar Integrity

Scar integrity and palpation post knee surgery are essential to prevent complications like necrosis and infection.¹¹ The scar appeared pink and showed good healing with intact skin upon palpation.

Gait speed

The gait speed assessment can be used as a baseline for functional recovery and to plan rehabilitation.¹⁷ A gait time of 0.60 m/s was calculated by using the 4-meter distance ambulated by the patient with a rollator walker. According to one study by Hammid Abbasi, et al. the test-retest reliability of gait speed is higher showing gradual improvement with rehabilitation.¹¹

Time Up and Go Test

The time up and go test is used to assess mainly mobility. It also evaluates walking ability, balance(static and dynamic) and fall risk. The test begins when a person rises up from a chair, walks three meters, turns around 180 degrees, comes back to the chair and sits. Patient was able to complete TUG test in 16.5 seconds. Ability to walk and gait speed are important factors determining pain level and patient's function. It is an objective measure that demonstrates a good correlation ($r = -0.557$ to -0.770 , $P = 0.00010.005$) as reported by patients.¹²

Numeric Pain Rating Scale

This scale is an easiest method to know the patient verbalized pain level. As part of the measurement, the patient is asked to rate the pain from 0 (zero) to 10, where zero is "no pain" and 10 is "maximum pain." Initial examinations revealed a 2/10 pain level, which was followed up at every subsequent visit. Studies have shown that numerical rating scale shows good sensitivity and the data obtained can be analyzed for further use.¹³

Clinical impression 2

The data obtained from the baseline assessment of body systems confirmed that after surgery, the patient presented with pain, limited knee range of motion, difficulty in independent ambulation, reduced muscle strength and endurance. Considering the patient's need for an extended rehabilitation to improve the above outcomes measures, she was considered to be a suitable candidate for the case report. The interventions were administered at outpatient facility as early as 2 weeks post TKR and progressed appropriately to make patient recovery faster while being able to return to recreational activities and independent walking. Being independent and motivated to return to her prior level of function like going to the gym, walking outdoors and participating in various activities conducted at the independent living facility showed good prognosis in this patient.

A re-examination or re-assessment will be done after six weeks and twelve weeks of physical therapy to evaluate the effectiveness of the intervention. One study conducted on older adults revealed that patients who undergo hip or knee replacements may take longer time to recover but they show excellent long-term outcomes.¹⁴

Intervention

Based on patient's condition post-surgery, outpatient physical therapy was recommended twice a week for twelve weeks followed by the home exercise program. The treatment included: manual mobilization of the patellofemoral and tibiofemoral joints, therapeutic strengthening exercises to improve the lower extremity strength, range of motion and flexibility exercises. The interventions were designed to achieve both short- and long-term objectives (Table 4). Each visit lasted approximately forty five minutes and the patient was educated to adhere to the home exercise

program for achieving the successful treatment outcome. The Brigham and Women's Hospital TKA protocol served as a guide to prognostic indicators, as well as to general advancement of exercises and manual therapy.¹⁵

Warm-up- Each session commenced by doing warm-up that included stretching the quadriceps, hamstrings and calf with 10 seconds hold 3 times. Studies indicate that the muscle performance can be improved after adequate warm-up activities like stretching before the exercises.¹⁶

Pain and ROM- To reduce pain and improve ROM, joint mobilizations were performed on tibiofemoral and patellofemoral joint.¹⁷ The physical therapist performed grade 1 and 2 mobilization for pain relief and grade 3 and 4 for improving range of motion. It is believed that joint mobilization for primary TKA accelerates the rehabilitation in patients. It also aides in reducing the pain and improves ROM in turn affecting the quality of life.¹⁸ In order to improve ROM, the patient was advised to ride a bike at home and during the session for 10-15 minutes at load levels 1-3 in the beginning, eventually increasing to levels 4-9.

Strengthening exercises- Exercises focusing on strengthening were prescribed for optimal functional strength. Exercises were progressed based on principles of gravity, resistance, leverage and resistance. Patient performed strengthening exercises which includes isometrics of quadriceps, hamstrings and gluteal muscles. Supine heel slides and seated long arc quadriceps. Additionally, SLR in four planes (flexion, abduction, adduction, extension) was performed in supine for added mobility and strength.¹⁵ Partial lunges and small arc squats in standing showed the additional benefits in improving the quadriceps strength in later weeks. Initially, repetitions and sets were performed ten times for each exercise, but overtime repetitions and sets were increased for increased strength and endurance.

Therapeutic activities and functional training- Therapeutic activities like sit to stand to improve knee flexion during functional tasks, weight shifting anteriorly, posteriorly were added to enhance the weight bearing capacity of the joint. Lower limb progressive resistance exercises were provided to aide in strengthening the major muscle group. Progressive resisted exercises are known to be safe and effective in improving the functional performance and strength.¹⁹

Balance training- A significant positive correlation exists between balance training and functional recovery and mobility outcomes in patients with knee osteoarthritis following a total knee replacement.²⁰ Balance training on a foam surface under contact guard assistance (CGA) was provided to the patient thus in turn improving proprioception stimulation to the joint.

Gait and aerobic training- Gait training was an integral part of the treatment as patient exhibited lack of knee bending post TKA. Constant education was provided on heel to toe pattern while walking and bending the knee. Many patients report improvements in gait speed after a few weeks following TKA, due to reduced pain and improved function.²¹ The rehabilitation program also included aerobic training of at least 15-20 minutes every day. American college of sports medicine recommends aerobic training and strength training to be performed 2-3 times per week for 30 to 40 mins during phase 1 rehabilitation.²² For the first two weeks of rehabilitation, the patient exhibited antalgic gait with decreased weight acceptance on the right, heavy reliance on a walker, uneven steps, and minimal knee flexion during swing phase on right. Upon discharge, patient demonstrated near normal gait pattern and marked improvement in ambulation distance. This improvement was noted objectively with TUG test and gait speed upon completion of care.

Additional rehabilitation included passive range of motion (PROM) exercises, transverse friction massage and soft tissue mobilization to quadriceps and hamstrings to improve muscle flexibility. During the rehabilitation program, these techniques were applied for about ten to twenty minutes each session.

Outcome

The interventions that focused on reducing pain, improving right knee ROM, strength and overall functional mobility showed remarkable improvement. Additional progress was seen with functional mobility and strength towards the end of intervention.

The goal for this patient was to walk independently and return to her previous level of active function in order to participate in recreational activities. During discharge the patient was walking independently more than 500 feet without assistive device.

TUG test and gait speed are excellent indicators of mobility and functional gains. She improved from 16.5 seconds to 14.9 seconds on the TUG test, meeting one of her long-term goals. Gait speed showed improvement from 0.60 m/s to 0.78 m/s with a meaningful improvement of >0.18 m/s at the end of care. Pain improved from a 2/10 to less than a 1/10 on the NPRS with the rehabilitation. Her functional activities became more independent after the pain was reduced.

In terms of right knee ROM, the patient made considerable gains in flexion ROM from 110 degrees to 130degrees and extension from -10degrees to 3degrees. Furthermore, the operated knee measured 16 inches in circumference, the same as its opposite knee by the end of rehabilitation, indicating no swelling. Patient achieved the muscle strength on MMT in right lower extremity from -3 to 4 improving her ability to actively participate in ADLs. Overall, the patient complied with all PT instructions. Also, she followed the home exercise program and used the cold pack for 10 minutes each day as instructed by the doctor.

Discussion

This case report describes physical therapy intervention including therapeutic exercises, gait and strength training to improve ROM and functional mobility post total knee replacement. The intervention and progression of the patient's therapy were based on evidence-based practice, clinical judgment and the patient's response to the therapy. Further research is needed to determine the long-term impact of these interventions.

The patient progressed well in twelve weeks of physical therapy treatment based on functional outcome measures. Therefore, a combination of therapeutic exercise and functional mobility training could be effective in improving functional status after a total knee replacement. Prognostic indicators for this patient included being highly motivated to participate in therapy, having strong family support, and complying with the HEP.

There was a complete achievement of all short-term and long-term goals, including independence with ambulation, improved gait speed and symmetry, improved right knee strength to 4/5. Constant patient education was provided including visual and verbal cues for continual maintenance of normal gait pattern. Based on the various research articles available supporting the lower extremity strengthening exercises post TKA, this patient also attributed a great achievement in strength. As the patient resumed the gym after longtime she started using leg press, knee extension and knee curls on the gym equipment. As a result of this case report, it is concluded that a combination of manual therapy and therapeutic exercises that strengthen hips and knees, along with balance, can improve functional mobility and quality of life after TKA.

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Appendix

Table 1:- Examination Systems Review.

Pulmonary/Cardiovascular	Respiratory rate: 20 breaths per minute Blood pressure: 118/96 mm/hg(millimeters of mercury) Pulse:72 beats/minute Oxygen Saturation: 97% Edema: impaired
Musculoskeletal	Gross strength: Impaired Gross ROM: Impaired Gross symmetry: Impaired Posture: Impaired
Neuromuscular	Balance: Unimpaired Coordination: Unimpaired Gait/locomotion: Impaired Transfers: Impaired
Integumentary	Skin color/ discoloration: Unimpaired Scar formation: Impaired
	Scar Integrity: Impaired
Affect, Cognition, Language, Learning Style	Affect: Unimpaired Cognition: Unimpaired Language: Unimpaired Learning style: Visual demonstrations

Table 2:-Tests & Measures with Initial Examination.

Active Range of Motion Flexion	Right 110 degrees
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Extension Passive Range of Motion Flexion Extension	-10degrees 115degrees -8degrees
Manual muscle strength Hip flexors Quadriceps Hamstrings	3-/5 3-/5 3-/5
Knee Girth Measurement	Right-19.5 inches, Left-16 inches
Palpation	Swelling around the knee joint line. Moderate tenderness at the popliteal fossa.
Skin Integrity	Intact scar with good healing.
Assistive device	Rolling walker
Supportive Devices	Thrombo embolic deterrent Stockings(TED)

Table 3:-Outcome Measure Scores at Initial Examination, Re-Assessment, and Discharge.

Outcome measures	Initial Examination	Re-Assessment	Discharge
Gait speed	0.60m/s ^a	0.70m/s	0.78m/s
TUG test ^b	16.5 seconds	15.4seconds	14.97 seconds
NPRS	2/10	1/10	0/10

^am/s-meter/second^bTUG test -Time up and go test**Table 4:- Short-term and long-term goals.**

Short-term goals	Long-term goals
Increase the right knee flexion AROM from 110 degrees to 120degrees within 4 weeks from the start of care in order to improve gait function.	Increase the right knee flexion AROM from 120degreesto 130degrees within 10 weeks from the start of care in order to normalize the gait function.
Decrease the R knee circumference from 19.5 inches to 16inches within 3 weeks of start of care to reduce pain and improve ROM.	To improve the knee pain <2/10 on NPRS within 9 weeks to improve the ability to safely and effectively return to prior level of function.
Increase the right knee extension ROM from -10 degrees to >3 degrees within 4 weeks from start of care to improve the gait and mobility.	Improve the TUG test score from 16.5 seconds to 15 seconds within 10 weeks to improve the community mobility.
To show improvement in R lower extremity muscle strength on MMT from -3 to 4 within 4 weeks to increase the active participation in ADLs*.	Improve the ambulation to >500ft without assistive device within 11 weeks from start of care to participate in recreation activities.

*ADLs-Activities of daily living

Table 5:- Interventions.

Interventions	Early exercises (week 2-week 4)	Middle exercises (week 4-week 6)	Later exercises (week 6-week 12)
Warm-up	Stretching(flexion and extension).	Stretching (flexion and extension).	Stretching (flexion and extension).
Recumbent bike	For ROM at load level 1-3.	For ROM at load level 4-6	For ROM at load level 6-9.
Patellofemoral glides (superior/inferior) glides	Grade 1-2	Grade 2-3	Grade 3
Tibio-femoral glides (anterior/posterior) glides	Grade 1-2	Grade 2-3	Grade 3
Exercises	-Isometric quadriceps, hamstring, and gluteal isometric exercises.	-Isometric quadriceps, hamstring, and gluteal isometric exercises.	-Isometric quadriceps, hamstring, and gluteal isometric exercises.

	-Supine heel slides and seated Long Arc Quad (LAQ). -SLR in four planes. -Repetitions: 10x1 set	-Supine heel slides and seated Long Arc Quad (LAQ). -SLR in four planes. -Frontal and lateral step up-down. -Repetitions: 10x2 sets.	-Hip abduction in side lying. -Repetitions: 10x2 sets.
Partial lunges	-	2 sets of 10 repetitions.	3 sets of 10 repetitions.
Resistance exercises	-	Resistance with 1lb ^a ankle weights during exercise.	Resistance with 2lb ankle weights during exercise.
Squats	-	Partial squats 1 set of 10 repetitions.	Full squats 2 sets of 10 repetitions.
Gait training	Educated and motivated about heel toe pattern and knee bending.	Visual feedback via mirror provided for improving knee flexion during walking.	Visual feedback via mirror provided for improving knee flexion during walking.

^a lb-Pound.