Standard of Care: Total Knee Arthroplasty

Physical Therapy Management of the Patient following Total Knee Arthroplasty

Case Type / Diagnosis:

Practice Pattern:
4H: Impaired Joint Mobility, Motor Function, Muscle Performance, and Range of Motion Associated With Joint Arthroplasty

ICD-9 Codes:
170, 171, 213, 215, 714, 715, 716, 717, 718, 719, 729, 730, 731, 733, 836, 958

The disorders that are under consideration for this standard of care include, but are not limited to: osteoarthritis (OA), rheumatoid arthritis (RA), avascular necrosis, tumors/osteosarcoma, Ehlers-Danlos syndrome, and traumatic joint injuries.

This standard of care applies to patients following total knee arthroplasty (TKA) and serves as a guide for clinical decision-making for physical therapy management of this patient population at Brigham and Women's Hospital (BWH) acute care and outpatient physical therapy services.

The purpose of TKA is to improve the biomechanics of the knee joint by replacing the damaged joint with a prosthetic implant, realigning of the soft tissues, and eliminating structural and functional deficits. The basic concepts of physical therapy management following TKA are the same regardless of the severity of the underlying disorder, the type of knee prosthesis, or the surgical approach. These basic concepts are:

- return to normal biomechanics
- improvement in range of motion
- recovery of muscle balance
- alleviation of pain
- improvement in function and quality of life

The time for recovery and the intensity of physical therapy treatments may need to be adjusted based on the severity of the underlying pathology and other surgical and patient related factors.

Indications for Treatment:

Total knee arthroplasty has become the standard of care for patients with end-stage knee OA and is the most frequently performed orthopedic procedure in the United States.[1] It is expected that by 2030, nearly half a million TKA will be performed in the United States.[2] In a recent meta-analysis of largely osteoarthritic patients, TKA was found to be associated with substantial functional improvements and pain relief.[3] In patients with RA[4] and avascular necrosis[5], TKA has also resulted in recovery of function compared to the pre-surgical state.

New development in TKA design has allowed higher flexion ranges following surgery.[6] This improvement in design allows for flexion ranges as high as 155 degrees without tension on the extensor mechanism. Improved surgical techniques, pre-operative counseling and aggressive post-operative rehabilitation increase the chances of gaining a higher degree of flexion. This enables patients to potentially participate in activities such as gardening and deep kneeling for various daily activities.

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Surgical Technique and Approach:

Bicompartmental Arthroplasty

Knee arthroplasty design in the United States has its roots at BWH with the first bicompartmental knee used in the 1960's.[7] The Press-Fit Condylar (PFC) Sigma Total Knee System is the most common total knee design used at BWH. The first PFC Total Knee System was designed and implanted by Dr. Thomas Thornhill and Dr. Richard Scott in 1984.[8] This system was a cementless or cemented fixation with or without porous coating. The design had a broad spectrum of proportional sizes, tibial tray modularity, universal exchangeability among femoral and tibial sizes, and an oval-shaped patellar component for increased metal-plastic contact within the trochlea during knee flexion.

The PFC Sigma Total Knee System (Figure-1) was further advanced by the addition of a mobile-bearing rotating platform in the mid-1990's by Dr.Thornhill and Dr.Scott.[7] In this design, a polished chrome-cobalt tray accepts highly conforming, PCL-preserving, -sacrificing, or -substituting tibial inserts that are free to rotate about a central post inside the tray. The mobile-bearing alternative was designed to allow for high conformity between metal and plastic to minimize stresses and lower the potential for wear.

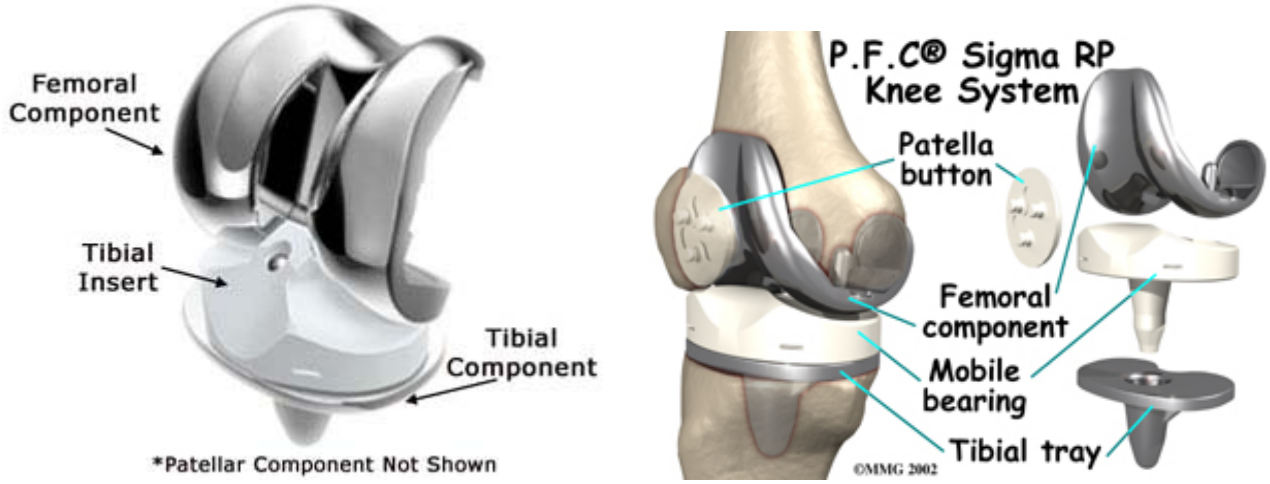

Figure-1: Bicompartmental Total Knee System
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Unicompartmental Arthroplasty

The evolution of unicompartmental knee arthroplasty dates back to 1972 when unicompartmental designs were used with 92% good to excellent results in two to six year follow up.[9] In 1990, Dr. Thornhill and Dr. Scott designed the PFC unicompartmental knee.[7] This design allowed for more conservative tibial and femoral resection with an anatomic geometry that allowed for decreased wear stresses on the polyethylene surface.

Posterior Cruciate Ligament Retention versus Substitution
Different schools of thought exist with regards to the retention or substitution of the posterior cruciate ligament (PCL). Both approaches have been shown to have excellent clinical results. Posterior cruciate retaining TKA has the advantage of maintaining the proprioceptive and stability function of the ligament, therefore resulting in less force imparted on the insert tray of the prosthesis. PCL substituting design is proposed to be effective in patients with an ankylosed knee, severe flexion contracture, or with chronic patellar dislocation.[7] Rehabilitation protocols are generally identical for both approaches.

Surgical Approach for Total Knee Arthroplasty
Standard Total Knee Arthroplasty is most often performed with the patient in a supine position and the knee exposed in flexion. A 13-15 cm straight vertical incision is often made to expose the knee joint. The incision is centered proximally over the shaft of the femur extending to the mid-third of the patella and distally just medial to the tibial tubercle. Different approaches are used to perform the arthrotomy for primary total knee arthroplasty. Some common approaches are: medial parapatellar arthrotomy, subvastus, mid-vastus, and lateral parapatellar arthrotomy. Once the incision into the joint has been made, the soft tissue around the joint is retracted to expose the bone. The bone is prepared by performing a femoral, tibial, and patellar cut and inserting the implant components. The joint capsule and soft tissue are then closed and the knee is brought through its ROM to measure the patient's quadriceps excursion and potential final flexion. The wound is dressed with non-adhesive gauze, sterile pads, and an elastic-type bandage or stocking from the foot up to the thigh. Some surgeons prefer to drain the knee after an arthroplasty. Therefore, some patients may have one or two small suction drains placed laterally in the joint, typically Hemovac or Jackson-Pratt. Depending on the amount of drainage and the surgeon preference, these drains may be removed the morning after surgery.

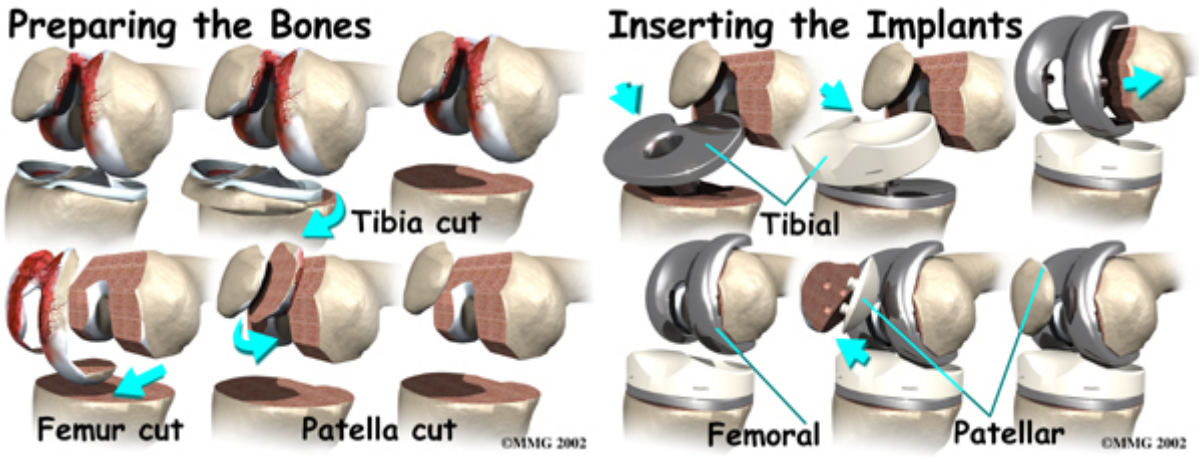

Figure-2: Surgical Approach for TKA
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Minimally Invasive Total Knee Arthroplasty

Minimally invasive knee arthroplasty was first introduced in the early 1990's using the unicondylar prosthesis. Ten years later, it was performed utilizing the bicompartmental design, thus innovating the minimally invasive TKA. Early studies resulted in less intraoperative blood loss, shorter length of stay, increased range of motion (ROM), with similar implant accuracy compared to standard TKA.[10]
Typically, minimally invasive TKA is performed on patients with OA who have good bone quality, minimal valgus/varus deformities, and mild to moderate ROM limitations. It is usually not indicated in patients with the following:

- severe flexion ROM deficits
- RA
- osteoporosis
- insulin-dependent diabetes
- morbid obesity
- chronic steroid use[11]

Among the minimally invasive approaches, the most commonly performed are the mini-midvastus and mini-subvastus. With the leg fully extended, a vertical incision typically less than 10 cm is made over the anteromedial aspect of the knee, from the proximal patella down to the tibial tubercle. After the muscle fibers are spread, the knee is then flexed to 70-90 degrees, the patella is subluxed, and the joint is then exposed. The primary differences between the standard and minimally invasive procedures include:

- smaller arthrotomy with less than 2 cm incision into the quadriceps tendon
- preservation of most of the suprapatellar pouch
- avoidance of patellar eversion and anterior dislocation of the knee
- smaller skin incision[12]

Furthermore, the innovation of computer-assisted surgery in conjunction with minimally invasive TKA has resulted in improved post-operative radiographic alignment as compared with standard TKA.[13]

Revision Total Knee Arthroplasty

Revision TKA is an unfortunate necessity that occurs in rare cases due to complications following total knee arthroplasty. The incidence of revision TKA is approximately 0.5 to 1.0% per year over the first 15 years after primary TKA. The most frequent causes leading to revision include:

- insert wear
- infection
- loosened/fractured femoral or tibial components
- hemarthrosis
- synovitis
- joint laxity
- ganglion cysts
- joint stiffness that requires manipulation

Mobile-bearing articulations which minimize the liner wear are becoming more frequently used in surgery, therefore the incidence of revision TKA is expected to decrease. In revision TKA, there is more

connective tissue and potentially structural/muscular changes, therefore caution must be taken by physical therapists in both the evaluation and treatment of these patients as compared to primary/standard TKA.[7]

Peri-operative Medical Management:

Anticoagulation Therapy
Patients undergoing TKA are often started on anticoagulants such as warfarin, coumadin, heparin, or aspirin the night before surgery, with an initial dose of 5-10 mg depending on age, weight, and medical status. This dose is adjusted after surgery depending on the patient's international ratio (INR) hematology values. At the time of discharge, patients who are at a high risk for deep vein thrombosis (DVT) will remain on anticoagulation therapy for 4-6 weeks, and then transition to aspirin for an additional 6 weeks. These high-risk patients include those who have undergone bilateral TKA, have a history of prior DVT, are on estrogen therapy, and/or have a recent history of cancer. For patients who are at a low risk for DVT, the transition to aspirin is made upon discharge from the acute hospital setting. Prior to this transition, these patients will typically undergo lower extremity non-invasive studies (LENIS) to screen for the absence/presence of DVT.

Pain Management
There are several different modes of analgesia used during and after TKA surgery. Continuous epidural anesthesia is the most widely used among the TKA surgeons at BWH. Bupivacaine is the most common medication infused via the spinal/epidural catheter through an infusion delivery pump controlled by the patient. Patient-controlled epidural anesthesia (PCEA) has shown proven benefit in the management of pain after knee arthroplasty.[14] However, there are patients who are unable to receive epidural analgesia due to prior spinal surgery, morbid obesity, or anticoagulation disorders. In these cases, a localized femoral nerve block may be performed, in which a similar medication is localized to the femoral nerve distribution of the operative leg. This can also be patient-controlled.

Intra-articular analgesia, such as the Stryker pain pump, is another alternative sometimes used for TKA patients. This is an indwelling catheter placed in the knee joint which provides a continuous infusion of Bupivacaine.[14] Depending on the patient's pain tolerance and levels, a patient controlled analgesia (PCA) pump with an intravenous (IV) narcotic is used either alone or in conjunction with any of the above outlined approaches. Most often, these pain management methods are discontinued on post-operative day 1 (POD#1). The patient is then transitioned to oral (PO) pain medication. All patients receive a standing dose of Tylenol, as well as a long-acting narcotic such as Oxycontin. In addition, a short-acting narcotic such as Oxycodone is used as needed for breakthrough pain control. If necessary, IV infusions of Morphine or Dilaudid are also provided to the patient for additional breakthrough pain relief. In certain cases, IV Toradol is also administered. Toradol is a short-term analgesic and potent NSAID (non-steroidal anti-inflammatory drug) that is typically used only in young healthy patients. Due to the potential for harmful gastrointestinal side effects such as peptic ulcers and bleeding, as well as decreased renal clearance, Toradol is contraindicated in patients over the age of 65, or those with creatinine levels greater than 1.5.

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Rehabilitation Management:

The typical length of stay at BWH for patients following TKA is two to three days excluding the day of surgery. The average acute care length of stay was found to be 3.5 days in a recent literature review of unilateral elective total joint replacements.[15] Due to the short length of stay following TKA, the focus of physical therapy (PT) management begins on POD#1 with initial evaluation and includes patient education, mobility, functional training, as well as increasing ROM and motor control of the articular and peri-articular structures of the knee joint. It is important to keep in mind that ROM, along with proper soft tissue balance is required to ensure proper biomechanics in the knee joint. Therefore, PT must address both impairments in order to ensure good outcomes. Aggressive post-operative PT has been shown to be effective in improving patient outcomes and shortening length of stay. Knowledge of the basic concepts in TKA and the acute care hospital course will guide clinical decision making in the outpatient physical therapy setting.[16, 17]

CONTRAINDICATIONS / ORDERS / PRECAUTIONS:

The following post-operative activity recommendations are often included in the MD consult for patients following TKA in the acute care setting:

- Weight bearing status (usually WBAT to FWB, occasional exceptions)
- Range of motion (ROM) parameters (most often there is no ROM limit, except in rare cases)
- Use of continuous passive motion device (CPM), typically set at 0-90 degrees
- Positioning of the operative extremity

It is important to recognize signs and symptoms of early post-operative complications and consult with other appropriate health care providers. Most common acute complications following TKA are:

- blood loss requiring transfusion
- deep vein thrombosis
- pulmonary embolism
- excessive joint bleeding
- joint infection
- peroneal nerve palsy
- compartment syndrome

If a patient presents during the first few days post-operatively with increased pain, excessive swelling, decreased muscle strength or sensation along a motor and/or sensory nerve distribution, sudden shortness of breath and decreased oxygen saturation along with increased resting heart rate, physical therapy interventions must be stopped, and the medical team consulted.

Late-onset complications following TKA may include:

- Skin necrosis requiring drainage and potentially surgery to correct the defect. In such cases it is recommended to stop all flexion exercises and refer the patient to the surgeon.
- Persistent joint drainage in the weeks following TKA. This complication is often treated with joint aspiration, antibiotics, and at times, debridement and joint lavage.

- Large hematoma formation. Patients are often asked to rest the knee joint, use ice to help decrease the size of the hematoma, and stop taking anticoagulants. If the hematoma does not resolve, patients may need surgical evacuation.
- Patellar tendon avulsion, more commonly in younger active patients. It is recommended to stop active extension exercises and refer the patient to the surgeon.[7]
- Wound healing complications in the first few weeks after surgery. Typically occurs in patients who are on chronic steroids or chemotherapy, have rheumatoid arthritis, obesity, diabetes, or are active smokers. The signs and symptoms are increased joint swelling, pain, and redness in the joint or at the site of the incision.

MEDICAL RECORD REVIEW/ PATIENT INTERVIEW:

Past Medical/Surgical History:
Review the pertinent past medical and surgical history documented in the medical record. Some comorbid conditions that can affect outcomes are:

- diabetes
- asthma
- medication-controlled hypertension
- coronary artery disease or prior myocardial infarction
- stroke with residual neurological deficits
- cancer
- renal disease requiring dialysis
- peripheral vascular disease with claudication
- Parkinson's disease
- systemic disorders
- active psychiatric disorders

Attention to the number of co-morbid conditions and the patients' age are important information as research has demonstrated factors such as age >=70 years and >1 co-morbid condition affects patient outcomes following TKA.[18, 19]

History of Present Illness and Hospital Course:
Attention to pre-operative ROM and strength values for the knee are among the most important data for the physical therapist during the medical history review. It is also imperative to review relevant diagnostic imaging and other tests that lead to the current diagnosis and decision to pursue surgical management. Inquire about presenting signs and symptoms, including: duration/severity, impact on function, and any prior management of symptoms via PT, medication, or other conservative means. Lastly, post-operative laboratory workup, especially hematocrit and INR level, need to be monitored when evaluating the TKA patient in the acute care setting. INR levels should not exceed 3.0 as this places patients at risk for post-operative hemarthrosis. Generally, if the patient's INR is 3.0 or higher, appropriateness of treatment must be discussed with the medical team. Please refer to the General Surgery Standard of Care for further details on hematocrit and INR parameters.

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Medications: Review current pharmacological management of current medical conditions. Common medications used in the acute management of patients following total knee arthroplasty are: bupivacaine, hydromorphone, oxycodone, oxycontin, and coumadin. Take note of the route of administration for medications (i.e. via epidural, IV, PO, etc), as this will help guide the examination.

Social History: Inquire regarding vocation, avocation, prior functional level, home environment, family/caregiver support, patient goals, and use of assistive devices and/or possession of durable medical equipment (DME).

EXAMINATION: (Physical / Cognitive / Applicable Tests and Measures)

This section is intended to capture the minimum data set and identify specific circumstance(s) that might require additional tests and measures. If Pain is identified as an examination category, then an objective measure should be selected for use to describe the current status; and an "action plan" identified for PT management.

Systems Review

Upon observation, the typical patient on POD#1 from a TKA will commonly have the following lines, tubes, and positioning devices:

- Epidural catheter, femoral nerve catheter, and/or PCA pump for pain medication administration
- Foley Catheter
- Nasal Cannula for oxygen therapy
- Cryocuff over the knee joint for cryotherapy
- Venodyne (compression) boots for DVT prophylaxis
- Telemetry/Cardiac and/or continuous oxygen saturation monitors depending on whether there is an epidural catheter in place or due to specific co-morbid conditions
- Knee immobilizer (depending on surgeon preference) to maintain the operative knee in extension, especially at night, when the patient is in bed, and off the CPM machine
- Towel roll under the ankle of the operative leg while in bed to maintain knee extension
- Hemovac or JP Drain to extract excess fluid from the operated knee joint

Musculoskeletal:

Anthropometrics

Body Mass Index (BMI) and/or height and weight of the patient should be included in the systems review to assist with guiding your examination.

ROM

Goniometric measurement of ROM of all lower extremity (LE) joints and gross assessment of ROM of the upper extremity (UE) joints are to be documented in the systems review. Active and passive ROM of the operative knee is measured, to include extension (while positioned over ankle towel roll), and flexion while seated or dangling. Limitations in ROM are also documented to further describe the end-feel of the joint (i.e. firm, bony, empty/painful).

Strength

Manual muscle test (MMT) or gross measurement of the LE and UE muscles is assessed and documented. Special attention is given to assess quadriceps strength, including the MMT score, ability to straight leg

raise (SLR) and perform long arc quad (LAQ), and the quality of an isometric quad contraction (i.e. trace, poor, fair, good) via palpation and observation. It is well established that quadriceps weakness, along with pain, is one of the first symptoms reported by patients with knee osteoarthritis.[20] Even though joint surgery is successful at eliminating many joint related factors, reduced muscle mass and strength reduction are not addressed by surgical interventions. It has been found that the quadriceps cross-sectional area at 10 days post-operatively is decreased by 10% as compared to pre-operatively.[21] Therefore, attention to these impairments is important in developing an appropriate treatment plan and achieving good outcomes.

Joint Mobility
Assessment of tibiofemoral and patellofemoral joint play of the operative knee is often indicated in the late post-operative phase. However, depending on surgeon preference, patellofemoral joint mobilization may begin as soon as POD#1.

Posture
Assessment and documentation of leg length discrepancy and/or posture in supine, sitting, or standing are important information to capture from a systems review. For example: whether the patient's knees (both operative and non-operative) are in valgus or varus alignment, as well as noting the resting position of the LE (neutral or rotated).

Gait
Qualitative gait assessment is detailed with statements on the type, pattern, and biomechanics of gait, as well as the type of assistive device used. Changes in stride and step length, as well as cadence should be documented in patients with knee osteoarthritis both before and after total knee arthroplasty.

Pain:
Intensity of pain at rest and with treatment is documented at every inpatient encounter using the visual analogue scale (VAS) or verbal report scale (VRS) if possible. Plan of action such as pre-medication or cryotherapy is also included in the systems review. Other qualitative details of pain that are important to obtain include the frequency, alleviating/aggravating factors, and descriptors of pain.

Neuromuscular:
Sensation
Light touch sensation is assessed in bilateral LE especially on POD#1-2 to ensure that there is complete resolution of the epidural anesthesia and no nerve damage.

Proprioception
Knee joint proprioceptive testing may be indicated depending on where the patient is in their post-operative course, as this may impact balance.

Balance
Following TKA, it is important to assess and document both static and dynamic balance in the sitting and standing positions, including the use of UE support. Particularly in the acute post-operative phase, sitting and standing balance may be impaired, thereby impacting the overall plan of care. In the sub-acute

period, patients after TKA should be examined in their ability to perform static and dynamic standing without assistive devices, as well as unilateral standing as appropriate.

Cardiovascular/Pulmonary:

Vital Signs

Blood pressure, heart rate, respiratory rate, and peripheral oxygen saturation should be assessed and documented as appropriate during patient encounters based on the patient's symptomatology, particularly in the early post-operative days. As previously referenced, anemia and concomitant orthostatic hypotension are common complications immediately after TKA. They can cause clinical symptoms such as shortness of breath, lightheadedness or dizziness, blurred vision, and nausea. The clinical signs include drop in blood pressure with positional changes, tachycardia, diaphoresis, and vomiting. Attention to these signs and symptoms including appropriate documentation is important during the patient examination following TKA, in addition to communication with the clinical team.

Endurance

Examination of activity tolerance by utilizing the rate of perceived exertion (RPE) scale or a gross subjective and objective assessment of fatigue level should be documented in TKA patients. This should detail the amount of functional activities the patient was able to tolerate during the exam.

Integumentary:

Skin

Skin assessment is noted, including observation of surgical incision and presence/absence of dressing, discoloration/erythema, drainage, or ecchymosis, as well as LE pressure points due to the potential presence of a knee orthosis.

Edema

Soft tissue swelling commonly occurs immediately after TKA, as well as in the sub-acute phase. Therefore, the amount of LE edema is documented by gross qualitative assessment, or via circumferential measurements of the knee as appropriate.

Communication, Affect, Mental Status/Cognition, Language, and Learning Style:

The patient's level of arousal/alertness, orientation, ability to follow commands, communicate/make needs known, and learning preferences is taken into account and documented in the examination.

Functional Tests and Outcome Measures:

The following functional tests and measures may be used in the acute care setting and during the home or outpatient phase of rehabilitation to assess locomotor and functional capacity of TKA patients:

- Timed Get Up and Go (TUG)
- Six Minute Walk Test (6MWT)
- Stair Climbing Test (SCT)
- Lower Extremity Functional Scale (LEFS)
- Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)
- Short-Form-36 (SF-36)

The TUG has been found useful in detecting early improvements within the first three months following TKA. The 6MWT was originally conceived for a respiratory population, however has become a popular measure of LE functional limitation for patients with OA progressing towards arthroplasty. The SCT has also been widely cited in the literature for patients following TKA. The LEFS may be helpful in tracking and documenting progress during the outpatient phase after TKA, as it has been shown to detect change similarly, or better, than the WOMAC in recent studies.[22] The SF-36 is a more general, but widely used, physical function scale in patients following TKA.[3]

EVALUATION:

Based on the Guide to Physical Therapist Practice[23], patients following TKA are classified into the following practice pattern:

4H: Impaired Joint Mobility, Motor Function, Muscle Performance, and Range of Motion Associated With Joint Arthroplasty

Patients in this pattern may demonstrate the following impairments:

- decreased range of motion
- muscle performance (including strength, power, and endurance)
- motor control
- balance
- gait
- tissue integrity
- pain

Particularly in the first few post-operative days, these impairments will result in decreased independence with bed mobility, transfers, ambulation, functional activities, basic/instrumental activities of daily living (B/IADL), and quality of life.

Therefore, the short-term goals (STG) for this patient population during their acute hospital course (2 to 3 days) are as follows:

- Patients will perform all bed mobility and transfers with the least amount of assistance and devices
- Patients will ambulate household distances (50-100 ft) and negotiate stairs (step-to pattern) with the least amount of assistance and devices
- Patients will demonstrate a fair to good isometric quad contraction, ability to perform SLR, and MMT of >=3-/5 to increase independence with bed mobility, transfers, and ambulation
- Patients will gain >=90 degrees of flexion and full extension knee ROM to allow for proper biomechanics during gait cycle and stair climbing
- Patients will be independent with all home exercise programs and activity precautions

These STG will vary depending on the patient's prior functional level, as well as the patient's own personal goals.

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Long-Term Goals:

Most patients are expected to ambulate without assistive devices within 2-4 weeks of their surgery. Operative knee ROM is expected to be at least 0-115 degrees and quadriceps strength >=4+/5 MMT within 3 months following TKA. Recent studies report that average knee flexion ROM after TKA ranges from 105 degrees to 113 degrees.[24] The overall long-term goal for the patient is to at least return to their pre-operative level of function with less pain, however most tend to see an overall improvement when compared to their pre-operative function.

Prognosis:

The degree to which patients reach these projected goals depends on the reason for the TKA, prior functional level, comorbidities and post-op complications. In addition, patients who have lower pre-operative function may require more intensive physical therapy intervention, thereby longer recovery times because they are less likely to achieve functional outcomes similar to those of patients who have less pre-operative dysfunction.[25] Eighty-five to 90% of patients with TKA report pain relief after surgery, and 70% to 80% report functional improvement.[25] A recent literature review showed significant increases in WOMAC and SF-36 functional scores when comparing baseline to post-operative TKA scores at a two-year follow-up.[3] In a newly published prospective follow-up study looking at LEFS and 6MWT scores, the greatest improvements after TKA were found within the first 12 weeks, continued more gradually up to 26 weeks, and very minimally at one year post-operatively.[22]

Re-evaluation / Assessment:

The average inpatient length of stay for following TKA is 2-3 days. Patients are re-evaluated on a daily basis with respect to their range of motion, quality of movement, muscle contraction, pain intensity, gait quality, and functional independence. If the patient's hospital course is prolonged due to complications, a formal re-evaluation will be performed every 7-10 days to re-assess progression towards the previously outlined goals and outcomes. In the outpatient setting, the patient is to be formally re-evaluated every 30 days, however impairments such as ROM should be monitored each visit.

Discharge Planning:

It is expected that most patients following TKA will be discharged home after the inpatient acute rehabilitation phase. Several factors including age, co-morbidities, unpractical home environment, and lack of assistance/support from family/caregiver may all contribute to the patient's discharge to a short-term rehabilitation setting instead of directly home. Commonly expected outcomes for discharge home are the ability to perform bed mobility and functional transfers independently, safely ambulate distances of 50-100 ft on even and uneven surfaces with an assistive device, and increased knee ROM and strength, as previously identified in the goals outlined above. In a recent community-based prospective study, more than half of the patients (57%) were discharged directly home following TKA, and all patients returned to the community within 6 months post-operatively.[25] Those who were discharged directly home tended to be younger than those who were transferred to another facility.[25]

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TREATMENT PLANNING/INTERVENTIONS:

Established Pathway	__ Yes, see attached.	X No
Established Protocol	X Yes, see attached.	__ No

This section is intended to capture the most commonly used interventions for this case type/diagnosis. It is not intended to be either inclusive or exclusive of appropriate interventions.

The expected number of visits per episode of care ranges from 12 to 60. The various episodes of care following TKA consist of inpatient acute care PT, short-term rehabilitation or Home PT, and Outpatient PT (when indicated). Based on the Guide to Physical Therapist Practice, it is anticipated that 80% of patients will achieve their anticipated goals and expected outcomes during this time frame of visits.[23] During the acute care stay, TKA patients are typically seen 1-2 visits daily. The focus of treatment during this time is on increasing knee joint ROM, muscle control, and functional independence. If outpatient care is required, ROM, strength, gait, balance, and swelling impairments should be treated and treatment should be progressed as appropriate in order to maximize functional outcomes.

Coordination, Communication, and Documentation

Collaboration with care coordination for discharge planning is initiated at the time of initial evaluation. This collaboration is documented in the initial physical therapy evaluation note and in any other encounter note as appropriate. This will assist in facilitation of appropriate discharge destination of home with services or transfer to an extended care facility. Additional communication with the clinical team including the surgeon, surgical associates, and nursing staff also is documented.

Patient/Family/Caregiver Education

Beginning on POD#1, patients and their families/caregivers are educated on correct positioning of the operative LE, benefits and use of the CPM, the importance of initiating early mobility, safety, weight bearing precautions (if indicated), details of the PT intervention plan including independent exercises, and the expected discharge goals and outcomes. Pre-operative joint education class is also conducted at BWH for patients who plan to undergo TKA. Most orthopedic surgeons at BWH refer and highly recommend that their patients attend this interdisciplinary pre-operative course. Based on the findings of a recent meta-analysis, pre-operative education for orthopedic patients appears to decrease anxiety levels and increase patient's knowledge.[26]

Procedural Interventions

The following treatments should be initiated in a patient following TKA as deemed appropriate by the evaluating PT:

- Flexion and Extension A/AA/PROM of operative knee, use of Stationary Bicycle
- Therapeutic Exercise/Strength Training with focus on isometric and functional quadriceps control, hamstrings, as well as hip abductors and adductors. In addition, respiratory and circulatory exercises starting POD#1, to include deep breathing, coughing, and ankle pumps. Closed chain exercises when the patient demonstrates good pain control, muscle strength, and balance.

- Resistive Exercises for the quadriceps and hamstrings are generally not used in the acute phase of rehabilitation, but are commonly initiated within 2 months post-operatively.[7]
- Gait Training on even surfaces, stairs, uneven terrain as indicated
- Balance and Coordination Activities
- Body Mechanics and Postural Exercises

Functional Training in Self-Care and Home Management
Basic and Instrumental Activities of Daily Living (B/IADL) training including bed mobility and transfers are initiated on POD#1 following TKA to promote the patient's independence. Assistive device or equipment training are initiated, if indicated, during B/IADL, such as the use of a bedrail, overhead trapeze, or transfer devices. In most cases, the goal is to gradually wean the patient off such assistive equipment by POD#2-3 and instruct them on mobility techniques to allow them to function safely and independently in their home environment. Proper technique for vehicle transfers is also introduced and reviewed to the patient prior to discharge home.

Prescription and Application of Appropriate Assistive Devices/DME
Patients are measured, fitted, and trained with the most appropriate assistive device to increase safety and independence during ambulation and transfers. The most common ambulatory devices used in patients immediately following TKA are walkers (standard or rolling), axillary crutches, and in some cases, only a straight cane or a single crutch. Patients should be progressed to the less restrictive assistive devices as safety allows. Other Durable Medical Equipment (DME) generally used or recommended to facilitate safe and independent transfers include commodes, raised toilet seats, and tub/shower seats.

Manual Therapy Techniques
Depending on surgeon preference, patellofemoral and tibiofemoral joint mobilization may be indicated as early as POD#1 from TKA, typically with gentle distraction and glides. However, most often, it is reserved for the sub-acute to late phase of treatment. Soft tissue mobilization and superficial massage to the operative knee joint can also be performed on the patient to minimize hypersensitivity following surgery. This often becomes part of the patient's home exercise and pain management program.

Electrotherapeutic Modalities
As indicated and appropriate, use of biofeedback and neuromuscular electrical muscle stimulation (NMES) is encouraged to improve volitional quadriceps contraction and improve functional outcomes following TKA.[20] Persistent residual quadriceps femoris muscle force deficits after TKA are commonly reported and can prevent patients from returning quickly and fully to functional activities. A recent case report of an elderly patient who was treated with NMES 3 weeks following his TKA, in conjunction with a strength training program, resulted in his operative quadriceps femoris muscle force to be 81% of the uninvolved LE at 10 weeks post-TKA.[27]

Cryotherapy
Cryotherapy, the therapeutic use of cold, is recommended following physical therapy treatment. It is used to control inflammation, pain, and edema in the knee joint via its physiological effects on hemodynamic, neuromuscular, and metabolic processes.[28] It has become standard practice by many orthopedic surgeons

at BWH to place continuous cryotherapy on the operative knee immediately post-op for the first 72 hours post-TKA.

Interdisciplinary Interventions
Patients who are in need of assistance for B/IADL are referred to occupational therapy for training using adaptive equipment as needed. In addition, social workers may be consulted in complicated situations where patients may have difficulty coping with recovery and have limited social supports.

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References

1. Nizar MN, Barrett J, Katz J, Baron JN, Wright J et al. Epidemiology of total knee replacement in the United States Medicare population. *JBJS* 2005; 87(6): 1222-1228.
2. American Academy of Orthopedic Surgeons. Orthopedic Patients and Conditions. Available at: http://www.aaos.org/wordhtml/research/stats/patientstat.htm
3. Kane RL, Saleh KJ, Wilt TJ, Bershadsky B. The Functional Outcomes of Total Knee Arthroplasty. *JBJS* 2005; 87(8): 1719-1723.
4. Sarokhan AJ, Scott RD, Thomas WH, Sledge CB, Ewald FC, Cloos DW. Total knee arthroplasty in juvenile rheumatoid arthritis. *JBJS* 1983; 65:1071-1080.
5. Seldes RM, Tan V, Duffy G, Rand JA, Lotke PA. Total knee arthroplasty for steroid-induced osteonecrosis. *J Arthroplasty* 1999; 14: 533-537.
6. Bin SI, Nam TS. Early results of high-flex total knee arthroplasty: Comparison study at 1 year after surgery. *Knee Surg Sports Traumatol Arthrosc* 2006.
7. Scott RD. Total Knee Arthroplasty. Saunders and Elsevier, 2006.
8. Scott RD, Thornhill TS. Press-fit condylar total knee replacement. *Tech Orthop* 1986; 1 (4): 41-58.
9. Scott RD, Santore RF. Unicondylar unicompartmental knee replacement in osteoarthritis. *JBJS* 1981; 63:536-544.
10. Tria AJ, Coon TM. Minimal incision total knee arthroplasty: early experience. *Clin Orthop* 2003; 416:185-190.
11. Aglietti P, Baldini A, Giron F, Sensi L. Minimally invasive total knee arthroplasty: is it for everyone? *HSSJ* 2006; 2(1):22-26.
12. Haas SB, Manitta MA, Burdick P. Minimally invasive total knee arthroplasty; the mini midvastus approach. *Clin Orthop* 2006; 452:112-116.
13. Dutton AQ, Yeo SJ, Yang KY et al. Computer-assisted minimally invasive total knee arthroplasty compared with standard total knee arthroplasty. *JBJS* 2008; 90:2-9
14. DeWeese FT, Akbari Z, Carline E. Pain Control After Knee Arthroplasty: Intraarticular Versus Epidural Anesthesia. *Clin Orthop* 2001; 392: 226-31.
15. Orest MR. Total Joint Replacement Literature Review. *Acute Care Perspectives* 2004; Spring: 8-10.
16. Hughes K, Kuffner L, Dean B. Effect of weekend physical therapy treatment on postoperative length of stay following total hip and total knee arthroplasty. *Physiother Can* 1993; 45: 245-249.
17. Shoji H, Solomonow M, Yoshino S, D'Ambrosia R, Dabezies E. Factors affecting postoperative flexion in total knee arthroplasty. *Orthopedics* 1990; 13: 643-649.
18. Hurley MV. Quadricepes weakness in osteoarthritis. *Curr Opin Rheumatology* 1999; 10:246-50.
19. Munin MC, Kwoh CK, Glynn N et al. Predicting discharge outcomes after elective hip and knee arthroplasty. *Am J Phys Med Rehabilitation* 1995; 74: 294-301.
20. Avramidis K, Strike PW et al. Effectiveness of electrical stimulation of the vastus medialis muscle in rehabilitation of patients after total knee arthroplasty. *Arch Phys Med Rehabil* 2003; 84: 1850-1853.

21. Bhave A, Mont M, Tennis S et al. Functional problems and treatment solutions after total hip and knee arthroplasty. *JBJS* 2005; 87(2): 9-21.
22. Kennedy DM, Stratford PW, Riddle DL et al. Assessing recovery and establishing prognosis following total knee arthroplasty. *Phys Ther* 2008; 88: 22-32.
23. Guide to Physical Therapist Practice; 2nd Edition, APTA. *Phys Ther* 2001; 81: 9-744.
24. Miner AL, Lingard EA, Wright EA et al. Knee range of motion after total knee arthroplasty: how important is this as an outcome measure? *J Arthroplasty* 2003; 18: 286-294.
25. Jones CA, Voaklander C, Suarez-Almazor ME. Determinants of function after total knee arthroplasty. *Phys Ther*. 2003; 83: 696 –706.
26. Johansson K, Nuutila L, Virtanen H et al. Preoperative education for orthopaedic patients: systematic review. *Journal of Advanced Nursing* 2005; 50(2): 212-223.
27. Lewek M, Stevens J, Snyder-Mackler L. The use of electrical stimulation to increase quadriceps femoris muscle force in an elderly patient following a total knee arthroplasty. *Phys Ther* 2001; 81: 1565–1571.
28. Cameron MH. Physical Agents in Rehabilitation: From Research to Practice. Saunders and Elsevier, 2003, 2nd Edition.

