

# An Overview on Knee Replacement Surgery Indications and Techniques

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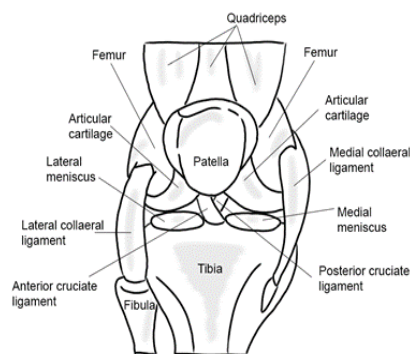
## Abstract

The knee is a synovial hinges-type joint, it is prone to different diseases that may lead eventually to its deterioration. The wearing of knee joint results in enormous pain that can be described as unbearable by the patient, which ultimately affects their overall well-being, their capability to take care of themselves, and their social and psychological status. Knee replacement surgeries are one of the solutions that helped in changing people's lives during the past few decades. We aimed to review the literature investigating knee replacement surgeries, indications, different techniques, and assessment of success. PubMed database was used for articles selection, gathered papers had undergone a thorough review. The choice of whether the patient should undertake this kind of operation or not should be strictly tailored to each case. Despite the different suggestions of trying to make one universal criterion for knee replacement surgeries, for instance, Escobar criteria, it still can be variable due to different personal and medical specifications of the case. Different techniques of knee replacement surgeries are practiced with advantages and disadvantages for each, consequently, the choice should be made on the scientific ground and solid judgment.

**Keywords:** Knee replacement surgery, Knee replacement arthroplasty, Osteoarthritis, Measured resection

## INTRODUCTION

The knee is a synovial joint, hinge type, which allows the movement in flexion and extension direction. Three bones are involved in the knee joint, namely, the patella, tibia, and femur [1, 2]. The articulation surfaces of the joint, which are the main focus of this review, are located between the tibia and femur (tibiofemoral) and between the femur and patella (patellofemoral). Those three give the three major knee compartments, medial compartment (the inside part of the knee) lateral compartment (the outside part), and the patellofemoral compartment (the front of the knee between the kneecap and thighbone). The joint is secured by ligaments connecting the bones, see **Figure 1** for more anatomical details. Total knee replacement surgeries aim to replace the weight-bearing surfaces of the bony joint due to different diseases or wear and tear in the elderly.



**Figure 1.** The anatomy of the knee joint, showing the bony soft tissue connective parts.

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**How to cite this article:** Alsayed MA, Alshehri MA, Hakami MH, Altherwi MB, Al Masaud MM, Alojami SM, et al. An Overview on Knee Replacement Surgery Indications and Techniques. Arch Pharm Pract. 2021;12(2):125-9. <https://doi.org/10.51847/JHhUNoPIGx>

## MATERIALS AND METHODS

PubMed database was used for the selection process of relevant articles, with the help of following keys (“Knee replacement”[Mesh]) OR (“Knee arthroplasty”[Mesh]) AND (“techniques”[Mesh] OR “assessments”[Mesh] OR “advantages” OR “disadvantages” [Mesh])). Inclusion criteria were the articles that have at least one of the following leads: total knee replacement, knee arthroplasty, TKR, TKA, TKA advantages, TKA techniques. Exclusion criteria were all other articles that did not meet the set criteria by failing to have any of the inclusion criteria mentioned.

## RESULTS AND DISCUSSION

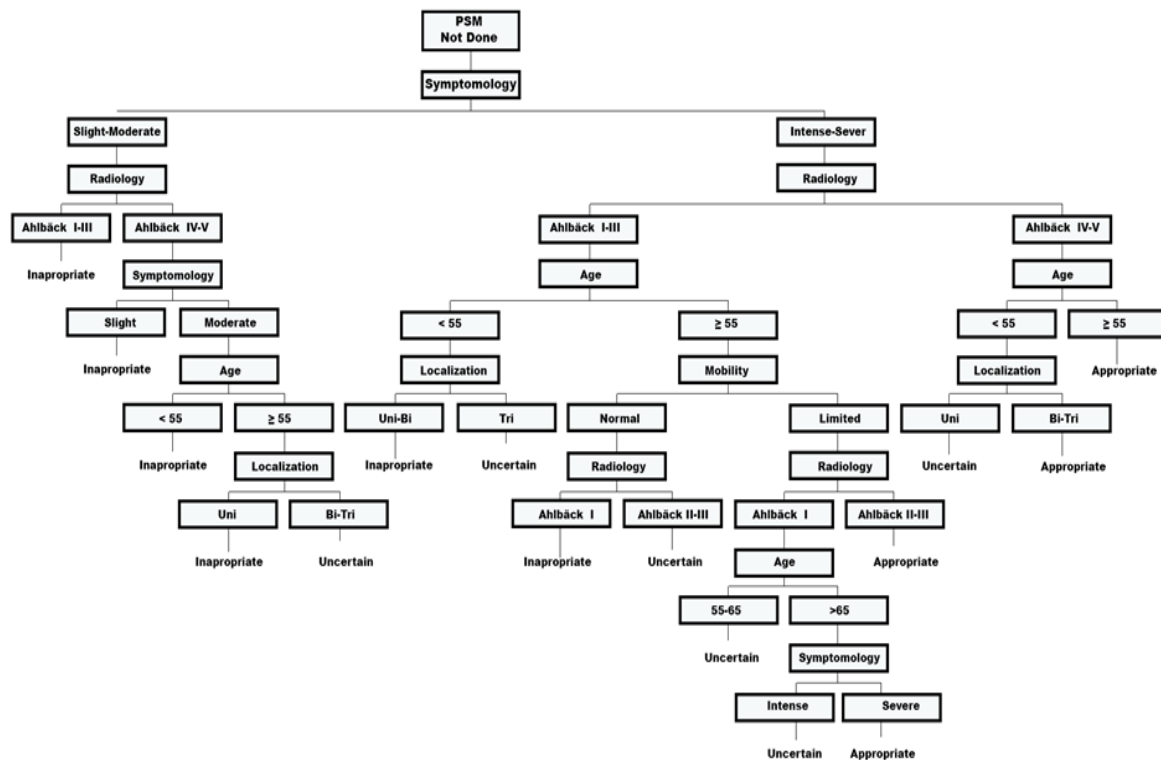
The main indication of total knee replacement (TKR) surgeries is severe arthritis, mainly osteoarthritis (OA). OA is a very common degenerative disease associated with aging, as it affects up to 25% of the population over the age of 18 years old. It involves progressive destruction of the normal anatomy and physiology of the knee joint, degenerating of articular cartilage, ligaments, and menisci, formation of osteophytes, thickening of the subchondral bone, and inflammation with different degrees of the synovium [3, 4]. With the progress of this disease, various symptoms are experienced by the patients which hinder their day-to-day activity, certain limitations come in the concern of the doctors throughout the year to enhance their quality of life. Chronic

pain, joint instability, joint space narrowing, and extreme stiffness are all expected to be reported by the patients [3, 5].

The decision-making for whether the patient should undergo TKR surgery or not has been a ground for debate in the orthopedic field for years. Different criteria were suggested, and Escobar criteria are one of them (Table 2). These criteria rely on the history of previous surgical management, age, localization (how much joint space is involved), mobility and stability, symptoms, and radiological findings and grade according to Ahlbäck classification, see Table 1 for the radiological grading [6]. Escobar criteria follow a stepwise tree-like pattern to determine the fitness of the patient, see Figure 2. For the details of Escobar, criteria refer to Table 1. The rate of misclassification following these criteria were found to be 3.4% in a sample consists of 150 real-life clinical scenarios [7].

**Table 1.** Ahlbäck radiological classification

Grade 0	No radiological findings concern with osteoarthritis
Grade I	Joint space narrowing <3 mm
Grade II	Joint space obliterated or almost obliterated
Grade III	Minor bone attrition <5 mm
Grade IV	Moderate bone attrition 5-15 mm
Grade V	Severe bone attrition >15 mm



**Figure 2.** Stepwise Escobar’s tree for those who had not undergone any previous surgical management (PSM). *Uni-localization* uni compartmental; *Bi-localization* unicompartmental and patellofemoral; *Tri-localization* tricompartmental.

**Table 2. Escobar Criteria**

Domain	Categories
Age	<55 years 55 to 65 years > 65 years
Radiology	Slight (Ahlbäck grade I) Moderate (Ahlbäck grades II and III) Severe (Ahlbäck grades IV and V)
Localization	Unicompartmental tibiofemoral Unicompartmental plus patellofemoral (Bi) Tricompartmental
Knee Joint Mobility and Stability	Preserved mobility and stable joint (a minimum range of movement from 0° to 90° and absence of medial or lateral gapping of more than 5 mm. in the extended knee.) Limited mobility and/or unstable joint (a range of movement of less than 0° to 90° and/or medial or lateral gapping of more than 5 mm. in the extended knee.)
Symptomatology	Slight: Sporadic pain, (e.g., when climbing stairs, daily activities typically carried out) nonsteroidal anti-inflammatory (NSAID) drugs for pain control. Moderate: Occasional pain (e.g., when walking on level surfaces, some limitation of daily activities, NSAIDs to relieve pain. Intense: Pain almost continuous (e.g. pain when walking short distances or standing for less than 30 minutes, limited daily activities, frequent use of NSAIDs, may require crutch or cane) Severe: Pain at rest, daily activities always significantly limited, frequent use of analgesics- narcotics/NSAIDs, frequent use of walking aids.

**Contraindications**

The knee replacement surgery sounds like a miraculous option for treating the deformative joint, nevertheless, studies showed that not all the patient going to appreciate the outcomes of the surgery equally. Some variables may affect the overall outcome, for instance, those who are younger than 50 years old or older than 90, especially the former group they usually will require revision surgery due to their very active lifestyle. While in the latter group the concerns go toward the comorbidities instead of the age itself [8].

**Surgical Options**

The goal of all total knee replacement surgeries is to mimic the actual nature of the natural knee joint, different approaches have been developed throughout the years. While in the native knee most of the load is mostly transmitted into the medial compartment, the artificial knee joint is not capable of dealing with such force in one compartment, instead, it diffuses the load between the medial and lateral compartment to achieve better stability [9]. Each technique based on a different philosophy, yet share the same aim, measured resection and gap balancing techniques are all examples of those surgeries. Measured resection is mostly associated with cruciate-retaining design, whereas gap balancing is frequently assigned to posterior stabilized knee design [10].

**Measured Resection**

This technique is based on cutting according to bony landmarks regardless of the soft tissue attachments. This technique has two essentials targets: replacing the bony resected parts with a prosthesis with matched thickness and preserving the femoral rotation. In this technique, the reference landmarks are the trans-epicondylar axis, anterior-

posterior axis, and posterior condylar axis [11]. Each one of those anatomical carries pros and cons, trans-epicondylar axis (TEA) provides better coronal axis stability but falls short when it comes to the identification of this landmark during surgery due to erosions expected to be encountered [12]. Posterior condylar axis is considered a superior option to TEA as the condylar portion seems to exhibit less deformity in this axis, hence resulted in the more accurate installment of the prosthesis and better angulation. The pitfall of this technique is the measured angle on which the resection is done based on mean statistical studies of angulation, thence this measure might not be suitable for all patients [13-15]. anteroposterior axis is recommended when erosions are found in the condylar region, it also provides patellofemoral stability compared with the other two lines [9]. Like the rest, this modality also is not perfect as if this line was the sole predictor for resection, severe trochlear dysplasia occurs leading to excessive external rotation [16].

**Gap Balancing**

This technique unlike its predecessor relies on releasing the soft tissue before cutting. This method aimed to optimize the flexion and extension and preserve their symmetry. In the absence of osteophytes and ligamental problems, this procedure gives an excellent outcome in terms of extension, flexion, restoration of anatomical rotation, and improved proprioception [17, 18]. This technique can be further classified according to sequence, by stabilizing either the flexion gap or the extension gap. Using this technique results in better flexion stability, and more accurate angulation without excessive valgus or varus. As this technique heavily includes the ligaments and uses them in the stabilization of the de novo joint, iatrogenic or pathological damage to those tissues may lead to undesirable movements. The superficial

medial tibial ligaments deficit may lead to an exaggerated medial flexion gap, thereafter excessive internal rotation of the femoral compartment. While if the lateral collateral ligament-popliteus tendon complex is lacking, excessive external rotation develops [11, 19].

### Assessment of Improvement

The Oxford Knee Score (OKS) is a twelve-item self-reported patient-based scale [20]. See **Table 3**. This scale can be both administered before and after TKR to assess the difference the patient perceives [21]. Despite the common use of this scoring system, criticism of oversimplification of the questions falls short in expressing the complexity of the patient's needs. The intentional oversimplification of this important feature of the patients' condition, the scale is used point to more is the worst while the other known scales go on the other direction which may confuse, and the lack of the population-based expected norms [22].

**Table 3. The Oxford Knee Score**

Item	Response
<b>In the last four weeks</b>	
1) How would you describe the pain you usually have from your knee?	1 None 2 Very mild 3 Mild 4 Moderate 5 Severe
2) Have you had any trouble washing and drying yourself (all over) because of your knee?	1 No trouble at all 2 Very little trouble 3 Moderate trouble 4 Extreme difficulty 5 Impossible to do
3) Have you had any trouble getting in and out of a car or using public transport because of your knee? (Whichever you tend to use)	1 No trouble at all 2 Very little trouble 3 Moderate trouble 4 Extreme difficulty 5 Impossible to do
4) For how long have you been able to walk before the pain from your knee becomes severe? (With or without a stick)	1 No pain/N30 min 2 16 to 30 min 3 5 to 15 min 4 Around the house only 5 Not at all—severe on walking
5) After a meal (sat at a table), how painful has it been for you to stand up from a chair because of your knee?	1 Not at all painful 2 Slightly painful 3 Moderately painful 4 Very painful 5 Unbearable
6) Have you been limping when walking, because of your knee?	1 Rarely/never 2 Sometimes or just at first 3 Often, not just at first 4 Most of the time 5 All of the time
7) Could you kneel and get up again afterward?	1 Yes, easily 2 With little difficulty 3 With moderate difficulty 4 With extreme difficulty 5 No, impossible
8) Have you been troubled by pain from your knee in bed at night?	1 No nights 2 Only 1 or 2 nights

9) How much has pain from your knee interfered with your usual work/housework?	3 Some nights 4 Most nights 5 Every night  1 Not at all 2 A little bit 3 Moderately 4 Greatly 5 Totally
10) Have you felt that your knee might suddenly “give way” or let you down?	1 Rarely/never 2 Sometimes or just at first 3 Often, not just at first 4 Most of the time 5 All of the time
11) Could you do the household shopping on your own?	1 Yes, easily 2 With little difficulty 3 With moderate difficulty 4 With extreme difficulty 5 No, impossible
12) Could you walk down a flight of stairs?	1 Yes, easily 2 With little difficulty 3 With moderate difficulty 4 With extreme difficulty 5 No, impossible

### CONCLUSION

Total knee replacement techniques became one of the most demanded surgeries in orthopedic fields, this can be explained due to the increasing life expectancy worldwide [23] as the most people undergo these surgeries are from the geriatrics age group. Despite the variability between the methods, the main outcome of this operation is to restore the native knee joint function and improve the patient's quality of life. Classification of the patients according to their medical and surgical history is a fundamental step that must be taken to achieve the best results. Preassessment of the knee joint according to any of the proposed scoring systems, i.e., Oxford Knee Score (OKS), would help in setting a baseline, thence measuring the progress and possible failure in every individual case.

**ACKNOWLEDGMENTS:** None  
**CONFLICT OF INTEREST:** None  
**FINANCIAL SUPPORT:** None  
**ETHICS STATEMENT:** None

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