CODEN [USA]: IAJPBB ISSN : 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

SJIF Impact Factor: 7.187
https://doi.org/10.5281/zenodo.7802529

Available online at: http://www.iajps.com *Review Article*

AN OVERVIEW OF TECHNIQUES OF TOTAL KNEE ARTHROPLASTY

[1]Raied Noor takroni,
[2]Aamer Mutlaq Alharbi,
[3]Majd Abdulrhman Majoun,
[4]Abdulkarim Mutlaq alharbi

Abstract:
Total knee arthroplasty (TKA) is an effective treatment for advanced degenerative joint condition. Proper implant alignment, size, and rotation, as well as adequate soft-tissue balance, are required for positive clinical outcomes. Literature were searched for relevant studies that were published up to 2022. Using electronic medical databases; PubMed and Embase. Current TKA implants are designed to meet the fundamental requirements of achieving stability in both flexion and extension, as well as optimizing patellar tracking. The two different approaches used to implant the TKA components used today are measured resection and gap balancing. Both approaches have been proven as long-lasting and effective, and each offers distinct advantages and downsides. A hybrid technique has been devised that combines the advantages of measured resection and gap balancing while minimizing the drawbacks of both procedures. This hybrid strategy has the potential to increase TKA kinematics while also refining surgical technique.

Corresponding author:
Raied Noor takroni,

QR code

Please cite this article in press Raied Noor takroni et al, ***An Overview Of Techniques Of Total Knee Arthroplasty****,Indo Am. J. P. Sci, 2023; 10(03).*

INTRODUCTION:

Total knee arthroplasty (TKA) is one of the most cost-effective and consistently successful orthopedic operations performed. Patient-reported outcomes have been proven to significantly improve in terms of pain alleviation, functional restoration, and quality of life [1]. TKA produces consistent results for patients with end-stage, tri-compartmental degenerative osteoarthritis (OA). While OA affects millions of people in the United States, the knee is the most usually affected joint by this degenerative disorder characterized by slow degeneration and loss of articular cartilage [1,2].

TKA is a successful technique for treating advanced knee arthritis. TKA aims to increase stability, range of motion (ROM), function, and pain reduction. Proper implant alignment and soft-tissue balance are critical in accomplishing these objectives. However, the ideal strategy for achieving adequate implant alignment and soft-tissue balance is debatable [3]. Both measured resection and gap balancing are surgical procedures used to achieve implant alignment and soft-tissue balance [3,4].

Long thought to be a surgery reserved for the elderly and low-demand patient population, primary TKA is now offered more frequently and has consistently excellent outcomes in younger patient cohorts. Primary, end-stage tri-compartmental osteoarthritis is the most common underlying diagnosis associated with TKAs across all patient age groups [5,6].
The surgeon uses gap balancing to establish equal and rectangular flexion and extension gaps by suitably tensioning ligaments on a perpendicular tibial resection. To fulfill the specified TKA aims, many surgeons employ a hybrid method [7]. Despite breakthroughs in implant design, surgical technique, technology innovation, and understanding of knee kinematics, over 20% of TKA patients are dissatisfied for a variety of reasons [7].

DISCUSSION:

Knee osteoarthritis (OA) is becoming more common as obesity rates rise and average life expectancy increases. Despite breakthroughs in treatment, knee OA remains one of the top causes of disability [8]. Because of its effectiveness, conservative, non-surgical therapy is the first choice for the treatment of knee OA, according to international evidence-based clinical recommendations [9,10]. When symptoms worsen after conservative treatment, surgical intervention is required. Total knee arthroplasty is the most commonly done operation for knee OA (TKA). A recent study found TKA to be both valid and cost-effective for people who have difficulty doing activities of daily living (ADL) [11]. Physical therapy following TKA attempts to improve the individual's functional outcomes. Physical therapists are particularly interested in research reports on functional prognosis.

Functional limits, such as standing and walking, are the most important difficulties in people with knee OA, as are range of motion (ROM) limitations in the knee joint. According to a recent cross-sectional study, the moveable range of the knee joint necessary for ADL such as standing, walking, and stair climbing ranges from 5 to 110 degrees [12]. The purpose of TKA for knee OA is to enhance functional abilities by reducing pain and increasing ROM in the knee joint. After surgery, the goal is to have a knee joint flexion angle of greater than 110 degrees [13]. A prior cohort research found that ROM restrictions following TKA diminish patient satisfaction [14]. As a result, one of the most important measured results in the field of rehabilitation is the recovery of knee ROM following TKA [15].

Those receiving TKA can begin walking with a T-cane in the early postoperative phase, but they must continue physical therapy after discharge to fully recover knee ROM. In a prior study testing the recovery of knee joint function after TKA, the postoperative knee joint flexion angles were considerably worse than the preoperative measures [16]. POD 14 is a critical period for individuals to resume ADL, with the goal of gradually increasing activity. Furthermore, a prior observational study indicated that C-reactive protein levels were greater than the reference value up to POD 11, and a significant relationship was identified between deep temperature around the operated knee and knee ROM recovery at POD 14 [17]. As a result of knee joint inflammation, the joint angle takes longer to recover following TKA in some people, and functional ROM recovery may take more than two weeks. In contrast, some people successfully restore knee ROM in the early stages of TKA. As a result, it is critical to examine key preoperative factors that influence early recovery of knee OA in patients in order to personalize rehabilitation goals [17].

During the 1950s, TKA prosthesis designs have evolved, beginning with Walldius' creation of the first hinged-knee replacement. The complete condylar prosthesis (TCP) was the first TKA prosthesis designed to resurface all three compartments of the knee in the early 1970s. The TCP was a design that was posterior-stabilized. The four major categories of TKA prosthesis designs are given below in increasing order of design constraint [18,19].

Mechanical Alignment:

Initially, distal femoral and proximal tibial resections dictated implant orientation with cruciate retaining TKA implants. The distal femoral cut was set at 9° valgus and the proximal tibia cut at 3° varus, resulting in an overall limb alignment of 6° valgus. Anatomic alignment supported re-creating the tibia's original posterior slope of 9°. TKA alignment conceptual differences influenced knee implant design, resulting in the creation of two distinct surgical techniques: measured resection and gap balancing [20]. Even though any prosthetic design can be employed with either approach, cruciate-retaining designs became connected with measured resection and posterior stabilized knee designs with gap balancing. as well as total limb alignment. The normal distal femoral alignment is 9 degrees anatomic valgus, whereas the normal proximal tibial alignment is 3 degrees anatomic varus (Figure 1). Load is largely transmitted through the medial compartment of the native knee. Insall emphasized that adopting native knee mechanics to TKA would result in improper load distribution and could lead to arthroplasty varus failure. Consequently, so-called classical alignment emphasized alignment goals, which result in equal load distribution over the medial and lateral compartments. The combination of neutral tibial resection and enough distal femoral resection to achieve 5° to 7° of valgus results in equal load distribution across the joint [21]. In contrast to the purpose of classical alignment, the principle of anatomic alignment was proposed. Anatomic alignment's core premise is the preservation of the joint line, and the procedure was initially employed with cruciate retaining TKA implants. The distal femoral cut was set at 9° of valgus and the proximal tibia cut at 3° of varus, for an overall limb alignment of 6° of valgus. Anatomic alignment supported re-creating the tibia's natural 9° posterior slope [22].

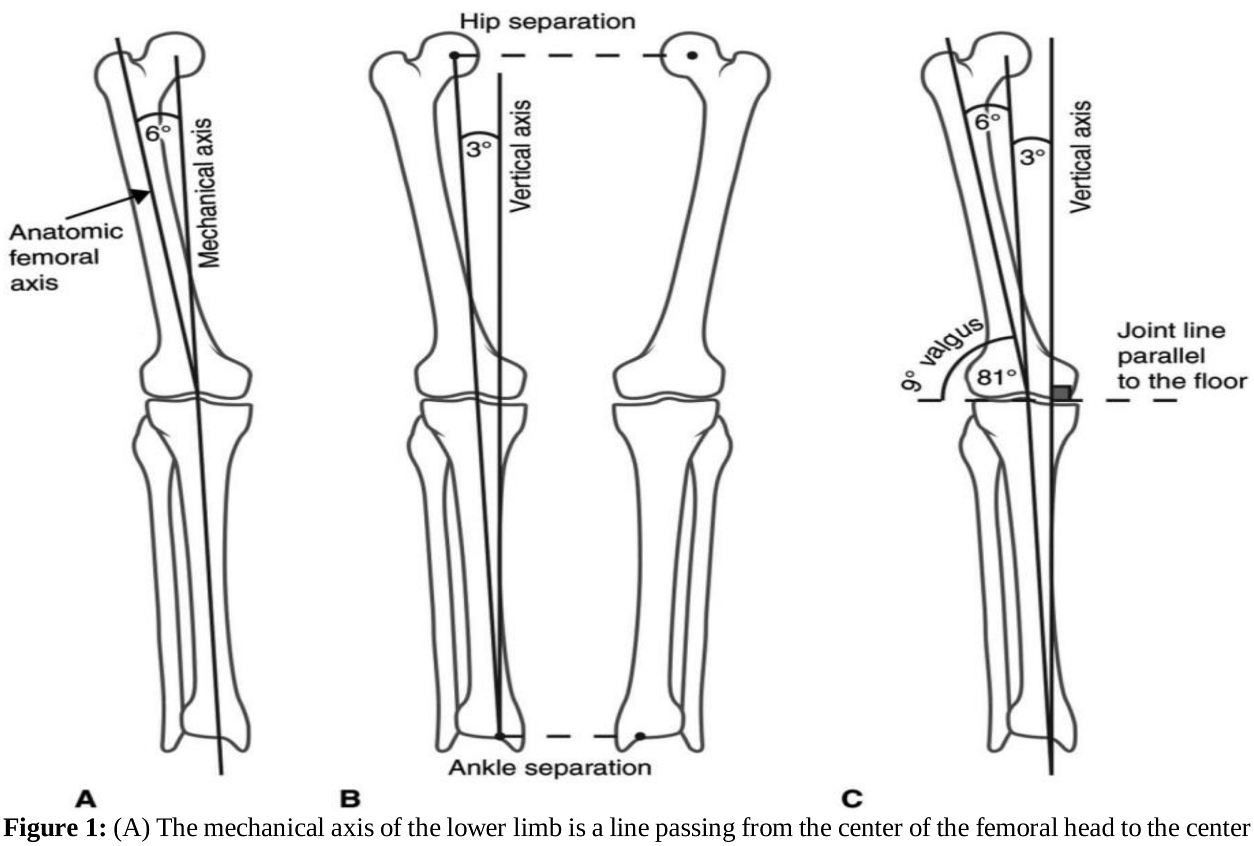

Figure 1: (A) The mechanical axis of the lower limb is a line passing from the center of the femoral head to the center of the ankle. (B) The vertical axis is a line that connects the anterior body of S2 to the center of the ankle; this axis represents the center of gravity. (C) The joint line is parallel to the floor and perpendicular to the vertical axis. Combining the 6°of valgus from the anatomic femoral axis with the 3° of valgus of the mechanical axis accounts for 9° of distal femoral valgus relative to the vertical axis.

Surgical Approaches:
The medial parapatellar, midvastus, and subvastus routes are the most commonly used for the typical primary TKA technique. The medial parapatellar method, which involves proximal dissection into a medial cuff of the quadriceps tendon to promote superior tissue quality closure at the end of the treatment, is the most usually used. A thorough, continuous medial subperiosteal dissection sleeve is conducted proximally, while preserving intimate contact with the proximal tibial bone. The extent of dissection is frequently determined by the amount of deformity to be addressed. This medial release is generally vigorous in cases of severe varus deformity and modest in cases of moderate to advanced valgus knee deformity. This soft tissue sleeve is also used to resect the medial meniscus [23,24].

The particular order of bone resections and soft tissue releases will vary depending on the surgeon. The purpose of this technical review of the TKA procedure [23] is to provide a general understanding of a recommended method.

Following the completion of the arthrotomy, the patella is everted and the knee flexed, with additional soft tissue releases required prior to achieving knee dislocation. If the surgeon chooses to start with the femur, an intramedullary (IM) drill is used to gain access to the femoral canal for the use of a distal femoral IM jig. The angle established on the guide is determined by the patient's preoperative examination (AP X-ray), which typically yields 5 or 7 degrees of valgus. Although this varies by system, most surgeons choose to resect 9 to 10 mm of the distal femur [24].

Implant Sizing and Rotation:
Patellar tracking is affected by implant size and rotation. The most essential technical variables for proper patellar tracking are femoral and tibial implant rotation optimization and restoring the Q angle to between 13° and 19° [25,26]. An elevated Q angle can produce lateral patellar tilt or subluxation, resulting in anterior knee pain, mechanical symptoms, accelerated wear, and patellar instability. Lateralization of the femoral implant, external rotation of the femoral implant, external rotation of the tibial implant, and medial insertion of the patellar implant are all implant positions used to achieve an adequate Q angle [25,26]. The key predictor of flexion gap symmetry and patellofemoral kinematics is femoral implant rotation relative to tibial alignment. Many surgeons feel that in the measured resection technique, appropriate femoral rotation is established by anatomic landmarks, but in the gap balancing technique, it is determined by tibial resection and subsequent soft-tissue release (**Figure 2**) [27]. Gap balancing and measured resection procedures have been proven to be trustworthy and accurate in evaluating femoral implant rotation, with comparable outcomes and success. When the tibial implant rotation is placed to the medial one-third of the tibial tubercle, the femorotibial rotational alignment improves [28].

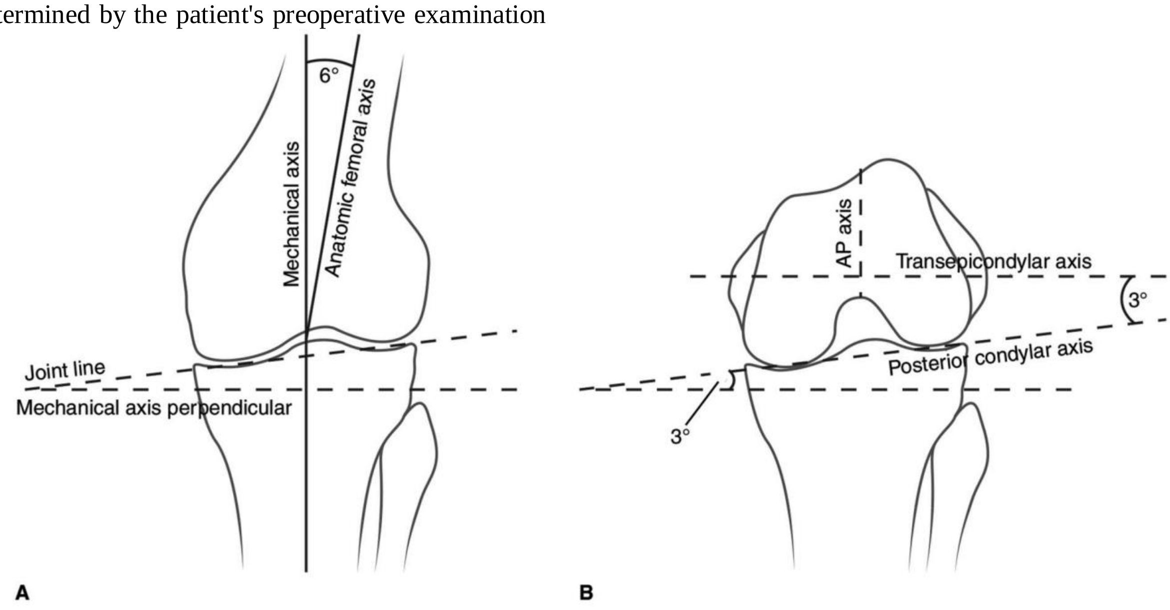

Figure 2: A) in relation to anatomic femoral landmarks in knee flexion (B). The joint line or proximal tibia is in 3° of varus relative to the mechanical axis perpendicular. The joint line is perpendicular to the vertical axis.

CONCLUSION:

To prevent and manage comorbidities after total knee replacement, an interprofessional team is required. Many of the patients are elderly and/or suffer from cognitive impairment. As a result, a dietary consultation is required. Prior to beginning therapy, a pain consultation is required. Yet, the analgesic chosen must be able to regulate pain while also preventing sedation. Also, long-term pain management is not advised since it may disguise any fever infection or symptoms of vascular impairment. Constipation, which is particularly common in this population, should be treated.

Although the overall durability of the TKA prosthesis is determined by a variety of patient-related and prosthetic technological aspects, a lifespan of 15 to 20 years is estimated. Clinicians should confirm that surgical candidates have exhausted all nonoperative therapy options, as discussed earlier in this review. Since the number of surgical procedures performed on children and the elderly continues to rise, orthopedic surgeons can expect outstanding outcomes in the right patient populations.

REFERENCES:

1. Daines BK, Dennis DA: Gap balancing vs. measured resection technique in total knee arthroplasty. Clin Orthop Surg 2014;6(1): 1-8
2. Springer BD, Parratte S, Abdel MP: Measured resection versus gap balancing for total knee arthroplasty. Clin Orthop Relat Res 2014;472(7):2016-2022.
3. Babazadeh S, Dowsey MM, Stoney JD, Choong PF: Gap balancing sacrifices jointline maintenance to improve gap symmetry: A randomized controlled trial comparing gap balancing and measured resection. J Arthroplasty 2014;29(5):950-954.
4. Luyckx T, Peeters T, Vandenneucker H, Victor J, Bellemans J: Is adapted measured resection superior to gap-balancing in determining femoral component rotation in total knee replacement? J Bone Joint Surg Br 2012;94(9):1271-1276.
5. Vasso M, Antoniadis A, Helmy N. Update on unicompartmental knee arthroplasty: Current indications and failure modes. EFORT Open Rev. 2018 Aug;3(8):442-448.
6. Walker LC, Clement ND, Deehan DJ. Predicting the Outcome of Total Knee Arthroplasty Using the WOMAC Score: A Review of the Literature. J Knee Surg. 2019 Aug;32(8):736-741.
7. Bourne RB, Chesworth BM, Davis AM, Mahomed NN, Charron KD: Patient satisfaction after total knee arthroplasty: Who is satisfied and who is not? Clin Orthop Relat Res 2010;468(1):57-63.
8. Cross M, Smith E, *et al.*: The global burden of hip and knee osteoarthritis: estimates from the global burden of disease 2010 study. *Ann Rheum Dis*. 2014; 73: 1323-1330.
9. Brosseau L, Taki J, *et al.*: The Ottawa panel clinical practice guidelines for the management of knee osteoarthritis. Part two: strengthening exercise programs. *Clin Rehabil*. 2017; 31: 596-611.
10. Brosseau L, Taki J, *et al.*: The Ottawa panel clinical practice guidelines for the management of knee osteoarthritis. Part three: aerobic exercise programs. *Clin Rehabil*. 2017; 31: 612-624.
11. Zhang W, Nuki G, *et al.*: OARSI recommendations for the management of hip and knee osteoarthritis: part III: changes in evidence following systematic cumulative update of research published through January 2009. *Osteoarthritis Cartilage*. 2010; 18: 476-499.
12. Hyodo K, Masuda T, *et al.*: Hip, knee, and ankle kinematics during activities of daily living: a cross-sectional study. *Braz J Phys Ther*. 2017; 21: 159-166.
13. Kurosaka M, Yoshiya S, *et al.*: Maximizing flexion after total knee arthroplasty: the need and the pitfalls. *J Arthroplasty*. 2002; 17: 59-62.
14. Ritter MA, Lutgring JD, *et al.*: The role of flexion contracture on outcomes in primary total knee arthroplasty. *J Arthroplasty*. 2007; 22: 1092-1096.
15. Molloy IB, Martin BI, *et al.*: Effects of the length of stay on the cost of total knee and total hip arthroplasty from 2002 to 2013. *J Bone Joint Surg Am*. 2017; 99: 402-407.
16. Chang SY, Lin LH, *et al.*: Knee joint function, walking ability, and quality of life within 6 weeks after total knee arthroplasty: a prospective cohort study. *J Clin Nurs*. 2019; 28: 3222-3232.
17. Ueyama M, Takamura D, *et al.*: Alterations in deep tissue temperature around the knee after total knee arthroplasty: its association with knee motion recovery in the early phase. *Phys Ther Res*. 2018; 21: 1-8.
18. Metcalfe AJ, Ahearn N, Hassaballa MA, Parsons N, Ackroyd CE, Murray JR, Robinson JR, Eldridge JD, Porteous AJ. The Avon patellofemoral joint arthroplasty: two- to 18-year results of a large single-centre cohort. Bone Joint J. 2018 Sep;100-B(9):1162-1167.

19. Sutton JC 3rd, Antoniou J, *et al.*: Hospital discharge within 2 days following total hip or knee arthroplasty does not increase major-complication and readmission rates. *J Bone Joint Surg Am.* 2016; 98: 1419-1428.
20. Dorr LD, Boiardo RA: Technical considerations in total knee arthroplasty. Clin Orthop Relat Res 1986;205:5-11.
21. Dennis DA, Komistek RD, Kim RH, Sharma A: Gap balancing versus measured resection technique for total knee arthroplasty. Clin Orthop Relat Res 2010; 468(1):102-107.
22. Hungerford DS: Measured resection: A valuable tool in TKA. Orthopedics 2008;31 (9):941-942.
23. Innocenti B, Fekete G, Pianigiani S. Biomechanical Analysis of Augments in Revision Total Knee Arthroplasty. J Biomech Eng. 2018 Nov 01;140(11)
24. Soranoglou V, Poultsides LA, Triantafyllopoulos GK, De Martino I, Memtsoudis SG, Sculco TP. Optimizing Intraoperative Blood Management for One-Stage Bilateral Total Knee Arthroplasty. HSS J. 2018 Jul;14(2):202-210.
25. Figgie HE III, Goldberg VM, Figgie MP, Inglis AE, Kelly M, Sobel M: The effect of alignment of the implant on fractures of the patella after condylar total knee arthroplasty. J Bone Joint Surg Am 1989; 71(7):1031-1039.
26. Berger RA, Rubash HE, Seel MJ, Thompson WH, Crossett LS: Determining the rotational alignment of the femoral component in total knee arthroplasty using the epicondylar axis. Clin Orthop Relat Res 1993;286:40-47.
27. Berger RA, Crossett LS, Jacobs JJ, Rubash HE: Malrotation causing patellofemoral complications after total knee arthroplasty. Clin Orthop Relat Res 1998;356:144-153.
28. Aglietti P, Sensi L, Cuomo P, Ciardullo A: Rotational position of femoral and tibial components in TKA using the femoral transepicondylar axis. Clin Orthop Relat Res 2008;466(11):2751-2755.