

Total knee replacement: Understanding patient-related factors

Obesity, comorbidities, and unrealistic expectations can all contribute to poor outcome after knee arthroplasty and should be discussed by surgeons and patients during the preoperative informed consent process.

ABSTRACT: Total arthroplasty of the knee to address symptomatic osteoarthritis has become increasingly common as the population ages. Many nonoperative treatment approaches exist and should be attempted before surgical intervention is considered. Surgical alternatives to total knee arthroplasty also exist and may be appropriate. These include osteotomy, unicompartmental arthroplasty, and patellofemoral joint arthroplasty. Though suitable for some patients, these less invasive procedures have reduced survivorship at 10 years when compared with total knee arthroplasty. The primary indication for knee replacement is pain that significantly reduces walking tolerance, impairs ability to perform activities of daily living, and interferes with sleep. Patient-related factors that can affect the success of knee replacement include obesity, comorbidities,

and unrealistic expectations for total pain relief and joint function. Absolute contraindications to knee arthroplasty include active knee sepsis and severe untreated or untreatable peripheral arterial disease. Total knee replacement may be considered for patients of any age once a diagnosis of osteoarthritis is confirmed clinically and radiographically, the patient continues to experience moderate to severe pain and poor quality of life despite an extended course of nonoperative treatment, and no contraindications exist. Referral before the patient's disease reaches an extremely advanced stage leads to better outcomes. While usually beneficial, knee arthroplasty is a major surgical procedure with possible complications and risk of failure to provide the desired result. An understanding of the many patient-related factors that can greatly affect outcome and patient satisfaction is essential.

Total arthroplasty of the knee continues to be among the most common and successful major elective surgical procedures. The aging of the population has resulted in a significant increase in the demand for this procedure. This is due, in part, to an increase in patient expectation for high functional capacity into the later decades of life despite the presence of a painful degenerative joint condition. Additionally, the success of knee arthroplasty in alleviating arthritis-related joint pain in most patients, both young and old, has increased patient demand.

History

Knee replacement has evolved considerably over the past 100 years. In

Dr Dooley is an orthopaedic surgeon at Vernon Jubilee Hospital and a clinical instructor at the University of British Columbia. Dr Secretan is an orthopaedic surgeon at Vernon Jubilee Hospital and a clinical instructor at the University of British Columbia.

This article has been peer reviewed.

its earliest form, interposition arthroplasty was attempted to manage the most severe pathology of the knee using materials such as bursa, fascia lata, skin, and pig bladder, usually with very poor results. Until the 20th century, arthrodesis remained the treatment of choice for severe degenerative knee conditions.

Metallic interposition arthroplasty of the tibiofemoral joint has been evolving since the 1930s with the use of many different designs and materials. Modern total knee arthroplasty (TKA) was born when the importance of the patellofemoral articulation was recognized and the patellar component was introduced in the 1970s.

Surgical alternatives to total knee replacement

Concurrent with the evolution of the modern TKA, other surgical options for management of knee arthritis were developing. These options are still viable today in appropriate patients and include osteotomy, unicompartmental arthroplasty, and patellofemoral joint arthroplasty.

Osteotomy

Osteotomy refers to cutting of bone for the purpose of altering alignment. In the management of knee arthrosis, this most often involves osteotomy of the proximal tibia in a varus knee with medial compartment arthritis. Proximal tibia osteotomy has several other indications that are beyond the scope of this article.

Osteotomy may be considered as an alternative to total knee arthroplasty, but an understanding of the indications, contraindications, and limitations is essential. Typically, patients are younger than 65, have good range of motion (more than 120 degrees and less than 5 degrees flexion contracture), have arthrosis isolated to one compartment only, have no ligamen-

tous instability, and lack inflammatory condition of the joint. The success of the procedure is highly dependent on accurate correction of alignment and requires adherence to postoperative protocols, which may involve restricted weight bearing for up to 12 weeks. Osteotomy may be considered in the individual who meets the above criteria and wants to continue engaging in high-impact activity or be able to kneel on the affected knee—an action poorly tolerated by many total knee arthroplasty designs. It is generally accepted that pain relief after osteotomy is not as predictable as after knee arthroplasty. Persistence or development of degenerative pain after osteotomy may require further surgical intervention in the form of arthroplasty. While arthroplasty following osteotomy is certainly possible, the procedure can be more complicated and it is unclear at this time whether outcomes following this procedure are equivalent to primary knee arthroplasty.¹⁻³

Unicompartmental arthroplasty

Unicompartmental arthroplasty may be an option for individuals with symptoms of isolated compartment arthrosis. For isolated medial or lateral compartment arthrosis, the surgical indications and contraindications are similar to those for osteotomy. Recovery is typically quicker after unicompartmental arthroplasty than after osteotomy, but at this time it is unclear which of the two is better in terms of function and survivorship.⁴ It is well understood, however, that total knee arthroplasty provides superior survivorship when compared with both osteotomy and unicompartmental arthroplasty.

Patellofemoral joint arthroplasty

Although not a common occurrence, symptomatic degenerative change

can be isolated to the patellofemoral articulation. When nonoperative treatments fail to control symptoms related to degeneration, isolated arthroplasty of the patellofemoral articulation may be considered. This procedure involves resurfacing of the patella as well as the femoral trochlea while leaving the tibiofemoral compartments alone.

Though less invasive than total knee arthroplasty, patellofemoral joint arthroplasty clearly demonstrates reduced survivorship at 10 years, with a cumulative revision rate of 27.0% compared with 5.5% for TKA.

Indications

The primary indication for total knee replacement has been and continues to be arthritis-related pain that significantly reduces walking tolerance, impairs ability to perform activities of daily living, and interferes with sleep. Furthermore, such symptoms must be resistant to readily available, less invasive, and more cost-effective management approaches. Once it has been determined that surgical intervention is warranted, consideration must be given to options other than total knee arthroplasty, including osteotomy and isolated compartment replacement, where appropriate.

It is critical that both surgeons and patients understand that knee arthroplasty is not without risk and are fully in agreement regarding reasonable expectations following knee arthroplasty. To this end, patient expectations need to be discussed and tempered by reality prior to embarking on a knee replacement. Surgeons must explain that patient-related factors such as obesity and comorbidity can significantly affect outcome following this increasingly common procedure.

Patient-related factors affecting outcome

After undergoing knee arthroplasty, the majority of patients demonstrate significant improvement over their preoperative state. An appreciable minority of patients (10% to 20%) demonstrate some degree of functional impairment or dissatisfaction despite an absence of identifiable technical deficiency or complication.⁵

A number of patient-related factors have been found to contribute to poor outcome following knee arthroplasty. These include, but are not limited to, obesity, comorbidities, unrealistic expectations, and tolerance to narcotics. It is important that clinicians identify patients at risk of poor outcome in order to counsel them appropriately during the process of deciding whether TKA is appropriate.

Obesity

The Canadian Institute for Health Information estimates that 1 in 4 Canadians are obese and that the rates are continuing to increase. Along with contributing to the development of comorbidities such as diabetes, hypertension, and coronary artery disease, obesity can contribute to the development and severity of symptomatic knee arthritis.⁶

Conflicting evidence exists regarding the impact of obesity on outcomes following arthroplasty of the knee and those studies that exist tend to be low-level case series. A recent systematic review identified 41 studies looking at this issue and found that the majority, including three systematic reviews, concluded that obesity adversely affected outcome, rate of complications, implant survival, and cost of TKA.⁷

Obesity can increase the risk of superficial and deep infection of surgical wounds, one of the most significant complications that can arise and

affect the success of the procedure,⁸⁻¹² and can also contribute to increased length of stay and direct medical costs following knee arthroplasty.^{11,13} This is an area of increasing interest and study in our current environment of fiscal restraint in health care.

Despite concerns about the impact of obesity on knee arthroplasty, most obese patients will benefit from the procedure. In some patients with morbid obesity, however, knee replacement should probably not be offered. While each surgeon's practice varies, and understanding that body mass index (BMI) is not necessarily a perfect measure of obesity, many surgeons would agree that a BMI of 45 to 50 or greater should be considered a contraindication to joint replacement, and patients should be counseled about the importance of weight loss as treatment of their life-threatening condition. Increasingly, bariatric surgery is being used to assist in the management of morbid obesity and its long-term health consequences. A recent systematic review indicates that bariatric surgery in the setting of prearthritic knee pain resulted in significantly decreased knee pain and stiffness as well as improved function.¹⁴ It has not yet been determined how this approach to weight reduction might affect outcome following knee arthroplasty in previously morbidly obese patients.

Comorbidities

As the population ages, the number of elderly patients proceeding to knee arthroplasty is growing. With increasing age comes increasing comorbidity. It is well established that such comorbidity can negatively affect outcome following knee arthroplasty. In a prospective study, Wasielewski and colleagues determined that increased comorbidity was associated with increased length

of stay and hospital cost, as well as poorer patient-reported outcome.¹⁵ Other studies have found a similar relationship between comorbidity and decreased patient satisfaction following knee arthroplasty.^{16,17} While good outcomes have been reported in octogenarians and nonagenarians, postoperative delirium is a major risk in this age group. Interviewing family members to make sure that early cognitive impairment is not present can lessen the chance of postoperative delirium occurring. Patients need to be counseled about this real risk prior to agreeing to joint replacement surgery. Similarly, mental health issues such as anxiety, depression, and pain catastrophizing must be considered in the preoperative consultation process, as these factors have been shown to contribute to dissatisfaction and poor outcome following arthroplasty.^{16,18}

Expectations

Patient satisfaction is becoming an increasingly important metric in health care delivery, particularly in publicly funded and third-party payer systems. Patient expectations can contribute significantly to satisfaction following knee arthroplasty, and should be addressed as part of the informed consent process. It is now well established that unrealistic or unmet expectations can lead to patient dissatisfaction independent of objective measures of knee function.^{19,20} To ensure patient expectations are realistic, the limitations of knee replacement surgery must be discussed. Patients who expect to be 100% pain-free after surgery, to return to a high level of athletic performance, or to be able to squat and kneel unimpeded will inevitably be disappointed with the outcome of the operation.

Tolerance to narcotics

The increasing use of narcotic medi-

cations in the medical management of arthritis means that patients may be on high-dose narcotics prior to surgery. This can put them at substantial risk of a poor outcome because their tolerance to narcotics makes safely achieving adequate pain control after surgery almost impossible.²¹ Escalating doses of narcotics can be needed postoperatively, and pain can worsen as narcotics are withdrawn. To end the vicious circle of escalating and reducing doses, narcotics need to be withdrawn gradually or reduced to below 100 mg of morphine equivalent per day prior to joint replacement surgery. Long-acting narcotics need to be replaced with immediate-release narcotics and the doses tapered off prior to surgery.

When to refer

Referral for total knee arthroplasty is appropriate when pain arising from joint failure due to osteoarthritis, osteonecrosis, rheumatoid arthritis, and other inflammatory arthropathies is refractory to nonoperative management. The first step in determining the need for knee replacement is to confirm the diagnosis that surgery is expected to address. Causes of knee pain other than arthritis must be ruled out, including pain referred from the hip and lumbar radicular pain. Appropriate weight-bearing radiographs of the knee (Figure) and skyline views of the patella must be obtained. If there is a question regarding the true source of the pain, diagnostic injections with anesthetic agents can be helpful. Appropriate placement of the

anesthetic is essential and referral for image-guided injection can be utilized. Once the diagnosis is confirmed on radiographs, there is no need for magnetic resonance imaging. MRI scans yield no useful information and should not be ordered. The first-line investigation in the assessment of knee pain in any patient older than 40 should be standing radiographs and not an MRI scan.

Once the patient's symptoms, signs, and radiographic features are clinically clear, nonoperative management should be initiated. First-line treatments include activity modification, weight loss, and the use of walking aids such as a cane. Although patients may resist such options, a treatment plan should be discussed and agreed upon. Acetaminophen and

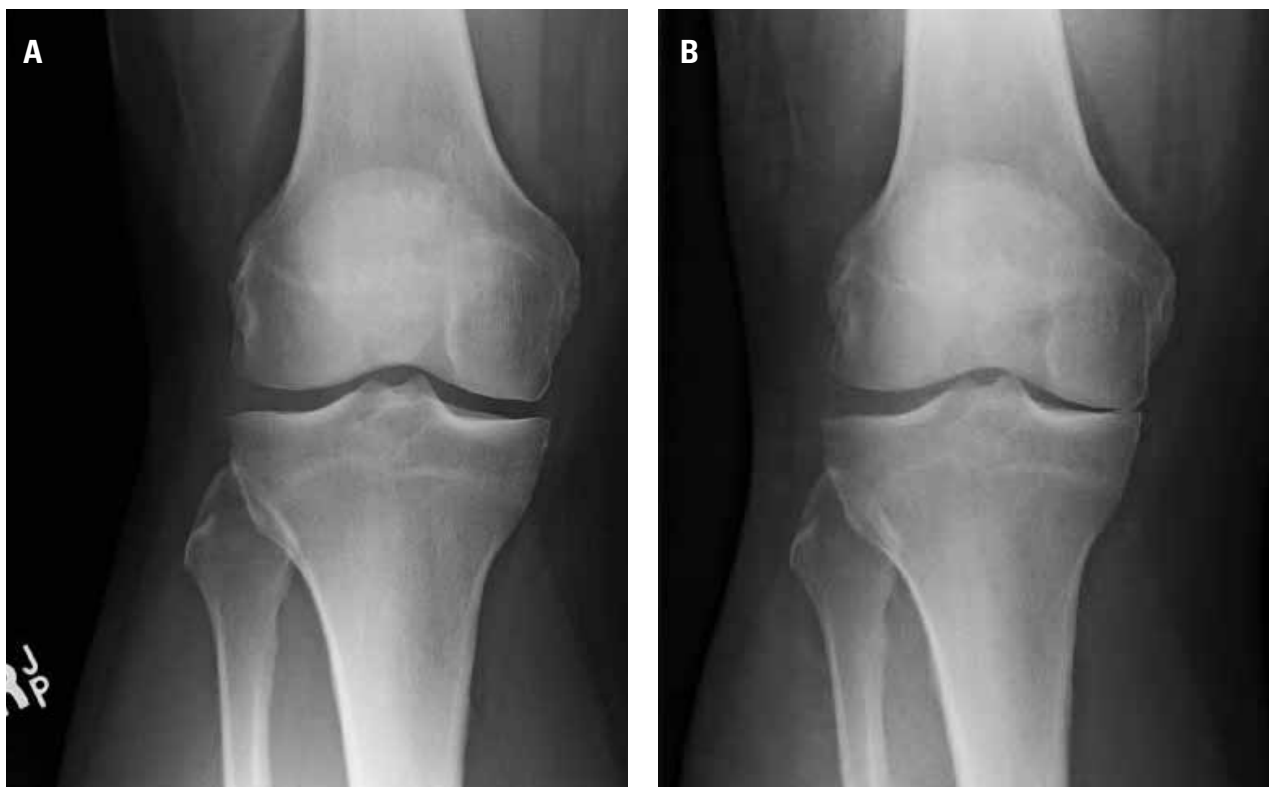


Figure. Two anteroposterior radiographs of the same knee. The non-weight-bearing radiograph (A) shows minimal medial joint space loss, while the weight-bearing radiograph (B) reveals significant loss.

NSAIDs may be added to the treatment plan if appropriate, although long-term NSAID use should be avoided. If NSAIDs are used, patients must be monitored for renal and cardiac toxicity. Narcotics should never be used for the treatment of pain related to osteoarthritis. Patients should be referred for surgical consideration well before narcotics are even considered as dependence on opioids can lead to complications and delays in recovery during the postoperative period.²¹ Other treatment options, including viscosupplementation, prolotherapy, and injections of steroids, platelet rich plasma stem cells, or glucose, lack definitive clinical evidence.²²⁻²⁴ Physiotherapy, chiropractic treatment, and acupuncture also lack evidence of significant benefit.^{25,26} Joint mobility and patient activity should be encouraged with an emphasis on those activities that limit joint load and focus on cardiovascular health.

Absolute contraindications to knee arthroplasty include active knee sepsis, previously untreated or chronic osteomyelitis, ongoing remote source of infection, absent extensor mechanism, and severe untreated or untreatable peripheral arterial disease. Relative contraindications include surgical site skin conditions such as psoriasis and excessive scarring, physical and mental conditions that prohibit appropriate rehabilitation, morbid obesity, and a neuropathic joint. Age is not a contraindication to surgery. There is no age cut-off for surgery, and patients of all ages may be suitable candidates for a knee replacement.

Once a diagnosis of osteoarthritis has been confirmed clinically and radiographically, nonoperative management has been optimized and used for an extended period, and any contraindications have been ruled out, sur-

gical intervention can be considered for any patient with ongoing moderate to severe pain that is significantly affecting quality of life. It is important to refer the patient early once it is clear that nonoperative treatment is failing because surgical outcomes are better when patients are operated on before the disease is at an extremely advanced stage.

How to optimize outcomes

When TKA has been deemed appropriate and the patient is awaiting surgery, any modifiable risk factors should be addressed. Medical treatment of diabetes and cardiopulmonary illness should be optimized. While there is no evidence that tight glycemic control prevents complications after knee replacement, better glycemic control is good for patients in general, and patients contemplating referral for knee replacement surgery should have an HbA1c of 7% or less. Smoking cessation protocols should be initiated if necessary. Although complete cessation can be an unrealistic goal for some smokers, patients should be informed that even a reduction in smoking can lead to a lower risk of perioperative complication. Patients who are immunocompromised because of medication load or illness should be assessed and appropriate treatment changes should be initiated. Immunocompromise is a common concern for those suffering from rheumatoid arthritis. Many of the disease-modifying antirheumatic drugs (DMARDs) such as methotrexate and gold can be continued through the perioperative period; however, the biologic agents associated with the treatment of rheumatoid arthritis may need to be stopped temporarily.²⁷ Steroid use should be reduced or stopped where possible. Decisions regarding DMARDs should be made with input from the family practitio-

ner, orthopaedic surgeon, and internal medicine specialist/rheumatologist. Malnutrition is also a common occurrence in the aging population and can adversely affect surgical outcomes. Appropriate screening tools should be used and referral made to a dietitian or nutrition support team when problems are identified.²⁸

Although there is interest in developing a clinical tool that can be applied preoperatively to predict the likelihood of positive or negative outcome,²⁹ no such tool is readily available yet. Certainly an outcome prediction tool of some kind could improve the informed consent process as well as the delivery of health care services, including knee arthroplasty.

Summary

Total arthroplasty of the knee continues to be one of the most common surgical procedures as the population ages and patients with painful degenerative joint conditions seek high functional capacity in their later decades. Overall, the majority of patients who undergo knee arthroplasty have a significant reduction in pain and improvement in function. However, outcomes following knee arthroplasty vary and clearly involve a complex interplay of technical and patient-related factors. Until we have a tool that can reliably predict patient outcome based on these factors, we must focus on appropriate diagnosis and patient selection, establish appropriate expectations, optimize patient health, and avoid preventable complications. In this way we will be able to improve outcomes and maximize patient satisfaction.

Competing interests

None declared.

References

1. Amendola A, Bonasia DE. Results of high

- tibial osteotomy: Review of the literature. *Int Orthop* 2010;34:155-160.
2. van Raaij TM, Reijman M, Verhaar JA. Total knee arthroplasty after high tibial osteotomy: A systematic review. *BMC Musculoskelet Disord* 2009;10:88.
 3. Erak S, Naudie D, MacDonald SJ, et al. Total knee arthroplasty following medial opening wedge tibial osteotomy: Technical issues early clinical radiological results. *Knee* 2011;18:499-504.
 4. Dettoni F, Bonasia DE, Castoli F, et al. High tibial osteotomy versus unicompartmental knee arthroplasty for medial compartment arthrosis of the knee: A review of the literature. *Iowa Orthop J* 2010;30:131-140.
 5. Robertsson O, Dunbar M, Pehrsson T, et al. Patient satisfaction after knee arthroplasty: A report on 27 372 knees operated on between 1981 and 1995 in Sweden. *Acta Orthop Scand* 2000;71-3:262-267.
 6. Blagojevic M, Jinks C, Jeffery A, Jordan KP. Risk factors for onset of osteoarthritis of the knee in older adults: A systematic review and meta-analysis. *Osteoarthritis Cartilage* 2010;18:24-33.
 7. Rodriguez-Merchan EC. Review article: Outcome of total knee arthroplasty in obese patients. *J Orthop Surg (Hong Kong)* 2015;23:107-110.
 8. Namba RS, Paxton L, Fithian DC, Stone ML. Obesity and perioperative morbidity in total hip and total knee arthroplasty patients. *J Arthroplasty* 2005;20(7suppl 3):46-50.
 9. Dowsey MM, Choong PF. Obese diabetic patients are at substantial risk for deep infection after TKA. *Clin Orthop Relat Res* 2009;467:1577-1581.
 10. Samson AJ, Mercer GE, Campbell DG. Total knee replacement in the morbidly obese: A literature review. *ANZ J Surg* 2010;80:595-599.
 11. D'Apuzzo MR, Novicoff WM, Browne JA. Morbid obesity independently impacts complications, mortality, and resource use after TKA. *Clin Orthop Relat Res* 2015;473:57-63.
 12. Kerkhoffs GM, Servien E, Dunn W, et al. The influence of obesity on the complication rate and outcome of total knee arthroplasty: A meta-analysis and systematic literature review. *J Bone Joint Surg Am* 2012;94:1839-1844.
 13. Kremers HM, Visscher SL, Kremers WK, et al. The effect of obesity on direct medical costs in total knee arthroplasty. *J Bone Joint Surg Am* 2014;96:718-724.
 14. Groen VA, van de Graaf VA, Scholtes VA, et al. Effects of bariatric surgery for knee complaints in (morbidly) obese adult patients: A systematic review. *Obes Rev* 2015;16:161-170.
 15. Wasielewski RC, Weed H, Prezioso C, et al. Patient comorbidity: Relationship to outcomes of total knee arthroplasty. *Clin Orthop Relat Res* 1998;356:85-92.
 16. Clement ND. Patient factors that influence the outcome of total knee replacement: A critical review of the literature. *OA Orthopaedics* 2013;1:11.
 17. Scott CE, Bugler KE, Clement ND, et al. Patient expectations of arthroplasty of the hip and knee. *J Bone Joint Surg Br* 2012;94:974-981.
 18. Scott CE, Howie CR, MacDonald D, Biant LC. Predicting dissatisfaction following total knee replacement: A prospective study of 1217 patients. *J Bone Joint Surg Br* 2010;92:1253-1258.
 19. Noble PC, Condit MA, Cook KF, Mathis KB. Patient expectations affect satisfaction with total knee arthroplasty. *Clin Orthop Relat Res* 2006;452:35-43.
 20. Dunbar MJ, Richardson G, Robertsson O. I can't get no satisfaction after my total knee replacement: Rhymes and reasons. *Bone Joint J* 2013;95-B(11suppl A):148-152.
 21. Zywił MG, Stroh DA, Lee SY, et al. Chronic opioid use prior to total knee arthroplasty. *J Bone Joint Surg Am* 2011;93:1988-1993.
 22. Filardo G, Kon E, Di Martino A, et al. Platelet-rich plasma vs hyaluronic acid to treat knee degenerative pathology: Study design and preliminary results of a randomized controlled trial. *BMC Musculoskelet Disord* 2012;13:22.
 23. Rutjes AW, Juni P, da Costa BR, et al. Viscosupplementation for osteoarthritis of the knee: A systematic review and meta-analysis. *Ann Intern Med* 2012;157:180-191.
 24. Rabago D, Best TM, Beamsley M, Patterson J. A systematic review of prolotherapy for chronic musculoskeletal pain. *Clin J Sport Med* 2005;15:376-380.
 25. French HP, Brennan A, White B, Cusack T. Manual therapy for osteoarthritis of the hip and knee—A systematic review. *Man Ther* 2011;2:109-117.
 26. Quilty B, Tucker M, Campbell R, Dieppe P. Physiotherapy, including quadriceps exercises and patellar taping, for knee osteoarthritis with predominant patello-femoral joint involvement: Randomized controlled trial. *J Rheumatol* 2003;30:1311-1317.
 27. Howe CR, Gardner GC, Kadel NJ. Perioperative medication management for the patient with rheumatoid arthritis. *J Am Acad Orthop Surg* 2006;14:544-551.
 28. Gherini S, Vaughn BK, Lombardi AV, Mallory TH. Delayed wound healing and nutritional deficiencies after total hip arthroplasty. *Clin Orthop Relat Res* 1993;293:188-195.
 29. Barlow T, Dunbar M, Sprowson A, et al. Development of an outcome prediction tool for patients considering a total knee replacement—The knee outcome prediction study (KOPS). *BMC Musculoskelet Disord* 2014;15:451. **BCMJ**