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REVIEW ARTICLE

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Total knee arthroplasty for rheumatoid arthritis

Abstract Total knee arthroplasty is a proven technique for the management of deformity and unremitting pain in the rheumatoid arthritic knee. Many important considerations must be taken into account in order to maximize the results of total knee replacement in this challenging patient population.

Key words Arthroplasty · Knee · Rheumatoid arthritis (RA)

The knee is among the most commonly affected joints in rheumatoid arthritis (RA). Indeed, it is estimated that up to 90% of patients with RA will eventually have the involvement of one or both knees.[1] While medical management is frequently successful in managing the symptoms of synovitis related to RA, progressive joint destruction may lead to unremitting pain and articular deformity that cannot be managed adequately without surgical intervention. Fortunately, the evolution of total knee replacement (TKR) has enabled many of these patients to experience predictable pain relief, increased functional capabilities, and an overall marked improvement in their lifestyle.

Preoperative assessment

Before performing total knee replacement on a patient with rheumatoid arthritis, a careful preoperative assessment is essential. The orthopedic surgeon must have a thorough understanding of the systemic nature of RA and its implications.

Polyarticular involvement of rheumatoid arthritis requires careful planning in order to optimize the patient's overall function. As many as 50% of patients with rheumatoid disease of the knee have concomitant hip involvement.[2] In most cases, hip replacement should be undertaken before knee replacement where both are indicated in the same leg. The pain relief obtained from hip replacement may delay knee replacement, as these two conditions often have overlapping symptomatology. Also, the rehabilitation after a hip replacement, even when the ipsilateral knee has significant symptomatic involvement, is usually tolerable, whereas the converse is not always true. Adequate hip flexion and a relatively painless arc of hip motion are required for the use of physical therapy modalities and the techniques used to achieve maximal knee motion after knee replacement. In addition, from the patient's perspective, recovery from a hip replacement is often easier than recovery from a knee replacement in terms of pain and a return to relatively normal function. Therefore, while both hip and knee arthroplasty are major undertakings, it may be beneficial from a psychological perspective to have a comparatively easier first experience of joint replacement. Finally, contractures that frequently develop in patients with RA of the hip and knee tend to be best addressed proximally at the hip first.

Upper-extremity involvement must also be assessed prior to undertaking TKR in the rheumatoid patient. Frequently, the involvement of the shoulders, elbows, or wrists precludes the use of the assistive devices which are necessary for ambulation in the weeks following knee replacement. Approximately 105° of knee flexion is required to rise from a seated position without the use of the upper extremities. Therefore, any surgical technique should attempt to restore adequate flexion in order for patients with upper-extremity disease to maintain independent function.[3] In many cases, the need for specialized gait aids, including platform crutches or a walker, should be anticipated.

The final consideration from the musculoskeletal perspective is the cervical spine. Collins et al.[4] reported that 61% of patients with RA who were evaluated had roentenographic evidence of significant atlantoaxial subluxation, atlantoaxial impaction, and /or subaxial subluxation. This pathology was asymptomatic in 50% of patients. While

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surgical stabilization may not be necessary in the asymptomatic patient, the presence of cervical instability is an important factor in anesthetic choice, as it clearly increases the risks associated with standard endotracheal intubation.

An accurate history of the patient's medication usage, particularly with regard to corticosteroids, nonsteroidal anti-inflammatory drugs (NSAIDS), and disease-modifying medications that may alter the immune function, is critical. It has been reported that as many as 10% of TKR patients with RA are on maintenance corticosteroids at the time of surgery. Although the number of patients on chronic corticosteroid regimens is decreasing with the advent of newer immunological agents, corticosteroids still remain a mainstay in the care of RA. The long-term use of glucocorticoids is associated with adverse effects in a dose-dependent manner. Studies have demonstrated that maintenance doses of 7.5 mg prednisone per day, or less, may be relatively safe.[5,6] However, other reports have documented significant side effects even at these lower doses.[7,8] From the perspective of the musculoskeletal system, the most important side-effects are related to bone quality, wound healing, and infection rate, which will be addressed in the following sections.[9] The issue of perioperative dosing of corticosteroids remains controversial. The established practice of perioperative "stress-dose" corticosteroids is based largely on anectodal evidence and case reports.[10] Friedman et al.[11] prospectively studied 28 patients who underwent major orthopedic procedures after being on prednisone from 6 months to 32 years. None of these patients showed signs of adrenal insufficiency after being treated with their baseline prednisone dose throughout the perioperative period. If supplemental "stress-dose" steroids are prescribed, the dosage should be physiological (i.e., 50–100 mg every 8 h), and immediately tapered to the preoperative dose as soon as the patient is deemed to be hemodynamically stable.[10]

In addition to corticosteroids, NSAIDS are a mainstay in the treatment of rheumatoid symptoms. The use of NSAIDS has implications with regard to deep venous thrombosis (DVT) prophylaxis, anesthesia, and postoperative pain management. Aspirin and ibuprofen adversely affect the coagulation profile of patients, and therefore the use of warfarin or low-molecular-weight heparin (LMWH) in patients requiring these NSAIDS is contraindicated. The use of epidural or spinal anesthesia is contraindicated where bleeding is a concern, and while general anesthesia is safe, there may be a benefit to the preemptive analgesia provided by regional anesthetics, although this is still a matter of debate. Futhermore, many orthopedic surgeons prefer to use an in-dwelling epidural catheter for a sensory block for 1–2 days postoperatively for pain control. In consideration of these factors, traditional NSAIDS should be discontinued at least five half-lives prior to surgery, and aspirin should be discontinued at least 7–10 days prior to surgery.[12] With the advent of the COX-2-inhibiting class of nonsteroidals, these medications may be used in conjunction with LMWH and warfarin. Studies have shown that the more selective mechanism of action of these medications does not significantly affect the coagulation profile of patients receiving conventional anticoagulants.

Finally, the use of disease modifying agents in the perioperative period has been of concern to orthopedic surgeons. Recommendations have been put forward to discontinue methotrexate use for approximately 2 weeks preoperatively and also in the immediate postoperative period because of concerns over fluid-balance alterations and the possibility of infection.[12,13] However, Perhala et al.[14] and Sany et al.[15] have published articles in the rheumatology literature that support the safe continuous use of methotrexate throughout the perioperative period. Larger-scale prospective clinical trials may be necessary to ascertain the precise effects of methotrexate and other disease-modifying agents on the TKR population.

Technical considerations

While a detailed discussion of surgical techniques is beyond the scope of this article, there are certain factors which are important for the referring physician to understand because of the impact they have on the outcomes of total knee replacement in the rheumatoid population.

Unlike a patient with osteoarthritis (OA), bone quality in patients with rheumatoid arthritis is generally poor. This poor bone quality is a function of the disease process itself, disuse, and the frequently associated use of corticosteroids. The bone abnormalities in rheumatoid arthritis are characterized by a loss of bone volume and strength as a result of increased bone remodeling. A decrease in the density of both cancellous and cortical bone is commonly found on radiographs of patients with long-standing rheumatoid disease. For such findings to be detectable on radiographs, a minimum of 30% loss of bone substance must be present.[16] Of particular concern with regard to total knee arthroplasty is the relative lack of strong subchondral bone. Both the fixation and the support of the tibial component of a knee prosthesis require an adequate subchondral platform. Using cement as the primary mode of fixation instead of relying on bone ingrowth has become the standard for tibial fixation. In addition to bone grafting techniques, modular components have been devised with stems and metallic augments to account for severe bone loss (Fig. 1). Most often, however, a successful arthroplasty can be performed with the use of standard components.

Perhaps even more important than its effect on bone stock is the effect that rheumatoid disease has on the periarticular soft tissues. Meticulous attention to the atraumatic handling of the skin and soft tissues is essential. Medication and poor nutrition often render these tissues atrophic, with reduced healing ability. The relative subcutaneous nature of the knee joint, as compared with the hip joint, places a premium on wound healing and the maintenance of soft-tissue viability to avoid infection.

The involvement of the periarticular soft tissues is part of the constellation of pathology in rheumatoid arthritis. This may result in attenuation of the usual ligamentous restraints of the knee. Instability secondary to soft tissue laxity, and soft tissue contractures resulting in and from deformity, are

issues that must be addressed intraoperatively. In contrast to patients with OA, the majority of patients undergoing TKR secondary to RA have ligamentous laxity with hyperextension and no fixed deformity.[3] However, fixed varus or valgus deformities with severe flexion contractures do occur. Appropriate soft-tissue balancing in the form of ligament and capsular release at the time of arthroplasty is essential to the success of the procedure. Occasionally, severe flexion contractures are present, as in the case of a wheelchair bound patient, and supplemental measures to address the deformity, such as additional bone resection and extensive soft-tissue releases, must be used (Fig. 2).

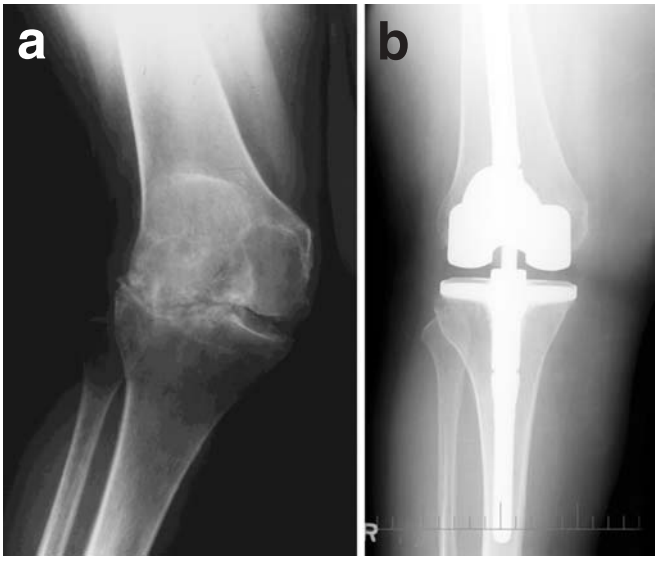

Fig. 1. **a** AP radiograph of a knee with severe valgus deformity and bone loss. **b** Postoperative radiograph after TKR, demonstrating restored alignment

Results

The success of total knee replacement for rheumatoid arthritis has been well documented. While debate within the orthopedic community centers on issues such as the value of retaining the posterior cruciate ligament, many studies support the fact that with modern total knee designs, excellent functional improvement and long-term prosthesis survivorship should be expected. Ranawat and co-workers reported on 104 total knee replacements in patients with rheumatoid arthritis after an average of 12.7 years follow-up. In that study, 81% of patients had good or excellent HSS scores. Schai et al.[18] evaluated 81 patients who had received a posterior cruciate retaining implant after an average of 11 years. The Knee Society score in this cohort averaged 95 points, with prosthesis survivorship, based on the need for revision surgery, of 97%. Scuderi et al.[19] studied cruciate sacrificing and posterior stabilized TKR, and found an overall prosthesis survivorship of 97.3% at 10 years and 90.6% at 15 years. As the life expectancy of patients with RA increases, it will be important to assess the results of TKR carefully into the second and third decades following prosthesis implantation, as people with RA tend to undergo joint replacement at a younger age than osteoarthritic patients. However, although patients with RA have joint replacement performed at a younger age, they generally have lower activity levels, which place faces demands on their lower extremities. Therefore, it is possible that the long term results of TKR in rheumatoid patients will exceed those achieved in patients with OA. Rand and Ilstrup,[20] in a review of over 9000 knee replacements, identified rheumatoid arthritis as an independent variable related to a significantly lower risk of failure. Decreases in function and activity over time in patients with RA tend to be related to the involvement of other joints, and not to prosthetic

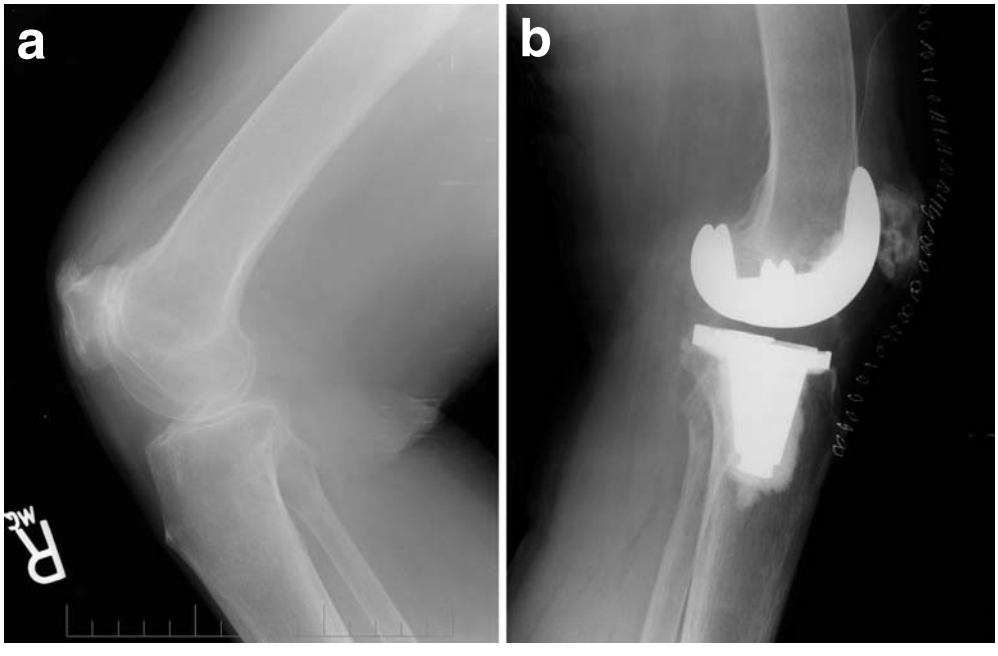

Fig. 2. **a** Lateral radiograph of pt with 70° fixed flexion contracture. **b** Postoperative radiograph with flexion contracture resolved

failure. However, contradictory evidence exists. Several smaller series directly comparing the results of TKR in RA with those in OA have not demonstrated a significant difference between these two groups of patients. Furthermore, Nafei et al. reported worse results in patients with RA, with a 97% implant survivorship at 12 years in patients with OA versus 87% for RA.

Complications

Most complications that occur after TKR are common to both the osteoarthritic and the rheumatoid patient alike. Postoperative monitoring for DVT, pulmonary embolus, and cardiac events are necessary components of postoperative management for all joint-replacement patients. The most important complication affecting the results of TKR in patients with RA is infection. Rates of infection have been reported to be approximately three times greater in patients with RA than in those with OA.[21,22] The reasons for this are multifactorial, but the use of immunosuppressive medications, most importantly, corticosteroids, are the main factor. Steroids not only affect the immune response of patients, but also have a tendency to render the skin atrophic and easily injured. Rapid wound healing is crucial to the prevention of infection, and is inhibited in patients on glucocorticoids.[9,23]

Summary

Total knee replacement has clearly been established as a valuable and predictable intervention for patients suffering from rheumatoid arthritis. A multidisciplinary approach towards the management of rheumatoid arthritis, including the rheumatologist, orthopedic surgeon, and physical therapist, will ensure that the benefits of TKR are maximized. Crucial to the success of TKR in this patient population is a recognition of the systemic nature of RA, and the resulting implications. Despite the complexities associated with surgery in the rheumatoid population, a well-timed, well-executed total knee replacement has been proven to enhance the quality of life for people with disabling RA of the knee.

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