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Total Knee Arthroplasty in Rheumatoid Arthritis

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The course of rheumatoid arthritis varies from mild disease to severe joint destructive variant that progresses rapidly, eventually leading to unremitting pain and joint deformity. In advanced disease, total knee arthroplasty has proven to be the most successful intervention that reduces knee pain and improves physical function in rheumatoid arthritis patients. However, as rheumatoid arthritis patients carry additional potential for late complications, many important considerations regarding preoperative evaluation and surgical technique must be taken into account in order to improve the results of total knee arthroplasty in this subgroup of patients.

Key words: **Knee, Rheumatoid arthritis, Total knee arthroplasty.**

Introduction

The knee is one of the most commonly affected joints in patients suffering from chronic rheumatoid arthritis (RA). The course of RA varies from mild disease to severe joint destructive variant that progresses rapidly, eventually leading to unremitting pain and joint deformity[1-3]. Despite recent improvement in biological agents and treatment modalities in the field of rheumatology, progressive joint destruction continues to occur in a subgroup of RA patients, who eventually require joint surgery. In advanced disease, when synovectomy is of no benefit, total knee arthroplasty (TKA) has proven to be the most successful intervention that reduces knee pain and improves physical function in RA patients[4,5]. However, as RA patients carry additional potential for late complications, many important considerations regarding preoperative evaluation and surgical techniques must be taken into account, in order to improve the results of TKA in this subgroup of patients.

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Preoperative Considerations

1. Age and Activity

RA patients are often younger (by approximately 10 or more years) than osteoarthritis (OA) patients at the time of TKA. The life span of RA patients with a knee replacement is not well known, however, assuming that RA patients have a normal life span, a TKA in this subgroup of patients on average needs to last longer and accordingly, the potential risk of late complications increases. Ranawat et al.[6] reported the results of 93 cemented TKAs in patients younger than 55 years, and there were 80% rheumatoid and 20% osteoarthritic knees in their series. Dalury et al.[7], in a series of 87 TKAs in patients younger than 45 years, reported that 87% of their patients had a diagnosis of RA or juvenile RA. In 1997, Gill et al.[8] also reported results of 68 TKAs (52 patients) in patients younger than 55 years, and the diagnosis was osteoarthritis in 37 knees, rheumatoid arthritis in 29 knees, and ankylosing spondylitis in 2 knees in their series. They found that all knees were rated as good or excellent for knee and function scores with an average follow-up period of 9.92 years, and concluded that TKA performed in younger patients with OA and RA can attain results comparable to the excellent results obtained in the older age groups. However, because of the polyarticular involvement and decreased activity level in patients with RA, it is important to evaluate the functional activity of the knee based on physiological age rather than chronological age.

2. Multiple Joint Involvement

RA is a chronic, systemic, and inflammatory disease, most often involving small peripheral joints, although many other synovial joints can be affected. Adult RA is usually polyarticular in nature, with a clinical picture characterized by synovitis and destruction of the affected joints. It is well known that up to half of RA patients suffering from knee pain have concomitant hip involvement[9]. Eberhardt and Fex[10] reported 15% hip involvement at 1 year after onset of the disease, compared with 28% at 5 years. There is controversy regarding the priority of joint surgery in patients with both joints affected in the same limb; however, in most cases, it is accepted that hip replacement should be undertaken before knee replacement, when both are indicated. The symptoms of these two conditions may overlap and pain relief obtained from hip replacement may delay knee replacement. The rehabilitation may be more tolerable after hip replacement even with significant ipsilateral knee involvement, whereas the converse is not always true. Additionally, adequate arc of hip motion is required for deep knee flexion, which is often required for successful TKA procedures. Conaty and Nickel[11] reported that, after successful hip and knee replacements, they were able to convert approximately 30% of class III and IV patients with combined hip and knee lesions to a more functional level.

Cervical spine also needs careful attention in patients undergoing surgery. It is well known that RA involves cervical spine in three ways: basilar invagination, atlanto-axial instability, and subaxial instability. Collins et al.[12] reported that 61% of RA patients who have undergone knee or hip replacement were noted to have radiographic evidence of cervical spine instability in their study. Although surgical intervention is rarely needed, it is important to routinely check both flexion and extension on lateral cervical x-rays during preoperative evaluation, and pay special attention during intubation to avoid possible neurological compromise.

Involvement of other joints, especially the ipsilateral ankle or contralateral knee or both, should be evaluated as it frequently precludes adequate rehabilitation. Upper-extremity involvement must also be evaluated prior to TKA. Frequently, in RA patients, involvement of shoulders, elbows and wrists precludes the use of assistive devices that are necessary for ambulation in the early postoperative period and, in such cases, the ability to rise from a seated position may depend solely on the individual's legs[1,11].

3. Medication History

Medications used in RA patients fall into three important categories: nonsteroidal anti-inflammatory drugs (NSAIDs), glucocorticoids and disease modifying antirheumatic drugs (DMARDs). DMARDs are comprised of drugs known as methotrexate, leflunomide, sulfasalazine, azathioprine, hydroxychloroquine, and the class of biologic response modifiers, including tumor necrosis factor alpha (TNF-α) inhibitor and interleukin-1 (IL-1) inhibitor[13-15].

With the exception of newer cyclooxygenase (COX)-2 inhibitors, most NSAIDs inhibit COX-1 and block formation of platelet-derived thromboxane A2, thus impairing thromboxane-dependant platelet aggregation. Aspirin irreversibly blocks COX-1, resulting in effective inhibition for the life span of platelet, whereas inhibition of COX-1 by traditional NSAIDs is reversible and can be restored, as the drug is cleared from circulation. In consideration of these factors, traditional NSAIDs should be discontinued for at least five half-lives for complete drug clearance prior to surgery, and aspirin should be discontinued for 7-10 days for the normal life span of platelet. Selective COX-2 inhibitors (e.g., celecoxib) do not necessarily need to be discontinued, as they do not affect this mechanism of platelet inhibition[13,15].

Chronic use of glucocorticoids is not uncommon in RA patients and, from the perspective of musculoskeletal system, the most concerned side-effects are related to bone quality, wound healing, and infection. The issue of perioperative dosing of glucocorticoids remains controversial and therefore, the current standard has been to individualize supplementation based on the magnitude of surgery and severity of illness[16,17]. In their study, Shaw and Mandell[18] reported that, if supplemental "stress dose" steroids are prescribed, the dosage should be physiologic (i.e., 50-100 mg every 8 hours), and immediately tapered to preoperative dose as soon as the patient is hemodynamically stable.

In the perioperative period, the use of DMARDs, especially methotrexate, has been of concern because of possible fluid-balance alterations and increased risk of perioperative infection[13,15,18]. However, in their prospective studies, both Perhala et al.[19] and Grennan et al.[20] recommended safe continuous use of methotrexate throughout the perioperative period. The perioperative use of methotrexate appears warranted but must be approached with a great deal of caution. As methotrexate and its metabolites are primarily excreted through the kidneys, it has been suggested to hold methotrexate the week before surgery and 1 to 2 weeks after in renally impaired individuals. According to the guidelines of the American College of Rheumatology[15] it has been recommended that biologic agents, such as abatacept, TNF-α inhibitor (e.g., etanercept), and rituximab, should not

Table 1. Perioperative Medication Recommendations for Rheumatoid Arthritis Patients

Medication	Comments
NSAIDs	Discontinue 5 half-lives before surgery. Aspirin should be stopped 7-10 days before surgery
Corticosteroids	Individualized based on the magnitude of surgery and the severity of patient's illness
Methotrexate	Continue perioperatively for all procedures. Consider withholding 1 to 2 doses for patients with poorly controlled diabetes; the elderly; and patients with liver, renal, or lung disease
Leflunomide	Withhold 1-2 days before surgery and restart 1-2 weeks later or withhold 2 weeks before surgery and restart 3 days later
Sulfasalazine	Withhold 1 day before surgery and restart 3 days later
Hydroxychloroquine	Continue for all procedures
TNF antagonist	Withhold etanercept for 1 week, and plan surgery for the end of the dosing interval for adalumimab and infliximab Restart 10-14 days postoperatively
IL-1 antagonist	Withhold 1-2 days before surgery and restart 10 days postoperatively

NSAID: nonsteroidal anti-inflammatory drug, TNF: tumor necrosis factor, IL: interleukin.

be used during the perioperative period, for at least 1 week prior to and 1 week after surgery. Perioperative medication recommendations for RA patients undergoing TKA are summarized in Table 1.

Intraoperative Considerations

1. Bone Quality

Bone quality is generally poor in RA patients. This poor bone quality occurs due to the combined effect of inflammatory disease process itself and disuse and chronic use of steroids[1,16,17]. Additionally, prostaglandin released by rheumatoid synovium has been suggested as an additive local deleterious factor because of its direct role in subchondral bone resorption[1]. Poor bone integrity of subchondral bone is of particular concern, as the fixation and support of components (especially on tibial side) require adequate subchondral platform. For such reasons, in RA patients, cemented TKA is preferred over cementless or hybrid TKA[1,3,6]. Secondary osteonecrosis around the knee may be found in the field of TKA in RA patients. The cause of secondary osteonecrosis is unknown. However, chronic steroid use or rheumatic disease itself may be the factors associated with secondary osteonecrosis. Depending on the extent of bony collapse, large uncontained bone defects can be filled with either bone graft or modular prosthesis augmentation. Additionally, the use of stem extensions and offset stem can assist component positioning and supplement fixation and reduce stress at the bone-implant interface.

In addition to poor bone integrity of subchondral bone, it is not uncommon to confront with cyst formation in RA knees[1,3]. These cysts often form contained defects with intact peripheral cortical rim, and can be very large in size. Such contained defects should be reconstructed either using autologous bone obtained at the time of surgery or allograft.

2. Soft Tissue

The involvement of soft tissue is a part of the pathology in RA; therefore, meticulous handling of soft tissue is essential. Although, there is little direct evidence that the underlying disease process in RA affects the skin condition in terms of wound healing, many authors have reported that RA patients usually have a greater risk of poor wound healing and late infections than OA patients. Medication (e.g., steroids) and poor nutrition often render these soft tissues atrophic. Attenuation of usual ligamentous restrains of the knee may occur, and in severe cases more constrained type of prosthesis may be required. Most often, however, a successful TKA can be performed using standard components. Valgus and varus deformities in RA patients are initially passively correctable. With time, however, a fixed varus or valgus deformity with flexion contracture develops[1,4,6,7].

Severe flexion contracture may occur in patients with wheel-chair dependency. Scott et al.[21] recommended that RA patients with severe flexion contracture should be treated by serial manipulation and casting in order to decrease the preoperative flexion contracture as much as possible. They also added that it is important to treat such a deformity by posterior soft tissue release, rather than simple removal of additional distal femoral bone. Correction of flexion contracture with increased distal femoral resection would elevate the joint line and may create mid-flexion instability. In contrast to OA patients in whom an almost complete resolution of flexion contracture is required at the time of surgery, RA patients undergoing TKA can be left

with approximately 1/3rd of the initial flexion contracture, when all other techniques to obtain full extension have failed but a large distal femoral resection is required thereby putting the collateral ligaments and popliteus tendon in danger, as the flexion contracture can be expected to resolve over time with physical therapy and continued loosening of the soft tissues[22].

Another deformity that may be present in chronically involved RA knee is fixed valgus. In fixed valgus knees, the lateral structures, including lateral collateral ligaments, iliotibial band, joint capsule and popliteus, are contracted with relative laxity of the medial structures. Adequate gradual lateral release is critical, since insufficient lateral release would tighten the lateral side, with relatively lax medial structure, and this may result in either recurrence or aggravation of valgus deformity after knee replacement. Correction of such deformity usually consists of gradual release, such as in the pie-crust technique, progressing from division of the iliotibial band to the lateral collateral ligament at its femoral origin[1,21].

In RA patients, management of synovitis in the field of TKA has also been a concern. In the presence of active inflammatory synovitis, complete synovectomy is recommended, because recurrent synovitis after TKA may occur in this patient group, and complete synovectomy in such patients may lead to improvement in the patient's general condition. However, limited synovectomy should be considered in the presence of inactive, quiet synovitis as it may induce fibrotic reaction.

3. Bone Deformities

Correct rotational alignment of the femoral prosthesis is essential to achieving good outcome after TKA. Numerous anatomical studies have shown that the transepicondylar axis is a reliable rotational landmark. Posterior condyles can also be used as a rotational landmark since the posterior condyles can be easily identified intraoperatively. However, the anatomical features of the posterior condyles vary with deformity, which is often encountered in RA knees, adoption of posterior condyles as a rotational landmark can result in rotational malalignment of the femoral prosthesis. The lateral femoral condyle usually appears hypoplastic in valgus knees, and, in such cases, careful attention should be paid when determining the rotational axis of femoral prosthesis[1,23].

Determining the level of tibial osteotomy could also be a problem in RA knees with valgus deformities, because of possible sinking of the lateral tibial condyle, and in such cases, positioning a 10 mm stylus at the usual highest position of the lateral tibial condyle can result in over resection. Therefore, it is essential to place the tip of the stylus, at a level higher than usual, on the imaginary convex lateral tibial plateau level.

Clinical Results

Long-term results of TKA for osteoarthritic and rheumatoid knees have been well documented. Up to 10 years of long-term results in RA patients have been reported by several authors, with survival rates of the prosthesis between 81% and 97.7%[6,7,24,25]. Laskin and O'Flynn[4] used total condylar knee prosthesis for RA patients and reported survival rate of 81% at 10 years with revision surgery as the endpoint. There is still controversy whether to retain or sacrifice the posterior cruciate ligament (PCL) during the procedure, because of perceived attenuation of the ligament often noted in RA patients. Many authors also expressed concern that late failure of the PCL could lead to late posterior instability. Laskin and O'Flynn[4] reported 50% of instability in the sagittal plane after TKA using posterior cruciate retaining designs that resulted in increased revision rate. However, Scott et al.[21] argued that in more than 95% of RA patients undergoing TKA, the PCL was intact and should be preserved to maximize tibial rollback and subsequent knee flexion. Furthermore, Archibeck et al.[26] reported 95% good or excellent results in 46 RA knees treated with cruciate retaining TKA with a mean follow-up of 10.5 years.

Choi et al. (Choong H. Choi, Unpublished data) reviewed 75 TKAs (71 PCL-retaining, and 4 PCL-sacrificing designs) in 55 RA patients with a minimum 15-year follow-up, and reported an implant survival rate of 85.5% at 15 years and 79.0% at 19 years. They found a significant increase in the incidence of revision due to loosening of the prostheses after 10 years of follow-up, occurring at an average of 12.4 years (range, 3 to 16 years).

Only few studies have compared the outcome of TKA in OA and RA knees. In a study with an equal number of OA and RA knees, van Loon et al.[27] reported prosthesis survival rate of 90% at 10 years. However, TKA for RA and that for OA were not similar in terms of the activity of patients, osteoporosis around the knee, disorder of other joints and age at surgery. Therefore, the data of follow-up results for the two conditions were not exactly comparable if the prosthesis, disease population and age at surgery were considered. Gill et al.[8] compared the clinical results of TKA between RA (30 knees) and OA (37 knees) patients with an average follow-up period of 9.9 years, and reported that the results were good to excellent in all knees in terms of pain relief, range of motion, and knee stability, however, because of polyarticular involvement, the functional results were

inferior in OA patients.

Complications

Complications after TKA can be more frequent and serious in RA patients than OA patients, because of poor healing nature of soft tissue, higher rate of deep wound infection, severe preoperative joint deformity and laxity, poor bone stock and involvement of other multiple joints precluding adequate rehabilitation. The most important complication affecting the results of TKA in RA patients could be deep wound infection. Rates of infection have been reported to be three times higher in RA patients compared to OA patients[28,29]. Although other reports have documented favorable infection rates after TKA, Rodriguez et al.[30] found delayed (average of 7 years) infection in 4.1% of RA patients who had undergone primary TKA. The reasons for this are multifactorial, but it has been suggested that corticosteroids, rather than the disease process itself, may be responsible.

Rheumatoid arthritis and chronic steroid use have been associated with an increased risk of periprosthetic fracture because of poor bone quality. However, it is unclear whether steroid use is a risk factor or an indicator of the severity of disease itself. Bogoch and Moran[23] reported in their series of 16 patients with supracondylar periprosthetic fracture that 12 had RA, 10 of which were chronic steroid users. Choi et al. (Choong H. Choi, Unpublished Data), in their study of 75 TKAs in 55 RA patients with a minimum 15-year follow-up, found a significant increase in the incidence of supracondylar periprosthetic fracture at an average of 11.9 years after surgery (range, 9 to 14 years).

Conclusions

TKA has been established as one of the most successful surgical interventions for reducing pain and enhancing physical function in RA patients. It is crucial to understand the systemic nature of RA since patients with RA often have additional medical, anesthetic, and multiple musculoskeletal problems when compared to patients with OA. Complications following TKA may be more frequent and serious in RA patients because of poor healing nature of soft tissue, higher rate of deep wound infection, severe preoperative joint deformity and laxity, poor bone stock, and involvement of other multiple joints that precludes adequate rehabilitation. Despite such complexities often encountered in RA patients, a well-timed, well executed TKA has been proven to improve overall function and quality of life of patients with disabling RA of the knee.

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