

Surgery Insight: orthopedic treatment options in rheumatoid arthritis

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SUMMARY

Longstanding rheumatoid arthritis (RA) leads to disability, caused mainly by joint destruction. The current goals of surgical intervention are to restore function and quality of life, prevent joint deterioration, relieve pain, and correct deformity. A number of different surgical treatment options are available to patients with RA, including synovectomy, arthrodesis, joint replacement, and soft tissue and special hand surgery; nonoperative management is also important. Decision-making and timing for orthopedic intervention are complex issues because of polyarticular involvement. Functional impairment, pain, and the subsequent loss of quality of life and inability to work have become the main considerations for surgical reconstruction. Early referral for orthopedic treatment can lead to improved functional benefit for patients with RA. The decision for orthopedic intervention should be established by an interdisciplinary team that includes rheumatologists and orthopedic surgeons experienced in the surgery of RA. Priority should be given to the joint that causes the greatest disability and pain. Disease progression and pharmaceutical treatment options should be taken into consideration when establishing an orthopedic intervention protocol.

KEYWORDS arthroplasty, decision-making, orthopedic intervention, rheumatoid arthritis

REVIEW CRITERIA

Original, English, full-text papers and reviews published in MEDLINE from January 2000 onwards were identified using the following terms: "rheumatoid arthritis" and "surgical strategy" or "surgical concept". Only papers that discussed more than one joint location were included in the first phase of the Review, but the search was later widened to include earlier publications and papers that discussed only one anatomical location.

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INTRODUCTION

There is evidence that the course of disease activity in patients with rheumatoid arthritis (RA) has become milder in recent years;^{1,2} nevertheless, longstanding RA leads to a significant decrease in a patient's ability to work over time.³ Statistical data from the Schulthess Clinic indicate that the absolute number of large and peripheral joint replacement procedures in patients with RA has remained constant over the past 10 years (BR Simmen and J Goldhahn, unpublished data). Recent findings regarding cytokine-independent pathways of joint inflammation might explain the remaining basic disease activity, despite currently available pharmaceutical therapies,^{4,5} and the progression of radiological damage in patients in clinical remission.^{6,7} Patients who fail to respond to pharmaceutical therapies, in particular, require surgical intervention to prevent further loss of function.⁸

Disability in the later stages of RA is caused mainly by joint destruction,⁹ which influences patient function and quality of life.¹⁰ Reconstructive surgery can improve a patient's function, reduce work disability, and prevent further joint destruction. Some surgical interventions, such as synovectomy that is not associated with other joint surgery, might become obsolete with improved pharmacological treatment. The superior results of high-volume orthopedic surgery^{11–13} have driven the evolution of subspecialization in this discipline in recent years, leading to a situation whereby each joint might be operated upon by a different surgeon. This can be disadvantageous for the patient unless there is an overall plan for patient care and intervention.

In this article, we aim to present the status of different surgical treatment options in RA through a review of the literature, focusing on orthopedic treatment concepts, decision-making and timing, rather than on single interventions.

SURGICAL INTERVENTION

The goals of orthopedic intervention for patients with RA have changed over time. As a result of the introduction of effective new drugs, such as

tumor necrosis factor (TNF) inhibitors, surgical correction of chronic, inflammatory disease by procedures such as synovectomy is now less frequently a treatment goal. Furthermore, as pain caused by synovitis can now be well controlled by medical treatment, synovitis is usually not a primary indication for operative treatment; however, persistent symptomatic synovitis without articular surface destruction that is resistant to modern pharmacotherapy remains a valid indication for arthroscopic synovectomy of the knee, shoulder, elbow and other joints.

The current aim of surgical intervention is, therefore, to achieve one or more of the following treatment goals: re-establishment of function and subsequent quality of life,¹⁴ prevention of further joint deterioration, relief of pain resulting from articular surface damage, correction of deformity, and improvement of appearance, particularly of the hand and the foot.¹⁵ There are several options for surgical intervention, which are outlined below.

Synovectomy, including arthrosynovectomy and tenosynovectomy

The first surgical method introduced to relieve pain and swelling in patients with RA was the removal of inflamed synovial tissue from affected joints (arthrosynovectomy) or tendons (tenosynovectomy). More than 40 years ago “the therapeutic efficacy of synovectomy” was “generally accepted”,¹⁶ and three randomized controlled trials have subsequently reported that synovectomy of the knee, ankle or wrist reduces joint swelling, effusion and pain for at least 2–5 years following the procedure.^{17–19}

Good intermediate- and long-term results have also been reported for synovectomy of the upper limb joints, particularly by Scandinavian centers,^{20,21} with marked or moderate relief of pain, improved range of motion, and high patient satisfaction observed at an average of 7.5–14 years after synovectomy of the elbow. In the hand, synovectomy is able to increase the range of motion most effectively when combined with correction of joint deformity through balancing of the joint capsule and ligaments of the affected joint. The principle of soft-tissue balancing is to correct joint deformity by lengthening contracted ligaments and the joint capsule while tightening overstretched soft tissues on the opposite side of the joint. The best results for synovectomy have been documented in the upper extremity, especially

in the hand.²² Tenosynovectomy might prevent flexor tendon rupture in the hand, and has been shown to increase mobility and strength in the affected extremity.²³ In larger joints, such as the hip, knee, ankle, shoulder and elbow, synovectomy can be performed arthroscopically.²⁴ Early, supervised rehabilitation is required to prevent joint stiffness.

Despite the widespread use of synovectomy, evidence that the assumed reduction of antigen load significantly alters radiological disease progression is not available.^{25,26} The need for this intervention has decreased with the introduction of effective disease suppression therapies, including TNF inhibitors, but synovectomy remains a local treatment option if injection of corticosteroids fails for nonresponders.

Arthrodesis

The stable fusion of painful and/or unstable joints is a valid surgical treatment option for certain joints that have been severely destroyed by RA. In several locations a stiff but painless joint can contribute more to function than a painful but mobile one.²⁷ Fusion is a well-accepted surgical option that is suitable for the wrist, metacarpophalangeal and interphalangeal joints of the thumb and interphalangeal joints of the fingers, and joints of the ankle and foot, in which limitations in the range of motion can be partially compensated for by the adjacent joints.^{28–32} This surgical option generates good functional results, particularly in the treatment of carpal collapse at the wrist,³³ even when performed bilaterally. In the early stages of RA, partial wrist arthrodesis preserves a significant range of both active and passive motion.³⁰ Although the procedure does not limit the progression of destruction of the joint articular surface,³⁴ it might prevent further dislocation of the wrist.

Arthrodesis of foot joints might also contribute to increased patient mobility. Talonavicular and triple (i.e. talonavicular, talocalcaneal and calcaneocuboid) arthrodesis help to achieve stability and relief from pain in the hindfoot to facilitate walking. Arthrodesis of the ankle is still a viable option, despite the growing success of ankle joint replacement. This procedure is suitable for cases of severe deformity of the hind and midfoot, osteonecrosis of the talar dome or failed prosthesis.³⁵

In contrast to the situation in small joints of the hand and foot, arthrodesis of large joints (such as the shoulder or the knee) substantially

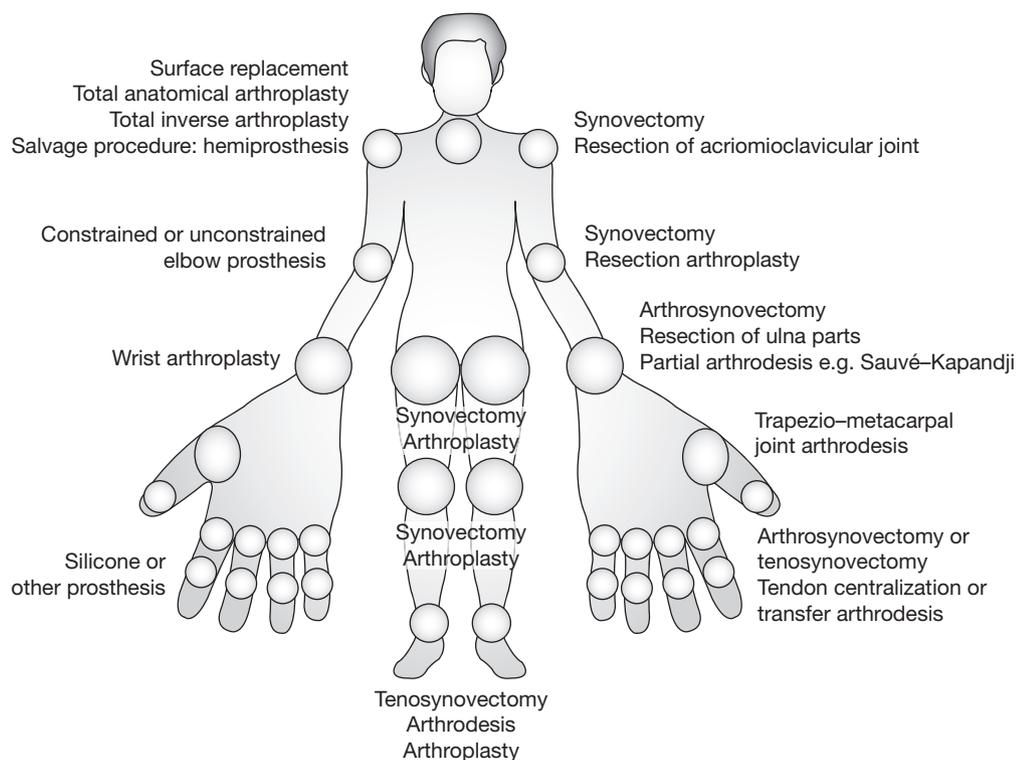


Figure 1 Overview of the main surgical treatment options available to patients with rheumatoid arthritis. Prosthetic replacement options are shown on the left side, soft tissue and corrective procedures are shown on the right side. Note the variety of surgical options available for the affected hand compared with fewer options for the large joints. The size of the circles does not correspond to the incidence of the procedure. Figure modified from image kindly provided by Professor Piet LCM van Riel, Department of Rheumatology, University Medical Centre, Nijmegen, The Netherlands.

impairs function and quality of life, and has, therefore, been abandoned, except in complex circumstances, such as brachial plexus injury.

Joint replacement

The introduction of the low-friction principle by articulation of a polished metal surface on high-density polyethylene and fixation of the components by polymethyl methacrylate, first introduced by Sir John Charnley for hip arthroplasty,³⁶ finally enabled reliable joint replacement to be carried out. Today, joint replacement is the standard treatment for several types of joint damage and has an established record of good long-term success.³⁷ Joint replacement is a mainstay of treatment for many patients with RA (Figure 1). There has been substantial improvement in the materials and techniques utilized for joint replacement, with more rapid rehabilitation protocols. The impact of certain new developments in arthroplastic surgery, such as surface replacement, mini-invasive surgery and

navigation, has, however, not yet been defined for RA. Surface replacement of the hip involves resurfacing of the femoral head with a metal cap, rather than removal and replacement of the femoral head with a femoral stem attached to a prosthetic femoral head. Mini-invasive replacement arthroplasty of the hip or knee is designed to remove damaged joint surfaces and implant prostheses through smaller surgical approaches, which minimizes disruption of muscles and tendons. Surgical navigation utilizes a variety of modern electronic technologies to orient bone cuts and the placement of implants within the skeleton.

Arthroplasty in hips, knees, shoulders and elbows

Hip, knee, shoulder or elbow destruction due to RA is the main indication for arthroplasty. The expected survival rate of hip and knee prostheses at 10 years, with revision surgery as the end point, is approximately 90%, and at 20 years it is approximately 70%. Shoulder and elbow replacements are now considered to provide

moderately reliable clinical results, with mean 10-year survival rates of 80–85% and 69–85%, respectively;³⁷ better results can be expected if the destruction process did not lead to severe distortion of the joint anatomy or accompanying soft tissue problems, such as rotator-cuff tears (see the section below on decision-making). Another challenge might arise from concomitant, severe osteoporosis resulting from RA—in this situation, poor local bone quality might compromise prosthetic anchorage.³⁸ Despite a trend towards lower functional outcome scores, the long-term results of large joint arthroplasty in patients with RA, when quantified with the prosthetic survival rate, are comparable to those in patients with osteoarthritis (OA).^{39–42}

Postoperative complications associated with total hip or total knee arthroplasty include pulmonary emboli, hip dislocation and deep wound infection, all of which might require revision surgery. The risk of developing these complications following hip arthroplasty is slightly higher in RA patients compared with patients with OA; however, the 2-month and 3-month postoperative mortality rates for total hip arthroplasty are lower in RA patients compared with OA patients.³⁷

Arthroplasty in hands

Silicone interpositional arthroplasty (e.g. Swanson, NeuFlex™ [DePuy Orthopaedics, Warsaw, IN], etc.), which maintains the original joint space, has facilitated the reconstruction of severely deformed metacarpophalangeal and interphalangeal finger joints of patients with RA, and has an important role in orthopedic management.^{43,44} In a systematic review of 20 studies of metacarpophalangeal joint arthroplasty in RA patients, with follow-up durations ranging from a few months to 16 years, the weighted mean improvement in the range of motion was 11°, the arc of motion changed toward extension, ulnar deviation was improved by 9–30°, and 54–100% of patients reported no pain following surgery.⁴⁴ In several studies, patients have indicated that pain, function and esthetic appearance of the hand are important outcomes, and improvements in pain and esthetic appearance correlated highly with overall patient satisfaction with the surgery.^{15,44,45}

Complications of metacarpophalangeal arthroplasty in patients with RA include wound infection and implant fracture; however, the rates of infection are quite low (0–3%) and are comparable to clean surgical cases,⁴⁴ and the incidence of implant fracture has decreased with the

introduction of more durable implants in the late 1980s. Furthermore, fractured implants sometimes do not require removal, as encapsulation of the implant maintains joint stability.

Soft-tissue and specialized hand surgery

RA leads to characteristic disease patterns in the hand. In the wrists of RA patients, cartilage loss, synovial expansion with erosive disease and ligamentous laxity result in a loss of carpal height and stability, the development of varying amounts of ulnar–palmar translocation and supination of the carpus in the distal forearm. These changes result in a painful wrist, which influences the development of distal deformity.⁴⁶ Fingers might undergo ulnar drift and develop characteristic deformities, such as shoemaker's thumb (flexed position of the metacarpophalangeal joint and hyperextension of the interphalangeal joint) or swan-neck deformity (hyperextension of the proximal interphalangeal joint of the fingers and flexed position of the distal interphalangeal joint). If the wrist anatomy remains stable according to the Simmen classification,⁴⁷ such deformities can be addressed by various tendon transfer procedures, the release of tight ligaments or shortening of stretched ligaments, generally referred to as soft-tissue balancing.

The goal of soft-tissue surgery in the hand is usually the correction of ulnar deviation.⁴⁸ A combination of interventions, such as dorsal wrist synovectomy with osseous stabilization and radio-ulnar arthrodesis (the Sauvé–Kapandji procedure), or radiolunate fusion (Chamay technique) with the excision of a prominent distal ulna, might help to prevent rupture of extensor tendons (Figure 1). This is one example where prophylactic surgery has value in RA. Despite a trend towards improved functional outcomes reported in a systematic literature review, level 1 evidence (i.e. from randomized controlled trials) to support the long-term functional benefit of these procedures in patients with RA is generally lacking.⁴⁸

NONOPERATIVE MANAGEMENT

Splints or orthoses, including resting hand splints, wrist supports, finger splints, special shoes and shoe inserts, have frequently been used to decrease pain and swelling and/or prevent deformity. A Cochrane database systematic review was undertaken “to assess the effectiveness of splints/orthoses in relieving pain, decreasing swelling and/or preventing deformity and to determine the impact of splints/orthoses on

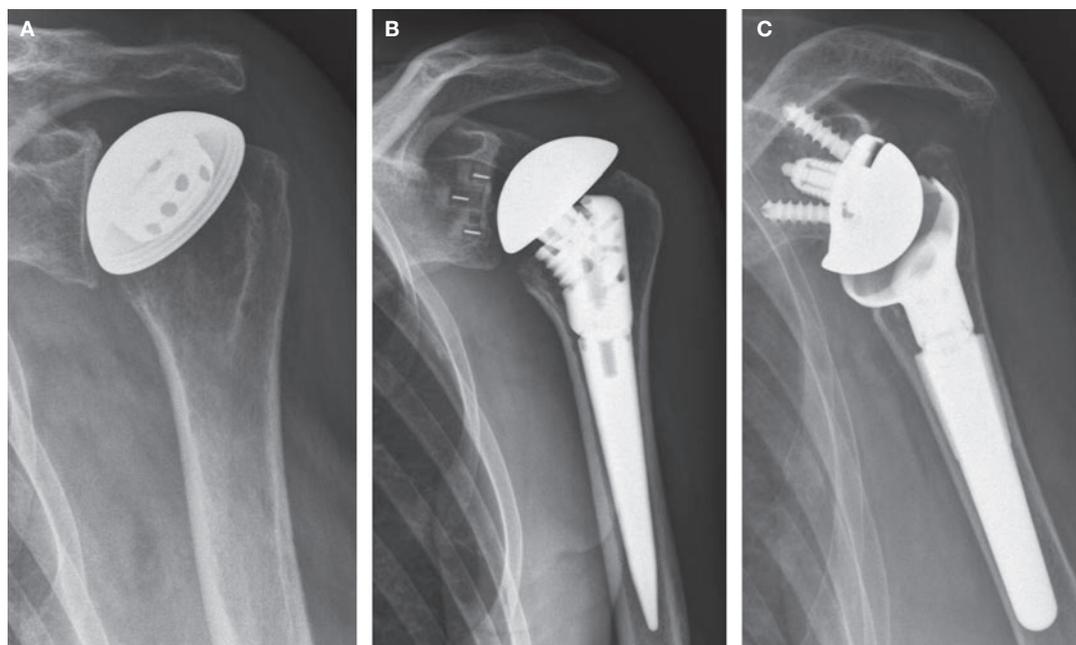


Figure 2 Examples of prosthetic treatment options available for patients with rheumatoid arthritis in the shoulder. **(A)** Replacement of the surface of the joint. **(B)** Anatomical total shoulder arthroplasty (Promos® Modular Shoulder System; Plus Orthopedics AG, Rotkreuz, Switzerland). **(C)** Total reverse shoulder arthroplasty. Although the invasiveness of the surgical procedure increases from **(A)** to **(C)**, the expected functional outcome might decrease owing to concomitant soft tissue problems, such as rotator cuff tear, and/or technical limitations (e.g. abduction limitation of the inverse arthroplasty).

strength, mobility and function in people with RA.⁴⁹ The authors found one high-quality study that convincingly demonstrated a significant reduction of pain in patients wearing extra-depth shoes, and showed that wrist splints worn during work decreased grip strength but did not affect pain, stiffness or pinch grip. The authors found no evidence that resting wrist and hand splints changed pain, grip strength, Ritchie Index score or the number of swollen joints. Although resting hand and wrist splints did not seem to affect the range of motion or pain, patients preferred wearing a resting splint to not wearing one. These findings are supported by a crossover study by Pagnotta *et al.*⁵⁰ of static wrist splint use in the performance of daily activities. These authors found that, for most tasks, splint use improved or did not change pain levels, did not interfere with work performance, increased or maintained endurance, and did not increase perceived task difficulty. They concluded that “wrist splint prescription is not a simple process; clinicians and clients need to work together to determine the daily wear pattern that maximizes benefit and minimizes inconvenience according to the client’s individual needs”.

DECISION-MAKING AND TIMING

The specific pattern of joint destruction in RA leads to progressive loss of function and increased work disability.^{3,51} The progression of joint erosion, as well as concomitant damage to soft tissue structures (such as rotator-cuff tears and tendon ruptures), limits orthopedic surgical treatment options in the later stages of joint destruction.¹⁴ For example, early stages of arthritic changes in the shoulder joint may be treated by surface replacement of the humeral head⁵² or hemiarthroplasty without the glenoid component.⁵³ In later stages, total joint replacement might be necessary. Irreparable rupture of the rotator cuff imposes deficits in function and in the active range of motion,⁵⁴ and limits the choice of shoulder prosthesis to either conventional hemiarthroplasty with a large head, or a reverse prosthesis design, in which the convex component is attached to the glenoid and the concave component is attached to the humerus (Figure 2). These considerations would favor early reconstructive orthopedic intervention, prior to total loss of the rotator cuff. Similarly, in total knee or total hip arthroplasty, preoperative function is highly correlated with the ultimate postoperative functional result.³⁷ Postponement of surgery in

patients with RA might result in poorer functional outcomes owing to musculoskeletal comorbidity, and might also lead to an increase in postoperative complications as a result of the need for an extensive surgical procedure³⁷ or because of poor bone quality.³⁸ Early referral for orthopedic treatment can, therefore, provide greater functional benefit for the RA patient.

Whereas in the past there was active debate between orthopedic surgeons and rheumatologists regarding the timing of referral of RA patients for synovectomy, with orthopedic surgeons requesting early referral for synovectomy in the early stages of the disease, the current focus is more on the timing of reconstructive operations before the development of severe tissue loss and irrecoverable disability. Reasons for late referral might include perceptions regarding the possible risk of complications, the possible poorer surgical outcomes of procedures carried out earlier, or simply a lack of knowledge about current surgical treatment options.

From the patient's perspective, impaired function and pain are the most important factors that contribute to the decision to pursue surgical intervention.⁵⁵ RA patients with hand involvement are also concerned with improvements in appearance, in addition to improving function and reducing pain.^{15,45}

Functional staging

Surgical interventions in patients with RA are usually considered elective procedures.⁵⁶ Repeated functional staging is, therefore, required for optimal timing of the intervention and maximal patient benefit. At the level of the wrist, for example, the interaction between the tendons and the joint, as well as the individual type of rheumatoid destruction at this complex joint, requires well-informed staging and evidence-based indications for surgery. Deficits in the function of single joints or affected extremities can be measured with objective outcomes, such as active and passive ranges of motion, grip strength and functional tests. The consequences of functional deficits on activities of daily living (ADL) and subsequent quality of life can be quantified using standardized patient self-assessments that correspond to the WHO International Classification of Functioning, Disability and Health.^{57,58} A number of different outcome measures, such as the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire,⁵⁹ were developed for this purpose, but there is no consensus on a gold standard,^{1,60,61} however, the

combination of a joint-specific and an extremity-specific measurement of ADL with a patient-specific assessment of quality of life seems to provide a more realistic assessment of the impact of surgical interventions.^{62,63} Functional staging, the patient's perceived deficits and the anticipated disease progression should together form the rationale for orthopedic intervention.⁶⁴ The same measures can be utilized as a benchmark and for planning further interventions. The concept "start with a winner" (i.e. perform the most beneficial and easily rehabilitated procedure first)³² is a highly patient-centered notion, and is a valuable approach to prioritizing surgical interventions, particularly where multiple joints are damaged and symptomatic, as it facilitates patient acceptance and cooperation. A well-integrated, team approach for patients with RA provides the best chance of an optimal outcome following surgery.^{56,65} The aforementioned subspecialization requires a coordinating surgeon with a thorough understanding of RA pathophysiology and long-term progression—usually a surgeon with a long-standing interest in the field. An orthopedic surgeon who is specialized in surgery of the upper extremity is a suitable lead in the coordination process owing to their knowledge of the specific RA destruction patterns.

CONCLUSIONS

Functional impairment and the subsequent loss of quality of life and inability to work have become the main considerations for surgical reconstruction. Repeated, comprehensive, subjective, clinical and functional staging, combined with standardized objective and subjective measures, help to identify the loss of joint and limb function in the upper or lower extremities and clarify the effects on ADL. The decision for orthopedic intervention should be established by an interdisciplinary team of rheumatologists and orthopedic surgeons experienced in the surgery of patients with RA. The earlier model of large interdisciplinary panels of experts who convene to examine an RA patient is currently less utilized because of financial constraints. In the current environment, where each body part is likely to be operated on by a separate surgical subspecialist, a need exists for a mechanism to ensure that the global approach to the care of the RA patient is adjusted and optimized from time to time. The contributions of rheumatologists, therapists, social workers and other experts must be integrated. This integration requires the collaboration of different specialists and leadership by a physician or surgeon who

understands the 'big picture' and can organize complex, continuing care.

Priority should be given to procedures that are likely to be of the most clinical benefit, while requiring moderate rehabilitation and imposing acceptable surgical risks. Disease progression and pharmaceutical treatment options should be taken into consideration when establishing an orthopedic intervention protocol in order to achieve maximal patient benefit.

Orthopedic surgery is rapidly evolving, with the development of new surgical techniques and prostheses. The evaluation of new surgical methods requires expensive clinical trials that involve large numbers of patients, and evaluation of these new methods in RA patients (as distinguished from the much more common and homogenous arthrosis patient population) is an ongoing challenge.

The efficacy of the recently introduced biologic therapies (e.g. anti-TNF agents) for the management of RA promises to alter the pattern of surgical pathology encountered by orthopedic surgeons in the future. Physicians and surgeons interested in the surgical management of RA will need to be aware of and respond to these changes. One related issue is the need to consider temporary cessation of biologic agents in the perioperative period,⁶⁶ a subject that is now attracting considerable interest.

There are numerous options for surgical intervention, but all share common goals, which include restoring function and quality of life, preventing progression of the disease, relieving pain, correcting deformity, and in some cases providing prophylaxis of further destruction.

KEY POINTS

- Functional impairment, pain, and the subsequent loss of quality of life and inability to work are main considerations for surgical reconstruction in patients with rheumatoid arthritis
- Early referral for orthopedic treatment can result in greater functional benefit
- The decision for orthopedic intervention should be established by an interdisciplinary team that includes rheumatologists and orthopedic surgeons who are experienced in the surgery of patients with rheumatoid arthritis
- Priority for surgery should be given to the joint that causes the greatest disability and pain
- Disease progression and pharmaceutical treatment options should be taken into consideration when establishing an orthopedic intervention protocol

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Competing interests

The authors declared no competing interests.

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