

# Surgical Management of Rheumatoid Arthritis of the Hand

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## INTRODUCTION

Rheumatoid arthritis (RA) is a painful autoimmune disease that affects about 1% of the population.<sup>1</sup> A comprehensive epidemiological study of global disease burden in 2015 found that the prevalence of RA was about 25 million individuals, with an overall increase by 23.8% from 2005.<sup>2</sup> RA usually causes bilateral joint pain, stiffness, and swelling, which is typically worse after periods of inactivity or in the morning. While RA is characterized by joint involvement, other inflammatory manifestations include fever, anemia of chronic disease, pericarditis, and pulmonary fibrosis. RA can also be associated with other autoimmune diseases, including systemic lupus erythematosus and psoriatic arthritis.

The disease process of RA is a Type III hypersensitivity reaction that involves autoimmune cellular activation and immune complex formation in joints. These deposits lead to thickening of joint capsules, cartilage and bone damage due to inflammatory cascades, and rupture of tendons and ligaments. Chronic RA can lead to pannus formation, due to inflammation and proliferation of the joint synovium.<sup>3</sup> Damage to ligaments and tendons in the hands causes deformities such as boutonniere, swan neck, and ulnar deviation of the fingers as well as tendon ruptures affecting the ulnar digits.<sup>4</sup>

Rheumatoid arthritis has a multivariable inheritance pattern, and environmental factors influence the severity of the disease. Risk factors associated with RA include female sex and family history while environmental factors include exposures to cigarette smoke and silica dust.<sup>1</sup>

The diagnosis of rheumatoid arthritis is both clinical and serological. RA can be classified as a seropositive disease process with rheumatoid factor (RF), an autoantibody against the Fc portion of IgG, or as a seronegative form. Other autoantibodies in RA include anti-citrullinated protein antigens (ACPAs) as well as antinuclear antibody (ANA) and other, less specific antibodies. While RF was classically associated with the disease, newer data show that ACPA is the most specific antibody for RA.<sup>5</sup> Serological markers may be present before clinical symptoms; there is a group of patients in

Definitions	
Synovectomy	Surgical resection of inflamed and hypertrophied synovial tissue within a joint. This is generally performed through an open or arthroscopic approach.
Arthrodesis	A surgical procedure on a joint in which the bones comprising the joint are fused. This is generally accomplished through removal of the articular cartilage of the joint, resection of cortical bone on all sides of the joint, and the application of surgical hardware to apply compression across the prepared joint for a period of time.
Arthroplasty	A broadly defined surgical procedure on a joint in which the joint is reconstructed or replaced in order to maintain function while treating pain. This may be accomplished through implanting an artificial prosthesis or resecting the joint with or without interposing a biological or artificial spacer

whom RF is not present in the early stages of the disease but does develop later, so its sensitivity for early detection is somewhat limited.<sup>6</sup>

There are multiple classification systems for RA, and the most recent one (2010) defines “definite RA” based on a score generated by four domains: number and site of joint involvement, serological markers, elevated acute-phase response, and duration of symptoms.<sup>7</sup>

Involvement of the hands in patients with RA can lead to pain, significant limitations in function, and concerns about cosmesis. Every joint can be affected, from the wrist to the individual interphalangeal joints. Although medical management may be appropriate for many, some patients may not tolerate medications or be treated until their joint deformities are advanced. In these patients, surgical treatment may be beneficial. The purpose of this article is to describe the manifestations and surgical treatment options for painful rheumatoid arthritis of the hand.

## WRIST

The wrist is affected in approximately 80% of patients with RA.<sup>9</sup> All three articulations of the wrist (distal radioulnar (DRUJ), radiocarpal, and midcarpal joints) can be affected by RA, with the DRUJ being the most commonly involved

(Figure 1). The surgical goals for the rheumatoid wrist are to reduce pain, improve function, and prevent progressive deformity.

Synovial hyperproliferation characterizes early rheumatoid disease and is therefore a primary surgical target. Synovectomy and tenosynovectomy are indicated in relatively early disease in which wrist motion and radiocarpal joint space are preserved, but absolutely contraindicated in advanced degenerative disease.<sup>10</sup> These procedures reduce wrist pain through denervation of nociceptive nerve fibers,

but do not slow the overall disease process.<sup>11</sup> Synovectomy can be performed via open or arthroscopic approaches, with comparable pain relief, but a higher risk of recurrence and radiographic progression after the arthroscopic technique.<sup>12</sup>

Following early synovitis, RA frequently involves the ligamentous structures of the distal ulna. When the synovial-lined ulnar carpal ligaments and other stabilizers of the distal radial ulnar joint (DRUJ) are affected, patients may experience dorsal subluxation and eventual dislocation of the distal ulna (“caput ulna syndrome”). In these patients,

various surgical interventions to treat the DRUJ may be considered. A common surgery is the resection of the ulnar head, or Darrach procedure, but this may be complicated by excessive ulnar translation of the carpus. To prevent this complication, the Suave-Kapanji procedure creates a radioulnar fusion (arthrodesis) following partial ostectomy of the ulna just proximal to the DRUJ.<sup>9</sup> Ulnar head replacement (arthroplasty) has also been used in the RA wrist. It can confer improved stability and function compared to ulnar head resection and can also salvage a failed Darrach procedure.<sup>13</sup> While good outcomes have been reported in small case series, larger studies with longer follow-up are necessary to determine its long-term efficacy and safety.<sup>10</sup>

With progressive degenerative changes of the wrist, patients may experience involvement of midcarpal and radiocarpal joints. Surgical options include partial arthrodesis, complete arthrodesis, and

**Figure 1. Wrist involvement in the Rheumatoid Hand**

PA and lateral radiographs of the wrist in a 91-year-old patient with largely untreated rheumatoid arthritis. Note the extensive joint space destruction in the radiocarpal, ulnocarpal, and distal radioulnar joints, as well as auto-fusion of the carpus.



**Figure 2. Treatment Options for End-Stage Wrist Arthritis**

Left: Total wrist arthroplasty. Right: Total wrist arthrodesis.



arthroplasty. Partial arthrodesis of the radiolunate joint prevents ulnar drift of the wrist and digits. Results are promising, with reports of decreased pain, improved stabilization, and grip strength; however, destruction of the midcarpal joint may persist. Other partial fusions can be attempted, depending on the specific joints involved, such as radioscapulohumeral arthrodesis for radioscapoid arthritis. In cases of severe destruction of the wrist joint, total arthrodesis is the preferred treatment.<sup>14</sup> Complications of arthrodesis surgeries are not uncommon, and in the case of total wrist arthrodesis may be as high as 29%, with a 4.4% rate of nonunion. Among these, major complications, such as deep infection, carpal tunnel syndrome, symptomatic hardware, extensor tenosynovitis, and ulnocarpal impaction may occur in 19% of wrists.<sup>1</sup> Total wrist arthroplasty can also be considered for carefully selected patients with an end-stage rheumatoid wrist (**Figure 2**). This treatment option may be used for low-demand patients with good bone stock for distal fixation, who require maintenance of wrist range of motion. Patients must be well educated on the lifelong restrictions related to joint arthroplasty, as well as the potential complications including infection, implant failure, and requirement for fusion in the future.<sup>15</sup>

### METACARPOPHALANGEAL JOINT

Although the wrist is frequently involved, the most common deformity affecting the rheumatoid hand involves the metacarpophalangeal (MCP) joint; volar and ulnar subluxation of the proximal phalanx on the metacarpal causes ulnar displacement of the finger (**Figure 3**).<sup>16</sup> Early theories, which have mostly been discounted, attributed this ulnar

deformity to the effect of gravity on patients with hands held in the neutral position during rest, atrophy of the interossei leading to muscle imbalance, and pain-related flexor muscle spasm.<sup>17</sup> The current understanding of ulnar drift at the MCP joint is that chronic synovitis damages the radial fibers of the MCP capsule and sagittal bands of the extensor hood leading to ulnar extensor subluxation, radial joint laxity, and radial forces with functional activities.<sup>17</sup>

Ulnar drift is more than a cosmetic deformity, although aesthetic considerations are indeed important to patients. Functional limitations include difficulties with gripping large objects and performing tip-to-tip pinch. In addition, extensor tendon subluxation leads to weakness with digit extension.<sup>16</sup>

Treatment of the MCP joint in patients with RA is challenging. Unlike the distal interphalangeal joint, for example, fusion is not commonly performed due to the significant loss in range of motion. In the early stages of disease with comparatively less deformity, synovectomy and/or crossed-intrinsic transfer may be beneficial. As rheumatoid arthritis is a disease of the synovium, the rationale behind synovectomy involves reducing the burden of inflammatory cells and tissue, thereby also treating pain. Crossed intrinsic transfer involves detaching the intrinsic muscle tendons at the ulnar aspect of each digit and rerouting them to the radial proximal phalanx of the adjacent ulnar digit, thereby providing a radially deviating force to restore position of each digit. This treatment is not ideal for patients in whom the disease is not well controlled medically, as further synovitis and joint destruction can stress the repaired connective tissues and predispose the patient to recurrent deformity.<sup>18</sup>

In patients with more advanced disease or more rigid deformities, arthroplasty is a treatment option. The main advantages to arthroplasty are maintenance of joint range of motion and shortening of the joint, which relaxes deforming tendon stresses and allows for easier joint repositioning. As in other hand joints, silicone implants are commonly used and have been well studied in the literature. A longitudinal analysis of 325 silicone arthroplasty cases with an average 7-year follow-up demonstrated good short-term outcomes and 95% revision-free survival at 15 years. Although recurrent coronal plane deformity > 10 degrees and implant fracture were common at 15 years, neither was associated with diminished function or the need for revision.<sup>19</sup>

**Figure 3. Ulnar Deviation of Digits in the Rheumatoid Hand**

PA radiographs of bilateral hands in a patient with rheumatoid arthritis demonstrating the characteristic ulnar deviation deformity at the metacarpophalangeal joints along with extensive joint destruction in the digits and wrist.



As in other joints, pyrocarbon implants have been studied for RA of the wrist. Pyrocarbon refers to high-strength graphite substrates with hydrocarbon coatings. Their mechanical properties are intermediate between diamond and carbon, and their elastic modulus is similar to cortical bone. Cook et al. reported a 68% revision or dislocation-free survival at 16-year follow-up, with an average final arc of motion at the MCP joint of 52 degrees.<sup>20</sup>

## DIGITAL INTERPHALANGEAL JOINT

Interphalangeal joint involvement is also common in patients with RA, and often leads to swan neck or boutonnière deformities. Swan neck deformities involve proximal interphalangeal joint (PIP) extension and distal interphalangeal joint (DIP) flexion. PIP hyperextension occurs due to the tightness of the intrinsic hand musculature and weakness of the volar plate of the PIP joint. DIP flexion occurs due to chronic inflammation at DIP joint along with extensor tendon damage and subluxation. A boutonnière deformity, characterized by PIP flexion and DIP hyperextension, results from injury to the central slip at the dorsal PIP joint; volar subluxation of the lateral bands causes a flexion force at the joint. Up to half of patients with RA develop a boutonnière deformity in at least one digit.

As with other joints, surgical treatment of the rheumatoid finger is indicated for painful synovitis, loss of power-grip or pinch, or concerns about the appearance of the hand. The specific surgical approach to finger deformities depends mainly on whether they are flexible (passively corrected) or rigid. Flexible deformities are generally managed through soft tissue reconstruction while rigid deformities require either arthrodesis or arthroplasty.<sup>21</sup>

For a flexible boutonnière deformity, the treatment is PIP joint synovectomy, tightening of the stretched central slip, and relocation of the lateral bands dorsally. This restoration of force vectors along the extensor mechanism improves PIP extension and hyperextension at the DIP joint. The aim of surgeries for a flexible swan neck deformity is to prevent a fixed extension deformity.<sup>22</sup> Flexible swan neck deformities may be treated through dermodesis, flexor tendon tenodesis,

spiral oblique retinacular ligament reconstruction, and lateral band tenodesis. A review of these options reported generally good outcomes with all procedures.<sup>22</sup>

The mainstays of surgery for rigid IP deformities are arthrodesis and arthroplasty, with either silicone, polyethylene, titanium, or pyrocarbon components. The treatment depends on the joint involved.<sup>18</sup> If the thumb is affected, the IP joint is fused to provide stability for gripping. With the PIP joint, the lack of ligamentous support and tendon imbalance make arthroplasty an unfavorable option.<sup>18</sup> While arthroplasty can improve mobility and the deformity, Ghattas et al. demonstrated a trend towards a relapse of symptoms and prosthetic fracture.<sup>23</sup> Arthrodesis is preferred unless the patient has adequate ligamentous support.<sup>18</sup> The distal IP joint is typically treated with fusion because the tip of the finger requires stability.<sup>18</sup> Even with advances in surgical interventions, the role of specific surgeries continues to be a source of controversy.<sup>8</sup>

## CONCLUSION

Rheumatoid arthritis affects all the joints of the hand, from the wrist to the MCP joints to individual IP joints. Not only does the disease lead to chronic pain in these patients but also to progressive deformity, which can compromise both function and appearance. Treatment for the wrist usually addresses the affected DRUJ and can range from arthroplasty procedures to partial or complete fusion. Total wrist arthroplasty is also an option for certain patients. For the MCP joint, treatment goals are to correct ulnar drift of the digits, and options range from soft tissue procedures like crossed-intrinsic transfer to arthroplasty with silicone or pyrocarbon implants. In the IP joints, swan-neck and boutonnière deformities are treated based on whether they are flexible or rigid, with connective tissue procedures for the former and fusion or arthroplasty for the latter. For deformities of the distal IP joint, fusion is the preferred procedure. Although pharmacologic and rehabilitation treatments play an important role in the initial management of RA, the progression of pain and deformities often necessitate surgical treatment (**Table 1**).

**Table 1.** Summary of Surgical Treatment Options for the Rheumatoid Hand

	Wrist	MCP	PIP	DIP
<b>Early/ Flexible</b>	Synovectomy, Tenosynovectomy	Synovectomy, crossed intrinsic transfer	<b>Boutonnière:</b> central slip repair, lateral band relocation <b>Swan neck:</b> Dermodesis, flexor tendon tenodesis, spiral oblique retinacular ligament repair, lateral band tenodesis	Symptomatic treatment
<b>Late/ Rigid</b>	<b>DRUJ:</b> Ulnar head resection (Darrach), partial ulnar ostectomy, radioulnar fusion (Sauve-Kapandji), or arthroplasty <b>Radiocarpal/midcarpal joints:</b> limited wrist arthrodesis, total wrist arthrodesis, or total wrist arthroplasty	Arthroplasty: silicone, pyrocarbon, polyethylene, or titanium	Arthrodesis or Arthroplasty: silicone, pyrocarbon, polyethylene, titanium	Arthrodesis

## References

1. Deane KD, Demoruelle MK, Kelmenson LB, *et al.* Genetic and environmental risk factors for rheumatoid arthritis. *Best Pract Res Clin Rheumatol* 2017;**31**:3–18.
2. Vos T, Allen C, Arora M, *et al.* *Global, Regional, and National Incidence, Prevalence, and Years Lived with Disability for 310 Diseases and Injuries, 1990–2015: A Systematic Analysis for the Global Burden of Disease Study 2015*, 2016.
3. Elshabrawy HA, Chen Z, Volin MV, *et al.* The pathogenic role of angiogenesis in rheumatoid arthritis. *Angiogenesis* 2015;**18**:433–48.
4. Toyama S, Tokunaga D, Fujiwara H, *et al.* Rheumatoid arthritis of the hand: A five-year longitudinal analysis of clinical and radiographic findings. *Mod Rheumatol* 2014;**24**:69–77.
5. Sieghart D, Platzner A, Studenic P, *et al.* Determination of autoantibody isotypes increases the sensitivity of serodiagnostics in rheumatoid arthritis. *Front Immunol* 2018;**9**, DOI: 10.3389/fimmu.2018.00876.
6. Barra L, Pope J, Bessette L, *et al.* Lack of seroconversion of rheumatoid factor and anti-cyclic citrullinated peptide in patients with early inflammatory arthritis: A systematic literature review. *Rheumatology* 2011;**50**:311–6.
7. Aletaha D, Neogi T, Silman AJ *et al.* 2010 Rheumatoid arthritis classification criteria: An American College of Rheumatology/ European League Against Rheumatism collaborative initiative. *Arthritis Rheum* 2010;**62**:2569–81.
8. Malahias M, Gardner H, Hindocha S, *et al.* The Future of Rheumatoid Arthritis and Hand Surgery - Combining Evolutionary Pharmacology and Surgical Technique. *Open Orthop J* 2012;**6**:88–94.
9. Lee SK, Hausman MR. Management of the Distal Radioulnar Joint in Rheumatoid Arthritis. *Hand Clin* 2005;**21**:577–89.
10. Chim HW, Reese SK, Toomey SN, *et al.* Update on the surgical treatment for rheumatoid arthritis of the wrist and hand. *J Hand Ther* 2014;**27**:134–42.
11. Ossyssek B, Anders S, Grifka J, *et al.* Surgical synovectomy decreases density of sensory nerve fibers in synovial tissue of non-inflamed controls and rheumatoid arthritis patients. *J Orthop Res* 2011;**29**:297–302.
12. Chalmers PN, Sherman SL, Raphael BS, *et al.* Rheumatoid Synovectomy: Does the Surgical Approach Matter? *Clin Orthop Relat Res* 2011;**469**:2062–71.
13. Rizzo M, Cooney WP. Current concepts and treatment for the rheumatoid wrist. *Hand Clin* 2011;**27**:57–72.
14. Trieb K. Treatment of the Wrist in Rheumatoid Arthritis. *J Hand Surg Am* 2008;**33**:113–23.
15. Kobus RJ, Turner RH. Wrist arthrodesis for treatment of rheumatoid arthritis. *J Hand Surg Am* 1990;**15**:541–6.
16. Longo UG, Petrillo S, Denaro V. Current Concepts in the Management of Rheumatoid Hand. *Int J Rheumatol* 2015;**2015**, DOI: 10.1155/2015/648073.
17. Morco S, Bowden A. Ulnar drift in rheumatoid arthritis: A review of biomechanical etiology. *J Biomech* 2015;**48**:725–8.
18. Chung KC, Pushman AG. Current concepts in the management of the rheumatoid hand. *J Hand Surg Am* 2011;**36**:736–47.
19. Boe C, Wagner E, Rizzo M. Long-term outcomes of silicone metacarpophalangeal arthroplasty: a longitudinal analysis of 325 cases. *J Hand Surg Eur Vol* 2018;**43**:1076–82.
20. Cook SD, Beckenbaugh RD, Redondo J, *et al.* Long-term follow-up of pyrolytic carbon metacarpophalangeal implants. *J Bone Jt Surg - Ser A* 1999;**81**:635–48.
21. Longo UG, Petrillo S, Denaro V. Current Concepts in the Management of Rheumatoid Hand. *Int J Rheumatol* 2015;**2015**, DOI: 10.1155/2015/648073.
22. Smith GCS, Amirfeyz R. The flexible swan neck deformity in rheumatoid arthritis. *J Hand Surg Am* 2013;**38**:1405–7.
23. Ghattas L, Mascella F, Pomponio G. Hand surgery in rheumatoid arthritis: State of the art and suggestions for research. *Rheumatology* 2005;**44**:834–45.

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