

# Distal Ulna Arthroplasties

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## KEYWORDS

- Ulnar arthroplasty • Distal radioulnar joint • Wrist replacement • Triangular fibrocartilage complex

## KEY POINTS

- Understanding the complex distal radioulnar joint (DRUJ) and distal ulnar anatomy is key to success.
- Treatment options for degenerative ulnar head problems are ever evolving.
- DRUJ implant arthroplasty is a useful and viable option for ongoing wrist pain.

The distal radioulnar joint (DRUJ) is the distal link between the radius and the ulna, and forms a pivot for forearm pronation and supination. The DRUJ is half of a bicondylar forearm joint, with its condyle, the head of the ulna, articulating with the sigmoid notch of the radius. The DRUJ provides 2 functions: transmission of force with lifting and grip from the carpus to the forearm, and facilitation of forearm rotation. After years of study, it has become clear this bony articulation is inherently incongruent, and little stability at this joint is provided from the bony architecture.<sup>1-3</sup> The articular congruity between the ulna and the radius through the DRUJ has been shown to account for approximately 30% of the total constraint of the DRUJ.<sup>3</sup> The surrounding soft tissues about the DRUJ play a substantial role in guiding and restraining the joint. The soft-tissue constraints of the DRUJ include static and dynamic stabilizers. The primary stabilizers of the DRUJ, the dorsal and palmar radioulnar ligaments, are components of the triangular fibrocartilage complex (TFCC). These ligaments attach to the radius at the margins of the sigmoid notch and converge to form a single attachment at the fovea and base of the ulnar styloid. There are several different interpretations of the specific roles of each of these ligaments, but it is clear that the integrity of both ligaments is necessary for a stable DRUJ.<sup>1-3</sup> The DRUJ joint capsule is an important stabilizer of the DRUJ, most evident in positions of extreme pronation and supination. The entire soft-tissue

envelope of the ulnar side of the distal forearm and wrist (including the volar extrinsic ligaments, retinaculum and the extensor carpi ulnaris subsheath) forms an important secondary stabilizer, as does the interosseous membrane.<sup>1-3</sup>

As well as being susceptible to idiopathic arthritis, any injury or deformity of the DRUJ involving the radius or ulna can alter the function of this joint.

Over the last 30 years, various treatment options have been explored for treating DRUJ pain, instability, and degeneration. Treatment options for irreparable destruction of this joint have ranged from fusion of the DRUJ joint to a variety of excision techniques with soft-tissue reconstructions.<sup>4-7</sup>

Historically, debilitating symptoms relating to the DRUJ have been treated with surgical techniques performed with partial or complete ulnar head resections. Common surgical interventions over the last 30 years include the Darrach procedure, Sauvé-Kapandji procedure, or hemi-resection interposition of tendon (HIT), also referred to as the Bower procedure.<sup>4-7</sup> As these customary practices do not yield desirable results for all patients, surgeons and device manufacturers have sought to develop alternative treatment modalities in recent years.

The Darrach procedure is considered to be the traditional approach to excising the arthritic surface of the DRUJ. This procedure was first illustrated in 1913.<sup>4</sup> William Darrach described a volar approach to the DRUJ followed by distal

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ulnar head resection to alleviate ulnar-sided wrist pain. While this is a widely performed practice, potential complications include distal forearm instability and convergence. The primary cause of these complications is the removal of the ulnar head and destabilization of the remaining distal ulna, which ironically is also commonly the basis of patients' pain relief. Subsequently, there have been several modifications to his procedure that entail limited or partial excision of the distal ulnar head, with interposition of soft tissue to stabilize the remaining distal ulna and to prevent distal ulnar convergence and impingement with the radius.<sup>8-12</sup>

The HIT was formulated by William Bowers.<sup>6</sup> Many variations of this concept have also been described. The general concept of the procedure involves a partial resection of the distal ulna in an oblique fashion to match the slope of the sigmoid notch of the radius with preservation of the TFCC origin/insertion on the remaining distal ulnar styloid. Tendons (either the palmaris longus, flexor carpi ulnaris, or extensor carpi ulnaris), joint capsule, or pronator quadratus muscle has been used as an interposition spacer placed into the newly established void. This custom has shown good success in younger patients; however, the clinical outcomes still leave patients with reduced grip strength among other potential complications, as previously mentioned.<sup>13-15</sup>

While excision procedures are well documented, each of them relies on permanently altering the wrist anatomy by removal of bone mass with no replacement or substitution of the excised bone. As described by Berger in 2008,<sup>16</sup> when the ulnar head is removed the stability of the DRUJ is altered. The radius and ulna are uncoupled and the radius is no longer in contact with the ulna at the wrist level, creating an intrinsically unstable construct. In addition, there is loss of the soft-tissue attachments of the TFCC and DRUJ joint capsule to the distal ulnar head, as in the case of a Darrach resection arthroplasty. The dynamic stabilizers in this region are then unopposed, and pull the radius and ulna together. This process results in convergence of the ulnar stump and distal radius as well as loss of tension in the interosseous membrane, further destabilizing the forearm.<sup>17</sup>

To offset these prospective occurrences, fusion of the DRUJ was proposed by Sauvé and Kapandji.<sup>5</sup> This procedure involves the resection of a wafer of ulnar bone several centimeters proximal to the DRUJ. However, the ulnar head itself remains intact. The ulnar head is then fused to the distal radius after denuding the remaining articular cartilage of the DRUJ. The presence of the distal ulna stabilizes the joint and provides a buttress from ulnar and proximal translocation of the carpus. While this

procedure may effectively alleviate DRUJ arthritic pain, there remains potential for complications including nonunion as well as osteosynthesis across the pseudoarthrosis site, convergence of the proximal ulnar stump, reduced grip strength, and reduced rotational range of motion.<sup>18-21</sup>

In recent years, new approaches for treating patients suffering from DRUJ instability and arthritis of the distal ulna have emerged, including various implants and techniques for DRUJ implant arthroplasty. Surgical indications include patients with debilitating pain, deformity, weakness, and/or diminished hand function from any of a multiple of underlying ailments including osteoarthritis, rheumatoid arthritis, ulnar impaction or impingement, failed Darrach procedures, and failed matched resections or HIT procedures. Additional indications also include failed fracture management of the distal ulna. Over the last several years, numerous orthopedic manufacturers have developed ulnar arthroplasty products. The benefits to patients who have received an ulnar head implant include pain relief (as was the case with the Darrach procedure), good stability of the DRUJ (an advantage of the Sauvé-Kapandji procedure), and better forearm stability by diminishing convergence while improving form and function.

Attempts to use soft-tissue procedures alone to stabilize the DRUJ after ulnar head resection have been found to be mechanically ineffective because of the inability to create a soft-tissue stabilizing procedure based on a vector that holds the radius and ulna apart.<sup>22</sup> Therefore, attempts to counter such instability with soft-tissue procedures have been largely unsuccessful.

Silicone ulnar head replacements, described by Swanson<sup>23</sup> in 1973, have largely been abandoned in recent years because of the potential for the development of silicone synovitis.<sup>24</sup> Subsequent studies have reported poor results, with cases demonstrating postoperative fractures 15% of the time, angulation 40%, and bony resorption 100% of the time.<sup>25</sup> A second study of 45 patients noted migration or breakage 63% of the time, and all developed silicone synovitis.<sup>24</sup>

Recent advancements in technologies and understanding of the ulnar aspect of the wrist have permitted more attractive options of replacement/reconstruction of the ulnar head and DRUJ. As an alternative to silicone, Herbert and van Schoonhoven<sup>26</sup> designed a ceramic ulnar head endoprosthesis. Although avoiding the dilemma of silicone synovitis and implant breakdown, the ceramic implant also demonstrated limited successes, as there are limited opportunities for soft-tissue reconstruction or stabilization of the implant.<sup>26</sup>

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