CURRENT CONCEPTS REVIEW

# Distal Radioulnar Joint Prosthesis

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## Abstract

The distal radioulnar joint (DRUJ) prostheses have been available for many years and despite their superior outcomes compared to conventional DRUJ reconstructions in both short and long-term follow-ups, they have not become as popular as common hip and knee prostheses.

In the current review article, at the first step, we discussed the applied anatomy and biomechanics of the DRUJ, and secondly, we classified DRUJ prostheses according to available literature, and reviewed different types of prostheses with their outcomes. Finally we proposed simple guidelines to help the surgeon to choose the appropriate DRUJ prosthesis.

**Level of evidence:** IV

**Keywords:** Distal radioulnar joint, Prosthesis, Review article

## Introduction

The distal radioulnar joint (DRUJ) has an important role in the axial rotation of forearm and wrist stability (1, 2). To overcome DRUJ problems, especially arthrosis, many surgical procedures have been developed. Darrach, hemi-resection interposition arthroplasty and Sauve´-Kapandji techniques are some of the well-known procedures (3-5). Instability of proximal bony stump and its impingement on the radius bone in Darrach and Kapandji procedures and convergence of the distal ulnar stump in resection arthroplasty techniques are frequent complications in those arthroplasties (6-11).

The alternative treatment for traditional reconstructive techniques are arthroplasty implants. DRUJ implants mechanically stabilize the distal forearm after ulnar head resection; In addition, DRUJ implants provided more normal transfer of the force in the wrist and forearm areas (12-14).

DRUJ arthroplasty can be classified into two general categories: Distal radioulnar joint hemiarthroplasty and total radioulnar joint replacement. In DRUJ hemiarthroplasty the Prosthesis only include the ulnar component ("UHP, Martin GMBH, Germany" and "U-Head, Small Bone Innovation, USA prostheses") and in total DRUJ replacement, the prosthesis in addition to the ulnar component, replace the sigmoid notch, including the radial component. ("Aptis DRUJ Prostheses, Aptis Medical, USA" as well as the prosthesis designed by Schuurman AH) (15). Recently, a newly-designed prosthesis based on the Sauvé´-Kapanji technique has been introduced.

In the present review article, we reviewed the anatomy and biomechanics of DRUJ as well as discussing different types of DRUJ prostheses with their advantages and disadvantages. Finally, we proposed guidelines for proper selection of DRUJ prostheses according to the literature and authors' experience.

## Anatomy

### *TFCC anatomy*

The Triangular Fibrocartilage Complex (TFCC) is the term used to describe the interconnected soft tissues supporting both DRUJ and ulnocarpal articulations. The TFCC is composed of five basic elements: (1) palmar and dorsal radioulnar ligaments; (2) triangular fibrocartilage (articular disk); (3) floor of the sixth

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extensor compartment (ECU sheath); (4) ulnocarpal meniscal homolog; and (5) palmar ulnocarpal ligaments [Figure 1] (16).

The distal articular surface of the ulna can vary from a flat to a partial sphere (17). The TFCC disk is a semilunar cartilaginous structure covering most of the ulnar head articular surface. The ulnar styloid is a 2-6 mm long bony projection on the dorsoulnar side of the dome of the distal ulna. The extensor carpi ulnaris (ECU) tendon sheath and the radioulnar ligaments attach ulnar styloid. On the dorsomedial side of the styloid, there is a groove for the ECU tendon. "Fovea" is a shallow concavity at the base of the ulnar styloid and in which radioulnar and ulnocarpal ligaments are inserted. Supplying vessels to the TFCC also originate from the fovea. The articular disk originates from the ulnar side of the distal rim of the sigmoid notch. The disk is surrounded with the volar and dorsal radioulnar ligaments and fills the gap between distal ulna and Triquetrum [Figure 1] (18, 19).

The role of the TFCC is to partially transmit axial load across the ulnocarpal joint while supporting the DRUJ junction, and extending the smooth articular surface of the distal radius over the ulnar head. The multidisciplinary roles of TFCC make the simulation of its function very difficult; therefore, majority of DRUJ implants neglect the ulnocarpal function of the TFCC.

### *DRUJ Ligaments*

The radioulnar palmar and dorsal ligaments are the primary stabilizers of the DRUJ; these ligaments extend from the palmar and dorsal distal margins of the sigmoid notch and attach to the ulna [Figure 1]. Both volar and dorsal radioulnar ligament compose of two limbs. The deep limb attaches to the fovea (also known as ligamentum Subcruetum) and the superficial limb attaches to the base and midportion of the ulnar styloid [Figure 1] (20-22). Function of the radioulnar ligaments determines the type of prosthesis to be implanted. In case there is no function, it is better to use multi-component implants.

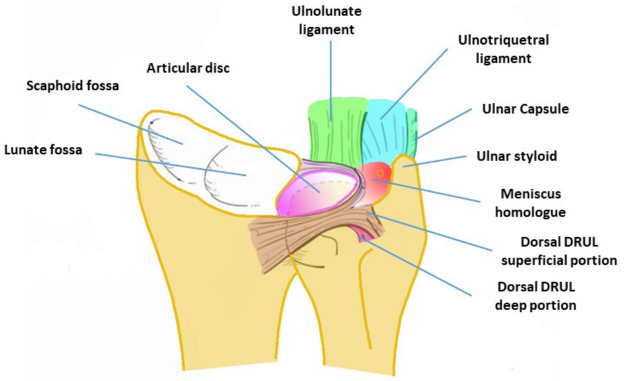


**Figure 1. The Triangular Fibrocartilage Complex anatomy (TFCC): TFCC is composed of palmar and dorsal radioulnar ligaments, triangular fibrocartilage (articular disk), floor of the sixth extensor compartment, ulnocarpal meniscal homolog; and palmar ulnocarpal ligaments.**

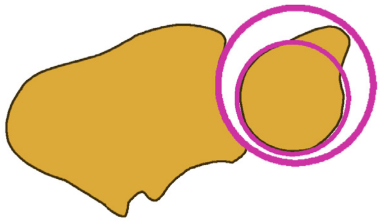

**Figure 2. In axial plane the radius of curvature of the sigmoid notch is greater than the ulnar head so the soft tissue stabilizes the joint.**

## DRUJ anatomy

### *Variations in the coronal plane of DRUJ*

The radius of curvature of the sigmoid notch (15 to 19 mm) is larger than the ulnar head (about 10 mm) so that the soft tissue can stabilize the joint [Figure 2]. Moreover, the dorsal rim of sigmoid notch is angled acutely, while the palmar rim is more rounded (23-26). According to cadaveric studies, four different sigmoid notch shapes were found; among them the flat face (42%), and "C" type (30%) are more common. The flat type of sigmoid notch is more disposed to instability [Figure 3] (25).

### *Variation in sagittal plane of DRUJ*

The slopes of the articular surfaces of the sigmoid notch, in comparison with the long axis of ulna, may be parallel (55%), oblique (convergence to long axis of ulna) (33%), or reverse oblique (divergence to long axis of ulna) (33%) [Figure 4] (25, 27). These differences have no impact on the normal DRUJ joint function, yet it is one of the challenges in ulnar head replacement implant designing specially in DRUJ hemiarthroplasty.

In conclusion, it is important to note that variation in coronal and sagittal planes of the DRUJ is one of the most important concerns for comprehensive designing of DRUJ implants and actually the logics of developing the multicomponent DRUJ prosthesis is on the later data.

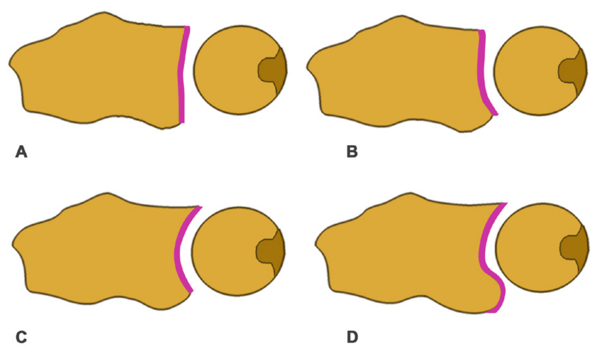


**Figure 3. In axial plan, four different sigmoid notch shapes were diagnosed: A: Flat face sigmoid, B: Sky slop sigmoid, C: "C" type sigmoid and D: "S" type sigmoid. Among them the flat face (42%), and "C" type (30%) are more common.**

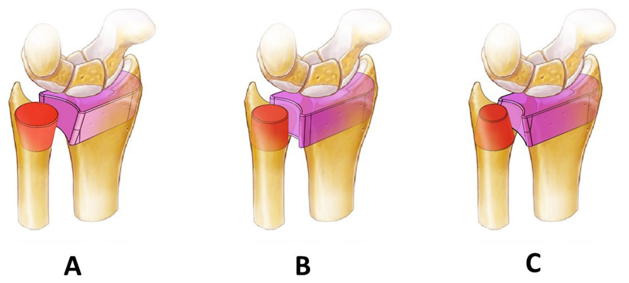


**Figure 4. In sagittal plane the slopes of the articular surfaces of the sigmoid notch compared with the long axis of ulna may be: A: reverse oblique (divergence to long axis of ulna), B: parallel (55%), C: oblique (convergence to long axis of ulna).**

## Biomechanics

The ulna is the main stone of the forearm around which the radius rotates. The radius lays on ulna in axial load as well (28). In axial load through the wrist, 20% of the load passes through the ulna articular surface; but it is in neutral wrist position. In wrist ulnar deviation and pronation, the transmitted force through the ulnar articular surface would increase up to 50% (29, 30). 2.5 mm shortening of ulna decreases the transmitted force to 4% while 2.5 mm lengthening of ulna increases the transmitted force to 42% (30).

The interosseous membrane (IOM) is one of the main stabilizers of the forearm in both axial rotation and prevention of distal migration of the ulna. Two main structures which contribute to longitudinal forearm stiffness of the ulna are the central band and distal oblique bundle (DOB) [Figure 5] (31). The central band is a part of the IOM that originates from the middle of the radius and is inserted distally on the ulna. In radial head removal, the central band provides 71% of the soft tissue longitudinal stability of the forearm (31). The DOB originates from the ulna near the proximal border of the pronator quadratus muscle and extends distally toward the DRUJ. At distal, it merges with the DRUJ capsule and rims of sigmoid notch of the radius (31). The thickness of DOB varies among individuals (31). DOB contributes to dorsal–palmar translational stability on the DRUJ (32). The ECU sheath also augments the dorsal capsule which is separated from the ECU tendon (22). In total DRUJ replacement prostheses, soft tissue dissection is usually vast which might lead to possible injuries to the distal radioulnar stabilizers.

**Figure 5. Two main interosseous membrane structures which contribute to longitudinal forearm stiffness of the ulna are the central band (marked in purple) and distal oblique bundle (marked in green).**

Dynamic stabilizers of DRUJ are ECU and pronator quadratus. During active pronation, ECU contracture depresses the ulnar head to palmar (33, 34). The pronator quadratus coapts the distal radioulnar joint during passive supination and active pronation (34).

## Classification of DRUJ prosthesis

Various DRUJ implants are designed and available. They can be, nevertheless, categorized into four major types:

### *Partial Ulnar head replacement DRUJ prosthesis*

In this type of prostheses, only the ulnar head is partially replaced and they are perfect examples of "resurfacing". This type is a good choice in patients with intact DRUJ ligaments, but joint osteoarthritis. Secondary to DRUJ sagittal and coronal variations, radial notch sclerosis is a common finding in long term follow-ups so, "S" or "ski shape" anatomy of sigmoid notch may affect the outcome [Figure 3].

A partial ulnar head prosthesis replacement is indicated in multi-segment osteoporotic distal ulna fractures, DRUJ arthrosis, and failed DRUJ reconstructive procedures such as failed partial ulnar head resections. In partial ulnar head prosthesis, only the articular surfaces of the distal ulnar is replaced and the soft tissue elements remain intact.

The implant is contraindicated for patients with substantial positive ulnar variance in which proper DRUJ congruity cannot be obtained or in those cases where stylocarpal impingement would result. Also, they are not indicated for patients with a previous complete ulnar head resection and in patient with DRUJ instability. In a cadaveric study, the implant provided a close match to the native ulnar head and good joint stability (35). "First Choice DRUJ System, Integra, Austin, TX" concerns the available ones.

### *Complete ulnar head replacement DRUJ prosthesis*

In this type, the ulnar head is replaced totally and it is a "Unipolar" joint replacement. This type can be used in secondary to failed Darrach's procedure and patients with osteoarthritis or with radioulnar impingement syndrome. Similar to partial ulnar head replacement, notch erosion is a common finding in this type. Instability is another common complication. The available examples of this kind of prosthesis include UHP, Martin GMBH, Germany, and U-Head, Small Bone Innovation, USA.

### *Total DRUJ prosthesis*

In this type both radial and ulnar sides of the joint are replaced, therefore, the DRUJ mismatch will not happen. However, the DRUJ is a complex joint and two major disadvantages of this type of prosthesis are: the TFCC is scarified, so axial force transmits only through the radiocarpal joint and, the radial component needs a vast soft tissue dissection to be placed on ulnar border of radius.

### *Kapandji extension DRUJ prosthesis*

This innovative prosthesis is the only "intra-osseous"

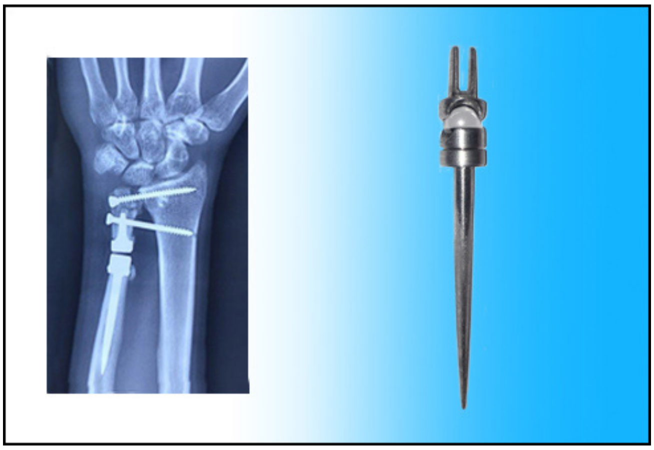

**Figure 6. Kapandji extension DRUJ prosthesis (Moradi's intra-osseous" prosthesis): This innovative prosthesis is the only "intra-osseous" prosthesis in the body. The prosthesis is located in the bone instead of the joint. One stem is in distal ulna and the other in proximal ulnar medullary canal. A ball with two sockets (in proximal and distal) simulates DRUJ movements.**

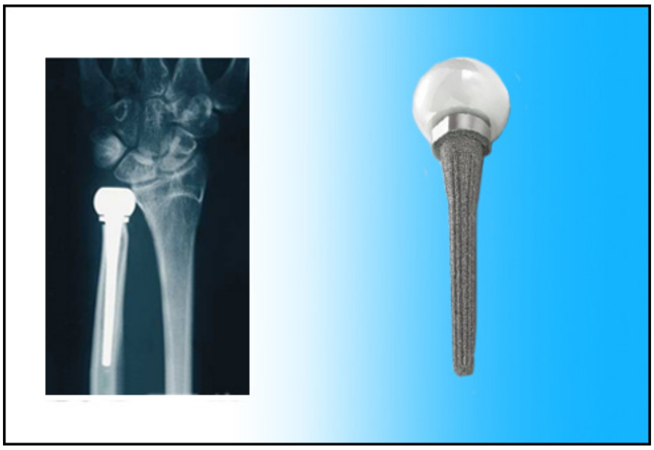

**Figure 7. UHP, Martin GMBH, Germany DRUJ prosthesis: The prosthesis consists of a porous-coated titanium stem and a ceramic head. The head is spherical in the axial sections but at the distal end, it is designed concavely so that it can be matched with carpal bones and decrease pressure across the ulnocarpal joint.**

prosthesis in the body [Figure 6]. A segment of distal ulnar bone cut and two stems of prosthesis are inserted in the distal and proximal remaining segments of ulna respectively. This type of prosthesis indicted when the TFCC is intact or with minor defects. The advantage of this type of prosthesis is TFCC sparing, and simply converting to the Suve-Kapandji's procedure. In theory, the DRUJ range of motion is transmitted to a pivot in ulnar bone near the natural joint which in turn, may influence wrist range of motion and prosthesis stability. However, biomechanical studies confirmed the stability and preservation of the range of motion after prosthesis insertion. Unfortunately, long-term results are not available (36, 37).

## Different types of DRUJ prosthesis

***First Choice DRUJ System, Integra, Austin, TX***

The First Choice DRUJ system by Ascension is an implant which replaces only the articular surfaces of the ulnar head [Figure 11]. This partial implant allows a conservative resurfacing of only the articular surface of the ulna, leaving the ulnar styloid intact and maintaining the attachment of the TFCC and ulnocarpal ligament to the ulna (35). This company has a total-head replacement prosthesis as well which is quite similar to UHP prosthesis [Figure 12].

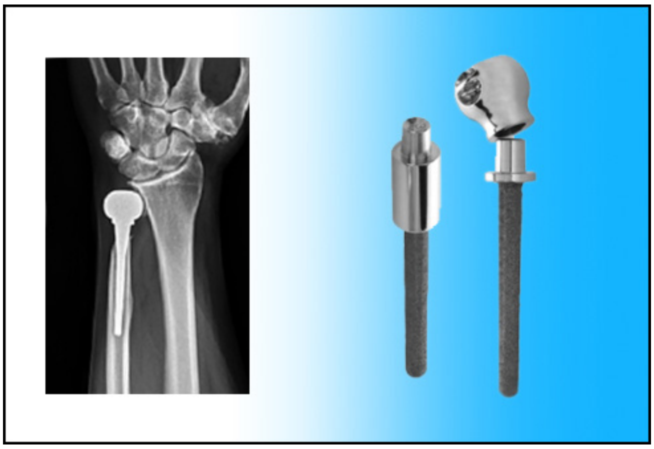

**Figure 8. U-Head, Small Bone Innovation, USA DRUJ prosthesis: The U-Head prosthesis is a modular prosthesis that consists of a metal stem (cobalt–chrome) that can be press-fitted or cemented into the intramedullary canal of the ulna and a metal hemispheric ulnar head.**

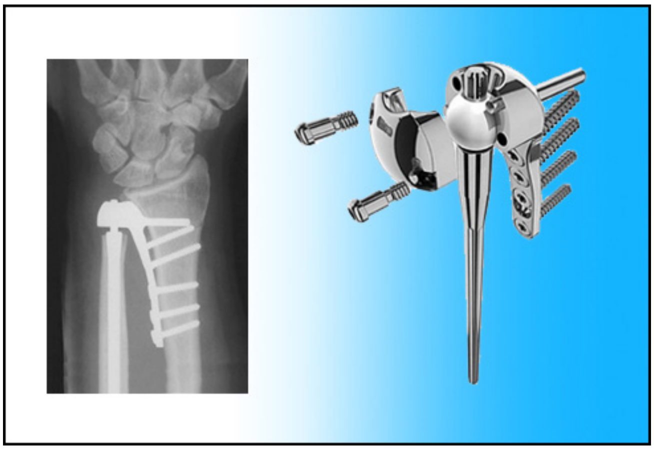

**Figure 9. Aptis DRUJ Prostheses, Aptis Medical, USA DRUJ prosthesis: This prosthesis is a semi-constrained ball and socket joint composed of a radial and an ulnar component to replace the function of sigmoid notch and ulnar head. The radial component is fixed to the radius by distal peg and cortical screws.**

### *UHP, Martin GMBH, Germany*

The UHP prosthesis is a modular DRUJ prosthesis that was developed by Timothy J. Herbert between 1992 and 1994 [Figure 7]. The prosthesis consists of a porous-coated titanium stem and a ceramic head. The head is spherical in the axial sections but at the distal end, it is designed concavely so that it can match carpal bones and decrease the pressure across the ulnocarpal joint. Moreover, it can allow force transition through the ulnar bone, especially during the wrist pronation and ulnar deviation. Three different sizes of stem and head are available, and they can be combined according to the size of the patient's ulna diameter. The stems are designed in three different collar sizes to allow accurate length correction during reconstruction (38). The stem was designed to press-fit within the medullary canal without cement and permit osteo-integration (13, 39).

### *U-Head, Small Bone Innovation, USA*

The U-Head prosthesis is a modular endo prosthesis that consists of a metal stem and a metal hemispheric ulnar head [Figure 8]. Stem and articulating head are made of cobalt–chrome alloy and the head is connected to stem through a tight-fit Morse-taper junction (1).

Stem can be press-fit or cemented into the intramedullary canal of the ulna. There are two stem-neck designs: a normal collar for primary arthroplasty or for revision of a failed procedures where only ulnar head was resected previously. An extended collar is also available for revision of previous distal ulna complete resection (Darrach procedure) (40).

The head has orifices for reattachment of the triangular fibrocartilage complex (TFCC) and extensor carpi ulnaris (ECU) sheath to the prosthesis by sutures. In theory, that has an important role in soft-tissue stabilization (41).

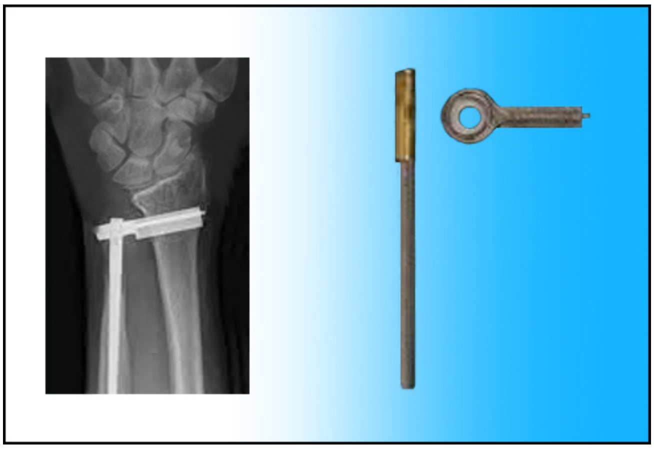

**Figure 10. Schuurman AH DRUJ prosthesis: This prosthesis is a two-component total DRUJ prosthesis formed by an ulnar and radial component. The proximal portion of the ulnar component (intramedullary portion) is coated with hydroxyapatite and the distal portion is coated with ceramic. The radial component has a ring and a rode where the ring joins with proximal portion of the ulnar component and allows axial rotation. The ring has a polyethylene lining.**

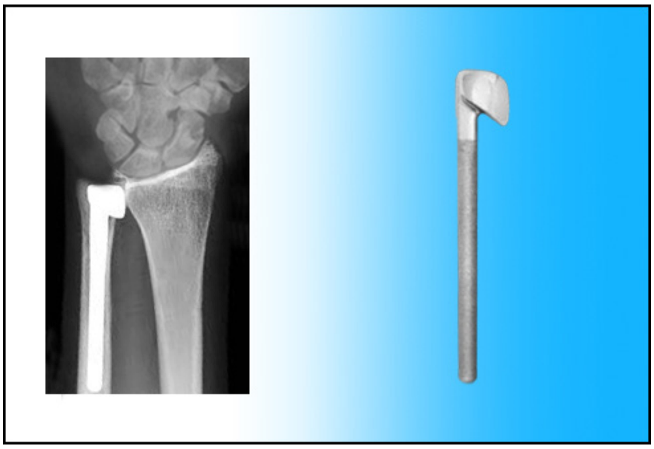

**Figure 11. First Choice DRUJ System, Integra, Austin, TX partial head DRUJ prosthesis: This type of prosthesis is an implant which replaces only the articular surfaces of the ulnar head. The partial implant allows a conservative resurfacing of only the articular surface of the ulna, leaving the ulna styloid intact and maintaining the attachment of the TFCC and ulnocarpal ligament to the ulna.**

### *Aptis DRUJ Prostheses, Aptis Medical, USA*

This prosthesis is a semi-constrained ball and socket artificial joint that comprises a radial and an ulnar component to restore the function of sigmoid notch and ulnar head [Figure 9]. The ulnar component has a stem made of a cobalt-chromium alloy whose distal third is coated with titanium plasma spray. The stem is press-fitted inside the ulnar medullary canal, and the plasma spray induces bone in growth (42).

The radial component has two parts. The main part consists of a preconfigured plate to fit against the ulnar side of the distal radius. The distal part of the main radial component consists of a radial peg and a hemi socket. The radial component is fixed to the radius by distal peg and

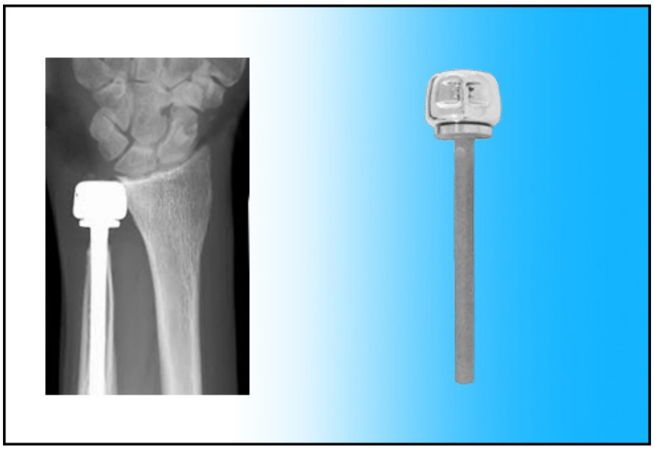

**Figure 12. First Choice DRUJ System, Integra, Austin, TX total head DRUJ prosthesis: This type of prosthesis is an implant which replaces only the articular surfaces of the ulnar head.**

cortical screws. The second part of the radial component is a hemi socket cap that is connected to its counterpart on the radial plate and makes a full socket to receive the UHMW polyethylene ball and articulate with the ulnar component (43).

This prosthesis restores the anatomical relationship between the distal radius and ulna by allowing longitudinal migration of the radius throughout rotational movement of forearm and restores function of TFCC (44).

***Schuurman AH***

This prosthesis was introduced by Schuurman. It is a two-component total DRUJ prosthesis formed by an ulnar and radial component [Figure-10]. The ulnar component is made of chromium cobalt. The proximal portion of the ulnar component (intramedullary portion) is coated with hydroxyapatite and the distal portion is coated with ceramic. This ceramic coating reduces metal-on-polyethylene wear. The surface area of the ulnar component is enlarged with longitudinal grooves to increase stability (45). The radial component has a ring and stem structure where the ring joints with distal portion of the ulnar component and allows axial rotation. The ring has a polyethylene lining to facilitate axial movement. There exist four longitudinal blade shape projections on the stem to increase radial component stability. The radial component is inserted in distal radius perpendicular to radius axis [Figure 10].

***Moradi's intra-osseous" prosthesis***

This innovative prosthesis is the only "intra-osseous" prosthesis in the body [Figure 6]. A segment of distal ulnar bone cuts out and two stems of prosthesis are inserted in the distal and proximal remaining segments of ulna respectively. This type of prosthesis indicted when the TFCC is intact or has minor defects. The advantage of this type of prosthesis is TFCC sparing, and simply converting to the Suve-Kapandji's procedure in failures. In theory, the DRUJ range of motion is transmitted to a pivot in ulnar bone near the natural joint which in turn, may influence wrist range of motion and prosthesis stability. However, biomechanical studies confirmed the stability and preservation of the range of motion after prosthesis insertion. Unfortunately, long-term results are not available (37).

***Silicone implant***

The silicone implants are applicate combined with soft tissue reconstruction. Although silicone implants decreased pain and symptoms in short term follow-up, but due to secondary to high rate of complications, mainly silicone synovitis, they are historical implants andhave been abandoned (46).

## Outcome of DRUJ prosthesis

***UHP prosthesis (UHP, Martin GMBH, Germany)***

In 6 studies carried out from year 2000 to 2019, 93 UHP DRUJ prostheses were evaluated with mean follow-up of 68 months [Table 1] (47-52). Pain in wrist improved 5 scores out of 10 according to the VAS score. All wrist range of motions improved significantly especially in supination by changing from 55 degrees to 73. Pronation, wrist extension and flexion improved from 70, 48, and 37 degrees to 77, 53 and 43 respectively. Grip strength increased by73% after operation. All patient-related questionnaires improved.

Among the index 6 studies on 93 patients, the most complications were heterotopic ossification (5.4%), unstable painful DRUJ (4.3%), and sigmoid notch arthrosis (3.2%) [Table 2] (47-52).

***Aptis DRUJ prosthesis (Aptis DRUJ Prostheses, Aptis Medical, USA)***

Aptis DRUJ prosthesis is the most popular one and most clinical investigations are performed it. There are 8 clinical studies on 271 Aptis prostheses available from 2008 to 2014 [Table 1] (53-60). Findings showed that pain improved by 5.4 scores out of 10 accompanied by slight improvement of range of motions in these series. Pronation, supination, extension, and flexion changed from 64, 57, 51, and 52 degrees before the operation to 77, 73, 54, and 52 degrees after the operation respectively (53-55, 57, 58). Grip strength improved by 70% after prosthesis insertion. All patient-related questionnaires improved significantly (53, 57-60).

The most common complications in Aptis prosthesis were ECU tendinopathy (8.9%), heterotopic ossification (5.9%), and distal ulna resorption (4.8%) [Table 2] (53-60)

***U-Head DRUJ prosthesis (U-Head, Small Bone Innovation, USA)***

There are only two studies available on U-Head prosthesis on 66 patients with follow-up mean of 49 months; first by Willis et al. on 19 patients in 2007 and the other by Kakar et al. on 47 patients in 2012 [Table 1] (41, 61). Pain improved 3.4 scores out of 10 compared to preoperation. Wrist range of motions did not change significantly in such DRUJ prostheses. Pronation and supination decreased from 79 and 63 before operation to 71 and 59 after operation respectively. Also extension and flexion changed from 47 and 41 to 47 and 43 respectively (40, 61). Grip strength improved by 16% after operation. Mayo wrist score improved in both studies. Prosthesis loosening was the most common complication (10.6%) [Table 2] (40, 61).

***Schuurman DRUJ Prosthesis***

There is only one study on this type of DRUJ prosthesis on 19 wrists with 49 months follow-up in 2013 [Table 1] (45). Pain improved 1.8 score out of 10 and range of motion increased slightly. Grip strength rose by 60%; more details are available in table-1. Prosthesis loosening was as high as 26.3% in this type of prosthesis [Table 2].

***Moradi intra-osseous" prosthesis***

There is only one study on this type of DRUJ prosthesis on 5 patients with a mean follow-up of 27.6 months (37). Pain improved 3.7 scores out of 10 compared to preoperation. Wrist range of motions improve in such DRUJ prosthesis. Pronation and supination increased from 66.7 and 53.6 before operation to 81.1 and 71.7 after operation respectively. Also extension and flexion changed from 93.1 and 73.6 to 88.1 and 74.1 respectively.

**Table 1. Outcome data of different DRUJ prosthesis in available studies**

| study | year | Implant type | Number of implants | Mean follow-up (months) | Mean pain score before treatment (out of 10) (Befor/ After) | Prona-tion (Befor/ After) | Supina-tion (Befor/ After) | Exten-sion (Befor/ After) | Flexion (Befor/ After) | Grip strength before (%) | Grip strength after (%) | DASH score before/ after | PRWE before/ after | Mayo score before/ after |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Van Schoonhoven et al. | 2000 | Herbert | 23 | 27 | 9.3/4.3 | 73/86 | 52/77 | N* | N | 42 | 72 | N | N | N |
| Fernandez et al. | 2006 | Herbert | 10 | 31 | N | 60/73 | 66/70 | N | N | 27 | 55 | N | N | N |
| Van Groningen et al. | 2011 | Herbert | 6 | 24 | 4.0/2.5 | 69/84 | 38/47 | 28/31 | N/19 | 17 | 27 | 44/27 | N | N |
| Van Schoonhoven et al. | 2012 | Herbert | 16 | 132 | 9.3/4.3 | 73/83 | 52/81 | N | N | 42 | 81 | N | N | N |
| Axelsson et al. | 2015 | Herbert | 21 | 90 | 2.9/8.9 | 65/65 | 55/70 | 45/50 | 40/35 | N | 81 | N/27 | N/31 | N/71 |
| Fok et al. | 2019 | Herbert | 17 | 72 | N | 74/74 | 64/76 | 60/66 | 42 | 46 | 66 | 77/41 | N | N |
| Mean according to each study population | | | 93 | 68 | 8.6/3.6 | 70/77 | 55/73 | 48/54 | 38/44 | 39 | 66 | | | |
| Willis et al. | 2007 | uHead | 19 | 32 | 9.0/4.5 | 74/72 | 61/60 | N | N | 75 | 73 | N | N | 41/77 |
| Kakar et al. | 2012 | uHead | 47 | 56 | 9.2/4.2 | 77/71 | 64/59 | 47/47 | 41/43 | 17 | 21 | N | N | 41/69 |
| Mean according to each study population | | | 66 | 49 | 6.2/2.7 | 76/71 | 63/69 | 47/47 | 41/43 | 34 | 36 | | | |
| Scheker et al. | 2008 | Aptis | 49 | 24 | 7.6/2.6 | N/79 | N/72 | N | N | 54.7 | 63.4 | N | N | N |
| Laurentin-Perez et al. | 2008 | Aptis | 31 | 71 | 8.4/2.0 | 66/74 | 53/70 | N | N | 30.5 | 61 | N/23 | N/29 | N |
| Savvidou et al. | 2013 | Aptis | 27 | 60 | 8.3/2.7 | 66/81 | 52/75 | N | N | 48 | 90 | N/16 | N/24 | N |
| Axelsson et al. | 2013 | Aptis | 9 | 45 | 5.3/0.8 | 55/67 | 68/76 | N | N | 46.8 | 60 | 52/32 | N | N |
| Scheker et al. | 2013 | Aptis 1st generation | 31 | 70 | 8.4/2.0 | N/79 | N/72 | N | N | 31.2 | 61.2 | N/23 | N/29 | N |
| | Aptis 2nd generation | 35 | 60 | N | 62/83 | 51/75 | N | N | 44 | 94 | N/14 | N/22 | N | |
| Bizimungu et al. | 2013 | Aptis | 10 | 60 | 4.8/3.6 | 64/70 | 64/72 | 35/45 | 45/32 | N | N | N | N | N |
| Galvis et al. | 2014 | Aptis | 19 | 39 | 7.3/2.2 | 56/78 | 57/71 | N | N | N | N | N/24 | N/24 | N |
| Kachooei et al. | 2014 | Aptis | 14 | 60 | N/0 | N/64 | N/51 | N | N | N | N | N/1.3** | N/2.5** | N |
| Rampazzo et al. | 2015 | Aptis | 46 | 61 | 8.0/2.0 | 69/77 | 62/73 | 55/56 | 53/56 | 31 | 49 | 56/27 | 64/30 | N |
| Mean according to each study population | | | 271 | 54 | 6.3/1.9 | 64/77 | 57/73 | 51/54 | 52/52 | 41 | 68 | | | |
| Schuurman et al. | 2013 | Schuurman | 19 | 49 | 5.3/3.5 | 79/88 | 70/72 | 48/59 | 39/46 | 10 | 16 | 39/31 | N | N |

*N=No data

**Median

Grip strength and Pinch Strength increased from 40.6 and 52.6 (percent in relation to unaffected hand) to 65.8 and 69.6 after prosthesis insertion respectively. The result of two questionnaires (PRWE and Quick DASH) improved 26.5 and 5.8 scores out of 100 prosthesis insertion (36).

## How t chose a proper DRUJ prosthesis

Our experience in DRUJ prosthesis is little and studies with long term follow-up as well as studies aiming at comparing different types of DRUJ prostheses are rare. The criteria to select a proper implant are as below:

1. If the TFCC is preservable (intact, central perforation or repairable) or not
2. If the radioulnar ligaments work well
3. If the sigmoid notch has degenerative changes

Guidelines in can help the surgeon to select an appropriate DRUJ prosthesis among the available ones; however, implant usage is highly dependent on surgeon experience and accessibility [Table 3].

DRUJ is a complicated joint that has complex

**Table 2. Complications in different types of prosthesis**

| Type of prosthesis | Studies (Fist autor) | Number of cases | Complication | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infection | Unstable painful DRUJ | Loosening | Heterotopic ossification | Sigmoid notch or radiocarpal arthrosis | Ulnar neuropathy | ECU tendinopathy | Distal ulna resoption | Others |
| Herbert | Van Schoonhoven (2000), Fernandez, Van Schoonhoven (2012), Axelsson, Van Groningen, Margaret Woon Man Fok | 93 | 1 (1%) | 4 (4.3%) | 1 (1%) | 5 (5.4%) | 3 (3.2%) | 1 (1%) | 0 (0%) | 1 (1%) | 0 (0%) |
| uHead | Willis, Kakar | 66 | 0 (0%) | 3 (4.5%) | 7 (10.6%) | 0 (0%) | 2 (3%) | 2 (3%) | 0 (0%) | 0 (0%) | 1*(1.5%) |
| Aptis | Laurentin-Perez, Savvidou, Axelsson, Scheker (2008), Bizimungu, Galvis, Kachooei, Scheker(2013), Rampazzo | 271 | 6 (2.2%) | 0 (0%) | 7 (2.6%) | 16 (5.9%) | 6 (2.2%) | 0 (0%) | 24 (8.9%) | 13 (4.8%) | 7**(2.6%) |
| Schuurman | Schuurman | 19 | 0 (0%) | 0 (0%) | 5 (26.3%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) | 0 (0%) |

* intraoperative fx of ulna

** 2 clicking with active motion, 2 CRPS, 2 screw tip prominance, 1 transient carpal tunnel syndrome

**Table 3. Prostheis type,synonymous advantages,Disadvantages,Indications & contraindications**

| Prostheis type | synonymous | advantages | Disadvantages | Indications & contraindications |
|---|---|---|---|---|
| Partial Ulnar head replacement DRUJ prosthesis | resurfacing | TFCC peresering, axial load preservation through ulna | radial notch erosion scondary to DRUJ mismatch | a good choice in patients with intact DRUJ ligaments but joint osteoarthritis |
| Complete ulnar head replacement DRUJ prosthesis | unipolar | Can be used in TFCC injuries | radial notch erosion scondary to DRUJ mismatch, DRUJ instability | A good choice in failed Darrach procedure |
| Multicomponent DRUJ prosthesis | Total | DRUJ mismatch will not happened | the TFCC is scarified, axial force transmit only through radiocarpal joint, needs vast dissection of soft tissue to place radial component, tenosynovitis | Good choice in other failed procedures |
| Kapandji extension DRUJ prosthesis | intra-osseous | TFCC sparing, simply converting to Kapandji procedure | teoricaly may affect forearm axial ROM | indicted when the TFCC is intact or with minor defect, good choice in failed Kapandji procedure |

junctional anatomy with both distal radius and carpus. The sophisticated anatomy of DRUJ makes the task of developing DRUJ prosthesis challenging which is why some types of prostheses have to ignore the ulnocarpal joint such as Aptis prosthesis. Kapandji extension DRUJ prosthesis is a clever idea to save the ulnocarpal joint as well as restoring forearm axial rotations. Although different types of DRUJ prostheses have been developed, the rate of complications is high and the follow-up duration is not long enough to propose strict guidelines for appropriate selection.

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