Original article

Intermediate term evaluation of the Eclypse distal radio-ulnar prosthesis for rheumatoid arthritis. A report of five cases

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ABSTRACT

Hypothesis: Early medical management of rheumatoid arthritis with biotherapy has changed the traditional musculoskeletal damage from this disease. When the distal radio-ulnar joint (DRUJ) is involved, classic procedures may be inappropriate. We chose a hemi-arthroplasty of the DRUJ joint (Eclypse™) in patients with persistent synovitis and chondrolysis with a stable joint. The aim of this study was to assess the intermediate term results of this approach in these specific cases.

Materials and methods: We report a retrospective study of 5 Eclypse arthroplasties implanted between March 2005 and March 2011. There were 4 women and 1 man, mean age: 58.4 years old (54–62) with RA that had been present for 21.6 years (15–33). This hemi-arthroplasty replaced the ulnar head with a pyocarbon component. Patients were evaluated by an independent observer for pain by VAS, range of motion, grip strength in the neutral position by Jamar dynamometer, pronation and supination strengths with a pronosupinator, DASH score and wrist X-rays.

Results: One patient was lost to follow-up and the 4 others underwent a follow-up evaluation at 64 months (43–90). There were no intra-operative or postoperative complications. The pain score at the final follow-up was 1.5/10 (0–4), pronation was 70° (60–80) and supination was 80° (80–80). Grip strength was 148% compared to the contralateral side (73–200%). Pronation and supination strengths were 1.7 kg (1.5–2) and 2.1 kg (2–2.5) respectively. The DASH score was 55.9 points (42.6 to 79.3). X-rays did not show any changes in the ulnar notch.

Conclusion: This distal radio-ulnar arthroplasty is less invasive and preserves the bone and ligaments. Clinical results are rapid, remain stable over time and are well tolerated. This arthroplasty, which was initially developed for osteoarthritis and traumatic lesions of the DRUJ, is promising for specific cases of rheumatoid arthritis.

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1. Introduction

Distal radio-ulnar joint (DRUJ) involvement is frequent in rheumatoid arthritis (RA) and can result in a functional disability. Surgical treatment is indicated if pain, synovitis or tendon tears persist despite appropriate medical treatment. Conventional management of DRUJ involvement in RA is based on resection of the distal ulnar epiphysis [1,3] or arthrodesis [2]. Although the clinical outcome of these procedures is good, they may result in ulnar instability, DRUJ convergence or a loss of grip strength.

Biotherapies [4,5] have made it possible to stabilize disease progression of RA and preserve osteoarticular function, while allowing the patient to remain in his/her socioprofessional environment. Thus the classic solution for DRUJ involvement does not seem to correspond to the non-invasive goal of conservative treatment. To respect joint anatomy, we used the Eclypse (Bioprofile – Tornier, Grenoble France) hemi-arthroplasty to preserve the distal epiphysis, ulnar styloid process and the ulnar insertions of the triangular fibrocartilage complex (TFCC) and maintain stability of the DRUJ.

This hemi-arthroplasty was implanted in patients in whom RA was well managed by biotherapy with persistent synovitis and chondrolysis of the DRUJ and a well-preserved TFCC on a stable joint.

The goal of our study was to evaluate the intermediate term radiological and clinical results of this prosthesis in RA controlled by medical treatment.

2. Materials and methods

We retrospectively studied a series of 5 Eclypse hemi-arthroplasties that were performed between March 2005 and March 2011 by a single surgeon (YSC). There were 4 women and 1
man, mean age 58.4 years old (54–62) who had had RA for a mean 21.6 years (15–33). This hemi-arthroplasty replaced the ulnar head with a pyrocarbon component attached to the ulnar epiphysis by an intra-medullary press fit stem.

The indication for hemi-arthroplasty was determined by a preoperative clinical examination that confirmed anteroposterior DRUJ instability and the absence of palmar subluxation of the extensor carpi ulnaris. A standard radiographic evaluation evaluated chondrolysis of the ulnar head and the appearance of the ulnar notch of the radius. In case of dorsal subluxation of the ulnar head or joint damage of the ulnar notch we opted for a more standard surgical procedure (Darrach, Sauvé-Kapandji).

Surgery was performed by a longitudinal medial dorsal approach centered on the radiocarpal joint space to expose the extensor retinaculum. Two retinacular flaps were raised, one radial and the other ulnar, at the medial end of the 6th compartment and pedicled to the dorsal Lister’s tubercle demolishing the intercompartmental septa according to the “butterfly flap” technique [6] and providing centering of the 4th, 5th and 6th dorsal compartment extensor tendons. Total synovectomy of the extensors was then performed followed by a distal radiocarpal and radio-ulnar arthroscopy. The distal radio-ulnar arthroscopy was performed longitudinally 4 mm from the radial insertion of the TFCC (Fig. 1). A distal radio-ulnar synovectomy was then performed. We use the specific cut guide to perform two osteotomies, one proximal, perpendicular to the longitudinal axis of the ulna at the proximal ulnar notch of the radius, and the second longitudinal, tangential to the ulnar styloid.

The medullary canal was reamed to facilitate insertion of the press fit stem. The four legs of the stem were pressed together with a surgical clamp. Once the stem was fully inserted, the 4 legs expanded for stem stability. The appropriately sized ulnar head was placed on the stem (Fig. 2). Implant position and stability were fluoroscopically controlled. After closing the joint capsule, we created a sling with the dorsal extensor retinaculum by transposing the extensor retinaculum on the ulnar side in front of the extensors and joining the two sutured retinacular flaps together (Fig. 3).

Patients were followed-up by an independent observer (NB) for a clinical and radiological evaluation. Pain was evaluated on the Visual Analogic Scale (VAS), wrist pronation and supination range of motion was determined (Fig. 4a), as well as Jamar 2 grip strength (Patterson Medical, Warrenville, USA) and pronation-supination strength by pronosupinator® [7] (Bioprofile – Tornier, Grenoble France) (Fig. 4b). The DASH score [8,9] was also determined.

3. Results

One English patient was lost to follow-up and the four other patients were seen after a mean 64 months (43–90). There were no intra- or postoperative complications.

The results for each patient are reported in Table 1. The pain score was 1.5/10 (0–4). The range of motion was 70° (60–80) for pronation and 80° (80–80) for supination. Jamar grip strength was 148% compared to the contralateral side (73–200%).
Table 1
Patient characteristics and results.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Onset of RA</th>
<th>Length of follow-up (months)</th>
<th>Pain (VAS)</th>
<th>Pronation-supination ROM</th>
<th>Jamar strength (compared to contralateral side) (%)</th>
<th>Pronation-supination strength (kg)</th>
<th>DASH score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>62</td>
<td>F</td>
<td>25</td>
<td>90</td>
<td>4</td>
<td>70 / 80</td>
<td>73</td>
<td>1.5 / 2</td>
<td>42.6</td>
</tr>
<tr>
<td>2</td>
<td>54</td>
<td>F</td>
<td>18</td>
<td>61</td>
<td>0</td>
<td>60 / 80</td>
<td>156</td>
<td>2 / 2</td>
<td>58.3</td>
</tr>
<tr>
<td>3</td>
<td>58</td>
<td>F</td>
<td>17</td>
<td>Lost to follow-up</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>– / –</td>
<td>–</td>
</tr>
<tr>
<td>4</td>
<td>62</td>
<td>F</td>
<td>33</td>
<td>62</td>
<td>2</td>
<td>70 / 80</td>
<td>163</td>
<td>1.5 / 2</td>
<td>43.3</td>
</tr>
<tr>
<td>5</td>
<td>57</td>
<td>M</td>
<td>15</td>
<td>43</td>
<td>0</td>
<td>80 / 80</td>
<td>200</td>
<td>2 / 2.5</td>
<td>79.3</td>
</tr>
<tr>
<td>Mean</td>
<td>58.6</td>
<td>21.6</td>
<td></td>
<td>64</td>
<td>1.5</td>
<td>70 / 80</td>
<td>148</td>
<td>1.7 / 2.1</td>
<td>55.9</td>
</tr>
</tbody>
</table>

Fig. 5. 3D reconstruction of a CT-scan in pronated position (a), neutral (b) and supination (c) evaluating the centering of the head of the prosthesis during the pronation-supination movement.

Fig. 6. Preoperative and postoperative X-rays at 90 months’ follow-up (patient n° 1).

Pronation strength measured by a pronosupinator was 1.7 kg (1.5–2) and supination strength was 2.1 kg (2–2.5). The DASH score was 55.9 points (42.6–79.3).

A CT-scan was performed in the lost to follow-up patient (Fig. 5) who had early postoperative pain, allowing us to evaluate centering of the prosthesis during pronation, supination and neutral pronation and supination. There was a tendency to subluxation during pronation but no clinical instability.

The X-rays performed at the final follow-up (Fig. 6) did not show any change in fixation of the expanding stem or radiological changes in the ulnar notch of the radius: there was no chondrolysis or bone loss.

4. Discussion

Approximately 80% of patients with RA have symptoms in the wrist [10]. Backdahl [11] provided the physiopathological
Table 2
Studies in the literature.

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>Materials</th>
<th>Number of patients</th>
<th>Indications</th>
<th>Follow-up (months)</th>
<th>Results</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stanley [25]</td>
<td>1992</td>
<td>Silicone</td>
<td>20</td>
<td>Post-traumatic</td>
<td>44.2</td>
<td>70% excellent or good results</td>
<td>Periprosthetic bone loss in all cases</td>
</tr>
<tr>
<td>Sagerman [26]</td>
<td>1992</td>
<td>Silicone</td>
<td>42</td>
<td>Osteoarthritis and RA</td>
<td>91</td>
<td>Pronation-supination 81–64</td>
<td>Implant migration or fracture 63%</td>
</tr>
<tr>
<td>Van Schoooven [28]</td>
<td>2003</td>
<td>Ceramic</td>
<td>57</td>
<td>Osteoarthritis and revision</td>
<td>38</td>
<td>Pronation-supination 78–76. Strength 77%</td>
<td>1 loosening. Remodelling of the ulnar notch of the radius</td>
</tr>
<tr>
<td>Sabo [29]</td>
<td>2014</td>
<td>Ceramic</td>
<td>79</td>
<td>Arthritis, post-traumatic, arthritis and revision</td>
<td>180</td>
<td>Strength 67% Survival 90% at 15 yrs</td>
<td></td>
</tr>
<tr>
<td>Berger [30]</td>
<td>2005</td>
<td>Chromium-Cobalt</td>
<td>22</td>
<td>Fracture, arthritis and revision</td>
<td>24</td>
<td>Good to excellent in18 patients</td>
<td>2 instabilities, 2 loosening</td>
</tr>
<tr>
<td>Willis [31]</td>
<td>2007</td>
<td>Chromium-Cobalt</td>
<td>19</td>
<td>Arthritis and revision</td>
<td>32</td>
<td>Pain score –50%. Strength +4 kg</td>
<td>2 loosening. 1 instability</td>
</tr>
<tr>
<td>Yen Shipley [32]</td>
<td>2009</td>
<td>Chromium-Cobalt</td>
<td>22</td>
<td>Arthritis and revision</td>
<td>54.3</td>
<td>Mayo Wrist Score 72.73</td>
<td>2 instabilities. 1 stem fracture</td>
</tr>
<tr>
<td>Sauerbier [33]</td>
<td>2013</td>
<td>Chromium-Cobalt</td>
<td>25</td>
<td>Arthritis and revision</td>
<td>30</td>
<td>Pronation-supination range of motion 124° DASH score 33 points Pronation 75°; Supination 80°. Strength PS: 4 kg</td>
<td></td>
</tr>
<tr>
<td>Garcia-Elias [7]</td>
<td>2007</td>
<td>Chromium-Cobalt</td>
<td>3</td>
<td>Arthritis and revision</td>
<td>10</td>
<td>Pronation 75°; Supination 80°. Strength 77%</td>
<td>None</td>
</tr>
</tbody>
</table>

description of the DRUJ under the name of the caput ulnae syndrome. Progression of RA in the DRUJ follows the usual process: inflammatory synovitis affecting the TFCC, the ulnocarpal ligaments and the sheath of the extensor carpi ulnaris [12]. Besides this articular involvement, tendon tears may also occur due to impingement with the head of the ulna and attrition [13,14].

Although pain and functional disability of the DRUJ joint can usually be improved by simple resection of the distal ulna using the Darrach [1] or Bowers [3] technique, this creates an imbalance in the entire forearm by creating instability [15–17] or impingement of the distal ulnar stump with the distal radial epiphysis [18] and loss of grip strength which may be moderate in patients with low functional needs, but which can alter functional outcome in active individuals, for example, in patients with RA that is well managed by biotherpay. Surgical stabilization techniques have not been shown to be highly effective [19–21] in restoring stability to the distal ulnar stump. Sauvé and Kapandji [2] tried to solve the problem of instability following Darrach resections by performing arthrodesis of the ulnar head to the ulnar notch of the radius and creating nonunion of the ulnar neck. However, this procedure is associated with the same risk of convergence and instability as simple distal ulnar resection.

Thus, several authors [22–24] have suggested performing arthroplasty of the DRUJ (Table 2) to prevent or solve the problem of instability of the distal ulnar stump. However, the results of arthroplasty are better [29,31–33] as first line therapy than for revision of instability following resection of the distal epiphysis of the ulna.

DRUJ hemi-arthroplasty is normally limited to DRUJ osteoarthritis because good quality soft tissue is needed to ensure stability and durable bone fixation. Because these conditions are uncertain in patients with RA, hemi-arthroplasty should only be indicated after careful consideration. However, the contribution of biotherapies has significantly changed the progression of RA and its parameters. Thus, it is now possible to discuss the option of arthroplasty that respects the anatomy and preserves the bone.

DRUJ hemi-arthroplasty was first developed with a silicone implant [25,26] and 70% of patients presented with good or excellent results. However, this arthroplasty with associated with a risk of periprosthetic bone resorption in all patients due to silicone-induced synovitis [26] with implant migration or mechanical failure in 63%. Although there was no significant difference between implant survival and functional outcome the authors did not recommend its use.

More recently ceramic head [24,28,29,34] cobalt chromium [30–33] implants were introduced with very satisfying pronation-supination results and a strength of 67 to 77% compared to the contralateral side. Implant survival was 90% according to Sabo [29]. However, cases of DRUJ instability [27,31,33] and loosening of the ulnar stem [31] were still reported.

The use of ceramic heads [24,34] has been shown to require remodelling of the ulnar notch of the radius from 1 to 2 because of the ceramic head, which we did not find in our study. This may be due to the Young module twenty times less for the pyrocarbon than the ceramic [35] with better tolerance to cartilage wear as well [36].

The use of pyrocarbon is more recent and only one publication [7] was found in the literature reporting 3 cases with a follow-up of 10 months. There was total range pronation-supination and pronation-supination strength was 4 kg. In our series strength was twice as weak, however this might have been influenced by the stage of RA of the upper limb.

Our study was limited by the small number of patients, and longer follow-up is needed. However, this was a homogenous group of patients with RA that was well managed by medical treatment and with disability of the DRUJ.

5. Conclusion

Arthroplasty of the ulnar epiphysis using an Eclypse prosthesis that preserves bone, ligament and joint capsule integrity seems to be an interesting option and achieves the goal of providing conservative and preventive treatment associated with the existing medical treatment of RA. The results of this prosthesis, which was initially indicated for traumatic injuries and DRUJ osteoarthritis are promising in RA that has been stabilized by biotherpay.
Nevertheless, the indication for this type of arthroplasty should be limited to stable radio-ulnar joints with RA that is well controlled by conservative medical treatment.

Disclosure of interests

The authors declare that they have no competing interest.

References