

# Distal Radioulnar Joint Reconstruction After Fracture of the Distal Radius

Bertrand Coulet, MD, PhD, Danny Onzaga, MD,  
Christian Perrotto, MD, Jorge G. Boretto, MD



## THE PATIENT

A 50-year-old man had a distal radius fracture of his dominant right hand 3 years ago. He reports wrist pain for the past 6 months. He has pain with forearm rotation, and supination is limited to 30°. He is tender at the distal radioulnar joint (DRUJ) and has pain with forceful ulnar deviation of the wrist. Radiographs show dorsal angulation of the distal radius and positive ulnar variance.

## THE QUESTION

What is the best option for reconstruction of posttraumatic DRUJ dysfunction after fracture of the distal radius?

## CURRENT OPINION

Distal ulna resection (Darrach's procedure) has fallen out of favor due to concerns about symptomatic radioulnar convergence and instability of the ulnar stump. Some surgeons reserve Darrach's procedure for patients who are elderly or debilitated or have low functional demands, or to salvage other failed DRUJ procedures. The Sauvé-Kapandji procedure (distal radioulnar arthrodesis and intentional distal ulnar pseudoarthrosis) retains support for the ulnar carpus but can also have problems with the ulnar stump. Prosthetic replacement of the distal ulna is appealing for patients with damage to the articular surface of the ulna, but it cannot address malalignment and instability of the DRUJ unless the prosthesis is constrained.

*From the Hand and Upper Limb Surgery Department, Lapeyronie University Hospital, Montpellier, France; CLIMBA, Clínica de la Mano Buenos Aires, Ciudad Autónoma de Buenos Aires, Argentina; Hand and Upper Limb Surgery Department, Orthopedic and Traumatology Service, Hospital Italiano de Buenos Aires, Ciudad Autónoma de Buenos Aires, Argentina.*

Received for publication July 7, 2010; accepted July 11, 2010.

No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

**Corresponding author:** Jorge G. Boretto, MD, Hospital Italiano de Buenos Aires, Potosí 4247, C1199ACK, Ciudad Autónoma de Buenos Aires, Argentina; e-mail: [jboretto@hotmail.com](mailto:jboretto@hotmail.com).

0363-5023/10/35A10-0019\$36.00/0  
doi:10.1016/j.jhssa.2010.07.016

## THE EVIDENCE

### Darrach's procedure

Darrach's procedure is widely used, with several retrospective case series reporting satisfactory results in more than 75% of patients with posttraumatic DRUJ dysfunction.<sup>1-4</sup> Tulipan et al.<sup>4</sup> reviewed 33 patients after Darrach's procedure for posttraumatic DRUJ dysfunction and noted an increased range of motion in wrist flexion/extension and forearm rotation, as well as increased grip strength, with only one patient diagnosed with instability of the distal stump of the ulna.

De Witte and colleagues<sup>2</sup> described 26 patients who had Darrach's procedure for posttraumatic reconstruction of the DRUJ—primarily severe restriction of the forearm rotation and radioulnar length discrepancy. Patients treated for pain relief alone were excluded. Forearm rotation improved from 49° to 136°, and pain was relieved in 7 of 15 patients who reported pain before surgery. Two patients were diagnosed with symptomatic radioulnar impingement.

DiBenedetto and colleagues<sup>5</sup> described increased forearm rotation and grip strength in 18 patients an average of 8 years after Darrach's procedure. Four patients were diagnosed with radiographic ulnar carpal translocation.

McKee and Richards<sup>1</sup> identified dynamic radioulnar convergence on radiographs of 14 of 25 wrists after Darrach's procedure, but there was no correlation between radiographic convergence and Garland and Werley scores or grip strength. Radiographic radioulnar impingement was thought to be more likely with greater resection of the distal ulna. In addition, moderate or severe arthritis correlated significantly ( $p = .01$ ) with decreased grip strength and clinical outcome.

Recently, Mansat and colleagues<sup>6</sup> reported the long-term results of 20 consecutive patients with resection of the distal ulna after a distal radius fracture. At an average of 11 years of follow-up, the rate of patient satisfaction was 95%. They noted that pain decreased and mobility increased from the preoperative period. Nei-



ther ulnar stump instability nor pain on palpation of the ulna was found.

Others have reported more problems with Darrach's procedure. For example, af Ekenstam and colleagues<sup>7</sup> reported that 12 of 24 patients felt that they were not improved by resection of the distal ulna for treatment of limited forearm rotation with or without pain from the DRUJ after a distal radius fracture. Only 8 of the 24 reported relief of pain. Eight of 11 patients with pain and osteoarthritis of the distal radioulnar joint reported improvement. Ten patients had a second surgery to address "clicking" when they rotated the forearm.

Field and colleagues<sup>8</sup> reported the results of 36 patients after the Darrach procedure performed for wrist trauma (31 after Colles' fractures). At 6 years of follow-up, 31 patients had pain, either on pronation and supination or at gripping. Only 18 patients had satisfactory clinical results. They also found a correlation between postoperative length of the ulnar stump and grip strength and the presence of radiocarpal osteoarthritis with unsatisfactory results.

### Sauvé-Kapandji procedure

Pain at the ulnar stump following the Sauvé-Kapandji procedure has been reported in 16% to 25% of patients.<sup>9,10</sup> Voche et al.<sup>11</sup> described 21 patients who had the Sauvé-Kapandji procedure for posttraumatic reconstruction of the DRUJ, reporting an average forearm rotation of 87% and an average grip strength of 55% of the contralateral side. Instability of the distal ulnar stump was diagnosed in 8 patients; however, there were no radiological signs of impingement. Three patients had ossification of the ulnar pseudoarthrosis.

Carter and Stuart<sup>9</sup> reported the results of the Sauvé-Kapandji procedure in 37 patients, 33 for problems after a distal radius fracture, noting 92% forearm rotation and 62% grip strength compared with the contralateral side. Nine patients had pain at the ulnar stump, 5 had nonunion of the DRUJ, and 18 had a "click" at the site of the surgery; however, only 5 found it uncomfortable. Younger patients seemed to have worse results.

In a prospective study,<sup>12</sup> 84 patients with a mean age of 41 years were followed up for at least 1 year after the Sauvé-Kapandji procedure. Fifty-one patients had prob-

lems related to a distal radius malunion. At final follow-up, 20 patients had excellent results; 34, good; 18, fair; and 12, poor, according to the Mayo wrist score. Pain decreased significantly ( $p < .001$ ), and forearm rotation, and grip strength (65% of the healthy side) increased significantly ( $p < .006$ ) after surgery. One patient had severe radial impingement of the ulnar stump.

In another case series,<sup>13</sup> in 44 patients (29 after a distal radius fracture), a short proximal ulnar stump was associated with a lower Mayo wrist score, a higher Disabilities of the Arm, Shoulder, and Hand score, and increased risk of pain.

### Darrach versus Sauvé-Kapandji procedure

One retrospective study compared the results of both procedures in patients younger

than 50 years of age.<sup>10</sup> Thirty patients with a mean age of 39 years treated with Darrach's procedure were compared with 18 patients with a mean age of 34 years treated with the Sauvé-Kapandji procedure. Only 13 of the 30 patients in the Darrach group and 9 of the 18 patients in the Sauvé-Kapandji group were available for follow-up examination. At a mean follow-up of 4 years in the Darrach group and 2 years in the Sauvé-Kapandji group, there were no marked differences in motion, Mayo wrist scores, or Disabilities of the Arm, Shoulder, and Hand scores. There were many complications in both groups; however, there was no considerable difference between the complication rates of the 2 procedures. Common complications to both techniques were painful and painless "click" and neuritis of the dorsal branch of the ulnar nerve. Tenderness at the hardware site was found in the Sauvé-Kapandji group, and ulnar carpal translation and pain at the ulnar stump were found in the Darrach group. Only one patient in both groups required additional surgery (a Sauvé-Kapandji wrist was converted to a Darrach for a painful "click").

### Ulnar head arthroplasty

Twenty-three patients with an average age of 45 years were treated for symptomatic radioulnar convergence or ulnar stump instability after Darrach's procedure.<sup>14</sup> At an average of 27 months, pain decreased an average of 50% compared with the preoperative period. Grip strength, forearm rotation, and patient satisfaction in-

### EDUCATIONAL OBJECTIVES

- State the complications following distal ulnar resection (Darrach's procedure).
- Discuss the contraindications for prosthetic replacement of the distal ulna.
- Compare and contrast the Darrach resection and Sauvé-Kapandji procedure.
- Describe the changes in the ulna and sigmoid notch following prosthetic replacement of the distal ulna.
- Summarize the peer-reviewed scientific support for prosthetic replacement of the distal ulna.

Earn up to 2 hours of CME credit per *JHS* issue when you read the related articles and take the online test. To pay the \$20 fee and take this month's test, visit <http://www.assh.org/professionals/jhs>.

creased significantly ( $p < .001$ ) at final follow-up. The prosthesis dislocated in 2 patients. Radiological assessment showed remodeling of the radial sigmoid fossa, bone resorption beneath the collar of the prosthesis, and one stem loosening. Chronic infection requiring removal of the prosthesis was observed in one patient.

Willis et al.<sup>15</sup> reported the results of 17 patients (19 ulnar head prostheses) noting a 50% decrease in pain, increased grip strength, and no change in forearm rotation. Radiological evaluation showed signs of remodeling of the sigmoid fossa, with 5 patients having bone resorption beneath the collar and 2 patients having stem loosening. Complications were present in 4 patients. There was 1 intraoperative fracture of the ulna, 1 neuroma of the dorsal branch of the ulnar nerve, 1 intermittent instability of the ulnar head prosthesis, 1 case of progressive degenerative change in the sigmoid notch, and 2 cases of intramedullary stem loosening.

### SHORTCOMINGS OF THE EVIDENCE

The evidence is limited to small cohort studies, many by promoters of a given technique. There are no randomized trials and only one study with any type of controls. There are inconsistent diagnoses, inclusion criteria, age ranges, and associated procedures. The amount of distal ulna resected is usually not clearly stated. Because it is possible that some of the problems ascribed to the reconstructive procedure are related to impairment resulting from the initial injury or subsequent pathophysiology, it is difficult to interpret uncontrolled studies.

Both Darrach's procedure and the Sauvé-Kapandji procedure provide substantial increases in forearm rotation and grip strength but inconsistent improvement of pain. It is not clear how to define and measure "instability" of the ulnar stump, and it seems that persistent pain after surgery might be overconfidently ascribed to this nebulous concept. Radioulnar convergence is more clearly defined and measured, but it has a limited relationship to symptoms. Recent reports of DRUJ arthroplasty are from enthusiasts of a given technique, sometimes the developers of a device, and it is not clear that consistent inclusion and exclusion criteria are used. Many prostheses currently marketed have no published, peer-reviewed scientific support.

### DIRECTIONS FOR FUTURE RESEARCH

Prospective, randomized studies comparing the results of Darrach and Sauvé-Kapandji procedures and different types of prostheses would help to determine the advantages and disadvantages of these procedures, but they will likely need to be done as multicenter trials because these problems are uncommon. The value of

any of these procedures in the treatment of pain would need to be compared with other approaches (eg, cortisone injection or sham surgery) to be certain that there were meaningful improvements directly as a result of the surgery rather than the placebo effect, regression to the mean, or the natural course of the illness. Furthermore, we need a means for isolating pain at the DRUJ from other sources of pain. Longitudinal, prospective studies of patients with DRUJ replacement are needed to evaluate the long-term results, including survivorship and the consequences of the contact between cartilage and prosthesis.

### OUR CURRENT CONCEPTS FOR THIS PATIENT

The Darrach and Sauvé-Kapandji procedures can provide meaningful, objective improvement to patients with severe impairment of forearm rotation after trauma, but they are less reliable for the painful mobile forearm. Patients with severe impairment of forearm rotation are often willing to risk radioulnar convergence to decrease their impairment. Ulnar stump instability and radioulnar impingement occur after both procedures, but their relationship to pain and dissatisfaction are incompletely defined. The DRUJ arthroplasty seems best reserved as a salvage of Darrach or Sauvé-Kapandji procedures when persistent pain can be clearly related to radioulnar impingement and instability is not a problem. Therefore, we would offer this patient a distal ulna resection as a primary procedure. We favor a minimal resection of the distal ulna based on data that suggest this will limit symptomatic instability of the distal ulnar stump.

### REFERENCES

1. McKee MD, Richards RR. Dynamic radio-ulnar convergence after the Darrach procedure. *J Bone Joint Surg* 1996;78B:413-418.
2. De Witte PB, Wijffels M, Jupiter JB, Ring D. The Darrach procedure for post-traumatic reconstruction. *Acta Orthop Belg* 2009;75:316-322.
3. Watson HK, Gabuzda GM. Matched distal ulna resection for post-traumatic disorders of the distal radioulnar joint. *J Hand Surg* 1992;17A:724-730.
4. Tulipan DJ, Eaton RG, Eberhart RE. The Darrach procedure defended: technique redefined and long-term follow-up. *J Hand Surg* 1991;16A:438-444.
5. DiBenedetto MR, Lubbers LM, Coleman CR. Long-term results of the minimal resection Darrach procedure. *J Hand Surg* 1991;16A:445-450.
6. Mansat P, Ayel JE, Bonneville N, Rongieres M, Mansat M, Bonneville P. Long-term outcome of distal ulna resection-stabilisation procedures in post-traumatic radio-ulnar joint disorders. *Orthop Traumatol Surg Res* 2010;96:216-221.
7. af Ekenstam F, Engkvist O, Wadin K. Results from resection of the distal end of the ulna after fractures of the lower end of the radius. *Scand J Plast Reconstr Surg* 1982;16:177-181.
8. Field J, Majkowski RJ, Leslie IJ. Poor results of Darrach's procedure after wrist injuries. *J Bone Joint Surg* 1993;75B:53-57.
9. Carter PB, Stuart PR. The Sauvé-Kapandji procedure for post-traumatic disorders of the distal radio-ulnar joint. *J Bone Joint Surg* 2000;82B:1013-1018.

10. George MS, Kiefhaber TR, Stern PJ. The Sauvé-Kapandji procedure and the Darrach procedure for distal radio-ulnar joint dysfunction after Colles' fracture. *J Hand Surg* 2004;29B:608–613.
11. Voche P, Van Overstraeten L, Merle M. Correction of posttraumatic disorders of the distal radio-ulnar joint with the Sauvé-Kapandji surgical procedure [in French]. *Rev Chir Orthop Reparatrice Appar Mot* 1993;79:464–472.
12. De Smet LA, Van Ransbeeck H. The Sauvé-Kapandji procedure for posttraumatic wrist disorders: further experience. *Acta Orthop Belg* 2000;66:251–254.
13. Daecke W, Martini AK, Schneider S, Streich NA. Amount of ulnar resection is a predictive factor for ulnar instability problems after the Sauvé-Kapandji procedure: a retrospective study of 44 patients followed for 1–13 years. *Acta Orthop* 2006;77:290–297.
14. van Schoonhoven J, Fernandez DL, Bowers WH, Herbert TJ. Salvage of failed resection arthroplasties of the distal radioulnar joint using a new ulnar head prosthesis. *J Hand Surg* 2000;25A:438–446.
15. Willis AA, Berger RA, Cooney WP III. Arthroplasty of the distal radioulnar joint using a new ulnar head endoprosthesis: preliminary report. *J Hand Surg* 2007;32A:177–189.

## JOURNAL CME QUESTIONS

### Distal Radioulnar Joint Reconstruction After Fracture of the Distal Radius

When comparing the Sauvé-Kapandji procedure to the Darrach resection, which outcome measurement is superior?

- a. Range of motion
- b. Mayo wrist score
- c. Arm-specific disability (DASH score)
- d. Constant score
- e. None of the above

What is the current indication for prosthetic replacement of the distal ulna?

- a. Salvage for failed Darrach or Sauvé-Kapandji procedure
- b. Distal radioulnar joint instability
- c. Distal radioulnar joint arthritis following wrist fracture
- d. Ulnar translocation after Darrach resection
- e. Inflammatory distal radioulnar joint arthritis at the time of wrist replacement

To take the online test and receive CME credit, go to <http://www.assh.org/professionals/jhs>.