Ulnar Stump Instability After Darrach Procedure For Post-Traumatic Wrist Disorders

*D. L. Alagar ***, T.R. Kiefhaber **, P.J. Stern **

*From the Department of Orthopedics, University of Cincinnati Medical Center, Cincinnati OH, USA

**From the Hand Surgery Specialist, Cincinnati, OH, USA

***From the Hand Surgery Service, Philippine Orthopedic Center, Quezon City, Philippines*

ABSTRACT

Purpose: Ulnar stump instability after a Darrach procedure may be difficult to treat . The purpose of this study is to determine the incidence, predisposing factors, and treatment outcome of this complication in patients with post-traumatic wrist disorders.

Method: A retrospective chart review of 90 consecutive patients who underwent Darrach procedure from 1991 to 2001 was carried out . Office and surgical records were reviewed to determine demographic data, previous treatments, operative details, postoperative complications, and management of complications . Pre- and postoperative radiographs were evaluated for antero-posterior subluxation of the ulnar stump and radio-ulnar convergence.

Results: There was an 18% (16/90) incidence of ulnar stump instability after the Darrach procedure; 10 patients with antero-posterior instability (API) and 6 with radio-ulnar impingement (RUI) . No statistically significant differences were noted in the incidence of this complication between those who were less than 45 years old at time of surgery and those older (p=0.069), those more than 1.5 cm bone resected and those less than 1.5 cm bone resected (p=0.109), those who had previous surgery on the involved wrist and those who had none (p=0.179), and those who had other concurrent wrist procedure and those who only had the Darrach procedure (p =0.954). Nine of 10 patients with API had their symptoms controlled with non-surgical treatment alone, and one patient who underwent stabilization of the ulnar stump reported improved symptoms . In contrast, 2 of 6 patients with RUI improved with non-surgical management and only 1 of 4 improved following ulnar stump stabilization.

Conclusion: Younger age (less than 45 years old) at surgery showed a trend towards stump instability (p=0.069). More than 1.5 cm of ulna resected, previous surgery, and additional surgery done in combination with Darrach procedure, did not appear to predispose patients to ulnar stump instability . Between API and RUI , the former appears to have a better prognosis.

Keywords: antero-posterior instability, Darrach procedure, post-traumatic, radio-ulnar impingement, ulnar stump instability

Running head: Instability after Darrach procedure

Distal ulnar resection was one of the first successful treatments for derangements of the distal radio-ulnar joint after traumatic wrist injuries. It has been used for treatment of instability, arthritis, and ulnar abutment. Since the description by William Darrach in 1912, several studies have been published describing the technique and its clinical outcome. Early reviews showed satisfactory results with marked pain relief and improved range of motions (1,2,3,4,5,6). However, later studies have not shown the same trend (7,8), with complications (ulnar impingement syndrome, algodystrophy) contributing to poor results (9,10). Modifications to the procedure (11,12,13,14,15,16) and less radical surgical alternatives (17,18,19,20,21) have since come out .

Ulnar stump instability is frequently seen after a Darrach procedure . This manifests either as an antero-posterior instability (API) (14,22,23) or a radio-ulnar impingement (RUI) (5,9,10,24) . Its clinical presentation varied from a mild "click"

to a severe disabling pain on the distal forearm on gripping or forearm rotation. Additional surgery to stabilize the ulnar stump have not consistently improved the symptoms and clinical outcome (11,25,26,27,28,29,30) .

Several authors have attempted to identify the factors that predispose to postoperative ulnar stump instability . Conflicting views have been reported on the influence of ulnar length resection . Hartz and Beckenbaugh found no correlation between residual length and symptomatic ulnar stump instability (5). However , more recent series suggest higher risk with more than necessary ulnar length resection (10,14,24) . Age at the time of surgery and joint laxity have also been mentioned to possibly play a role in its development (9,22) . Careful patient selection , strict adherence to the original technique ,and adjunctive soft tissue reconstructions are just some of the recommendations found in the literature to prevent this complication.

This study was undertaken to determine the incidence of ulnar stump instability following the Darrach procedure for post-traumatic wrist disorders, identify predisposing factors, and assess the outcome of its treatment.

MATERIALS AND METHODS

Between January 1991 and December 2001, 90 patients with post-traumatic derangement of the distal radio-ulnar joint were treated with a Darrach procedure. Office notes and surgical records were reviewed, and available radiographs of the wrist and forearm were evaluated. There were fifty-nine females and thirty-one males, with an average age of 60 years at the time of surgery (range 17 years –81 years). Occupations varied , most engaged in light manual jobs (70%) and the rest were heavy manual laborers . The majority of the initial injuries (76) were Colles' fractures sustained after a fall (84%), with the remaining divided among motor accidents (7), gunshot wound (2), twisting (3), and sudden heavy lifting injuries (2) . The dominant hand was involved in 44 patients (49%). Common indications for surgery included ulnar impaction syndrome, distal radio-ulnar joint arthritis, wrist arthritis, among others (Table 1). The average time from injury to surgery was 24 months (range 1 month – 25 years) .

The procedure consisted mainly of resection of the ulnar head at the level of the proximal sigmoid notch, beveling of the dorsal cortical surface of the ulna, and imbrication of the dorsal capsule. Additional soft tissue reconstructions to prevent ulnar stump instability were not performed on any of these patients. Half of the cases (45 patients) had other wrist procedures done in combination with the Darrach resection (Table 2). Follow-up averaged 22 months (range 6 months - 144 months) with 33 patients having more than five years follow-up. Forty-seven patients had previous surgical procedures done on the involved wrist (Table 3).

Seventy-six patients (84%) had acceptable wrist and forearm radiographs available for evaluation. X-ray evaluation included measurement of postoperative ulnar variance, and identification of postoperative dorsal subluxation of the ulnar stump and radio-ulnar covergence. Postoperative dorsal subluxation of the ulnar stump on the zero-rotation lateral view of the wrist was defined as greater than 25% of the ulnar stump being dorsal to the dorsal cortex of the radius. This was interpreted as indicative of API of the stump (Figure 1) . Signs of RUI included scalloping and subchondral sclerosis over the ulnar side of the radius at the level of the stump, as well as the presence of radio-ulnar convergence on grip loaded postero-anterior view of the wrist (Figure 2). The presence of radiographic findings of ulnar stump instability without documented clinical symptoms was not considered a complication.

RESULTS

Sixteen patients (18%) experienced clinically significant symptoms of ulnar stump instability. Documented physical examination and radiographic findings confirmed the diagnosis. Initial treatment consisted of non-surgical measures including muscle strengthening exercises, bracing , and anti-inflammatory medication . The decision to proceed with surgery was made by the patient and the attending physician after no improvement of symptoms with conservative measures.

Anterior -Posterior Instability (API)

Ten of the 18 patients with ulnar stump instability showed signs and symptoms of API (Table 4). They complained of a "clicking" pain on the distal forearm with rotational movements. Lateral view radiographs of the wrist showed dorsal subluxation of the ulnar stump. Nine responded favorably to non-surgical measures with only one patient requiring additional surgery. Flexor and extensor carpi ulnaris tenodeses for ulnar stump stabilization was performed. All patients improved at an average follow-up of 56 months (range 8months-114 months).

Radio-Ulnar Impingement (RUI)

The remaining 6 patients with ulnar stump instability showed signs and symptoms of RUI (Table 5). They complained of "bone to bone rubbing" associated with severe pain at the distal forearm with gripping activities. Radio-ulnar convergence was noted on posterior-anterior dynamic view of the wrist. Only two patients responded favorably to non-surgical measures with 4 requiring surgical intervention. Surgery performed included further ulnar bone shortening in one patient , ulnar shortening with tenodesis in two patients , and revision of stump in another. Unfortunately, only one had significant improvement after the second procedure. The mean duration of follow-up was 41 months (range 12 months-97 months).

Data on patient age, amount of ulnar bone resected (reflected by post-Darrach procedure ulnar variance), previous surgery, and other surgery done in combination with Darrach procedure, were subjected to statistical analysis (MINITAB Inc. in State College,PA) (Table 6). There were 41 patients who were less than 45 years old at time of surgery, 10 of whom had complications. On the other hand, there were 49 patients who were at least 45 years old, 6 of whom had complications. Statistically, there was no significant difference in the incidence of ulnar stump instability between the two groups ($p=0.069$) although there was a trend towards instability in the younger set of patients. With respect to the amount of ulna removed, there were 36 patients who had less than 1.5 cm bone resected with 5 having complications. And there were 31 patients who had at least 1.5 cm of bone resected, 8 of whom had complications ($p=0.109$). With respect to previous surgery, 47 patients had previous procedure done with 10 having complications. Forty-three patients had no previous surgery with 6 having complications ($p=0.179$). There was also no statistical evidence to suggest that doing other wrist surgery in combination with Darrach procedure leads to increased incidence of instability ($p =0.954$). Surprisingly, there were more complications in those who had no combination surgery (11 / 45) than those who had (5 / 45).

Other than the synostosis and reflex sympathetic dystrophy which both occurred in one patient with an old malunited Colles' fracture, no other complications were recorded.

DISCUSSION

The numerous procedures found in the literature addressing ulnar stump instability after distal ulnar resection is a testament to its common occurrence and difficulty in treatment .Surgical procedures for ulnar stump stabilization ranged from soft tissue reconstructions using tendons and muscles , to salvage procedures like further ulnar bone shortening and radio-ulnar fusion. None of these have consistently provided satisfactory results.

Antero-posterior instability has been described as the migration of the ulnar stump during muscle contraction in either the volar or dorsal direction , mostly dorsal . This may fray the overlying soft tissues and manifests as a catching or clicking of the distal forearm during rotation or gripping motions. Many previous reports imply that API is common but usually asymptomatic (5,8,13) . Since our study looked only into complications, asymptomatic patients were excluded. Despite this, surprisingly, a significant number of cases were identified.

Radio-ulnar impingement refers to the rubbing of the ulnar stump on the distal radius usually on gripping motion. This has been described as more disabling than the API (9) . Although our series had fewer patients with RUI compared to those with API , they presented with more symptomatic complaints.

Successful treatment for ulnar instability was defined in this study as the patient reporting minimal to no symptoms and no requirement for further medical treatment . In this regard, patients with API had a much better outcome than those with RUI . Nine of 10 patients with API had symptoms relieved with non-surgical measures and only one required additional surgery. In contrast , only two patients with RUI had symptoms controlled by non-surgical measures. Four impingement patients required surgical intervention with only one having symptomic improvement after surgery.

We attempted to identify factors that may place a patient at risk for developing ulnar stump instability. Young age at surgery has been mentioned in the literature (9,22) . Bieber et.al. have suggested that patients less than 45 years old at the time of surgery especially those with lax ligamentous habitus have the greatest risk of developing this complication (22) . In this series, there was a trend towards post-Darrach instability in patients less than 45 years old but it did not reach statistical significance (p=0.069). None of those with instability had any history of joint laxity or connective tissue disease as well. Some authors have also implied that instability is caused by excessive ulnar resection (10,14,24) . Again, this was not evident in the present study. As reflected by post-Darrach procedure ulnar variance , both patients with and without instability had an average of 1.3 cms of ulna resected. Our analysis also did not show any statistical difference in complications comparing those who had less than 1.5 cm negative variance post-Darrach to those more than 1.5 cm negative variance.

Anatomic changes secondary to previous surgery or other wrist procedures concomitant with the Darrach procedure could have altered the integrity of the remaining ulnar stabilizers and increased the risk of developing ulnar stump instability. However, this was not proven in our series. The incidence of instability was not significantly different between those with and without previous surgery, as well as between those with and without combination surgery.

REFERENCES

1. Boyd HB, Stone MM. Resection of the distal end of the ulna. J Bone Joint Surg 1944; 26:313-21.

2. Dingman PVC. Resection of the distal end of the ulna (Darrach operation). J Bone Joint Surg 1952; 34A: 893-900.

3. Lugnegard H. Resection of the head of the ulna in post-traumatic dysfunction of the distal radio-ulnar joint. Scand J Plast Reconstr Surg 1969;3: 65-9.

4. Kessler I, Hecht O. Present application of the Darrach procedure. Clin Orthop 1970; 72:254-60.

5. Hartz CR, Beckenbaugh RD. Long-term results of resection of the distal ulna for post-traumatic conditions. J Trauma 1979; 19:219-26.

6. Shearman CP. The long-term outcome following Darrach's procedure for complications of fractures of the distal radius. Injury 1988; 19: 318-320.

7. 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; 16:177-91.

8. Fraser KE, Diao E, Peimer CA, Sherwin FS. Comparative results of resection of the distal ulna in rheumatoid arthritis and post-traumatic conditions. J Hand Surg 1999 ; 24B:667-670.

9. Bell MJ, Hill RJ, McMurty RY. Ulnar impingement syndrome. J Bone Joint Surg 1985; 67 B: 126-29.

10. Field J, Majkowski RJ, Leslie IJ. Poor results of Darrach's procedure after wrist injuries. J Bone Joint Surg 1993 ; 75B:53-7.

11. Breen TF, Jupiter JB. Extensor carpi ulnaris and flexor carpi ulnaris tenodesis of the unstable distal ulna. J Hand Surg 1989; 14 A:612-17.

12 Dibenedetto MR, Lubbers LM, Coleman CR. Long-term results of the minimal resection Darrach procedure. J Hand Surg 1991;16A: 445-50.

13. Nolan III WB, Eaton RG. A Darrach procedure for distal ulnar pathology derangements.Clin Orthop Rel Research 1992; 275:85-89.

14. Tulipan DJ, Eaton RG, Eberhart RE. The Darrach procedure defended: Technique redefined and long-term follow-up. J Hand Surg 1991 ;16A: 438-44.

15. Tsai TM, Shimizu H, Adkins P. A modified extensor carpi ulnaris tenodesis with the Darrach procedure. J Hand Surg 1993;18A:697-702.

16. Sotereanos DG, Leit ME. A modified Darrach procedure for treatment of the painful distal radio-ulnar joint. Clin Orthop Rel Research 1996;325:140-47.

17. Darrow JC, Linscheid RL, Dobyns JH , Mann JM, Wood MB, Beckenbaugh RD. Distal ulnar recession for disorders of the distal radio-ulnar joint. J Hand Surg 1985;10:482-91.

18. Bowers WH. Distal radio-ulnar arthroplasty: the hemiresection-interposition technique. J Hand Surg 1985;10A:169-78.

19. Kapandji IA.The Kapandji-Sauve operation: Its techniques and indications in non-rheumatoid disease. Ann Chir Main 1986;5:181-193.
20. Feldon P, Terrono AL, Belsky MR. The "Wafer" Procedure. Clin Orthop 1992; 275:124-9.
21. Watson HK, Gabuzda GM. Matched distal ulna resection for post-traumatic disorders of the distal radio-ulnar joint. J Hand Surg 1992;17A:724-30.
22. Bieber EJ,Linscheid RL, Dobyns JH, Beckenbaugh RD.Failed distal ulna resections. J Hand Surg 1988;13A:193-200.
23. Lichtman DM, Ganocy TK, Kim DC. The indications for and techniques and outcomes of ablative procedures of the distal ulna. Hand Clinics 1998; 14:265-77.
24. McKee MD, Richards RR. Dynamic radio-ulnar convergence after the Darrach procedure. J Bone Joint Surg 1996;78B:413-8.
25. Kleinman WB, Greenberg JA.Salvage of the failed Darrach procedure. J Hand Surg 1995;20A:951-58.
26. Noble J, Arafa M. Stabilisation of distal ulna after excessive Darrach procedure. The Hand 1983; 15 :70-72.
27. Schneider LH, Imbriglia JE. Radio-ulnar fusion for distal radio-ulnar joint instability. Hand Clinics 1991;7:391-95.
28. Sotereanos DG, Gobel F, Vardakas DG, Sarris I. An allograft salvage technique for failure of the Darrach procedure: A report of four cases. J Hand Surg 2002; 27B:317-21.
29. Watson HK, Brown RE. Ulnar impingement syndrome after Darrach procedure:Treatment by advancement lengthening osteotomy of the ulna. J Hand Surg 1989;14A:302-6
.30. Wolfe SW, Mih AD, Hotchkiss RN , Culp RW, Kiefhaber TR, Nagle DJ. Wide excision of the distal ulna: A multi center case study. J Hand Surg 1998;23A:222-228.

FIGURE LEGENDS

Figure 1. *Lateral view radiograph of the wrist showing dorsal subluxation of the ulnar stump indicative of antero-posterior instability.*

Figure 2. *Postero-anterior view radiograph of the wrist showing scalloping on the distal radius opposite the ulnar stump with radio-ulnar convergence suggestive of radio-ulnar impingement.*

Table 1: Indications for surgery

Ulnar abutment syndrome	28
Distal radio-ulnar joint arthritis	26
Arthritis	12
Radius malunion	9
Radius nonunion	7
Distal radio-ulnar joint instability	5
Failed Sauve-Kapandji procedure	2
Failed hemi-resection arthroplasty	1
Total	90

Table 2: Surgeries done in combination with Darrach procedure

Radius osteotomy	13
Wrist fusion	13
Removal of radius plate	5
Carpal tunnel release	4
Tenolysis	3
Tendon transfer	3
Capsulotomy	2
Total	45

Table 3: Previous surgical procedures

External fixation w/ bone grafting	16
Percutaneous pin fixation distal radius	7
Radius plating	6
Wrist fusion	4
Four-corner fusion	3
TFCC debridement	2
Sauve-Kapandji procedure	2
Intercarpal fusion	2
Proximal row carpectomy	2
Ulnar shortening	1
Hemiresection with interposition of tendon	1
Total	47

Table 4: Summary of cases with antero-posterior instability

	Gender	Age (years)	Occupation	Indication for surgery procedures	Additional after Darrach (cms)	Ulnar Variance
1.	F	35	none	Ulnar abutment	no	-1
2.	F	38	Housekeeper	DRUJ arthritis	removal of plate	-1.5
3.	M	43	Machine optr	Ulnar abutment	no	-1.5
4.	F	39	Binder	Ulnar abutment	no	-1
5.	F	43	Mail carrier	DRUJ arthritis	no	n/a
6.	M	49	Refrig. tech.	Ulnar abutment	no	-1.5
7.	F	64	Fitness instr	Ulnar abutment	no	-1.5
8.	M	23	Carpenter	Wrist arthritis	wrist fusion	-1
9.	F	60	Analyst	Failed HIT	no	--1.5
10.	F	46	Machine optr	Ulnar abutment	no	-1.5
Average		48				- 1.33

DRUJ=distal radio-ulnar joint, Optr=operator, HIT=hemiresection with interposition of tendon

Continuation of Table 4

	Subluxation on X-ray	Treatment	Outcome	Follow-up (months)
1	yes	Therapy	Improved	8
2.	no	Therapy	Improved	107
3.	no	Therapy	Improved	57
4.	no	Therapy	Improved	78
5	yes	FCU,ECU tenodesis	Improved	81
6.	no	Therapy	Improved	10
7.	no	Therapy	Improved	95
8.	no	Therapy	Improved	15
9.	no	Therapy	Improved	114
10.	no	Therapy	Improved	35
Average				60

FCU=flexor carpi ulnaris, ECU=extensor carpi ulnaris

Table 5: Patients with ulnar impingement

Gender/ Age (years)	Occupation	Indication for Surgery Procedure	Additional Procedure	Variance after Darrach (cms)	Treatment	Outcome	Follow-up (mos.)
M/43	Carpenter	DRUJ arthritis	no	n/a	Tenodesis, shortening	Not improved	97
M/52	Mechanic	DRUJ instability	no	-2.3	Therapy	Improved	27
M/62	Laborer	DRUJ arthritis	no	n/a	Revision of stump	Not improved	33
M/35	Janitor	Ulnar abutment	no	-1.5	Tenodesis, shortening	Not improved	21
M/29	Janitor	DRUJ instability	no	-0.7	Therapy, splint	Improved	54
F/38	Sales	Radius malunion	radius osteotomy	-1	Shortening	Improved	12
Average	43			-1.37			41

n/a= not available

Table 6: Statistical Analysis on Predisposing Factors

Factor		W/ Instability	W/O Instability	Statistical Values
Age	<45 Y/O	10	31	
	45 Y/O & older	6	43	p = 0.069
Length Removed	<1.5 cms	5	31	
	1.5 cms & longer	8	23	p = 0.109
Previous Surgery	With	10	37	
	Without	6	37	p = 0.179
Combined Surgery	With	5	40	
	Without	11	34	p = 0.954

Standard normal test for comparing 2 proportions
Level of significance = 0.05

Correspondence:
Dr. Peter J. Stern
University of Cincinnati, Dept. of Orthopaedics, P.O. Box 670-212, Cincinnati, OH, USA, 45267-0212
Phone: (513) 558 2220
Fax: (513) 558 4592
Email: Pstern@handsurg.com