



Long term results after bipolar radial head arthroplasty

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Radial head fractures are common injuries, occurring mostly in active young people 85%. Treatment of the more complex radial head fractures (Mason type III and IV), appear to be challenging and remain a subject of controversy. Replacement of the radial head with a metal prosthesis imitates the stabilizing role of the radial head and has been considered as the treatment of choice. However, long-term results are scarce. We report our mid to long-term (mean 9.4 year) clinical and radiographic results after insertion of a Judet Bipolar Radial Head prosthesis.

34 patients were treated with the Judet Bipolar Head prosthesis between 2000 and 2008. In this study, 21 patients were re-examined after a mean period of 113 months (range, 174-84), ie, 9.4 years (range, 14.5-7). Follow-up examinations included both the Mayo Elbow Performance Index (MEPI) and Disabilities of the arm, shoulder and hand (DASH) score. Range of motion was measured with a hand goniometer. X-rays were evaluated for peri-articular ossifications, radiolucent lines and signs of proximal erosion, capitellar erosion.

Mean Mayo Elbow Performance Index was 88.6 (Range 100-50). According to the MEPI score we had 14 excellent, 1 good, 5 fair results and one poor result. One patient reported severe pain, 3 patients reported moderate pain, one patient reported mild pain and 16 patients reported no pain at all.

Difference between pronation-supination range was noted between primary or secondary indication of the

radial head, no other significant differences were found.

Mean DASH score was 23.1° (Range 0-63) without difference between primary and secondary indication.

Mean flexion was 121.8° (Range : 110-140), mean extension deficit was 24.8° (Range 15-40), mean pronation was 62.4° (Range : 50-80) and supination 58.8° (Range : 45-80).

Ten patients showed signs of ulnohumeral joint degenerative arthritis. One patient developed symptomatic ulna plus.

One patient showed radiolucent lines surrounding the prosthesis with proximal bone erosion. There were no reports of dislocations of the prosthesis. One case of radiological signs of overlengthening was noted.

Mainly good clinical results are achieved with the Judet bipolar radial head implant. Functional results after long term follow-up are, however less optimistic

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then the excellent results achieved after short- to mid-term follow-up. No clear link between radiological signs and functional results can be found.

Keywords : radial head prosthesis ; judet.

INTRODUCTION

Radial head fractures are common injuries, they represent up to 1.7-5.4% of all fractures and 33% of all elbow fractures (9,10,15,16). Occurring mostly in active young people 85% the main mechanism is a fall onto an outstretched hand with the forearm in supination and the elbow in extension (9,10,15).

Strategy of treatment is based on the widely used Mason classification modified by Johnston (15) and Broberg Morrey (6,18). Treatment of the more complex radial head fractures (Mason type III and IV), appear to be challenging and remain a subject of controversy (3,11). Most type III and IV fractures are caused by high-energy trauma, they are often accompanied by ligament injuries. In these cases the radial head becomes the primary stabilizer of the joint (2,23,26).

Open reduction and internal fixation (ORIF) should be considered when encountering these fractures whenever possible in order to restore stability and anatomy of the elbow joint. ORIF can be a challenge in severely comminuted fractures. When stable fixation cannot be achieved, complications as non-union, limited forearm rotation and necrosis of the bone fragments might occur (20,21).

Alternate options when stable fixation cannot be achieved are radial head resection and radial head replacement. For a long time, radial head excision was the recommended type of treatment, but post-operative complications were frequent (2). If excision of the radial head is performed, this will lead to proximal radial migration and valgus instability, when accompanied by soft tissue damage. This will lead to a variety of symptoms such as pain, weakness, cubitus valgus, ulnar nerve neuritis, instability of the elbow and wrist problems (5,24,25,27). Replacement of the radial head with a metal prosthesis imitates the stabilizing role of the radial head (i.e. varus-valgus and axial fore-arm stability) and has

been considered as the treatment of choice. By conserving the stability of the elbow joint, the previously mentioned complications can be prevented (1,4,7,8,17,19,22,28). Despite complications such as stem loosening, radiocapitellar erosion, radiolucent lines, heterotopic ossification and osteoarthritis, the clinical and radiographic short-term (< 5 yrs) and mid-term (5-10 yrs) results of radial head arthroplasty are promising (1,4,5,8,17,20,21). However, long-term results are scarce. We, hereby, report our mid to long-term (mean 9.4 year) clinical and radiographic results after insertion of a Judet Bipolar Radial Head prosthesis.

MATERIALS AND METHODS

In our department, 34 patients were treated with the Judet Bipolar Head prosthesis between 2000 and 2008. In this study, 21 patients were re-examined after a mean period of 113 months (range, 174-84), ie, 9.4 years (range : 14.5-7). Prosthetic replacement was mostly performed as primary treatment method for comminuted fractures of the radial head and sometimes after primary osteosynthesis or radial head resection. Fourteen prostheses were placed primarily, 3 were placed after radial head resection and 1 after failed osteosynthesis. Two prostheses were placed after failure of a primary radial head prosthesis and one for destruction of the radial head caused by rheumatoid arthritis.

Of the 14 fractures (primary indication), 7 were classified as Masson III, 7 were classified as Masson IV with dislocation of the elbow joint. According to the Regan and Morrey classification there were 4 type I, 2 type II and 2 type III fractures of the coronoid. There was one radial head fracture associated with an open fracture-dislocation of the proximal humerus (Gustillo type II open fracture).

After approval by the ethics committee of the University Hospital of Antwerp (B300201523719), an informed consent was presented to each patient and subsequently signed. Antero-posterior (AP) and lateral X-rays of the elbow were made and follow-up examinations were performed.

Follow-up examinations included both the Mayo Elbow Performance Index (MEPI) and Disabilities of the arm, shoulder and hand (DASH) score. The MEPI score has a maximum of 100 points : pain (45 points), range of motion (20 points), stability (10 points), and function (25 points) are evaluated. The DASH score has a set of 30 questions concerning functional performance of the

patient. All patients completed the entire set of 30. Range of motion was measured with a hand goniometer.

X-rays were evaluated for peri-articular ossifications according to the Hastings and Graham classification for heterotopic ossification of the upper-limb (14). Furthermore, we evaluated the X-rays for radiolucent lines and signs of proximal erosion, capitellar erosion and suboptimal placement of the Judet implant.

Hastings and Graham classification :

Class I : Without functional impairment

Class II : subtotal limitation

Class IIA : limitation flexion / extension

Class IIB : limitation pro/supination

Class IIC : limitation both planes

Class III : complete bony ankylosis

Degenerative changes of the capitellum :

Grade I : Increased subchondral density

Grade II : Mild erosion

Grade III : Severe erosion

Degenerative changes of the ulnohumeral joint :

Grade I : Increased subchondral density

Grade II : Joint space narrowing

Grade III : Severe changes/ankylosis

RESULTS

Mean Mayo Elbow Performance Index was 88.6 (Range 100-50). According to the MEPI score we had 14 excellent, 1 good, 5 fair results and one poor result. One patient reported severe pain, 3 patients reported moderate pain, one patient reported mild pain and 16 patients reported no pain at all. Difference between pronation-supination range was noted between primary or secondary indication of the radial head (Table I), no other significant differences were found.

Mean DASH score was 23.1° (Range 0-63) without difference between primary and secondary indication. Mean flexion was 121.8° (Range : 110-140), mean extension deficit was 24.8° (Range 15-40), mean pronation was 62.4° (Range : 50-80) and supination 58.8° (Range : 45-80).

Table I. — Results of primary and secondary indications of the Judet radial head prosthesis

	Primary (n=14)	Secondary (n=7)	P-Value
MEPI	89.3	87.1	0.40
DASH	20.3	32.6	0.25
Flexion	127.3	122	0.20
Extension	23.2	28.3	0.11
Pronation	67.1	53.3	0.04
Supination	66.5	41.7	0.02

Fourteen patients showed radiological signs of capitellar erosion. One was minor, showing only increased subchondral density. 7 Patients showed mild erosion on X-ray of whom only one was symptomatic. The remaining 6 patients showed signs of major erosion of whom 3 were symptomatic. Of the fourteen patients with capitellar erosion, 4 indicated pain on the MEPI score. All 4 patients with pain showed radiological signs of ulnohumeral joint degeneration, showing moderate to severe joint narrowing.

Ten patients showed signs of ulnohumeral joint degenerative arthritis. (I:1 II:6 III:3). One patient had a radial head replacement for destruction of the radial head caused by rheumatoid arthritis (Fig. 1). She happened to be our longest follow-up of 174 months, indicating no pain and having almost perfect range of motion. She did show signs of severe capitellar erosion and ulnohumeral joint narrowing.

One patient developed symptomatic ulna plus. This patient decided to be treated conservatively. 3

One patient showed radiolucent lines surrounding the prosthesis with proximal bone erosion (Fig. 2). This patient was treated with resection of the radial head prosthesis. There were no reports of dislocations of the prosthesis. One case of radiological signs of overlengthening was noted. This patient was symptomatic with a MEPI score of 50 and a DASH score of 63. No radiological signs of capitellar erosion were seen with this patient.

Table II shows the summary of our results (Table II).

The radial head prosthesis was implanted because of a Mason IV fracture of the radial head.

Table II. — Results of our long-term follow-up of the Judet radial head prosthesis

Nr	Age	F/U	Indication	S	Mayo	DASH	Flex	Ext	Pro	Sup	Pain	Cap	Cor	UHJ	HO	RLL	Extra
1	64	174	RA	V	100	5	140	15	70	80	No	III	N/A	II	0	0	
2	65	171	Mason 3	M	100	5.83	130	20	60	70	No	0	0	0	I	0	
3	39	153	Mason 3	M	85	3.33	130	25	80	50	Mild	0	0	0	0	0	Associated wrist fracture
4	48	139	Revision RH	V	65	65	120	30	60	60	Mod	0	0	0	0	0	
5	76	138	Mason 3	V	100	2.5	140	30	80	80	No	III	0	0	0	0	
6	72	136	Mason 4	M	100	0.83	140	20	60	50	No	II	1	0	II	0	
7	47	134	Revision RH	M	100	3.33	130	25	60	70	No	0	0	0	0	0	
8	35	124	Mason 4	M	100	8.33	120	20	80	45	No	II	1	II	0	0	
9	47	110	Mason 4	M	70	47.5	120	20	60	70	Mod	III	0	III	IIA	0	
10	64	105	Mason 4	M	65	62.5	120	35	60	80	Mod	II	2	III	IIA	0	Open fracture Gustilo II
11	46	103	Mason 4	M	95	27.5	110	35	25	30	No	N/A	3	N/A	IIC	0	Conversion to total elbow replacement
12	49	101	Mason 4	M	100	0	120	20	60	60	No	II	3	II	I	0	
13	38	100	Mason 4	M	100	15	130	15	70	80	No	III	2	0	I	0	
14	40	91	Mason 3	M	100	2.5	140	25	80	60	No	II	0	0	0	0	
15	48	89	Mason 3	M	100	5	130	20	80	80	No	0	0	0	0	0	
16	58	89	Revision RHOS	V	100	5	120	20	70	40	No	II	0	II	0	0	
17	66	87	Revision RHR	V	65	57.5	130	35	50	70	No	III	0	III	IIC	0	Ulna plus, symptomatic
18	49	85	Mason 4	M	65	61.7	100	30	30	50	No	III	1	II	IIC	1	Revised to resection RH
19	60	84	Revision RHOS	M	100	7.5	120	20	60	20	No	II	0	0	IIB	0	
20	61	84	Revision RHR	V	100	35	130	20	65	50	No	I	0	I	0	0	
21	46	84	Revision RH	V	50	63.33	110	40	50	40	Sev	0	1	0	0	0	Overstuffing

F/U : months follow-up ; cap : capitellar erosion ; Cor : coronoid fracture ; UHJ : ulnohumeral joint arthritis ; HO : heterotopic ossification ; RLL : radiolucent lines.

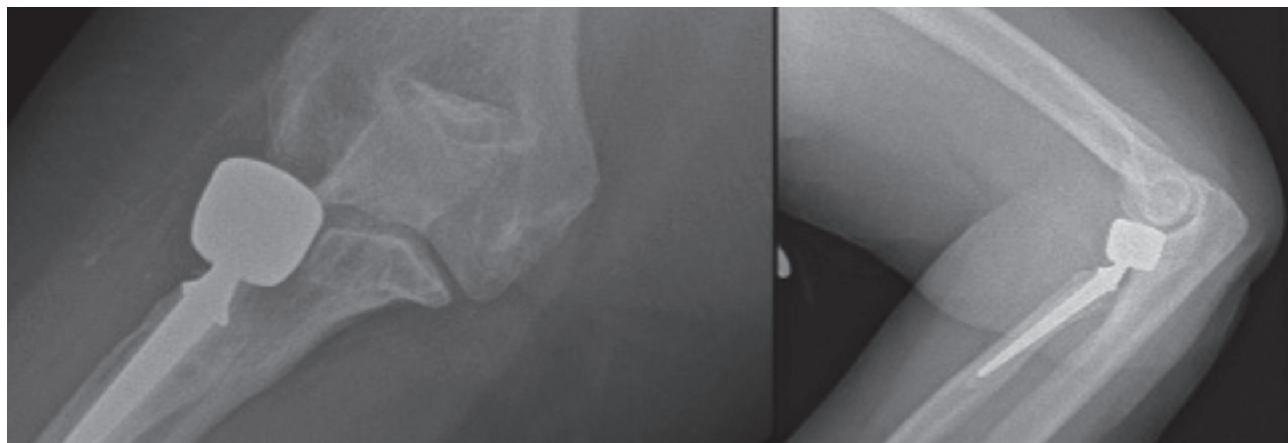


Fig. 1. — Patient with 174 month follow-up, 66 year old female with rheumatoid arthritis. Note the significant, though asymptomatic, capitellar erosion pattern.

Significant capitellar erosion and radiolucent lines were noted on the X-ray. He had radiological signs of third degree ulnohumeral osteoarthritis. The patient was severely limited in activities of daily life. A salvage operation was performed, resecting the radial head prosthesis. Photographs taken during the procedure indicates the level of capitellar erosion. 5 patients had significant capitellar erosion (Fig. 3).

DISCUSSION

Radial head prosthesis has found its place in treatment of complicated radial head fractures. Both monobloc and bipolar metal designs have proven to restore stability in the elbow joint (10,15,16,18).

A specific subgroup of patients showed good results after radial head resection Antuña *et al* (2)

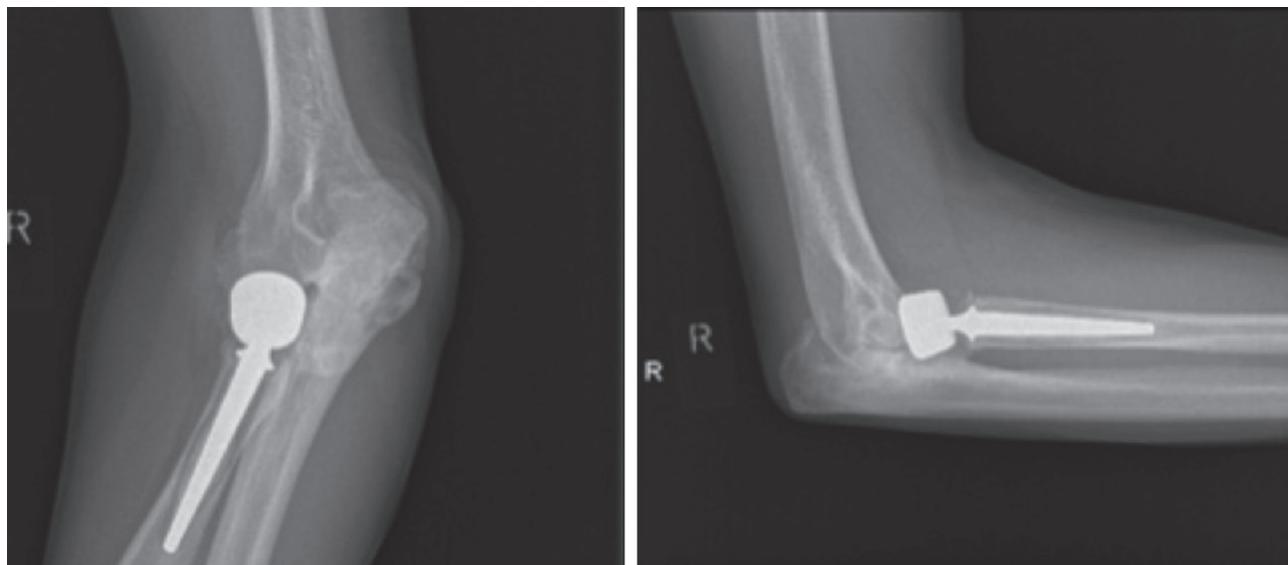


Fig. 2. — Patient with a 85 month follow-up. a 50 year old male, was diagnosed with Class 2C heterotopic ossifications (significant ossifications with impaired function in all movements).

reported good results after radial head resection in young adult patients with an isolated radial head fracture. For the general population though, radial head resection is no longer considered the treatment of choice for irreparable radial head fractures (9, 10,15). Short term results have been reported many times, for both monobloc and bipolar design. Evidence concerning mid- to long-term results remain scarce (7,19). Harrington *et al* (13) reported the longest follow-up of 20 patients with a cemented monobloc design. They reported 12 excellent results, 4 good, 2 fair and 2 poor. In four cases, the implant had to be removed. 8 patients showed radiological signs of heterotopic ossification and all patients demonstrated radiolucent lines around the implant stem (12).

Two studies reported the bipolar cemented radial head design. Popovic *et al* conducted a large survey of 51 patients treated with the Judet bipolar radial head arthroplasty after 8.4 years (19).

They reported 14 excellent, 25 good, 9 fair and 3 poor results according to the Mayo Elbow Performance Index (MEPI) 31 patients showed radiolucent lines on X-ray. Eleven started appearing be-

fore the first postoperative year. The other 16 were progressive, ending in loosening of the prosthesis in 5 cases.

Burkhart *et al* reported results of 19 patients treated with the Judet bipolar design in a 8.8 year follow-up (7). They had 6 excellent, 10 good and one fair result. No poor results were observed. No radiolucent lines were observed in their study. they too used the DASH and MEPI score, observing a score of 9.8 (DASH) and 90.83 (MEPI).

No correlation has been found in past studies between radiolucencies and pain/loss of function (19,22). The observations of Popovic *et al* were interpreted as being the result of the cementing technique since they remained stable after the first post-operative year.

Our study, the longest running follow-up to our knowledge, showed, according to the MEPI score, one poor result. 20 other patients scored fair to excellent. The mean DASH score of 23.1 reflects a good functional result after 9.2 years. Mean MEPI of 88.6 is still regarded as good, though not excellent. DASH scores of 23.1 seem significantly higher than the above mentioned studies. However given

the fact that only 5 of our patients were treated for Mason 3 fractures and all others for complicated lesions such as Mason 4 with dislocations and several revision cases (even one conversion to total elbow prosthesis) one would expect a higher number than the general population which, according to Hunsaker, would score a mean 10.1.

Many radiological signs were found in our X-rays. We only observed one case showing radiolucent lines on X-rays and proximal bone erosion. This observation was recent, ending in loosening of the implant requiring removal. During revision surgery, we saw de visu large capitellar erosions, also evident on X-ray (Fig. 3 and 4).

One case of overlengthening was noted, the patient was symptomatic but without radiological signs of capitellar erosion were seen with this patient. Since only one case of overlengthening was noted, we cannot draw conclusions. Overlengthening of the radius causing 'overstuffing' of the radio-capitellar joint, has been reported to cause loss of elbow flexion, capitellar erosions, pain, and early-onset osteoarthritis (28).

One interesting fact showed up in our results as it did in the previous study of Burkhardt *et al* a large incidence of capitellar erosion and ulnohumeral joint narrowing became apparent. These radiological signs did not seem to translate into symptoms of pain. Even from the patients showing the more severe degenerative capitellar changes, only half indicated pain. However, out of all patients showing capitellar erosion every symptomatic patient had ulnohumeral joint degeneration on X-rays. From a total of 9 patients showing ulnohumeral degeneration we saw 5 patients being asymptomatic. The remaining four patients also showed signs of capitellar erosion.

CONCLUSION

Mainly good clinical results are achieved with the Judet bipolar radial head implant. Functional results after long term follow-up are, however less optimistic than the excellent results achieved after short- to mid-term follow-up. No clear link between radiological signs and functional results can be found.

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