RESEARCH ARTICLE

Radial Head Prosthesis Removal: a Retrospective Case Series of 14 Patients

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Abstract

Background: The purpose of this study was to report the preoperative complaints and postoperative outcome of patients after removal of the radial head prosthesis.

Methods: This is a retrospective review of 14 adult patients (6 females and 8 males) from 2007 to 2011, who underwent radial head prosthesis removal by three surgeons. The average time between implantation and removal was 23 months (range from 2 weeks to 12 years, median 12 months).

Results: The leading reported complaints before removal were restricted mobility of the elbow (active range of motion of less than 100 degrees) in 6, pain in 3, and pain together with restricted mobility in 4 patients. The objective findings before removal were restricted mobility of the elbow in 10 (71%), capitellar cartilage wear, loose implants, and heterotopic ossification each in 8 (57%), subluxation of the radio-capitellar joint or malpositioning of the stem in 5 (36%), and chronic infection in 2 (14%) patients. All patients with pain had wear of the capitellar cartilage on radiographs. The ulnar nerve was decompressed in four patients at the time of removal. Four patients underwent a subsequent operation for postoperative ulnar nerve symptoms 5 to 21 months after removal. Four patients were still complaining about persistent pain at the last follow-up visit. Except two patients, the total range of motion improved with a mean of 34 degrees (range 5 to 70) after a mean follow-up of 11 months.

Conclusions: Removal of radial head prosthesis improved function and lessened pain in our case series. The reoperation rate was yet nearly 30% due to ulnar neuritis. Selective ulnar nerve decompression at the time of removal must be evaluated, especially in patients with expected large gain in range of motion after removal.

Key words: Prosthesis, Radial head, Radial head fracture, Removal

Introduction

Radial head arthroplasty is commonly performed when managing unreconstructible comminuted radial head fractures or less often in the treatment of chronic post-traumatic complications. Thorough preoperative planning, operation, and rehabilitation following radial head arthroplastyhas led to good to excellent results in 50 to 70% of patients in several series (1-4). In contrast, the remainder of patients, roughly 30%, demonstrated fair or poor functional outcome scores with follow-up. This was more likely due to the sequelae of the complex injuries rather than the radial head prosthesis itself (1, 2, 4). Complications, such as limited range of motion, heterotopic ossification (HO) and transient neurologic symptoms were encountered and contributed to negative clinical outcomes. It should be stated that a certain amount of pain as well as stiffness can be expected following these complex injuries, and thus should not be viewed as a complication.

Reported etiologies leading to prosthetic radial head

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Table 1. Overview of patients' details and reason of implantation

ID	Age *	Sex	Side	Reason for implantation	Type	Implant ®	Cemented	Approach	Δ time #
1	51	m	l	head arthritic †	Delayed	ExplorR Biomet	no	lateral	13
2	30	m	l	head arthritic †	Delayed	Evolve Wright Medical	no	lateral	13
3	51	m	r	posterior olecranon fracture dislocation	Acute	rHeadSBi	no	posterior	10
4	61	f	l	elbow dislocation, radial head fracture	Acute	Evolve Wright Medical	no	lateral	0.5
5	65	m	r	loss of fixation, redislocation †	Delayed	Evolve Wright Medical	no	posterior	7
6	45	m	r	radial head fracture	Acute	Silicone ^	yes	lateral	167
7	52	f	l	posterior olecranon fracture dislocation	Acute	Evolve Wright Medical	no	posterior	36
8	52	m	r	pain ‡	Delayed	RHS Tornier	no	lateral	10
9	51	f	r	loss of fixation †	Delayed	ExplorR Biomet	no	lateral	17
10	47	f	l	radial head fracture	Acute	Solar Radial Head Stryker	yes	(lateral) ^	14
11	24	m	r	posterior olecranon fracture dislocation	Acute	Evolve Wright Medical	no	posterior	3
12	60	f	l	radial head fracture	Acute	Evolve Wright Medical	no	lateral	6
13	28	m	r	terrible triad	Acute	Evolve Wright Medical	no	lateral	9
14	59	f	l	terrible triad	Acute	Evolve Wright Medical	no	posterior	22

* at radial head removal (years)

between implantation and removal (months)

† after open reduction and internal fixation of a (complex) radial head fracture

‡ after radial head excision for a comminuted radial head fracture

^ not known due to missing data

m=Male; f=Female; r=Right; l=Left

removal were mechanical or technical issues, namely, prosthesis dislocation, mechanical impingement, overstuffing, or intermittent slippage of the bipolar radial head prosthesis (5-7). Painful loosening and polyethylene wear with painful synovitis were other additional primary concerns (7, 8). Prosthesis removal has also been described as part of elbow contracture release surgery, and following joint infections (9). However, there is a paucity of reported complications following radial head arthroplasty in the literature and a shortage of published reports outlining complications that resulted in implant removal (10).

The purpose of this study was to 1) describe the preoperative complaints, 2) radiographic findings, and 3) postoperative outcome in patients who underwent radial head prosthesis removal.

Methods

A retrospective review of a trauma database was performed from 2007 to 2011. Under an IRB approved protocol, we used billing records to identify adult patients (age 18 or greater) who underwent radial head prosthesis removal as an inclusion criterion. A total of 14 patients including 6 women and 8 men with 14 radial head prostheses met the inclusion criteria and had complete follow-up data. There were no exclusion criteria. Three surgeons performed the prosthesis removals at a single institution.

Right and left elbows were equally involved. In 9 patients, implantation of radial head prosthesis was done in an acute setting (less than one week after trauma), and in five patients arthroplasty was performed in a chronic setting (on average 13 months after trauma, range 7 weeks to 29 years) [Table 1]. The index surgery was performed in our institution in eight patients with a Wright Medical radial head implant (Wright Medical Technology, Arlington, TN). The size of the stem was 5.5 millimeters (mm) in three patients (one with a 20 mm and two with a 22 mm head), 6.5 mm in three patients (one with a 20mm and two with a 26 mm head) and 7.5mm in two cases (22 mm and 26 mm head). All implants were non-cemented. Regarding the prostheses implanted in other institutions, the make of the radial head was specified and recorded; however, the size of stems and heads were unknown [Table 1]. The mean age of the patients was 48 years (range 24 to 65 years) at the time of radial head prosthesis removal. The average time between implantation and removal surgery was 23 months (range 2 weeks to 12 years).

The follow-up period was defined as time between the prosthesis removal surgery and the last outpatient clinic visit. Medical records were retrospectively screened for preoperative and postoperative objective and subjective findings. Stiffness (restricted motion)was considered if the total active range of elbow motion was less than 100° (11). Radiographs were evaluated by four experienced

Table 2. Complaints before radial head prosthesis removal

ID	Pain	Stiffness
1	present	present
2	present	present
3	no	present
4	no	no
5	no	present
6	present	present
7	present	no
8	present	no
9	present	no
10	present	present
11	no	present
12	no	present
13	no	present
14	no	present

surgeons for the presence or absence of an oversized radial head implant, overlengthening, subluxation of the radio-capitellar joint, malposition of the stem, loosening of the prosthesis, osteoarthritis (based on the Broberg and Morrey osteoarthritis scale), HO, and capitellar wear (12-14). We acknowledge the subjectivity of many of these parameters, but these were included based on the authors' consensus. Pre-operative radiographs were unavailable for one patient. The findings for this patient are based solely on the operative notes and postoperative radiographs. To analyze our data, descriptive and bivariate comparative statistical methods were utilized.

Results

Most common clinical complaints prior to removal were pain in 7 and restricted motion of the elbow in 10 patients [Table 2]. Clinical instability was not reported by the patients nor encountered by the three surgeons.

Preoperative radiographs showed 6 prostheses resulting in overlengthening, with two of these due to oversized radial head prosthesis [Table 3]. Other mechanical problems or technical errors including subluxation of the radio-capitellar joint and malpositioning were present in five cases and led to radial head prosthesis removal in less than 14 months. Chronic processes such as loose implants as well as capitellar cartilage wear were each seen in 57% (8/14) based on radiographs. All 7 patients with pain had wear of the capitellar cartilage on radiographs (P=0.005). Radiographic loosening and pain had no statistically significant association (P=0.59). Mild arthritic changes were seen in 50% (7/14) of patients, and moderate changes were noted in 14% (2/14) based on the Broberg and Morrey classification. HO was seen in 57% (8/14), and seven of these were defined as having stiffness, while three patients demonstrated proximal radio-ulnar synostosis.

Mean follow-up was 11 months (range 1.5 months to 2.2 years) [Table 4]. Ten (71%) patients had an

Table 3. Preoperative radiographic findings

ID	Head size	Overlength	Loose	Wear	OA	HO	Miscellaneous
1	adequate	no	present	present	mild	no	
2	adequate	present	present	present	mild	present	
3	adequate	no	present	no	moderate	present	malposition
4	adequate	present	no	no	no	no	subluxation
5	adequate	present	present	no	mild	present	
6*	adequate	no	no	present	no	no	
7	too big	present	present	present	moderate	no	
8	adequate	no	no	present	no	no	malposition
9	too big	no	present	present	mild	present	
10	adequate	present	present	present	mild	no	malposition
11	too big	present	no	no	no	present	subluxation
12	too big	no	no	no	no	present	
13	too big	no	present	present	mild	present	
14	adequate	no	no	no	mild	present	

* No preoperative radiographs available, findings are based solely on the operative notes and postoperative radiographs

OA osteoarthritis, HO heterotopic ossification

Table 4. Postoperative outcome

Pat-ID	Follow-up *	Complications	Complaints at last follow-up	ROM improvement
1	26	UNC, impingement	no more pain	5
2	11		some discomfort	40
3	26	UNC, massive HO	no	55
4	21	UNC	no	70
5	6		no	20
6	1 1/2		some discomfort	30
7	20		aching	15
8	1 1/2		no more pain	0
9	9		pain persistent	0
10	4		no more pain	35
11	9	UNC	no	65
12	10		some discomfort	20
13	1 1/2		no	40
14	6		no	10

* between removal and last outpatient-clinic visit (months)

ROM total range of motion, UNC ulnar nerve compression, HO heterotopic ossification

uneventful follow-up following prosthesis removal. Four patients (29%) underwent a subsequent operation. One patient underwent revision with an anconeus muscle interposition flap as well as ulnar nerve decompression after 5 months for proximal radio-ulnar joint impingement and ulnar neuritis. Three patients developed symptoms of cubital tunnel syndrome 6, 10, and 21 months respectively after removal of their radial head prosthesis and were treated with ulnar nerve decompression. A stable and painless elbow was present in 10 patients. Four patients had persistent pain, aching, or some discomfort following surgery. These patients had the prosthesis removed after a mean of 25 months, whereas the group with no pain had the prosthesis removed after 9 months (P=0.024). Twelve patients demonstrated a mean improvement of 34 degrees in total range of motion (ROM) (range 5 to 70 degrees). Two patients had the same ROM before and after implant removal. No patient lost motion. When looking specifically at extension, the overall mean extension deficit before radial head removal was 28 degrees (range, 0 to 70), which was improved to 15 degrees (range, 0 to 35) after prosthesis removal.

Discussion

Radial head arthroplasty is increasingly utilized as a treatment modality in elbow reconstructive surgery. However, knowledge about indications for radial head implant removal and complications encountered thereafter is lacking. To the best of our knowledge, there are only some large comprehensive series (15-17). The purpose of this study was therefore to describe the preoperative complaints, radiographic findings, and postoperative outcome in patients who underwent radial head prosthesis removal.

This study has several significant limitations. It is a retrospective, small case series without a control group. We recognize that the exact reasons for radial head replacement were not completely documented in all patients. This is important on account of the fact that the original injury could have in itself caused radio-capitellar cartilage trauma, which could adversely impact overall recovery and influence the development of pain during the short term as well as in the long term. The reasons for removal of the radial head rely on intraoperative notes and x-rays. The radiographic assessment is difficult, subjective, and we did not have radiographs of the contralateral (healthy) side to better judge parameters such as overlengthening and head size of the prosthesis (18). Three surgeons were involved in the treatment and there was no standardization in the reporting of findings. In addition there was insufficient data to analyze pronation and supination, which are relevant to overall function. Our follow-up was short in a few cases to assess for long-term outcome of radial head prosthesis removal.

In our series, the two main complaints were painful elbow and stiffness. A chronically painful elbow after radial head prosthesis implantation was always associated with wear of the capitellar cartilage in our study. Progressive capitellar erosion following radial head prosthetic implantation presenting with increasing pain and stiffness has been described (19). In our case series, the chronic wear process took more than a year to develop, although mechanical problems seem to accelerate the process. Burkhart and colleagues also reported three cases of capitellar erosion, mainly caused

by overstuffing of the radio-humeral joint (5). Although we agree that overlengthening can cause wear of the capitellar cartilage, more than half of our cases with wear did not appear to be affected by this technical problem. It appears that capitellar cartilage wear is a common sequel of the initial injury resulting in radial head implantation as well as a response to cartilage contact with metallic radial head prosthesis. An important unanswered question is whether the capitellar wear in these circumstances is the cause of pain, and can be ameliorated by radial head prosthesis removal. Besides the possible association of pain and wear, loosening of the radial head prosthesis was often in conjunction with pain in our study, especially after one year. Based on the implant, some radial head prostheses are designed to be loose, acting only as a spacer. Several studies have shown that radiolucency and pain are unrelated in the setting of radial head arthroplasty (4, 9, 20). However, O'Driscoll et al. noted that pain from a loose stem within the proximal radius may present as proximal radial forearmpain, and furthermore suggest that its presence be used as an indicator of symptomatic mechanical loosening (8). Stiffness was mostly associated with heterotopic ossification, pain, or articular degenerative changes. In addition, there seems to be a correlation between HO and ulnar neuritis, which could be explained by the fact that most HO is found posteromedially as seen in our cohort as well as described recently by Park et al (21). Mechanical or technical problems were found to typically result in early reoperation. This is in contrast to chronic process, which usually resulted in late explantation in our case series. Mechanical issues included oversized radial head implants, overlengthening or malpositioning of the prosthesis, and subluxation. Although rare, Burkhart et al. also described two cases of prosthetic dislocation in mid- to long-term follow-up (5). We did not see any cases of frank implant dislocation in our series.

In selected cases, pain did appear to resolve completely after prosthesis removal surgery. There seems to be an association between pain persistence and duration of the interval between implantation and removal of the prosthesis in our patients. Patients that underwent implant removal earlier tended to have less persisting pain. We would speculate that patients with ongoing pain are likely to represent a more severe initial injury or a greater degree of capitellar wear or both, but are unable to substantiate this speculation. Our findings also raise the question of whether some of the currently available radial head prostheses which rely on a loose intramedullary fit may actually allow for excessive degrees of motion in several planes that may contribute to or accelerate capitellar wear. If so, this could support routine removal of radial head prostheses after an arbitrary period of 6 to 12 months when the soft tissues have healed and possibly before radio-capitellar symptoms manifest. According to Wretenberg et al, the removal of the radial head even several years after implantation led to further improvement in range of motion (22). We shared similar results; the extension deficit and overall total ROM improved after removal nearly the same amount as noted by these authors. In contrast to our findings, Harrington et al. reported four patients requiring removal of the radial head prosthesis for pain, and could not correlate a better outcome following removal (4). Ulnar nerve compression can be a complication seen in patients following complex elbow trauma. After removal of the radial head prosthesis, three of our first four patients underwent additional surgery to decompress the ulnar nerve. One reason for this could be the development of further heterotopic ossification and scarring as mentioned earlier. Another reason could be the additional gain in range of motion causing increased stretch and traction on the ulnar nerve as it traverses an injury scarred bed, which could potentially hamper its normal physiologic mobility with elbow motion. As a consequence, we therefore advocate the liberal use of ulnar nerve decompression in cases involving heterotopic ossification or when a significant increase in range of motion is anticipated or noted intraoperatively.

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