

Hemiarthroplasty for irreparable distal radius fractures in the elderly: A comprehensive review

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Abstract

BACKGROUND

Elderly patients maintaining functional independence can now be candidates for primary wrist hemiarthroplasty to manage acute irreparable distal radius fractures (DRFs). However, further investigation with long-term follow-up is required to validate these initial findings.

AIM

To review the literature on the outcomes of distal radius hemiarthroplasty with available implants to assess its viability as a treatment option.

METHODS

A comprehensive review of the literature was conducted using electronic databases, including PubMed, Medline, and Scopus. The search terms employed were "distal radius fracture", "hemiarthroplasty", "wrist arthroplasty", and related terminology. The search was restricted to articles published in English from 1980 until June 2023. Inclusion criteria encompassed cases or case series of DRF treated with hemiarthroplasty, providing clinical or radiographic outcomes, and published in peer-reviewed journals.

RESULTS

A total of 2508 articles from PubMed and 883 from Scopus were identified initially. Following screening and removal of duplicates, 13 articles met the inclusion criteria. These articles, predominantly clinical retrospective studies, provided insights into hemiarthroplasty outcomes, including functional improvements and complications. Hemiarthroplasty was a treatment option for complex DRF, particularly those cases with severe comminution, intraarticular involvement, or severe

osteoporosis. Functional outcomes demonstrated improvements in pain relief, wrist mobility, and grip strength, with variability across studies. Complications included implant loosening, infection, nerve injury, and stiffness, with varying incidence rates influenced by surgical techniques and implant choice. Long-term outcomes were inadequately documented, warranting further research.

CONCLUSION

Hemiarthroplasty is a promising treatment for irreparable DRF in the elderly. Long-term outcomes and complications require further study.

Key Words: Irreparable distal radius fracture; Hemiarthroplasty; Osteoporosis; Wrist prosthesis; Elderly

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Core Tip: Distal radius fractures in elderly individuals often present challenges for stable fixation. Hemiarthroplasty has emerged as a treatment option, but definitive guidelines are lacking. This review aimed to clarify the circumstances warranting hemiarthroplasty in distal radius fractures.

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INTRODUCTION

Distal radius fractures (DRFs) represent 12%-17% of all fractures[1-5]. DRFs have a bimodal distribution in the population because they occur after a high-energy trauma in young adults and after low-energy trauma in elderly adults, particularly in females. This kind of fracture is so common that it has been estimated that DRFs in the elderly are second only to proximal femur fractures. Approximately 10% of 65-year-old White females will experience a DRF in their remaining life span[6]. Orbay and Fernandez[7] determined that 33% of DRFs in the elderly were classified as type C3 according to the AO classification.

Martinez-Mendez *et al*[8] concluded that the use of volar plating should be preferred to other treatments even though complications such as loss of reduction, intraarticular screw penetration leading to malunion, osteoarthritis, and clinical failure do occur[9,10]. Due to these complications, Roux[11], inspired by hip and shoulder hemiarthroplasty, was the first to propose the implementation of radius hemiarthroplasty to minimize hospitalization and facilitate an early recovery and return to daily activities. Moreover, Herzberg *et al*[12] suggested a list of at least six criteria to proceed with a distal radius replacement[12,13]. The criteria included patient characteristics, energy of the accident, characteristics of the fracture chart (*e.g.*, AO type C complete intraarticular fracture, high extraarticular and intraarticular displacement scores exceeding 6/12, main fracture line distal to the watershed line, impaction, and circumferential comminution), and trauma occurring in an active and autonomous patient.

The objective of this review was to gather, condense, and contrast findings reported in the literature regarding the efficacy of various implants in distal radius hemiarthroplasty as a potential treatment approach for elderly patients with DRFs.

MATERIALS AND METHODS

The literature review encompassed studies accessible through the electronic databases PubMed and Scopus. Searches were conducted using logical operators such as "AND" and "OR" in combination with keywords including "wrist arthroplasty", "wrist hemiarthroplasty", "wrist replacement", "wrist prosthesis", "wrist hemiprosthesis", "wrist fracture", and "distal radius fracture". Articles were restricted to those available in French, English, Italian, or Spanish and were confined to those published until December 1, 2023.

Initially, a total of 2508 articles were identified from PubMed and 883 from Scopus. Following the elimination of duplicates, full-text articles from indexed journals were screened by the authors based on abstracts, specifically focusing on studies where hemiarthroplasty was employed as the primary treatment for DRF. Exclusion criteria were applied to eliminate studies involving total wrist prostheses or those with indications not pertinent to DRF, such as primary or secondary wrist arthrosis (Figure 1).

Ultimately, 13 articles meeting the selection criteria were deemed eligible for inclusion in the review. All 13 articles were clinical retrospective studies, with 2 among them being case reports.



Figure 1 Preferred reporting items for systematic reviews and meta-analysis flowchart for study selection.

RESULTS

High variability was found between the 13 studies, which did not allow for a comparative statistical analysis. However, some features were consistent between the papers, allowing a descriptive analysis. As shown in Table 1, all 13 studies had a mean age at surgery of at least 73-years-old. Most patients were female, as there were only 7 males (4.2%) out of a total of 165 patients. With the exception of Aparad *et al*[14] (a case report), all studies had a follow-up period of at least 18 months with a mean of 34.3 months.

All fractures were defined as irreparable with complete intraarticular fracture with high extraarticular and intraarticular displacement, main fracture line distal to the watershed line, impaction, and circumferential comminution[12,13]. Furthermore, only 10 studies classified them as type C according to the AO classification, and 3 studies did not specify whether they were C1, C2, or C3. An evaluation of the pain perceived at the last follow-up was reported with the visual analog scale (VAS) in all the studies except that by Roux[15]. The pain at last follow-up did not exceed 3. The highest pain of almost 4 was observed by Anger *et al*[16].

The Disability of the Arm, Shoulder, and Hand (DASH) and Lyon scores were the most utilized functional outcome measurements. DASH was reported in 10 studies, ranging from 18 to 59 points, and the Lyon score was calculated in 7 studies, ranging from 50%-80%. The Patient Rated Wrist Evaluation (PRWE) was reported in six studies, ranging from 72 to 18. All authors provided grip strength, flexion and extension degrees, and pronosupination arc measurements. However, only six studies provided measurements for ulnar and radial deviation degrees.

The use of cement was specified in every study. All SOPHIA prostheses were cemented, and the Prosthelast prostheses were not cemented. When the Cobra or the proximal component of the ReMotion prostheses were used, cement was used in 7 out of 13 patients by Benedikt *et al*[17], in 8 out of 11 patients by Anger *et al*[16], and in 2 out of 28 patients and 2 out of 27 patients by the Cobra inventor Herzberg *et al*[18,19].

Major complications were reported with acceptable rates. There were no reports of any form of infection even in minimally exposed fractures. The most frequently reported complication was complex pain regional syndrome (15 cases). Less frequent complications included 1 case of extensor pollicis longus rupture, 2 cases of extensors tenosynovitis, 5 cases of ulnar head resections for distal radio-ulnar joint conflict, 3 cases of implant revision secondary in 2 cases to implant loosening and in 1 case to a post-traumatic fracture, and 8 cases of asymptomatic radial head perforation.

DISCUSSION

Due to several factors including the variety of implants (SOPHIA, ReMotion, Cobra, Prosthelast), the different follow-up periods, and the absence of detailed results for single patients, we were not able to conduct a statistical analysis. Nevertheless, some general conclusions can be drawn for all studies except for Anger *et al*[16]. In this study, the follow-up period was much shorter compared to the other studies. However, even with this limit, those other investigators observed satisfactory VAS scores in their elderly patients.

The SOPHIA implant showed a DASH score < 30 points when all studies were considered. A DASH score of < 40 points was reported in the two studies using the Prosthelast implant. This result is promising because the data comes from the study of Martins *et al*[20]. Those authors reported a DASH score of 39.8 and had the longest mean follow-up

Table 1 Clinical outcomes reported by the different studies for each implant

Ref.	Patient number	Sex		Mean age	Prosthesis indication			AO classification					Follow-up in mo	VAS	DASH	Lyon score, %	PRWE	Grip strength	Flexion	Extension	Forearm rotation arc	Ulnar deviation	Radial deviation	Cemented	Non cemented	
		M	F		Fracture	Mal union	Tumor	OTF	C	C1	C2	C3														A3
Cobra, Benedikt <i>et al</i> [17], 2022	13	1	12	73.5	13	0	0	0	0	0	0	13	0	31.2	1.1	39.1	63.3	36.2	78.3%	22°	46°	136°	29°	17°	7	5
Cobra, Anger <i>et al</i> [16], 2019	11	0	11	80	11	0	0	0	0	0	2	9	0	18.3	3.8	59.0	50.0	72.0	44.0%	36°	27°	164°	26°	15°	8	3
Cobra, Apard <i>et al</i> [14], 2022	1	0	1	83	1	0	0	0	0	0	0	1	0	6.0	1.0	ND	80.0	ND	ND	ND	70°	ND	ND	ND	0	1
EMIReMotion, Holzbauer <i>et al</i> [25], 2022	1	0	1	73	1	0	0	0	0	0	0	1	0	78.0	0	38.0	ND	ND	28 kg	35°	35°	180°	20°	15°	0	1
SOPHIA, Roux <i>et al</i> [11], 2009	12	1	11	73	4	1	1	0	NA	NA	NA	NA	NA	27.0	1.5	27.2	ND	ND	80.0%	30°	65°	110°	20°	20°	6	0
SOPHIA, Roux <i>et al</i> [15], 2011	12	1	11	75	6	5	1	0	NA	NA	NA	NA	NA	29.0	ND	ND	ND	ND	72.0%	36°	60°	128°	26°	21°	12	0
SOPHIA, Vergnenègre <i>et al</i> [26], 2015	8	0	8	80	8	0	0	0	0	0	8	0	0	25.0	2.0	18.0	ND	ND	92.0%	46°	44°	160°	25°	25°	8	0
ReMotion/Cobra, Herzberg <i>et al</i> [18], 2023	26	1	25	79	28	0	0	0	28	0	0	0	0	32.0	1.0	ND	75.0	ND	68.0%	25°	35°	148°	ND	ND	2 C§	10 R ² ; 16 C ¹
ReMotion/Cobra, Herzberg <i>et al</i> [22], 2017	15	0	11	74	12	0	0	0	12	0	0	0	0	32.0	1.0	25.0	75.0	22.0	69.0%	27°	35°	149°	ND	ND	0	12/12
		0	4	78	1	3	0	0	NA	NA	NA	NA	NA	24.0	2.3	31.0	67.0	39.3	59.3%	25°	41°	146°	ND	ND	0	4/4
ReMotion/Cobra, Herzberg <i>et al</i> [19], 2018	25	1	24	77	19	5	0	3	NA	NA	NA	NA	NA	32.0	1.0	26.0	74.0	25.0	68.0%	24°	36°	150°	ND	ND	2/27	25/27
ReMotion/Cobra, Herzberg <i>et al</i> [21], 2015	11	0	11	76	12	0	0	0	12	0	0	0	0	30.0	1.0	32.0	73.0	24.0	64.0%	26°	34°	151°	ND	ND	9 R ² ; 2 C ¹	0
Prosthelast, Ichihara <i>et al</i> [23], 2015	12	0	12	76	11	0	0	1	0	1	6	3	2	32.0	2.8	37.4	ND	ND	49.9%	40°	52°	138°	ND	ND	0	12
Prosthelast, Martins <i>et al</i> [20], 2020	24	2	22	78	24	0	0	0	0	0	7	15	0	55.0	2.1	39.8	ND	42.7	65.5%	39°	49°	142°	ND	ND	0	24

¹C: Cobra prosthesis implant.

²R: ReMotion implant.

DASH: Disability of the arm, shoulder, and hand; NA: Not available; ND: Not done; OTF: Other treatment failure; PRWE: Patient rated wrist evaluation; VAS: Visual analog scale.

period (55 months). They also reported that all prostheses were primary implants in fractures. It was more difficult to establish a DASH score for the Cobra and ReMotion prostheses because four[18,19,21,22] of the six studies were from the same group and presented the two prostheses together. Excepting of the report of DASH score of 59 by Anger *et al*[16], the collective reported DASH scores obtained by Cobra and ReMotion are < 40 and comparable to those obtained with Prosthelast[20,23]. Other functional scores, such as the Lyon score and the PRWE, were measured only in the Cobra and ReMotion studies and in the Prosthelast work by Martins *et al*[20] and were consistent with the DASH scores.

Almost all the studies reported the grip strength at the last follow-up. They compared the grip strength with the contralateral hand and observed the highest percentages in patients with the SOPHIA implant, followed by Cobra, ReMotion, and finally Prosthelast. All studies also reported forearm rotation arc and flexion-extension arc. Studies on Prosthelast and SOPHIA reported a flexion-extension arc of approximately 90°, while the studies on ReMotion and Cobra reported a flexion-extension arc that ranged from 60° to 70°. The forearm rotation arc was satisfactory in all the studies, ranging from 164° in the study by Anger *et al*[16] to 100° in the studies by Roux[11,15]. The lower forearm rotation arc reported by Roux[11,15] was justified by the higher dimension of the SOPHIA implant and the use of the ulnar head to gain implant stability, which can lead to distal radioulnar impingement or limitation on forearm rotation.

All SOPHIA implants were cemented since it has a relatively short stem in comparison to the prosthesis dimensions. All Prosthelast implants were cementless since the absence of implant subsidence should be granted by the intramedullary Kirschner. The rotation is controlled by the stem design, and the distal radius periosteal flaps are isolated and sutured above the implant. The ReMotion implant was never cemented. The Cobra implants were only cemented in two studies by Herzberg *et al*[18,22]. Benedikt *et al*[17] and Anger *et al*[16] were less confident in the osteointegration, especially in highly osteoporotic patients. Therefore, they cemented 7 of 13 prostheses and 8 of 11 prostheses, respectively.

Although most complications were resolved with a secondary procedure and ultimately a good recovery was achieved for all the patients, it is important to note that the complication rate in 7 of 11 retrospective studies was around 25% when excluding complex regional pain syndrome cases that improved without consequences. Nevertheless, the absence of a prolonged period of hospitalization, which is necessary in less invasive treatments, prevents the development of a major complication as described by Diaz-Garcia *et al*[24].

CONCLUSION

Although most studies had a relatively short follow-up period and small sample size, we believe that distal radius hemiarthroplasty should be considered as a treatment option for elderly patients with DRF. Distal radius hemiarthroplasty in carefully selected patients is an excellent option due to the short recovery time and low complication rate.

FOOTNOTES

Author contributions: De Vitis R was the guarantor and designed the study; Cannella A wrote the manuscript; Cannella A, Sassara GM, Caruso L, and Marescalchi M participated in the acquisition, analysis, and interpretation of the data and drafted the initial manuscript; De Vitis R, Taccardo G, and Passiatore M revised the article critically for important intellectual content.

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