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Preserving the radial head in comminuted Mason type III fractures without fixation to the radial shaft: a mid-term clinical and radiographic follow-up study

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Background: The treatment of multifragment Mason type III fractures is challenging. Open reduction–internal fixation (ORIF), radial head arthroplasty, and in some cases, even radial head resection are the current options; however, each of these treatment methods is associated with characteristic benefits and complications. We present our experience with a radial head salvage procedure in comminuted radial head fractures irrespective of concomitant injuries, which are not accompanied by typical ORIF-related complications.

Methods: The first group comprised 29 patients with multifragment Mason type III fractures treated surgically with biological radial head spacers (group S). The fragments were reduced and fixated in an extracorporeal manner, and the reconstructed radial head was placed in its anatomic position without fixation to the shaft. The second group comprised 12 patients treated with conventional ORIF using mini-fragment plates (group P).

Results: Thirty patients were enrolled to undergo clinical and radiographic follow-up at an average of 76 months (range, 12-152 months). In group S, nonunion at the head-neck junction developed in 70% of the cases; however, the overall Mayo Elbow Performance Index averaged 94.8, which was superior to the average Mayo Elbow Performance Index of 83.1 in group P. Radiographic evaluation showed development of osteoarthritic changes in 75% of patients in group S and 62.5% in group P. None of the patients had wrist-joint pain.

Conclusions: Preserving the native radial head in comminuted Mason type III fractures without fixation to the radial shaft is a reliable option. Excellent functional results can be expected; however, the development of osteoarthritis cannot be impeded.

The study was approved by the Ethics Committee of the Medical University of Vienna (EK nos. 19882015 and 10512019).

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Radial head fractures are common injuries and make up about one-third of all fractures around the elbow.[13] The recorded incidence is between 28 and 38.8 per 100,000 inhabitants per year.[12,30] The most common injury mechanism is a fall on the outstretched arm.[12] Osteoporosis seems to be a risk factor.[9]

For 95% of radial head and neck fractures, conservative treatment can be performed, expecting good or excellent results in over 90% of cases.[14] In unstable Mason type III fractures with or without associated ligamentous or bony injuries, the optimal treatment is still a matter of debate.[34]

Treatment options include open reduction–internal fixation (ORIF),[10] radial head resection,[17,39] and radial head arthroplasty (RHA).[41] The necessity for preserving or replacing the radial head in unstable complex elbow injuries is beyond contention. It is well known that the radial head provides the main resistance against valgus stress, transfers the axial load of the forearm to the capitellum, and acts as a posterolateral stabilizer in combination with the lateral collateral ligament (LCL) and the lateral ulnar collateral ligament (LUCL).[19,25,50] Therefore, radial head resection has been associated with disastrous results among these cases.[20] If we compare ORIF and RHA, there are studies reporting better results after RHA[8] than those after ORIF[52,60] whereas others could not find any major differences in functional outcomes,[1] even in highly unstable elbow injuries.[57] All these methods have their characteristic benefits and pitfalls. At our institution, we prefer a head-preserving technique in which the patient's own radial head acts as a biological spacer. Therefore, it is used in both isolated comminuted radial head fractures and complex elbow injuries with radial head fractures. The purpose of our study was to determine the clinical short- and mid-term outcomes of this treatment method and to identify late-onset sequelae. Furthermore, we wanted to compare the results of biological head spacers with those in patients in whom the radial head was fully fixated to the shaft using low-profile mini-fragment plates. We hypothesized that the functional results of biological head spacers would be comparable with those of current treatment methods with the benefit of a lower prevalence of osteoarthritis.

Materials and methods

In this retrospective case-control study, a search of our medical database discovered 188 surgically treated radial head fractures between 2005 and 2015. We used the original classification system of Mason[42,49] and included only patients with complete multifragment fractures of the radial head in which the fragments were completely separated from the shaft. Therefore, we included only type IIIB and IIIC fractures according to the subclassification of Mason type III fractures of Ikeda et al.[29] The exclusion criteria were defined as follows: age younger than 18 or older than 75 years, pathologic fractures, Mason type I and II injuries, neurologically affected patients, severe ipsilateral injuries of the affected arm, previous injuries of the elbow, and fractures older than 2 weeks. A total of 41 patients were selected according to these criteria, all of whom had been treated with a biological radial head spacer (group S) or ORIF using low-profile mini-fragment plates (group P). Within these groups, 2 patients had returned to their home country and 9 patients were lost to follow-up or had a follow-up period of less than 1 year (Fig. 1).

All patients were treated in our department. Classification of injuries was made using plain radiographs and computed tomography scans. Patients with associated injuries were assigned into different groups of complex injury patterns according to Ring,[47,48] who divided fractures of the radial head with rupture of the interosseous ligament of the forearm (Essex-Lopresti and variants) as type 1; fractures of the radial head and rupture of the medial collateral ligament complex and/or fracture of the capitellum as type 2; fracture of the radial head and posterior dislocation of the elbow as type 3; posterior dislocation of the elbow with fractures of the radial head and coronoid process (terrible-triad injury) as type 4; and finally posterior olecranon fracture-dislocations (posterior Monteggia pattern injury) as type 5. All other patients, whose injury pattern did not match any of these 5 complex types, were deemed to have uncomplicated injuries. As radiographic parameters, osteoarthritic changes were assessed using the Broberg and Murray scale[5] and heterotopic ossification was graded according to Hastings and Graham.[26] Tilting of the radial head, which usually occurred in the first 6 to 8 weeks postoperatively, was defined as the radial head-shaft angle. Clinical data have been extracted from our medical database to assess intraoperative and postoperative complications and functional outcome parameters. We further called in patients to assess the medium- and long-term outcomes if they did not return to our department for a minimum of 12 months after the trauma. All these patients signed informed consent forms. The Mayo Elbow Performance Index (MEPI) was used to assess the functional outcome. All clinical evaluations were performed by an independent observer (S.Z.); radiographic assessment was performed by 2 authors (M.G. and S.Z.).

Single-shot antibiotics are routinely used in every patient immediately prior to the operation. Patients with open fractures receive intravenously applied antibiotics for a minimum of 7 further days. A lateral or posterolateral approach is used for the treatment of the radial head fracture. A long curved posterior approach with the patient in the prone position is performed if both the ulna and radial head have to be addressed. Care is taken to preserve the LCL, if uninjured. If the radial head is replaced with an autologous implant, the fragments are removed and

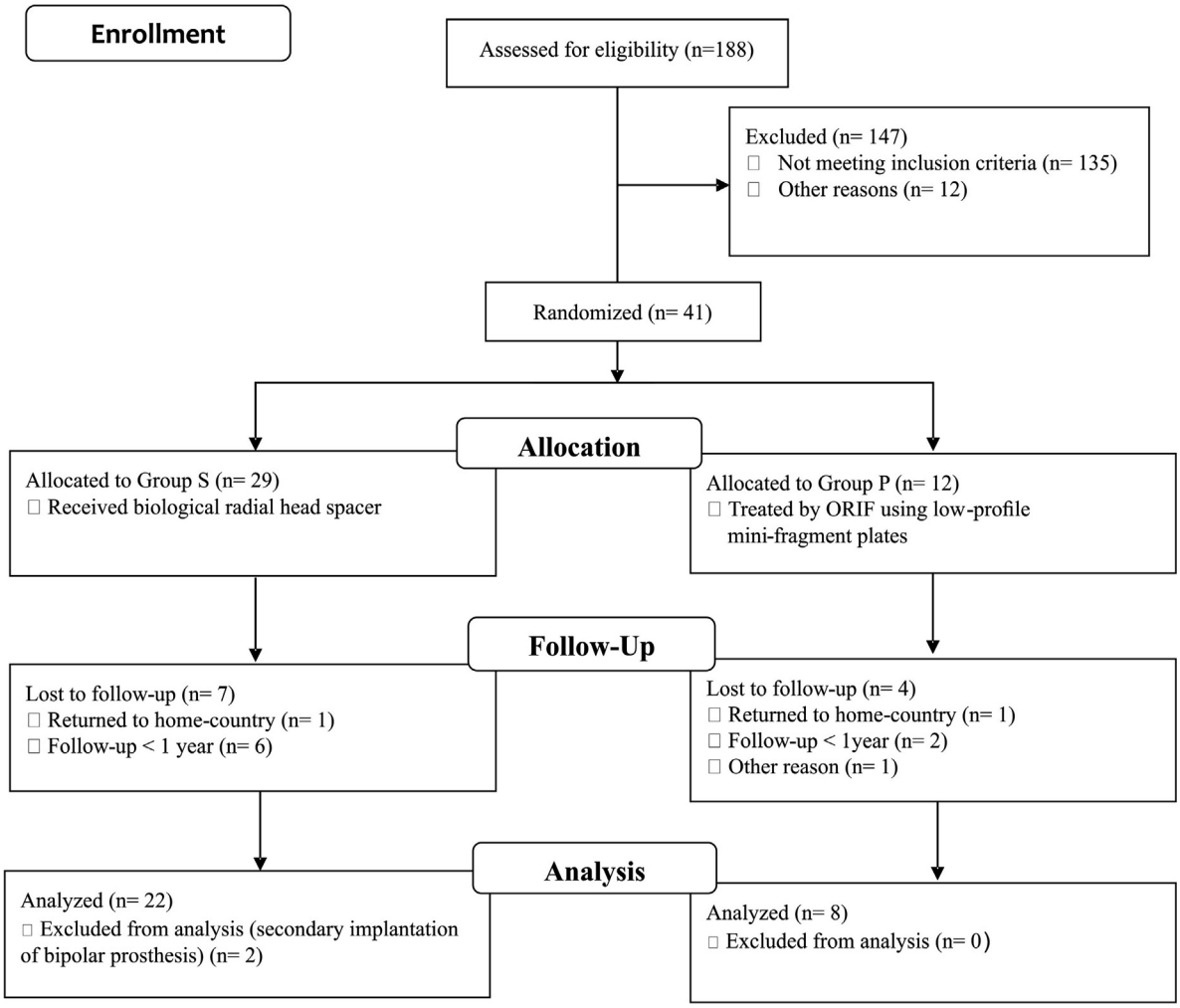

Figure 1 Flow diagram of study cohort. *ORIF*, open reduction–internal fixation.

assembled in an extracorporeal manner on the nurse table in most cases. In our opinion, the extracorporeal reassembling is an essential step during surgery to check whether all fragments are retrieved and reconstruction is feasible. The benefits of the ''on-table reconstruction'' for head sizing in RHA or reduction in ORIF techniques have already been reported in the literature.[4,6,33] The type of osteosynthetic material used for interfragmentary fixation of the radial head and additional surgical procedures are shown in Table I. Once anatomic reconstruction is achieved, the radial head is returned to its anatomic position without fixation to the radial shaft. Forearm rotation and bending movements are performed intraoperatively to control optimal radiocapitellar alignment, as well as joint and radial head stability. Reconstruction of the annular ligament with absorbable sutures is mandatory. Ulnar fractures are treated according to the fracture pattern. Disruptions of the LCL complex are reconstructed with suture anchors or transosseous sutures. Fractures of the coronoid process are treated surgically if the fragment exceeds 50% or if joint instability remains after radial column reconstruction. In cases in which the radial head is fixed to the radial shaft, ORIF is performed by in situ fixation of the fragments using low-profile mini-fragment T-plates (Fig. 2).

All patients are immobilized using an upper arm splint with elbow flexion of 90° until wounds are healed. The period of immobilization depends on the severity of concomitant injuries. Complex elbow injuries are immobilized with a cast for up to 3 weeks, followed by a hinged brace with limited motion for a further 3 weeks. Passive motion exercises start at day 14. At 6 weeks postoperatively, active full radius motion is permitted, followed by strengthening exercises after the eighth postoperative week. Return to arm-demanding sports and heavy manual work is permitted at 12 weeks postoperatively.

Results

A total of 30 patients (73%) met the inclusion criteria and were included (Tables I and II). The left side had been injured in 13 patients, and the right side, in 17. The trauma mechanism was a simple fall from a standing position in 12 cases, fall from a bicycle in 6, fall from a height greater than 2 m in 6, and sports injury in the remaining 6. One patient sustained an open ulnar fracture as part of a

Table I Patient demographic characteristics and functional and radiographic outcomes in spacer group

	Age, yr	Type of injury	No. of fragments	Risk factors	RH-fix	Other surgery	FU, yr	MEPI	HSA,°		HO grade	OA grade	
									Coronal	Sagittal		RC	UH
Case 1	51	UC	3		Screws		8.8	100	9	9	0	0	0
Case 2	56	UC	3		Ethipins (ETHICON, Johnson & Johnson Medical GmbH, Norderstedt, Germany)		9.9	100	8	11	1	1	1
Case 3	38	UC	3	Nicotine	Sutures		0.9	100	1	9	0	1	0
Case 4	26	UC	3		Sutures		8.9	100	16	19	0	0	0
Case 5	24	UC	4	Nicotine	Sutures, Ethipins		1.0	100	5	21	1	1	0
Case 6	56	UC	3		Sutures		8.4	100	4	27	1	2	1
Case 7	21	UC	3	Nicotine	Sutures		1.9	85	6	15	0	0	0
Case 8	62	UC	3	Nicotine	Sutures, Ethipins		6.6	100	9	10	1	1	0
Case 9	54	UC	3		Screws, Ethipins		2.8	100	1	8	1	0	0
Case 10	63	UC	3		Ethipins		1.4	100	5	5	0	1	0
Case 11	35	Complex type 2*	3		NA		10.9	100	13	10	0	0	0
Case 12	40	Complex type 2*	3		Screws		9.7	100	21	3	1	1	0
Case 13	60	Complex type 4*	4	Rheumatoid arthritis	Sutures	Transosseous sutures in LCL	8.3	100	17	8	1	1	0
Case 14	38	Complex type 4*	3		Screws	Resection of upper third of coronoid process and capsular transosseous reattachment	2.8	100	26	25	2B	2	0
Case 15	56	Complex type 4*	4		Screws, K-wires	Suture anchor refixation of LCL and coronoid process with capsular attachment	5.3	80	8	4	1	1	1
Case 16	58	Complex type 5*	4		Screws	6-hole anatomic 2.7-/3.5-mm locking olecranon plate (Johnson & Johnson, DePuy Synthes, Vienna, Austria)	4.9	80	6	1	2A	2	2
Case 17	20	Complex type 2*	4	Nicotine	Sutures, screws		11.1	100	10	16	1	1	1
Case 18	38	Complex type 5*	4		Screws, sutures	6-hole anatomic 2.7-/3.5-mm locking olecranon plate	7.6	100	1	30	1	1	1
Case 19	40	Complex type 5*	3	Nicotine	Ethipins	6-hole anatomic 2.7-/3.5-mm locking olecranon plate	7.0	55	8	4	2C	3	2
Case 20	56	Complex type 2*	3		Ethipins		3.5	95	0	11	1	1	1
Revision 1	42	Complex type 5*	3	Nicotine	Screws	Index surgery: 8-hole LCP plate in ulna Revision surgery: bipolar prosthesis	10.5	85	22	21	2C	2	2
Revision 2	26	Complex type 4*	3	Nicotine	K-wires	Index surgery: transarticular ulnohumeral K-wire fixation Revision surgery: bipolar prosthesis	5.7	100	19	3	2A	1	1

RH-fix, type of radial head fixation; *FU*, follow-up; *MEPI*, Mayo Elbow Performance Index; *HSA*, head-shaft angle; *HO*, heterotopic ossification; *OA*, osteoarthritis; *RC*, radiocapitellar; *UH*, ulnohumeral; *UC*, uncomplicated; *NA*, not available; *LCL*, lateral collateral ligament; *LCP*, Locking compression plate.

* Complex elbow injury according to Ring.[47,48]

Figure 2 Grade 1 degenerative changes with minimal osteophyte formation and slight joint space narrowing in a 65-year-old woman 7 years after trauma. *R*, right.

Monteggia-equivalent lesion, which was classified as grade 1 according to Gustilo and Anderson.[22] We recorded 4 partial radial nerve palsies: 2 occurred postoperatively, and the other 2 occurred as part of the primary injury. Full remission occurred in all patients. One patient sustained an axonal injury of the ulnar nerve during trauma (case 28). No infections occurred during primary surgery. Two patients underwent revision surgery and were evaluated separately because the implants had been changed to conventional radial head prostheses.

In 70% of group S patients and 75% of group P patients, ectopic ossifications developed according to Hastings and Graham.[26] In group S, nonunion developed at the head-neck junction in 14 of 20 patients (Figs. 3 and 4). This was the main radiographic characteristic within the first 3 months after the operation. The extent of bone resorption of the replanted radial head varied, but the articular surface remained intact in 17 of 20 patients. In 3 patients, we observed small longitudinal areas of discontinuity, but there was no association with a worse clinical outcome (case 2, 7, and 17 in Table I). At final follow-up, 75% of patients in group S and 62.5% of patients in group P had radiographic signs of osteoarthritis. The radiographic carrying angle averaged 13° (range, 5°-18°) in group S and 11° (range, 5°-22°) in group P.

In the remaining 20 patients treated with biological radial head implants, the overall MEPI was 94.8 (range, 55-100) at a mean follow-up of 6 years (73.1 ± 41.3 months; range, 12-133 months). According to the MEPI rating scale, the functional outcome was excellent in 16 patients, good in 3, and poor in 1. In patients who were treated with low-profile mini-fragment plates, the average MEPI was 83.1 (range, 55-100) at a mean follow-up of 8 years (97.6 ± 28.6 months; range, 57-152 months). The outcome was excellent in 3 patients, good in 3, fair in 1, and poor in 1.

The mean sagittal motion arc was 135° (range, 90°-150°) in group S and 122° (range, 90°-155°) in group P. The mean forearm rotation arc was 169° (range, 130°-180°) and 154° (range, 65°-180°), respectively. None of the patients complained about wrist-joint pain during daily activities or had pain in the wrist joint during clinical examination (Fig. 5).

Revision surgery and subsequent surgical procedures for post-traumatic sequelae

In group S, 2 patients underwent revision surgery (Table I). The first patient (revision 1) sustained a trans-olecranon posterior Monteggia fracture. At 8 months after primary surgery, the patient still complained about painful restriction of elbow motion consisting of a 40° pronation deficit and total sagittal motion of 100° with an extension deficit of 20°. Following radial head resection and RHA using a modular, cemented-stem prosthesis, pain decreased but slight pain during manual work was still present. The MEPI was 85, the sagittal arc of motion 95°, and the pronation deficit improved to –15°. The second patient (revision 2) sustained a terrible-triad injury and underwent revision surgery on the seventh postoperative day. A malpositioned K-wire used for temporary trans-fixation of the humeroulnar joint did not prevent ongoing instability, which resulted in early dislocation of the biological head implant within the splint. The radial head was replaced by a modular prosthesis with a press-fit stem to ensure stability without the risk of recurrent radial head subluxation in case of ongoing elbow dislocations.

Implant removal on the radial side was required in 50% of patients in group P. Secondary arthroscopic joint débridement was performed in 2 patients (cases 21 and 28); olecranon tip resection, in 2 patients (cases 21 and 25); and olecranon fossa–plasty, in 1 patient (case 21).

Discussion

We believe that preserving the radial head in Mason type III fractures as a biological implant provides excellent clinical results following reconstruction of Mason type III radial head fractures without fixation to the shaft. In comparison with a group of patients treated with ORIF using low-profile mini-fragment plates for full fixation of the radial head to the shaft, the functional results were superior. Most authors still recommend reconstruction of the radial head, especially in young and active patients.[7,10,29,50] On the other hand, the authors of a large retrospective analysis of

Table II Patient demographic characteristics and functional and radiographic outcomes in plate group

Case	Age, yr	Type of injury	No. of fragments	Risk factors	RH-fix	Other surgery	FU, yr	MEPI	HSA,°		HO grade	OA grade	
									Coronal	Sagittal		RC	UH
21	29	UC	3		Mini-plate		8.2	65	4	5	2A	2	2
22	34	UC	3	Nicotine	Mini-plate		8.0	100	15	20	0	0	0
23	54	UC	3		Mini-plate		10.1	85	3	11	1	0	0
24	58	Complex type 2*	3		Mini-plate		6.5	80	3	18	0	1	1
25	53	Complex type 5*	4	Obesity	Mini-plate	3.5-mm reconstruction plate in olecranon	12.6	95	10	24	2C	2	1
26	40	Complex type 3*	4		Mini-plate	Suture anchor refixation of LCL	8.0	100	24	0	1	0	0
27	21	Complex type 5*	3	Nicotine	Mini-plate	6-hole anatomic 2.7-/3.5-mm locking olecranon plate	6.9	85	8	3	2A	1	2
28	62	Complex type 4*	3	Nicotine	Mini-plate, headless compression screw		4.8	55	9	10	3	1	1

RH-fix, type of radial head fixation; *FU*, follow-up; *MEPI*, Mayo Elbow Performance Index; *HSA*, head-shaft angle; *HO*, heterotopic ossification; *OA*, osteoarthritis; *RC*, radiocapitellar; *UH*, ulnohumeral; *UC*, uncomplicated; *LCL*, lateral collateral ligament.
* Complex elbow injury according to Ring.[47,48]

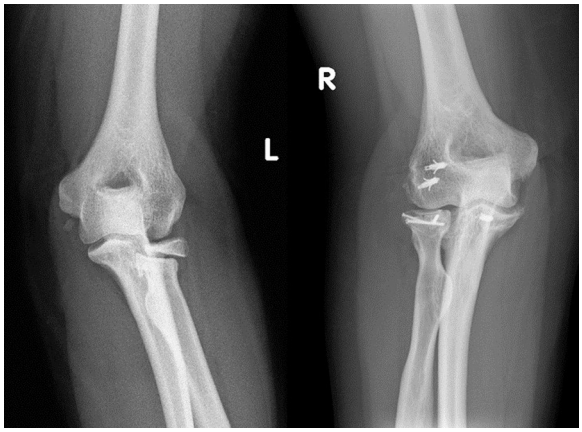

Figure 3 Characteristic sign of nonunion (*left*) and a case of bony union of the radial head (*right*) following biological radial head spacer treatment. *L*, left; *R*, right.

surgical revisions of radial head fractures concluded that complications in comminuted radial head fractures were predominantly ORIF related.[24] However, they added that most of the cases were treated with hand plates rather than anatomically precontoured radial head plates,[24] which could also have influenced our results. Compared with other studies, our study found slightly worse results following ORIF (mean MEPI, 83.1; satisfactory results in 75%). Nalbantoglu et al[44] revealed a mean functional index of 87 and satisfactory results in 80% of patients among 25 cases. Ikeda et al[29] presented satisfactory results in 12 of 13 patients following ORIF and a mean functional index of 90.7. Crönlein et al[10] showed excellent results with a mean MEPI of 98 in 24 patients, who were treated with anatomically preshaped low-profile plates. Our study shows that good end results can be achieved following ORIF, but they have been inferior to those in a group of patients in whom fixation of the radial head to the shaft was not performed (MEPI, 83.1 vs. 94.8).

Satisfactory outcome rates have been reported, but implant-related complications are not uncommon, including implant failure, restricted forearm motion, and secondary hardware removal at rates of up to 83% to 100%.[6,8,38,47] In our study cohort, 50% of the patients required hardware removal following ORIF using low-profile mini-fragment plates because of complaints such as crepitation and pain during forearm rotation or even loosening of the implants. We found only 1 study in which the authors compared the outcome of Mason type III fractures with and without fixation of the radial head to the shaft.[45] The study included 13 patients in a group in which the radial head was fixed to the shaft with low-profile mini-plates and 12 patients in a group in which the radial head was not fixed to the shaft following ORIF of the radial head fragments. Patients were treated without plate fixation only if the head synchronously rotated with the shaft during forearm rotation.[45] The authors did not observe any differences in clinical outcomes and recorded excellent results in both groups; therefore, they proposed that anatomic reconstruction of the radial head without fixation to the shaft is preferable. Our excellent results

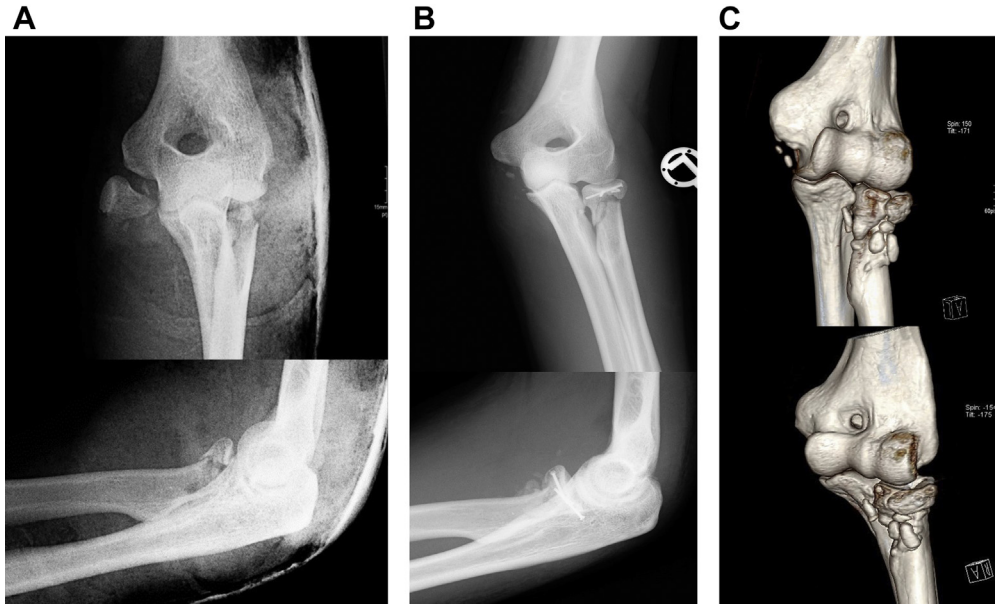

Figure 4 Imaging in a 21-year-old man. **(A)** Preoperative radiograph. **(B)** Radiograph at 3 months after surgery. **(C)** Three-dimensional computed tomography reconstruction 11 years after trauma. *L*, left.

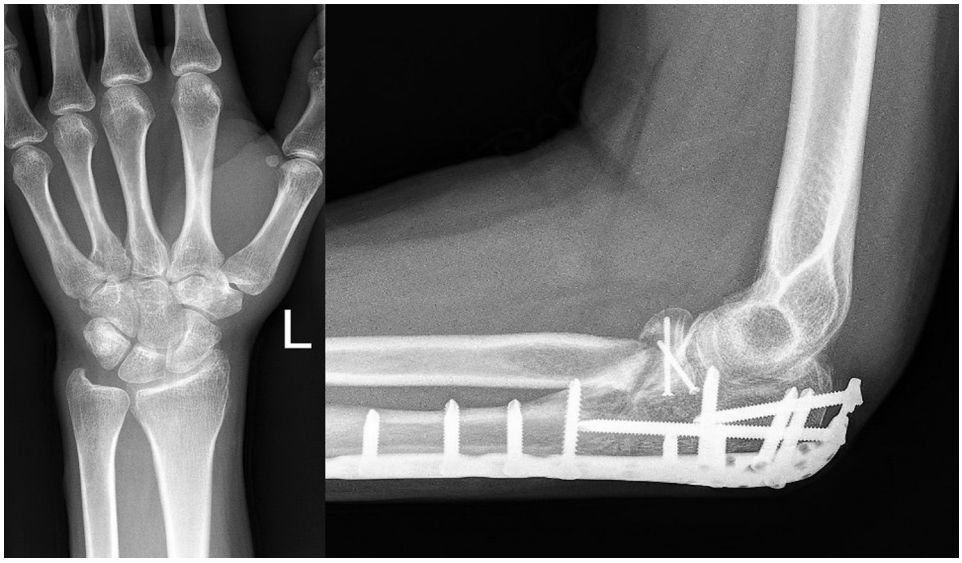

Figure 5 Radiograph at 3 months after surgery with a biological radial head spacer without signs of ulnar variance in a 38-year-old woman. *L*, left.

support these findings, but our study differs in some respects. Neumann et al[45] included 3 patients (25%) with radial neck fractures and intact radial heads: type IIIA according to the subclassification of Mason type III fractures of Ikeda et al.[29] We included only Ikeda type IIIB and IIIC injuries, which covers multifragment radial head fractures with dislocated or tilted fragments. Furthermore, we included only patients who were followed up for at least 12 months. This may also be the reason we observed a higher rate of post-traumatic osteoarthritis. However, the prevalence of post-traumatic degenerative changes is generally high, even in uncomplicated Mason type II and III fractures.[28] In their group of 12 patients without fixation of the radial head to the shaft, Neumann et al documented only 1 nonunion. Healing rates of radial head fractures are generally high.[28,29,32] However, nonunions often remain asymptomatic and do not require intervention.[3,32,37,48,49] Our results support these findings. In our series, we had a 70% rate of nonunion among 20 patients, and this was the main characteristic that appeared on radiographs within the first 3 months if the native radial head was replanted without fixation to the shaft (Fig. 3). None of these patients required revision surgery.

Another study group has presumed that biomechanical instability in symptomatic nonunions following conservative treatment can be due to high-demand activities and the inability of patients to comply with a non–weight-bearing treatment regimen or immobilization.[3] Our postoperative protocol did not allow weight bearing for 6 to 8 weeks after surgery. Head necrosis was frequently seen, but the functional outcome was not compromised. The extent of radiolucent gap at the head-neck junction differed. We presume that the amount of bone resorption may depend on the severity of radial neck comminution and the quality and size of the reduced fragments. Anatomic studies have revealed that the radial head obtains its blood supply from vessels entering at the radial neck.[58] On the basis of this study, the blood supply to all dislocated (and probably also nondislocated) radial head fragments is disrupted. Therefore, in osteosynthesis of the radial head, we consider all fragments as free bone transplants. In 2 patients, fragments were dislocated to the ulnar side of the elbow joint and had been retrieved through a separate skin incision. We believe that biological head spacers heal as rigid nonunions at the neck, but further studies on the structure of healing tissue must be performed to support this. The nutrition of the radial head itself may presumably be provided by the synovial fluid too, as we know from intra-articular loose bodies, but we do not have any supporting evidence.

In severely comminuted radial head fractures, ORIF has been associated with highly unsatisfactory results.[49] As a consequence, some authors have recommended RHA if the radial head consists of more than 3 fracture fragments.[11,48,50] RHA seems to be a favorable method to regain congruity and stability with satisfactory functional outcomes. In the current literature, the early clinical results are encouraging in several clinical trials.[16,21,40] Short- and mid-term follow-up studies documented MEPI scores of 80 to 95.[11,16,21,27,41,43,52,57] Our study shows similar excellent results following reconstruction of the radial head, with a MEPI of 94.8 in the radial head spacer group. With rates of 75% in patients treated with radial head implants and 62.5% in patients treated with mini-fragment plates, we observed higher rates of osteoarthritis than in other trials reported so far.[2,23,29,41,59] This finding could be explained by the longer follow-up periods (mean follow-up time, 6.3 years). The rate of osteoarthritis in the spacer group was higher than that in patients treated with ORIF, but the study cohort was too small to determine the reasons for this. We cannot preclude that small loose bodies during partial radial head resorption or some tilting of the radial head during the first weeks causes attrition. However, degenerative changes greater than grade 1 developed in only 20% of the patients in the spacer group. On the other hand, there are studies reporting several unsatisfactory results and a high rate of degenerative changes in patients with Mason type III fractures treated with metal prostheses, even after an average follow-up period of 42 months.[39] Allavena et al[2] revealed satisfactory results in only 71% of cases using a bipolar RHA system in an acute setting. One of the major concerns is nonanatomic radiocapitellar tracking in RHA. In addition, it is important to prevent overlengthening of the radius, associated with increased radiocapitellar pressure, capitellar wear, and development of osteoarthritis.[11,48,54] Using the native radial head, we are not confronted by the risk of overstuffing. Progressive osteolysis following RHA is a well-documented complication.[46] Flinkkilä et al[18] reported a high rate of implant loosening after a mean time of 11 months. In their study, 9 of 37 metal prostheses had to be removed. If the native radial head is used as a spacer, the radial shaft is not affected by implant-related complications, such as stress shielding, presuming that vascularity of the bone stock remains undisturbed, which may be advantageous for possible future surgery.[18,51] Although this method is not technically challenging, surgeons should also be trained in RHA if stable reconstruction of the radial head is not accomplishable. In cases of bone loss or absent fragments, we definitely recommend RHA. The patient‘s own radial head acts as a fully functional spacer,[3] preventing valgus instability and gross shifting of the radial shaft affecting the distal radioulnar joint. Because none of the patients complained about wrist-joint pain, we did not obtain comparative radiographs of both wrist joints for ulnar variance analysis. Therefore, we believe that the function as a spacer has been adequately fulfilled.

In comparison with RHA and ORIF, we believe that similar functional results can be expected without the risks encountered with ORIF- or RHA-typical complications, such as pain, implant loosening, overstuffing, instability, infection, and disassembly of the bipolar prosthesis.[31,35,55] There are studies showing high complication rates associated with RHA, including reoperation rates of up to 39%.[36] Young age is one of the main risk factors for revision surgery following RHA,[4,15] and rates of medium- to long-term survivorship of radial head prostheses reported in the literature widely range between 60% and 97%.[36,53] With the native radial head reconstructed, we could demonstrate satisfactory end results even in the medium to long term, up to 11 years after the trauma. Regarding the lower functional scores following revision surgery after RHA,[56] we prefer a head-preserving technique in young adults whenever possible. On the basis of our good experience, we do not fix the radial head to the shaft in most cases. However, randomized controlled studies have to be planned to determine whether biological radial head spacers lead to worse degenerative changes compared with ORIF using anatomically precontoured plates.

To our knowledge, this is the largest study reporting the mid-term functional and radiographic outcomes using biological radial head implants in uncomplicated and complex Mason type III, Ikeda type IIIB and IIIC fractures. However, our study has several limitations concerning the retrospective nature, the small study cohort, and the absence of radiographic analysis of ulnar variance.

Regarding the nonunion rate of 70%, if the radial head is not fixed to the shaft, we cannot preclude minimal proximal migration of the shaft in some cases. However, there were no clinical signs indicating distal radioulnar joint disturbances. Nevertheless, study protocols of future prospective randomized trials should include these radiographic measurements.

Conclusion

Preserving the patient's own radial head in multifragment Mason type III fractures without fixation to the radial shaft is a reliable and cost-effective alternative to conventional ORIF techniques and RHA. Excellent functional results can be expected even in the mid to long term, but the process of osteoarthritis cannot be impeded. Nonunions are frequently observed, but they remain asymptomatic. Care must be taken to restore additional injuries adequately to prevent radiocapitellar maltracking and early dislocation of the radial head. The vascularity of the shaft is not disturbed, which may be advantageous if future radial head or radiohumeral arthroplasty is required.

Disclaimer

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