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A comparative study of functional outcome for mason type II & III radial head fractures treated with excision and fixation

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Abstract
The treatment of Mason type II and type III fractures of the radial head has been a long source of contention among orthopaedic surgeons. Radial head excision was the simplest choice for surgical treatment of these fractures. With improvised surgical procedures and availability of highly sophisticated implants and instruments, open reduction and internal fixation (ORIF) of these fractures has become more common. However, the associated complications and outcome of elbow function for both radial head excision and ORIF in managing Mason type II and type III fractures remain yet to be systematically evaluated. To overcome this lacuna, we undertook a retrospective study in Karnataka, India for patients from July 2014 to May 2021 with a mean follow-up period of 161.2 weeks (3.1 years). The study comprised of 20 patients with Mason type II and type III acute fractures of the radial head. Their age group ranged from 20 to 66 years. They were grouped into two categories viz., 10 patients who had their radial heads removed (Group I) and 10 patients who had ORIF with Herbert screws/ mini-plates (Group II). Postoperatively, the final follow-up evaluations of patients were carried out after periods ranging from thirty seven to three hundred and fifty two weeks. During final follow-up, range of motion, radiographic and complications data were collected from patients and functional outcome measures of the elbow were estimated. The rating system of Broberg and Morrey was used to evaluate elbow function. It was observed that the functional rating score averaged 84 points in Group I and 96 points in Group II. Hence, we conclude that the patients who received ORIF had better functional outcome than those who received excision. After radial head excision, the complications recorded were proximal radial migration (n=2) and peri-articular ossification (n=2). When compared with radial head excision treatment, ORIF was found to be better management procedure in terms of adequate joint motion, better function and more strength. These findings suggest the use of ORIF as a more efficient therapeutic option for Mason type II and III radial head fractures.

Keywords: fractures of radial head, broberg and morrey scoring, herbert screws, excision, fixation

Introduction
Fractures of the radial head constitute approximately one-third of all elbow fractures. Women between 50-60 years and men between 30-40 years have been found to have a greater rate of these injuries [1]. Four categories of radial head fractures were described by Mason according to their severity [2]. Un-displaced or mildly displaced fractures were classified as Mason type I. Fractures involving displacement, depression, or angulation>2mm were classified as Type II injuries. Comminuted fractures of the entire radius head are included in Type III and radial head fracture along with dislocation of the elbow joint are included in Mason type IV. In the past, when nonsurgical care for elbow fractures failed, radial head excision surgery was adopted for Mason type II & III fractures. However, with the advent of improved sterile surgical procedures and instruments Open reduction and internal fixation (ORIF) of type II and type III injuries are becoming more prevalent [3, 4].
For management of Mason type I fractures of radial head the conservative method of using a splint or sling for a few days [5] is the treatment of choice. In Mason type II radial head fractures minimally invasive treatment is done by intramedullary pinning. ORIF exhibited more complications and its superiority to conservative therapy for partially displaced radial head fractures was doubtful [6]. There is still insufficient data to determine which type of radial head fracture care is preferable [7]. Favorable results were also obtained related to ORIF for comminuted complications of radial head fractures [4]. Radial head arthroplasty was observed to have better functional outcome than open reduction internal fixation [8]. The present study examines the problems that occur in the treatment of Mason type II and type III radial head fractures, with radial head excision and ORIF methods using Herbert bone screws and mini-plates followed by the evaluation of the outcomes of elbow function.

Limitations
The study was carried out in a small sample size, with 10 patients in each group, with varied injury patterns and the mean follow-up period was about 160 weeks long. Follow-up of larger cohort could not be performed, as many patients failed in attending the health-care appointment owing to Covid-2 lockdown and due to their distance of residences from the hospital.

Materials and Methods
After receiving institutional ethical approval and after obtaining

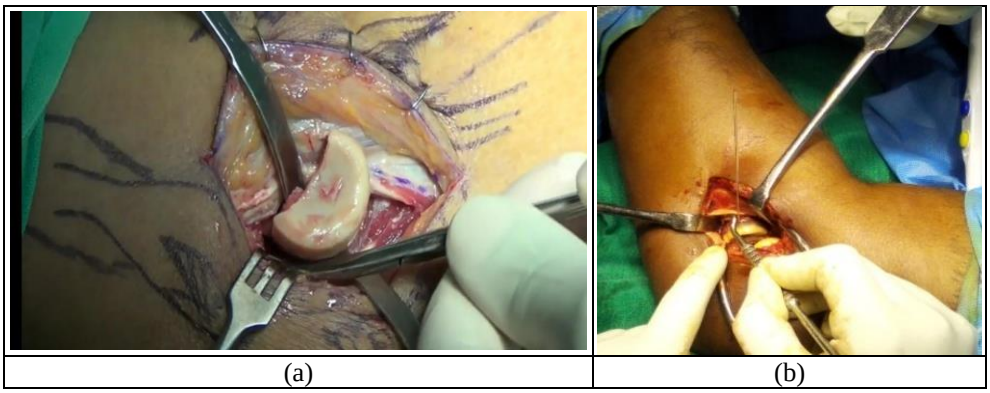
informed consents from all patients, a retrospective study was initiated in the Department of Orthopaedics, KVG Medical College and Hospital, Kurunjibag, Sullia, Karnataka. The patients were studied for the period from July 2014 to May 2021.

Study population

The study sample included 20 patients with age group ranging from 20 to 66 years and already diagnosed with acute closed uncomplicated Mason type II and type III fractures of radial head. Equal number (n=10) of males and females were selected. The study excluded patients with Mason type I and IV fractures and also patients with head injuries, solid organ injuries, ipsilateral upper limb injuries, pathological fractures, skeletal immaturity, osteoarthritis of the elbow or concomitant neurovascular injuries and also those who refused to participate. Two groups of patients were created. The Group I included 10 patients who underwent radial head excision, whereas the Group II included 10 patients who underwent ORIF with Herbert screws/ micro-plates.

Operative procedure

The benefits and drawbacks of both treatments were thoroughly presented to the patients, taking into account the nature of injury, degree of displacement and comminution, day-to-day activities, professional position and financial status among other factors. After obtaining medical fitness details, preoperative antibiotics were administered six hours prior to surgery. Under general anaesthetic or brachial block, the patient was placed in supine position on the orthopaedic table with the elbow kept in 90-degree flexion, shoulder in internal rotation, and forearm in mid-pronation. Both the surgical procedures used a lateral Kocher's approach (fig. 1) to the proximal radius, where the intermuscular plane between the extensor carpi ulnaris and the anconeus muscle was made [9-11].



(a) (b)

Fig 1: Radial head exposure using Kocher's approach for (a) excision (b) fixation with Herbert screws

For patients in Group I, the displaced and comminuted fragments were carefully removed without further damage, and using an osteotome the radial head was osteotomized (fig. 1a). In Group II the fragments were reduced and stabilized with k wires and fixation was done using Herbert screws/ mini-plates [12] (fig. 1b). Postoperatively, a plaster of paris slab was placed above the elbow and left in place for three weeks. Intravenous antibiotics were administered until the third postoperative day, after which oral antibiotics were administered until the sixth postoperative day. On postoperative day 12, the sutures were removed and the patient was discharged. The removal of slab was performed after 3rd week and beginning of elbow rehabilitation was observed afterwards.

Evaluation

Postoperative reviews were carried out during final follow-up. The range of motion (flexion, pronation and supination) was documented using photographs and using the Broberg and Morrey scoring system, evaluation of patients elbow function were rated [13]. Final X-ray evaluations were also carried out to assess the fracture healing as shown in figs. 2 - 4.

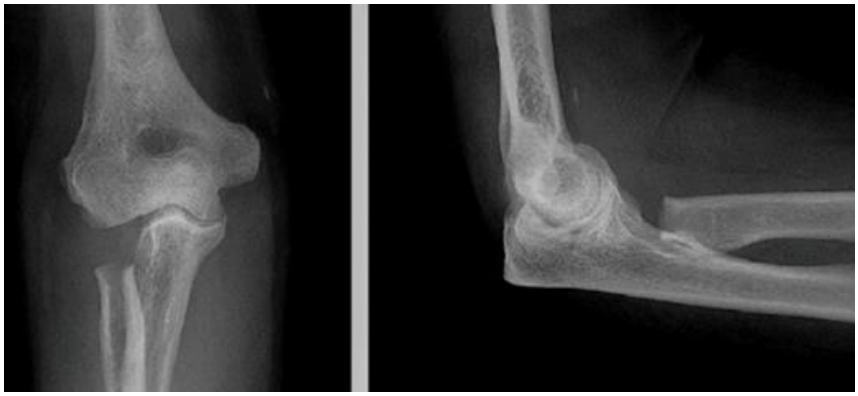


Fig 2: Radiographs at final follow-up of radial head excision

Fig 3: Radiographs at final follow-up of ORIF with mini-plate

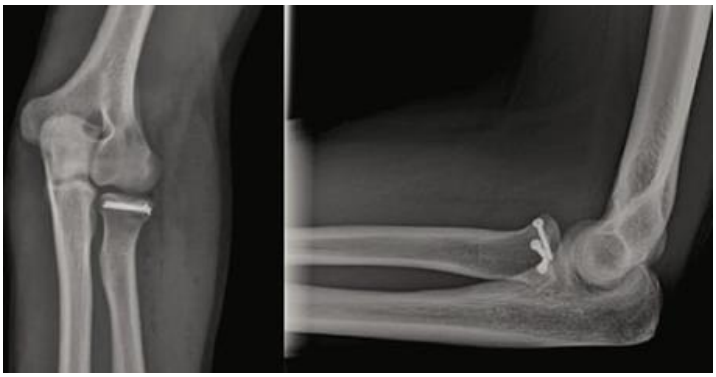


Fig 4: Radiographs at final follow-up of ORIF with Herbert screw

Statistical analysis

Chi-square test was used to compare, and analyze the collected data.

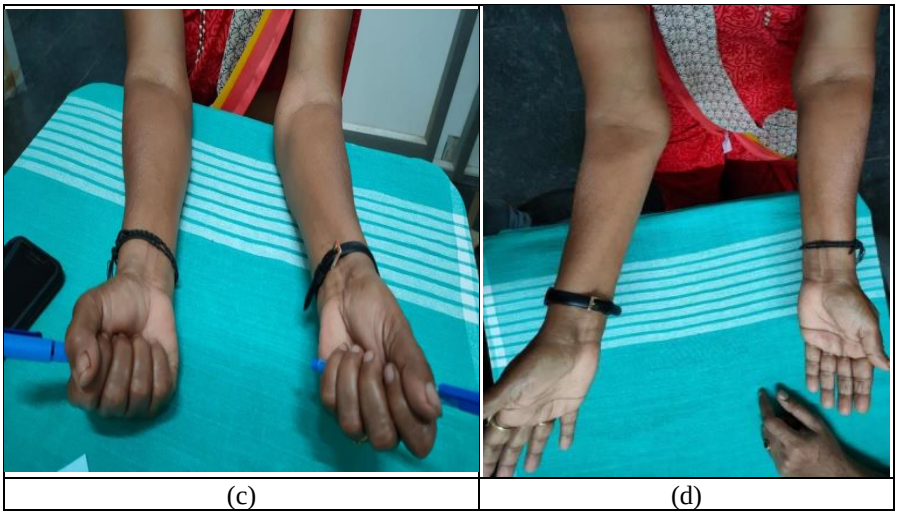
Microsoft Excel 2007 software was used to perform the chi-square test and a significance of '$p<0.05$' was determined. Range of motion, grip strength, functional stability, and pain are all factors in the Broberg and Morrey system functional evaluation score for the elbow, which ranges from 0 to 100 [13]. A questionnaire survey on pain, impairment, and elbow disability was included in the outcome evaluation.

Broberg and Morrey's functional rating score was based on the responses.

Results

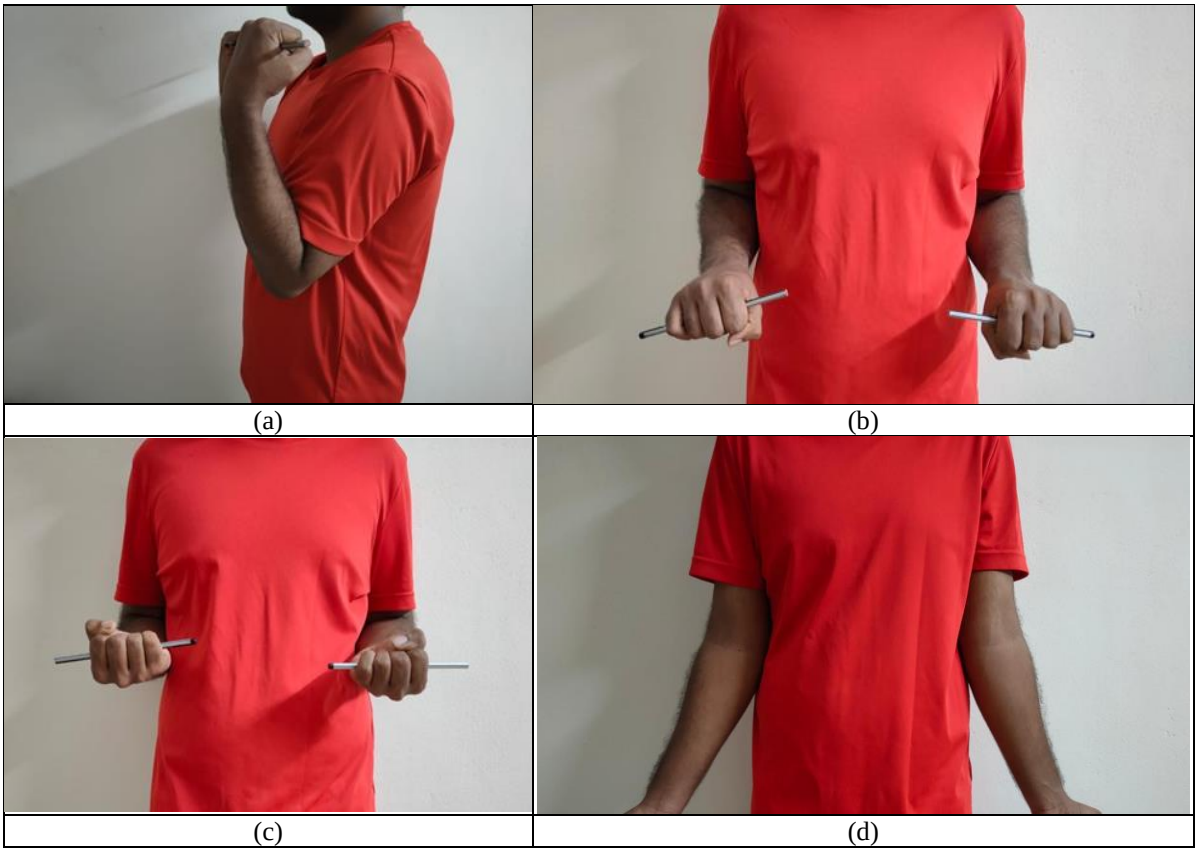
Broberg and Morrey's elbow functional evaluation criteria were used to track all of the patients. If the result was good or excellent, it was deemed satisfying; if it was fair or poor, it was regarded unsatisfactory. The typical photographs of range of motion (flexion, pronation and supination) and stability are shown in figs. 5 and 6 for excision and fixation respectively. In Group I (Table 1), the Broberg and Morrey functional rating score averaged 84.4 points (range, 73 to 91 points) while in Group II (Table 2), the score averaged 96.1 points (range, 90 to 99 points) ($p = 0.032$). In Group I, the outcome was graded as good for eight patients and fair for two, according to this rating method.

(a) (b)



(c) (d)

Fig 5: Functional outcomes (a) flexion (b) pronation (c) supination (d) stability during final follow-up of patient 1 of Group I.



(a) (b)

(c) (d)

Fig 6: Functional outcomes (a) flexion (b) pronation (c) supination (d) stability during final follow-up of patient 2 of Group II.

Table 1: Group I Broberg and Morrey scores

No.	Age (years)	Sex	Type of fracture	Follow up (weeks)	Motion		Strength	Stability	Pain	Total	
					Flexion	Pronation/ supination					
1	50	F	III	351.6	135	50/60	5	2	28	73	FAIR
2	38	F	II	219.4	120	60/60	13	4	35	88	GOOD
3	50	F	III	216.4	135	50/50	20	4	28	89	GOOD
4	44	F	III	195.3	125	50/50	13	4	35	87	GOOD
5	45	F	III	173.5	120	50/60	20	5	28	88	GOOD
6	24	M	III	125.3	135	50/60	13	5	35	91	GOOD
7	31	M	III	112.2	115	40/50	20	4	28	84	GOOD

8	50	F	II	105.1	120	50/50	13	2	28	77	FAIR
9	32	M	III	81.3	125	50/50	13	4	28	80	GOOD
10	35	M	II	117.2	125	50/50	13	4	35	87	GOOD
Mean	39.9			169.7	125.5	50/53	14.3	3.8	30.8	84.4	GOOD

Table 2: Group II Broberg and Morrey scores

No.	Age (years)	Sex	Type of fracture	Follow up (weeks)	Fixation material	Motion		Strength	Stability	Pain	Total	
						Flexion	Pronation/ supination					
1	47	F	II	302.4	Mini-plates	135	50/60	20	5	35	91	EXC
2	27	M	II	341.5	Mini-plates	135	60/70	20	4	35	99	EXC
3	20	M	III	164.3	Mini-plates	125	60/60	20	5	28	90	GOOD
4	44	M	II	93	Herbert screw	130	60/60	20	5	35	98	EXC
5	23	M	II	92	Herbert screw	135	50/60	20	5	35	98	EXC
6	66	F	II	62.4	Mini-plates	135	60/60	20	5	35	99	EXC
7	34	M	III	37.4	Herbert screw	135	60/70	20	4	28	92	GOOD
8	29	M	II	133.4	Herbert screw	130	60/60	20	5	35	98	EXC
9	36	F	III	131.4	Mini-plates	125	60/70	13	5	35	91	GOOD
10	62	F	II	169.2	Mini-plates	130	60/70	20	4	35	98	EXC
Mean	38.8			152.7		131.5	58/64	19.3	4.7	33.6	96.1	EXC

In Group II, the outcomes of seven patients were excellent, and for three patients the outcome was good. In Group I Proximal radial migration was observed in two of the 10 patients and also it was observed that two of the ten patients had peri-articular ossification (Table 3). No other complications were observed in Group I patients and Group II patients. During the follow-up no patient was observed to develop osteoarthritis in both groups.

Table 3: Rates of complications in Groups I and II during follow-ups

Difficulties	Excision	Fixation
Proximal radial migration	2	0
Osteoarthritis	0	0
Peri-articular ossification	2	0
None	6	10
Total	10	10

Discussion

In the 1970s, when conservative measures failed excision of radial head was the mainstay of treatment for Mason type II and type III fractures [14].

After radial head excision, several studies have observed problems such as proximal radial migration and peri-articular ossification [16, 17]. In the 1980s when the radial head was found as a secondary stabiliser of the elbow joint, reconstruction of the radial head became popular [15]. As surgical techniques and technology improved in the 1990s, radial head fixation became more important [5].

In the present study, Broberg and Morrey scores of elbow function were compared between the radial head excision (Group I) and ORIF (Group II). Comparative study clearly indicates that the ORIF group had significantly higher Broberg and Morrey ratingsthan the radial head excision group. Patients who received ORIF of the radial head had relatively better functional outcomes in terms of elbow function. These findings were similar to those of Ikeda *et al*., (2006) who found that the Broberg and Morrey functional scoring system averaged 81.4 points in the radial head excision group and 90.7 points in the ORIF group in a series of 28 patients with isolated type III Mason's radial head fractures [18].

Conclusion

We conclude that in this study ORIF of Mason type II and type III fractures of radial headhave a better functional outcome and lower complication rates. Hence, this procedure is more effective treatment option compared to radial head excision. Our results need to be interpreted with caution because of the retrospective nature and other limitations of the study. Long-term, prospective studies with larger patient groups are required for a definite judgment.

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