International Journal of Orthopaedics Sciences

ISSN: 2395-1958
IJOS 2017; 3(3): 320-327

www.orthopaper.com
Received: 28-05-2017
Accepted: 30-06-2017

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Short term outcome of patients with radial head fracture treated with operative management

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DOI: http://dx.doi.org/10.22271/ortho.2017.v3.i3e.60

Abstract
Introduction: Fractures of the radial head are common, constituting approximately one-third of all elbow fractures. These fractures typically occur when an axial load is applied to the forearm, causing the radial head to hit the capitellum of the humerus. The severity of these injuries runs the gamut from minimally displaced fractures needing minimal treatment to those with major displacement or comminution, requiring surgical fixation, excision, or replacement. Many elbow dislocations also involve fractures of the radial head. Radial head fractures are more frequent in women than in men, and are more likely to happen in people who are between 30 and 40 years of age.
Aim: To evaluate the result of different operative procedures in radial head fracture based on mayo elbow perfomance index score. Assesment of elbow function and functional abilities of patient in follow up studies.
Materials and Methods: This is a prospective study of 30 cases of radial head fractures of elbow in adults treated by surgical fixation and excision. The fractures were classified using the Mason's classification of Radial head fractures. The functional outcome was evaluated using the Mayo's elbow performance score system.
Results and Discussion: The mean Mayo Elbow Performance Score was 82.16 points; the score was classified as good or excellent for twenty six elbows (87%) and as fair for four. These results were quite comparable to those observed by Broberg *et al*, in their study.
Conclusion: In our study, we found the functional rating score of ORIF was higher than that of the Excision. The reason we thought was that ORIF had a better anatomical or functional reduction, a better recovery of physiological and physical function.

Keywords: radial head fracture, operative management, elbow dislocations

1. Introduction
Fractures of the radial head are common, constituting approximately one-third of all elbow fractures. These fractures typically occur when an axial load is applied to the forearm, causing the radial head to hit the capitellum of the humerus. The severity of these injuries runs the gamut from minimally displaced fractures needing minimal treatment to those with major displacement or comminution, requiring surgical fixation, excision, or replacement [1].
While trying to break a fall with your hands may seem instinctive, the force of the fall could travel up your forearm bones and dislocate your elbow. It also could break the smaller bone (radius) in your forearm. Fractures of the radius often occur in the part of the bone near the elbow, called the radial "head."
Radial head fractures are common injuries, occurring in about 20% of all acute elbow injuries [2]. Many elbow dislocations also involve fractures of the radial head.
Radial head fractures are more frequent in women than in men, and are more likely to happen in people who are between 30 and 40 years of age.
The surgical management of fracture of the radial head is primarily a function of the presence or absence of associated injuries. We have assessed the Mayo index score and demonstrated a correlation between the Mason type of fracture and associated injuries and describe a classification scheme to reflect this association. In general, any type II or III fracture should be considered to have an associated lesion, unless proven otherwise. The spectrum of management covers the broad potential of resection, internal fixation, or replacement. The indications for radial head restoration are principally related to associated injuries that dictate

the presence of a functioning radiohumeral articulation. Management of the uncomplicated fracture according to the mason grade.

The radial head is an important structure that is crucial to the stability of both the elbow and forearm.

Radial head has two primary functions

1. Load transmission from wrist and forearm
2. Secondary restraint to valgus stress at elbow level

Isolated radial head fracture involves part of the radial head and heals well with nonsurgical treatment. Sometime they are displaced enough to block forearm rotation and benefit from surgical treatment. In absence of a mechanical block or grinding, surgeon treat type 1, 2, conservatively In the presence of mechanical block to motion, we prefer to use open reduction and internal fixation to treat patient with high demand. For both type 2 and 3 fracture, we reserve option of radial head excision if stable and accurate reduction cannot achieved. Treatment of complex fracture based on associated injury. In presence of valgus instability we use hinged elbow orthosis. Radial head prosthesis is used if the elbow is unstable and radial head has been excised.

Aim

To evaluate the result of different operative procedures in radial head fracture based on mayo elbow perfomance index score. Assesment of elbow function and functional abilities of patient in follow up studies.

Materials and Methods

This is a prospective study of 30 cases of radial head fractures of elbow in adults treated by surgical fixation and excision.

Patients falling in the below mentioned inclusion criteria were included in the study:

1. Radial head and neck fractures of elbow in adults >18 years
2. Comminuted and displaced fractures

Patients falling in the following exclusion criteria were excluded from the study:

1. Compound fractures
2. Malunited fractures
3. complicated fracture

The cases were analysed as per the following criteria

1) Age distribution
2) Sex distribution
3) Side of injury
4) Mode of injury
5) Classification of fracture
6) Time interval between injury and surgery
7) Associated injures
8) Complications
9) Duration between injury and hospitalization
10) Mayo's elbow score

Mayo's elbow index score [3]

Function	Points	Definition	Points
Pain	45	None	45
		Mild	30
		Moderate	15
		Severe	0
Motion	20	Arc>100°	20
		Arc 50-100°	15
		Arc<50°	5
Stability	10	Stable	10
		Moderate instability	5
		Gross instability	0
Function	25	Comb hair	5
		Feed	5
		Hygiene	5
		Wear shirt	5
		Wear shoes	5
Total score = 100, Excellent result = >90, Good result = 75-89, Fair = 60-74, Poor result = <60			

Procedure and post operative protocol

All the patients were received in the casualty department and primary treatment was given to them. If there were any other major associated injuries, they were treated accordingly at first. After the general condition of the patient improved, radiographs (AP View and lateral view) of elbow were taken. The fractures were reduced in closed manner (supination – flexion technique) at first under sedation and an above elbow slab was applied. Fractures with comminution were taken for excision of radial head. Other simple cases were fixed with plates.

Most of the cases were taken for elective fixation after 2 days. The patients who had associated major injuries were taken up for surgery between 3rd and5thday.

Implant

2.4 mm LCP Radial head plates

Plate features: 09 radial head plates were available to address various fracture pattern of the proximal radiusThe plates were pre contoured for anatomical fit. Combi hole allowed fixation with locking screw in the threaded section for angular stability and cortex screw in the dynamic compression unit section for distraction. A Fixed angle construct provided advantage in osteopenic bone or multifragment fracture, where traditonal screw compromised.

Screw used with the 2.4mm LCP radial head plate

- 2.0mm cortex screw for the use in round hole in plate to provide compression or neutral fixation
- 2.4mm cortex screw for use in combi hole n plate shaft to provide distraction
- 2.4mm locking screw, self tapping threaded conical head locks securely to provide angular stability.
- 2.7mm corte screw, self tspping for us in combi hole in plate shaft to provide distraction.

Open reduction and internal fixation with radial head plates [4]

A tourniquet was used during surgery. The radial head was

exposed from lateral side of elbow. We used kocher's approach for exposing the radial head. The cleavage between anconeus and extensor carpi ulnaris was developed. The LCL was retracted medially along with ECU. An incision was made in the annular ligament in the midlateral plane to avoid injury to lateral ulnar collateral ligament (LUCL). It is better to do a Z capsulotomy for better repair after plate fixation or arthroplasty.

The fractured site was identified and with minimal periosteal stripping, they were mobilized. The medullary cavity was cleared of any hematoma and the fractured fragments were reduced by carefully matching the interdigitations using bone holding forceps. A radial head plate of appropriate length was selected and applied to the radial head on the lateral side and fixed with 2.7mm locking cortical screws. All the fractures were fixed such that there were at least four to six cortical purchases on either side of the bony fragment. Thorough wash of both wounds done. The LCL and annular ligament were repaired after that subcutaneus and skin closure was done. Compression bandage was applied. Tourniquet was released and an above elbow slab was applied.

Post operative protocol

In the immediate post operative period the upper limb was immobilized in an above elbow slab, and kept elevated till the edema of fingers subsided. The wound was inspected on the 2nd POD and then suture removal was done on 10th POD. The upper limb was immobilized depending upon the rigidity of fixation. At the end of 4th and 6th weeks, X rays were taken to visualize callus response. The pronation and supination movements were started by the end of 6th week.

Radial head excision

Most of the comminuted fractures which could not be fixed adequetely were excised. We routinely used tourniquet during surgery. The radial head exposed from lateral side of elbow. We always used kocher's approach for exposing the radial head. The cleavage between anconeus and extensor carpi ulnaris was developed. The LCL was retracted medially along with ECU. incise the annular ligament in the midlateral plane to avoid injury to lateral ulnar collateral ligament (LUCL). Fracture fragment should be identified and removed with nimbler check under iitv to avoid missing of fragments. The wounds were sutured as above mentioned.

Post operative protocol

The upper limb was kept elevated. Wound inspection was done on II POD. Suture removal was done on Xth POD, and above elbow slab was applied. After 4 weeks the slab was removed, after obtaining check X rays. Active elbow mobilization exercises were started at the end of 4th week. By the end of 6 weeks, the cast was discontinued and active pronation and supination exercises were started.

Pittfalls and their management

Infection

Three cases developed wound infection, 2 of them were superficial and one deep. Pus culture for sensitivity was sent in all the three cases and treated with appropriate antibiotics. The superficial infections subsided with treatment for 3 weeks, but in the case with deep infection debridement of the wound was done and appropriate antibiotics were given and finally the infection subsided after 3 weeks.

2. Delayed union

Delayed union developed in one case treated with radial head plating. The patient had comminuted fracture of radial head. At the end of 6th week, there was tenderness at lateral side of elbow. Radiologically there was no callus. The fracture was immobilized with above elbow cast for another 4 weeks. Eventually there was adequate callus response and the fracture went on to unite well.

3. Elbow stiffness

Two patients who were treated with radial head platting developed elbow stiffness at the end of 6th week while removing above elbow cast. The patients were put on strict regimen involving active mobilization exercises of elbow. Eventually both patients had good range of motion of elbow.

4. Nerve injuries

Injury to posterior interosseous nerve can occur in kocher's approach during plating of radial head. Also, there are chances of injury to recurrent radial artery and superficial branch of radial nerve through this approach. These can be prevented by knowing the proper anatomy of forearm and gentle handling of soft tissues.

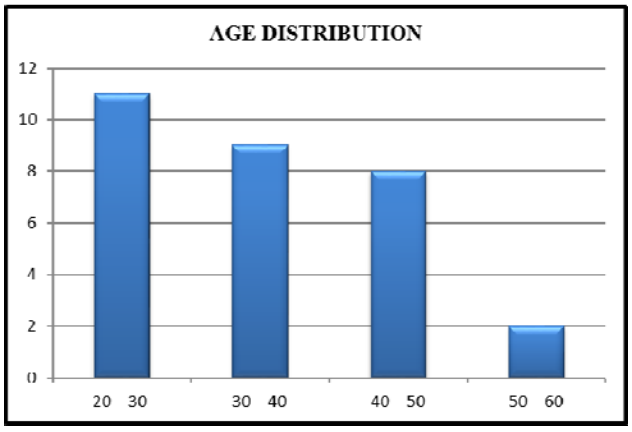
Results

Age distribution

The age group varied from 20 years to 60 years with the mean age of 40 years. Incidence of fracture was observed maximum between 20-30 years of age.

Table 1

Age Group	Number of cases	Percentage
20 – 30 years	11	36.7
30 – 40	9	30.0
40 – 50	8	26.7
50 – 60	2	6.7



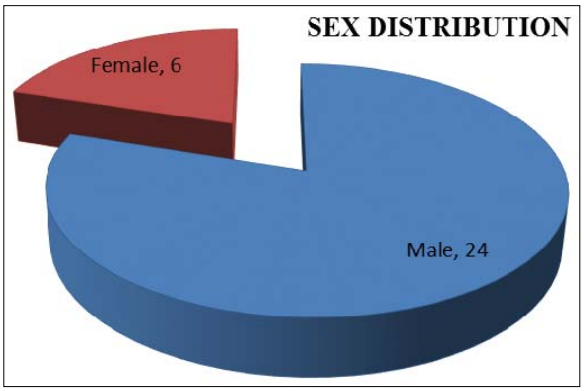
Graph 1

II. Sex distribution

Among the 30 cases in our study, males (80%) were predominant.

Table 2

Sex	Number of cases	Percentage
Male	24	80
Female	6	20



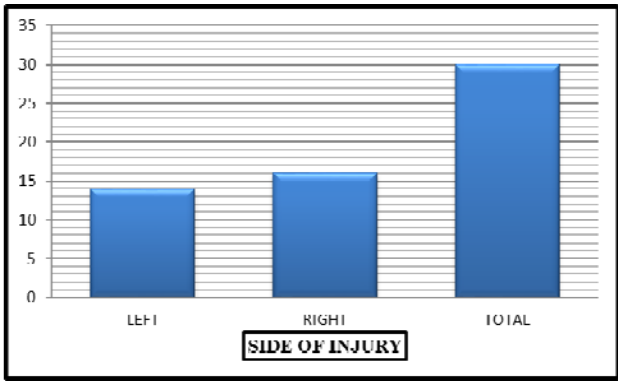
Graph 2

III. Side of Injury

Right side was more common in our series.

Table 3

Side Of Fracture	Frequency	Percentage
Left	14	46.7
Right	16	53.3
Total	30	100



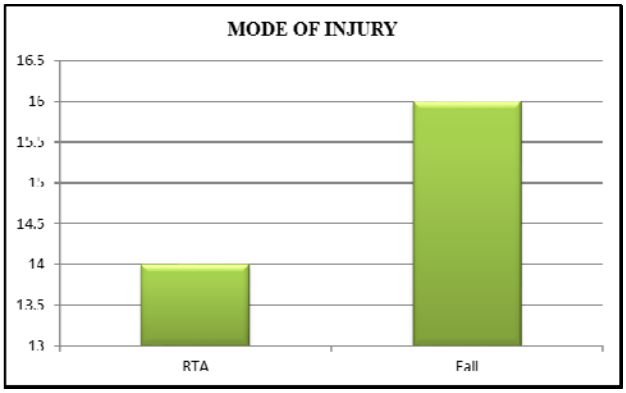
Graph 3

IV. Mode of Injury

Commonest mode of injury had been fall down with outstretched hand.

Table 4

Mode of Injury	No. of cases	percentage
RTA	14	46.66
Fall Down	16	53.33



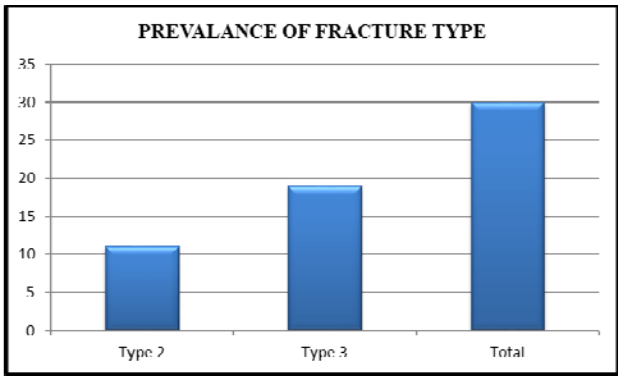
Graph 4

V. Classification of fracture

Mason's [5] type 3 fracture had more prevalence.

Table 5

Mason's type	No. of cases	Percentage %
Type 2	11	36.6
Type 3	19	63.3
Total	30	100.0



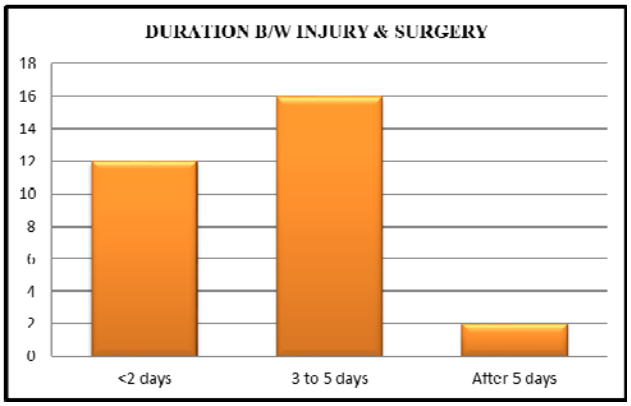
Graph 5

VI. Time interval between injury and surgery

Most of patients (43.3%) were treated within 5 days.

Table 6

Time interval	No. of cases	Percentage %
<2 days	12	40
3 to 5 days	16	43.3
After 5 days	2	6.7

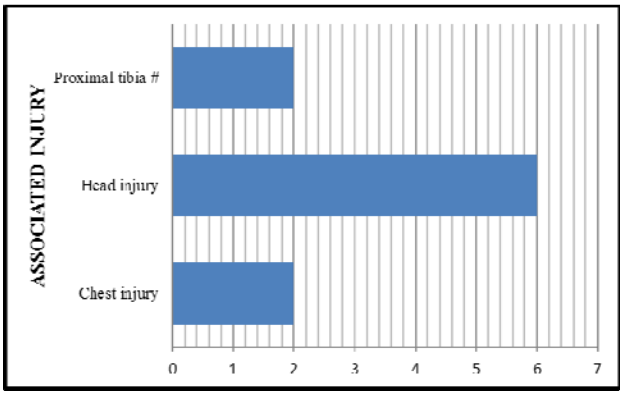


Graph 6

VII. Associated Injuries

Most common associated injury was head injury in our series.

	Frequency	Percentage
Chest injury	2	20
Head injury	6	60
Proximal tibia #	2	20

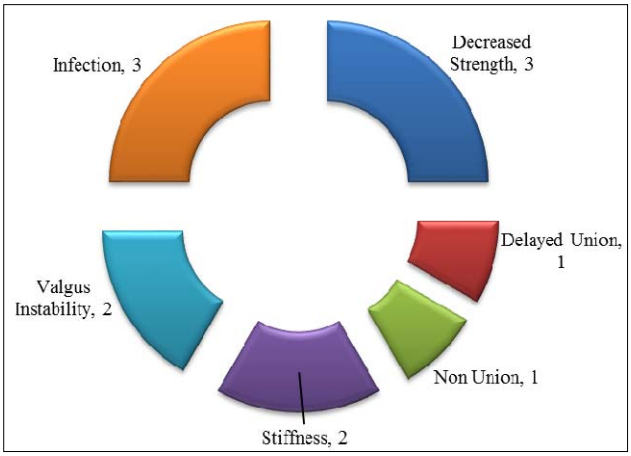


Graph 7

VIII. Complications

Decreased strength and infection was observed to be the most common complication in operative modalities of radial head fracture.

	Frequency	Percent
Decreased Strength	3	25
Delayed Union	1	8.3
Non Union	1	8.3
Stiffness	2	16.6
Valgus Instability	2	16.6
Infection	3	25
Total	12	100.0



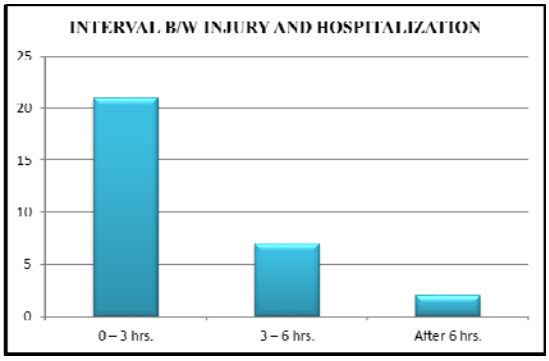
Graph 8

IX. Duration between injury and hospitalization

Almost 70 % patients were hospitalized within 03 hours of injury.

Table 7

Time interval	No. of cases	Percentage
0 – 3 hrs.	21	70
3 – 6 hrs.	7	23
After 6 hrs.	2	6.7
Total	30	100



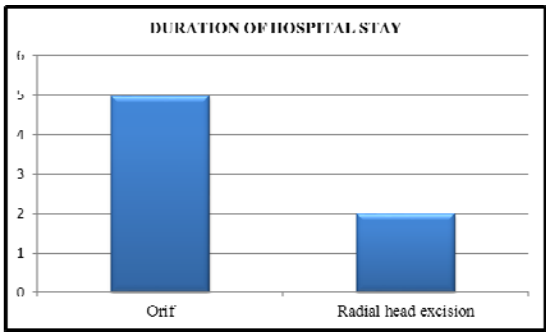
Graph 9

X. Duration of hospital stay post operatively

Duration of hospital stay was observed to be more in radial head platting than in excision.

Table 8

Procedure	Duration of stay
Orif	5 days
Radial head excision	2 days



Graph 10

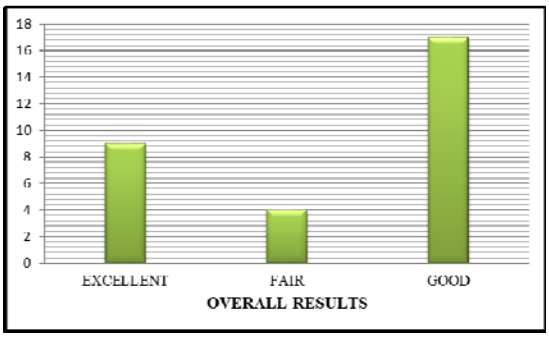
Analysis of functional outcome

The Analysis was done using modified mayo's elbow score index and the following results were obtained.

I. Overall results

Table 13

Grading	Number of Cases	Percentage
EXCELLENT	9	30.0
FAIR	4	13.3
GOOD	17	56.7
Total	30	100.0

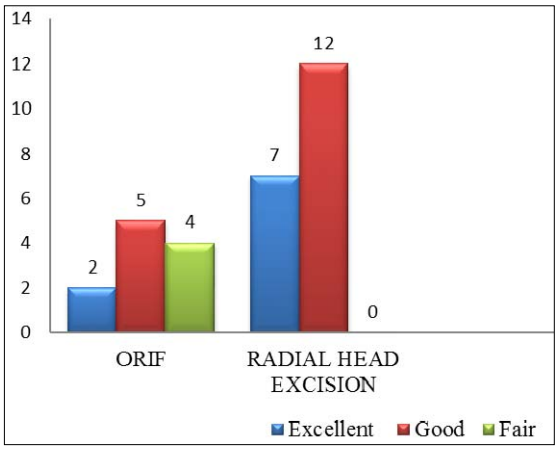


Graph 11

II. Results according to procedure

Table 14

Implant	Grading	Number of cases	Percentage
ORIF	Excellent	2	18.18%
	Good	5	45.45%
	Fair	4	36.36%
	Grading	**Number of cases**	**Percentage**
Radial head excision	Excellent	7	36.84%
	Good	12	63.15%
	Fair	0	0%



Graph 12

Statistical analysis

The average time for return to normal work was 12.54 weeks in plating patients and 11.2 weeks in patients treated with radial head excision. The S.D. was found to be 1.508 and 0.9335 in patients treated with plating and radial head excision respectively. The P value is 0.0074 and T value is 2.890 at 95% CI at degree of freedom 28, hence it is significant.

The mean value of Mayo's elbow score in Patients who underwent radial head excision wass 84.73 and in plating was 77.72 Standard deviation being 8.736 and 9.318 for patients who underwent excision and plating respectively. The P value was found to be 0.00484 and the p value < 0.01. The T Value is 2.068 at 95% CI at degree of freedom 28 hence it is statistically significant. Hence the study supports that radial head excision is superior to platting.

Discussion

Radial head fractures are among the most common fractures occurring around the elbow in adults, accounting for 1.5% to 4% of all fractures and approximately 33% of all elbow fractures [6]. Although radial head fractures can occur in isolation, associated fractures and ligament injuries are common. Assembling the clinical presentation, physical examination, and imaging into an effective treatment plan can be challenging. The characteristics of the radial head fracture influence the technique used to optimize the outcome.

The mechanism of injury in radial head and neck fractures is usually a fall onto an outstretched hand with a partly flexed elbow and pronated forearm, causing a longitudinal impact of the radius against the capitellum. The force of trauma is transmitted along the forearm, producing a valgus stress at the elbow and causing compression of the radial head against the capitellum, which results in fracture due to shear between the vertically aligned trabeculae and may injure the capitellum. Clinically, moderate to severe pain, local tenderness with swelling, and a positive fat pad sign with a fracture line on radiography are diagnostic features. Conventional radiography with anteroposterior and lateral views is usually adequate for detection of radial head and neck fractures. Internal and external oblique radiographs are occasionally required. Computed tomography with reconstruction images is helpful to aid in decision making.

Mason's classification [5], based on the severity of radial head and neck fracture, is used clinically to formulate the type and extent of treatment. Mason classified radial head fractures into 3 groups: type I is an undisplaced marginal fracture, type II is a displaced marginal fracture, and type III is a comminuted fracture. A fourth group was subsequently added: type IV, which includes any radial head fracture with dislocation of the humeroulnar joint.

The aim of this study was to know the results of treating radial head fractures of elbow with operative modalities mainly radial head excision and radial head platting. We selected 30 cases of radial head fractures in the elbow in adults. Most of these patients fell into the age group of 20-30 years (range: 20-60 years) with majority of them being males. These injuries are commonly seen in young adults owing to the fragility of this area at this age, when exposed to violent trauma. These observations were similar to those observed in a study undertaken by Hung-Yang Chien, *et al*, in December 2010 [7] also by Boufettal *et al*, in March 2014 [8]. The mode of violence is either due to RTA or due to accidental fall. The patients who had simple mason type 2 fracture pattern were fixed with plate and the fractures with comminution were undergone radial head resection. Compound fractures were excluded from our study.

The fractures were classically classified using Mason's classification and it was observed in our study that majority of the patients had mason's Type III fracture. This observation was analogous to those observed by Chien, *et al*, in December 2010 [7].

Average time of fracture healing was 8 to 10 weeks in patients who had undergone radial head platting, except one patient had a delayed union, and it took 12 weeks until osseous union was evident radiographically. Six patients had restricted pronation & supination. Five patients were treated with radial head platting and one patient with radial head excision had restricted supination and pronation. Seven patients treated with excison gave excellent results with regard to pronation & supination. The mean pronation was 84°, and the mean supination was 85°. Restoration of pronation & supination activities were possible by the end of 6th week using excision whereas they were possible by the end of 9th week using orif.

Two patients developed post-operative stiffness of elbow joint. Both patients were treated with orif. However, all these patients eventually had fair range of motion by the end of 12 weeks following intense physiotherapy.

Almost all people treated with platting and excision could resume their own normal activities and could continue their previous work successfully. Restoration of normal activities

were possible at the end of 12-14 weeks in patients treated with radial head platting but in case of radial head excision it was around 10-11 weeks.

Twenty-one patients (70%) had no elbow pain, five had mild pain, and four had moderate pain. The mean arc of motion was from 9° to 139° of flexion.

The mean Mayo Elbow Performance Score was 82.16 points; the score was classified as good or excellent for twenty six elbows (87%) and as fair for four.These results were quite comparable to those observed by Broberg *et al* [8], in their study in March 2016.

Three patients complained of wrist pain, which was mild in two patients and moderate in one. Twenty seven elbows had normal strength in comparison with the unaffected side.

In two patients, some degree of elbow instability could be detected on physical examination. The mean carrying angle of the involved elbow was significantly greater than that of the uninjured elbow (21° compared with 10°).

Two patient required antibiotics for a superficial wound infection in the immediate postoperative period. There were deep infections in 1 case treated with debridement and sensitive antibiotic. Occasional pain and/or paresthesias were present in two patients; however, these symptoms decreased with time, and, at the time of the final follow-up, they did not require treatment for this problem.

In this patient radial head excision was chosen because he has no other associated soft tissue injury. However he may still develop complications associated with radial head excision such as loss of grip strength, wrist pain, valgus instability, heterotrophic ossification and post-traumatic arthritis of the trochlea-olecranon articulation. Another complication which has not been recognized previously as a complication of radial head resection is postero-lateral rotatory instability. This complication is difficult to diagnose due to the absence of the radial head after radial head excision. Hall and McKee [9] have identified a series of patients with postero-lateral rotatory instability following radial head resection. They believe that this instability is secondary to unrecognized lateral ulna collateral ligament deficiency pre-operatively and this instability may be a cause of unexplained elbow pain and instability following radial head excision.

The reported long term outcomes of the treatment of radial head and neck fractures with excision of the radial head have been mixed. Herbertson and colleagues [9] has shown that following a displaced radial head or neck fracture, excision of the radial head often leads to a good or fair result. They also found no differences in outcome between primary and delayed radial head excisions following a Mason type II or III fracture. The other available option to avoid these complications especially in a young patient population is replacement of the radial head with prosthesis.

In the elderly patient, low energy injury or lack of associated soft tissue disruption, resection of the radial head alone is an acceptable approach and in most instances is not associated with long term sequelae. This has been shown by Janssen and Vegter [10], where more than half of the patients had radiographic evidence of proximal migration of radius from 1 to 3mm after radial head excision, but only a few had any or mild wrist symptoms.

This case illustrates that excision of the radial head is an acceptable option and often leads to a good or fair result if used in the right situation. It also stressed the importance of assessing other associated soft tissue injuries with radial head fracture as it will affect the choice of treatment for individual patient and the long term outcome. Although Modified Mason classification does not include associated soft tissue injuries, it is still useful to guide the surgeon for the most appropriate treatment for each type of fracture.

A satisfactory device for internal fixation must hold the fracture rigidly, eliminating as completely as possible angular and rotatory motion. This can be accomplished by radial head plates.

During radial head platting, to minimize further injury to blood supply of the bone, the periosteum was stripped sparingly with a periosteal elevator and only sufficiently for applying a plate. The fragments were carefully reduced with interdigitating bone spicules being fitted properly. Comminuted fragments were fitted accurately in place. The plates were selected such that at least there were four to six cortical purchases on either side of fracture fragments. The plates were contoured before they were applied to the bone. Our study has showed good fracture union occurred in 91% of cases.

Orif offers the following advantages when compared with radial head excision.

a) better stability
b) full strength
c) good functional outcome

In our study, the rehabilitation time was much shorter for fractures operated with excision when compared with orif. The average time required for functional recovery is more than 9 weeks in orif, and about 6 weeks when excision. The duration of hospital stay post operatively was also less (on an average of 3 days for excision and 5 days for orif).

Excision provides for short operating time, short hospital stay and early rehabilitation than orif but poor functional outcome e.g. decreased strength, valgus instability, proximal radial head migration. While orif have better functional outcome and less complication. If adequate fixation done in orif, its excels better results than excision.

Conclusion

Over the past years, people used to hold the opinion of that excision was more likely leading to migration of the radius, thus resection was performed less than ORIF. While our study discovered that migration of the radius is not the only and most important difference between these two operations. It is functional rating score or degree of functional recovery that really makes a difference. In our study, we found the functional rating score of ORIF was higher than that of the Excision. The reason we thought was that ORIF had a better anatomical or functional reduction, a better recovery of physiological and physical function.

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