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Original Research Article

Monteggia fracture dislocation in adults: study of functional outcome following surgical treatment in patients attending a tertiary care center in North India

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ABSTRACT

Background: Monteggia fracture dislocations are rare injuries that comprise less than five percent of all forearm fractures. Good results in monteggia fractures depend on early and accurate diagnosis, rigid fixation of ulna, accurate reduction of radial head and post-operative immobilization to allow ligamentous healing about the dislocated radial head. The objectives of the study were to assess the mean time taken for union of fracture, complication encountered during treatment, to assess the functional outcome and to present conclusions based on the results of plate osteosynthesis of monteggia fracture dislocation in adults.
Methods: In a prospective study from September 2013 to August 2016, twenty adult patients of monteggia fracture were admitted and treated by closed reduction/excision of radial head and compression plate fixation of ulna. The results were evaluated by assessing union on serial x-rays at follow-up (6-18 months) and functional outcome using Anderson's criteria.
Results: Most of the cases were type-1 fracture-dislocation according to Bado's classification. Mean time taken for union was 4.1 months. Using Anderson scoring system, we achieved 65% excellent results, 30% satisfactory result and 5% failure in study case. The complication encountered were superficial infection and non-union.
Conclusions: The technique of early closed reduction of radial head and open reduction and internal fixation of ulna using compression plate is a simple and effective means of treating monteggia fracture dislocation in adults with excellent functional outcome. Upper limb should be immobilized in 110-120 degrees of elbow flexion and forearm in supination to prevent radial head redislocation.

Keywords: Functional outcome, Monteggia fracture, Radial head dislocation, Ulna fracture

INTRODUCTION

Giovanni Battista Monteggia of Milan in 1814 published his classical description of the fracture that is associated with his name monteggia fracture. He described as fracture to proximal 1/3rd ulna associated with anterior dislocation of radius head.[1]

Bado classified monteggia lesions into four distinct categories (Figure 1).[1] Type-I is fracture of ulnar diaphysis at upper third level with anterior angulation at the fracture site and an associated anterior dislocation of the radial head. Type-II is fracture of ulnar diaphysis with posterior angulation at the fracture site and a posterior dislocation of radial head. Type-III is fracture of ulnar

metaphysis distal to coronoid process with lateral dislocation of radial head and Type-IV is fracture of the proximal third of radius and ulna at the same level with anterior dislocation of radial head. Type-I lesion is the most common, Type-III and type-II lesions are next in the frequency and Type-IV lesions are the rarest.

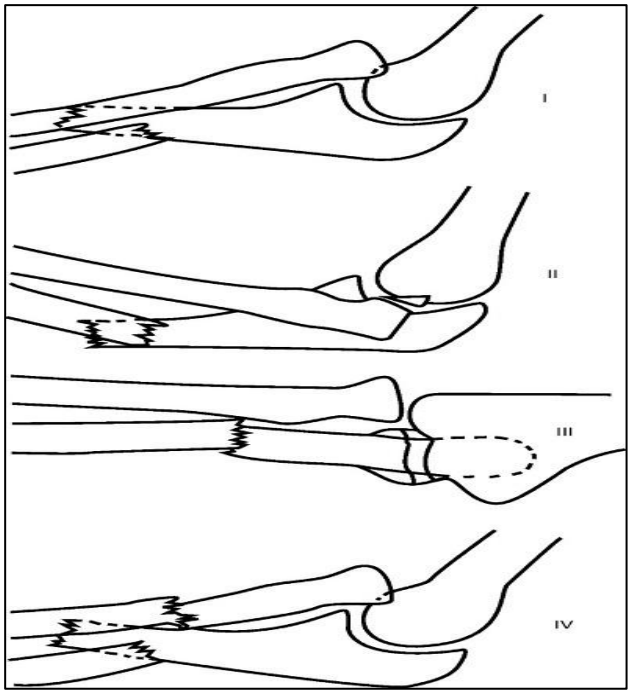

Figure 1: Bado's classification of monteggia fracture dislocation.

Jupiter and colleagues found four different subgroups of the posterior monteggia lesion based on the location of ulnar fracture (Figure 2).[2] According to them, Bado type-II lesions with comminuted anterior surface of ulna are unstable injuries. Type II A is the ulnar fracture involving the distal olecranon and coronoid process; in Type II B the ulnar fracture is at metaphyseal and diasphyseal juncture, distal to Coronoid; in Type II C the ulnar fracture is diaphyseal and in Type II D the ulnar fracture extends along the proximal third to half of the ulna.

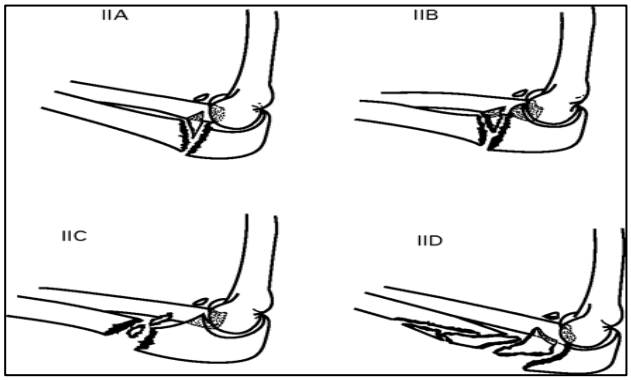

Figure 2: Jupiter classification of posterior Monteggia fractures (Bado type II).

Monteggia fracture dislocations are rare injuries that comprise less than five percent of all forearm fractures.[3] These fractures have variety of complications that are unique to this lesion including error in diagnosis, redislocation of radial head and radioulnar synostosis apart from complications like joint stiffness, heterotropic ossification nerve injuries, malunion, nonunion and infection.[4-9]

Historically the treatment of monteggia fracture-dislocation especially the dislocation of radial head has been controversial. Many surgeons believed that monteggia fracture dislocation could be treated nonoperatively.[10] Closed methods are now considered satisfactory only in paediatric patients.[11]

For acute injuries in which the dislocation of the radial head can be reduced by closed methods, open reduction of the dislocation is not indicated but the fracture of the ulna is rigidly fixed. In the proximal third of ulna where medullary canal is small, either a compression plate or intramedullary nail is used. Subluxation of radial head requires open reduction.[4] For acute injuries in which interposition of annular ligament or capsule prevents reduction of the dislocation, repair or reconstruction of annular ligament and rigid internal fixation of the fracture of ulna is done.[10] For old injuries (six weeks or older) in which dislocation of radial head has never been reduced or in which insufficient fixation of fracture of ulna has allowed angulation of this fracture and redislocation of radial head, the radial head is excised and ulna rigidly fixed with cancellous bone graft supplement.[10]

Good results in monteggia fractures depend on early and accurate diagnosis, rigid fixation of ulna, accurate reduction of radial head and post-operative immobilization to allow ligamentous healing about the dislocated radial head.[12-13]

The objectives of the study were to assess the mean time taken for union of fracture, complications encountered during treatment, assess the functional outcome and to present conclusions based on the results of plate osteosynthesis of monteggia fracture dislocation in adults. This study is undertaken to verify the claims of various authors regarding surgical management of monteggia fracture-dislocation in adults and to know the advantages and complications of surgical management.

METHODS

The present prospective study was conducted in the Department of Orthopaedics, Hind Institute of Medical Sciences, Barabanki, extending from September 2013 to August 2016. Study was approved by Institutional Review Board. Patients of 18 years of age and above with closed fracture of shaft of ulna with dislocation of proximal radioulnar joint, admitted in orthopaedic wards of the hospital were included in the study. Patients presenting with open fracture, polytrama, neurovascular

injury, pathological fracture, monteggia variants and missed monteggia lesions were excluded from this study. During the study period, 20 cases of monteggia fracture dislocation in adults were studied. There were twelve male patients and eight female patients who underwent surgery. Seven of the male patients had right side involvement and five had left side involvement. Six of the female patients had right side involvement and two had left side involvement. Of the twenty cases, nine patients met with road traffic accidents. Eight patients had fallen from a height on to the ground and three patients sustained injury while guarding against assault with a stick.

Clinical and radiological evaluation

As soon as the patient was admitted to hospital, thorough clinical examination was done regarding general condition of the patient. Any associated systemic disease and any associated injuries were recorded. All patients presented with elbow in some flexion supported by the other hand. All of the cases were simple fracture-dislocations. Tenderness, bony irregularity, crepitus and deformity of ulna were elicited clinically. In sixteen patients, radial head was palpable anteriorly which was confirmed by rotatory movements. One of the patients who presented late to the hospital had minimal pain and restriction of movement. In three patients, radial head was palpated posterolaterally and in one patient who had signs of fracture of proximal ulna and proximal radius, the head was palpated anteriorly. Standard X-rays in anteroposterior and lateral views were taken for confirmation of diagnosis and classifying fractures by analyzing location, displacement and angulation of ulna and/or radius fracture dislocation according to Bado's classification system.

The upper limb was immobilized in above elbow POP posterior slab. The affected limb was kept elevated. Pain and inflammation was managed by using diclofenac sodium 50mg twice daily. In one of the patients who had head injury, patient was treated by neurosurgeon. He was diagnosed to have concussion, which resolved in four days. Another patient had contra lateral fracture of the radial shaft at the junction of middle and lower third, which was immobilized with above elbow POP slab. There was one male patient who sustained injury by falling on to the ground after being hit by a bicycle. This patient presented to the hospital seven weeks after the injury. Patient had not taken treatment anywhere prior to presenting to the hospital.

Surgical procedure

Routine preoperative tests were done. Fitness and consent for surgery obtained. All operations were performed under general anaesthesia using tourniquet. First, attempt was made to reduce the dislocation of the radial head by traction on the forearm and counter traction on the arm followed by flexion of the elbow to 110-120 degrees. Once the radial head dislocation was reduced, which was confirmed by palpation of radial head just below the lateral epicondyle. A vertical incision along the subcutaneous border of ulna extending distally was made.[14] Fascia was incised along the line of skin incision. An interval was developed between flexor or carpi ulnaris and extensor carpi ulnaris and incision was made through the periosteum of the ulna to expose the fracture site. Sufficient periosteum was stripped sparingly from each fracture end using periosteal elevator. Fracture hematoma was cleared off and the fracture site was gently curetted with small curette. Accurate anatomical reduction was achieved and fixation done using 3.5mm dynamic compression plate or limited contact dynamic compression plate and cortical screws minimum three on either side of fracture. Once rigid fixation was achieved, the wound was closed in layers and sterile compression dressing was applied with forearm in supination and elbow flexed to 100 to 110 degrees to prevent the radial head re-dislocation. After removing the tourniquet, the limb was immobilized in a posterior POP slab. Check X-ray was taken to confirm that the radial head has remained reduced and ulna is fixed properly.

Post-operative management and follow up

All the patients were treated with Injections Cefotaxim 1gm twice daily and Gentamycin 80mg twice daily for five days. Some cases were treated with Amikacin 500mg twice daily. Postoperative pain and inflammation was managed using Diclofenac sodium 50mg twice daily. Affected limb was kept in elevation and patient was asked to perform finger movements on day 1 and continued. On fifth day, wound inspection was done and if found to be healing satisfactorily, injectable antibiotics were stopped and tablet Cifran 500 mg twice daily was started. On tenth day, the posterior slab and the sutures were removed, oral antibiotics were stopped and long arm cast was applied with elbow in flexion and patients were discharged. At four weeks, the cast was removed and the extremity was supported with cuff and collar sling, maintaining the elbow at 110 to 120 degrees. Gentle pronation and supination motions were permitted, but extension was not permitted below 90 degrees until 6 weeks after injury.

At follow up after six weeks, a detailed clinical examination was done and the patient was assessed subjectively for the symptoms like pain and restriction of joint motion. On clinical examination, tenderness, movements of the elbow joint, nutrition and power of the muscles acting on the joint were noted. Check X-rays were taken for radiological assessment of the union of fracture. Patients were instructed to carry out active exercises at home, like active flexion, extension, pronation and supination without loading. Later, patients were advised to report for follow up after 12 weeks and thereafter every 3 months for total of 18 months. Check x-rays were taken for assessment of radiological union (Figures 3-7).

Figure 3: Preoperative anterioposterior and lateral X-ray views of type 3 monteggia fracture.

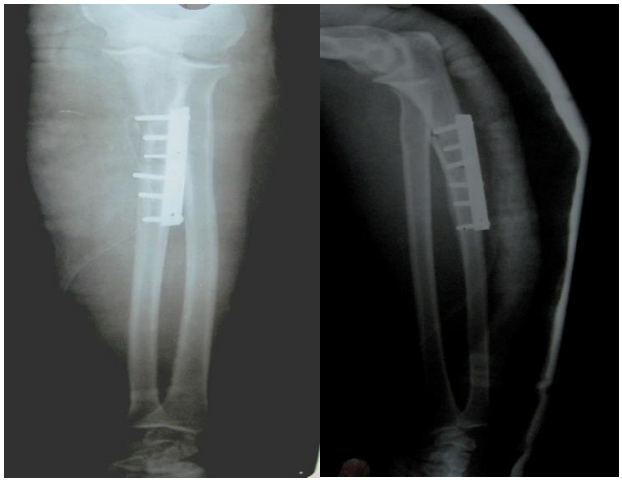

Figure 4: Immediate post-operative X-rays.

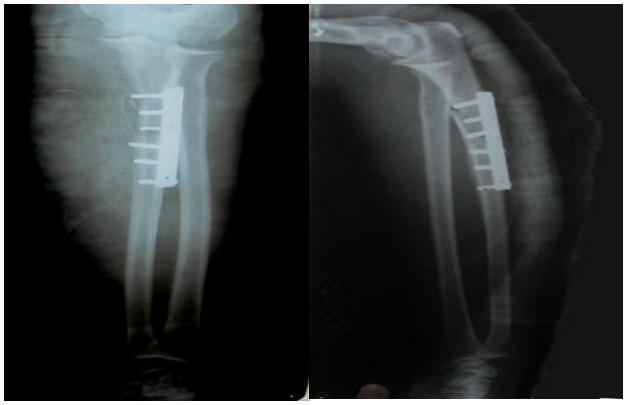

Figure 5: Post-operative 6 weeks X-rays.

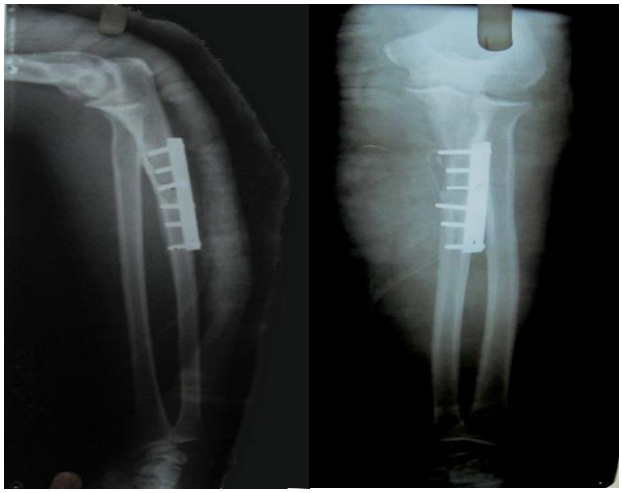

Figure 6: Post-operative X-rays at 12 weeks showing union.

Figure 7: Photographs showing excellent range of motion achieved following fixation.

Evaluation of results

The fracture was considered united when clinically there was no tenderness, no subjective complaints and radiologically when the fracture line was not visible. Fractures, which healed 6 months later, without an additional operative procedure was considered as delayed union. Fractures which did not unite after six months or that needed additional operative procedure to unite was considered as nonunion The results of all treated monteggia fracture dislocations were evaluated in our study using Anderson et al., scoring system (Table 1).[15] An excellent result meant union of the fracture, loss of flexion and extension at the wrist or elbow of less than 10 degrees, and loss of pronation and supination of less than 25 per cent. In a satisfactory result, there was union of fracture, loss of flexion or extension at the wrist or elbow of less than 20 degrees, and loss of pronation and

supination of less than 50 per cent. A result was unsatisfactory when there was union of the fracture and either loss of flexion and extension at the wrist or elbow of more than 20 degrees or loss of pronation and supination of more than 50 per cent. A failure was a nonunion or unresolved chronic osteomyelitis.[16]

Table 1: Anderson's scoring system for functional outcome.

Results	Union	Flexion/extension at elbow joint	Supination and pronation
Excellent	Present	< 10° loss	< 25% loss
Satisfactory	Present	< 20° loss	< 50% loss
Unsatisfactory	Present	> 20° loss	> 50% loss
Failure	Nonunion with or without loss of motion		

Nineteen of the cases were fresh fractures, wherein closed reduction of the radial head was done and ulna fixed with compression plate. In none of the cases annular ligament reconstruction was done and there was no case of radial head redislocation.

In the patient who presented late to the hospital, radial head was excised; edges of the ulnar fragments freshened and fixed with compression plate. Bone grafting was not done in this patient. One patient presented with signs of posterior interosseous nerve injury. This patient recovered spontaneously three weeks after the injury.

In three patients who had superficial infection, culture and sensitivity was done. *Staphylococcus aureus* and *Klebsiella spp*. were isolated in these patients and they were treated as per sensitivity reports. In all the three cases, superficial infection resolved within ten days. None of the patients had deep infection. In one of the patient presenting with non-union, bone grafting from iliac crest was done which united subsequently.[16]

RESULTS

Age distribution

The age of the patients included in our study ranged from 21-70 years with fracture dislocation being most common in 2nd and 3rd decade and average of 35.9 years.

In this study 6 (30%) patients were between 21-30 years, 8 (40%) patients between 31-40 years, 3 (15%) between 41-50 years, 2 (10%) patients between 51-60 years and patients below 61 years were 1 (5%).

Sex distribution

Out of 20 patients, 12 (60%) were male and 8 (40%) were females showing male preponderance with male to female ratio of 1.5:1.

Side affected

In this study, 13 (65%) cases and 7 (35%) cases presented with monteggia fracture dislocations on the right and left side of the patient respectively.

Mode of injury

In our study, there were 9 (45%) patients with road traffic accidents, 8 (40%) patients with fall and 3(15%) patients with assault.

Type of fracture

In the present study, 16 (80%) of the cases were of type i bado's classification, 3 (15%) of cases type iii, 1 (5%) type iv and none in type ii fractures.

Timing and type of procedure

All the cases were operated on our regular operation theatre days, at earliest possible time, an average being 5. 13 days after surgery, and the range was between 2-10 days. All the cases were fixed with compression plates and screws. Radial head was reduced in 19 (95%) cases and radial head excision in 1 (5%) case. Annular ligament reconstruction was not done in any of the cases. There was no case with redislocation of radial head.

Duration of union

16 (80%) patients had sound union in less than 4 months, 3 (15%) had union between 4-6 months and 1 (5%) patient developed non-union.

Functional outcome

Using Anderson et al., scoring system we found 65% excellent results, 30% satisfactory results and 05% of failure in our study (Table 2).

Table 2: Functional outcome in present study according to Anderson's criteria.

Results	No. of cases	Percentage
Excellent	13	65
Satisfactory	6	30
Unsatisfactory	-	-
Failure	1	05

Complications

Three patients developed superficial infection which resolved on further treatment. One patient developed non-union which was successfully treated by bone grafting

DISCUSSION

In 1998, David Ring, Jesse B. Jupiter and N. Shaun Simpson conducted studies which showed average age of 52 years (18-88) and our study showed average of 35.9 years (21-70 years).[13] Present findings are comparable to study made by Bruce HE, Harvey JP and Wilson J, showing the fracture dislocation being common in third and fourth decade of life.[17] Our study had male preponderance of 60%, which could be compared to studies of David Ring with similar observations (52.1% male and 47.9% female).

David ring accounted to 33.5% of his cases to road traffic accidents, 64.5% to fall and none to assault. Henry Bruce observed 43.0% of cases were due to road traffic accidents; 31.7% was due to fall and 25.3% to assault. Study conducted by Reckling FW showed road traffic accidents in 29.75%., fall in 64.84% and assault in 5.5% of cases.[18] In the present study, road traffic accidents were in about 45% of cases, fall in 40% cases and assault in 5.5% cases.

Based on Bado's classification, study conducted by Henry showed 79% of cases to be Type-I, 12% of cases Type II, 6% of cases Type III, and 3% of cases Type IV. David Ring noted about 14.5% Type I fracture dislocations, 79.25% of cases Type II, 2.09% of cases Type III and Type IV in 4.16% cases. Fredrick noted that 70% of cases were Type I, 18% were Type-II, 12% of cases Type IV and no cases in Type III. In the present study, we had 80% of fracture dislocations to be Type I, no cases in Type II, 15% cases in Type III and Type IV comprising of 5% of cases which correlated with studies of Bruce H and Reckling FW.

In series conducted by Reckling FW, radial head reduction was done in 63.45% of cases and excision in 36.55% of cases. In the present study; in 95% of cases, radial head was reduced and in 5% of cases, it was excised.

In series conducted by Reckling FW; 6.25% cases developed proximal radio ulnar synostosis, 6.25% nonunion and 31.25% malunion. David Ring noted 6.25% cases of proximal radio ulnar synostosis, 8.3% nerve palsies, 2.1% nonunion cases and 4.1% delayed union. Bruce H stated that, 6% of cases in his study had proximal radioulnar synostosis, 6% superficial infection, 17% nerve involvement and 35.5% of cases went for non-union. Chapman MW noted 7.5% delayed union.[15] In our study, 15% cases of superficial infection and 5% cases of nonunion were noted.

Ring D reported 37.5% excellent results, 43.75% satisfactory results, 8.5% unsatisfactory results and failure in 10.45% of cases. Henry reported 30% satisfactory, 20% unsatisfactory and 50% failure results. Reckling FW reported that no case had excellent results; 23% of cases being satisfactory, 58% unsatisfactory and 19% cases of nonunion. Chapman MW reported 67% excellent, 15% satisfactory and 18% unsatisfactory results. The present study showed 65% of cases to be excellent, 30% satisfactory and 05% cases went for failure (Table 3).

Table 3: Comparison of functional results with previous studies.

Results	Ring D (%)	Bruce H (%)	Reckling FW (%)	Chapman MW (%)	Present series (%)
Excellent	37.5	-	-	67	65
Satisfactory	43.75	30	23	15	30
Unsatisfactory	8.3	20	58	18	-
Failure	10.45	50	19	-	5

CONCLUSION

Monteggia fractures are uncommon injuries. The commonest type of monteggia fracture dislocation in adults according to Bado's classification is type-1. The technique of early closed reduction of radial head and open reduction and internal fixation of ulna using compression plate, is a simple and effective means of treating monteggia fracture dislocation in adults with excellent functional outcome. Upper limb should be immobilized in 110-120 degrees of elbow flexion and forearm in supination to prevent radial head redislocation. Once a monteggia fracture is missed, long-term disability and pain result. Limitation of the study was small number of cases and results need to be tested on a large group.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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