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A Study on management of paediatric Monteggia fractures by closed reduction and plaster casting

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Abstract
Background: Monteggia fractures represent a unique orthopaedic injury especially in the children. Early diagnosis and management are imperative for attainment of good functional results. The purpose of this study was to evaluate the effectiveness of closed reduction and plaster casting in the management of paediatric Monteggia fractures in relation to achievement of union and functional results.
Methods: This was a prospective observational study conducted on 20 patients of either sex with an average age of 5.6 years presenting to the Government Hospital, Pakherpora, J&K, India between January 2017 and April 2019, with a diagnosis of Monteggia fracture. All the patients underwent closed reduction and above elbow plaster casting. The patients were followed up for a period of 6 months. The patients were analysed for union and functional results using the Mayo Elbow Performance Score.
Results: All the fractures united and the average time of union was 7.38 weeks. According to the Mayo Elbow Performance Score, the results at follow up were excellent in 12(60%), good in 5(25%), fair in 2(10%) and poor in 1(5%) of the patients, respectively in our study.
Conclusions: Thus, results of our study demonstrate that closed reduction and above elbow POP casting is a safe and effective modality of treatment in the management of paediatric Monteggia fractures.

Keywords: monteggia fracture, closed reduction, plaster, casting, union, mayo elbow performance score

1. Introduction
Monteggia fractures are defined as fractures of proximal one third of the ulna associated with dislocation of the radial head. This injury complex was originally described by Giovanni Monteggia [1] in 1814. Certain other authors such as Smith[2], Speed and Boyd [3], Tompkins [4], Evans [5], Penrose [6], and Wright [7] made important contributions in the understanding of the patho-mechanics of this injury. This injury has been classified by Bado [8] into four types and three variant[9] lesions have also been described. This injury has a propensity of being missed early, especially the radial head dislocation. A neglected radial head dislocation or subluxation can cause chronic elbow disability, progressive deformity, and loss of motion, particularly supination and pronation. Thus, early diagnosis and management of these injuries is essential for attainment of optimal clinico-radiological outcomes.
Several treatment methods have been proposed over the years for the management of Monteggia lesions, which include closed reduction and above elbow plaster casting, closed reduction and intramedullary K wire fixation, open reduction and internal fixation. Several authors have proposed different treatment options depending on the fracture type and associated lesions [10, 11, 12].
In general, most paediatric Monteggia fractures can be managed conservatively with closed reduction and plaster cast immobilization, with surgical treatment reserved for unstable, irreducible fractures and in fractures in whom radial head cannot be reduced. Closed reduction and plaster immobilization is a safe, simple and daycare procedure, which reduces the risk of operative complications and obviates the need for hospitalization of the patient.
In the present study we evaluated the effectiveness of closed reduction and above elbow plaster casting in the management of paediatric Monteggia fractures in relation to achievement of union and functional results using the Mayo Elbow Performance Score.

2. Materials and methods.
After approval by the institutional ethics committee and informed written consent, the study was started. This was a prospective observational study conducted on 20 patients of either sex with an average age of 5.6 years presenting to Government hospital Pakherpora between January 2017 and April 2019, with a diagnosis of Monteggia fracture. The sex distribution was 12 males and 8 females.

2.1 Inclusion criteria
1. Age between 1 to 9 years.
2. Closed Monteggia fractures.
3. Injury to presentation interval less than 2 weeks.

4. Bado type 1, 2 and 3 fractures.

2.2 Exclusion criteria

1. Age less than 1 year and greater than 9 years.
2. Open Monteggia fractures.
3. Injury to presentation interval more than 2 weeks.
4. Bado type 4 fractures.
5. Polytrauma patients.
6. Associated neurovascular injury or compartment syndrome.

At presentation all the patients were thoroughly examined and neurovascular assessment of the limb was done. Standard anteroposterior and lateral radiographs of the injured forearm along with elbow and wrist were obtained. Analgesia was given to the patients.

2.3 Procedure.

Under intravenous analgesia, the patients were placed in supine position on the reduction table, with the injured arm hanging by the table. Longitudinal traction was given to reestablish the length of ulna and manual correction of the angular deformities was done. The forearm was held in relaxed supination as longitudinal traction was applied, with manual pressure directed over the apex until the angular deformity was corrected clinically. Once ulnar length and alignment were reestablished, the radial head was relocated by flexing the elbow to 90 degrees producing spontaneous reduction. If this manoeuvre was unsuccessful then direct pressure over the radial head in the opposite direction of the dislocation, was applied for attainment of reduction. Once reduction was achieved, the elbow was immobilized in an above elbow plaster of Paris cast with the elbow in 90 degrees of flexion and forearm in position of mid-supination to neutral rotation to alleviate the forces of the supinator muscle and the anconeus, as well as the forearm flexors, which tend to produce radial angulation of the ulna. After cast application, anteroposterior and lateral radiographs were obtained to check the adequacy of the reduction. If the reduction was satisfactory, the patients were discharged with the advice regarding cast complications.

The patients were then followed up weekly for 6 weeks with serial radiographs. At six weeks after initial reduction, if there was radiographic evidence of ulnar fracture consolidation, the cast was removed and elbow and wrist range of motion was started. Physical therapy protocols were explained to the parents and gradual return to routine activities was encouraged. The patients were then followed up monthly for six months and at the end of this period all the data collected was subjected to analysis.

2.4 Statistical methods

The data was analysed with SPSS version 17.0 software. The demographic variables were assessed by number and percentage. Simple arithmetic mean was used for the description of the values of the time taken for union in weeks. Mayo Elbow Performance Score (Fig 1.) was used for assessment of functional results.

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			

Fig 1: Mayo Elbow Performance Score

3. Results

This was a prospective observational study. The fractures of all the patients in this study united with an average duration of 7.38 weeks. According to Mayo Elbow Performance Score, the results were excellent in 12(60%), good in 5(25%), fair in 2(10%) and poor in 1(5%) patients of the patients respectively in our study. One patient developed local plaster sore which resolved with antiseptic dressings and antibiotics, while one patient had residual elbow stiffness which improved with physical therapy.

Table 2: Age Distribution.

Age in years	No. of patients	Percentage (%)
1-3	3	15
4-6	10	50
7-9	7	35

Table 3: Sex Distribution.

Gender	No. of patients	Percentage (%)
Male	12	60
Female	8	40
Total	20	100

Table 4: Table depicting the results of the study

Parameters	Mean age of the patients in years.	Mean time taken for union in weeks	Mayo Elbow Performance Score at follow up in various patients by number and percentage			
Values of the parameters	5.6	7.38	Excellent	Good	Fair	Poor
			12(60%)	5(25%)	2(10%)	1(5%)

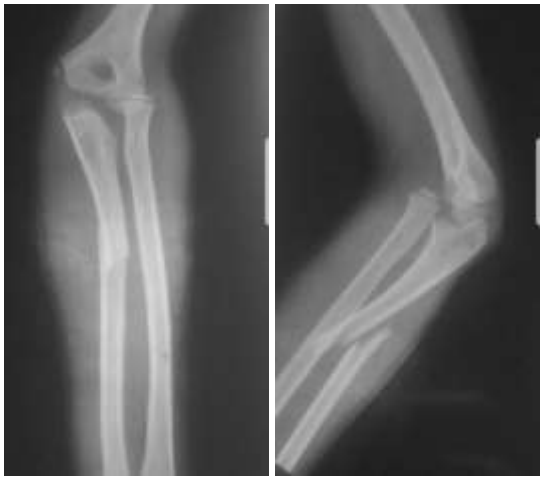

Fig 1: Anteroposterior and lateral radiographs of the forearm showing Monteggia fracture dislocation.

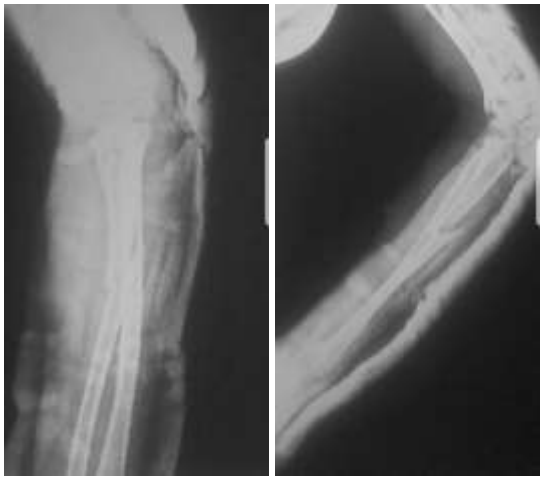

Fig 2: Anteroposterior and lateral radiographs of the same fracture after closed reduction and above elbow plaster application depicting acceptable reduction of the ulnar fracture and relocation of the radial head.

Fig 3: Follow up lateral radiograph of the forearm demonstrating a united Monteggia fracture with the relocated radial head.

4. Discussion

Monteggia fracture dislocations involve an ulna fracture in association with a radial head dislocation. The main problem with this injury has been a failure to correctly diagnose the injury. The original description of an anterior dislocation of the proximal radius and fracture of the proximal ulna has been expanded to include dislocations of the radial head in multiple directions and combinations of injuries to the ulna and radius. Monteggia fractures in children present a unique challenge to the orthopaedic surgeon because of difficulties in diagnosis, propensity for instability, and complexity of late reconstruction. These injuries are often missed, especially the radial head dislocation which can lead to severe dysfunction of the limb. A neglected dislocation or subluxation of the radial head can cause radial head dysplasia, elbow pain, decreased elbow motion, increasing valgus deformity, and neurologic problems [13, 14]. Thus, early diagnosis and management of these injuries is essential for attainment of satisfactory functional results. Several methods of treatment have been devised for the management of paediatric Monteggia lesions. Closed reduction and above elbow plaster of Paris casting is one of the most common treatment modalities employed tor these injuries. The effectiveness of this treatment option has been demonstrated by several studies over the years [15, 16].

In our present study we evaluated the effectiveness of closed reduction and above elbow plaster casting in the management of paediatric Monteggia fractures in relation to achievement of union and functional results. Mayo Elbow Performance Score (Table 1.) was used for assessment of functional results. This was a prospective observational study, conducted on 20 patients of either sex (Table 3.) with an average age of 5.6 years (Tables 2,4), with the diagnosis of Monteggia fracture dislocation (Fig 1.). All the patients were managed with closed reduction and above elbow plaster cast application (Fig. 2). The fractures of all the patients in this study united (Fig 3.) with an average duration of 7.38 weeks (Table 4.). Majority of the patients in our study had satisfactory functional results at follow up. According to Mayo Elbow Performance Score, the results (Table 4.) were excellent in 12(60%), good in 5(25%), fair in 2(10%) and poor in 1(5%) of the patients respectively in our study. One patient developed local plaster sore which resolved with antiseptic dressings and antibiotics, while one patient had residual elbow stiffness which improved with physical therapy.

The results of our study are quite comparable to other studies [16, 17, 18], done about this technique. In the study by Foran *et al*, [16] majority of the patients (83%) were managed successfully conservatively with closed reduction and casting which compares quite favourably to our study. In the study by Leonidou *et al*, [17] all the 32 patients treated with closed reduction and casting had excellent results which compares favourably to our study. In the study by He *et al*, [18], in the 25 fresh injury cases, the Mayo Elbow Performance Score at follow up was excellent in 21(84%), good in 3(12%), fair in 1(4%) and poor in 0(0%) patients which is quite comparable to our study.

5. Conclusion

From the above analysis we can infer that closed reduction and above elbow plaster of Paris casting is a safe and effective modality of treatment for paediatric Monteggia fracture

dislocations with a high rate of union and excellent functional results.

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