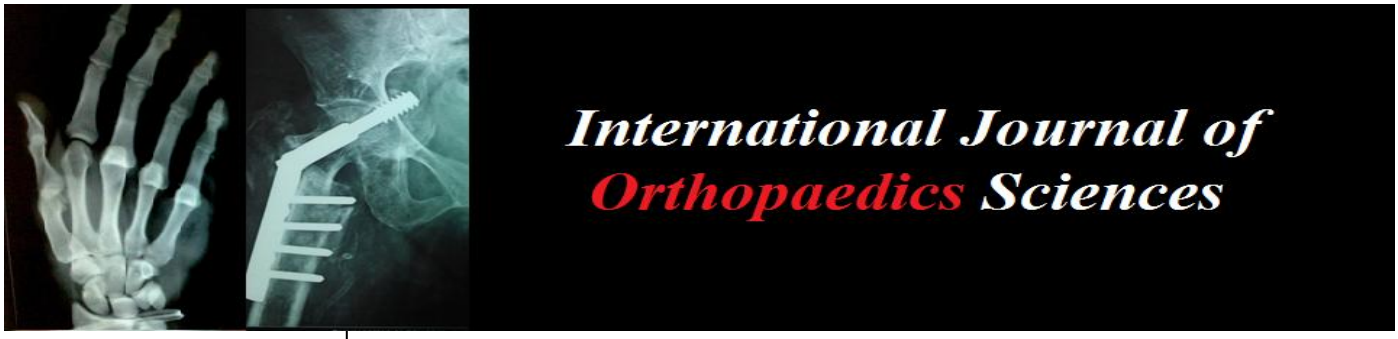

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Fractures of humerus and their treatment modalities

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Abstract
Introduction: The majority of humerus fractures are low energy osteoporotic injuries in the elderly and their incidence is increasing in the light of an ageing population. Non-operative management has been associated with good functional outcomes in stable, minimally displaced and certain types of displaced fractures. Absolute indications for surgery are infrequent and comprise compound, pathological, multi-fragmentary head-splitting fractures and fracture dislocations, as well as those associated with neurovascular injury.
Aim of the study: The aim of study is to understand current concepts with regards to treatment options for fractures of the humerus.
Materials and Methods: This is a retrospective study involving 181 cases of fracture humerus which occurred due to fall or trauma.
Results: In this study, 84 cases (46.40) were proximal humerus fractures, 58 cases (32.04) were shaft of the humerus fractures and 39 cases (21.56) were distal humerus fractures and which were treated conservatively, open reduction and internal fixation or other surgical methods.
Conclusion: Patients presenting with fractures of the humerus were more commonly elderly women and occur due to low energy fall or minor trauma. Early restoration of function is the main aim of the treating orthopedician depending on the age and other comorbidities and surrounding structures involvement.

Keywords: Fracture, humerus, proximal, distal, open reduction and internal fixation, hemiarthroplasty

Introduction
Humerus fractures are routinely encountered in the elderly population, with the highest prevalence being 415 per 100,000 in those patients aged over 70 years [1-3]. They usually occur due to low energy fall or trauma and for those that are minimally displaced conservative treatment yields positive results with return to a functional shoulder [4, 5]. It has been quoted by many authors that only about 20 -25% of proximal humeral fractures require operative intervention [6]. Humeral shaft fractures represent 3% of all managed fractures and occur with an incidence of 13 per 100,000 per year [7, 8]. The incidence of these fractures has been increasing with the aging population [9]. These injuries occur in a bimodal age distribution affecting both young and old patients. Most patients are elderly ([65 years old), representing fragility-type fractures; however, these injuries also occur in younger patients (30 years old) secondary to high-energy trauma [9]. Historically, non-operative management has been the preferred method for treating humeral shaft fractures, given the shoulder's ability to compensate for angular and rotational mal-alignment [10, 11]. Fractures of the elbow constitute about 7% of adult fractures; distal humerus fractures account for less than half of all elbow fractures. There is evidence; however, that incidence is increasing. They are common in women older than 60 years and they are at double the risk when compared to other age groups [12]. The partial articular fractures can be described as "unicolumnar" fractures; they are rare in adults (2% to 3%) and are more common in children and adolescents. Fractures of the lateral column are more common than those of the medial column. Capitellar fractures are a special instance of partial articular fractures representing a shearing injury with very little soft-tissue attachment to the anterior fragment. In proximal humerus fractures, it is still unclear about however the best modality in which to perform definitive treatment in order to maximize the return to function. Both reconstructive and reparative options continue to evolve, each with various advantages and associated complications.

In the shaft of the humerus fractures, Sarmiento popularized non-operative management with a functional brace in 1977 after swelling had abated following 1–2 weeks in a coaptation splint [13, 14]. In distal fractures of the humerus, nonsurgical treatment is appropriate for stable, nondisplaced fractures and in patients with neurologic impairment or otherwise nonfunctional extremities. Hinged or static external fixation can be used for either temporary or definitive treatment in patients with severely contaminated open wounds or extensive soft-tissue defects. In older patients with osteopenia and/or comminution of the joint surface in which stable reconstruction cannot be achieved, total elbow arthroplasty using a semiconstrained linked prosthesis may be preferable to other options. 4 For most displaced unstable fractures in patients with functional arms, open reduction and internal fixation (ORIF) is indicated to restore optimal elbow function. Decisions regarding which treatment modality is best suited to attaining a favorable outcome with regards to humeral fractures are difficult and multi-faceted.

AIM of the study

The aim of study is to understand current concepts regarding the various treatment options for fractures of the humerus.

Materials and Methods

This was a retrospective study done for a period of two years between January 2017 and December 2018. This study included 181 cases of fracture humerus who presented to department of orthopedics, Surabhi Institute of Medical Sciences, Siddipet, Telangana and India. Inclusion criteria employed were –All the patients presented with history of trauma or fall with pain, swelling and deformity of the arm with radiological evidence of fracture of the humerus. Plain radiographs are the main baseline investigation for the diagnosis, classification and management planning of proximal humerus fractures. The proximal humerus should be imaged in a minimum of two planes. Routine assessment includes true anteroposterior and either transcapular "Y" or axillary lateral views, if tolerated by the patient. Additional investigations are then performed as necessary, on the basis of clinical and plain radiographic findings. Doppler ultrasound examination may be used for the evaluation of associated vascular injuries, as well as of concomitant rotator cuff tears. Computerized tomography (CT) is employed in the evaluation of complex fracture patterns, whilst it also allows quantification of available bone stock and assessment of the extent and position of fracture union. CT angiography may accurately diagnose and guide interventional management of co-existing arterial injuries. Magnetic resonance arthrography and angiography are additional high-quality imaging tools for the assessment of peri-articular soft tissue and vascular injuries respectively.

Results

Total number of cases in this study was 181. Out of which, 33.70 (62 cases) were males and 66.30 (119 cases) were females –Figure 1. All the cases were classified into age groups between 20 years and 90 years; most of the cases were noted in women above 60 years of age- Table1.

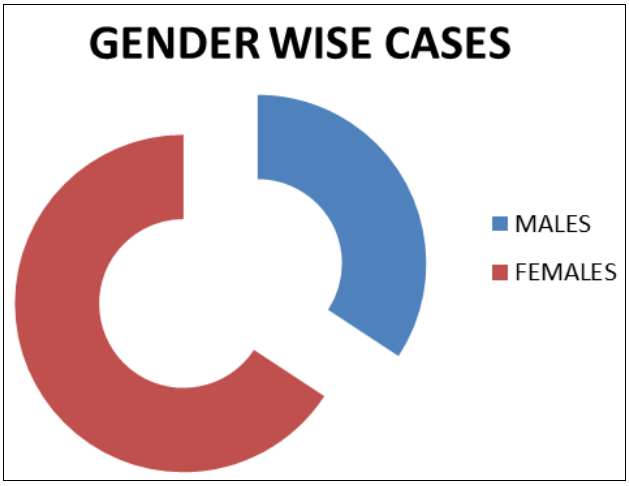

Fig 1: Gender wise distribution of the cases

Table 1: Age wise distribution of the cases

Age Group	Number of Patients	Percentage
20- 30 YEARS	11	06.07
30-40 YEARS	14	07.73
40-50 YEARS	29	16.02
50-60 YEARS	26	14.36
60-70 YEARS	41	22.65
70-80 YEARS	54	29.84
80-90 YEARS	06	03.33
TOTAL	181	100

In this study, 84 cases (46.40) had proximal humerus fractures, 58 cases (32.04) had shaft of the humerus fractures and 39 cases (21.56) had distal humerus fractures –Table 2. The proximal humerus fratures were further classified into Type A, B and C. Type A- Unifocal, Extra-articular fracture which includes tuberosity fractures, impacted metaphyseal and non-impacted metaphyseal, Type B-Bifocal, Extra-articular fractures which includes with impaction, without impaction and with glenohumeral dislocation, Type C- Intra-articular fractures-displaced, impacted and dislocated.

Table 2: Site of fracture

Site of fracture	Number of patients	Percentage
Proximal humerus	84	46.40
Shaft of humerus	58	32.04
Distal humerus	39	21.56
Total	181	100

In this study, fractures of the humerus were managed by 1) conservative management, 2) Open Reduction and Internal Fixation (ORIF), 3) Closed Reduction with Fixation, 4) Open

Reduction without Fixation, 5) Hemiarthroplasty,6) Intra-Medullary Nailing and 7) Arthroplasty surgeries. Table 3 shows the kind of treatment given to the patients.

Table 3: Treatment of humerus fractures

Site of fracture	Type of treatment	Percentage
Proximal Humerus (N=84)	Conservative Management	32.50
	Orif	55.85
	Hemiarthroplasty	11.65
Shaft Of Humerus (N=58)	Conservative Treatment (Fracture Brace)	36.85
	Orif	45.15
	Closed Reduction With Fixation	08.25
	Open Reduction Without Fixation	09.75
Distal Humerus (N=39)	Conservative Management	38.15
	Orif	49.95
	Intramedullary Nailing	06.25
	Arthroplasty	05.65

Discussion

In this study, 32.50 % of the proximal humerus fractures were treated conservatively, 55.85 % were treated by open reduction and internal fixation (ORIF) and 11.65% patients were treated by Hemiarthroplasty. In the cases of fracture shaft of humerus, 36.85% of the patients were treated conservatively by fracture brace and cylindrical brace, 45.15% with ORIF, 8.25% with closed reduction with fixation and 9.75% with open reduction without fixation. Distal humerus fracture was treated by conservative management in 38.15%, ORIF in 49.95%, Intramedullary nailing in 6.25% and Arthroplasty 5.65%.

Non-displaced and minimally displaced head-split fractures may be treated conservatively including neutral brace or sling immobilization for 3–4 weeks with passive motion of the shoulder, followed by active-assisted range-of motion exercises progressing to resist strengthening at 3 months. However, there is no consensus on the threshold that distinguishes minimally displaced from displaced fractures in particular with regard to the intra-articular step formation. Displaced headsplit fractures are usually not suitable for conservative treatment; however, in some cases, age and severe comorbidities impede surgery. In these cases, malunion or nonunion of the fragments can lead to severe movement restriction; however, many of these low-demand patients are satisfied with the residual function and benefit from generally low pain levels.

An option for joint-preserving treatment of head-split fractures is open reduction and internal fixation (ORIF) using a locking plate and additional a/p screw fixation to stabilize the headsplit fracture. An anatomical reduction can be achieved through a stepwise approach. First, the head-split component is reduced via image-intensifier control. If a satisfactory reduction cannot be achieved, the rotator interval is opened and the fracture line is palpated in order to facilitate the maneuver of reduction. If reduction is still unsatisfactory, the subscapularis tendonis partially or completely released to allow access to the articular surface. K-wires are used to retain the reduction. Finally screws (i. e., a/p screw) are applied and the plate is attached for definitive fixation.

Primary arthroplasty must be considered in patients where a stable reduction is not feasible because of severe comminution, considering the goal to avoid poor outcome and the necessity of multiple revision surgeries after a failed osteosynthesis [15]. The decision to perform a primary shoulder arthroplasty should always be made on an individual basis and include patient-specific factors such as age, general health status, functional demand, as well as preexisting shoulder pathologies, including symptomatic glenohumeral osteoarthritis, or cuff tear arthropathy. Primary replacement of the humeral head in the form of a Hemiarthroplasty has been advocated for head-split fracture [16].

Union rates with non-operatively treated humeral shaft fracture have been reported between 67 and 98% [17, 18, 19]. Despite these rates, some patients are unable or unwilling to undergo non-operative management. Clinical union and removal of brace takes an average of 11.5 weeks with a range of 4–22 weeks with functional bracing compared with 6.3–9.8 weeks for intramedullary nailing and 8.9–10.4 weeks for compression plating [19, 20, 21]. Return to weight-bearing depends on the bone quality and efficacy of surgical fixation. Weight-bearing restrictions may be devastating to the elderly, who often require their arm to transfer the load or even bear the weight. In the younger patient, non-operative management may also delay their ability to return to work. In addition to functional limitations, functional bracing also carries a 1–9.5% risk of skin and soft tissue complications [22, 23, 24]. Surgical treatment of humeral shaft fractures all over the world has been increasing over time. The reason for this rise remains unclear, as numerous studies have reported satisfactory treatment with non-operative management. Possible reasons for increased ORIF utilization include a perceived quicker return to work, earlier initiation of shoulder and elbow rehabilitation, and avoidance of brace wear during the recovery period. While fixed-angle locked plating was introduced in 2005 and has been described for comminuted humeral shaft fractures and osteoporotic bone, the mainstay of treatment remains non-locked plating [25, 26]. However, the development of intramedullary nailing for humeral shaft fractures does coincide with the timing of the increase in operative intervention [27, 28, 29]. The increasing utilization of this technique may correlate with the observed trend.

In distal fractures of the humerus, nonsurgical treatment is appropriate for stable, non-displaced fractures and in patients with neurologic impairment or otherwise nonfunctional extremities. Hinged or static external fixation can be used either as a temporary or definitive treatment in patients with severely contaminated open wounds or extensive soft-tissue defects. In older patients with osteopenia and/or comminution of the joint surface in which stable reconstruction cannot be achieved, total elbow arthroplasty using a semiconstrained linked prosthesis may be preferable to other options [30]. For most displaced unstable fractures in patients with functional arms, open reduction and internal fixation (ORIF) is indicated to restore optimal elbow function or deficient soft tissues.

The surgical approach and implant strategy for ORIF of a distal humerus fracture are guided by the classification of the fracture. Nonarticular fractures (type A): These usually can be fixed through a triceps-splitting approach or triceps-sparing approach with restoration of alignment and bicolumnar fixation. Isolated epicondylar fractures in many cases can be fixed with lag screws alone. Partial articular fractures (type B): In the uncommon adult unicolumnar fracture, lag screws alone may be adequate fixation when the bone quality is good. Otherwise, a buttress or antiglide plate should be used. Some capitellar fractures can be fixed through a lateral or posterior approach with lag screws placed from posterior to anterior or even anterior to posterior headless compression screws while small or comminuted capitellar fragments are usually excised. Complete articular fractures (type C): ORIF can be performed through several approaches;the most

common are the extensile medial approach (Bryan and Morrey), the extensile lateral approach (Kocher), or the posterior transolecranon approach [31, 32]. The plating construct that provides the greatest sagittal plane stiffness without loss of coronal or torsional stiffness is a medially positioned reconstruction plate and a small-fragment compression plate on the posterolateral surface.

Conclusion

Fractures of the humerus are seen commonly in elderly women and occur due to low energy fall or minor trauma. Early restoration of function is the main aim of the treating orthopedic surgeon depending on the age and other comorbidities and surrounding structures involvement.

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