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Original Research Article

A multicentric retrospective study for the treatment of humerus bone fracture following humerus plate fixation with screws

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ABSTRACT

Background: The goal of this study was to investigate the performance of the humerus bone fixation with screws while treating humerus bone fracture.
Methods: The 34 patients' retrospective data was collected with 1 year of follow up. Humerus fractures were treated by humerus plate fixation in different hospitals and countries, including 26 males and 8 females, with the age range of 32 -74 years (mean 47.4 years). Clinical and radiological follow-ups were conducted at 1 month, 3 months, 6 months and 1 year after surgery to check the bone union and implant-related complications. Ten different plates were used for the treatment of fracture as per the fracture type. The patient's health status was evaluated by the American society of anesthesiologists grade and the visual analogue score (VAS) was also obtained.
Results: The progressive decline in the VAS score showed positive results related to pain management. All patients receive continuous physiotherapy under the supervision of physiotherapists, which aids in faster recovery and mobilization. No biomechanical issue related to implant plate and screw loosening, corrosion, bend, or other factors was detected in our 34 patients. Out of 34 patients 91% were satisfied with no pain and the remaining 9% were unsatisfied due to pain. About 85% of patients were happy with aesthetic appearance and the rest 14% of patients were unhappy related to aesthetic appearance.
Conclusions: Humerus plate fixation is feasible for the treatment of humerus fracture. The clinical outcomes and prognosis of patients are dependent on the accuracy of intraoperative reduction and surgical expertise.

Keywords: Humerus fracture, Proximal end segment, Diaphyseal end, Distal end segment, Humerus plate, Distal fracture, Locking plate, Nonunion, Outcomes

INTRODUCTION

The humerus (upper arm) is the longest (mean: 33.4 cm in males; 30.7 cm in females) and the thickest bone lies in the upper arm that characterizes the human upper limb. It attaches proximally to the shoulder joint and distally to lower arm bones radius and ulna through elbow joint. Its primary function is to provide wide movements for the arm and support to the shoulder. Humerus bone can be divided into three parts which are classified as proximal end segment, diaphyseal segment and distal end segment.

The head of humerus is the utmost proximal portion, which shapes a ball and socket joint on the scapula with a glenoid cavity. Below the head is the anatomical neck of the bone that categorized the head of the humerus from lesser and greater tubercles. Proximally an intertubercular is located, which outlines the two tubercles vertically direction.

Following tubercles is the surgical neck of the arm bone, to some extent typically liable to fractures.[1,2]

Fractures are the most well-known injuries to the humerus bone. Upper arm fractures are categorized by their site i.e., proximal, shaft and distal. Proximal arm fracture is said to occur at the end of the humerus near to the shoulder. About 5-6% of the proximal fracture accounts of the human skeleton system.[3]

The majorly three common osteoporotic fractures include vertebral compression fractures, distal radius fractures and proximal humerus fractures.[4-7] This causes complications like poor movement of the shoulder, stiffness and deformity. Depending on the fracture type, proximal fracture can be given treatment without surgery if the bone fragments does not displace from their position, surgery is frequently performed in order to allow for early mobility. Other factors are also taken into consideration while deciding between not involving surgery and surgical fixation. Fracture fragments are frequently fixed with plates, screws, or pins during surgery.

Mid shaft fractures are defined as a break in the middle of the humerus. Approximately 3% of all fractures occur in the humeral shaft. The cause of the midshaft humeral fractures is most typically caused by a direct impact to the upper arm, which can happen as a result of falls, car accidents, or motorcycle accidents, etc. These fractures can be classified according to the type of fracture line, its location and whether it is open or closed, and according to the bone condition (normal or diseased).[8,9]

The symptoms such as severe arm pain, swelling, restricted motion of the shoulder and arm can be noticed. Depending on the fracture pattern and concomitant complications, a humerus shaft fracture may be treated with or without surgery (i.e., nerve injury or open fracture). Initially management of the fracture, a temporary splint spanning from the shoulder to the forearm and holding the elbow bent at 90 degrees can be employed. Startlingly, non-surgical treatment includes the use of fracture bracing, which is replaced 3 to 4 weeks later by a cylinder brace (Sarmiento brace) that fits upper arm while leaving elbow free. Operative includes internal fixation of fragments with a nail, plates or screw.

Distal fractures of the humerus occur near the elbow. This type frequently occurs as part of a more serious elbow injury and can include loose bone fragments. Approx. its occurrence is 2% of all fractures.[10] Major symptoms associated with distal humerus fracture include severe pain in the elbow, swelling, Bruising and stiffness.

Depending on degree of fracture displacement, arm may develop a deformity. Non-operative fracture treatment includes when there is no displacement of bone and surgery is recommended in case of displacement bone is influenced. Placement of plates and screws may be necessitated.

This study is a retrospective multi centric study conducted between 2020 to 2021. Fractures were classified using the AO system classification and they were 12A1, 11A1.1, 11A1.2, 13A1.1, 13A1.2, 13A3.1 and 13B1.1.

METHODS

This was a retrospective study of all patients treated for a humerus bone fracture in different countries and hospitals between April 2020 to December 2020.

Patients were treated with humerus plate at Jeetoo Hospital (Mauritius), Servicio de Salud Antofagasta Hospital L (Chile), Serviclinicos Dromedica S. A. (Colombia), Justo Sierra, Cruz Verde Ruiz, Sanchez Sanatorio, Santa Isabel Salutaris, Clinica San Jose, Mayoreo Clínica Guadalupana, Centro Medic (Mexico).

The following information collected from the patient: age, weight, implant name, side and type of fracture using the AO system classification. There 34 patients (26 males and 8 females) treated with humerus plate fixation. Out of which 17 patients with 11A1.1 type of fracture, 7 patients with 11A1.2 type of fracture, 1 patient with 12A1* type of fracture, 3 patients with 13A1.1 type of fracture, 4 patients with 13A1.2 type of fracture, 1 patient with 13A3.1* type of fracture and 3 patients with 13B1.1 type of fracture were observed. The fracture occurs due to fall from height (10), accident (5), sports injury (8), slip (6), physical stress (5).

The ASA (American Society of Anesthesiologists) score classification system is used globally for determining a patient's fitness prior to surgery. The system's goal is to examine and discuss a patient's medical co-morbidity before anesthesia. The categorization method does not predict perioperative risks on its own, but when used with additional factors (such as the frailty, type of surgery and level of de conditioning), it can be useful in assisting perioperative risks (Table 2).[11]

The VAS is the pain grading scale utilized for the first time in 1921 by Hayes and Patterson. It's frequently used in epidemiology and clinical studies to assess the severity or frequency of various symptoms. For example, the degree of pain that patients experience can range from none to a severe degree of pain. The outcomes from the study were measured using VAS score (Figure 1).

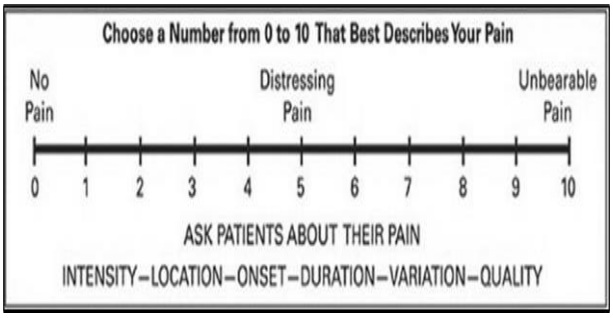

Figure 1: VAS scoring.

Inclusion criteria

The study comprised male and female patients who were skeletally mature and had a humerus bone fracture. The patients who were physically fit except the injured site, with proper body mass index and should not be prone to any disease were included.

Exclusion criteria

If any of the following apply, the volunteer will be unable to participate in study: Subjects with any neuromuscular disorder that would possess complication, an unacceptable risk of fixation failure in post op care; subjects with substance abuse/alcohol issues; subjects associated with CVS disease, elevated blood pressure, patient with fast joint disease, bone absorption, osteopenia, and/or osteoporosis, subject with suspected/ proven metal allergy/ intolerance.

Materials

Humerus plate fixation with screws (Auxein medical private limited, Sonipat, Haryana, India) were used for Humerus bone union. Plate fixation with screws made up of stainless-steel alloy as per ISO 5832-1 (316L) and titanium as per ISO 5832-3 (Ti-6Al-4V ELI).

Treatment

Firstly, all the patients underwent standard radiological workup presentation. Radiographs of both anteroposterior (AP) and lateral view were taken. On behalf of which types of humerus fractures were treated based on site and type. At the hospital where the study was conducted, plate fixation with screws was considered the gold standard for the treatment of humerus fractures. Bone plates with screws were used of the same type of material. The operations were carried out by an orthopedic trauma surgeon. The surgical approach was left to the treating surgeon's choice, depending on the fracture pattern and soft tissue characteristics. Twenty-four cases of proximal fracture were treated by the choice of the type of implant (PHEELOS -3.5 mm wise-lock proximal humerus plate, short, PHEELOS-3.5 mm wise-lock proximal humerus plate, long, 3.5 mm wise-lock proximal humerus plate, one case of diaphysis fracture was treated with choice of implant (4.5/5.0 mm wise-lock narrow dynamic compression plate with the LC under cuts and twelve cases of distal fracture were treated by preferred implant (2.7/ 3.5 mm wise-lock dorsolateral medial distal humerus plate, 3 mm wise-lock small "T" plate, oblique angled, 2.7/3.5 mm wise-lock dorsolateral distal humerus plate, 3.5 mm wise-lock extra-articular distal humerus plate, 2.7/3.5 mm wise-lock dorsolateral distal humerus plate with the lateral support the 3.5 mm wise-lock metaphyseal plate for the distal medial humerus (Figure 3).

At 6 weeks, 3 months, and 1 year after surgery, outpatient clinical and radiological follow-up was performed. Patients underwent standard radiographs and clinical examinations at each follow-up appointment to assess bone healing, strength, and range of motion.

Statistical analysis

Primary outcomes were measured using VAS with mean, standard deviation, median minimum and maximum with 95% significance level. VAS from baseline to each visit was analysed using paired t test at 5% level of significance. All statistical analysis was performed using mini tab 19.

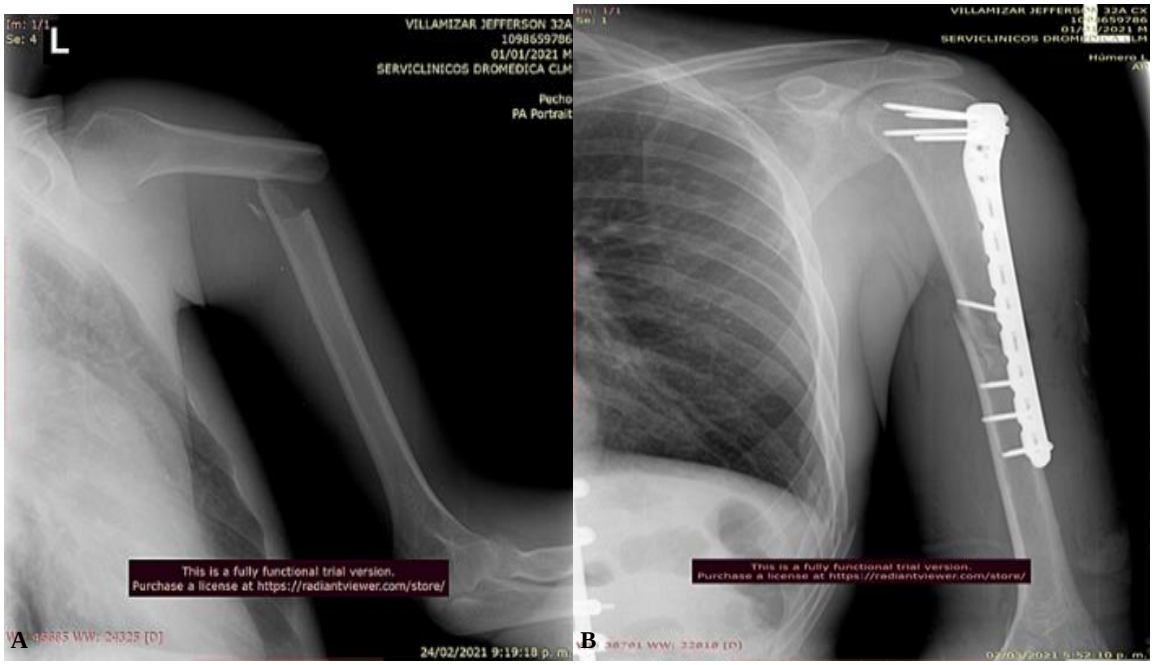

Figure 2 (A and B): Pre-op and represents post-op radiological images of proximal humerus fracture.

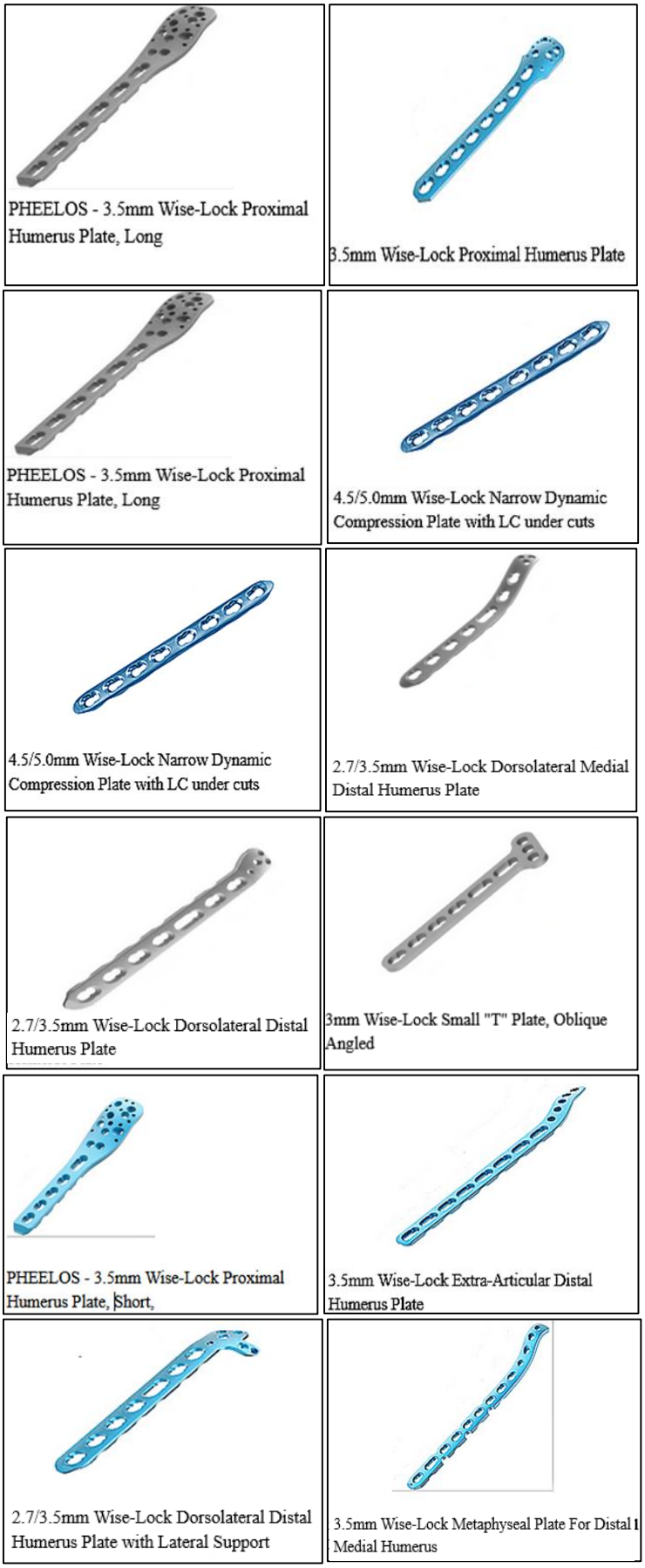

Figure 3: Implants.

RESULTS

All incisions healed by first intention, and 34 cases including 26 males and 8 females, with age range of 32-74 years (mean 47.4 years) were reported fractured. In the retrospective study, proximal end segment fractures have 70.58 rate of occurrence, diaphyseal segment fractures have 2.94 rate of occurrence and distal end segment have 35.29 rate of occurrence. Causes of fracture were reported maximum in 29.4% patients (10) due to fall from height, 14.7% patients (5) due to accident, 23.5% patients (8) due to sports injury, 17.6% patients (6) due to slip and 14.7% patients (5) due to physical stress (Table 1).

Patients were followed up for 1 month, 3 months, 6 months and 1 year after the surgery. The optimal surgical approach for plating humerus fractures was dependent on the location of the fracture. Surgery was carried out by experienced orthopedic surgeons. The average operating time was 75 minutes. For early activation of humerus bone various post-surgical treatments were given to the patients. As per the VAS score the VAS percentage after 1 month was 46, after 3 months 30, after 6 months 12 and after 12 months was 2. There were 5 patients complaining about pain, 3 patients complained about irritation at the first follow up. However, after frequent follow up it was reported that there was proper union of bone and no health-related complications were observed (Table 3).

Table 1: Demographic data.

Demographics	N	Percentage (%)
Mean age in years	47.4	--
Sex		
Male	26	76.4
Female	8	23.5
Dominant side		
Left side humerus	16	47.05
Right side humerus	18	52.94
Mode of injury		
Fall from height	10	29.4
Accidents	5	14.7
Sports injury	8	23.5
Slip	6	17.6
Physical stress	5	14.7
ASA		
Grade I	29	85.2
Grade II	5	14.7
Grade III	0	0
Grade IV	0	0
Grade V	0	0
Types of fractures		
Proximal fracture	24	70.58
Diaphyseal fracture	1	2.94
Distal fracture	12	35.29

Table 2: VAS score.

Variables	VAS score (%)
Follow up time	
1 month	46
3 months	30
6 months	12
12 months	2
The ASA score was calculated as under	
Grade I	A normal healthy patient
Grade II	A patient with mild systemic disease
Grade III	A patient with severe systemic disease
Grade IV	A patient with severe systemic disease that is a constant threat to life
Grade V	A moribund patient who is not expected to survive without the operation

Table 3: Evaluation parameters, (n=34).

Evaluation parameters	No. of patients, N (%)	
	Satisfied	Not satisfied
Pain	31 (91)	3 (9)
Aesthetic appearance	29 (85)	5 (14)

DISCUSSION

The humerus is the arm's longest bone. A humerus fracture is the most common injury to this bone that occurs commonly in young and elderly people. Humerus fracture classified on the basis of affected area: Proximal, metaphyseal and distal. Humerus fracture can be treated by various methods such as skeletal traction, bone plates, intramedullary nailing rehabilitation.

This study illustrates the results of plate fixation in a cohort of patients. The humerus plate fixation with screw (Auxein medical private limited, India) shows effective results for humerus bone union. In the present study all different types of fracture treated with particular plates have success rate of mobilization and bone union.

The progressive decline in the VAS score showed positive results related to pain management. All patients receive continuous physiotherapy under the supervision of physiotherapists, which aids in a faster recovery and mobilization. No biomechanical issue related to implant plate and screw loosening, corrosion, bend, or other factors was detected in our 34 patients. Out of 34 patients 91% were satisfied with no pain and the remaining 9% were unsatisfied due to pain. About 85% of patients were happy with aesthetic appearance and the rest 14% of patients were unhappy related to aesthetic appearance.

A study conducted by Femke et al in which 129 adult patients with distal fracture were included which showed that 12% of patients underwent reoperation for loosening or breakage of implants.[12] But no complication seen in our study related to reoperation and breakage of implant till final follow up.

Second study conducted by Zhang et al in which 35 patients with proximal and distal fracture were followed up for thirty-three months. Which showed two cases with symptoms of radial nerve paralysis, one patient faced humeral head necrosis, two patients with shoulder pain. The 29 cases visualized by X-ray films showed fracture healing in 6 months after post operation and all the patients had bone union 12 months after operation.[13]

But in our study, pain was observed in 3 patients and 5 patients were not satisfied by aesthetic appearance but no complications such as paralysis, head necrosis were not observed till the final follow up period of 1 year.

Another study conducted by Plecko et al, 64 patients with acute fractures of the proximal humerus were treated with fixed-angle plating. Out of which 34 patients follow inclusion criteria. This study showed good clinical results of a fracture healed with a short period of immobilization with no pain as compared to our analysis.[14]

The small sample size and 12-month follow-up period were the most significant limitations of our study. Despite these limitations, the outcomes were satisfactory, just as we had anticipated before beginning this clinical study.

CONCLUSION

The humerus fracture treated with plate fixation is effective in maintaining early bone union and immobilization. The clinical outcomes showed least complications treated with plate fixation. Better results depend upon the accuracy of intraoperative reduction and surgical expertise.

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Conflict of interest: None declared
Ethical approval: The study was approved by the institutional ethics committee

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