



1. MBBS, MD, FCPS
Professor Orthopedics
Faisalabad Medical University,
Faisalabad.
2. FCPS
Senior Registrar Orthopaedic
DHQ Hospital, Faisalabad.
3. FCPS
Senior Registrar Orthopaedic
DHQ Hospital, Faisalabad.
4. MBBS
Medical Officer
DHQ Hospital, Faisalabad.
5. FCPS
Senior Registrar Orthopaedic
DHQ Hospital, Faisalabad.
6. MBBS
Demonstrator
The University of Lahore, Lahore.

Correspondence Address:
Dr. Muhammad Javaid Iqbal
Department of Orthopedics
Faisalabad Medical University,
Faisalabad.
drshahzad225@hotmail.com

Article received on:

18/11/2019

Accepted for publication:

27/01/2020

TO DETERMINE FREQUENCY OF UNION WITH ORTHOGONAL DOUBLE LOCKING PLATE IN DISTAL HUMERAL FRACTURE.

Muhammad Javaid Iqbal¹, Shahzad Mahmood Shahid², Afzal Javid³, Usman Akmal⁴, Allah Rakha⁵, Anoosh Qayyum⁶

ABSTRACT... Objectives: To determine frequency of union with orthogonal double locking plate in distal humeral fracture. **Study Design:** Descriptive, case series. **Setting:** Orthopedic department Punjab Medical College. **Period:** From April 2, 2017 to October, 2017. **Material & Methods:** 75 consecutive patients with distal humeral fractures were managed by open reduction of internal fixation with double locking plates in orthogonal configuration. Radiographic evaluation was done to see the callus formation after 12 weeks of treatment. **Results:** There were 54 (72%) males and 21 (28%) female patients having the average age 43.5 ± 15.9 years. Union was seen in 71 (94.7%) patients. In 4 (5.3%) patients there was non-union. **Conclusion:** Anatomically pre-contoured distal humeral locking plates are useful in providing stable internal fixation for complex distal articular fractures, and hence allowing early rehabilitation.

Key words: Double Locking Plates, Orthogonal (90-90), Parallel (180).

Article Citation: Iqbal MJ, Shahid SM, Javid A, Akmal U, Rakha A, Qayyum A. To determine frequency of union with orthogonal double locking plate in distal humeral fracture. Professional Med J 2020; 27(5):1059-1064.
DOI: 10.29309/TPMJ/2020.27.05.4290

INTRODUCTION

Distal humeral fracture (DHF) comprises of 2% of all fractures and 1/3rd of humeral fracture¹ bimodal incidence 12 to 19 in men and 80 above in women.² In elderly fracture occurs with simple fall on out starched hand. In younger people motor vehicle accidents are common cause.³ Compartment pressure measurements for compartment syndrome is essential. Standard radiograph include anteroposterior and lateral views. In adults with supracondylar fracture intercondylar fracture are also present. It occurs in elderly and osteoporotic bone and results in compromised joint function due to stiffness. But now the outcome has improved with implantation equipments, surgical procedures and rehabilitation, having good to the excellent results in 87% patients.⁴

Fixation with K-wires and joint immobilization in POP has poor results.⁵ Non operative treatment with bag of bone is only practical in old age patient with considerable comorbidities.⁴ Goal is to restore articular surfaces, stable rigid fixation to allow early motion.⁶ Mostly posterior

approach and triceps reflecting is used. In all of the posterior approaches ulnar nerve is identified and dissected and can be transported anteriorly.⁵ Standard plating technique is 90-90 plating (orthogonal plating).³ Parallel plating is another sound option. In osteoporotic bone locking plates should be used.⁷

Treatment is individualized according to patient age, bone quality and degree of communication.³ If fixation is stable, rehabilitation can be started within 3 days.⁸ Aggressive physiotherapy is mandatory, in first 3 months. With locking plates union rate have increased.⁷ DASH score and range of motion is used to access stiffness of elbow joint.⁹

Study by Holub et al showed in study of 41 patients, non-union rate of 5%, union rate of 95%.¹⁰ Complications includes joint stiffness, ulnar neuropathy, post traumatic arthritis, osteonecrosis and symptomatic hardware.¹¹

Rationale of my study is that with this study we may provide the surgeons with standard for

treatment of distal humeral fracture is that fixation with double locking plate. As it may give best surgical outcome.

MATERIAL & METHODS

This is a Descriptive, case series. It was conducted at Orthopedic Departments Punjab Medical College and Affiliated Hospitals from April 2, 2017 to October 2, 2017. 75 patients was the sample size by taking union rate of 95%¹⁰, absolute precision 2.5%, confidence level 95%. Non-probability, consecutive sampling was used.

Inclusion Criteria

Patient aged 20-80 years, Patients of both sexes, Distal humeral fracture type A, B & C were included.

Exclusion Criteria

Patient with Suspicion of primary or metastatic tumors with a pathological fracture and open fractures were excluded.

75 patients with distal humeral fracture that arrives in emergency after trauma were initially managed with ATLS protocol. After thorough clinical & radiological examination, informed consent was taken, all the patients were undergone for surgery under general anesthesia and pneumatic tourniquet applied. In lateral position through a posterior approach, ulnar nerve was identified and mobilized to prevent iatrogenic injury. Triceps tongue (Van Gorder Approach) was raised by dividing the tendon at musculotendinous junction. This transaction creates the V so that V to Y plasty can be performed in case of lengthening of extensor mechanism. Fracture was reduced for correction of anatomic position, including the articular surface with the exceptional consideration to the trochlear reconstruction. The reduction was fixed by the K-wires momentarily and the reduction bone clamps applied. The stabilization of fracture was done by using the distal humerus locking plates as per preoperative planning. First medial pillar was stabilized by placing a locking plate on it and then a posterolateral plate was applied with all screws in locking mode.

After the fracture fixation, elbow joint was moved

with its entire range of motion for checking of stability of fixation. Incision was closed in layers over a negative suction drain. Back slab was applied.

Physiotherapy of operated elbow joint was advised after removing back slab when the patient was out of pain and then back slab reapplied. Initially physiotherapy was given once a day and later after couple of days as the patient tolerated changed to twice daily. Back slab was kept applied as the patient tolerated.

Daily dressing was applied, till the removal of cutaneous stitches at 15th postoperative day after examining the status of wound. Back slab was removed at four weeks and active physiotherapy was advised. Patients were reviewed initially at 2 weeks interval twice and monthly followed for clinical-radiological examination and complications if any (nonunion, malunion, screw cutout, myositis ossificans and implant breakage). For the study purpose union status was accessed by a check X-ray at 12 weeks to see the callus around the fracture. It was considered to be united when patient was pain free on palpation and in two views AP and lateral there was bridging callus.

SPSS (Statistical Program for Social Science) version 20 was used for analysis. Quantitative variables like age was presented in the form of mean + SD. Qualitative variables like gender and union were presented in the form of frequency of percentage. Pearson Chi-square test was applied to evaluate the difference of union rate among two groups. Stratification was done to control the effect modifiers i.e.; age, gender, side involved & type of fracture. A p-value ≤ 0.05 was taken as significant.

RESULTS

In this study, out of 75 patients, 43.51 ± 15.9 year were the average age and minimum to maximum age was 19 & 79 years. Mostly patients had age group 29-38 years. Male patients were dominant over females with 54 (72%). Right side was mostly involved (69.3%) than the left side. C 2 and C 3 were found in 21 (28%) patients.

Union of the bone was noted in 71 (94.7%) patients. There is no significant difference was found regarding the union among gender, side involved and type of fracture with p-value > 0.05. The difference was found significant in different age groups related to union with p-value < 0.05.

Variables		Frequency	Percentage
Age distribution	18-28 years	14	18.7
	29-38 years	20	26.7
	39-48 years	13	17.3
	49-58 years	15	20
	59-68 years	5	6.7
	69-79 years	8	10.7
Gender	Male	54	72
	Female	21	28
Side involved	Right	23	30.7
	Left	52	69.3
Type of fracture	A 2	2	2.7
	A 3	4	5.3
	B 1	3	4
	B 2	4	5.3
	C 1	20	26.7
	C 2	21	28%
	C 3	21	28%

Table-I. Baseline characteristics of the patients

	Frequency	Percent
United	71	94.7
Non-union	4	5.3
Total	75	100.0

Table-II. Union rate

Variable	Union		Total	P-Value
	United	Non-union		
Age				
18-28 years	14	0	14	0.001
29-38 years	20	0	20	
39-48 years	13	0	13	
49-58 years	15	1	16	
59-68 years	4	3	7	
69-80 years	5	4	9	
Gender				
Male	51	3	54	0.891
Female	20	1	21	
Side involved				
Left	22	1	23	0.801
Right	49	3	52	
Type of fracture				
A2	2	0	2	0.961
A3	4	0	4	
B1	3	0	3	
B2	4	0	4	
C1	19	1	20	
C2	20	1	21	
C3	19	2	21	

Table-III. Union rate among effect modifiers

DISCUSSION

Distal humerus fractures are a challenge to treat because of complex anatomy of elbow joint¹², small sized fractured bony fragments with minimum amount of subchondral bone, in which the screws can hold on. If the distal humerus fracture is not surgically managed with the open reduction of internal fixation then the functional impairment is likely to occur. It is now generally accepted to have a favorable outcome in these displaced intra-articular fractures if treated surgically. One of the frequently reported complications of open reduction is implant failure due to loosening of the implant anchorage at distal fragment.¹³

To overcome this problem following principles are followed: fixation in distal fragment maximized by placing as much screws as possible, using screws that locks in the plate creating a rigid internal fixation, plates must be tough rigid and strong to resist breaking and bending before fracture union has occurred. Locking plates were used in all patients on both pillars even if the

distal fragment was large. These locking plates were anatomically pre-contoured with fixed plate screw construct, through multiple screw choices for appliance in the distal fragment in two planes thus providing an angular stability. In the literature markedly high failure rates are reported when using conventional plates and screw fixation technique with failure rates of more than fifty percent. This was mostly due to loosening of the distal screws.¹⁴

In our study there were only four cases of non-union and required a second surgery to augment the union. But there was no case of implant loosening. The use of these locking plates allowed perioperative stability and early initiation of physiotherapy for rehabilitation. This does indicate that these locking plates provide a better fixation modality than the conventional locking plates and screws, hence permitting early mobility and a better rehabilitation.

Biomechanical studies on these locking plates had also shown that these locking plates provide better stiffness in bending and torsion.¹⁵ Different studies have shown that there is no difference in which mode either (parallel or orthogonal) the locking plates are applied in terms to achieve union but with orthogonal mode there is less soft tissue dissection on the posterolateral side.^{13,14,16,17} In our study all the patients were treated with locking plates applied to medial pillar and other locking plate on posterolateral side of distal humerus.

Adequate exposure is required for treatment of distal humerus fractures. If exposure is not adequate fracture fixation becomes difficult. Transolecranon (olecranon osteotomy), triceps-splitting, triceps-reflecting and triceps tongue (Van-Gorder approach) are most frequent posterior approaches to fully developed elbow. The transolecranon approach, provides complete visualization, requires olecranon osteotomy and is associated with complications such as prominence/migration of hardware and possible displacement/ nonunion of osteotomy site.¹⁸

In Triceps reflecting anconeus pedicle (TRAP)

ulna is completely separate and mobilization of the triceps and anconeus muscle off the posterior humerus and the intermuscular septa. The major disadvantage is that there is risk of later detachment or weakness.¹⁹ The TRAP procedure saves neurovascular supply of anconeus. In Triceps tongue approach, triceps tendon is divided at musculocutaneous connection. This approach is applied for ORIF and TEA. The approach has same draw backs as TRAP approach.²⁰

In our series all patients were operated on through posterior Van Gorder approach in lateral position. Dissection through tricep tendon was carried out. This approach is detrimental to triceps strength but not to elbow function and is not associated with iatrogenic risk of hardware complications. The approach has negative result on the muscle strength because of injury to the direct muscle having resultant fibrosis and intramuscular nerve and vessels injuries.

However proper repair of triceps muscle and aponeurosis in two layers followed by supervised physiotherapy results in normal triceps strength.²¹ As it was observed in the study. The exposure of articular surface by this approach is less than achieved by the transolecranon approach but this can be overcome by flexion of the elbow. It has the added advantage of retaining the whole olecranon to be used as a template against which the articular fragments of the trochlea can be assembled.¹³

The complication rate reported in this series is acceptable and common complications described with conventional implants like nonunion, implant loosening and implant cutting out was not detected in our series.

The rate of implant failure is remarkably low despite the high proportion of type C fractures included in our study. The final outcome is slightly better in younger patients.^{13,14}

There are some limitations regarding use of locking plates. These implants give very rigid fixation. So chances of delayed union are there especially if minimally invasive technique is used

& fracture is not reduced. Locking screws have a very strong purchase so in osteoporotic bone chances of enbloc pulling out of implant do exist. Moreover due to strong purchase of screws implant removal is often difficult. Successful outcome of locking plates depend upon proper mechanics, so proper planning & construct is key factor from avoiding implant failure & nonunion.

CONCLUSION

Anatomically precontoured distal humerus locking plate system is versatile implant providing enough fixation, helping restoration of normal anatomy for good result and early rehabilitation. The result of study showed good union rate & functional outcome, so double locking plates for distal humerus fracture is a useful and satisfactory option with minimal complications.

Copyright© 27 Jan, 2020.

REFERENCES

1. KC KM, Acharya P, RC DR, Sigdel A. **Functional outcomes of type C distal humerus fractures in adults fixed by orthogonal double plating.** Apollo Med. 2018; 15:15-20.
2. Jain P, Gupta A, Thakur R, Sharma S. **Stabilization of distal humerus fractures by precontoured bi-condylar plating in a 90-90 pattern.** Int J Orthop Sci. 2017; 3(2):186-90.
3. Athwal GS. Distal humerus fractures. In: Bucholz RW, Court-Brown CM, Heckman JD, Tormet P, editors. **Rockwood and greens fractures in adults.** Vol I, 7th ed. Philadelphia: Lippincott Williams & Wilkins; 2010. P:1926-85.
4. Perez EA. **Fracture of the shoulder, arm and forearm.** In: Canale ST, Beaty JH, editors. *Campbell's operative Orthopaedics.* Vol 3. 12th ed. Philadelphia: Elsevier; 2012.p.2862-2869.
5. Amir S, Jannis S, Daniel R. **Distal humerus fractures: A review of current therapy concepts.** Curr Rev Musculoskelet Med. 2016:199-206.
6. Kumar S, Singh S, Kumar D, Kumar N, Verma R. **Intercondylar humerus fracture parallel plating and its results.** J Clin Diagn Res. 2015; RC01-4.
7. Lee SK, Kim KJ, Park KH, Choy WS. **A comparison between orthogonal and parallel plating methods for distal humerus fractures: A prospective randomized trial.** Euro Orthop Surg Traumatol. 2014; 24:1123-31.
8. Tian D, Jing J, Qian L, Li J. **Comparison of two different double-plate fixation methods with olecranon osteotomy for intercondylar fractures of the distal humeri of young adults.** Exp Ther Med. 2013; 6:147-51.
9. Piekarczyk P, Kwiatkowski K, Piatkowski K, Golos J, Kuczmera P. **Outcomes after open reduction and plate fixation of distal humerus fractures.** Orthop Traumatol Rehabil. 2016; 17:627-36.
10. Holub K, Kolub M, Kopacka P. **AO type 13-C distal humerus fractures: Results of surgical treatment.** Acta Chir Orthop Traumatol Cech. 2012; 79:529-34.
11. Lawrence T, Ahmadi S, Morrey B, Sanchez-Sotelo J. **Wound complications after distal humerus fracture fixation: Incidence, risk factors and outcome.** Shoulder Elbow SuRG. 2014; 23:258-64.
12. Gupta GK, Rani S, Rajkumar, Singh B. **Outcome of management of distal humerus fractures by locking compression plate.** Int J Orthop Sci. 2017; 3:757-64.
13. Gupta RK, Gupta V, Marak DR. **Locking plates in distal humerus fractures: Study of 43 patients.** Chin J Traumatol. 2013; 16(4):207-11.
14. Leigey DF, Farrell DJ, Siska PA, Tarkin IS. **Bicolumnar 90-90 plating of low-energy distal humeral fractures in the elderly patient.** Geriatr Orthop Surg Rehabil. 2014; 5(3):122-6.
15. Pantalone A, Vanni D, Guelfi M, Belluati A, Salini V. **Double plating for bicolumnar distal humerus fractures in the elderly.** Injury. 2017; 48 Suppl 3:S20-3.
16. Zhang C, Zhong B, Luo C. **Comparing approaches to expose type C fractures of the distal humerus for ORIF in elderly patients: Six years clinical experience with both the triceps-sparing approach and olecranon osteotomy.**
17. Atalar A, Tunalı O, Erşen A, Kapıcıoğlu M, Sağlam Y, Demirhan M. **Biomechanical comparison of orthogonal versus parallel double plating systems in intraarticular distal humerus fractures.** Acta Orthopaedicaet Traumatol Turc. 2017; 51:23-8.
18. Atif M, Hasan O, Mohib Y, Rashid RH, Hashmi P. **Does surgical approach affect outcome after fixation of intra-articular fractures of distal humerus? Retrospective cohort study from a level-1 trauma centre in a metropolitan city.** Ann Med Surg. (Lond). 2019; 43:48-51.
19. Yadav V, Sharma P, Gohiya A. **Functional outcome of intraarticular distal humerus fracture fixation using triceps-sparing paratricipital approach.** Indian J Orthop. 2016; 50(6):595-601.

20. Donders JCE, Lorich DG, Helfet DL, Kloen P. **Surgical technique: Treatment of distal humerus nonunions.** HSS J. 2017; 13(3):282-91.
21. Pankaj A, Mallinath G, Malhotra R, Bhan S. **Surgical management of intercondylar fractures of the humerus using triceps reflecting anconeus pedicle (TRAP) approach.** Indian J Orthop. 2007; 41:219-23.

AUTHORSHIP AND CONTRIBUTION DECLARATION

Sr. #	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Muhammad Javaid Iqbal	Supervision of research, Analysis of article.	
2	Shahzad Mahmood Shahid	Principal investigator, Analysis of article, Discussion writing.	
3	Afzal Javid	Discussion Writing.	
4	Usman Akmal	Analysis write, Data collection.	
5	Allah Rakha	Proof reading, Data collection.	
	Anoosh Qayyum	Proof reading, Article analysis.	