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A PROSPECTIVE OBSERVATIONAL STUDY ON CLINICAL RADIOLOGICAL AND FUNCTIONAL OUTCOME OF ANTERIOR BRIDGE PLATING WITH MINIMALLY INVASIVE PLATE OSTEOSYNTHESIS (MIPO) TECHNIQUE FOR HUMERUS DIAPHYSEAL FRACTURES

Orthopaedics

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ABSTRACT

Introduction: Due to its wide range of acceptability closed humeral shaft fractures can be managed conservatively. As operative interventions evolve, Anterior bridge plating with minimally invasive percutaneous plate osteosynthesis (MIPPO) technique can be considered the latest. **Aim:** Our study aimed to evaluate the clinical radiological and functional outcome of Anterior bridge plating with MIPPO. **Methods And Materials:** A prospective clinical study was done on 25 patients that were treated with minimally invasive anterior bridge plating for humerus shaft fractures in the Department of Orthopaedics, Shri Vinova Bhave Civil Hospital, Silvassa between Oct 2020 and May 2023. Consent was taken from all patients for the purpose of clinical data collection, follow up and radiological evaluation. **Results:** In our study, out of 25 patients 16 were male and 9 females. The mean age was 35.46 years (range 21-60 years). The mean surgical time was 75mins (range 60 -120 mins). The mean fracture union time was 13.2 weeks (range 10-16 weeks). Shoulder function was graded excellent to good in 23(92.00%) cases and fair in 2(8%) cases on the UCLA SCORE. The number of patients achieving ideal Mayo elbow, Constant Murley and DASH score was 18 (72.9), 13 (52.1) and 17 (70.8) respectively. **Conclusion:** Anterior bridge plating with MIPO is a safe and effective technique which gives relative stability with union by callus formation. The longer pate on the tensile surface enables humerus to withstand greater rotational and bending forces. Due to its minimally invasive nature, it causes minimal soft tissue and vital structures damage thereby yielding high rate of union, excellent functional recovery, less time consuming, minimal complications and also better cosmesis. It can be one of the least option in polytrauma cases with multiple long bone fracture due to the above advantage.

KEYWORDS

MIPO (Minimally invasive plate osteosynthesis), Anterior bridge plate, Humerus diaphyseal fracture.

INTRODUCTION:

Diaphyseal humerus fractures accounts for three to five percent of the fractures of the human body[1] which can be approached by a different method for fixation including functional bracing, plating, intramedullary nailing[2,3]. Surgical indications include failed non-surgical treatment, open fractures, polytrauma with ipsilateral forearm fractures or bilateral injuries. Typically, ORIF requires an extensile approach for precise reduction and involves opening of anatomical site with concomitant soft tissue stripping and local vascular disruption. Methods of healing can be studied differently with various proposed methods of fixation. Surgical intervention by MIPO technique is one such that preserve fracture haematoma causing minimal soft tissue injury[4] with advantages over absolute anatomical reduction with compromising soft tissue and vascularity. On the other hand, classical intramedullary nailing has risks of potentially damaging the rotator cuff and causing shoulder impingement[5,6,7,8,9]. So anterior bridge plating by MIPO is recently gaining widespread popularity with less risk of complications[10,11], aiming to provide relative stability, secondary bone healing, limited soft tissue damage, preserving local vascularity and decreasing incidence of iatrogenic radial nerve injury. Minimally invasive technique for humerus shaft fractures has shown good results recently[12,13]. This study has evaluated the clinical, radiological, and functional outcomes of this minimally invasive procedure.

AIM:

i. To study clinical, radiological and functional outcome of Anterior Bridge Plating for humerus shaft fractures in adults
ii. To study duration of surgery
iii. To study time of union
iv. To study complications

METHODS AND MATERIALS:

A prospective observational study was carried out at the Department of Orthopaedics, Shri Vinoba Bhave Civil Hospital, Silvassa.
25 patients with fracture shaft humerus were treated with Minimally Invasive Anterior Bridge Plating in our study.

Inclusion Criteria –

i. Adults above 21 years of age
ii. Diaphyseal fractures open grade I and II
iii. Mid Shaft humerus fractures of AO class A and B
iv. Polytrauma patients (7 cases with femur fracture, 5 cases with tibia fracture and 2 with lower end radius fracture)
v. Consent for the surgery and to participate in the study

Exclusion Criteria –

i. Pathological fractures
ii. Open fracture grade III
iii. Malunited fracture
iv. Old neglected fracture
v. Fracture in skeletal immaturity patients
vi. Fracture with neurovascular insufficiency

Treatment protocol –

All these patients were treated according to protocol which consists of the following;
Standard anteroposterior and lateral radiographs

Fracture classification is done according to AO classification system

Open wound fractures were classified with Gustilo Anderson system and posted at operation theatre for proper wound management and debridement

Radiographs were used to decide the appropriate plate length and planning of surgery

All patients were operated within 3 to 7 days of injury

4.5mm narrow locking compression plate was used

Shoulder and elbow range of movement exercises post operatively

Advised A/E slab and patient discharged

Patients were followed up for routinely for wound care mobility and union status.

Surgical Technique –

Patient position and Anaesthesia: Supine with shoulder abducted at 30 – 60 degree, elbow at 90 degree and the forearm was in supine all

throughout the procedure. Anaesthesia induced was brachial block/ GA

Incision:
Proximal incision around 3-5 cm was given over deltopectorial groove between pectoralis major and deltoid muscle. Another 3cm skin incision was given distally lateral to the biceps in the distal third of arm of about 5cm proximal to the elbow crease.

Dissection:
A tunnel was made to go deep down the bone. Blunt dissection was made sure so that the tendon of long head of biceps lies medially to the intervening plane.

A 4.5mm dynamic/locking compression plate was then inserted through the tunnel extraperiosteally from proximal to distal. 2/3 Proximal and distal cortical screws were used to fix the plate.

Post Operative Care:
Above elbow POP slab was given to all patients. Dressing was done from Day 2 then followed by twice a week. Pendulum exercise with elbow wrist and hand ROM initiated next post operative day as tolerated by the patients. However active rotation and abduction above 90 degree was not allowed up to 1 month of surgery.

Assessment Of Outcomes:
All patients were radiographically assessed after surgery at 6 weeks, 3 months, and 6 months and finally at 12 months. Points considered during assessment includes callus formation, fracture alignment, angulation, delayed or non union.

Functional assessment was done at 1yr after surgery using UCLA score, mayo's elbow performance score, and disabilities of the arm shoulder and hand (DASH) score. Points that were checked includes abduction, external rotation in 90 degree of abduction and elbow flexion, internal rotation with the arm placed adjacent to chest and elbow flexed at 90 degree and forward elevation. The strengths of shoulder abductors, rotators, elevators, elbow flexors and extensors were assessed and compared with the contralateral limb. The final patient outcome and satisfaction were graded as poor, fair, good, very good and excellent.

Patients profile:

Pre-op x-ray

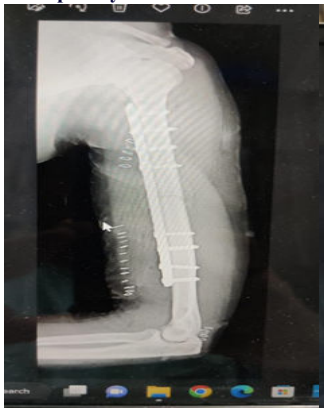

Fig.2 Immediate post-op x-ray

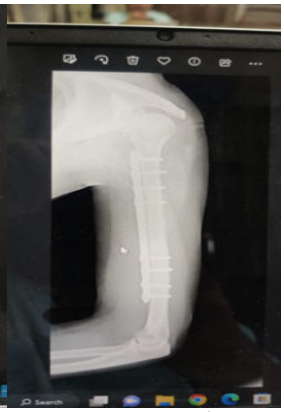

Fig.3 Post-op x-ray at 6th month

Statistical Analysis:
The data on categorical variables are presented as the number of patients and the data on continuous variables are presented as mean and standard deviation (SD). The statistical significance of pair-wise difference of the mean of continuous variables was tested using Wilcoxon signed rank test and that of one sample distribution was tested using one sample chi-square test for majority. A p-value less than 0.05 was considered statistically significant. All the hypothesis were formulated using two tailed alternatives against each null hypothesis (hypothesis of no difference). The entire data were statistically analysed using SPSS software.

RESULTS:

Table 1. The Distribution Of General Characteristics Of The Patients Operated (n = 25)

Age	No. Of Patients
<25	1
25-34	7
35-44	8
45-54	7
>55	2

Sex

Male	16
Female	9

Side

Dominant	21
Non-dominant	4

Mode Of Injury

Road traffic accident	15
Direct blow/assault	8
Fall	2

Fracture Pattern (AO)

12A	17
12B	6
12C	2

Table 2. The Distribution Of Patient Satisfaction After The Treatment (n=25)

Satisfaction	No.of patients
Excellent to good	23
Fair	2
Poor	0
Total	25 (100%)

Table 3. The Distribution Of Improvement Of Functional Outcome Scores (n=25)

Score	Achieved ideal score	Did not achieve ideal score	p-value
Mayo elbow	18[72.9%]	7[27.1]	<0.001
Constant Murley	13[52.1%]	12[47.9%]	0.773
DASH	17[70.8%]	8[29.2]	0.004

Values are presented as number(%)

Ideal score for Constant and Mayo elbow outcome measures is 100 and for DASH is 0. The proportion of patients who achieved score 100 for constant score not significantly high (p>0.05). The proportion of patients who achieved score 100 for Mayo score was significantly high (p<0.001). The proportion of patients who achieved score 0 for DASH score was significantly high (p= 0.004)

DASH: Disabilities of the Arm, Shoulder and Hand.

p-values by one simple chi-square test. A p<0.05 was considered to be statistically significant.

The mean time for return to the original activities was 64 days. The mean time for confirmed radiographic union was 45 days.
The mean Mayo elbow score was 95.94 +/- 6.74.
The mean Constant score was 95.73 +/- 5.76.
The mean DASH score was 1.56 +/- 3.15.

The number of patients achieving ideal Mayo elbow, Constant Murley, DASH score was 18(72.9), 13(52.1) and 17(70.8) respectively.

The mean side to side difference for abduction, ER, IR, and FE of the shoulder was 4.9, 4.0, 3.3 and 6.4 degrees respectively.

The majority of patients had no variations in post operative subjective strengths.

There were only 1 case of superficial infection which healed with local wound care and antibiotics. One patient developed tingling sensation over the forearm which resolved spontaneously over a period of 8 weeks. There were no case of deep infection and neurovascular injury. The majority of patients 92. %% fell in excellent to good category of our subjective outcome score. They were extremely satisfied with the results of the procedure and would recommend it to others or undergo same procedure again, if need arises. The mean surgical time was 75 mins (60-120)

We had accepted < 5% of varus / valgus angulation intraoperatively.

DISCUSSION:

Minimally invasive plate osteosynthesis (MIPO) was demonstrated for the first time by Krettek and Tscherne in 1996 in supracondylar femur fractures[14]. Though the main treatment of fracture humerus is still non-surgical it often leads many complications and unsatisfactory results or outcomes. In our study the most important finding is that anterior bridge plating by MIPO technique especially in polytrauma cases and in patients predominantly involved in overhead activities can be effective in treating mid shaft humerus fractures resulting into excellent functional and radiological outcomes. Regarding the functional outcome, as compared to the normal opposite side which is used as reference, most patients recovered their original range of movement and strength. We designed a general questionnaire focussing on the subjective outcomes so as to document the actual clinical outcome satisfactory rates and found out that the majority of the patients were extremely satisfied with the procedure and would recommend the same to others if need arises. As described by Sarmiento et al.[1], the humerus has a wide range of acceptability criteria in its reduction and is highly amenable to conservative management. But sometimes it requires prolonged period of cast or splint which is another cumbersome for the those patients who need to begin their activities at the earliest.

MIPO works on the principle of relative stability and full reduction of fracture fragments is usually not accomplished. Hence it promotes micromotion at the fracture site and so secondary healing occurs by the formation of callus which is more effective and faster than primary healing[15,16,17]. It is considered a more biological form of fixation and has the advantage of potential remodelling. The purpose of using a long plate in anterior bridge plating is to decrease the stress per unit area as by distributing over a larger surface area[18] and that it can withstand a larger amount of rotational and bending stresses than the shorter plate.

Anterior bridge plating with MIPO technique has its own advantages;

- Less amount of tissue damage and blood loss
- Less Incision length
- Less chance of radial nerve injury
- Callus formation
- Early mobilisation
- Shoulder movement restriction is negligible
- Less infection chances.

ABP procedure by MIPO, on the downside has steep learning curve and should not be attempted by inexperienced surgeons without supervision. The amount of intraoperative fluoroscopy exposure was comparatively greater than posterior plating or nailing. Risk of radial nerve injury in this procedure is still valid, though we did not encounter any. Sliding the plate in a wrong fashion, careless drilling for the distal screws, or over jealous retraction can lead to potential catastrophic damage and neuropraxia. The musculocutaneous nerve that lies below the biceps muscle should be meticulously handled. Another controversy with ABP is whether to use locking or simple cortical screws. But we preferred patients with poor bone quality with using locking screw. Besides in other cases we were using simple cortical screws. According to Apivatthakakul et al[19]. when a plate is placed on the anterior side of the humeral shaft, the mean distance from the closest part of the plate to the radial nerve is 3.2mm. Apivatthakakul et al[19]. also pointed out that when the forearm was pronated, the radial nerve was noted to move medially closer to the distal end of the plate and was at risk of iatrogenic injury. And for this reason, the supination of forearm should be maintained during the operation. The functional outcome achieved in our study is comparable to that published studies on this topic[20,21,22,23,24].

Certain drawbacks can be discussed in our study. Firstly, there was no control group to compare our results with, which might have introduced a bias in our study. Secondly, the malrotation of the humerus after union could not be accurately calculated as no post operative computed tomography scans were doing. So humeral retroversion angle as described by Boileau et al. was not evaluated. Finally, according to Wang et al. MIPPO techniques have an increased risk of secondary shoulder arthritis due to malrotation inadvertently caused during surgery.

CONCLUSION:

Anterior bridge plating for mid shaft humerus fractures is a safe and effective treatment modality yielding high rates of union, excellent functional recovery, minimal biological disruption, better cosmesis and superior patient satisfaction. In case of infection also, debridement can be early done and there is less chance of intramedullary involvement. Therefore, we would recommend considering this procedure as routine for any shaft humerus fractures specially in polytrauma patients where risk of potential blood loss, more tissue damage, more exposure and surgical time should not be entertained.

Conflict Of Interest:

No potential conflict of interest relevant to this article was reported.

REFERENCES:

1. Sarmiento A, Latta L. Functional fracture bracing: tibia, humerus, and ulna. Springer Science and Business Media. 1995.
2. Aronson J. for Bone Regeneration and Repair. Biol Clin Applications 2005:195.
3. Iwegbu G. Principles and management of acute orthopaedic trauma. Author House: 2015.
4. Zogaib RK, Morgan S, Belangero PS, et al. Minimal invasive osteosynthesis for treatment of diaphyseal transverse humeral shaft fractures. Acta Ortop Bras 2014;22(2):94-98
5. Walker M, Palumbo B, Badman B, Brooks J, Van Gelderen J, Mighell M. Humeral shaft fractures: a review. J Shoulder Elbow Surg. 2011;20(5):833-44.
6. Kurup H, Hossain M, Andrew JG. Dynamic compression plating versus locked intramedullary nailing for humeral shaft fractures in adults. Cochrane Database Syst Rev.2011;(6):CD005959.
7. Chao TC, Chou WY, Chung JC, Hsu CJ. Humeral shaft fractures treated by dynamic compression plates, Ender nails and interlocking nails. Int Orthop.2005;29(2):88-91.
8. Kim JW, Oh CW, Byun YS, Kim JJ, Park KC. A prospective randomised study of operative treatment for noncomminuted humeral shaft fracture: conventional open plating versus minimally invasive plate osteosynthesis. J Orthop Trauma.2015;29(4):189-94.
9. Bhandari M, Devereaux PJ, Mckee MD, Schemitsch EH. Compression plating versus intramedullary nailing of humeral shaft fractures: a meta-analysis. Acta Orthop.2006;77(2):279-84.
10. Krettek C, Schandelmaier P, Tscherne H. Distal Femoral Fractures: Transarticular reconstruction, percutaneous plate osteosynthesis and retrograde nailing [in German]. Unfall chirug, 1996;99:2-10.
11. Shantharam Shetty M, Ajith Kumar M, Sujay KT, Abhishek Kini R, KanthiKiran G. Minimally invasive plate osteosynthesis for humerus diaphyseal fractures. Indian J Orthopaed 2011;45(6).
12. Apivatthakakul T, et al. MIPO of the humeral shaft fracture: Is it possible? A cadaveric study and preliminary report. Injury, 2005; 36:530-8.
13. Livani B, et al. Is MIPO in humeral shaft fractures really safe? Postoperative ultra-sonographic evaluation. Int Orthop, 2009; 33:1719-23.
14. Krettek C, Miclau T, Grun O, et al. Intraoperative control of axes, rotation and length in femoral and tibial fractures. Technical note. Injury 1998;(29 suppl 3):C29-39.
15. An Z, Zeng B, He X, Chen Q, Hu S. Plating osteosynthesis of mid-distal humeral shaft fracture: minimally invasive versus conventional open reduction technique. Int Orthop. 2010;34(1):131-5.
16. Vilaca PR Jr, Uezumi MK, Anterior minimally invasive bridge-technique for treatment of humeral shaft non-union. J Orthop. Traumatol.2012;13(4):211-6.
17. Matsunaga FT, Tamaoki MJ, Matsumoto MH, dos Santos JB, Faloppa F, Belloti JC. Treatment of the humeral shaft fractures: minimally invasive osteosynthesis with bridge plate versus conservative treatment with functional brace; study protocol for a randomised controlled trial. Trails.2013;14:246
18. Uhthoff HK, Poitras P, Backman DS, Internal plate fixation of fractures: short history and recent developments. J Orthop Sci.2006; 11(2):118-26.
19. Apivatthakakul T, Arpornchayanon O, Bavornratanavech S. Minimally invasive plate osteosynthesis (MIPO) of the humeral shaft fracture. Is it possible? A cadaveric study and preliminary report. Injury.2005;36(4):530-8.
20. Ajmal M, et al. Antegrade locked intra medullary nailing humeral shaft fractures. Injury, 2001;32:692-4.
21. Petsatodes G, et al. Antegrade interlocking nailing of humeral shaft fractures. J Orthop Sci, 2004;9:247-52.
22. Ziran BH, et al. Percutaneous plating of the humerus with locked plating: Technique and case report. J Trauma In Infect Crit Care, 2007; 63:205-10.
23. Shetty MS, Kumar MA, Sujay K, Kini AR, Kanthi MG. Minimally plate osteosynthesis for humerus diaphyseal fractures. Indian J Orthop.2011,45(6):520-6.
24. Jiang R, Luo CF, Zeng BF, Mei GH. Minimally invasive plating for complex humeral shaft fractures. Arch Orthop Trauma Surg. 2007;127(7):531-5.