Original Article

Prospective Study for Anterior Bridge Plate (ABP) for Humerus Shaft Fracture with Combination Screw : Innovative SPV Technique

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Background : The traditional conservative treatment for a shaft of humerus fracture is either immobilization or open reduction internal fixation with plate osteosynthesis. A novel method of internal fixation for humerus fractures is anterior bridge plating. The present study was conducted to find out the effect of Anterior Bridge Plate with combination screw for humerus shaft fracture patients.

Material and Methods : The present prospective study was conducted among 20 patients of humerus shaft fracture at Department of Orthopedics for a period of one year. Using the UCLA score for the shoulder and the MEPI score for the elbow, the clinical and functional results of the procedure were evaluated at each follow-up period from the time of discharge on postoperative day 13 until the 6 months postoperative.

Results : Maximum patients were in the age group of 29 to 38 years (50%) and least were in the age group of above 58 years (5%). Male patients (65%) were more as compared to female patients (35%). Fracture union was observed in the majority of the patients (60%) at 9-12 weeks postoperative. At 6 months almost all (95%) patients had an excellent MEPI score, while only 5% patient had a good score. There was no significant difference in MEPI scores over time with p>0.05. The UCLA score at 6 months was excellent or good in almost all 95% patients while only one patient had a fair score. There was no significant difference in UCLA scores over time (p>0.05).

Conclusion : Anterior bridge plating with combination screw produces high rates of union, excellent functional recovery and minimal biological disruption.

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Key words **: Anterior Bridge Plate, Fracture, Humerus, Orthopedics, Shaft, Sidhdharath Patel Vapi (SPV).**

Twenty percent of all humeral fractures and 1-3 percent of all adult fractures are humeral shaft fractures[1-3]. The annual incidence of these fractures is from 13.5 to 15.5, per 1,00,000 persons[4,5]. In addition to promoting strong bone repair, the treatment aims to promptly restore limb function and complete range of motion. Even while non-operative care is still the go-to approach for treating isolated humeral shaft fractures, there are drawbacks to this strategy, including nonunion and shoulder disability[6-9]. Additionally, 12.6% of patients treated with this approach have consolidation, meaning that more than 10° of displacement has occurred, and 14% of patients have restricted range of motion[10].

Intermedullary nailing and plate fxation are examples of operational management. Compared to nail fixation, which has been linked to increased rates of shoulder dysfunction and reoperation and is typically recommended for pathologic or highly comminuted fractures, plate fixation yields better outcomes, such as a high rate of union, good functional scores and low complication rates[11].

Editor's Comment :

- Minimal Invasive Technique for Fracture Fixation with Maintaining Biology is key to achieve the union at fracture site.
- Particularly in the humerus Anterior Bridge Plating (ABP) with Combination Screw.

Although the conventional open posterior plating method is safe for the rotator cuff, there have been concerns raised about the direct handling of the radial nerve, poor cosmetic scarring and biological disruption of soft tissue[12,13]. The newest procedure on this list is Anterior Bridge Plating (ABP), which makes use of the minimally invasive technique known as Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO). Many papers on this subject in a range of case studies are found by conducting a recent literature search[14-16].

The ABP is minimally invasive, cosmetically pleasing, and requires little manipulation of important structures since it combines the best aspects of intermedullary and posterior plate fixation methods[17-19].

The present study was conducted to find out the effect of ABP with combination screw for humerus shaft fracture patients.

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Material and Methods

The present prospective study was conducted among patients of humerus shaft fracture at Department of Orthopedics for a period of one year. Ethical approval was taken from institutional ethical committee before commencement of study. Patients were asked to sign an informed consent form after explaining them the complete procedure.

Total 20 cases were selected for the study on the basis of inclusion and exclusion criteria. Skeletally mature patients with closed fractures as well as Gustillo Anderson type I open fractures of the humeral shaft were included. Excluded patients were with pathological fractures, as well as cases with intraarticular extension of the fracture, associated fracture of the same limb radius, ulna, or clavicle or associated neurovascular injury.

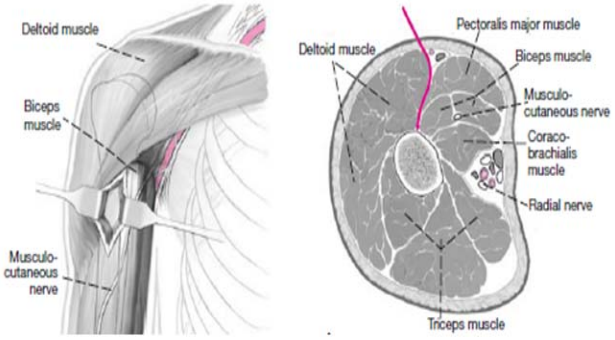
Technique in Brief :

Positioning and Anasthesia :

- General / Regional Anasthesia.
- Supine position with the arm in 60 - 90°abduction and the forearm in full supination. The arm is rested on radiolucent side-table.

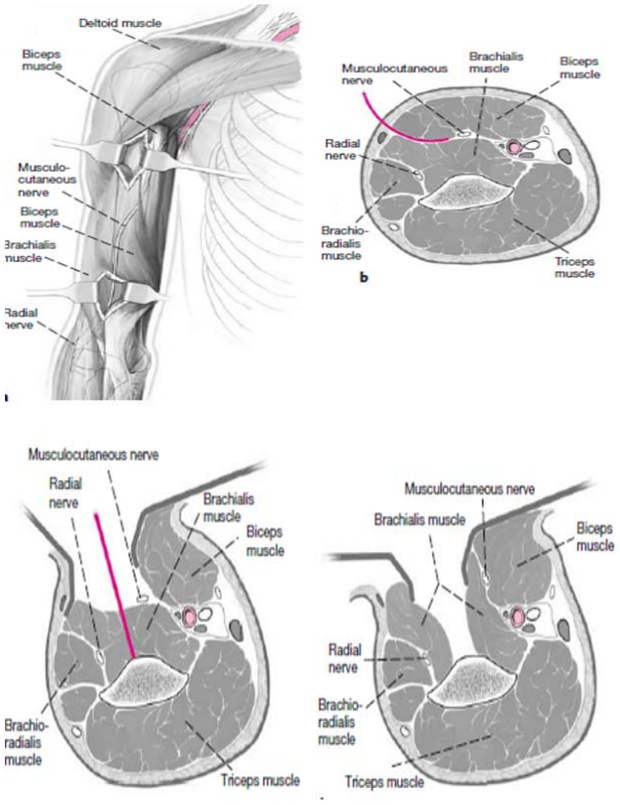
Anterior Bridge Plate Approach :

- The proximal incision, the interval between the lateral border of the proximal part of the biceps and the medial border of the deltoid are palpated.

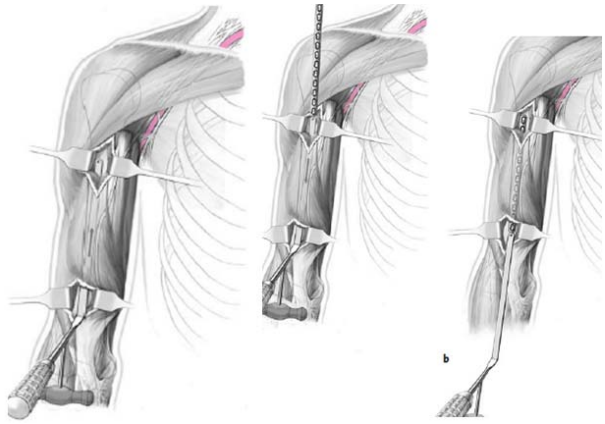


Distal Incision :

- The 3-cm distal incision is made along the lateral border of the biceps approximately 3 cm proximal to the flexion crease of the elbow.
- The brachialis is split longitudinally along its midline to reach the anterior surface of the distal humerus. The musculocutaneous nerve is retracted along with the medial half of the brachialis using the right angle retractor. The lateral half of the brachialis which serves as a cushion to protect the radial nerve is retracted with the retractor.

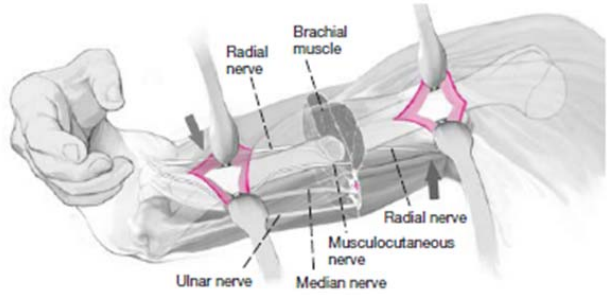


- A subbrachial tunnel is created by passing the tunneling instrument deep to the brachialis from the distal to the proximal incision.



To Avoid Nerve Injury :

- In the proximal and distal incisions, **Do Not Use Hohmann Retractors** instead use right angle retractor. To avoid to catch the radial nerve on the medial of the proximal incision and on the lateral of the distal incision.



- The musculocutaneous nerve has to be identified before splitting the brachialis to ensure that the nerve will be retracted with the medial half of the brachialis.

Unique Method to Reduce and Maintain Reduction for Ease of Fixation :

Once the submuscular tunnel is made, usaully a 10, 11 or 12 hole locking combination hole plate is inseted, one assistant reduces the fracture by longitudinal traction in approprirate rotation, the fracture reduction is checked on C-Arm in AP view for acceptable bony contact and rotaion, next two locking drill sleeve is applied to the plate, one distally and other proximally, with the plate in center postion over distal humerus shaft, a 3.2 mm drill is drilled through the drill sleeve and left insitu, now the again the fracture reduction is checked in ap plane and if we require more compression at fracture site, holding the proximal drill sleeve traction is given in proximal direction to achieve bony contact at the fracture site and than another 3.2 mm drill is inserted through the locking sleeve and left insitu, now our reduction is maintained in ap plane because of the drill bit left insitu on either end of the plate.

Next the hole next to the locking sleeve (in situ) is predrilled with 3.2 drill beath, both the cortical screw on either end are now inserted simulataneously, on insertion of the screw the fracture is visualised in lateral plane via C-Arm which will indirectly reduce the fracture in lateral plane.

Both the cortical screw are tightened, now the 3.2 drill left in the locking drill sleeve are removed after checking the fracture reduction in ap and lateral plane, they are now redrilled with locking screw drill bit (4.0mm) on either end and appropriate length locking screw are inserted with tourque controlled screw driver. if possible additional one locking screw are inserted one either end, giving us a final construct of one cortical and two locking screw on either end of the fracture.

Anteroposterior and lateral images of the humerus were taken on the first postoperative day, and then again at one, three, and six month intervals until the fracture union. Using the UCLA score for the shoulder and the MEPI score for the elbow, the clinical and functional results of the procedure were evaluated at each follow-up period from the time of discharge on postoperative day 13 until the 6 months post-op. Furthermore, the length of surgery and radiation exposure were documented.

Numerical variables are expressed as Mean±standard Deviation (SD), while categorical variables are expressed as counts and percentages. Using the chi-square, student t, and Fisher's tests, associations between study groups were evaluated. P values below 0.05 were regarded as significant.

Results

Maximum patients were in the age group of 29 to 38 years (50%) and least were in the age group of above 58 years (5%). Male patients (65%) were more

as compared to female patients (35%) as shown in Table 1.

Table 1 — *Distribution patients according to Age and Gender*

Variable		N (%)
Age	18-28	4 (20)
	29-38	10 (50)
	39-48	3 (15)
	49-58	2 (10)
	Above 58 years	1 (5)
Gender	Male	13 (65)
	Female	7 (35)

- The average week of union was 12.20 weeks.

The MEPI score was classified as follows: A score of >90 was graded as excellent, 75-89 as good, 60-74 as fair and <60 as poor. At 6 months almost all (95%) patients had an excellent MEPI score, while only 5% patient had a good score. There was no significant difference in MEPI scores over time with p >0.05 as shown in Table 2.

Table 2 — *Postoperative MEPI score at discharge and follow-up*

MEPI score	Discharge N (%)	One month N (%)	Three month N (%)	Six month N (%)	P value
Excellent	16 (80)	17 (85)	18 (90)	19 (95)	>0.05
Good	3 (15)	3 (15)	2 (10)	1 (5)	
Fair	1 (5)	0	0	0	
Poor	0	0	0	0	

The UCLA score was classified as follows : >27 points was graded as excellent to good and <27 as fair to poor. At discharge, 80% patients had an excellent to good score while the remaining 20% patients had a fair score. The UCLA score at 6 months was excellent or good in almost all 95% patients while only one patient had a fair score. There was no significant difference in UCLA scores over time (p>0.05) as shown in Table 3.

Table 3 — *Postoperative score at discharge and follow-up*

UCLA score	Discharge N (%)	One month N (%)	Three month N (%)	Six month N (%)	P value
Excellent to Good	16 (80)	17 (85)	18 (90)	19 (95)	>0.05
Fair to Poor	4 (20)	3 (15)	2 (10)	1 (5)	

Mean duration of radiation exposure was 175.7±40.2 seconds while mean duration of surgery was 126±18.32 minutes as shown in Table 4.

Table 4 — *Mean duration of surgery and radiation exposure*

Variable	Mean±SD
Duration of surgery (minute)	126±18.32
Duration of radiation exposure (seconds)	175.7±40.2

Discussion

The goal of soft tissue preservation and the requirement for complete anatomical reduction present significant challenges for surgical treatment. Traditional intramedullary nailing is less intrusive, however it might cause shoulder impingement due to rotator cuff injury. This can happen because of injury to the rotator cuff in its crucial zone of hypovascularity, which can lead to tendon tears, or because of subacromial impedement by a protruding nail or scar tissue. There is a biological cost associated with exact reduction and completely stable fixation in terms of soft tissue loss. Numerous research have looked into biological fixation as a potential solution to this stable mechanical fixation problem and have shown the later to be preferable[20,21]. This has resulted in improvements to biological fixation methods, such as the creation of stabilizing mechanisms[22, 23]. The most recent addition to this list is anterior bridge plating, which makes use of the minimally invasive procedure[24]. Furthermore, relative and elastic stability provided by anterior bridge plating is preferable to the absolute rigidity provided by open reduction and internal fixation utilizing the posterior technique. This is due to the fact that primary healing occurs in the later scenario while secondary healing and callus formation-which is stronger-occur in the former[25,26]. In addition, by spreading the tension over a greater surface area, a lengthy plate is used in anterior bridge plating to reduce stress per unit area[27]. Consequently, compared to the shorter plate, the plate positioned on the anterior tensile surface is able to tolerate higher rotational and bending forces.

The present study was conducted for a period of one year among 20 patients who visited to the Department of Orthopedics with humerus shaft fracture and treated with anterior bridge plate fixation with combination screw. It was found that the anterior bridge plating was associated with favorable radiological, clinical and functional outcomes. Sixty percent of the fractures in our study were united in nine to twelve weeks. Research by Mahajan, *et al*[26] Sharma, *et al*[27], Vegad, *et al*[28] and Ibrahim, *et al*[29] revealed similar findings.

16 patients (80%) had excellent MEPI scores at the time of discharge, compared to 3 patients (15%) and 1 patient (5%) who had good and fair scores, respectively. Only 1 (5%) patient had a good score at the 6-month follow-up, compared to 19 (95%) patients who had exceptional scores. According to the chi-square test, there was no discernible variation in the MEPI score (p>0.05). This is similar to research conducted by Mahajan, *et al* and Sharma, *et al*[26,27].

Clinical Examples :

Postoperative 6 Months

At 6 Months

Second Case :

Postoperative 6 Months

At 6 Months Function

At the time of discharge, 4 patients (20%) had a fair UCL score, while 16 patients (80%) had an excellent to good score. Only 1 (5%) patient received a fair grade at the 6-month follow-up, compared to 19 (95%) patients who had excellent to good scores. The UCLA score did not differ significantly (p>0.05). The results of Vegad, *et al* and Ibrahim, *et al*[28,29] are comparable to this.

No complication was seen in our study. Lack of comparison group and short duration of follow up were main limitations of this study.

Conclusion

We discovered that good radiological, clinical, and functional results were linked to the Anterior Bridge Plating approach for humeral shaft fractures. For Mid-shaft Humerus Fractures, Anterior Bridge Plating is a safe and efficient treatment option that produces superior cosmesis, high union rates and great functional recovery with little biological disruption.

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