

## Original Research Article

# A prospective study of the functional outcome of 3 stitch technique in a compound humerus shaft fracture

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### ABSTRACT

**Background:** Intramedullary nailing of compound shaft humerus fractures has been an innovative and surgically friendly technique to deal with extensive soft tissue injury that impedes open reduction and internal fixation. The purpose of this article is to highlight the minimally invasive technique of intramedullary humerus nailing to prevent the perioperative and postoperative complications encountered. A 1 year follow up of all the patients have shown functionally excellent results and good surgical outcome.

**Methods:** We have conducted this prospective study from Jan 2020 to Jan 2022 at DR. D.Y. Patil medical college and hospital. Informed consent from each patient was taken explaining the methods of study and probable complications. By this 3-stitch technique we have treated 25 adult patients sustaining post traumatic compound humerus shaft fractures by Antegrade humerus nailing. We have included compound injury upto type 3A (Gustilo-Anderson classification).

**Results:** Out of the 25 patients, 23 patients showed functionally excellent outcomes with good compliance to rehabilitation protocol but 2 patients had delayed wound healing of which 1 patient had undergone VAC therapy, which later healed well after a period of 2-3 weeks with sequential dry dressings. None have gone into nonunion.

**Conclusions:** Our study suggests that the 3-stitch technique is a good alternative method compared to external fixators and other various surgical techniques and yields good results with lesser complications and better cosmetic outcomes in compound injuries.

**Keywords:** Antegrade humerus nailing, Three stitch technique, MEPI score

### INTRODUCTION

Multifocal compound humerus shaft fracture has always been detrimental and challenging to treat since it is in much proximity to neurovascular bundles and higher incidence of deep seated infection due to bulky surrounding muscle mass.<sup>1</sup> In most of the cases high velocity injury is responsible for compound shaft humerus fracture making it a challenging task to execute open reduction and internal fixation as there is a high risk of post-operative or perioperative complications for instance surgical site infections, infected non unions, osteomyelitis and post infective scarring.<sup>2</sup> There are different modes of

treatment of compound humerus shaft fractures like plate osteosynthesis and intramedullary nailing but plate osteosynthesis needs wide surgical incision which is absolutely not indicated in view of compound humerus fracture due to probable complications like more blood loss, extensive soft tissue injury, nerve injury, more operative time compared to intramedullary nailing method.<sup>3</sup>

Intramedullary nailing technique works on load sharing and stress shielding mechanism that makes it biomechanically superior with less bending loads.<sup>4</sup>

In our study we have tried only antegrade nailing technique since retrograde nailing is technically more challenging and has a steep learning curve due to high risk of iatrogenic fractures in distal part of humerus and risk of axillary nerve injury in proximal interlocking screw.<sup>5</sup> Other possible difficulties and complications with retrograde nailing systems are narrow metaphyseal canal, rotator cuff injury, in view of above mentioned difficulties we tried antegrade humerus nailing by 3 stitch technique for superior functional results in the compound shaft humerus fractures.<sup>6,7</sup>

The purpose of this article is to highlight the minimally invasive technique of intramedullary humerus nailing to prevent the perioperative and postoperative complications encountered. A 1 year follow up of all the patients have shown functionally excellent results and good surgical outcome

## **METHODS**

We have conducted this prospective study at DR. D.Y. Patil medical college and hospital Nerul, Navi Mum bai, Maharashtra, from January 2020 to January 2022. These studies were recorded and analyzed by keeping a track of it on Microsoft excel. Informed consent from each patient was taken explaining the methods of study and probable complications.

By this three-stitch technique we have treated twenty five adult patients sustaining the post traumatic compound humerus shaft fractures by the antegrade humerus nailing.

### ***Inclusion criteria***

patients with compound injury upto type 3A (Gustilo-Anderson classification), linear lacerations and patients with no comorbidities were included in the study.

### ***Exclusion criteria***

Skeletally immature patients, advanced comorbidities (DM/HTN/IHD), associated head injuries, type 3B onwards (Gustilo-Anderson classification), patients with radial nerve palsy, patients with comorbidities, unstable vital signs and active arterial bleeding were excluded from the study.

### ***Surgical techniques***

The patient was positioned in the “beach chair” position with the operative shoulder slightly over the edge of the operative table. The image intensifier was placed above the arm, so that with the arm abducted, a clear anteroposterior and lateral view of the fracture can be obtained. The shoulder and arm are draped free for ease during intraoperative manipulation. The site of entry was accessed through a small stab incision approximately 1 cm in length in front of the anterior rim of the acromion, remaining anterior enough to avoid the rotator cuff. With

careful soft tissue dissection bone is exposed. Soft tissue protection sleeve is passed through the incision over the bone and an entry point is made with the help of a guide wire lateral to the articular surface of humeral head under image intensifier guidance. The entry point is widened taking care not to damage the surrounding soft tissue and a guidewire is inserted into the medullary cavity. Fracture reduction is achieved and guide wire is advanced into the distal fragment. Serial reaming is done over the guide wire and a nail of appropriate size and length is inserted. Now the guidewire is removed and distal locking (anteroposterior) is done with a free hand technique under image intensifier guidance. For this second stab skin incision is taken slightly lateral to the midline in order to avoid the neurovascular bundle. Careful blunt soft tissue dissection with the help of the blunt end of K wire is done till the bone surface is reached. With the help of a soft tissue protection sleeve passed over this K wire, hole is drilled through both cortices and distal locking is done with a screw. Now the proximal locking sleeve is inserted through the zig. Third stab incision approximately 1 cm in length is made over the skin and blunt soft tissue dissection is carried out with the help of blunt end of K wire till the bone surface is reached. Proximal locking sleeve is carefully advanced over this K wire till it reaches flush to the bone surface so as to avoid any damage to the soft tissue while drilling and insertion of the screw. Hole is drilled through the zig and proximal locking is done with an appropriate length screw. Simple mattress sutures are taken to close the stab incisions.

Ethical committee approval has been taken.

### ***Statistical analysis***

As per MEPI score: At 6 months, almost all (24 of 25, 96%) patients had an excellent MEPI score, while only one patient had a good score. As per UCLA score: At discharge, 21 (84 %) patients had an excellent to good score while the remaining 4 (13.3%) patients had a fair score. The most common age group encountered was 18-25: - 13 out of 25 patients (52%). More common in males (72%).

## **RESULTS**

Out of the 25 patients, 23 patients showed functionally excellent outcomes with good compliance to rehabilitation protocol but two patients had delayed wound healing of which 1 patient had undergone VAC therapy, which later healed well after a period of two-three weeks with sequential dry dressings. None have gone into the non-union.

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 six months, almost all (24 of 25, 96%) patients had an excellent MEPI score, while only one patient had a good score.

**Table 1: MEPI score.**

MEPI score	On discharge		At 1 months		At 3 months		At 6 months	
	N	%	N	%	N	%	N	%
<b>Excellent (&gt;90)</b>	18	72	21	84	23	92	24	96
<b>Good (75-89)</b>	3	12	1	4	1	4	1	4
<b>Fair (60-74)</b>	3	12	2	8	1	4	0	0
<b>Poor (&lt;60)</b>	2	8	1	4	0	0	0	0
<b>Total</b>	25	100	25	100	25	100	25	100

**Table 2: UCLA score.**

Duration	Excellent to good	Fair	Poor
<b>On discharge</b>	21	4	0
<b>At 1 month</b>	22	3	0
<b>At 3 months</b>	23	2	0
<b>At 6 months</b>	24	1	0

The UCLA score was classified as follows: >27 points was graded as excellent to good and <27 as fair to poor. At discharge, 21 (84 %) patients had an excellent to good score while the remaining 4 (13.3%) patients had a fair score. The UCLA score at 6 months was excellent or good in almost all (24 OF 25, 96 %) patients while only one patient had a fair score.

**Table 3: Age distribution.**

Age (Years)	N	Percentage (%)
<b>18-25</b>	13	52
<b>25-40</b>	7	28
<b>&gt;40</b>	5	20

The most common age group encountered was 18-25: 13 out of 25 patients (52%), 25-40: 7 out of 25 patients (28%) and >40: 5 out of 25 patients (20%).

**Table 4: Sex distribution.**

Sex	N	Percentage (%)
<b>Male</b>	18	72
<b>Female</b>	7	28

Interpretation: - More common in males (72%)

**Table 5: Distribution of side of injury.**

Side of injury	N	Percentage (%)
<b>Right</b>	15	60
<b>Left</b>	10	40

In our study we found that right sided injury was more common (60%).



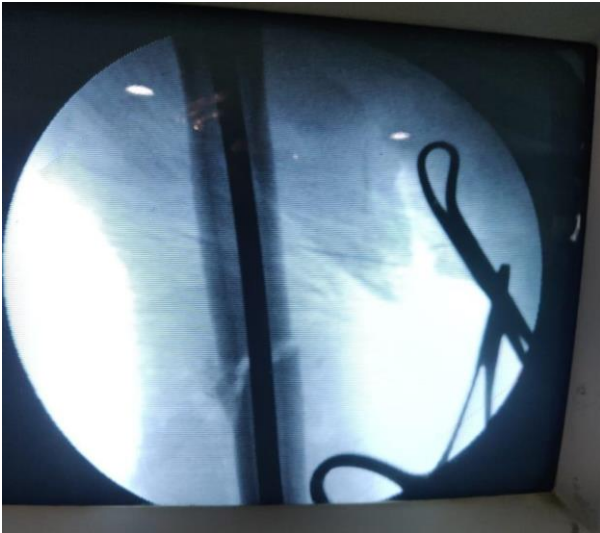
**Figure 1: Clinical presentation, clinical pic showing a compound injury over the humerus.**



**Figure 2: X-ray humerus ap showing a mid shaft fracture, pre op x-ray showing a mid-shaft humerus fracture.**



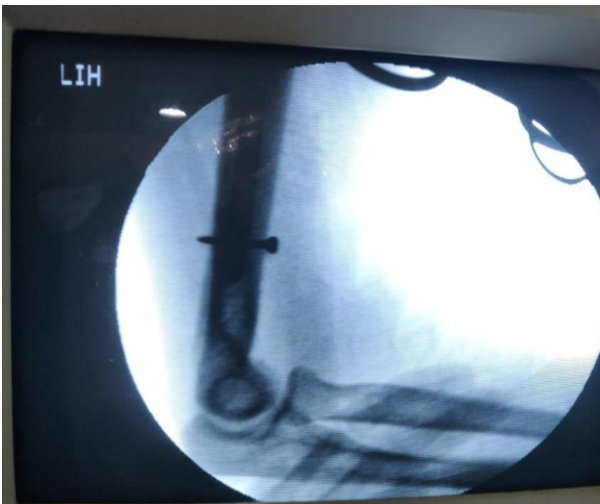
**Figure 3: X-ray humerus lateral showing a mid shaft fracture, pre op x-ray showing a mid-shaft humerus fracture.**



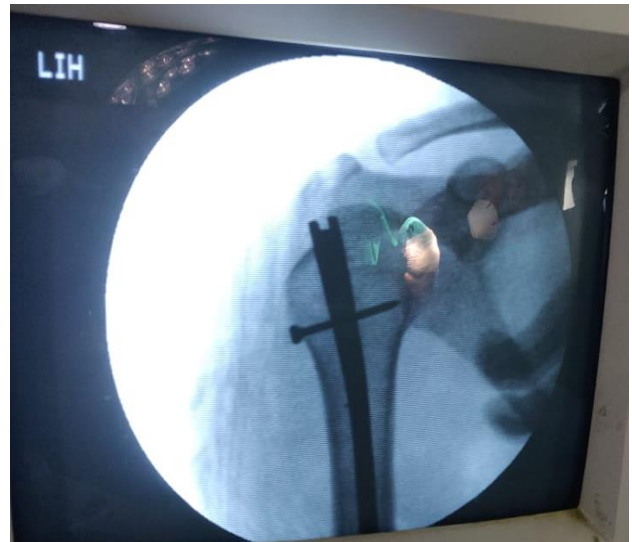
**Figure 4:** Intra op c-arm pictures, c-arm photo showing mid-shaft humerus post fixation by IMIL nailing.



**Figure 7:** Intra op pictures, c-arm photo showing proximal humerus post fixation by IMIL nailing.



**Figure 5:** Intra op c-arm (lateral), c-arm photo showing distal humerus post fixation by IMIL nailing.



**Figure 8:** Intra op pictures, c-arm photo showing proximal humerus post fixation by IMIL nailing.



**Figure 6:** Intra op pictures, c-arm photo showing distal humerus post fixation by IMIL nailing.



**Figure 9:** Three stitch technique, intra op photo of a 3 stitch technique.



**Figure 10: Post op x-rays post op x-ray showing IMIL nail in situ.**

## DISCUSSION

Although most authors recommend initial stabilization of fracture with decontamination of wound at presentation but in this study stabilization and decontamination have been done in 1 surgical setting to avoid increase incidence of infection and to minimize the wound healing problems due to multiple surgeries.<sup>8</sup> Since this study includes compound humerus fracture till Gustilo Anderson classification 3A it is surgically justified to use Intra medullary devices.<sup>9</sup>

Since plate osteosynthesis has been a gold standard for treating humerus diaphyseal fractures but it has been associated with higher incidence of infection, extensive soft tissue fibrosis, difficult rehabilitation and pain.<sup>10</sup>

Antegrade 3 stitch technique is a minimally invasive, one of the least complicated method of treating compound humerus diaphyseal fracture with good outcomes which we have proven in our study and can be a good alternative to plating.<sup>11</sup>

Conservative management of humeral shaft fractures, although giving high rates of union is losing popularity due to the need for prolonged immobilization to achieve solid union followed by vigorous rehabilitation to restore joint function and muscle strength. Plate osteosynthesis, considered as the “gold standard” by its advocates has yielded good results but at the cost of infection, nerve palsies and need for additional surgeries to salvage failures or for removal of the implant. Antegrade Interlocking intramedullary nailing has yielded varying and often contrasting results with complications like Shoulder stiffness and impingement observed in many patients.

However, there are cases where antegrade humeral nailing is irreplaceable, such as in the polytrauma patient who cannot be positioned prone to undergo retrograde nailing. In addition, the antegrade technique offers easier access to the humeral canal and easier handling of the image intensifier. The technique, being less time consuming, is also preferred by anaesthesiologists. Violation of the rotator cuff during antegrade humeral nailing has been considered to be responsible for suboptimal clinical outcomes and discomfort in the shoulder joint. To avoid this we make our entry portal slightly more anteriorly to avoid damage to the rotator cuff. Other problem encountered is the soft tissue injury around the shoulder. Vulnerable structures around the shoulder that could be injured during antegrade intramedullary nailing include the axillary nerve, the circumflex artery, the long head of biceps, and the deltoid. These structures are usually injured by the proximal locking bolts. Some authors advocated the use of antegrade nails that do not use locking bolts for the proximal interlock to avoid these complications, but these nails could increase the risk of problems with the fracture union process due to reduced stability at the fracture site. In our technique we carry out careful blunt soft tissue dissection with the help of blunt end of K wire to reach the bone surface and pass the proximal locking sleeve is over this K wire till it reaches flush to the bone surface so as to avoid entrapment and damage to the surrounding soft tissue. Distal interlocking of an antegrade humeral nail is considered difficult and time consuming as a lateral view of the humerus cannot be easily obtained with the image intensifier. Furthermore, the narrow locking holes of humeral nails and the ‘slippery’ bony surface at the distal humerus make distal interlocking even more challenging. Insertion of a locking screw from lateral to medial, apart from being technically more difficult, bears the danger of injury to the radial and/or the lateral cutaneous nerves. For this reason in our technique, we do antero-posterior distal locking. And to avoid the neurovascular structures present anteriorly we make our incision slightly lateral to the midline and carry out careful blunt soft tissue dissection with the help of blunt end of K wire till the bone surface is reached and pass the soft tissue protection sleeve over this K wire to avoid damage while drilling and insertion of the screw.

Limitations of this technique would include non-compliant patients, lost to follow up.

## CONCLUSION

As per MEPI score: -At 6 months, almost all (24 of 25, 96%) patients had an excellent MEPI score, while only one patient had a good score. As per UCLA score:-At discharge, 21 (84 %) patients had an excellent to good score while remaining 4 (13.3%) patients had a fair score. The most common age group encountered was 18-25-13 out of 25 patients (52%). More common in males (72%).

Our study suggests that the three-stitch technique is a good alternative method compared to external fixators and other

various surgical techniques and yields good results with lesser complications and better cosmetic outcomes in compound injuries.

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