Section: Orthopaedics

Original Research Article

CROSS-LINKED PERCUTANEOUS PINNING VERSUS JOSHI'S EXTERNAL STABILIZING SYSTEM IN TREATING PROXIMAL HUMERUS FRACTURE

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Received *: 03/05/2024*
Received in revised form *: 27/06/2024*
Accepted *: 12/07/2024*

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DOI: 10.70034/ijmedph.2024.3.10

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2024; 14 (3); 60-66

ABSTRACT

Background: Proximal humerus fractures are defined as fractures occurring at or proximal to the surgical neck of humerus. Various methods are used for treating such conditions with mixed results. The purpose of this study was to assess the outcome of these fractures treated by Crosslinked percutaneous pinning (CLiPP) and Joshi's External Stabilizing System (JESS) in terms of time of union, functional outcome and complications.

Materials and Methods: A prospective comparative study was done in a period of 1 year (2019-2020), which included 30 patients where 15 cases underwent surgery via CLiPP and other 15 cases via JESS. Neer's 2 and 3 part fractures, skeletally mature patients and patients presented within 3 weeks of presentation were included in the study. After the surgery, patients were followed up at 4 weeks, 6 weeks, 8 weeks, 12 weeks and 6 months and shoulder function was assessed using Constant Murley Score.

Results: Time of radiological union by both techniques showed no significant difference. Better functional result was observed by CLiPP group at 3 months whether at 6 months there was not significant difference between them. Excellent results were found in 20% patients with CLiPP group and 13.33% with JESS group. Same percentage (6.67%) of patients showed poor results in both the groups. 2 (13.33%) patients had pin tract infection of each group and 1 (6.67%) patient had pin loosening in JESS group.

Conclusion: Both the techniques are cost effective, enables early mobilisation with less soft tissue dissection and provides good results in treating Neer's 2- and 3-part fractures. CLiPP is better than JESS in terms of better early functional result.

Keywords: Proximal humerus fractures, CLiPP, JESS.

INTRODUCTION

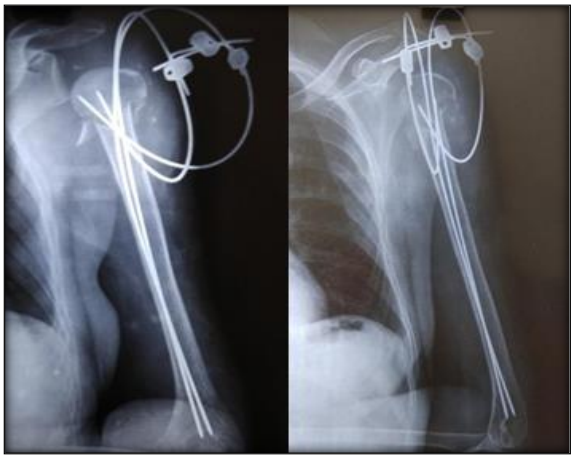
Proximal humerus fractures are defined as fractures occurring at or proximal to the surgical neck of humerus.[1] Most of the proximal humerus fractures (80%) are undisplaced or minimally displaced & usually treated conservatively,[2-4] but the displaced fractures (20%) require operative fixation5,6. The primary goal of treatment is restoration of proximal humeral anatomy with stable fixation that allows early functional range of motion,[7-9] Various fixation modalities are there for proximal humerus fractures like—transosseous suture fixation, percutaneous pinning, intramedullary nailing, plate fixation and hemiarthroplasty but they depends on patient's age, activity level, bone quality, fracture type, associated fractures and surgeon's technical ability.[9] Open reduction and internal fixation with plating is most widely used treatment for proximal humerus fracture. But it is an extensive procedure & there is a risk of vascular supply damage to the fragments which leads to AVN of the humeral head, blood loss, infections and need for reoperations.[10-

12] Moreover with pre-existing osteopenia, osteosynthesis is often difficult and rigid implant can lead to delayed healing or non-union by preventing dynamic bone contact or by simply cut out of the osteopenic bone.[13,14] Traditional percutaneous pinning (TPP) construct has the chances of pin migration, pin back out, pin loosening, loss of fixation and varus collapse without external fixator.[15,16] Augmenting external fixator to the pin construct can prevent the problems associated with traditional percutaneous pinning.[15,16] Cross Linked Percutaneous Pinning is a modified traditional pinning where the elastic K-wires are locked in a metallic clip which is placed externally on the skin. Joshi's external stabilizing system also serves as external fixator which provides adequate stability. Therefore, the current study was performed to compare the results of displaced proximal humerus fractures treated by cross-linked percutaneous pinning versus Joshi's External Stabilizing System.

MATERIAL AND METHODS

A hospital based observational study was conducted between June 2019 to May 2020 in Assam medical college and hospital for thirty patients (30) with proximal humerus fractures and divided them into two groups by quasi randomization. Each group had fifteen patients (15) and Group A was treated by cross linked percutaneous pinning
(CLiPP) and Group B by Joshi's External Stabilizing System (JESS). There were 12 (80%) females and 3 (20%) males in group A and 11 (73%) females and 4 (27%) males in Group B.
Mean age was 59.60 (range 55-70) years in group A and 58.15 (52-70) years in group B. Most common mode of injury was fall from standing height (66.67% in group A and 53.33% in group B) followed by road traffic accident (33.33 % group A and 46.67% in group B).
Fractures of proximal humerus were classified by Neer's classification system. Displaced (more than 45° of angulation or >1 cm of displacement) 2 and 3 part fractures, skeletally mature patients and patients presented within 3 weeks of injury were included in the study. Neer's 4-part fractures, open fractures, fracture dislocation, pathological fractures, those with other associated injuries and medically unfit patients, were excluded from the study.
Surgical Procedures: The procedure was performed with the patient under general/regional anaesthesia in a supine position, using a sandbag to elevate the ipsilateral shoulder for ease of manipulation. Reduction was attempted by traction and manipulation and confirmed in anteroposterior and axillary views. If reduction fails then minimal incision was given to achieve reduction under direct vision.
For group A (CLiPP): The first k-wire was introduced into the greater tuberosity and then pushed down to the lateral epicondyle. The second cranial wire was inserted into the largest part of the humeral head and directed to the medial epicondyle. The remaining two k-wires were inserted from the proximal humeral metaphysis in cranial direction until they reach the subchondral bone of the humeral head. Bending of the wires were done to lock them into the JESS clamp placed externally. An angular correction was done by compressing or distracting the wires into the metallic clamp. The fracture was then inspected under continuous fluoroscopic guidance to check stability.

PRE-OPERATIVE X RAY



IMMEDIATE POSTOPERATIVE X RAY
INTRAOPERATIVE IMAGES

PATIENT POSITIONING AND DRAPPING (SAME IN BOTH GROUPS)

WIRE INSERTED IN CLIPP TECHNIQUE (UNDER IITV GUIDANCE)

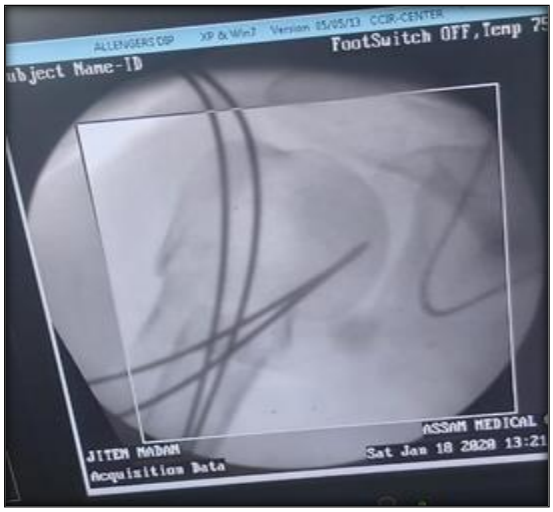
IMMEDIATE POST OPERATIVE

EXTERNALLY CROSS LINKED AND TIGHTENED WITH JESS CLAMP (FINAL)

AT 8 WEEK (FRACTURE UNITED)

MINIMAL OPEN INCISION WAS DONE IN FEW CASES FOR BETTER REDUCTION

POST OPERATIVE AT 6 MONTHS (FLEXION)



INTRAOPEARTIVE IITV GUIDANCE

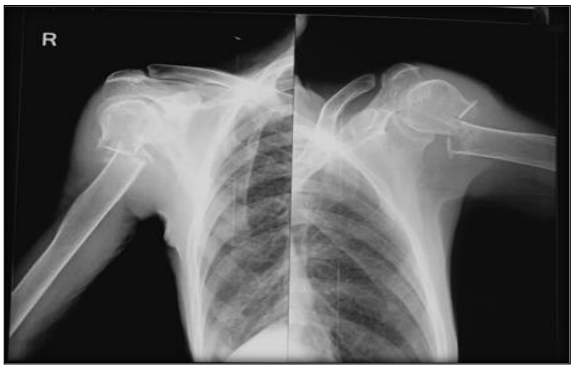
AT 6 WEEKS (ABDUCTION)

AT 6 MONTHS EXTERNAL AND INTERNAL ROTATION

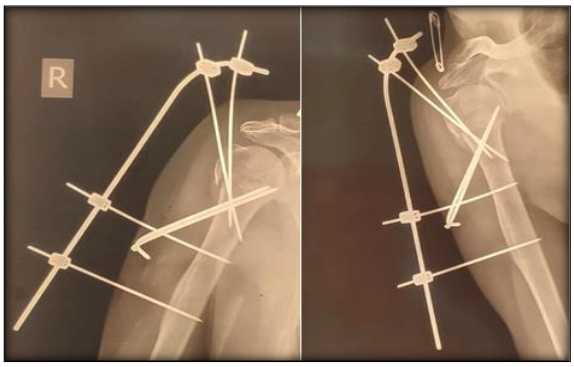
For group B (JESS): Two 2.5 mm Kirschner wires were put across the fracture starting at the lateral cortex of the proximal fragment engaging the subchondral bone of the head & resting on the calcar portion of the neck thus providing 3 point fixation. Once the reduction was stabilized with these 2 calcar rested Kirschner wires, we proceeded to the remaining

Kirschner wires for fixation of Joshi's External Stabilization System. Two (2mm) more Kirschner wires were placed obliquely from proximal to distal direction across the fracture & engaging the medial cortex of distal fragment. These Kirschner wires were inserted lateral to acromion engaging head & greater tuberosity. Two (2 mm) Kirschner wires were placed perpendicular to axis 8-10 cm distal to the fracture site. Now all the 4 wires were attached to a single JESS unit where the connecting rod was bent in a J-shaped manner proximally. The fracture was then inspected under continuous fluoroscopic guidance to check stability.

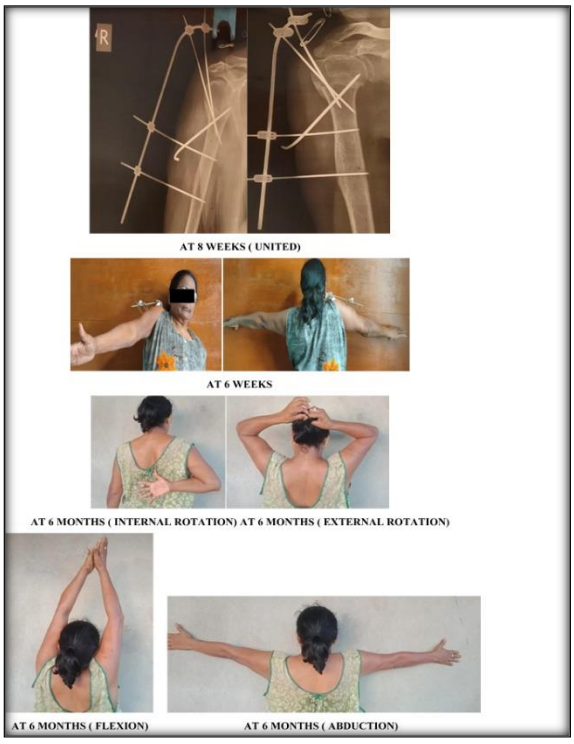
Pin tract dressing done & an arm sling was applied for patient's comfort. On 2nd or 3rd day once the patient was out of perioperative pain, pendulum exercises were started. By 2nd week passive abduction was started with progressive increase in range of motion exercises. Patients were followed up at 4 weeks, 6 weeks, 8 weeks and 12 weeks to look for clnical & radiological union. The fixator was removed when there was clinical (subsidence of pain) and radiological signs of union (bridging callus in 3 out of 4 cortices). Shoulder function was assessed using Constant scoring system at 3 month and 6 month follow up which consists of four variables that are used to assess the function of the shoulder i.e. pain, activities of daily living, range of motion and strength. Altogether there were 100 points. Constant score divides the outcome of patients into four categories, i.e. excellent having a score >85, good having a score between 71 and 85, fair having a score between 61 and 70, and poor outcome with a score of 60 or less.



PRE-OPERATIVE X RAY

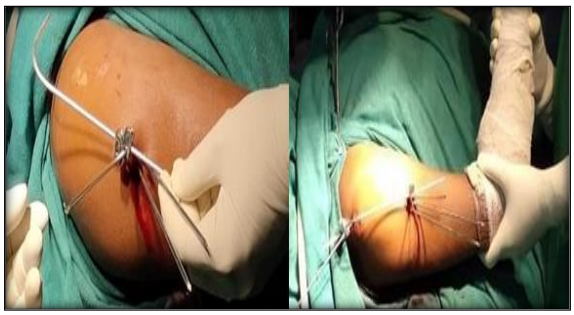


IMMEDIATE POST OPERATIVE



INTRAOPERATIVE IMAGES

FIRST WIRE AT DISTAL FRAGMENT FOR MANIPULATION OF DISTAL FRAGMEN AND TWO ADDITIONAL CALCAR WIRE PUT UNDER IITV GUIDANCE



JESS FRAME IS BENT AS J SHAPED MANNER AND WIRES WERE ATTACHED TO IT

FINAL JESS FRAME

RESULTS

Total thirty patients (n = 30) were included in the study and each group consisted of 15 patients. Group A had 10 patients with 2-part fractures, 5 patients with 3-part fractures and Group B had 9 patients with 2-part fractures and 6 patients with 3-part fractures. Mean interval between injury and surgery was 6.53 days in group A and 6.13 days in group B.

Mean time of radiological union observed in group A was 7.33 (SD1.23) and group B 7.47 (SD0.92) which was statistically insignificant. 100% union was observed in our study before fixator removal. Mean follow up period was 6 months. Constant score at 3 months for Group A was 67.20±8.28 and in Group B 62.30±4.37 which was statistically significant (p value <0.001). At 6 months constant score for group A 80.07(SD7.91) and Group B was 77.07(SD 8.88) which was statistically insignificant (p value >0.05). Shoulder function was assessed using constant score at 6 months and found that 3 cases (20%) showed excellent result, 9 cases (60%) showed good result, 2 cases (13.3%) showed fair result & 1 case (6.7%) poor result in group A. In group B excellent results found in 2 cases (13.33%), good in 9 cases (60%), fair in 3 cases (20%) and poor in 1 case (6.67%). Poor results may be due to noncompliance in physiotherapy. The average surgical time taken by Group A was 38.27 minutes and Group B, 42.27 minutes. 2 patients (13.33%) had pin tract infection in group A and 2 patients (13.33%) in group B while 1 patient (6.67%) had K-wire loosening in group B (calcar wire) but did not affect the union. In our study none had avascular necrosis, neurovascular injury or joint penetration.

Table 1: Inter-group comparison of age using unpaired t-test

Study	Design	Sample	Intervention	Follow-up	Results
Carbone *et al*[19] 2012	Non-RCT	52	MIROS (31) TPP (27)	6, 12, 24m	MIROS better results @6m,12m,24m & less complications than TPP
Mohamed Abdel Aziz Hassan[15] ,2017	NonRCT	20	MIROS (10) TPP (10)	12m (avg)	MIROS better functional result
Om P. Gupta *et al*[21] 2016	Non - RCT	18	JESS	6m	Constant score – 72 (comparable)
Ameya U. Kulkarni & Umesh M. Kulkarni,[22] 2020	NonRCT	25	JESS	4wk,8wk,6m	Constant score 75.7 (comparable with our result)
Our study	NonRCT	30	CLiPP (15) JESS with K wire (15)	6 m	No significant difference in clinical and
					radiological outcomes

Table 2: Functional outcome

Constant score	Our study CLiPP (Group A)	Our study JESS (Group B)	Dr Rajeev[16]	Gupta op et al[21]	Anil et al[20]	Kristiansen et al[23]	Monga et al[24]
Excellent	20%	13.33%	26%	22.22%	18.75%	8.69%	52.6%
Good	60%	60%	52%	44.44%	62.5%	43.48%	31.5%
Fair	13.33%	20%	22%	22.22%	18.75%	43.48%	10.5%
Poor	6.67%	6.67%	-	11.11%	-	4.35%	10.5%

Table 3: Union and functional outcome

Studies	Average union time	Complications
Dr Rajeev[16]	8 weeks	7.4%
Mohamed Elashmawy[15]	8 weeks	20%
Anil Kumar Gupta *et al*[20]	6.5 weeks	12.50%
Utkal Gupta *et al*[25]	6- 8 weeks	11.10%
Our study (Group A)	7.33(SD 1.23) weeks	13.33%
Our study (Group B)	7.47 (SD 0.92) weeks	20%
Anil Kumar Gupta et al[20]	6.5 weeks	12.50%
Utkal Gupta et al[25]	6- 8 weeks	11.10%
Our study (Group A)	7.33(SD 1.23) weeks	13.33%
Our study (Group B)	7.47 (SD 0.92) weeks	20%

DISCUSSION

Proximal humeral fracture is still a controversial subject.[17,18] These are generally osteoporotic fractures. Majority of proximal humerus fractures can be treated nonoperatively but it may lead to malunion and failure to obtain early mobilization which can lead to shoulder stiffness.[16,18] Surgical treatment options like transosseous suture fixation, percutaneous pinning, intramedullary nailing, plate fixation and hemiarthroplasty aid in early mobilisation but they depend on various factors and produce mixed results.[9] Open reduction with plate fixation may lead to devascularisation of fragments, avascular necrosis of humeral head, infection and with pre-existing osteopenia, osteosynthesis is often difficult and rigid implant can lead to delayed healing or non-union.[10-14,16] Traditional closed reduction and percutaneous pinning (TPP) construct without external fixator has chances of pin migration, pin back out, pin loosening, loss of fixation and varus collapse. Many of these complications can be prevented by augmenting an external fixator to this pin construct. By adding an external fixator the varus collapse is prevented and pin loosening is less because the site of fixation is shifted from cancellous bone of the proximal humerus to the stronger bone of the lateral cortex of the humerus.[15,16,19] Moreover minimal soft tissue dissection leads to less chance of avascular necrosis of head & provides adequate stable fixation for early mobilization & optimal functional outcome.18 CLiPP and JESS served as external fixators in our study. We found better early functional outcome of group A at 3 months by using constant score. Even though at 6 months constant score was not significantly significant. Mean time of radiological union of group A was 7.33 (SD1.23) and group B was 7.47 (SD0.92) and similar results were found in various studies using external fixator.[15,16,20,21] complications were comparable to other studies as shown in table 3 which were managed by oral antibiotics & regular pin tract dressing. There was no delayed union, nonunion, avascular necrosis of humeral head and pin migration in our study. Our study had some limitations like small sample size and less duration of follow up.

CONCLUSION

Both the techniques are cost effective, enables early mobilisation with less soft tissue dissection and provides good results in treating Neer's 2 and 3 part fractures. CLiPP is better than JESS in terms of better early functional result.

Both CLiPP and JESS with K wire are useful techniques in selected patients with proximal humerus fractures. Besides being cost effective it is biological and enables early mobilization. Irrespective of soft tissue status, immediate definitive operative intervention was possible in both the groups which reduced the hospital stay.

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