



“TO COMPARE FUNCTIONAL OUTCOMES OF PROXIMAL HUMERUS FRACTURE TREATED BY PHILOS AND TENSION BAND TECHNIQUE”

Orthopaedics

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ABSTRACT

Background : PHILOS technique for the management of proximal humerus fracture provides exceptional stability during fracture however the technique is invasive, On the other hand, tension band wiring is a less intrusive technique. Therefore we aimed to evaluate the comparative outcomes of both the techniques. **Material & Method :** Thirty patients with proximal humerus fracture were enrolled in this study and randomized into two groups i.e PHILOS (N=15) and Tension band (N=15). The patients were followed until 4week, 12 week, 6 month. Radiological union, Pain on activity, quality of life (DASH score), Clinical outcome (Range of motion) and functional outcome (Constant murley score and Oxford shoulder score) were assessed. Any complications were also reported during the follow up interval. **Results :** The demographic profile was comparable in both the groups. However, the clinical and functional outcome was significantly better in patients in PHILOS group as compared to tension band group. ($p<0.05$). Amongst the early complications, deep infection was observed in one patient in PHILOS group and two cases in Tension band group. Tension band group also had three cases of K wire loosening and 1 case of neurovascular complication i.e Neuropraxia of axillary nerve. Amongst late complications, one patient had secondary osteoarthritis and 1 patient had joint stiffness. In tension band group, two cases each of secondary osteoarthritis and joint stiffness was observed. **Conclusion –** It can be concluded that, PHILOS system provides better and stable fracture fixation for early mobilization when compared with tension band with K wiring as treatment option for proximal humerus fracture

KEYWORDS

INTRODUCTION

Proximal humerus fracture (PHF) is the second most common fracture of upper extremity following distal forearm fracture. Proximal humeral fractures are the third most frequent fracture in elderly patients after hip fracture and Colles' fracture.[1]

The goal of treatment for proximal humerus fractures is restoration of a painless shoulder with satisfactory function. This requires an understanding of the injury including the patient's age, expectations, medical condition, bone quality, and knowledge of the available fixation techniques and their limitations. [2]

Patients are frequently treated nonoperatively, but when surgical treatment is necessary, different techniques can be performed such as percutaneous pinning, plating, arthroplasty, or intramedullary nail [3-4].

Among the surgical treatments, open reduction and internal fixation (ORIF) is the most used, although it presents several downsides such as an increased risk of avascular necrosis (AVN) of the humeral head, non-union, malunion, and screw cut-out [5]

To overcome these problems and increased patient functional outcomes, an anatomical plate design was developed [6,7] by the AO/ASIF group: the Proximal Humeral Internal Locking System (PHILOS) plate. The PHILOS plate is an internal fixation system that enables stabilization thanks to multiple angular stable interlocking screws, with the goal of preserving the biological integrity of the humeral head while securing an anatomical reduction [8].

This method of fixation allows early mobilization, and owing to the presence of numerous holes in its proximal portion, it also allows if needed an anchorage for rotator cuff sutures. The indications for the use of the PHILOS plate are various: two-, three-, four-fragment dislocations of proximal humerus fracture including fractures in osteoporotic patients, pseudoarthrosis, and osteotomy in the proximal humerus [9,10].

The reliability of this device led the PHILOS plate to become the

standard surgical treatment for the fixation of PHFs. However, the most frequent complication associated with its usage was screw cut-out, followed by humeral head avascular necrosis and subacromial impingement[11].

The recent trends for the management of proximal humerus fracture are towards limited soft tissue dissection and minimal osteosynthesis. It is important to consider that, if soft tissue hinges have been retained, the ultimate prognosis is good regardless of the number of fragments present. It was observed that patients who underwent limited soft tissue dissection and osteosynthesis tolerated active exercises well.[12]

Tension band wiring is a less invasive techniques that allows less stripping of bone and therefore preservation of blood supply to the humeral head. Due to reduced adhesions, no aggressive rehabilitation was necessary. This procedure is simple to perform and provides good results and can be used at low resource setting. [12]

Therefore, the present study was planned to compare the functional outcomes of treatment modalities of proximal humerus fractures on the basis of hypothesis of principles, advantages and complications of Tension Band Wiring and PHILOS plating.

MATERIAL & METHODS

The present prospective study evaluated 30 patients having Proximal Humerus Fractures. in the department of Orthopedics, CSS Hospital, Subharti Medical College, Meerut. Informed consent of all participants was obtained after explaining the purpose of the study. Permission to carry out the study was obtained by Institutional Ethical Committee.

Adult patients with two-part, three-part, four-part proximal humeral fractures, Closed or dislocated fractures were included in the study.

Open fracture, Undisplaced fracture, Unfit for surgery, Associated Head or neurovascular injury, Pathological fracture, Fracture Ipsilateral upper limb, Axillary nerve injury were excluded from the study

All the patients were randomized using simple randomization method into two groups . PHILOS group (N=15) and Tension Band group (N=15)

The patients were then assessed clinically to evaluate their general condition and the local injury. The general condition of the patient and the vital signs were recorded. The methodical examination was done to rule out fractures at other sites. The local examination of the injured shoulder was done for swelling, deformity loss of function and altered attitude.

Any nerve injury was also looked for and noted. The local neurologic deficit of axillary nerve was also assessed by looking for the anaesthetic patch over the lateral aspect of the shoulder.

Radiograph of proximal humerus as Ap view ,lateral view was taken and fractures were classified according to Neer's classification. The patient was taken for surgery after routine investigation and after obtaining physician fitness towards surgery.

The investigations were done as follows: CBC, PTH, SERUM CALCIUM, VIT D3, urine for sugar, FBS, blood urea serum creatinine, HIV, HBsAg, and ECG.

Surgical Technique Of Philos-

Through delto-pectoral approach , this approach offers exposure of proximal humerus, the patient was placed supine on operative table. brachial block / general anaesthesia was given by anaesthesia team, a sand bag under the spine at the medial border of scapula, and arm was painted and draped, land mark of incision identified which are coracoid process and deltopectoral groove, incision made of approximately 10-15 cm in line with delto pectoral groove beginning from coracoid process.

The inter nervous plane identified which lies between deltoid muscle which is supplied by axillary muscle and pectoralis major muscle supplied by lateral pectoral nerve , soft tissue bluntly dissected and cephalic vein identified and retracted medially and deltoid and pectoralis muscle retracted laterally and bleeders were cauterized, short head of biceps and coraco brachialis was identified and displace medially, following which subscapularis was identified and retracted to expose the capsule of shoulder which was incised following which fracture is exposed, reduction of fracture fragment was done and held temporarily with k-wire and bone holding clamp, locking plate applied and with the help of locking drill bit holes were drilled and length of screw was measured with depth gaze and locking screw placed k wires and clamp removed and reduction was checked to be satisfactory and surgical wound washed with normal saline and closed in layer using 2-0 vicryl and 2-0 polymide for skin aseptic dressing done and patient was given a arm sling.

Tension Band Technique

Patients were placed supine in the semireclining (beach-chair) position on the operating table . brachial block / general anaesthesia was given by anaesthesia team, a sand bag under the spine at the medial border of scapula, and arm was painted and draped and c arm was used for intraoperative image . Through deltopectoral approach offer expose of proximal humerus.The fracture site irrigated and all of the debris and hematoma were removed.

Great attention was made during exposure and reduction to preserve all soft tissue attachments to the bone fragments. After acceptable fracture reduction, two 2 mm K-wires were inserted anterolaterally and posterolaterally along the non articular surface of the humeral head in a vertical manner. The intramedullary K-wire was parallel so that the proximal fragment could slide on the wires and were compressed to the distal fragment during tensioning of the cerclage wires. The tension band was localized in a way that .it was passed under the axillary nerve. A muscle bundle from the deltoid was inserted between the axillary nerve and the tension band. The K-wires were placed 2-3 cm apart from each other to increase rotational stability. Cerclage wire insertion around the K-wires were as figure of eight , with neither wire crossing the bicipital tendon.by tightening the twist and the loop with two pliers simultaneously. the two fragments are drawn together such that the fracture was placed under compression. reduction was checked to be satisfactory and surgical wound washed with normal saline and closed in layer using 2-0 vicryl and 2-0 polymide for skin aseptic dressing done and patient was given a arm sling.

Post Operative Protocol:

In Post operative period an arm sling was given immediately after surgery for 3 to 5 days .The x ray was advised and checked to evaluate the alignment of the bones and confirmation of satisfactory reduction, I.V. antibiotic was given for 3 days post operative. on the third post-operative day active and passive shoulder mobilisation were started under close supervision (pendulum and internal rotation and external rotation) as tolerated by patient. Especially Neer type 5 fractures rehabilitation was start after 15 to 20 days.

Outcome Assessment

These patients were followed at 4week, 12 week, 6 month post operatively and on each visit Xray was done to observe radiological union and their functional evaluation was done by various scoring systems (i.e.-, CONSTANT MURLEY SCORE ,OXFORD SHOULDER SCORE AND DASH SCORE) .Pain on movements was assessed by Visual Analogue score .

RESULTS

Demographic Profile

We observed that the demographic profile in both the groups was comparable. (Table 1)

Side	PHILOS (N=15)	Tension Band (N=15)	Total (N=30)	P value Chi square test
Age (in years)	48.06 ±13.55	49.86±13.15		0.179(paired T test)
Side				
Left	5 (33.34%)	8 (53.33%)	13(43.33%)	0.174
Right	10(66.66%)	7 (46.67%)	17(56.67%)	
Etiology				
Fall	5 (33.34%)	5 (33.34%)	10(33.33%)	0.256
RTA	10(66.66%)	10(66.66%)	20(66.67%)	
NEER classification				
2 part	8 (53.33%)	5 (33.34%)	14(46.66%)	0.116
3 part	6(40%)	10(66.66%)	16 (53.33%)	
4 part	1(6.67%)	-	1(3.33%)	

Radiological Outcome

The average time for radiological union was 12±3.5 weeks. In Tension band group, 1 patient had malunion and 4 cases had non union.In PHILOS Group, delayed union at 6 months was observed in 2 cases.

Pain On Activity At 6 Months

At 6 month followed, Majority of the patients , ten (66.66%) in PHILOS group and 8 (53.33%) in Tension band group had no pain .Mild pain was observed in 3 cases of PHILOS group and 4 cases of Tension band group . Pain with usual activity was observed in 2 cases of PHILOS group and 3 cases of Tension band group.

Function Outcome

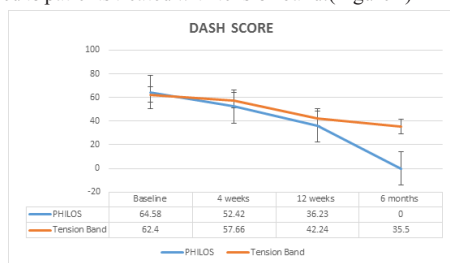
It was observed that after 4 weeks , 12 weeks and 6 months patients treated with PHILOS had significantly higher range of motion, Constant Murley score and Oxford shoulder score as compared to patients treated with tension band.(table 2)

	PHILOS (in degrees)	Tension Band (in degrees)	P value Paired T Test
Range of motion			
4 weeks	66.33±15.97	61.66±18.48	0.024*
12 weeks	92.33±16.02	87.66±16.71	0.017*
6 months	127±18.89	117±17.04	0.001*
Constant Murley score			
72.42±12.80	65.66±10.48	0.014*	72.42±12.80
76.50±11.35	70.24±10.22	0.002*	76.50±11.35
85.4±10.25	76.5±12.32	0.001*	85.4±10.25
Oxford Shoulder Score			
4 weeks	21.30 ± 7.8	24.26±4.48	0.041*
12 weeks	32.8 ± 8.2	29.54±5.40	0.046*
6 months	40.6 ± 5.8	36.5±5.32	0.0391*

DASH Score

It was observed that at 4 weeks , 12 weeks and 6 months patients

treated with PHILOS had significantly higher Dash Score as compared to patients treated with tension band.(Figure 1)



Complications

Amongst the early complications, deep infection was observed in one patient in PHILOS group and two cases in Tension band group.

Tension band group also had three cases of K wire loosening and 1 case of neurovascular complication. i.e Neuropraxia of axillary nerve)

Amongst late complications, one patient had secondary osteoarthritis and 1 patient had joint stiffness.

In tension band group, two cases each of secondary osteoarthritis and joint stiffness was observed.

DISCUSSION

It was observed that after 4 weeks, 12 weeks and 6 months patients treated with PHILOS had significantly higher range of motion as compared to patients treated with tension band.

Similarly Vijay A et al [46], in their study reported mean Neer's score for range of motion (ROM) in PHILOS Group as 86.0 while for K wiring group as 77., respectively. Difference between the groups was statistically significant. The findings could be attributed to the philosophy of ORIF with PHILOS, which offers better anatomical reduction with more rigid fixation into the metaphyseal bone and consequently allows for earlier mobilization, which decreases postoperative stiffness. Another advantage of this technique is the ability to obtain a good reduction of the greater tuberosity as compared to the tension band K wiring method.

Radiological Outcome

Quality of reduction, fracture alignment, restoration of articular congruity, fracture union, PHILOS plate deviation, screw penetration, K wire backout, implant loosening and failure were assessed radiologically during follow up intervals.

The average time for radiological union was 12±3.5 weeks. Two patients in PHILOS group had non union at 6 month follow up. In Tension band group, 1 patient had malunion and 4 cases had non union till 6 months. These 4 patients were kept on further follow up to evaluate their status.

In the study by Patil N, Bellad SH, Anand SR [40] patient treated with tension band k wiring, all fracture healed at period interval of 10-17 weeks.

In the study by Vijay A et al [46], There were no cases of delayed union or nonunion. The average time for union (in weeks) was found to be 10.34 (ranging 7–18 weeks) and was unaffected by the modality of treatment used.

In the study by Yadav U et al [45], group operated with ORIF (PHILOS) mean time of union was 11.10± 1.09 (In 10wks union happened in 10 patients; union took place in 12wks in 10 patients; 13wks time was taken only by 1 patient.). whereas for group operated with ORIF(k-wire) mean time of union was 11.74± 1.01weeks (in 10wks union took place in 5 patients; 12wks in 13 patients and 13wks in 4 patients, and 1 case went for avascular necrosis).

In the study by Aly Mohammed El-Geoshy et al [49], All patients in both groups achieved radiological union. However, the PHILOS group had a better neck shaft angle (mean was 128 degrees and 118 degrees for K-wires). There were three (20%) cases of pin loosening and malunion in the K-wires group.

Overall, Loss of reduction and malunion are more common with K-

wires than with plate fixation resulting usually in varus deformity. Jaura and colleagues [47] had four (13%) cases in the K-wire group.

The fixed angle plates in PHILOS, enable a gain in the torsional stiffness and stability and may therefore promote a superior outcome and less chance of complication like cut-out of the screws and plates, non-union, avascular necrosis and fracture distal to plate.[50] In our study, maintenance of medial periosteal hinge and careful surgical dissection prevented damage to the posteromedial vessels at posteromedial neck of humerus, resulted in no incidence of AVN in follow-ups.

Functional Outcome

It was observed that after 4 weeks, 12 weeks and 6 months patients treated with PHILOS had significantly higher range of motion, Constant Murley score and Oxford shoulder score as compared to patients treated with tension band. Comparative Literature assessing functional outcome were highlighted below

Study	Treatment modality	Number of cases	Follow-up (months)	Scores/criteria for evaluation of final functional outcome	Final mean Scores
Keener et al., 2007[51]	K-wires	62	35	Constant-Murley score,	73.9
				American Shoulder and Elbow Surgeon score	83.4
M Agrawal (2024)[52]	PHILOS	9 in each group	12	Constant-Murley Score	81 +/- 6.13
	K wire				76.88 +/- 7.37
Fazal and Haddad, 2009[53]	PHILOS	27	13	Constant-Murley Score	70
Cemil Yıldız [12]	Tension band K-wires	74	-	Constant-Murley score	Sixty-one patients (82.4%) had a Constant score of 80 or more and 13 patients (17.6%) had a score less than 70 points at the 6th month
Jaura et al., 2014[47]	PHILOS	30	12	Constant-Murley score	84.6
	K-wires	30			76.4
Chowdary et al., 2014[54]	PHILOS	70	-	Constant-Murley score	88
Vijay A et al 2018[46]	PHILOS	24	11	Neer's criteria	86
	K-wires	24			77.7
Yadav U et al 2020[45]	PHILOS	21	6	Constant-Murley score	85.29
	K-wires	23			79.48
Aly Mohammed El-Geoshy et al 2024[49]	PHILOS	15	1 year		88.47 ± 5.18
	K wire	15			91.53 ± 7.50
Present Study	PHILOS		6	Constant murley score	85.4±10.25
	K wire				76.5±12.32

Complications

Amongst the early complications, deep infection was observed in one patient in PHILOS group and two cases in Tension band group. The

infections were symptomatically managed using antibiotics.

Tension band group also had three cases of K wire loosening and 1 case of neurovascular complication i.e neuropraxia of axillary nerve, which was managed conservatively.

Amongst late complications, one patient had secondary osteoarthritis and 1 patient had joint stiffness in PHILOS group. In tension band group, two cases each of secondary osteoarthritis and joint stiffness was observed.

In the study by Patil N, Bellad SH, Anand SR [40], superficial infection (n=1), secondary displacement and malunion (n=2), and avascular necrosis (n=1). 2 patients had k-wire impingement

Following reconstructive surgery for proximal humerus fractures, among the most terrifying consequences is AVN of the head of the humerus. For the majority of individuals, AVN results in poorer clinical outcomes and further revision surgeries.

In the current study, no cases of AVN in either group were encountered throughout the follow-up.

In the ORIF studies: Thyagarajan DS and colleagues[55] had four cases of malreduction (16%); Chowdary and colleagues[54] had only one (1.5%) case. In the plate group, we had no cases of malunion (0%).

Jaura and colleagues[47] had six (20%) cases of pin tract infection in their K-wire group, who were treated by daily dressings and antibiotics. In our study, deep infection occurred in two cases of the K-wire group, which is comparable to the infection rate in the literature. It was superficially self-limited and resolved by frequent dressings and antibiotics. In the ORIF studies: Chowdary and colleagues [64] had two (2.8%) cases of superficial infection.

Jaura and colleagues[47] had four (13%) cases of deep infection in the tension band wiring group who were managed by intravenous antibiotics following the culture and sensitivity results had been obtained. Deep infection occurred in our study in two (13%) cases of the tension band wiring group, also comparable to the literature.

Screw penetration and cutout is a complication mentioned in the literature with plate fixation, which is highly predicted by bone quality in addition to the surgical technique: According to Chowdary and colleagues two (2.8%) cases had this complication. There were no cases of screw cutouts in our study. [54]

Pin perforation occurred in some studies where the wires perforate the head and migrate inside the joint or even to the axilla. Osteoporosis is among the major factors for risk for its incidence. This required retrieval of the wires in two (7.5%) cases in the Jaura and colleagues study[47]. In the current study, we did not encounter any case of pin perforation.

Stiffness and secondary osteoarthritis occurred in Thyagarajan DS and colleagues.[55] who had six (23%) cases of stiffness; Chowdary and colleagues had two (2.8%) cases. In this study, we had one (6%) case of postoperative stiffness in PHILOS group, which was a four-part fracture and two (12%) cases in the K wire group

Yadav et al [45] reported Post-surgical stiffness as most common complication encountered in their study with 17.4% patient being affected in the group who were treated with ORIF (K-wire) and 9.5% patients were affected who were treated with ORIF (PHILOS). Infection was second most common complication faced in our study, Whereas only 1 case landed in avascular necrosis which was treated with CRIF (k-wire) and 1 patient who was treated with ORIF (PHILOS) developed impingement.

CONCLUSION

Our result demonstrated that the PHILOS system provides better and stable fracture fixation for early mobilization when compared with tension band with K wiring as treatment option for proximal humerus fracture. Early results for functional and radiological outcome and quality of life with PHILOS plate system were promising, and if plate is placed at optimal position and proper physiotherapy is given results can be better. Also the complications were less frequent in the PHILOS group as compared to tension band with K wiring.

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