

# Outcome of proximal humerus fractures treated with k wire fixation by modified palm tree technique

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## Abstract

**Introduction:** Proximal Humerus fractures constitute nearly 5% of all fractures. These days most fractures are treated by Open Reduction and Internal fixation (ORIF) with locking plates. However, ORIF with Locking Plates is associated with complications such as periosteal stripping, excessive soft tissue dissection, and avascular necrosis of the Humeral head. K wire fixation by Modified Palm tree technique is an alternative with minimal soft tissue dissection and fewer chances of avascular necrosis. We here describe our clinical experience with the modified Palm tree Technique.

**Methods:** This was a Prospective study. Thirty patients who fulfilled the inclusion criteria were enrolled in the study. Baseline data including Age, Gender, and Type of fracture were noted. They were operated by closed reduction and K wire fixation by modified Palm tree technique. At the follow up the patients were evaluated for their Range of motion and the functional outcome was analyzed with Constant Murley Score.

**Results:** A total of 30 patients were enrolled in the study. One patient was lost to follow-up and was removed from the final data analysis. Out of these 29 patients, 16 patients (55.17%) were males, and the rest 13 (44.83%) were females. The patients were followed up for a period of  $14.45 \pm 1.97$  months with the range of follow-up being 12-18 months. All the fractures achieved union. One patient developed Avascular Necrosis of the Humerus head. The mean abduction was found to be  $124.83^\circ \pm 14.30^\circ$ . The mean forward flexion was found to be  $130.34^\circ \pm 15.29^\circ$ . The mean External Rotation was found to be  $46.07^\circ \pm 4.83^\circ$ . The Constant Shoulder Score was found to be  $74.34 \pm 11.46$ .

**Conclusion:** Modified Palm tree Technique is a reliable technique for the fixation of Proximal Humerus Fractures.

**Keywords:** Proximal humerus fractures, palm tree technique, modified palm tree technique

## Introduction

Proximal Humerus fractures are found to constitute nearly 5 percent of all the fractures

encountered in the emergency department <sup>[1]</sup>. Various treatment methods have been described to treat these fractures such as Non-Operative Treatment, Open reduction and internal fixation (ORIF) <sup>[2, 3]</sup> with Plates and Closed Reduction and Percutaneous Fixation with the K wiring <sup>[4]</sup>.

Out of this Non-Operative treatment with a shoulder immobilizer or arm pouch sling can be utilized for undisplaced or minimally displaced fractures to achieve good functional results <sup>[5]</sup>. But if used in displaced fractures, conservative treatment can lead to complications such as Non-union, malunion, decreased ROM (Range of Motion) and stiffness <sup>[6]</sup>.

These days most fractures are treated by Open Reduction and Internal fixation (ORIF) with locking plates <sup>[2,3]</sup>. Plates have the advantage of anatomical reduction with early postoperative rehabilitation in osteoporotic fractures <sup>[7, 8, 9]</sup>. But plating has disadvantages too such as periosteal stripping, damage to soft tissue due to extensive dissection and avascular necrosis of the Humerus head <sup>[10]</sup>. Though the locking plate for proximal humerus can be inserted by minimally invasive technique to avert these complications, this technique is limited only to minimally displaced fracture and cannot be utilized in comminuted fractures <sup>[11]</sup>.

Closed reduction and percutaneous fixation of the Proximal Humerus was first described by Kapandji in 1989 <sup>[4]</sup>. It has the advantage of being a minimally invasive technique with no risk of periosteal stripping or need for soft tissue dissection. There is preservation of the blood supply due to minimal soft tissue dissection. But it is mired with complications such as reduction loss and K wire loosening <sup>[12, 13]</sup>.

We in our study are presenting our clinical experience of Proximal Humerus fractures operated by closed reduction and K wire fixation by Modified Palm tree technique.

## Methods

This was a Prospective study. Thirty patients who fulfilled the inclusion criteria and Presented to our hospital between July 2018 to June 2021 were enrolled in the study. Baseline data including Age, Gender and Type of fracture were noted. They were operated by closed reduction and K wire fixation by modified Palm tree technique.

## Inclusion criteria

1. Angulation of articular surface more than 45°.
2. Displacement of Major fracture fragments more than 1 cm.
3. Fractures with valgus impaction.

## Exclusion criteria

1. Open Fractures.
2. Minimally displaced fractures.
3. Patients not willing to be included in the study.

The study was performed following the ethical standards given by the 1964 Declaration of Helsinki. Preoperatively X-rays of the Shoulder were taken.

The patients were explained about the Procedure. Expectations of the patients were noted and the queries of the patients were clarified. Pre-operatively written informed consent was signed by each patient. All the patients were operated by Closed reduction and K wire fixation by the Modified Palm tree technique. They were given a single intravenous dose of Prophylactic antibiotic preoperatively.

## Surgical technique

Patients were positioned on the operating table in a beach chair position. After clearance from the anesthesia side, the fracture was reduced depending on the displacement and deformity seen in the fluoroscopy unit by the combination of traction, abduction, and external rotation. A longitudinal incision was made on the deltoid tuberosity. A 3.5 mm oblique hole was made by drill bit at the base of the V-shaped insertion. Two Blunt Wires were bent and inserted through the hole. One hole was made proximal to the V-shaped insertion of the deltoid tuberosity. One wire was inserted from this site. During insertion, they were diverted to the different parts of the Humerus head by rotating the T handle used for insertion and hammering gently. Wires were inserted till they got hold in the subchondral bone. In Three-part and Four-part fractures where the GT (Greater tuberosity) was displaced a single wire was inserted from GT to the medial cortex and if required another wire was inserted from proximal end of humerus in an antegrade fashion. The reduction and stability were analyzed under the fluoroscopy unit. The wires were kept outside the skin and the skin incision was closed in layers.

## Postoperative care

Check X-rays were taken postoperatively. The arm was kept in an arm pouch sling for 4 weeks. Passive range of motion of the wrist and elbow was started on the 3rd postoperative day. Passive physiotherapy of the Shoulder was started as per the pain tolerance of the patients at 1 week. Active physiotherapy of the shoulder was started from 4 post-operative week. K wires were removed after the appearance of callus.

Patients were followed up regularly. At the follow up the patients were evaluated for their range of motion and the functional outcome was analyzed with Constant Murley Score.

Data was described in terms of range; mean  $\pm$  standard deviation ( $\pm$  SD), frequencies (number of cases), and relative frequencies (percentages) as appropriate. All statistical calculations were done using (Statistical Package for the Social Science) SPSS 21version (SPSS Inc., Chicago, IL, USA) statistical program for Microsoft Windows.

## Results

A total of 30 patients were enrolled in the study. One patient was lost to follow-up and was removed from the final data analysis.

Out of these 29 patients, 16 patients (55.17%) were males, and the rest 13 (44.83%) were females. The mean age of the patients was found to be  $47.93 \pm 13.52$  years with a range of 26 years to 72 years. Right Proximal Humerus was involved in 17 (58.62%) patients and Left Proximal Humerus was involved in 12 (41.38%) patients.

The fracture was found to be two-part in 15 patients (51.72%) and three-part in 9 patients (31.03%) and Four Part in 5 patients (17.24%). The mean operating time was found to be  $43.24 \pm 6.34$  minutes with a range of 36-58 minutes.

The patients were followed up for a period of  $14.45 \pm 1.97$  months with the range of follow-up being 12-18 months [Table 1]. All the fractures achieved union. One patient developed Avascular Necrosis of the Humerus head.

The mean abduction was found to be  $124.83^\circ \pm 14.30^\circ$  with a range of  $80^\circ$ - $150^\circ$ . The mean forward flexion was found to be  $130.34^\circ \pm 15.29^\circ$  with a range of  $90^\circ$ - $150^\circ$ . The mean External Rotation was found to be  $46.07^\circ \pm 4.83^\circ$  with a range of  $40^\circ$ - $55^\circ$  [Table 1].

The Constant Shoulder Score was found to be  $74.34 \pm 11.46$  [Table 1].

There were two cases of Pin site infection which were treated with Oral Antibiotics. Wound

dehiscence was seen in one case which resolved spontaneously with secondary healing. There was no case of Loss of Reduction or Migration of wire into the joint.

## Discussion

Proximal Humerus fractures constitute one of the common fractures of the shoulder [14]. Causal factors are Road traffic accidents in all age groups and trivial fall in the old age group due to osteoporosis [14]. The ideal treatment of proximal humerus fractures is still debated. Kapandji introduced the concept of the Palm tree technique for the fixation of proximal humerus fractures in the year 1987 [4]. This technique was based on the docking of the divergent k wires in the subchondral bone of the Proximal humerus [4, 15]. This is a minimally invasive technique with a smaller incision, minimal periosteal stripping, and preservation of the medial hinge which provides for the optimal situation for the union of the fractures [15]. Moreover, as the K wires used are flexible, this leads to a decrease in the chances of their breakout or cutout through from the bone and migration into the joint [16]. Bellec *et al.* in their study found satisfactory results in 71% of the patients with this technique though they faced complications such as CRPS (Complex Regional Pain Syndrome), radial nerve palsy, avascular necrosis, fixation failure and iatrogenic fracture in 48.4% of the patients [17]. During the next step in the evolution of treatment in the 1990s, a locking plate was introduced which became the mainstay of the treatment of proximal humerus fractures. Locking plates impart angular stability due to divergent locking screws [15]. But plates can cause major complications such as loss of fixation and screw cut out and plate impingement which cannot be ignored [11, 18]. Additionally, during locking plate insertion there is a requirement for adequate exposure with extensive soft tissue dissection and which in itself can cause increased chances of avascular necrosis of the proximal humerus in the years following the operative procedure [18, 19]. Brunner in his study on the plating in the proximal humerus fractures plating found a complication rate of 44% and subsequent revision either to plating or arthroplasty in 25% of the patients [20]. Nowadays it is being debated that early achievement of motion at the shoulder, the most highlighted result associated with locking plates does not necessarily lead to improved outcome [21, 22].

Alternative to Plating is being explored plating including modifications of the Kapandji technique such as done by Leonidou *et al.* [15] and Alfy *et al.* [16]. In the original Kapandji technique, all the wires were inserted from a single hole made at the V-shaped Insertion of the Deltoid Tuberosity. This may lead to all the wires acting as a single unit rather than a divergent construct, also known as the Bunching of wires [15]. We used a modified version of the Palm tree Technique to avoid this problem. The 3 wires were introduced from two different insertion sites on the Humerus. Two blunt wires were inserted through a 3.5 mm hole made at the V-shaped insertion of the Deltoid. One sharp wire was inserted through a hole which was made 2 cm above the Deltoid insertion. In the case of Three part or Four-part fractures with displaced GT fragment, one wire was inserted from The Greater tuberosity to the medial cortex and if required another wire was inserted from the proximal humerus in an Antegrade fashion. The wires which were inserted in a retrograde fashion led to three-point fixation as demonstrated by the Kapandji [4, 15]. The three points of fixation were one at the lateral entry point, the second at the medial cortex from where the wires slid proximally, and the third at the anchorage site in the subchondral bone. Due to the divergent nature and different entry point distally there were fewer chances of “Bunching” of the wires which can lead to failure of fixation [15]. The holes for wire insertion could be drilled at the same level but this would have increased the chances of the formation of stress riser at that part of bone and may have caused subsequent fracture at the insertion site. The additional wires which were inserted for three part and Four-part fractures lead to increased stability and negated the chances of fixation failure.

One of the major advantages of this technique is the removal of K wires after callus formation i.e. the patient is basically 'metal free' after that. If avascular necrosis develops in such a patient, then the salvage procedure in the form of Hemiarthroplasty can be performed right away, without the need for any implant removal<sup>[15]</sup>. The question arises why we need to bend the wires if they can be inserted without bending like in other fractures. The answer lies in the anatomy around the proximal humerus. If we do not bend the wires and directly insert them, then the entry point has to be very higher for gaining hold in the proximal humerus, which can lead to injury to the Axillary nerve.

Patients in our study were followed up for a period of  $14.45 \pm 1.97$  months which is a decent follow-up for any study. Only one patient was lost of follow-up.

The mean ROM recorded in our study echoes the results found by Leonidou *et al.*<sup>[15]</sup> and Alfy *et al.*<sup>[16]</sup>. The Constant Murley score in our study was found to be  $74.34 \pm 11.46$  which is similar to as shown by Leonidou *et al.*<sup>[15]</sup> and Alfy *et al.*<sup>[16]</sup>.

One patient developed Avascular Necrosis of the Humerus head for which he was advised further treatment but he refused. There were two cases of Pin site infection which were treated with Oral Antibiotics. Wound dehiscence was seen in one case which resolved spontaneously with secondary healing. There was no case of Loss of Reduction or Migration of wire into the joint.

We in our practice found the modified Palm technique to be a safe technique with less operative time, less soft tissue dissection, good functional recovery and satisfactory patient response. Though the patients were kept in a sling till the callus formation was seen but this does not have any effect on the final recovery of the patient.

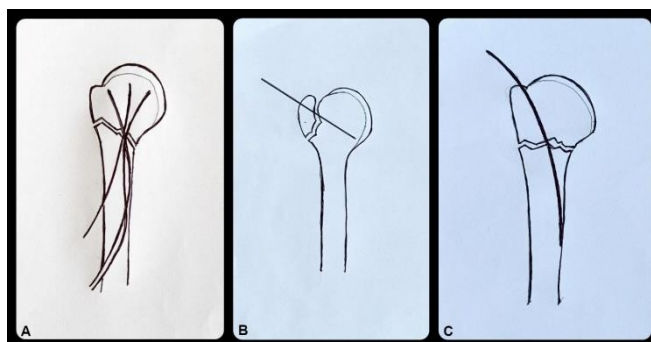
Limitations of our study were fewer patients and a study with a larger sample size is required to settle the debate.

## Conclusion

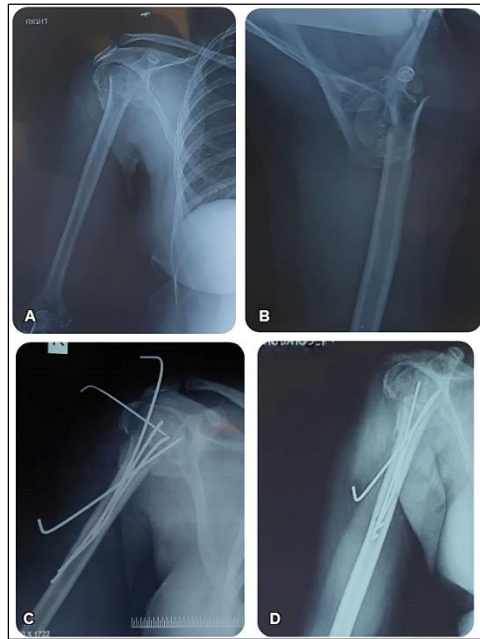
Modified Palm technique for the Proximal Humerus fractures is a refined and dependable technique with good functional recovery of the patients.

**Table 1**

	N	Minimum	Maximum	Mean	Std. Deviation
Age	29	26.00	72.00	47.93	13.52
Operating Time (Minutes)	29	34.00	58.00	43.24	6.33
Forward Flexion	29	90.00	150.00	130.34	15.29
Abduction	29	80.00	150.00	124.83	14.30
External Rotation	29	40.00	55.00	46.07	4.83
Follow-up (months)	29	12.00	18.00	14.45	1.97
Constant Murley Score	29	50.00	85.00	74.34	11.46



**Fig 1:** A) Modified Palm Tree Technique B) GT wire insertion in case of Three part or Four-part fractures C) Additional Proximal to Distal Wire in case of Three part or Four-part fractures



**Figure 2:** A) Preoperative Xray AP view B) Preoperative Xray Axillary view C) Postoperative view of Modified Palm tree Technique D) 1 Month Xray AP view: GT wire and Proximal wire removed to facilitate free overhead abduction

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**Presentation at a meeting:** None.

**Conflicting Interest:** None.

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