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A PROSPECTIVE STUDY OF FUNCTIONAL OUTCOME OF PROXIMALHUMERUSFRACTURES TREATED WITH LOCKING COMPRESSION PLATES (PHILOS PLATES)

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ABSTRACT

Fractures of Proximal Humerus may be extremely demanding. There are many pitfalls for the unwary patient and surgeon to avoid during the course of treatment. Emphasis is placed on complete and accurate diagnosis and formulation of safe and simple techniques for restoration of anatomical stability, fracture union, cuff integrity, range of motion and adequate muscle strength.This study focuses on to analyze the functional outcome of fifty patients with proximal humerus fractures treated using locking compression plates (PHILOS PLATES) and to assess the complications of proximal humerus fractures treated using locking compression plates (PHILOS PLATES).

Keywords
humerus fractures, prosthetic replacement, PHILOS plate, rehabilitation, coracoid.

INTRODUCTION

Proximal humerus fractures accounts for about 4 to 5% of all fractures [1,2,3,4,5,6]. It accounts for up to 45% of all humeral fractures [7]. In elderly patients it is the third most common fracture, the first two being hip fracture and Colle's fracture in that order [8]. It will be of great significance if the fractures are recognized early. It has been suggested by various authors that non operative procedures [9,10,11] can be considered for two, three and four part fractures of proximal humerus in elderly patients but pain, stiffness, loss of function and muscle power have been described in more percentage of patients following this conservative approach.

Diagnosis has been made easier with adaptation of 3-right angled trauma series X-rays [2,12,13,14] supplemented with CT or MRI. A protocol for management and comparison of long term outcome of similar injuries has been made possible by using Neer's 4-part Classification system for fracture and fracture dislocation [15,16,17,18].Attention is mainly focused on complete and accurate diagnosis and formulation of safe and simple standard techniques for fracture realignment, restoration of anatomic stability, fracture healing, cuff integrity, regaining movement and function.

Improvements have been achieved in fixation techniques and in the understanding of the role of prosthetic replacement [19,20,21,22] to maximize anatomic restoration and minimizing immobilisation time, the time period during which stiffness develops.Due to these improvements the elderly people can be effectively treated surgically. Maintenance of good shoulder function will surely help them have a better life.In this study we have analysed the functional outcome of fifty cases of proximal humerus fractures treated surgically using PHILOS (proximal humerus internal locking osteosynthesis system) plates.

MATERIALS AND METHODS

1. Study location:

The department of Orthopaedics in SREE BALAJI MEDICAL COLLEGE AND HOSPITAL, Chromepet, Chennai.

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2. **Study type:** Prospective study.

3. **Study duration:** AUGUST 2017 to AUGUST 2019.

4. **Study Size:** 50 Proximalhumerus fracture patients.

5. **Study tools:** Patients inclusion and exclusion criteria are given below:

Inclusion criteria:

- Patients aged between 18-60yrs of age with closed displaced humerus Fracture.
- Age of fracture – maximum within 7 days of injury.

Exclusion Criteria:

- Patients with less than 18 years or more than 60 years of age were excluded.
- Patients with pathological fracture were excluded.
- Patients with open injury were excluded.
- Patients with distal neurovascular deficit were excluded.
- Patient not giving consent for the study were excluded.

Proforma was created containing patient's history and examination of upper limb and shoulder joint were noted. Consent was taken in patient's own language. Routine investigations like complete hemogram, blood sugar, renal function tests, serum electrolytes, blood grouping and typing, bleeding time, clotting time, chest x ray PA view, ECG were done. Radiographs of the affected shoulder were taken in AP, Lateral and Axillary views and fractures were classified according to Neer's classification. CT pictures were taken in 3 part and 4 part fracture patients. Anaesthetic fitness was obtained for all the patients before surgery.

Intra operative details:

1. Blood loss - We calculated the blood loss after the surgery by measuring the suction apparatus and mop count, fully soaked 1 big abdominal pad contain 50 ml and 1 small gauze blood soaked contain 3 ml of blood.
2. Length of the surgical incision in cm was noted.
3. Duration of the surgery in minutes from the start of the incision till wound closure was noted.
4. Fluoroscopy time: After taking help from the Radiology department from our institution we calculated the intraoperative radiation exposure from C -arm with the help of an formula 10 x 0.987 x number of C-arm shorts taken [per exposure – 10 R/sec, conversion factor roentgen R to Rad or Radiation absorbed dose – 0.987]
5. Postoperative x-ray was taken. Followup was done with the examination hip joint, surgical scar, fracture union and range of movements were done at the interval every month till an evidence of radiological union followed by once in 3 months. If any intra or postoperative complications were noted.

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Instruments and Implants used:

Fig 11: Instruments and Implants

1. Kirschner K wire (1.6 and 1.8mm)
2. Drill sleeve (2.8mm)
3. Drill bit (2.5mm)
4. Screw drive (3.5)
5. Cortical locking screw (3.5mm)
6. Cancellous locking screw (3.5mm)
7. PHILOS plate

After obtaining for fitness for the surgery by anesthetist. Surgical consent was obtained in patients own language. Most of the cases were taken under general anaesthesia with interscalene block for postoperative pain management.

Surgical Approaches

There are many approaches used for treatment of fractures of Proximal Humerus. An approach which allows greatest visualization for performing a repair or fixation with the least disruption of soft tissues should be chosen for better functional recovery [18].

The various approaches are

A. Anterior deltopectoral approach

B. Deltoid approach

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C. Superior approach

D. Posterior approach

Only the approaches that we have used in our study has been dealt below.

Position of the patient:

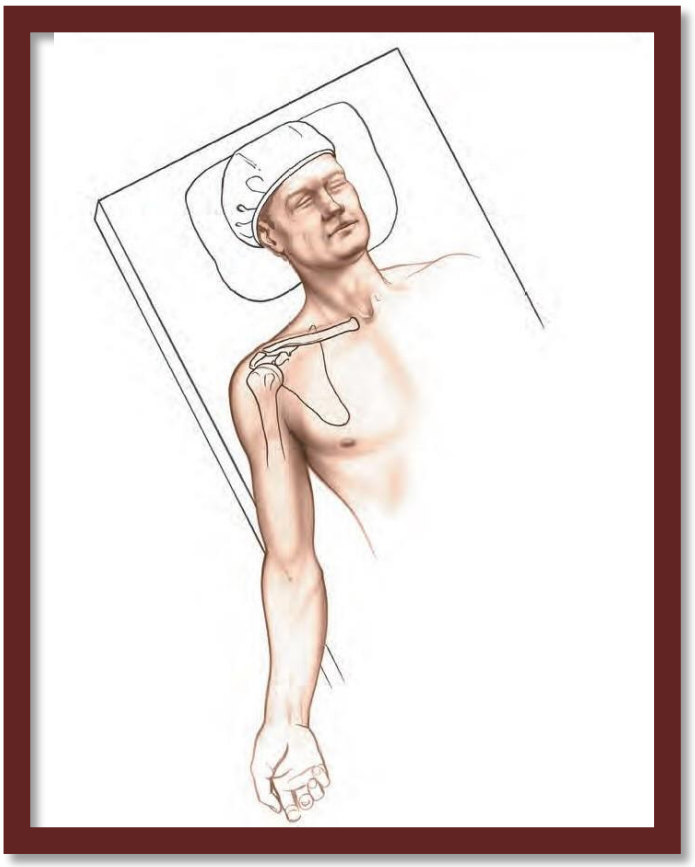

Fig 12: Position

Place the patient in the supine position on the operating table. Place a sandbag between the spine and medial border of scapula to push the affected side forward while allowing the arm to fall backward thus opening up the front of the joint. Elevate the head of the table to 30° to 45° to reduce bleeding and to allow blood to drain away from the operative field.

Anterior Deltopectoral Approach

A 15cm long incision is made from above the coracoid and carried distally in the line of deltopectoral groove to the deltoid insertion. The internervous plane lies between deltoid, which is supplied by axillary nerve and pectoralis major which is supplied by medial and lateral pectoral nerves. The cephalic vein is preserved with retraction towards either the deltoid or pectoralis major. Rarely it may be ligated. The clavipectoral fascia is incised. The muscles attached to the

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coracoid are retracted medially. With the arm abducted, anterior 1cm of deltoid is released and retracted laterally and retained with Richardson retractor.

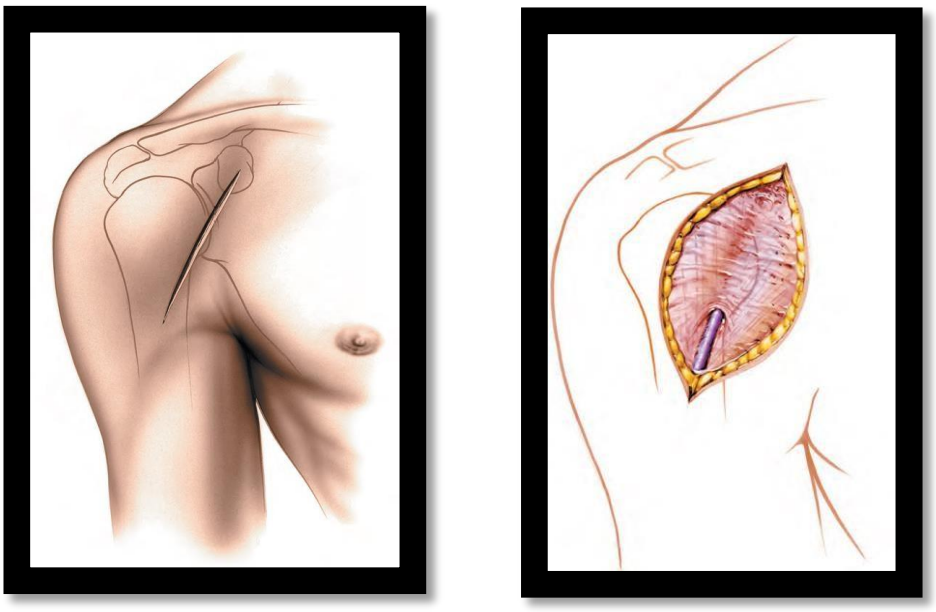

FIG 13 & 14: Incision and Deltopectoral groove

The long head of biceps, the key to anatomy of upper humerus is found under the insertion of pectoralis major. Palpate it as it proceeds upwards, but do not dissect it free, for fear of avascular necrosis. If lesser tuberosity is not fractured, access is gained to the front of the joint by means of a direct subscapularis and capsular longitudinal arthrotomy. Rarely coracoid osteotomy may be required for better exposure.

Operative technique:

After incising the skin, subcutaneous tissue, fascia and muscle, the conjoint tendon was retracted medially. The fragments were reduced indirectly and temporarily fixed with the help of 1.6 or 1.8mm K wires under image intensifier control.After obtaining acceptable reduction, the PHILOS plate was placed atleast 8mm distal to the upper end of the greater tuberosity. The long head of biceps tendon was identified and preserved. The plate was then placed lateral to the long head of biceps without compromising its function. The humeral head fragment as well as the metaphyseal shaft was fixed with locking head screws.Standard length wires were inserted into the humeral head through a guide and the length of screw determined by placing a measuring device over the protruding wire. The corresponding length locking screw was then inserted using a specifically designed screwdriver. The final position of the implant was checked with image intensifier in multiple planes. The shoulder was checked for stability of fixation, range of movements and absence of impingement.

In cases of irreducible fracture dislocation, the coracoid was predrilled and osteotomized and retracted with the tendon. Arm was externally rotated and blunt instrument passed between subscapularisand capsule and stay sutures applied. The same was divided one inch from its insertion and retracted. Capsule was incised longitudinally to open the joint and reduce the

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articular fragment. None of our patients required bone grafting. Suction drain kept in situ and closure was with 2-0 vicryl to muscle, fascia and subcutaneous tissue, 2-0 ethilon sutures or stapler to the skin.

Post op period:
Drain was removed on the second postoperative day. Intravenous antibiotics continued till two postoperative day. Sutures were removed on twelfth postoperative day.

Post op X-rays:
X-rays are taken in the immediate post op period to document the fracture alignment, reduction and fixation. There after X-rays are repeated at every 3 to 4 weeks interval to monitor the fracture union and to detect any implant loosening, deviation screw penetration, screw back out, impingement and failure.

Postoperative care and rehabilitation:
Proper postoperative rehabilitation is necessary to obtain and maintain of satisfactory range of motion, strength and shoulder function [10,18,19].Rehabilitation should be custom tailored to the patient and the fracture pattern, and is easier, more comfortable and assured with stable internal fixation. If fracture fixation is stable, then physiotherapy can be initiated soon. The most accepted and useful rehabilitation protocol is the three-phase system devised by Hughes and Neer [20].Application of this system is variable and depends on the fracture pattern, stability of fracture fixation and ability of patient to comprehend the exercise programme.

Phase 1:
Phase I exercises are started early in the postoperative period, usually between 5th and 10th post-operative day. After stable surgical fixation, passive exercises can be started within 24-48 hours. The surgeon should start elbow flexion and extension. Then gently assist the patient with pendulum exercises. The next exercise is supine external rotation with a stick. Assisted forward elevation and pulley exercises are started after three weeks. Isometric exercises are initiated at four weeks.

Phase 2:
This phase involves early active, resistive and stretching exercises. The first exercise is supine active forward elevation. During each session 3 sets of 10-15 repetitions are done regularly. This is followed by stretching for forward elevation on top of the door. The most important exercise to achieve abduction and external rotation is to place the hands behind the head with arm abducted and externally rotated.

Phase 3:
Resistive strengthening exercises are started at three months. During this phase, arm is stretched higher on top of wall by leaning the trunk onto the wall. Prone stretching for forward elevation is also useful. Light weights can be carried after three months. Weights are started at one pound and increased at one pound increments with the limit being 5 pounds. Strength can be achieved with effective functional activity.A well supervised rehabilitation protocol is essential for the success of any fracture treatment. Even a perfect surgical repair will not achieve good results, without proper rehabilitation efforts [19].

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RESULTS

The following analysis was made after collecting data for this prospective study of 50 proximal humerus fractures patients in the Department of Orthopaedics of SreeBalaji Medical College and Hospital, Chromepet, Chennai, during the period from AUGUST 2017 to AUGUST 2019.

Table 1: Sex Distribution

S. No.	Sex	No. of Patients	Percentage
1.	Females	30	60 %
2.	Males	20	40 %

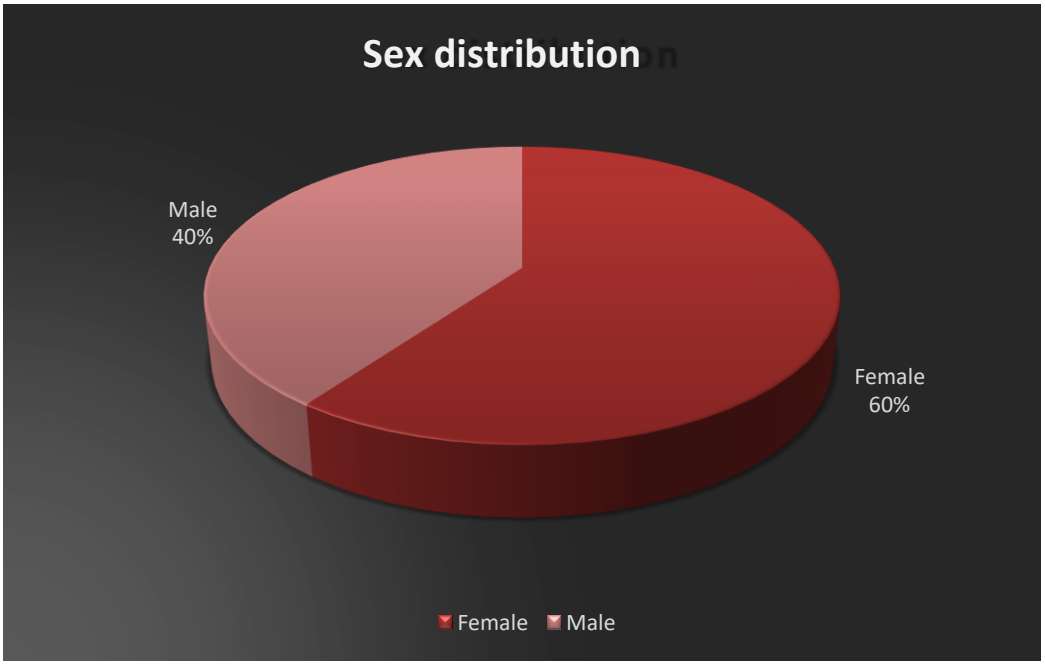

Table 2: Age Distribution

S. No	Age group	No. of Patients	Percentage	Males	Females
1	18-20	3	6 %	3	0
2	21-30	5	10 %	5	0
3	31-40	5	10 %	2	3
4	41-50	12	24 %	4	8
5	51-60	25	50 %	6	19

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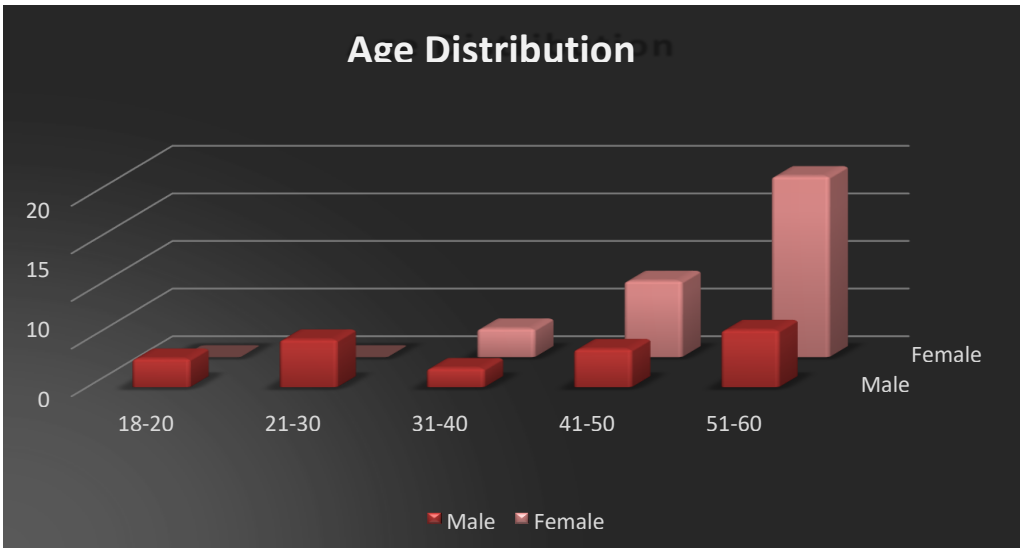

able 3: Mode Of Injury

S. No.	Mode of injury	No. of Patients	Percentage
1	Fall at ground level	25	50
2	RTA	15	30
3	Fall from height	8	16
4	Epilepsy	2	4

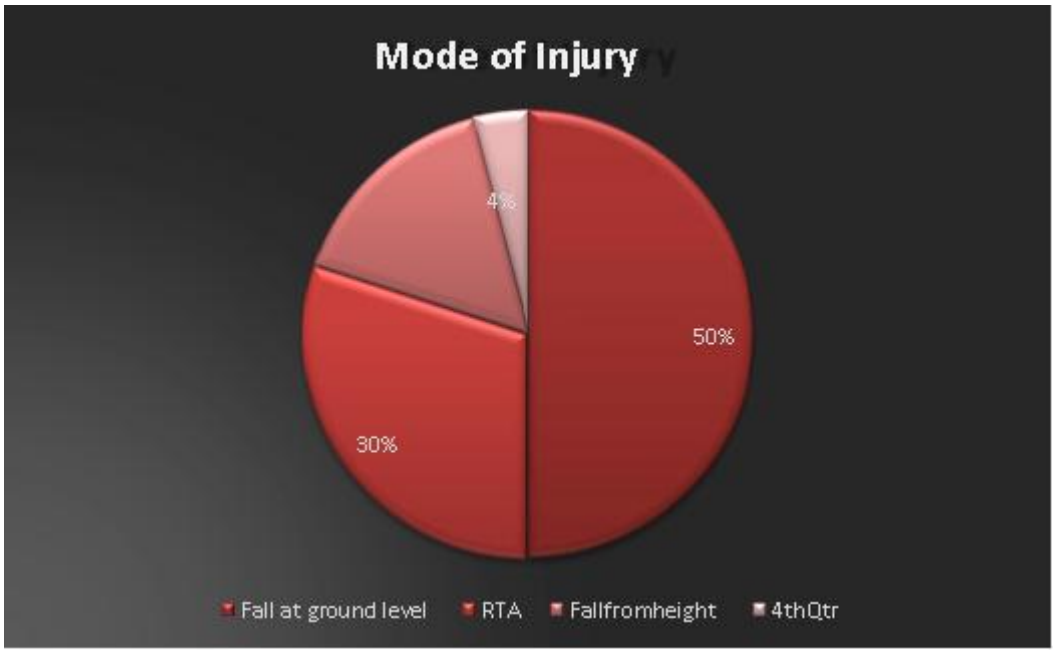

Table 4: Occupation

S. No	Occupation	No. of Patients
1	Labourer	13
2	House wife	15

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3	Skilled worker	13
4	Professional	2
5	Student	2
6	Business	5

Table 5: Side

S.No	Side	No. of patients
1	Unilateral	50
2	Bilateral	0

DISCUSSION

In this prospective study we have analysed fifty cases of Proximal Humerus Fractures treated surgically using proximal humerus locking plates (PHILOS) in our hospital. There was a female preponderance in our study 30 (60%) similar to the conclusion of the study conducted by Hawkins & Bell involving fifteen (15) patients of Proximal Humeral Fractures. In Kristiansen et al study of 565 proximal humerusfractures in 5,00,000 people, women were involved in 77% of fracture in all age groups. This is thought to be a result of advanced osteoporosis.

In our study the average age of the patients was 52 years which was corresponding to the reports by Hawkins, Bell and Gurr [21] and Flatow et al [20] and Cornell CN, Levine D S, Pagnani MJ [22].In our study, the most common mode and mechanism of injury was free fall at ground level and fall on an outstretched and average age is 52 years which were much comparative to the results of the study conducted by Flatow et al [23] as fall on the outstretched arm was the predominant mechanism of injury and average age of the patient is in their study. Since our people attain menopause at an earlier age and have poor quality of bone stock, the average age is a little lower. also in our study, unusual mode of injury like seizures was present in two patients.

Neer Classification is the most widely used scheme for Proximal Humeral Fractures. It has gained universal clinical acceptance by orthopaedic surgeons and radiologists and is considered to have significant implications for both treatment options and outcomes. In our study, we also have followed the Neer's four part classification but several authors have reported low level of interobserver reliability. Sidor et al 12 reported a reliability co-efficient of 0.48 for 1 viewing, 0.52 for 11 viewing and a reliability coefficient of 0.66.

In order to properly employ this classification, precise radiographic evaluation is of paramount importance [16]. We have found the Neer's three view trauma series to be of greatest value in evaluating these fractures. The importance of these series has been shown by Richard J, Hawkins Sand R.L. Angel [16].

Computed tomographic scans were done in patients who had equivocal findings and also to find the direction of dislocation. Flatowet al [14] believed that sole reliance on standard AP radiograph may lead to under estimation of the amount of displacement of fragments.There was a predominance of two part fracture in our study (60%), of which greater tuberosity fracture were the most common. In the reduction of glenohumeral dislocation if tuberosity fragment remained displaced >1 cm or angulated more than 45°, ORIF was done. Repair in such patients restored the dynamic stability by reattachment of the muscles of the rotator cuff [13].Flatow et al [14] in a series of 12 patients reported 50% excellent results and 50% good results in patients treated by ORIF with Locking Compression Plates (LCP) for two part greater tuberosity fracture.Closed

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treatment of three part fracture is often associated with moderate pain, poor range of motion and disability. Open Reduction and Internal Fixation (ORIF) was associated with good to excellent results in more than 80% of patients in a report by Hawkins et al [21] and recommended surgical treatment for healthy active individuals who have three part fractures of the Proximal Humerus. Cornell and Levine [22] reported good results with screw tension band technique for 3 part fractures. Prosthetic replacement for three part fracture has been used by several authors.

In the treatment of four part fracture and fracture dislocations, less than 10% good or excellent results are obtained by open reduction and internal fixation [20,21]. Isolated reports of revascularization of head of humerus following open reduction and internal fixation indicates satisfactory healing.Unfortunately, many of the cases referred in the literature often have not been true four part fractures with isolation of articular fragment and follow-up is not sufficient to rule out long term osteonecrosis. Hugg and Lundberg noted 74% AVN when ORIF was used for these fractures. AVN is reported to be as high as 90% in four part fractures and 3-25% in 3 part [4,11].All authors agree that pain relief has been greater than 90% with prosthetic replacement, but there has been varying results with regard to function, motion and strength. Neer and McIlveen have reported nearly 90% excellent results with an improved technique utilizing long deltopectoral approach and better rehabilitation.From the data presented in this study we have demonstrated that majority of the patients had no pain or only mild pain (86%) which is comparable to the study by Hawkins et al [16,20] and Flatow et al [21].

The average active elevation in our study in two part fractures was 126.25° and average external rotation was 47° which is comparable to the study by Flatowet al [21] in a study of 12 patients of two part fractures treated surgically.The average elevation in our study with three part fracture was 124.25° and external rotation was 45.5° which is also comparable to the study by Hawkins et al [22] of 15 cases of 3 part Proximal Humerus fractures treated surgically.Of the 20 patients with 3 and 4 part fractures 20 patients regained atleast 90°abduction and elevation.About 86% of the patients had full muscle strength which is also comparable to the study by Hawkins et al [56] and Flatow et al [21].We have seen few complications in our study. All fractures united and the average time taken for union was approximately twelve weeks. Two patients with three part fracture went for malunion. No cases of implant deviation, screw penetration, screw back out, impingement and failure was encountered.Malunion of greater tuberosity fragment in a patient with 3 part fracture treated with PHILOS plate resulted in restriction of abduction and impingement.There was no non-union or radiographic evidence of avascular necrosis or deep infection in our study.Finally a prolonged closely monitored and well defined program of rehabilitation was necessary to obtain the best functional results. We have followed the three phase rehabilitation protocol of Hughes and Neer in all our patients and this has provided good results.LCP results: The average constant score in our study with 50 patients was 81.7 which is slightly better than the study by Koukakis et al [19].

CONCLUSION

The present study has noted displaced proximal humeral fractures when treated surgically produce greater range of movements (ROM), less pain and less stiffness. Earlier the surgery is done better are the results. Results are best when operative method results in stable fixation that allows early passive mobilization. Functional outcome of 2 part fractures is better than 3 part and 4 part fractures.

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Ethical approval: The study was approved by the Institutional Ethics Committee

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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