Original article:

The Evaluation of Functional Outcome of the Surgical Management of Proximal Humerus Fractures by Using Proximal Humeral Locking Compression Plate

Suresh Choudhary[1], Arun Vaishy[2], Pradeep K Sharma[3], Mahaveer Prasad Kuri[1], Vardha Ram[1], Naveen Kumawat[1]

[1]PG Resident (IIIrd Year), [2]Professor &Unit Head, [3]Assistant Professor,
Department of Orthopaedics, Dr. S.N. Medical College, Jodhpur, Rajasthan, India.
Corresponding authors:
Dr. Pradeep K Sharma, Assistant Professor, Department of Orthopaedics, Dr. S.N. Medical College, Jodhpur, Rajasthan, India.

Abstract

Background: Proximal humeral fracture is the 3rdmost common fracture among the elderly population account for approximately 5% of all fractures. More than 70% of patients with these fractures are of sixty years of age above of age out of them 75% are women[3]. Significant controversy present regarding the best methods of treating displaced proximal humerus fractures, which recently moved towards internal fixation by locking plates. Given study is related to evaluation of functional outcome of the surgical management of proximal humerus fractures by using proximal humeral locking compression plate.

Methods: This prospective study had been conducted on 35 Patients with proximal humerus fractures treated with a proximal humeral locking compression plate at Dr. S.N. Medical college, Jodhpur from August 2016 to December 2018.

Results: Our study is male predominant with high incidence in the 40 to 60 age group involving both shoulders almost equally. Majority of patient were having RTA (68.6%) followed by fall from height (20%). According to Neer`s classification majority were 3-part fractures - 58%. In our series excellent results were noted in 7 patients (20%), good results in 14 (40%), moderate results in 11 (32%) and poor results in only 3 patients (8%), by Constant-Murley Scoring system.Mean time taken for fracture union in our study was 9weeks (with range of 6 to 12 week).

Conclusion: Internal fixation with PHILOS plate is well founded operative option for displaced proximal humerus fracture which provides stable fixation, particularly in comminuted fractures that allows early mobilization in post-operative period.

Key words: Proximal Humerus Fracture, RTA,PHILOS Plate.

INTRODUCTION

Proximal humeral fractures constitute for around 5% of all fractures.[1] It is the 3rdmost common fracture among the elderly population after hip and lower end radius fractures.[2]According to calculation more than 70% of patients suffering from these fractures are older than sixty years of age and out of them 75% are women.[3] In the elderly population, most of these fractures are related to osteoporosis. The osseous architecture of the humeral head with poor central cancellous bone stock,

www.ijbamr.com P ISSN: 2250-284X , E ISSN : 2250-2858

particularly in elderly patients, bring about a high risk of fixation failure with classic plate and screw fixation[4-6]

There is no consensus about the management of displaced 3- and 4-segment fractures. Poor consequence areusual/customaryin these types of fracturesand may be due to reduced humeral head blood supply and difficulties in achieving and maintaining exact fracture reduction with an appropriate stabilization method.

The purpose of proximal humerus fracture fixation is to acquire an anatomic reduction, mechanical stability, and fast recovery of the range of motion while perpetuating the blood supply of the humeral head. The angular stable locking plates have been introduced as a plausiblecounter measure to this problem. As compare to other locking plates, the endurance in this construct comes from play screw annexation which preclude the desideratum for extensive periosteal stripping and derogating damage to vascular supply. This coherence creates a fixed angle devise and is procured by threaded screw heads seeding properly into threaded plate. In addition, this technique does not rely on screw purchase in the bone for its strength, making it an attractive solution for osteoporotic bone. Despite the more extensive surgical approach the rate of humeral head necrosis is low, similar to those of proximal humeral nails. Anterolateral deltoid-split approach with minimal invasive insertion of the plate is advocated by some to reduce the incidence of avascular necrosis[7,8] Secondary loss of reduction into varus mal-alignment and potential perforation of angular stable screws through the humeral head into the joint is seen especially in fractures with medial comminution.[9] This can be overcome by anatomical reduction and careful placement of buttressing inferomedial screws[9] The best-quality bone is found in the medial and dorsal aspect of the proximal humerus just underneath the articular surface. Hence sub cortical purchase of screw with adequate length is important. The stability of the screw plate construct is increased by locking screws, which are fixed at a given angle within the plate; if used in sufficient numbers, they can maintain the position of a reduced fragment until bony healing has occurred.

Angular stable plates are more reliable for high primary stability in proximal humeral fracture. It help in firm anchorage in osteoporotic bone. Even elderly patients may allowed to do early functional exercise. Clinical results are more favorable as compared to other technique of fixation.[10]

Advantages of PHILOS

It perhaps impart better firmness as it has more number of screws in the head area and greater variability. Screws have somewhat converging and diverging placements to get more stability. PHILOS allows infero-medial screw placement in the best quality bone available (especially in osteoporotic heads). This results in better medial support and longer maintenance of reduction. The screws are perfectly locked into the plate so they may not pull out back/withdrawn which is a strong point in osteoporotic bone.PHILOS plate is anatomically precontoured. The plate has a low profile, which minimizes the risk of impingement syndrome.

OBJECTIVES

To study the role of LOCKING COMPRESSION PLATE in proximal humeral fractures and calculation of aftereffect with stability of fixation, union of the fracture, functional return and complications by Constant-Murley scoring System.

www.ijbamr.com P ISSN: 2250-284X , E ISSN : 2250-2858

MATERIAL AND METHODS

Earliest admitted 35 caseswith proximal humerus fractures who completed inclusion criteria treated by PHILOS during the period of August 2015 toDecember 2017 for duration of almost 2 years.

Inclusion criteria

1. Neer's of 2parts,3parts and 4parts fractures of proximal humerus
2. patients with fracture dislocation of the shoulder (Neer`s type5)
3. Neer's of 2parts, 3parts and 4parts fractures of proximal humerus with extension to shaft
4. Simple, closed proximal humeral fractures in adult patients (age >18 years).

Exclusion criteria

1. Pathologic fractures in proximal humerus.
2. Age under 18 years (immature skeleton)
3. With associated polytrauma

Preoperative Evaluation

As soon as these patients were admitted in the hospital, history was recorded and detailed clinical examination was done.

Local Examination

Detailed examinations of both the Shoulders were done. The attitude, any swelling, muscular wasting and skin changes were noted. Tenderness, local rise of temperature, and crepitus was noted. Examination of Cervical spine, Elbow and wrist were done, any associated injury or fracture was noted.

Investigations

Radiograph was taken of the affected shoulder, in at least two planes at right angles to one another i.e. antero-posterior and axillary lateral views.

Q-CT or Osteo CT lumbar spine was done in all elderly patients of more than 50years ageto assess the degree of osteoporosis.

Blood Routine Investigations

Special test like Liver Function Tests {for the patients who were on oral anticoagulants} and Renal Function Tests {previous history of raised serum creatinine or dialysis} were done if required. HBsAg and HIV test were done. For the patients who were on oral anticoagulants PROTHROMBIN TIME INR was also done.

Pre – Operative Treatment

Pre anestheticcheck up was done**.**The following training was given to the patients pre operatively so that the same could be carried out postoperatively.

1. Deep breathing exercises

2. Active fingers and wrist movements

The patients were counseled and consent taken for participation in the study. They were informed about all the possible complications that can happen during or as a result of surgery prior to their giving unconditional consent.

Surgical Procedures

All surgeries were performed on elective surgical basis using standard aseptic precautions

www.ijbamr.com P ISSN: 2250-284X , E ISSN : 2250-2858

Approach

Deltopectoral approach for proximal humerus (fig. 1).The yardstick proceedings for fixation of fractures of the proximal humerus is between the deltoid and the pectoral muscles. We have to start the skin incision at the coronoid process and continue it in a slightly convex way toward the medial side as far as the insertion of the deltoid muscle on the lateral humeral shaft. We can identify the cephalic vein with its main connection on the lateral side. Incise the fascia medial to the vein and with are a little abducted. After elimination of hematomo, the long biceps tendon can be recognized under internal and external rotation and will lead to identification of the greater and lesser tuberosities. Even though the tuberosities are fractured, they will still have some connections to the adjacent tissues and their attached muscles.

Fig 1: Deltopectoral approach skin incision

Temporary Reduction

After exposure, anatomical reduction of articular surface was done and which is the utmost important step. Using k wires or clamps or towel clips the pieces are held temporarily and looked for the articular alignment of the bone

Plate and Screw Fixation

Fracture fragments reduced without stripping the periosteum to maximum possible attendable anatomical position and reduction held with Kirschner wires. All locking screws were inserted/implanted with the help of screw driver. Plate span ratio, number of screws and working length all were followed according to the principle. The proximal screws of the plate were introduced under image intensifier. Upper Locking screws were inserted bicortically (fig. 2 A,B).Wound was closed in all layers after inserting the negative suction drain. Dressing was applied.

www.ijbamr.com P ISSN: 2250-284X , E ISSN : 2250-2858

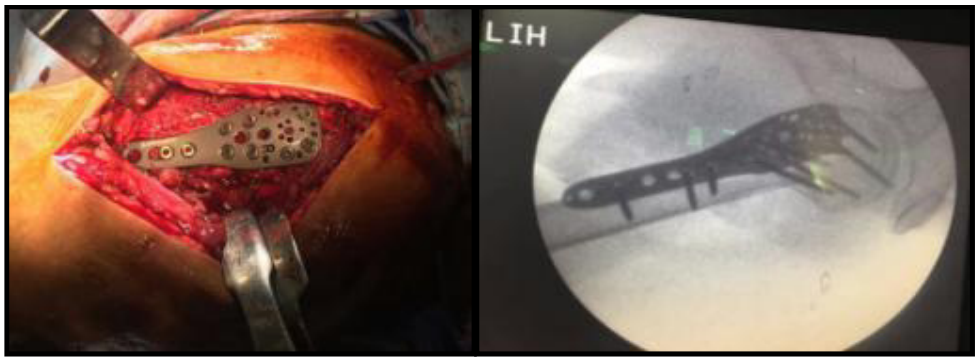


Fig 2 (A, B): Application of plate and sleeve to the plate

Post-Operative Protocol

Antibiotic Prophylaxis

3rd Generation Cephalosporin was administered intravenously 30 min. prior to the skin incision. The same antibiotic is then repeated for 48 hours. Then switched over to the oral cephalosporins up to suture removal.

Wound Care

In all cases negative suction drain was removed after 48 hours. The wounds were inspected on the 2nd& 5th post-operative day. Sutures were removed on the 10th or11th day.

Radiological Examination

Check x-ray (antero-posterior and axillary view) was taken on 1st post-operative day and assessed the reduction of fracture fragments and position of implants**.**Serial radiographs (antero-posterior and axillary views) were taken at the end of 6 weeks,3 months,6 months and then at 12 months for final evaluation, and evaluated for bony healing, loosening of implant, loss of reduction, non-union, malunion and avascular necrosis of head of humerus.

Evaluation and investigation of any barrier including impingement due to plate, malposition of greater tuberosity was done.

Mobilization & Rehabilitation

The patient was started with active finger and wrist movements on the first post-op day.Immediate passive range of motion of shoulder begun and active assisted forward flexion, backward flexion and abduction was done.An active internal and external rotation was allowed after 6weeks.Power building exercises was also started after 6weeks.Consequences were assessed according to Constant–Murleyscore 6weeks.

Follow up: Constant-Murley scoring system

www.ijbamr.com P ISSN: 2250-284X , E ISSN : 2250-2858

Assessment parameters	Extent / Position	Points
Scoring for pain (maximum=15)	None	15
	Mild	10
	Moderate	5
	Severe	0
Scoring for activities of daily living (maximum=20)	*Activity level*	
	Full work	4
	Full recreation/sport	4
	Unaffected sleep	2
	Positioning	
	Up to the waist	2
	Up to the xiphoid	4
	Up to the neck	6
	Up to the top of the head	8
	Above the head	10
Scoring for forward and lateral elevation (maximum=20, 10 for each)	*Elevation (in degrees)*	
	0-30	0
	31-60	2
	61-90	4
	91-120	6
	121-150	8
	151-180	10
Scoring for external rotation (maximum=10)	Hand behind head with elbow held forward	2
	Hand behind head with elbow held backward	2
	Hand on top of the head with elbow held forward	2
	Hand on top of the head with elbow held backward	2
	Full elevation from on top of head	2
Scoring for internal rotation (maximum=10)	Dorsum of hand to lateral thigh	0
	Dorsum of hand to buttock	2
	Dorsum of hand to lumbosacral junction	4
	Dorsum of hand to waist (L3 vertebra)	6
	Dorsum of hand to T12 vertebra	8
	Dorsum of hand to interscapular region (T7 vertebra)	10
Power (amount of weight that can be lifted in the scapular plane)	Up to 25 lb (11.4 kg) (1 for each lb [0.5 kg] lifted)	0-25
	Total	**100**

The Constant–MurleyScoring System, Graded as

Poor: (0–55 points),

Moderate: (56–70),

Good: (71–85), or

Excellent: (86–100)

Follow Up Protocol

All patients were followed up for one year approximately; the follow up wasscheduledas:

- 6 weeks
- Three months
- Six months
- One year

The important parameters assessed were:

- Clinical:
    1. Wound Condition
    2. Functional Score
- Radiological:
    1. Fracture Union
    2. Amount of collapse

www.ijbamr.com P ISSN: 2250-284X , E ISSN : 2250-2858

3. Malallignment

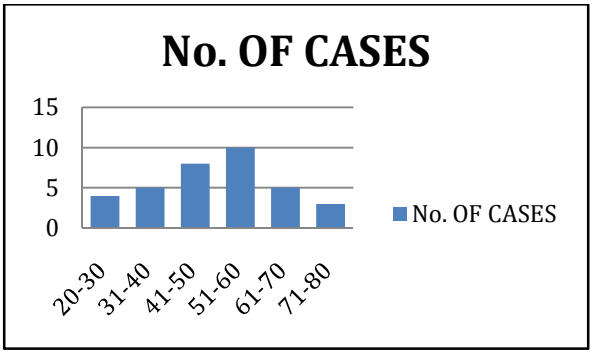
RESULTS

Our study is male predominant with high incidence in the 40 to 60 age group involving both shoulders almost equally (graph 1).Maximum number of patient were RTA (68.6%) followed by fall from height (20%) (graph 2).

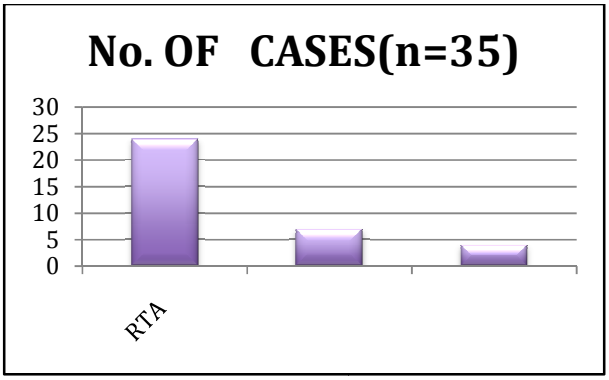
According to Neer`s classification majority were 3-part fractures - 58% (22), 2-part fracture- 29% (11) and 4-part fractures 13 %( 5) in our series (table 1). 2(5.7%) Patients presented with proximal humeral fracture with extension to shaft humerus. In these 2 patients,1case was associated with Neer`s 3parts fracture and another case was associated with 4parts fracture.

In our series excellent results were noted in 7 patients (20%), good results in 14patients (40%), moderate results in 11 patients (32%) and poor results in only 3 patients (8%), by Constant-Murley Scoring system (table 2).Mean time taken for fracture union in our study was 9weeks (with range of 6 to 12 week).

In our series 25 %(9 patients with 10complications) complication rate was seen, out of which 7 complications were implant related and 3 complications were non- implant related (graph 3)**.**



Graph 1: Distribution of cases according to age group



Graph 2: Distribution of cases according cause of injury

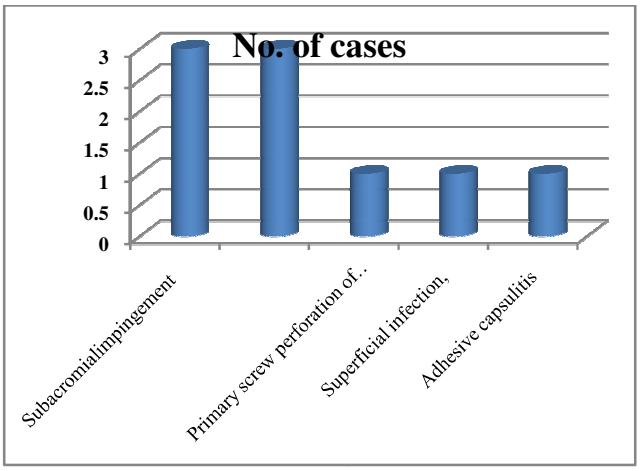
www.ijbamr.com P ISSN: 2250-284X , E ISSN : 2250-2858

Table 1: Neer`s type of fracture.

Type(Neer`s Classification)	No. Of Cases	With dislocation of head	With fracture extending to shaft
2 parts	11(31.428)	0	0
3 parts	19(54.285)	3(15.79%)	1(5.26%)
4 parts	5(14.285)	2(40%)	1(20%)
Total	35(100)	5(14.25%)	2(5.7%)

Table 2: Functional evaluation according to Constant-Murley Scoring system

Sl. No.	Outcome	No. Of Cases (N=35)	Percentage (%)
1	**Excellent**	7	20
2	**Good**	14	40
3	**Moderate**	11	31.4
4	**Poor**	3	8.57



Graph 3: Complications

DISCUSSION

With the increase in longevity and this being 3rd commonest fracture in the elderly osteoporotic bones, the health care delivery system should be prepared to offer a definitive solution.Conservative treatment of displaced proximal humeral fractures may result in unacceptable deformity and stiffness of the shoulder. It we use different operative techniques which are used for treating displaced proximal humeral fractures it can lead to unsatisfactory results in malunion, non-union and osteonecrosis of humeral head.It's very difficult to accommodate minimum of three screws or loosening them in proximal fragment, because of it's tiny size. There is a possibility of lose of reduction in conventional implants. Poor rotational and angular stability may occur which may result in loss of reduction into varus or retroflexiongiving unsatisfactory outcome. Locked plates have become a better and more

www.ijbamr.com P ISSN: 2250-284X , E ISSN : 2250-2858

attractive alternative as compared to conventional plates for fixing the proximal humeral fracture. Our study consisted of 35 patients of proximal humerus fractures treated with the locking plates

According to Neer`s classification majority were 3-part fractures - 54% (19), 2-part fracture- 32% (11) and 4-part fractures 14 %(5) in our series. Other authors like C.P.Charalambous.et.al[11] and Zhang H, et.al[12] have also reported similar results.

We had also used Constant Murley scoring system for evaluation of functional out come in our patients. Average constant scores in our series for injured shoulder is 72.15±12.81 points and for contralateral uninjured shoulder is 81.57±10.16 points, which is 88%of the score for the non-injured arm.

Other studies showed similar constant scores. Plecko et al[13].(2005) reported average Constant Score of 80.7 points, Moonot.P. et al[14].(2007) in a potential prospective series of 32 patients delineate mean constant score at final review as 66.5points, R.Chidambaram et.al[15].(2004) in a prospective series of 126 patients reported average constant score was 78 points, S. J Haridas et al[16].(2004) in a contemplative analysis of 30 consecutive patients treated surgically with the PHILOS plate for a displaced proximal humeral fracture reported average overall constant score as 55 points, MA Fazal et.al[17] in a prospective series of 27 patients who underwent Philos plate fixation for displaced proximal humeral fracture reported mean constant score of 70 point.

Table 3: Comparison of various studies

Year	Study	Total no of patients(n)	Average follow up(months)	Average time of fracture union(weeks)	Functional results	Complications (%)
2007	**Moonotet al**	32	11	10	66.5	28
2005	**Pleckoet al**	36	31	NA	80.7	NA
2002-2003	**Chidambaram R. et al**	126	NA	14	78	NA
2002-2003	**Haridas.J. et. al**	30	9	10	55	NA
2017	**Present Study**	35	9	10	72.2	25

We observed ten complications in nine patients. The most common stumbling block perceived was subacromial impingement in three patients because the Locking Proximal Humerus Plate was set positioned too far cranially. In three patients, fixation of greater tuberosity in mal position was noted. One of the patient also had primary screw perforation of the articular surface of the humeral head. One patient each had primary screw perforation of articular surface of humeral head, superficial infection, hematoma and adhesive capsulitis. Reassessment of the complications suggests that the majority (6/10) of the complications were technique related. Hence meticulous surgical discipline is pertinent.

Intraoperative screening is essential to ensure that the placement of plate is at the proper level and there is no breaching of articular surface during insertion of the screw. Regardless of intraoperative C-arm control, primary screw perforations through the articular surface can be fell to observe at the time of

www.ijbamr.com P ISSN: 2250-284X , E ISSN : 2250-2858

surgery. If we use measuring notations on drill bits and K-wires it seems in appreciable for bringing to successful conclusion get screw length in osteoporotic bone. One of the proceeding to circumvent as urged by Felix Brunner et al. is drilling the lateral half of the track, followed by the use of a depth gauge to feel the resistance of the subchondral bone; the final screw length should be 2–3 mm shorter than the measured length.

Primary malreduction with greater tuberosity improperly fixed resulted in poor functional out come in two of our patients. This type of complication may be avoided by proper reduction prior to plate fixation and use of additional fixation with lag screws and suture fixation through the appropriate holes before placing the plate against the bone.

CONCLUSIONS

The proximal humerus fractures are seen in all age groups from 3rd decade to 8th decade. The Road traffic accidents (high energy injury) were major cause of proximal humerus fractures in younger patients. All female patients with proximal humerus fractures are belong to 5th decade and above with Osteoporosis. PHILOS Plate allows stable fixation in all types of Neer`s fracture types of proximal humerus and fracture dislocation of proximal humerus. Proximal Humeral Internal Locking system (PHILOS); Provides angular and axial stability, eradicating the chances of screw toggling or sliding of the screw in the plate holes.Coupled with a divergent or convergent screw orientation, this makes for much improved resistance to pull out and failure of fixation.

BIBLIOGRAPHY

1. Helmy N, Hintermann B. new trends in the treatment of proximal humerus fractures. ClinOrthopRelat Res. 2006; 442:100-8.
2. Lauritzen JB, Schwarz P, Lund B, McNair P, Transbol I. Changing incidence and residual lifetime risk of common steoporosis related fractures. OsteoporosInt 1993; 3:127–32.
3. Kristiansen B, Barfod G, Bredesen J, Erin-Madsen J, Grum B, Horsnaes MW, Aalberg JR. Epidemiology of proximal humeral fractures. ActaOrthop Scand. 1987; 58:75-7.
4. Hall MC,Rosser M. The structure of the upper end of the humerus with reference to osteoporotic changes in senescence leading to fractures. Can Med Assoc J 1963;88:290-4.
5. Hawkins RJ, Bell RH, Gurr K. The three part fracture of the proximal part of the humerus. Operative treatment. J Bone and Joint Surge Am 1986; 68:1410-4.
6. Kristiansen B, Christensen SW. Plate fixation of proximal humeral fractures. Acta OrthopScand1986;57:320-3 .
7. Lill H, Hepp P, Rose T, König K, Josten C, The angle stable locking-proximal-humerus-plate (LPHP) for proximal humeral fractures using a small anterior–lateral–deltoid–splitting-approach – technique and first results [in German]. ZentralblChir. 2004; 129(1):43-48.
8. Lill H, Hepp P, Korner J, Kassi JP, Verheyden AP, Josten C, Duda GN. Proximal humeral fractures: how stiff should an implant be? a comparative mechanical study with new implants in human specimens. Arch Orthop Trauma Surg. 2003; 123(2-3):74-81.

9. Gardner MJ, Weil Y, Barker JU, Kelly BT, Helfet DL, Lorich DJ. The Importance of medial support in locked plating of proximal humerus fractures. J Orthop Trauma. 2007; 21(3):185-191.
10. K. M. Fakler, MD; Craig Hogan, MD; Christoph E. Heyde, MD; Thilo John, MDCurrent Concepts in the Treatment of Proximal Humeral Fractures orthopaedics2008; 31:42
11. C.P.Charalambous.I.Siddique.K.Valluripalli.M.Kovacevic.P.Panose.M.Srinivasan. H.Marynissen PHILOS for treatment of proximal humerus fractures Arch Orthop Trauma Surg. 2007;127:205-210
12. Zhang H,Ni W, Gao S, Liang X, Zhou A. Long PHILOS locking plate for treatment of proximal humerus and humeral shaft. 2009APR;23(4):419-22
13. Plecko M, Kraus A. Internal fixation of proximal humerus fractures using the locking proximal humerus plate. OperatOrthopTraumatol. 2005; 17(1):25-50.
14. P. Moonot, N. Ashwood, M. Hamlet Early results for treatment of three- and four-part fractures of the proximal humerus using the PHILOS plate system J Bone Joint Surg [Br]2007;89-B:1206-9.
15. R Chidambaram; T Stasch; and D Mok. Locking Plate System In The Treatment Of Displaced Proximal Humerus Fractures J Bone Joint Surg Br, 87-B;II: 166-167
16. SJ Haridas; D Thyagarajan; C Dent; R Evans; and R Williamas Functional Outcome Following PHILOS Plating For Displaced Proximal Humerus Fractures. J Bone Joint Surg.(Br).june2004;87-B;II:161-162
17. MA Fazal,FS Haddad Philos plate fixation for displaced proxima humeral fractures: Journal of Orthopaedic Surgery 2009;17(1):15-8.

www.ijbamr.com P ISSN: 2250-284X , E ISSN : 2250-2858