

**Original article**

**Minimally invasive percutaneous plate osteosynthesis for the treatment of proximal humerus fractures in osteoporotic patients with Philos plate**

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**Abstract**

**Introduction:** To investigate the effect of minimally invasive percutaneous plate osteosynthesis for treatment of proximal humerus fractures in osteoporotic patients with philos plate. **Methods:** A prospective study was conducted at Department of Orthopedics, M.M. Medical College, Mullana Ambala, from July 2005 to November 2010. A Total of 108 cases of proximal humerus fractures were treated with minimally invasive percutaneous plate osteosynthesis with philos plate. According to Neer classification, 89 cases had two part fractures, 19 had tree part fractures. **Results:** All the 108 cases were followed up ranging from 12 to 18 months with an average of 14 months. Radio graphically, union was observed in 92 patients at the end of 10 weeks. In 10 patients, times to union were 16 weeks. Six patients underwent autogenous bone grafting because of nonunion after 16 weeks. The mean Constant-Murley score was 86 (range 74-92). The functional results of the shoulder, according to Muley scores, were classified as excellent in 85.15% cases, good in 9.25% cases and fair in 5.55 cases. **Conclusion:** Minimally invasive percutaneous plate osteosynthesis for treatment of proximal humerus fractures in osteoporotic patients with philos plate shows good results and less complication.

**Key Words:** Proximal humerus fracture, Philos, Minimal invasive osteosynthesis.

**Introduction** Fractures of the proximal humerus, particularly in osteoporotic patients, remain a very difficulty problem<sup>1,2</sup>. Fractures are often complex and associated damage to the rotator cuff muscles results in poor shoulder function<sup>3,4</sup>. In osteoporotic patients, the small size and the poor bone stock of the humeral head fragments do not allow good purchase for internal fixation devices. Conventional plate osteosynthesis has been associated with high complication rates due to loss of fixation, screw pull out, and collapse of the head fragments<sup>5-8</sup>. Tension band wiring provides better stability but often requires valgus impaction of the head fragment. This may results in shortening, with laxity of the deltoid muscle and subsequent subluxation of the shoulder joints. Less invasive methods, such as close reduction and percutaneous pinning, require advanced surgical skills and are not always successful due to painful wire migration. The proximal humeral locking plate with angular stable locking head screws that enter the humeral head at

various angles appears to provide satisfactory purchase in osteoporotic bone. Additional plate holes allow sutures to anchor the rotator cuff. The anatomical design allows for an easier minimally invasive application of the plate and reduces subacromial impingement. Osteoporotic fracture of the proximal humerus stabilized with the philos plate utilizing locking head screws in different directions to provide angular stability<sup>9,10</sup>. The aim of this study was to evaluate the clinical outcome and complications of Minimally invasive percutaneous plate osteosynthesis for treatment of proximal humerus fractures in osteoporotic patients with Philos plate.

**Materials And Methods**

This prospective study was carried out at Orthopedics department of M.M. Medical College, from July 2005 to November 2010. A total of 108 patients with proximal Humerus Fracture were included in this study. (Figure I) The protocol was

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approved by Institutional ethics committee. A written informed consent was obtained from all the patients; they were explained about treatment plan, cost of operation, and hospital stay after surgery, and complications of an aesthesia. Inclusion criteria: 1. Closed humeral proximal fractures. 2. Failed conservative treatment due to inadequate position, osteoporotic fractures. 3. Patients older than 40 years. 4. Patients without neurological deficit. 5. Grade I–IV osteoporosis as per Singh's index Exclusion criteria: 1. Open fractures. 2. Four part fractures. 3. Patients with primary or metastatic tumors. 4. Fractures with nonunion. 5. Pathological fractures. They were followed up after surgery, were clinically and radio logically assessed for fracture healing, joint movements and implant failure. According to the criteria the results are graded as excellent when the fractures unites within 16 weeks without any complication, good when union occur within 24 weeks with treatable complications like superficial infection and knee stiffness and poor when union occur before or after 24 weeks with one or more permanent complications like infection (osteomyelitis), implant failure, non-union, limb shortening and permanent knee stiffness. Delayed union was recorded when the fracture united between three to six months while nonunion was noted when union had not occurred after eight months of treatment Follow-up was done. 66 male and 46 female patients were included, with mean age of 62 years (range 40 to 80 years) (Table I). 76 patients sustained their injury following a fall, 27 from a road traffic accident and 5 from direct assault. All fractures met the indications for operative treatment outlined by Neer et al<sup>4</sup>, i.e. an angulation of the articular surface of more than 45 degrees' or displacement between the major fracture fragments of more than 1cm. Fractures were classified with the AO/ASIF system and Neer clasification (Table II). Antero-posterior radiographs of pelvis including both hips were assessed for grading osteoporosis (Singh Index)<sup>11</sup> (Table V). All of them underwent surgical treatment with Philos plate system. The mean follow up was done for 12 to 18months.

#### ***Operative Technique:***

All patients received a prophylactic dose of 1gm cefoperazone + sulbactam intravenously preoperatively. The surgery was done under General anesthesia, in supine position; a small sand bag was

placed under the shoulder. Fracture was exposed through delto-pectoral approach. Fracture fragments were reduced without stripping periosteum to maximum possible achievable anatomical position and reduction was held with Kirschner wires. Reduction was checked under image intensifier. Definitive fixation with locking proximal humeral plate was done with plate positioned lateral to bicipital groove sparing tendon of long head of biceps. The plate was placed at least 1 cm distal to the upper end of greater tubercle. Plate was fixed with screw at longitudinal dynamic hole. After achieving near anatomical reduction, multi-directional screws were used to fix proximal fragments. Meticulous repairs of the rotator cuff, capsule and subscapularis muscle tears/avulsions were carried out, if found pre-operatively. Lesser tuberosity was fixed with a separate screw/wire if found avulsed. Range of motion of shoulder was checked on the table for impingement. Wound was closed under negative suction, which was removed after 48 hours. The patient were followed up at 15 days, then monthly for 6 months, and then at 12 months for final evaluation. Standard anteroposterior and axillary radiographs were obtained and evaluated for bony healing, non-union, malunion, loosening of implant, loss of reduction and a vascular necrosis of head of humerus (Table III). Comparing the immediate postoperative radiographs and those taken at the time of the final assessment assessed loss of reduction. (Figure II). Assessment and analysis of complications including axillary nerve injury and impingement due to plate was done. Functional outcome was assessed according to Constant–Murley score<sup>12</sup>. The Constant–Murley score was graded as poor (0–55 points), moderate (56–70), good (71–85), or excellent (86–100). (Table III).

#### **Results:**

70% of the cases were due to injury by fall, 25% were due to motor vehicle accident and 5% were due to direct assaults. Tables 4 and 5 shows functional outcome, presented as Constant–Murley score at 3, 6 and 12 months follow-up according to fracture type and grades of osteoporosis, respectively. Mean Constant–Murley score was 86 points at one-year follow-up. According to constant score, 85.18% had excellent outcome, 9.25% had good functional outcome and 5% had moderate outcome. All fractures united with an average



**Figure I:** Pre operative antero-posterior radiograph of proximal humerus fracture.



**Figure II:** Anteroposterior radiograph of same patient postoperatively.

union time of 18 (16–23) weeks. When the results were related to fracture classification, two-part fractures had the higher average Constant–Murley score (90 points, range 87–92 points) as compared to three-part fractures (80 points, range 74–88 points). When the results were related to grades of osteoporosis, grade IV osteoporotic fractures had highest average Constant–Murley score (81 points, range 78–88 points), followed by grade III osteoporotic fractures (77 points, range 70–91 points), followed by grade II osteoporotic fractures (72 points, range 66–86 points). No patient had axillary nerve paresis, vascular injuries or osteonecrosis of head and loosening of implant. In this study, complications were recorded as 6 cases (5.55%) of nonunion, that had been corrected with bone grafting, 2 cases (1.85%) of insignificant malunion, 8 cases (7.40%) of delayed union, 2 cases (1.85%) of a primary screw perforation of head A revision

surgery was performed for these two cases that had united within 16 weeks. And 8 cases (7.40%) of superficial infections that had resolved with antibiotics and regular aseptic dressing. (Table VII) At final follow-up all patients went on to osseous union and regained a full range of movement after rehabilitation. The results were excellent in 85.18% and good in 9.25% patients. (Table VI)

### **Discussion**

The majority of the fractures of proximal humerus are still treated conservatively. There are different surgical options for the fixation of these fractures including bone sutures, cerclage wires, K-wires, tension band wires, T-plates, intramedullary devices, double tubular plates, the Polaris nail, the Plan Tan Humerus Fixator Plate and prosthetic replacements<sup>13-19</sup>. Fixation of these fractures with plates and screws has been associated with complications such as pullout of screws in osteoporotic bone, subacromial impingement and avascular necrosis of the humeral head due to excessive periosteal stripping<sup>20,21</sup>. Kristiansen and Christensen have reported a high incidence of fixation failure following use of T-buttress plates in fixation of proximal humeral fractures. Wijnman et al. have reported good intermediate and long-term results in 87% of patients who had three- and four-part fractures fixed with T-buttress plate. The average age of the patients in their study was 48 years<sup>22</sup>. A newer surgical option in the management of these fractures that combines the principles of fixation with a conventional plate with those of locking screws. The plate is pre-shaped and contoured for the proximal humerus. The benefits of this implant are that it gives enhanced purchase in osteopenic bone, there is no loss of reduction or varus/valgus angulations, the locking screws into the plate provide angular and axial stability of the construct and it is a low-profile plate. We have been able to produce the early results with regard to functional outcome following use of locking plates. The only technically demanding part of the operation is to obtain the correct version of the humerus for accurate plate positioning. With this plate, there is less insult to the vascular supply of the fracture as the soft tissue envelope is not disturbed and hence there is less chance of osteonecrosis. The other demanding aspect is to avoid placing the plate too proximally on the humerus with resulting impingement of the top of

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**Table I: Age and sex variations in study group (n=108)**

Age (years)	Male			Female			Total
	R	L		R	L		
Less than 40	12	4	8	8	4	4	20
40-60	36	20	16	18	8	10	54
More than 60	18	12	6	16	8	8	34
Total	66	36	30	42	20	22	108

**Table II: Classification according to Neer and AO/ASIF of the proximal humeral fractures in a series of 108 patients treated with locking proximal humeral plate. (n=108)**

Neer	N	AO	N	Subtotal
2-Part	89	Type-A	A1	15
			A2	39
			A3	35
3-Part	19	Type-B	B1	3
			B2	14
			B3	2
Total	108			108

**Table III: Percentage of cases that had unions, malunion, delayed unions and non union (n=108)**

	Total Cases	Percentage of cases
1.Union	92	85.18%
2.Delayed union	8	7.40%
3.Non union	6	5.55%
4.Malunion	2	1.85%

the plate on the acromion. In my study there is no any case of impingment syndrome. But primary screw perforation of head was seen in two cases. A revision surgery was done for these two cases. This can be avoided by using a K wire inserted

**Table IV: Functional outcome in different fracture types, presented as mean and range of the Constant score at 3, 6 and 12 months follow-up. (n=108)**

Follow-up	All (N=108)	Constant score according to fracture type	
		2- Part (N=89)	3-Part (N=19)
3 Months	72 (60-80)	74 (60-80)	70 (62-78)
6 Months	77 (60-86)	80 (66-86)	75 (60-84)
12 Months	86 (74-92)	90 (87-92)	80 (74-88)

**Table V: Functional outcome in different grades of osteoporosis presented as mean and range of the Constant score at 3, 6 and 12 months follow-up. (n=108)**

Follow-up	Constant score according to grades of osteoporosis		
	2 <sup>nd</sup> (n=28)	3 <sup>rd</sup> (n=38)	4 <sup>th</sup> (n=42)
3-Months	62 (54-75)	66 (62-80)	70 (64-80)
6 Months	70 (60-81)	72 (66-86)	76 (68-86)
12Months	75 (65-86)	77 (70-91)	81 (78-88)

**Table VI: Out come of results of Philos plating. (n=108)**

Out comes	No	Percentage
Excellent	92	85.18%
Good	10	9.25%
Poor	5	5.55%

**Table VII: Complications. . (n=108)**

Complications	No	Percentage
1 Nonunion	6	5.55%
2 Malunion (coax- vara)	2	1.85%
3 Delayed union	8	7.40%
4 .A primary screw perforation of head	2	1.85%
5. Infection	8	7.40%

through a hole at the top of the plate, which should line up with the tip of the greater tuberosity. This is done during initial positioning of the plate. Positioning the plate too high can also lead to incorrect placement of the divergent screws in the humeral head. Care should be taken to avoid penetration of the head and subsequent chondrolysis with proximal interlocking screws. Image intensifier is necessary to check correct positioning and placement of the implant and screws, respectively. In my study the majority of my patients have been satisfied with the outcome of their surgery. Fracture union was achieved in 92 out of 108 patients (85.18%) with an overall mean Constant-

Murley score was 86 (range 74-92). I found 85.18% of excellent results, 9.25% good and 5.55% poor results. The limitations of my study is that there was no comparative group for study. I found some difficulties in follow-up of few cases because of their irregularity. The goal of surgical therapy is to obtain fracture reduction and stable fixation to enable immediate functional after treatment without the need for postoperative immobilization. The locking proximal humeral plate demonstrated superior biomechanical characteristics compared with the proximal humeral nail<sup>23</sup>. Additional holes in the plate allow tension band fixation of the rotator cuff. Stable construct allows early mobilization and satisfactory functional outcome. Constant-Murley score declined with increasing age. It is because after achieving a sat-

isfactory functional result with a good range of motion, elderly patients usually discontinue exercise at home and often lose range of motion. We have found locking proximal humeral plate an advantageous implant in comminuted 2-part fractures, 3-part fractures with osteoporosis in elderly patients. Fixed angular stability and meticulous rotator cuff repair leads to early mobilization and satisfactory functional outcome.

### **Conclusion**

The study of minimally invasive percutaneous plate osteosynthesis for treatment of proximal humerus fractures in osteoporotic patients with Philos plate is a near ideal method with high union rates. Philos provided excellent functional outcome and less complication.

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