Austin Journal of Orthopedics & Rheumatology

Open Access

Austin Publishing Group

Research Article

Locking Plate Fixation for Fractures of the Proximal Humerus: Analysis of Outcome and Complications

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Received: September 14, 2016; **Accepted:** October 18, 2016; **Published:** October 20, 2016

Abstract

Background: Proximal humeral fractures requiring surgical stabilization remain a therapeutic challenge particularly in elderly patients with unstable fracture types and poor bone quality. Locking plate technology has been developed as a potential solution to the difficulties encountered using conventional plating to treat these types of fractures.

Aim: The aim of our study was to analyze outcome and complications associated with use of locking plates in the treatment of displaced proximal humerus fractures.

Materials & Methods: We analyzed functional and radiographic outcome of 58 patients (average age 40.96 years) with displaced proximal humerus fractures who were treated with open reduction using Synthes 3.5 mm proximal humerus Locking Compression Plate (LCP) via deltopectoral approach. As per Neer's classification system we had 36 two-part, 16 three-part, 6 four-part fractures. Patients were assessed at two years using Constant Murley Score.

Results: Accordingly 8 patients had excellent, 40 patients had good and 6 patients had fair results. Average Score was 78.70. Two patients developed Avascular Necrosis (AVN) of humeral head; both were four-part fracture involving anatomical neck. No patient developed hardware impingement, infection or neurological complications.

Conclusions: With regards to functional outcome and complications our initial experience with this implant is encouraging.

Keywords: Proximal humerus fractures; Locking Compression plate; Osteosynthesis

Introduction

The ideal treatment of dislocated proximal humeral fractures is still the center of scientific debate. Various methods of osteosynthesis including external fixators [1], cannulated screws [2], intramedullary Kirschner wires [3], intramedullary nail [4], plates [5] and prosthetic replacement [6] have been tested and investigated, demonstrating the results vary from excellent to poor. Important drawback of above-mentioned methods includes unreliable stability provided by the implants, which can delay early post-operative range of motion. Open Reduction and Internal Fixation (ORIF) with Locking Compression Plate (LCP) has demonstrated promise in the treatment of displaced, comminuted proximal humerus fractures. This approach offers several potential advantages compared with more traditional open techniques [7-9]. These benefits include improved fracture stability because of the fixed-angle construct, particularly in more comminuted fracture patterns and in osteoporotic bone; a short period of immobilization with the opportunity for earlier rehabilitation; lower risk of damage to the rotator cuff or need for implant removal; reduced hardware complications; and, in patients with more complex fractures, the potential to avoid the use of hemiarthroplasty [10-12]. This implant also can be used in minimally invasive approaches [13]. Se of LCP is becoming more common; precise knowledge of and experience with the surgical technique is required to maximize clinical outcomes.

Materials and Methods

This is a prospective study was conducted in our institution. All patients with displaced proximal humerus fractures admitted in this hospital from June 2007 to December 2011 were considered for inclusion in the study. Two part fractures involving only greater or lesser tuberosity were excluded. For closed fractures initial immobilization was done with shoulder immobilizer. All patients were openly fixed using Synthes 3.5 mm proximal humeral LCP plates via deltopectoral approach. The mean delay from injury to surgery was 2.65 days (range 2-5 days). The timing of shoulder rehabilitation is determined by fracture stability, bone quality, and patient compliance. All the patients underwent a three-phase rehabilitation program consisting of I: Passive or assisted exercises. II: Active exercises starting at approximately 6 weeks postoperatively. III: Strengthening or resisted exercises were begun 10 to 12 weeks after surgery. All the patients were followed up by clinical and radiographic assessment immediately after the surgery and at 1 month, 3months, 6 months, 1 year and 2 years. At the end of two years' functional outcome was assessed according to Constant-Murley score. Out of 58 patients included in the study only 54 were available for follow up. Four patients were lost follow up due to unknown reasons.

Results and Analysis

There were total 58 patients, of which 16 were females and 42

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Table 1: Functional outcome at the end of two years (Constant Murley score).

Score / Fracture	Excellent (86-100)	Good (71-85)	Fair (56-70)	Poor (0-55)	Mean Score
Two Part	6	28	2	0	79.94
Three Part	2	8	2	0	78.33
Four Part	0	4	2	0	71
Total	8	40	6		78.70

Table 2: Studies in the literature using locking compression plates for treatment of proximal humerus fractures.

No	Author	No of pts	Mean Follow up	Constant M Score				Complication
				2 part	3 part	4 part	Over all	
1	Verdano MA et al. [27]	70	31 months				72	
2	Pak P et al. [28]	23	22 months				60.4	Infection 1, avascular necrosis 2, varus collapse 2 and non-union 1.
3	Kumar et al. [29]	52	15.21 ± 2.59 months	79.83 ± 6.95	74.22 ± 12.53	61.09 ± 14.29		Varusmalreduction 7, Screw perforation 4, Plate impingement 5, Infection 1, Nonunion 1
4	Sun et al. [30]	68	26.7 month				72.6 ± 13.2	Screw perforation, screws loosening, soft tissue infections, avascular necrosis and delayed union in 8 cases.
5	Piątkowski K et al. [31]	57	6 months		74.4	61.3	68.9	Non union 4 humeral head necrosis 12. loosening 2
6	Zeng et al. [32]	77	18.5 months				71.1 ± 11.9	Nonunion in 2 case The complications occurred in 25 cases
7	Parmaksizoğlu et al. [33]	32	25 months		88.3	74.2		Avascular necrosis with penetration of the screw into the joint in 2, Subacromial impingement 1,
8	MA Fazal et al. [34]	27	13 months	79	73	58	70	1 avascular necrosis with screw penetration
9	Current Study	54	2 years	79.94	78.33	71	78.7	2 avascular necrosis

were males. Age group ranged from 19 to 72 years (mean 40.96). Mode of injury was road traffic accidents (RTA) in 44 cases and household fall in 14 patients. According to Neer's classification 36 (62.06%) were Two Part fractures, 16 (27.58%) were Three Part fractures, 6 (10.34%) were Four Part fractures. We did not find any case of three-part fracture with lesser tuberosity as third fragment or fracture dislocation of shoulder joint. In two patients the fracture was Gustilo-Anderson type II open (6.89%), out of these one patient had Regimental Badge Anesthesia, which was resolved subsequently. Average time taken for union was around 3 months. Two patients developed AVN; both had four-part fracture involving anatomical neck. However, alignment was good and patients were pain free. None of patients developed implant failure; however, two patients developed refracture due to second episode of trauma. None had hardware impingement, infection or neurological complications. At the end of two years, functional assessment was carried out with Constant-Murely score (Photos1-3). Out of 54 patients available for follow up, 8 patients had excellent, 40 patients had good and 6 patients had fair results. Average Score was 78.70, for two part fractures the 79.94, for three part fractures 78.8, for four part fractures it was 71 (Table 1).

Discussion

During later part of last century and early part of this decade, fracture fixation has undergone revolutionary changes in the form of concept, technique, and implants. Today we can fix many difficult fractures resulting into better patient outcome than before, thanks to newer implants with newer technique of fixation. Periarticular fractures, communited diaphyseal fractures, and fractures in osteoporotic bones are some of these difficult fractures which can be managed in better ways nowadays than before and Locking plate invention is one of the many reasons for the better management of these difficult fractures. Operative treatment of displaced and unstable proximal humeral fractures is challenging. When these fractures occur in young patients, they are typically high-energy injuries with accompanying damage to the soft-tissue envelope. In elderly patients, these fractures frequently occur as a result of low-energy injuries to osteoporotic bone. The osseous architecture of the humeral head with poor central cancellous bone stock, particularly in elderly patients, leads to a high risk of fixation failure with classic plate-and-screw fixation [12,14,15]. Blade plate fixation may overcome this limitation with the advantage of a fixed-angle device but only affords a single primary proximal point of fixation and can bet technically difficult to insert correctly [12,16].

Locking plate fixation has recently become available for the treatment of proximal humeral fractures. Research suggests plates with screws locked to the plate may provide improved fracture stability [17]. Locking the screw to the plate mechanically recreates a point of cortical bone contact, which may be useful in the poor cancellous bone of the proximal humerus [18]. Locking plates offer the potential advantage of a fixed-angle device with multiple points of proximal fixation, increased load to failure when compared with unlocked plates, increased stability of fixation in osteoporotic bone, and the ability to limit soft-tissue stripping during fracture fixation [19]. Biomechanical studies have confirmed a potential benefit over conventional plate fixation via unlocked screws [20]. Early clinical results using the locking proximal humerus plates have been

promising, although no comparisons with other techniques have been published.

Some authors have reported excellent results after conventional plate osteosynthesis of proximal humeral fractures, [21]. However, this method has been associated with a high complication rate, particularly in elderly patients with comminuted fractures [22]. The technique of conventional plating often requires an extensive soft tissue stripping, which may compromise the vascular supply to the humeral head. On the other hand, available less invasive methods such as closed reduction and percutaneous pinning require advanced skills and good bone quality, minimal fracture comminution and a cooperative patient [23]. In the elderly population with osteoporosis, this method has also yielded poor outcome [24]. In order to obtain better and reproducible results, the AOASIF has developed a special locking compression plate for fractures of the proximal humerus [25]. According to our own findings, the main advantage of the new plate is apparent in elderly patients, since we had no failures of the internal fixation in this particular group, and they could attain an activity level that was sufficient to satisfy their needs regarding independent daily living. Patients with good bone quality have previously been treated successfully with the conventional plate osteosynthesis [26]. However, the conventional plate osteosynthesis has been associated with frequent hardware impingement . We have not observed any such symptoms in our patients.

This study reports our initial experience with locking compression plate designed specifically for proximal humeral fractures. We followed-up and assessed 54 patients at two years. At the end of two years' functional assessment with Constant Murely score shown out of 54 patients available for follow up, 8 patients had Excellent results 14.81% (6 two part, 2 three part fractures), 40 patients had Good results 74.07% (28 two part, 8 are three part, 2 are four part fractures), 6 patients had Fair results 11.11% (2 two part, 2 three part, 2 four part fractures). The functional outcome was better in the 2 or 3- fragment fracture group than in patients with 4-part fractures in our series. Also, as expected, the mean Constant score declined with increasing age. The number of complications did not differ between the groups, however, and the difference was mostly explained by the lower strength and a more limited range-of-motion in the elderly population. The subjective outcome was not often influenced by this fact, since the level of expectation was also lower for the elderly patients. Our functional results were comparable with other series using implants providing angular stability with respect to union, secondary loss of reduction, mean Constant Murely score (Table 2)

Although it was not a randomized controlled study, the results demonstrate several benefits of the proximal humerus locking plate. Most importantly, it is easy to use, it is biological in the sense that the blood circulation to the humeral head is not compromised, the plate does not need to be configured and the angular screw fixation ensures a fixed-angle stabilization which is advantageous in case of osteoporotic patients. In young patients it has advantage of early mobilization especially in polytrauma patients.

This study is admittedly limited in that it involves an unselected consecutive initial series of patients and, thus, includes the learning curve for use of the device and appropriate patient selection. The total numbers of patients available are insufficient for detailed statistical analyses. However, our initial experience with this implant shows that using the Locking Proximal Humerus Plate for treatment of proximal humeral fractures of all types is a reliable procedure, with good results being obtained with careful planning and familiarity with the special features of the operative technique.

But there are still many unanswered questions. Do these plates offer better outcomes than traditional methods? Is the procedure cost effective (cost of surgery and implant *vs* improvement in function)? Is there any place for fixation of 2 part fractures to enable earlier mobilization? Randomized studies will be needed in the future to solve these questions.

References

1. Kristiansen B, Kofoed H. Transcutaneous reduction and external fixation of displaced fractures of the proximal humerus. J bone Joint Surg Br. 1988: 70: 821-824.
2. Resch H, Povacz P, Frohlich R, Wambacher M. Percutaneous fixation of three- and four-part fractures of the proximal humerus. J Bone Joint Surg Br. 1997; 79: 295-300.
3. Qidwai SA. Treatment of proximal humeral fractures by intramedullary Kirschner wires. J Trauma. 2001; 50: 1090-1095.
4. Adedapo AO, Ikpeme JO. The results of internal fixation of three- and four-part proximal humeral fractures with the Polarus nail. Injury. 2001; 32: 115-121.
5. Hessmann M, Baumgaertel F, Gehling H, Klingelhoeffer I, Gotzen L. Plate fixation of proximal humeral fractures with indirect reduction: surgical technique and results utilizing three shoulder scores. Injury. 1999; 30: 453-462.
6. Robinson C M, Page RS, Hill RMF, Sanders DL, Court-Brown CM, Wakefield AE. Primary hemiarthroplasty for treatment of proximal humeral fractures. J bone Joint Surg Am. 2003; 85: 1215-1223
7. Charalambous CP, Siddique I, Valluripalli K, Kovacevic M, Panose P, Srinivasan M, Marynissen H. Proximal humeral internal locking system (PHILOS) for the treatment of proximal humeral fractures. Arch Orthop Trauma Surg . 2007; 127: 205-210.
8. Kettler M, Biberthaler P, Braunstein V, Zeiler C, Kroetz M, Mutschler W. Treatment of proximal humeral fractures with the PHILOS angular stable plate: Presentation of 225 cases of dislocated fractures. Unfallchirurg. 2006; 109: 1032-1040.
9. Rose PS, Adams CR, Torchia ME, Jacofsky DJ, Haidukewych GG, Steinmann SP. Locking plate fixation for proximal humeral fractures: Initial results with a new implant. J Shoulder Elbow Surg. 2007; 16: 202-207.
10. Vallier HA. Treatment of proximal humerus fractures. J Orthop Trauma 2007; 21: 469-476.
11. Helmy N, Hintermann B. New trends in the treatment of proximal humerus fractures. Clin Orthop Relat Res. 2006; 442: 100-108.
12. Siffri PC, Peindl RD, Coley ER, Norton J, Connor PM, Kellam JF. Biomechanical analysis of blade plate versus locking plate fixation for a proximal humerus fracture: Comparison using cadaveric and synthetic humeri. J Orthop Trauma. 2006; 20: 547-554.
13. Yang YS, Ma HT, Bi DW, Piao MS, Xu H. [Treatment of proximal humeral fractures with percutaneous locking plate fixation through lateral deltoid approach]. Zhongguo Gu Shang. 2014; 27: 244-7.
14. Gardner MJ, Griffith MH, Demetrakopoulos D, Brophy RH, Grose A, Helfet DL, et al. Hybrid locked plating of osteoporotic fractures of the humerus. J Bone Joint Surg Am. 2006; 88: 1962-1967.
15. 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: 290-294.

16. Instrum K, Fennell C, Shrive N, Damson E, Sonnabend D, Hollinshead R. Semitubular blade plate fixation in proximal humeral fractures: a biomechanical study in a cadaveric model. J Shoulder Elbow Surg. 1998; 7: 462-466.

17. Perren SM. Evolution of the internal fixation of long bone fractures. The scientific basis of biological internal fixation: choosing a new balance between stability and biology. J Bone Joint Surg Br. 2002; 84: 1093-1110.

18. Kolodziej P, Lee FS, Patel A, Kassab SS, Shen KL, Yang KH, et al. Biomechanical evaluation of the schuhli nut. Clin Orthop Relat Res. 1998; 347: 79-85.

19. Haidukewych GJ. Innovations in locking plate technology. J Am Acad Orthop Surg. 2004; 12: 205-212.

20. Kubiak EN, Fulkerson E, Strauss E, Egol KA. The evolution of locked plates. J Bone Joint Surg Am. 2006; 88: 189-200.

21. Wanner G A, Wanner-Schmid E, Romero J, Hersche O, von Smekal A, Trentz O, Ertel W. Internal fixation of displaced proximal humeral fractures with two one- third tubular plates. J Trauma. 2003; 54: 536-44.

22. Cofield R H. Comminuted fractures of the proximal humerus. Clin Orthop. 1988; 230: 49-57.

23. Herscovici D Jr, Saunders DT, Johnson MP, Sanders R, DiPasquale T. Percutaneous fixation of proximal humeral fractures. Clin Orthop. 2000; 375: 97-104.

24. Cordasco F A, Bigliani L U. Complications of proximal humerus fractures. Tech. Orthop. 1997; 12: 50.

25. Frigg R. Development of the locking compression plate. Injury. 2003; 34: 6-10.

26. Wijgman A J, Roolker W, Patt T W, Raaymakers E L, Marti R K. Open reduction and internal fixation of three and four-part fractures of the proximal part of the humerus. J Bone Joint Surg Am. 2002; 84: 1919-1925.

27. Verdano MA, Lunini E, Pellegrini A, Corsini T, Marenghi P, Ceccarelli F. Can the osteosynthesis with locking plates be a better treatment for unstable fractures of the proximal humerus? Musculoskelet Surg. 2014; 98: 27-33.

28. Pak P, Eng K, Page RS. Fixed-angle locking proximal humerus plate: an evaluation of functional results and implant-related outcomes. ANZ J Surg. 2013; 83: 878-882.

29. Kumar C, Gupta AK, Nath R, Ahmad J. Open reduction and locking plate fixation of displaced proximal humerus fractures. Indian J Orthop. 2013; 47: 156-160.

30. Sun JC, Li YL, Ning GZ, Wu Q, Feng SQ. Treatment of three- and four-part proximal humeral fractures with locking proximal humerus plate. Eur J Orthop Surg Traumatol. 2013; 23: 699-704.

31. Piątkowski K, Kwiatkowski K, Piekarczyk P, Przybycień M, Zaborowski D. Outcome of comminuted proximal humerus fracture treatment with locking compression plate. Pol Orthop Traumatol. 2013; 78: 239-246.

32. Zeng L, Chen Y, Wang L, Lu Y, Zhang W, Chen Q, et al. [Effectiveness of locking plates for Neer three- and four-part proximal humerus fractures]. Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi. 2012; 26: 1469-1472.

33. Parmaksizoğlu AS, Sökücü S, Ozkaya U, Kabukçuoğlu Y, Gül M. Locking plate fixation of three- and four-part proximal humeral fractures. Acta Orthop Traumatol Turc. 2010; 44: 97-104.

34. MA Fazal, FS Haddad. Philos plate fixation for displaced proximal humeral fractures. J Orthop Surg (Hong Kong). 2009; 17: 15-18.

Austin J Orthopade & Rheumatol - Volume 3 Issue 4 - 2016
ISSN: 2472-369X | www.austinpublishinggroup.com

Citation: Patil HG, Biraris SR, Khaleel VM, Chacko JM, Sonale VT and Kolar V. Locking Plate Fixation for Fractures of the Proximal Humerus: Analysis of Outcome and Complications. Austin J Orthopade & Rheumatol. 2016; 3(4): 1042.