Internal Medicine and Medical Investigation Journal
E-ISSN: 2474-7750
Homepage: www.imminv.com

ORIGINAL ARTICLE

Features of Three- and Four-Part Proximal Humeral Fractures and Outcome of Internal Fixation Using the Philos® Locking Plate

Ali Sadighi[1], Bahamin Attar[1]*, Alireza Sadeghpour[1], Hojjat Hossein Pourfeizi[1], Hossein Aslani[1], Arash Sakhaei[1], Zahra Azizian[2]
[1]*Department of Orthopedic, Shohada Hospital, Faculty of Medicine, Tabriz University of Medical Sciences, Tabriz, Iran*
[2]*Department of Dermatology, Iran University of Medical Sciences, Tehran, Iran*
Corresponding Author: Bahamin Attar, E-mail: Tdoc4146@yahoo.com

ARTICLE INFO

Article history
Received: Feb 20, 2017
Accepted: Mar 9, 2017
Published: Mar 20, 2017
Volume: 2
Issue: 1

Conflicts of interest: None
Funding: None

Key words
Humeral Fractures,
Internal Fixators,
Bone Plates,
Internal Fracture Fixation

ABSTRACT

Background: Proximal humeral fractures are among common types of fractures and remain a challenging issue for surgical management. This study aimed to assess the clinical outcomes and complication rates of three- vs. four-part proximal humeral fractures, treated with internal fixation using the Philos® plate. **Methods:** In this cohort study, a total of 30 consecutive patients with three-part or four-part proximal humeral fractures based on the Neer classification were included. Surgical treatment was performed with open reduction and internal fixation using the Philos® plate. The Constant score was evaluated 6 months later in follow-up. The $P<0.05$ was considered significant. **Results:** Four-part fractures were mainly caused by trauma from above, while insults of opposite direction were responsible for more than half of 3 part fractures ($P=0.01$). Open fractures were only observed in patients with a four-part fracture ($P=0.018$). No significant differences were noticed regarding gender, cause, and side of the fracture. The presence of other fractures, implant failure, reduction loss, avascular necrosis (AVN) of humeral head, rotator cuff injury, and revision surgery were significantly higher in patients with four-part fractures. The mean Constant score was 81.40±11.61 and 65.09±16.09 for three-part and four-part fractures, respectively ($P=0.006$). **Conclusion:** Open reduction and internal fixation with Philos® plate yield acceptable results in both types of fractures, however, the prognosis of this intervention is poorer four-part fractures.

INTRODUCTION

Proximal humeral fractures account for circa 4% of all types of fractures and 26% of fractures of the humeral head (1). Approximately 13-16% of proximal fractures are multi-fragmented three- and four-part ones (2). Proximal humeral head fractures are widely considered to be osteoporosis-associated particularly affecting the active elderly as a result of minimal trauma (3). As a result, these fractures have a substantial negative impact on the quality of life and independence of patients, as well as financial burden on health care systems (4).

Various surgical techniques have been proposed for fixation of comminuted and displaced proximal humeral fractures with the aim of proper restoration of a painless shoulder fulfilling patient's functional demands. However, these procedures pose difficult management problems and are not free of adverse events. Potential complications include avascular necrosis (AVN) of the humeral head, displaced tuberosity fragments, malunion or non-union, rotator cuff impingement, implant failure, painful frozen shoulder, neurovascular problems and arthritis (5,6). The complexity of the fracture, severity of soft tissue injury, patient's age, male sex, preexisting comorbidities and bone density have been reported as influential factors for failure and complication after surgery (7,8).

Locking compression plates have been recently utilized in proximal humeral fracture fixation and gained great popularity. The Proximal Humeral Internal Locking System (Philos®) plate has specifically been designed to provide stability in proximal humeral fractures. It can be applied with a minimally invasive method and has screws which are placed in converging and diverging directions (9). Several holes in the proximal part of the plate function as suturing anchors to the rotator cuff. The advantages of this device are early postoperative mobilization and a lower rate of complications (10).

The purpose of this prospective study was to present a comparison of the clinical outcomes and complication rates of 30 patients with three- vs. four-part proximal humeral fractures, who were treated with internal fixation using the Philos® plate in our center.

Published by Mehrabani Publishing LLC.

http://dx.doi.org/10.24200/imminv.v2i1.50

METHODS

In this cohort study, 30 patients with three part or four part proximal humeral fractures based on the Neer classification (11) were included. The patients were treated in Shohada Hospital from September 2012 to June 2014. Inclusion criteria consisted of age between 18 to 80 years and referral within the first 10 days after fracture. Patients with a history of metastatic tumors were excluded. The study was approved by Ethics Committee of Tabriz University of Medical Sciences, and an informed written consent was obtained from each patient before participation.

Surgical treatment was performed with open reduction and internal fixation with the Philos® plate. The degree of bone healing, the range of motion in the shoulder, necrosis of humeral head head, and nerve damage were evaluate 6 months later in follow-up using the Constant score (12).

Statistical analysis was conducted with IBM SPSS Statistics Software using Wilcoxon signed-rank test and the independent t-test. A $P<0.05$ was considered significant.

RESULTS

A total of 30 consecutive patients with proximal humeral fractures were treated with the Philos® plate between 2012 and 2014 in our center. The average age of participants was 43.4±14.45 years (mean±SD). Women comprised 40% (N=12) of all patients with the mean age of 45.58±16.05 years, and men made up the remaining 60% (N=18) with the mean age of 41.94±13.58 years.

Demographic characteristics of three-part and four-part fractures regarding gender, side, cause, and closed vs. open type are shown in Table 1. Four-part fractures were mainly caused by a source of energy in downward direction injuring the shoulder from above, while insults of opposite direction were responsible for more than half of 3 part fractures. This led to a significant difference (P=0.010). Furthermore, none of 3 part fractures resulted in open wounds, while open fractures afflicted 3 out of 11 patients with 4 part fracture. This difference was also significant with a P=0.018. However, regarding gender, cause and side of fracture no significant differences were noticed.

Additionally, accompanying complications were assessed and the results are listed in Table 2.

The presence of other fractures, implant failure, reduction loss, avascular necrosis (AVN) of humeral head head, rotator cuff injury, along with the necessity of performing revision surgery were significantly higher in patients with 4 part fractures. Nonunion was not observed in any of the patients.

The total average Constant score was 75.63±15.47 (women: 72.67±9.27, men: 77.61±18.51). This score was 81.40±11.61 and 65.09±16.09 for 3-part and 4-part fractures, respectively, which showed a statistically significant difference (P=0.006).

DISCUSSION

Locking plates are a new method with promising results; nonetheless, unsatisfactory outcomes have been reported. In a systematic review of locking plate fixation of proximal humeral head fractures by Sproul et al. which investigated 12 studies including 514 patients the rate of complications were reported as follows: 16% varus malunion, 10% AVN, 6% impingement, and 4% infection. 14% needed reoperation (6).

Gaheer et al. studied 56 patients with three-part or four-part fractures, who underwent internal fixation surgery using Philos® plate. In one case, screw disengagement from to plate led to revision surgery. Stiffness was observed in 3 patients, which improved with intensive physiotherapy. Similar to our study, only one patient developed superficial wound infection, who responded to oral antibiotic therapy (13).

Norouzi et al. conducted another comparable study in a teaching hospital in Tehran on 37 patients with 2, 3- and 4-part fractures. The results were in favor of the application of the Philos plate, as this method offered excellent outcomes with low risk of complication; AVN and infection were a notice in only one and two cases, respectively (14).

Erasmo et al. evaluated eighty-two cases in Italy. Twelve patients required revision surgery, 10 presented with AVN. These findings were higher compared to our study. Furthermore, non-union was noted in 3 patients, which was non-existent in our study (15).

Table 1. Features of 3-part and 4-part fractures

Features	Total (N=30) n (%)	3-part (N=19) n (%)	4-part (N=11) n (%)	P value
Male	18 (60)	11 (36.7)	7 (23.3)	0.2
Female	12 (40)	8 (26.7)	4 (13.3)	
Right	8 (26.7)	4 (13.3)	4 (13.3)	0.369
Left	22 (73.3)	15 (50)	7 (23.3)	
Accidentental	14 (46.7)	8 (26.7)	6 (20)	0.512
Falling	16 (53.3)	11 (36.7)	5 (16.6)	
High energy	18 (60)	8 (26.7)	10 (33.3)	0.01
Low energy	12 (40)	11 (36.7)	1 (3.3)	
Closed	27 (90)	19 (63.3)	8 (26.7)	0.018
Open	3 (10)	0 (0)	3 (10)	

Table 2. Complications associated with the primary thee-part and four-part proximal humeral fractures

Complication	Total (N=30) n (%)	3-part (N=19) n (%)	4-part (N=11) n (%)	P value
Presence of other fractures	9 (30)	3 (15.8)	6 (54.5)	0.028
Articular surface involvement	9 (30)	5 (26.3)	4 (36.4)	0.569
Nerve damage	4 (13.3)	2 (10.5)	2 (18.2)	0.559
Implant failure	3 (10)	1 (5.3)	2 (18.2)	0.018
Reduction loss	3 (10)	0 (0)	3 (27.3)	0.018
Varus malunion	7 (23.3)	3 (15.8)	4 (36.4	0.207
AVN of humeral head	5 (16.7)	1 (5.3)	4 (36.4)	0.030
Replacement	7 (23.3)	4 (21.1)	3 (27.3)	0.703
Rotator cuff injury	7 (23.3)	2 (10.5)	5 (45.5	0.032
Impingement syndrome	6 (20)	3 (15.8)	3 (27.3)	0.456
Revision surgery	3 (10)	0 (0)	3 (27.3)	0.018
Infection	1 (3.3)	0 (0)	1 (9.1)	0.189

Percentages are related to the item on top of columns. AVN=Avascular necrosis

In a similar study by Shadid et al. from England, it was shown that younger age and male gender were factors with a positive effect on the outcome of surgery. Also, the authors claimed that some fragments apparently do not affect the results, which was contrary to our study (2).

In a long-term follow-up of 64 patients by Hirschmann in Switzerland, the overall outcomes were favorable especially in younger patients and patients undergoing revision surgery, who had a rate of 29%. Older age and requiring revision surgery were mentioned as the most predictive factors yielding undesirable outcome (16).

Two other reports from early experiences by Moonot et al. and Koukakis et al. have also provided valuable information with almost similar outcomes (9,10). In the study by Moonot et al., it was mentioned that good bone density permits early post-operative mobilization of the upper extremity (9).

One of the shortcomings of our study is that the number of participants was limited and patients in the three- and four-part fracture groups were not matched with regards to their gender, age, and predisposing factors. This fact may have led to bias in the presented results. Also, comparison of the outcomes in internal fixation with Philos® plate method to other conservative and operative managements can shed light on the differences regarding potential complications in three- vs. four-part proximal humeral fractures and be valuable for clinical decision making.

CONCLUSION

To the best of our knowledge, there is no study on the comparison of 3- and 4-part fractures of the proximal humeral head. Based on our results, it can be concluded that the risk-benefit may not be justifiable for 4-part fractures. However further studies are necessary to investigate this aspect.

ACKNOWLEDGMENTS

Work attributed to Academic Department of Orthopedic Surgery, Tabriz University of Medical Sciences, Tabriz, Iran.

AUTHORS CONTRIBUTION

AS and HP designed the study; BA, ARS and HA interpreted the data and wrote the paper; ARS and BA gathered data; ZA conducted data analysis.

REFERENCES

1. Court-Brown CM, Garg A, McQueen MM. The epidemiology of proximal humeral fractures. Acta orthopaedica Scandinavica. 2001;72(4):365-71.
2. Shahid R, Mushtaq A, Northover J, Maqsood M. Outcome of proximal humeral head fractures treated by PHILOS plate internal fixation. Experience of a district general hospital. Acta Orthopaedica Belgica. 2008;74(5):602.
3. Court-Brown CM, Caesar B. Epidemiology of adult fractures: a review. Injury. 2006;37(8):691-7.
4. Slobogean GP, Johal H, Lefaivre KA, MacIntyre NJ, Sprague S, Scott T, et al. A scoping review of the proximal humeral head fracture literature. BMC musculoskeletal disorders. 2015;16(1):112.
5. Nouraei MH, Majd DA, Zamani F. Comparing the treatment results of proximal humeral head fracture based on surgical or nonsurgical methods. Advanced biomedical research. 2014;3.
6. Sproul RC, Iyengar JJ, Devcic Z, Feeley BT. A systematic review of locking plate fixation of proximal humeral head fractures. Injury. 2011;42(4):408-13.
7. Krappinger D, Bizzotto N, Riedmann S, Kammerlander C, Hengg C, Kralinger FS. Predicting failure after surgical fixation of proximal humeral head fractures. Injury. 2011;42(11):1283-8.
8. Petrigliano FA, Bezrukov N, Gamradt SC, SooHoo NF. Factors predicting complication and reoperation rates following surgical fixation of proximal humeral fractures. J Bone Joint Surg Am. 2014;96(18):1544-51.
9. Moonot P, Ashwood N, Hamlet M. Early results for treatment of three-and four-part fractures of the proximal humeral head using the PHILOS plate system. Bone

& Joint Journal. 2007;89(9):1206-9.
10. Koukakis A, Apostolou CD, Taneja T, Korres DS, Amini A. Fixation of proximal humeral head fractures using the PHILOS plate: early experience. Clinical orthopaedics and related research. 2006;442:115-20.
11. Neer CS. Displaced proximal humeral fractures. J Bone Joint Surg Am. 1970;52(6):1077-89.
12. Constant CR, Gerber C, Emery RJ, Søjbjerg JO, Gohlke F, Boileau P. A review of the Constant score: modifications and guidelines for its use. Journal of Shoulder and Elbow Surgery. 2008;17(2):355-61.
13. Gaheer RS. Fixation of 3-and 4-part proximal humeral head fractures using the PHILOS plate: mid-term results. Orthopedics. 2010;33(9).
14. Norouzi M, Naderi MN, Komasi MH, Sharifzadeh S, Shahrezaei M, Eajazi A. Clinical results of using the proximal humeral internal locking system plate for internal fixation of displaced proximal humeral fractures. Am J Orthop (Belle Mead NJ). 2012;41(5):E64-8.
15. Erasmo R, Guerra G, Guerra L. Fractures and fracture-dislocations of the proximal humeral head: A retrospective analysis of 82 cases treated with the Philos® locking plate. Injury. 2014;45:S43-S8.
16. Hirschmann MT, Fallegger B, Amsler F, Regazzoni P, Gross T. Clinical longer-term results after internal fixation of proximal humeral head fractures with a locking compression plate (PHILOS). Journal of orthopaedic trauma. 2011;25(5):286-93.