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Two-Part Proximal Humerus Fractures: Whether to Plate or Nail?

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Abstract:
Background: *Displaced Two-part proximal humerus fractures are common orthopedic injuries for which surgical intervention is often indicated. Purpose-The purpose of this study is to compare two methods of fixation for two-part proximal humerus fractures, locking plate (LP) with screws versus intramedullary nailing (IMN), with respect to alignment, healing, patient outcomes, and complications. Method and material-A prospective study was performed on 61 cases of displaced two-part surgical neck fractures of the humerus. 30 shoulders were treated using IMN fixation and 31 others were fixated with LP. Results Clinical and radiological outcome of two groups were compared. American Shoulder Elbow Surgeon (ASES) Score was used to evaluate patients clinically which was not significant for 1-year follow-up. Radiographic comparison of fixation by X-Rays demonstrated an average neck-shaft angle of 121.9° and 124° in the IMN group and LP group respectively. 117.7° of forward elevation in the IMN group and 136.3º in the LP group, which were significant. Operating time for both the procedures was found to be significant. Complications were not found to be significant.*
Conclusion: *Our results suggest that either LP fixation or IMN fixation for a two-part proximal humerus fracture provides acceptable fixation and both the procedures have some limitations over other. Although forward flexion and functional outcome were decreased in the IMN group, operative time was less and was significant.*

Keywords: *two-part proximal humerus fracture, locking plate, intramedullary nail, ASES shoulder score.*

I. Introduction

Proximal humerus fractures are common orthopedic injury (4–5 % of all fractures),[1] management of proximal humerus fractures remains a topic of debate. Multiple factors are considered before management including displacement of fracture fragments, age of the patient, type of injury, occupation.[2,3] Non-operative treatment is the gold standard for undisplaced proximal humerus fractures, with good outcomes.[4,5] Displaced fractures may be treated operatively using different fixation techniques which include percutaneous k- wire fixation, proximal humerus locking plate (LP) and screw fixation, intramedullary nailing (IMN), hemiarthroplasty with different success rates.[2] Open reduction and internal fixation (ORIF) and plate osteosynthesis and closed reduction with nailing are two common methods of fixing Neer[6] two-part proximal humerus fractures. Post-nailing rotator cuff complications have led a trend toward plate fixation as injury of the rotator cuff tendons is less.[7] Locking Plate has become increasingly popular due to its enhanced biomechanical properties in osteoporotic patients.[2] Locking Plate provides a good reduction in comminuted fractures of the metaphysis, particularly in old patients.[2] Complications of plate fixation include screw perforation and loosening, implant failure, infection, and varus malalignment with resultant subacromial impingement.[8] Nailing is a less invasive which allows less injury to the soft tissue envelope and blood supply to the bony fragments. Complications of IMN include inability to achieve adequate compression and stability in comminuted fractures, shoulder pain and stiffness, rotator cuff dysfunction, and back out of proximal screws.[7] The purpose of this study was to compare these two fracture fixation techniques (1)Intramedullary nailing and (2)Locking proximal humerus Plating with screws for treating two-part proximal humerus fractures. Our null hypothesis was that there would be no functional, clinical or radiographic differences in patients treated with either technique.

II. Materials and Methods

This is a prospective study, 61 shoulders were identified in 61 patients, with Neer two-part proximal humerus fractures that were treated with either IMN fixation or LP fixation by two trauma-trained surgeons over a period of three years. Three patients treated with IMN fixation were lost to follow-up. Thirty patients (16

male, 14 female) with a mean age of 61.97 years (range, 31–82) were treated with IMN fixation. (Nebula humerus interlocking nail) (Fig.1).[16] Mechanism of injury in this group included 22 falls from a standing height and 8 motor vehicle accidents (MVA).

Thirty-one patients (12 male and 19 female) with a mean age of 64.45 years (range, 26–80) were treated with a pre-contoured Locking Plate and screw construct. (Nebula PHILOS plate) (Fig.2).[16] These patients had similar fracture patterns, injury mechanisms and demographic parameters. Mechanism of injury included 25 falls from standing height and 6 MVA. Pre-operative radiographs were reviewed for displacement and angulation. IM nailing was performed in the beach chair position, draping the whole affected limb. Initial reduction was achieved closed or with the aid of percutaneous 3mm Kirschner wires used as joy sticks. An anterolateral subacromial approach was used; the deltoid was split at the junction of the anterior third and posterior two thirds and to protect the supraspinatus tendon. Starting point was made just lateral to the articular margin and humerus reamed over guide wire. Nail of adequate size was placed across the fracture and fixed with a minimum of two screws proximally and minimum of one distal locking screw in AP direction, all placed through stab incisions via a screw targeting jig. Fluoroscopy confirmed correct placement of all implants and the fracture reduction (Fig 3). Patients who underwent fixation using pre-contoured proximal humerus locking plates were also placed in the beach chair position. A delto-pectoral approach was used, and fragments were reduced using Kirschner wires. The plate was applied to the lateral aspect of the humeral shaft, just lateral to the bicipital groove, taking care of axillary nerve. All proximal locking screws were placed uni-cortically through locking jig and reduction was checked under fluoroscopy. A minimum of four screws were used in the humeral head to achieve fixation. A minimum of three distal shaft screws were placed bi-cortically and were a combination of locked and non-locked screws depending on the bone quality (Fig 4). Operative time was noted from start of draping till suturing. All patients were treated with same postoperative protocol. Operated limb was placed in an arm sling for the first 6 weeks. Isometric deltoid, biceps, and triceps strengthening exercises were started on the first postoperative day. Passive range of motion exercises were started in the second week after surgery and active range of motion were started at 6 weeks with a formal physiotherapy program. Postoperative radiographs were reviewed for alignment, healing, and presence of osteonecrosis. Range of shoulder motion was measured with a goniometer, functional outcomes of the patients were assessed by ASES score[19] (50 points on pain intensity scale and 50 points for strength and day to day activities) and the treating surgeon recorded the development of complications. All patients were followed until there was evidence of radiographic healing of the fracture preferably minimum of 12 months. Radiographic findings such as calcific tendonitis, heterotopic ossification within the deltoid, and osteonecrosis of the humeral head were considered as complications. Secondary surgery to revise or remove hardware was also considered a complication. Fracture malreduction was defined as a neck-shaft angle less than 120°.Statistical analyses comparing complications, forward elevation, and neck-shaft angle were performed using an unpaired Student's t test.

Figure 1- Nebula Intramedullary nail for humerus

Figure 2- Nebula PHILOS plate for proximal humerus

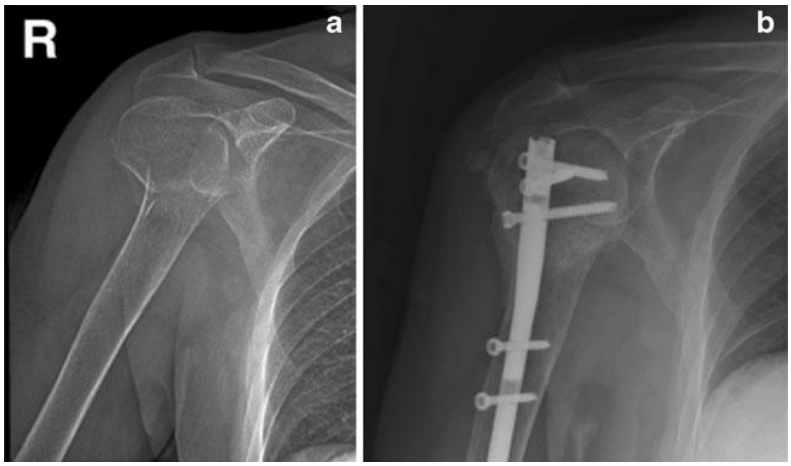

Figure 3- A 78-year-old male who sustained a two-part proximal humerus fracture. The patient underwent IM nail fixation of the fracture. A) AP view of the two-part proximal humerus fracture prior to IM nail fixation. B) 6-month follow-up AP view following intramedullary nail fixation of a right-sided two-part proximal humerus fracture.

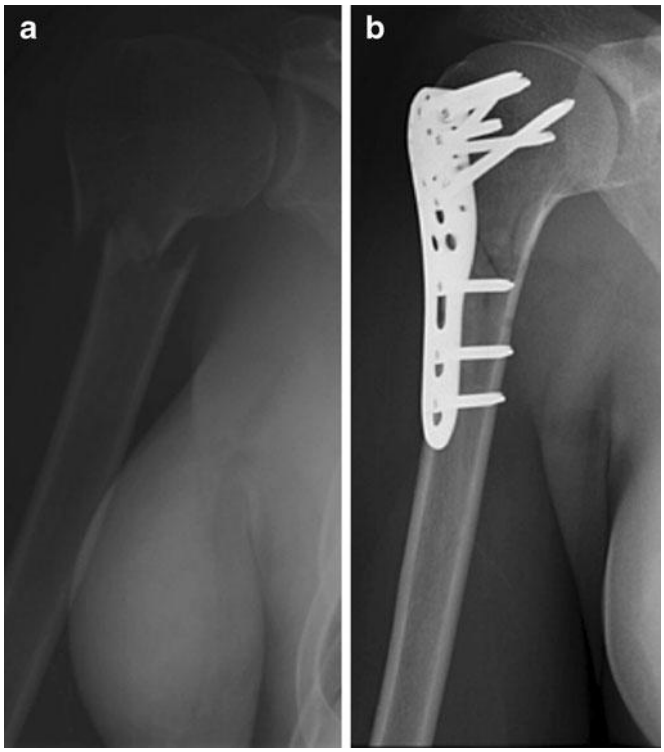

Figure 4- A 37-year-old female patient fall from height. The patient underwent ORIF with a locking plate. a) The two-part proximal humerus fracture prior to locking plate fixation. b) The two-part fracture following fixation with a locking plate.

III. Results

The mean age of patients treated by IMN and LP group were 61.97 and 64.45 respectively (Table 1). The difference between age groups was found statistically insignificant (p=0.459). The mean length of follow-up in both groups was minimum 12 months. Three patients within the IMN group lost to follow-up and excluded. The average forward elevation in the IMN group after 1 year of follow-up was 120.5° (range, 60–160) compared with a mean of 135.6° (range, 70–170) in the LP group. The forward elevation was found to be greater in patients following fixation with a LP as compared to IM nailing (Table 1), the difference in forward elevation between the two groups was found to be statistically significant (p=0.019). In both the IMN and LP groups, all fractures were united on radiographs by 3-month follow-up. The neck-shaft angle measured on radiographs at healing was 121.9° in the IMN group and 124° in the LP group (Table 1). The difference between neck-shaft angles in the two groups was found to be statistically insignificant (p=0.126). The mean operative

time taken for IMN and LP surgery were 76 minutes and 115 minutes respectively (Table 1). The difference between two groups was found statistically significant (p=0.00001). The present study shows that there were no intra-operative complications. Twenty seven percent (eight patients) of the patients in the IMN group had post-operative complications. Two patients in the IMN group (6.7 %) developed a painful heterotopic ossification within the subacromial space, painful impingement of hardware in the proximal shoulder was developed in five patients (16.6 %) and one patient had breakage of implant for which re-surgery was done. Seventeen percent (five patients) of the patients in the LP group had complications. 9.6% (three patients) had screw penetration from which one patient required screw removal surgery; osteonecrosis in 3% (one patient) and 3% (one patient) had post-op infection which subsided in 6 weeks. The difference in complication rate was not significant.

	Mean(ILN)	Mean(LP)	t-value	p-value
Age	61.97	64.45	-0.745	0.459
Operative Time	75.83	114.5	-11.736	0.00001
Neck-shaft angle	121.9	124	-1.551	0.126
Forward elevation	120.5	135.6	-2.41	0.019
1-year ASES score*	64.17	69.52	-2.624	0.11

Table 1- Showing statistical comparison between ILN and LP group.
*ASES- American Shoulder Elbow Surgeon Score.

IV. Discussion

The two groups of patient were compared on the basis of age, functional and radiological outcome, operative time, complications. There was not much difference in mean age of both the groups (p=0.459). In our study none of the implants were preferred for any specific age group and patient selection was randomized and blinded. Putti et al.[9] found that on the comparison of ILN and LP fixation of humeral shaft fractures had similar functional outcomes at 24-month follow-up on the American Shoulder and Elbow Surgeons (ASES) scale (45.2 with IMN and 45.1with locking plate), but their results demonstrated a significant difference in complication rate. In their study among 34 patients, there was a 50 % complication rate in the IMN group compared to 17 % in the LP group. However, the study did not account for severity of the injury, type of implant and age of patient when creating each cohort. Our study compared two different surgical fixation techniques between homogenous groups with respect to the injury pattern. In our study we used ASES score and forward elevation as our primary measurement of clinical outcome, findings suggest that those treated with LP have a greater forward elevation when compared to IMN, this difference was statistically significant (p=0.019), ASES score at the end of one year follow-up was found statistically insignificant(p=0.11). This suggests that patients treated with LP ha better functional outcome when compared to IMN group patients. Popescu et al.[7] and Sudkamp et al.[2] demonstrated a non-comparative range of motion outcomes following proximal humerus fractures treated with IMN and locking plate, respectively.[2,7] Patients treated with IMN had an average forward elevation of 135° at 12 months of follow-up[7], while a similar study, Esser et al.[10] found an average forward elevation of 147.3° at 24 months of follow-up. Patients treated with locking plate system had an average forward flexion of 132±35° at 12 months follow-up in study by Südkamp N et al.[2]

These outcomes are similar to those found in our study for LP group after 1 year follow-up, whereas forward elevation in IMN group was less in our study. These findings suggest that the functional outcome depends on the range of motion. Trepat et al.[11] compared same two group of fixation in two-part proximal humerus fractures and found similar outcome scores using the UCLA score, Constant score, and Oxford score, differences were statistically insignificant in the functional outcome of humeral head fracture treatment using either an angular stable plate or an angular stable antegrade nail. Trepat et al.[11] postulated that complications in LP group due to approach requiring more soft tissue dissection which might be avoided with a minimally invasive technique, particularly in two-part fractures, this complication could be avoided, no difference in range of motion was found with FE of 130 in the IMN group and 131 in the LP group and an average neck-shaft angle of 121 in the IMN group and 125 in the LP group after surgical fixation was reported. Konrad et al.[12] compared LP and IMN in three-part fractures and functional outcome scores and results differences were statistically insignificant. The complications were secondary to surgery in which screw penetration into the joint was not recognized during surgery; hence they concluded that surgical technique is more important than implant selection. Our results show that the percentage of complications was greater in the IMN group than the locking plate group but the difference was not statistically significant. Tanner and Propescue[7,13] demonstrates in two separate studies a 34% complication rate among 187 patients treated with a locking proximal humerus plate[13] as compared to a 51.3% complication rate in 115 patients treated with IMN.[7] These complication rates are at a higher side when compared to those found in our comparison of IMN vs. LP 27% and 19% respectively. The difference in complication rates was statistically insignificant to the location of the fracture in the humerus as IMN group was found to have a greater complication rate when compared to locking plate in the treatment of humeral shaft fractures. Common complication reported with IMN was back out of the nail and painful

impingement which caused 38 % of the total number of complications in one study. Brunner et al.[14] reported primary screw perforation through the glenohumeral articular joint surface as the most common complication following fixation of proximal humerus fractures with a locking plate system, and secondary screw perforation was noted as the second most common complication at 23 % of all complications. Our findings are consistent with the literature as 60 % of complications in the LP group were intraarticular screw perforation. Varus malreduction was found in both types of fixation. Agudelo et al.[15] found that among 73 patients treated with a locking plate, 30.4 % patients with a neck-shaft angle less than 120° developed loss of fixation as compared to 11 % patients with a postoperative neck-shaft angle greater than 120°.[15] It suggests that varus malreduction is a risk factor for loss of fixation; therefore we considered it in our study. Popescu et al.[7] found a mean neck-shaft angle of 123° in IMN treated patients while Agudelo et al.[15] found a mean angle of 130° in the same. Acceptable calcar reduction was found to be inherent in obtaining an acceptable neck-shaft angle in our study. Comminution is more likely to result in varus collapse, but it was not observed in our cohort of patients because they did not have much calcar comminution. Our study shows that both IMN and LP fixation methods yielded no significant difference in postoperative neck shaft angle with 120.5º and 135.6º in the IMN and LP group, respectively (p=0.126). Both groups resulted in neck-shaft angles that were greater than 120° which proved that varus malreduction can be avoided and is not attributed to the type of implant used. In our study the mean time taken for IMN and LP surgery were 76 minutes and 115 minutes respectively which was found statistically significant (p=0.00001); and found similar to study by Smejkal et al where operative times were 72 min and 117 min for IMN and ORIF groups respectively. Shortcoming of our paper was the relatively small number of patients in each group also a multivariate regression analysis to analyze other factors that may predispose patients to malreduction were not assessed. Multiple factors are considered when deciding on a method of fixation for proximal humerus fractures. Our study is limited by sample size, but results suggest a trend toward greater complication rates with IMN fixation, although this difference is not statistically significant, evidence from multiple studies indicates that IMN treatment results in greater complication rates when compared to ORIF with locking plate system in the treatment of displaced two part proximal humerus fractures. Most common complication found in locking plate group was primary screw perforation, resulting from incorrect surgical technique, poor bone quality and fracture compression.[6,13]

V. Conclusion

Both IM nailing and locking plate fixation are effective method of treatment in a displaced two-part proximal humerus fracture that requires operative stabilization. Skill and comfort of the surgeon play a significant role in the decision to use one of the methods. Restricted shoulder range of motion as suggested by decreased forward elevation following IM nailing may be related to violation of the rotator cuff musculature which can be avoided. Ideal reduction and fixation is preferred for better functional and radiological outcomes. Also in high risk patients IMN can be preferred as time taken in surgery is less and also blood loss is minimal. Future investigation with a large number of patients, randomized study is needed to assess multiple factors affecting union and complications in fixing displaced two part proximal humerus fractures.

References

[1]. Horak J, Nilsson BE. Epidemiology of fracture of the upper end of the humerus. Clin Orthop Relat Res. 1975;112:250–3.
[2]. Südkamp N, Bayer J, Hepp P, Voigt C, Oestern H, Kääb M, et al. Open reduction and internal fixation of proximal humeral fractures with use of the locking proximal humerus plate. Results of a prospective, multicenter, observational study. J Bone Joint SurgAm. 2009;91(6):1320–8.
[3]. Zyto K. Non-operative treatment of comminuted fractures of theproximal humerus in elderly patients. Injury. 1998;29(5):349–52.HSSJ (2012) 8:86–91 91
[4]. Handoll H, Brealey S, Rangan A, Torgerson D, Dennis L, ArmstrongA, et al. Protocol for the ProFHER (Proximal Fracture of the Humerus: Evaluation by Randomisation) trial: a pragmatic multicentre randomised controlled trial of surgical versus non-surgical treatment for proximal fracture of the humerus in adults. BMC Musculoskeletal Disorder. 2009;10:140.
[5]. Osman N, Touam C, Masmejean E, Asfazadourian H, AlnotJY. Results of non-operative and operative treatment of humeral shaft fractures. A series of 104 cases. Chir Main.1998;17(3):195–206.
[6]. Neer CS. Displaced proximal humeral fractures. I. Classification and evaluation. J Bone Joint Surg Am. 1970;52(6):1077–89.
[7]. Popescu D, Fernandez-Valencia JA, Rios M, Cuñé J, Domingo A,Prat S. Internal fixation of proximal humerus fractures using theT2-proximal humeral nail. Arch Orthop Trauma Surg. 2009;129(9):1239–44.
[8]. Egol KA, Ong CC, Walsh M, Jazrawi LM, Tejwani NC, ZuckermanJD. Early complications in proximal humerus fractures (OTA Types11) treated with locked plates. J Orthop Trauma. 2008;22(3):159–64.
[9]. Putti AB, Uppin RB, Putti BB. Locked intramedullary nailing versus dynamic compression plating for humeral shaft fractures. J Orthop Surg (Hong Kong). 2009;17(2):139–41.
[10]. Esser RD. Treatment of three- and four-part fractures of the proximal humerus with a modified cloverleaf plate. J Orthop Trauma.1994;8(1):15–22.
[11]. Trepat AD, Popescu D, Fernández-Valencia JA, Cuñé J, Rios M,Prat S. Comparative study between locking plates versus proximal humeral nail for the treatment of 2-part proximal humeral fractures.Eur J Orthop Surg Traumatol. 2012.
[12]. Konrad G, Audigé L, Lambert S, Hertel R, Südkamp NP.Similar outcomes for nail versus plate fixation of three-part proximal humeral fractures. Clin Orthop Relat Res. 2012;470(2):602–9.

[13]. Tanner MW, Cofield RH. Prosthetic arthroplasty for fractures and fracture-dislocations of the proximal humerus. Clin Orthop Relat Res. 1983;179:116–28.
[14]. Brunner F, Sommer C, Bahrs C, Heuwinkel R, Hafner C, RillmannP, et al. Open reduction and internal fixation of proximal humerus fractures using a proximal humeral locked plate: a prospective multicenter analysis. J Orthop Trauma. 2009; 23(3):163–72.
[15]. Agudelo J, Schürmann M, Stahel P, Helwig P, Morgan SJ, ZechelW, et al. Analysis of efficacy and failure in proximal humerus fractures treated with locking plates. J Orthop Trauma. 2007;21(10):676–81.
[16]. http://www.nebulasurgical.com/products.php?cid=13&subid=33.
[17]. Hawkins RJ, Bell RH, Gurr K. The three-part fracture of the proximal part of the humerus. Operative treatment. J Bone JointSurg Am. 1986;68(9):1410–4.
[18]. Savoie FH, Geissler WB, Vander Griend RA. Open reduction and internal fixation of three-part fractures of the proximal humerus. Orthopedics. 1989;12(1):65–70.
[19]. Werner BC, Chang B, Nguyen JT, Dines DM, Gulotta LV. What Change in American Shoulder and Elbow Surgeons Score Represents a Clinically Important Change After Shoulder Arthroplasty?. Clin Orthop Relat Res. 2016 Dec;474(12):2672-2681. Epub 2016 Jul 8.