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Comparison of plate and nail fixation for acute humeral shaft fracture of our experience

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ABSTRACT

Introduction: Plating fixation for treatment of humeral shaft fracture is a gold standard method in old days. Due to the progression of surgical technique and implant material, nailing fixation for humeral shaft fracture seems to also be a reasonable choice. However, different outcomes are reported. Hence, we make a retrospective study of our cases to compare and analyze plating and nailing system for humeral shaft fracture. **Materials and Methods:** From January 2007 to February 2012, all patients who are diagnosed humeral shaft fracture classified with Orthopedic Trauma Association classification, treated with nailing or plating fixation, and complete the follow-up are collected. A total of 53 patients treated with plating and 22 treated with nailing are included. Union rate and complications are recorded. Causing and consequent management for complications are also recorded and analyzed. **Results:** All the patients were observed within an average of 21.7 months. Union rate of plating system in our study is 94.3% (50/53), as mentioned in established data. However, the union rate of nailing system is only 72.7% (16/22) and that is lower than we used to get from established data. Revision is applied for all three non-union patients in the plating group and three in the nail group. Open reduction internal fixation with plating and autogenous bone graft are applied for patients receiving revision, and all of them got union. Complications are as well as established data mentioned, radial nerve palsy or paresis is the main problems for plating system (6/53). Although radial nerve palsy is much less frequent happened in the nailing group, but fracture site distraction, and shoulder pain that rarely happened in the plating system take a large proportion in the nailing system. **Conclusion:** Plating system for humeral shaft fracture remains the most secure method as high union rate and well-known complications. Nailing systems, though gets a higher proportion to use, there are still some problems needed to be solved, especially lower union rate and operative site complications.

KEY WORDS: Humeral shaft fracture, interlocking nail fixation, plate fixation

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INTRODUCTION

Humeral shaft fractures, which represent between 3% and 5% of all fractures. Conservative treatment stands for promising healing rate due to enveloped in muscle and soft tissue, but minor degrees of shortening and a wide range of radiographic malunion are still noticed. Hence, surgical intervention is then widely applied for ensuring alignment keeping and lowing the malunion or non-union rate.

Open reduction and internal fixation with a plate were gold standard in old days. Though high rate of union (about 95%) mentioned in established data, a proportion of post-operative complications as the radial nerve related injuries or infection are well known. As to other long bone fracture like femoral or tibial shaft fracture, open reduction and internal fixation with interlocking nail seems to be another good choice.

However, the outcome of fixing with the nailing system in the aspect of humeral shaft fracture seems not as well as lower limbs fracture do both in union rate and operative co-morbidity [1,2]. According to published data, the better method for humeral shaft fracture fixed with plating or nailing system is still controversial [3,4] and even some series reveal plating is somehow more superior than nailing [5,6].

Hence, this study discusses the results of patients with humeral shaft fracture treated with either locking nailing or plate in our hospital.

MATERIALS AND METHODS

This study collect 75 (38 male [51%] and 37 female [49%]) patients from our hospital diagnosed as acute humeral shaft fracture since January 2007-February 2012. Humeral shaft is defined as an area distal to the surgical neck of the proximal

humerus and proximal to the supracondylar ridge distally. Causing of fracture is traffic accident 43 (57.3%) and a falling 32 (42.7%). Fracture pattern is classified according to AO classification and there are 48 Type A (64%), 26 Type B (35%), 1 Type C (1%) [Table 1]. Before the collection, patients who do not suit our criteria are already excluded, including: (1) Patients not primarily operated in our facility, (2) chronic fracture (fracture episode happened longer than 2 weeks), (3) patients not able to be followed at least 15 months.

The 53 (23 male and 30 female) patients received plating system are all set at decubitus position. Posterior approach with triceps sparing is uniformly performed. During the surgery, radial nerve is identified in all cases and well protected. AO 4.5 mm dynamic compression plate (DCP) is applied for fixation and placed beneath the radial nerve.

The 22 (16 male and 6 female) patients received nailing system are set either at beach-chair position and supine according to physician's choice. All nails are inserted with an antegrade technique, and the nail tips are all seated beneath the articular surface of the humeral head.

Postoperative Treatment

All patients receiving the surgery were protected with sling. Gentle elbow and passive involved shoulder motion are allowed immediately, but resistance and rotational motion are allowed after callus formation observed under the radiography. After discharge, regular follow-up is arranged at the 1, 2, 4, 8, 12th week and then monthly, and radiography is arranged at the 4, 8, 12th week and then every 3 months. Healing is defined as both clinically free from pain or movement at the fracture site, and radiographically callus formation observed. During the follow-up, union time and complications are all recorded for both groups.

RESULTS [TABLE 2]

The average time of follow-up for all patients are 21.7 months (ranging from 14 to 36 months). The average union time at the plating group is 3.6 months (2.5-6 months), and the nailing group is about 3.2 months (2.5-5 months). Union rate [Chart 1] of the plating group is 94.3% (50/53), and the nailing group is 72.7% (16/22). Implant removal will be arranged both clinically and radiographicaly stable. The mean implant removal time at the plating group and the nailing group are 13.7 and 15.1 months.

Radiographic non-union is defined as no radiographic evidence of callus formation for 6 months of series follow-up. If both clinical (mostly presented with pain at the fracture site) and radiographic symptoms influence the patient's daily function. Revision will be arranged. Revision is uniformly performed as the following step as, (1) Remove the previous implants, (2) expose the non-union site with posterior approach, (3) debridement, decortications and re-canalization applied, (4) fracture site is filled with autogenous bone graft and fixed with 4.5 mm DCP [7-9]. There are three cases of non-union receiving revision in both groups, and all patients in both groups heal [Figures 1 and 2].

Complications [Chart 2] are also recorded with plating group 10/53 (18.9%), and nailing group 10/22 (45.5%). To analyze the causing of complications in the plating group, three cases are non-union (5.7%). Six cases are radial nerve injury (11.3%), including four nerve paresis and two nerve palsy. Two cases are deep infection (3.8%), and one of them even causing non-union. The causing of complications in the nailing group, six cases are non-union (27.3%). Five cases are shoulder pain (22.7%), and one radial nerve paresis (4.5%).

DISCUSSION

For humeral shaft fracture, although good healing might be achieved with conservative treatment, surgical treatment is able to obtain better functional result. Nowadays, plating system and

Table 1: Type of fractures according to AO classification

Type of fracture	Patient number
A	48
A1	28
A2	11
A3	9
B	26
B1	12
B2	8
B3	6
C	1
C1	1
C2	0
C3	0

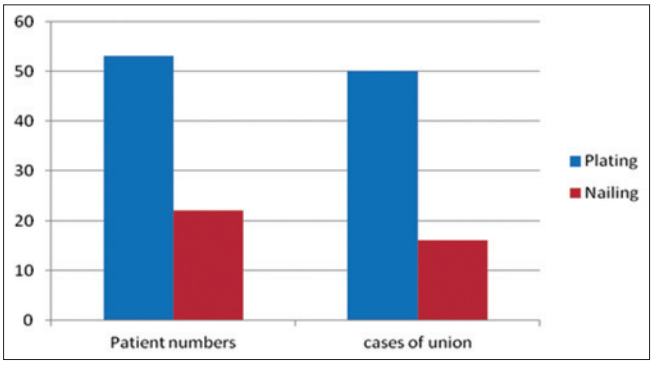

Chart 1: The P value between the two groups: 0.009

Table 2: Result of each group

	ORIF with DCP	ORIF with nail
Number of patients	53	22
Gender (M:F)	23:30	15:7
Type of fixation (A:B:C)	34:18:1	14:8:0
Union rate (P=0.009)	50/53 (94.3%)	16/22 (72.7%)
Average union time	3.6 months (2.5-6 months)	3.2 months (2.5-5 months)
Complication rate (P=0.018)	10/53 (18.9%)	10/22 (45.4%)
Revision rate	3/53 (9.4%)	3/22 (13.6%)
Revision union rate	3 (100%)	3 (100%)

ORIF: Open reduction internal fixation, DCP: Dynamic compression plate

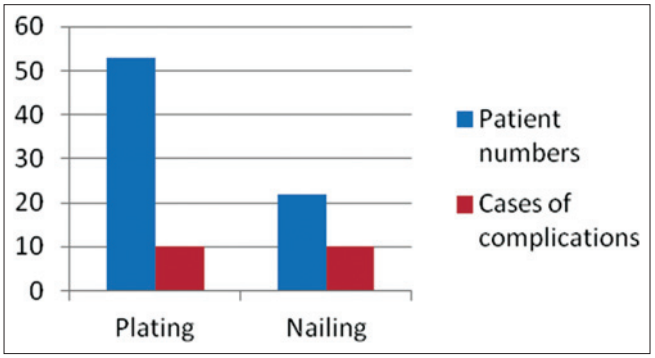

Chart 2: The P value between the two groups: 0.018

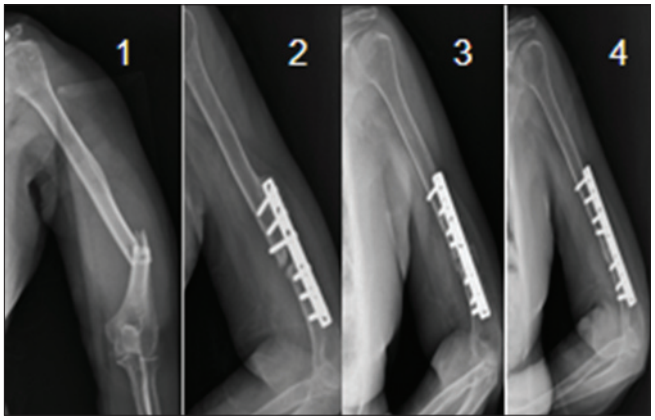

Figure 1: A 45-year-old female with, (1) Humeral D/3 shaft transverse fracture, (2) post plate fixation with non-union after 14 months follow-up, (3) revision applied with autogenous bone graft augmentation, (4) union achieved after 6 months

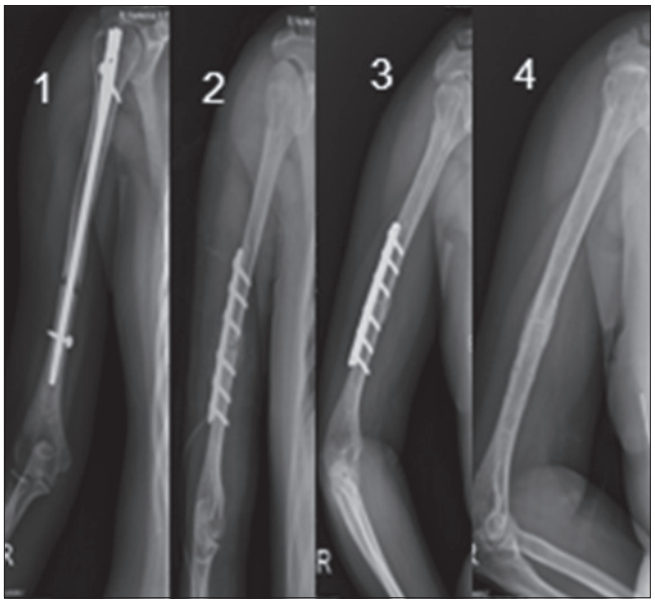

Figure 2: A 38-year-old female, (1) Post nail fixation with non-union after 12 months follow-up, (2) revision applied with autogenous bone graft augmentation, (3) union achieved after 8 months, (4) implants were removed with good clinical and radiographic outcome

nailing system are widely used for surgical intervention and good outcome is reported with both methods [10]. However, there are still some data show nailing for humeral shaft fracture is not as promising as for lower limbs are. In this study, nailing system seems to show lower union rate and higher complication rate, and the outcome corresponds to the Farrago's data [11]. Besides the above two methods, we also tried to fix the humeral shaft fracture with K-wire with cross pattern percutaneously. Poor outcome was then noticed, and 4 of 5 patients got non-union. Due to high non-union rate, we abandoned the method and decided not to compare this method with the other two methods.

To analyze the causing of non-union cases in the nailing system, 4 of 6 cases with fracture site gap after nailing fixation are noticed and thought to be the reason for non-union. We believe the gap is mainly caused by the distraction. There are some possible reasons for the fracture site gap formation, (1) Inadequate nail length distracting the fracture site due to the impaction at the distal humeral canal that getting more narrow due to anatomic architecture, (2) not getting adequate compressive force postoperatively as lower limbs do. For resolving the above problems, an elbow support is applied against the distraction during the procedure, and the non-union rate got improved, (3) cases with fracture site gap are happen between 2007 and 2009, but it decreases to one case between 2009 and 2012 after this step is applied. Another two cases of non-union are due to inappropriate apposition with close reduction. Three of the six non-union cases receive revisional surgery due to clinical symptoms developed, and all cases heal after revision. The other three cases of non-union show no clinical signs and refuse to receive revisional procedure.

Besides lower union rate, higher complication rate of nailing system compared to plating system is also noted (45.5% vs. 18.9%). Different from well-known complications as radial nerve palsy or infection in the plating system, shoulder pain are the main problems [12] (5/22, 22.7%). According to previous data, implants protruding might be the cause of shoulder pain and can be resolved after removal. However, all implants were seated beneath the articular surface during the surgery, but there are still five cases develop shoulder pain. Inflammation and edema caused by cutting the rotator cuff apart for inserting the implants might be another explanation for shoulder pain. The shoulder pain cases in this study can be well controlled with medication use, and all cases got much improved before implant removal. Well repairing the rotator cuff might also be helpful for reducing the shoulder pain.

Although all nailing surgery is applied with close reduction, still one case develops radial nerve paresis. We think somehow over traction might be the cause for it. The paresis only took a few days to recover to normal function.

Plating system thought seems to be better in the aspect of union [13], there are still some disadvantages compared to nailing system [14]. Radial nerve injury rate is supposed to be higher due to more manipulation and traction will be applied during the whole procedure. In this study, six cases with radial nerve injury were met, and four cases are radial nerve palsy with a period of function impairment. One case even needs revisional surgery for neurolysis due to long term radial dysfunction.

Besides radial nerve injury, higher rate of deep infection is noticed with plating fixation group (3.8% vs. 0%). This might be caused by larger wound, poor skin condition (etc.: Burn or abrasion over incision), and patients with extreme obesity.

CONCLUSION

Plating and nailing fixation for humeral shaft fracture is both thought to be ideal methods. Some studies including ours have opposite opinions. Our data shows some disadvantages with nailing fixation as lower union rate and higher complication rates. However, there are still some situations that nailing fixation is favored like poor skin condition, impaired immune status or severe osteoporosis.

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