

Conservative treatment of proximal humeral fractures by maintaining neutral rotation in elderly patients

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Abstract

Objectives: Proximal humeral fractures are common fractures in elderly patients. In some cases, operative treatment is difficult in elderly patients because of severe osteoporosis. An external rotation shoulder brace can maintain the arm in neutral rotation for conservative treatment, which has prompted its use for treatment of proximal humeral fractures in patients aged ≥ 65 years. We sought to confirm the efficacy of the neutral rotation position.

Methods: Eleven patients with a proximal humeral fracture were clinically and radiographically reviewed. Their mean age was 75 years, and the fracture type was classified according to the Neer group classification system. The duration of brace use prior to achieving bone union and the observation period were analyzed. The shoulder range of motion (ROM) was examined during the final follow-up.

Results: Displacement was not observed during the course of treatment. The patients stopped using the brace at 40 days, bone union was confirmed at 46 days, and the mean follow up period was 4 months. The mean active shoulder ROM for elevation, abduction, external rotation, and internal rotation was 148° , 146° , 50° , and L3, respectively.

Conclusion: We obtained good results during treatment of proximal humeral fractures by maintaining neutral rotation of the arm in elderly patients. Neutral rotation of the arm facilitated by use of an external rotation shoulder brace is an appropriate treatment for proximal humeral fractures in the elderly.

Keywords: Proximal humeral fractures, Conservative treatment, Arm in external rotation

Introduction

Proximal humeral fractures are common fractures in the elderly. Nevertheless, the most suitable treatment for each patient should be selected based upon the fracture type and the degree of osteoporosis. Operative treatments have developed such that the optimal therapy can be selected based upon the needs of each patient. This has resulted in improvements in surgical results. Nevertheless, the treatment of proximal humeral fractures in elderly patients, particularly women, remains controversial owing to the presence of osteoporosis. Fu et al. documented no significant differences in functional outcomes between operative and conservative treatment methods; rather, surgical treatment of displaced proximal humeral fractures in elderly patients led to a higher incidence of post operative complications.¹ Based on these results, elderly patients are thought to require more conservative treatment.

Two conservative treatment options are available for proximal humeral fractures: early active motion exercise, as described by Ishiguro,² and shoulder joint immobilization. During shoulder immobilization, the arm is often internally rotated and adducted. A sling and bust band are often used for this purpose;

nevertheless, fracture fragments are sometimes displaced when the arm is maintained this position. Several reports have described complications associated with maintenance of the arm in internal rotation.^{3,4} Conversely, Boileau et al.⁵ reported good results with maintenance of the arm in the neutral position. From these results we speculated that an alternative immobilization position could be used and that anatomically neutral rotation of the arm is a better position for avoiding displacement. Moreover, an external rotation shoulder brace (Shoulder Brace ER; Alcare, Tokyo, Japan[®]) can maintain the arm in such a neutrally rotated position. We evaluated the results of conservative treatment involving use of the Shoulder Brace ER to maintain the arm in neutral rotation.

Methods

Thirteen elderly individuals ≥ 65 years who had sustained proximal humeral fractures from 2015 to 2017 and who were able to use a Shoulder Brace ER (Figure 1) within 1 week after injury were clinically and radiographically reviewed. Among these patients, one with primary osteoarthritis and one who could not undergo follow-up were excluded. Of the 11 remaining patients who were examined, 3 were male and, 8 were female, and their mean age was 75 years (range, 65–86 years). The fracture types were classified using the Neer classification system⁶ (Figure 2).

A Shoulder Brace ER was placed on each patient to maintain neutral rotation of their injured arm. The Shoulder Brace ER was removed when a callus was observed by radiography along the medial portion of the fracture line. We determined that bone union had occurred when the fracture line was not detectable by

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Figure 1 Shoulder Brace ER. The patient can maintain the arm in a neutral position using this brace.

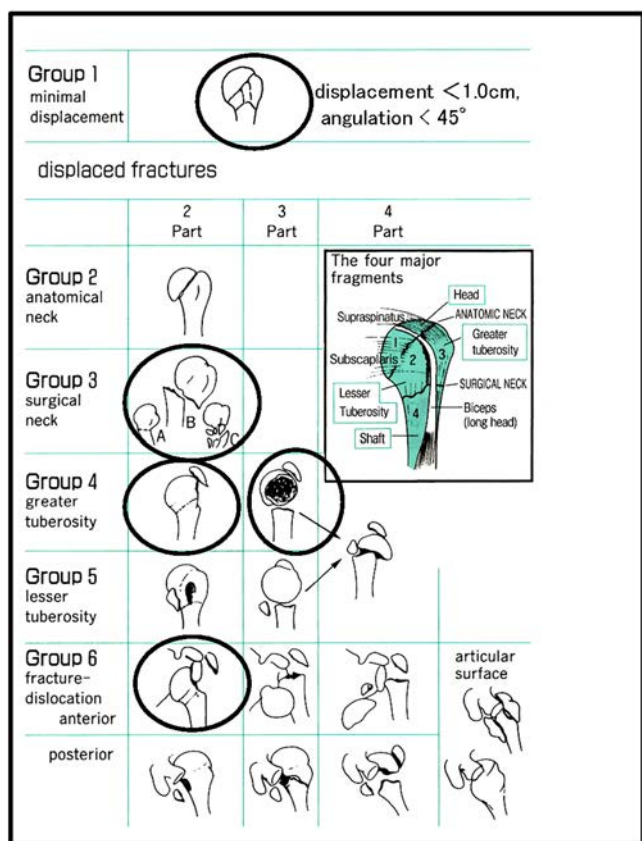


Figure 2 Neer classification system.⁶ The fracture types indicated by a circle were included in this study.

radiography. After the brace was removed, we initiated physiotherapy. Follow-up observation was finished when patients obtained maximum shoulder ROM over 90 degrees as flexion. We examined the radiograph findings to determine the extent of fracture fragment displacement. The duration of brace use prior to achieving bone union and the observation period were analyzed. Shoulder ROM was analyzed during the final follow-up.

Results

Two patients had Neer Group I fractures (minimal displacement), three patients had two-part Group III fractures (surgical neck fractures), one patient had a two-part Group IV fracture (greater tubercle fracture), two patients had two-part Group VI fractures (greater tubercle fractures with dislocation), and three patients had three-part Group IV fractures (surgical neck and greater tubercle fractures).

No patients exhibited displacement of fracture fragments during treatment. All patients achieved complete bone union. The mean duration of brace use was 3.9 weeks (range, 3–6 weeks), the mean duration until bone union was 5.9 weeks (range, 5–8 weeks), and the mean duration of follow-up was 3.8 months (range, 3–7 months). The mean active shoulder ROM for elevation, abduction, external rotation, and internal rotation was 148° (range, 100°–170°), 146° (range, 100°–170°), 50° (range, 30°–60°), and L3 (range, buttock–L1), respectively.

Representative Cases

Case 1

Case 1 involved an 82-year-old woman with a Neer Group I fracture (minimal displacement). A fracture line was observed at the surgical neck and greater tubercle. The Shoulder Brace ER was used for 3 weeks. Bone union was observed at 6 weeks after bracing. At 4 months after injury, follow-up was completed and her shoulder ROM was 150°, 150°, 60°, and L1 for elevation, abduction, external rotation, and internal rotation, respectively (Figure 3).

Case 2

Case 2 involved a 67-year-old man with a Neer three-part Group IV fracture (surgical neck and greater tubercle fracture). After bracing, all fracture fragments that had been displaced returned to their appropriate anatomical position. The Shoulder Brace ER was used for 3 weeks. Bone union was observed at 6 weeks after bracing (Figure 4). At 4 months after injury, follow-up was completed and his shoulder ROM was 150°, 150°, 60°, and L1 for elevation, abduction, external rotation, and internal rotation, respectively.

Case 3

Case 3 involved a 79-year-old woman with a Neer two-part Group VI fracture (greater tubercle fracture with anterior dislocation). After manual reduction, the humeral head was reduced with the fragment of the greater tubercle. The Shoulder Brace ER was used for 4 weeks. Bone union was observed at 6 weeks after bracing. At 2 months after injury, bone union was complete and no deformity was observed; thus, follow-up was completed (Figure 5). Her shoulder ROM was 150°, 150°, 60°, and buttock for elevation, abduction, external rotation, and internal rotation, respectively (Figure 6).

Discussion

Several studies have been performed to evaluate conservative treatment of proximal humeral fractures. While early motion exercise promises good results,² elderly patients with cognitive disorders have difficulty in understanding and performing this method.

Internal rotation of the arm is the most common position used

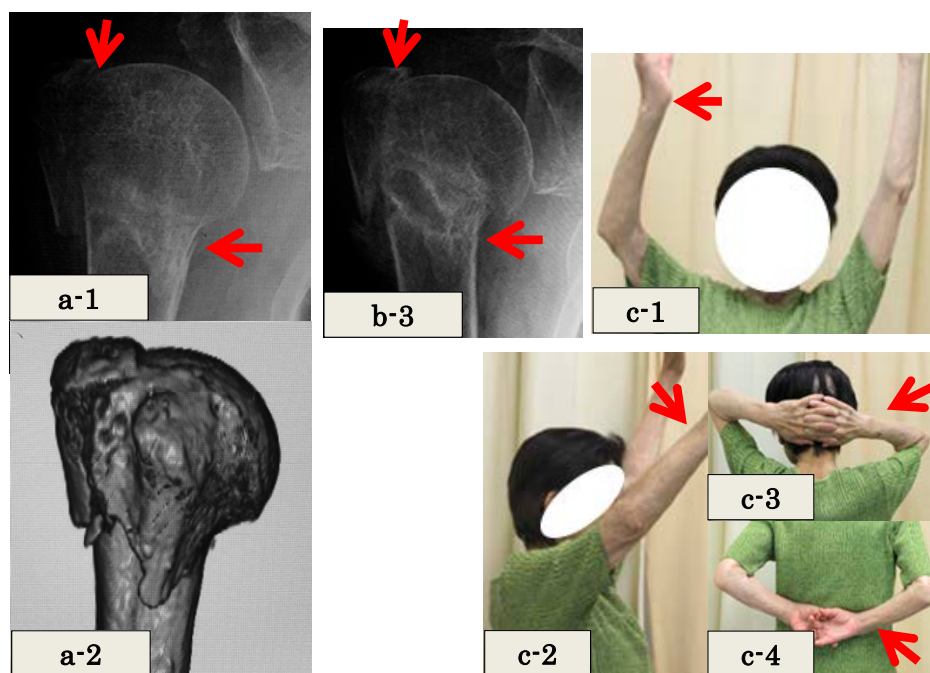


Figure 3 Case 1, 82-year-old woman, Neer Group I fracture.

(a-1) X-ray findings. (a-2) Three-dimensional computed tomography at the time of injury. Fracture lines are visible at the greater tuberosity and surgical neck; the arrow indicates the fracture line. (b) X-ray findings at 4 months after injury. The arrow indicates the fracture line. (c) Shoulder range of motion at 4 months after injury. The arrows indicate the injury side.

1: Elevation, 150°. 2: Abduction, 150°. 3: External rotation, 60°. 4: Internal rotation, L1.

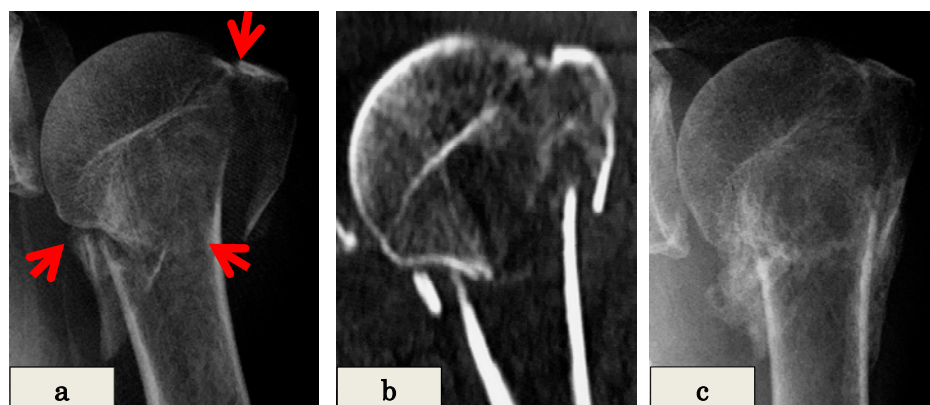


Figure 4 Case 2, 67-year-old man, Neer three-part Group IV fracture.

(a) X-ray examination and (b) coronal computed tomography scan of the surgical neck and greater tubercle fracture. (c) The fragments were anatomically reduced and bone union was achieved 4 months after injury. Arrows indicate the fracture lines.

for immobilization in patients with proximal humeral fractures.^{3,4,7-10} Young et al.⁷ examined 72 patients who underwent conservative treatment and concluded that most patients with non-displaced or two-part displaced humeral neck fractures were elderly and able to obtain a satisfactory outcome using physiotherapy alone. However, several complications associated with arm immobilization in an internally rotated position have been described. Momoi et al.⁸ analyzed 139 patients with proximal humeral fractures and concluded that a risk of displacement was associated with varus deformity at the fracture line and that this deformity occurred during immobilization of the arm in an internally rotated position (Figure 7). These researchers observed that displacements occurring along the proximal side of the fracture did not move, whereas those

occurring along the distal side were pulled internally and adducted. Shimizu et al.⁴ found that the greater tubercle fragment was easy to displace during treatment and that even when the greater tubercle fragment was not displaced, the patient frequently reported shoulder joint pain. Boileau et al.⁵ described the treatment of proximal humeral fractures and highlighted the importance of immobilization in a neutral position. They reported that internal rotation might not only lead to loss of external rotation but that potentially uncorrected rotator malunion could disturb the path of the bicipital groove, thereby resulting in accelerated biceps tenosynovitis. Kudo et al.¹¹ analyzed 31 proximal humeral fractures and identified predictive factors of malunion, including an age of >60 years and a fracture with dislocation. The authors found that displaced fragments most

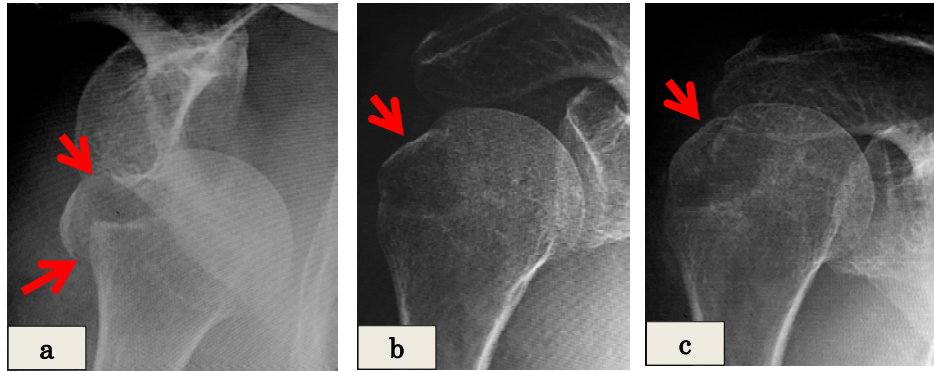


Figure 5 Case 3, 79-year-old woman, Neer two-part Group VI fracture. (a) X-ray examination at the time of injury showed a greater tuberosity fracture with anterior dislocation. (b) X-ray examination after manual reduction. The humeral head was reduced with the fragment of the greater tuberosity. (c) After 2 months, the humeral head position was good and bone union was achieved. Arrows indicate the fracture line.

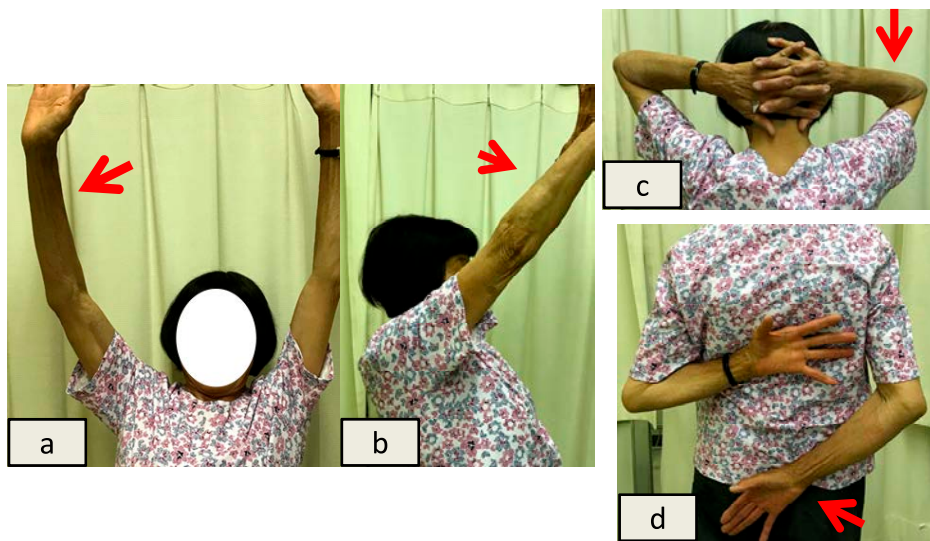


Figure 6 Shoulder range of motion in Case 3. (a) Elevation, 150°. (b) Abduction, 150°. (c) External rotation, 60°. (d) Inner rotation, buttock. Arrow indicates the side of injury.

frequently occurred at 2 weeks after injury. In addition, they stated that extreme caution is required during this early period after injury. In summary, immobilization of the arm in an internally rotated position is associated with several risks and can lead to adduction and internal displacement of the distal humerus following humeral neck fractures. Furthermore, in greater tubercle fractures, the humeral head rotates internally whereas the greater tubercle fragment is pulled postero-superiorly by the rotator cuff (Figure 7).

None of our patients had displaced fracture fragments. Moreover, bone union and good shoulder ROM were achieved in all cases. Good results were even obtained in the patient in Case 3, who exhibited factors indicative of a high risk of displacement (i.e., greater tubercle fracture with dislocation, osteoporosis, female sex, and an age of 75 years).

Immobilization of the arm in an internally rotated position using a sling is the traditional approach to treating upper extremity injuries. However, this position often results in shoulder joint contracture. To treat proximal humeral fractures, we used a conventional sling and bust band because these materials were easy to prepare at the time of injury. In this

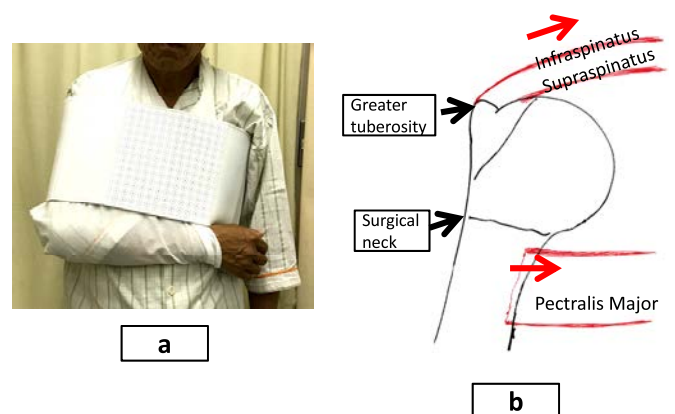


Figure 7 (a) Immobilization of the arm in internal rotation using a sling and bust band. (b) Schema of fragment displacement. The greater tuberosity fragment was pulled posterosuperiorly by the supraspinatus and infraspinatus muscles. The humeral shaft was displaced via internal rotation by the pectoral major muscle. Arrow indicates the direction of pull of each muscle.

Table 1 Results of all cases

case	sex	age	Neer type	brace	bone union	Follow up	elev.	abd.	ER	IR
1	F	82	group 1	3W	6W	4M	150	150	60	L1
2	F	74	group 1	4W	6W	4M	140	140	50	L3
3	F	70	group 3, 2 part	4W	6W	3M	150	150	60	buttock
4	F	86	group 3, 2 part	4W	6W	3M	140	130	40	L5
5	F	85	group 3, 2 part	4W	6W	3M	110	90	40	L1
6	F	83	group 4, 2 part	5W	8W	7M	100	100	30	buttock
7	F	68	group 4, 3 part	5W	5W	3M	140	130	50	L3
8	M	67	group 4, 3 part	3W	5W	4M	150	150	60	L1
9	M	65	group 4, 3 part	4W	6W	3M	170	170	60	L1
10	F	79	group 6, 2part	4W	6W	3M	150	150	40	L5
11	M	69	group 6, 2part	3W	6W	3M	160	160	50	L3

W, week; M, month

position, however, the distal humerus can be pulled internally and adducted. As a result, the fracture fragment can be displaced, necessitating operative treatment after internally rotated immobilization in some patients. Thus, in 2003, Itoi et al.¹² developed the Shoulder Brace ER for the conservative treatment of shoulder dislocation. Boileau et al.⁵ reported that a neutral position is suitable for conservative treatment of proximal humeral fractures. Patients can maintain a neutral position with this brace; therefore, we consider that this brace allows for effective conservative treatment of proximal humeral fractures.

Our results indicate that immobilization of the arm in a neutral position using the Shoulder Brace ER is an appropriate conservative treatment of proximal humeral fractures because it allows patients to obtain good functional results in their shoulders.

Conflicts of Interest

No benefits in any form have been received or will be received from any commercial party related directly or indirectly to the subject of this article. No funds were received in support of this study.

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