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SYMPOSIUM: FRACTURES OF THE SHOULDER GIRDLE

Proximal Humerus Fractures in the Elderly Can Be Reliably Fixed With a "Hybrid" Locked-plating Technique

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Abstract

Background Controversy exists regarding the best treatment of proximal humerus fractures in the elderly. Recent studies of open reduction and internal fixation have demonstrated high complication rates.

Questions/purposes We asked whether (1) open reduction and internal fixation could be performed with low rates of immediate and delayed complications, (2) reduction of these fractures could be maintained over time by evaluating long-term radiographs and visual analog pain scores, and (3) 6-week immobilization would lead to disabling stiffness by evaluating postoperative motion and functional scores.

Patients and Methods We retrospectively reviewed all 35 patients older than 75 years with displaced proximal humerus fractures treated using a "hybrid" technique between 2002 and 2008. All patients were immobilized for 6 weeks after surgery. Thirteen of the 35 patients either died or developed severe dementia during followup. The analysis included 22 patients followed a minimum of 1 year (mean, 3 years; range, 1–6.7 years).

Results There were no early or late reoperations in this series. An acceptable reduction was achieved in 89% of the shoulders and maintained over time. All fractures healed. Osteonecrosis was noted on radiographs in 11% of the shoulders. Six weeks of immobilization did not lead to disabling stiffness. At most recent followup, mean active elevation was 141°, mean active internal rotation L1, mean active external rotation 36°, and mean American Society of Shoulder and Elbow Surgeons score 68.

Conclusions Utilizing this approach, open reduction and internal fixation followed by 6-week immobilization results in a low rate of reoperation and good functional outcomes for elderly patients with proximal humerus fractures.

Level of Evidence Level IV, therapeutic study. See Guidelines for Authors for a complete description of levels of evidence.

Introduction

There is ongoing controversy about the optimal treatment for displaced proximal humerus fractures in the elderly [7]. Advocates of nonoperative treatment or hemiarthroplasty argue open reduction is difficult to attain and fixation is unreliable. In the elderly population, this is especially true, secondary to fracture comminution and osteopenia. Recent reports seem to support these concerns, with a substantial rate of delayed reoperations secondary to intra-articular screw penetration, osteonecrosis (ON), and hardware failures [6, 16, 17]. Technical errors have been implicated in most failures. Similarly, treatment with hemiarthroplasty has been associated with limited postoperative ROM and complications related to tuberosity fixation [1, 3, 11]. Nonoperative treatment has been functionally well tolerated in less severe proximal humerus fractures [8], but

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Each author certifies that his or her institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

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nonoperative treatment has resulted in low functional scores in more complex fractures [20]. Therefore, improved treatment strategies of these difficult fractures continue to evolve.

We propose an approach to open reduction and internal fixation (ORIF) of proximal humerus fractures in the elderly (older than 75 years). This combines several techniques in a "hybrid" approach, with locked plating and rotator cuff traction sutures.

We asked whether (1) ORIF could be performed with low rates of immediate and delayed complications, (2) reduction of these fractures could be maintained over time by evaluating long-term radiographs and visual analog pain scores, and (3) 6 weeks of immobilization would lead to disabling stiffness by evaluating postoperative motion and functional scores.

Patients and Methods

Following departmental and institutional review board approval, we retrospectively reviewed all 35 patients older than 75 years with displaced proximal humerus fractures using a "hybrid" technique between 2002 and 2008. There were 30 females and five males. The average age of the patients was 81 years (range, 75–95 years). No patients had a history of shoulder surgeries, and no patients had pre-existing arthritis. There were seven OTA A fractures, 20 OTA B fractures, and eight OTA C fractures. Twenty-one of these fractures were two-part fractures and 14 were three-part fractures according to the Neer classification [13]. Of the 35 patients, five patients died within the first postoperative year; between the first postoperative year and the survey period, five additional patients died. Three patients were unable to complete the survey secondary to dementia. This left 22 patients for analysis. Of these 22 patients, three had OTA A fractures [14], 13 OTA B, and six OTA C. OTA A fractures are extra-articular fractures in one location (tuberosity, impacted metaphysis, etc). OTA B fractures are extra-articular with bifocal involvement. OTA C fractures are intra-articular [14]. Eleven were two-part fractures and nine were three-part fractures according to the Neer classification [13]. Two fractures did not fit classic Neer subtypes and were classified as valgus impacted fractures as described by Jacob et al. [9]. The fracture was in the left arm in 10 patients and the right arm in 12 patients. All patients were retired. Eleven patients characterized their preoperative activity as light, while five stated they were sedentary and six stated they engaged in moderate physical activity. The minimum followup was 1 year (mean, 3 years; range, 1.0–6.7 years). No patients were recalled specifically for this study; all data were obtained from medical records and radiographs.

All surgery was performed by the senior author (MT). A systematic approach was utilized in reducing and maintaining reduction of all fractures in this series [18]. This began with a thorough review of preoperative imaging. Preoperative CT scans were obtained in most cases to understand the fracture morphology. In addition, contralateral shoulder radiographs were obtained to aid in assessing the reduction obtained intraoperatively. Before preparing and draping the patient, the ability to obtain high-quality fluoroscopic images was ensured, including an AP in the plane of the scapula with the arm held in external rotation to profile the greater tuberosity and a Velpeau axillary with the arm held in internal rotation to profile the lesser tuberosity.

A deltopectoral approach was utilized in all cases. A large bone reduction clamp was used to manipulate the humeral shaft. Rotator cuff traction sutures were placed to allow direct control over the tuberosities and indirect control of the head through the tuberosities when not fractured. In cases where the humeral head is detached from the tuberosities, a pin may be inserted and utilized as a joystick for control of the head segment; this was seldom required in the fractures included in this particular report. The fracture was then gently reduced. In surgical neck fractures, a small malleable retractor was used as a shoehorn to aid in reduction of the shaft under the head. In valgus impacted fractures, the humeral head was gently elevated, paying careful attention to preserving the medial hinge and associated blood supply. Considerable effort was taken to ensure adequate support of the humeral head after reduction. This was performed using the shaft (valgus "impaction osteotomy" of Fenlin), or in cases of extensive metaphyseal comminution and osteopenia, bone graft or bone graft substitute was used (Fig. 1) [2]. Bone graft was utilized in 15 cases (43%) in this series. This was autograft bone in seven cases and allograft in eight cases. Next, provisional fixation was obtained using a Kirschner wire (Fig. 2). The reduction was then assessed utilizing fluoroscopy in the AP and Velpeau axillary views. Contralateral films were used to avoid varus malreduction. In all cases, the fracture was reduced, adequate support was obtained (especially medially), and provisional fixation was placed before application of the plate. Adequate medial support was defined as contact between the humeral head segment and the shaft segment at the medial calcar region, especially posteromedially. Thus, with this technique, the plate was used in the neutralization mode rather than as a reduction tool.

The plate was positioned low enough to avoid subacromial impingement. Long screws into the subchondral bone were avoided to decrease the risk of intra-articular penetration. The screws were placed by predrilling the lateral cortex and advancing the depth gauge without

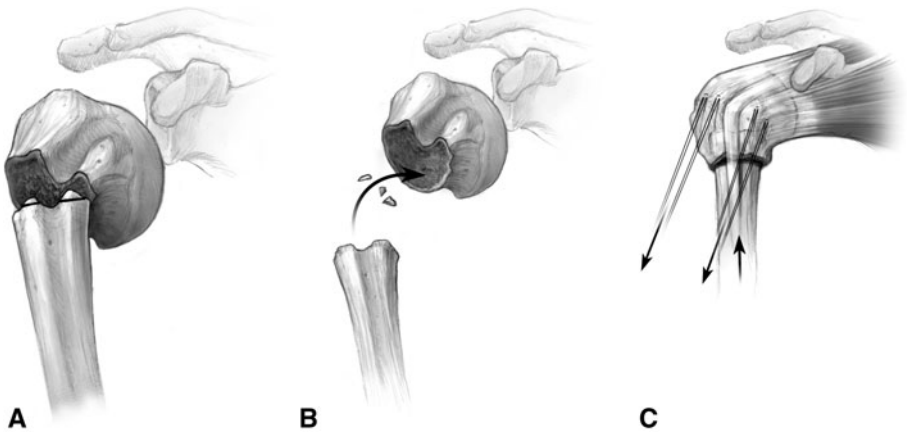


Fig. 1A–C (**A**) Bony comminution that would impede stable seating of the humeral head on the shaft is removed and preserved. (**B**) Bone fragments that were previously removed from the humeral shaft are placed back into the fracture site for final reduction. (**C**) Traction sutures are utilized to gain control of the head fragment, which is reduced onto the shaft, ensuring adequate support of the humeral head after reduction.

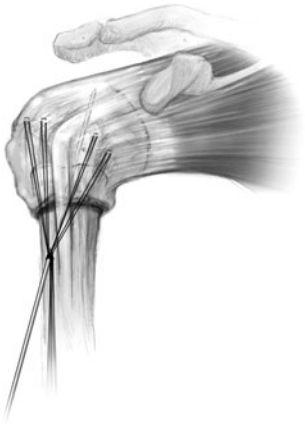


Fig. 2 Provisional fixation of the reduction is obtained using a Kirschner wire. The reduction is maintained utilizing the rotator cuff traction sutures and is compared with contralateral shoulder films to avoid malreduction.

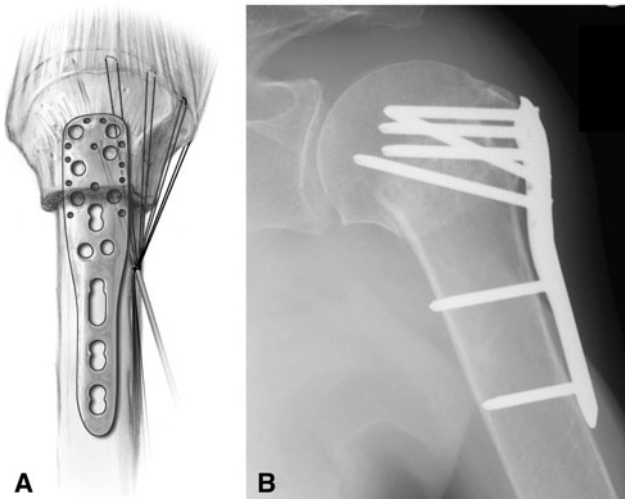


Fig. 3A–B (**A**) The precontoured plate is carefully placed to avoid subacromial impingement. (**B**) Screws are placed, avoiding intra-articular screw penetration. Each screw length is assessed with fluoroscopic imaging.

further predrilling to avoid placing screws close to the subchondral bone. All screws were scrutinized under fluoroscopy in varying degrees of internal and external rotation to ensure no intra-articular hardware. Rotator cuff traction sutures were utilized liberally to neutralize the varus deforming force of the supraspinatus (Fig. 3A). Because of the humeral head support obtained using the shaft, bone graft, or bone graft substitute, short screws and tension band suture fixation provided adequate stability to the humeral head fragment in all cases (Fig. 3B).

All patients were immobilized for 6 weeks after the operation. Patients were placed into a shoulder immobilizer immediately postoperatively and were instructed to stay in the immobilizer at all times until their first visit at 6 weeks. Patients were allowed to remove the immobilizer for hygiene only. Assisted ROM was initiated at 7 to 12 weeks, with therapist-driven ROM exercises and sling use the remainder of the day. After 3 months or demonstration of radiographic healing, the sling was discontinued.

A chart review was completed to determine the clinical outcome. ROM assessed at clinic appointments was gathered, and surveys were sent to all 25 living patients. The survey (Appendix 1) included illustrated self-assessments of ROM, in which patients selected diagrams showing maximum ROM, and a visual analog pain scale (1–10, with higher numbers indicating more severe pain) and allowed calculation of the American Society of Shoulder and Elbow Surgeons (ASES) score [15], the Simple Shoulder Test [12], and the QuickDash [4]. The QuickDash is a general study of upper-extremity function, with lower scores being better. The Simple Shoulder Test and ASES scores are shoulder-specific scores in which a higher score indicates better function. A second survey was sent to the 14 non-responders within 2 months. Followup telephone calls were made to the five patients who did not respond to the second survey, and survey information was obtained via telephone.

Radiographs of the involved shoulders were assessed for union and ON. Healing was considered complete when there was evidence of both cortical continuity on all cortices and trabecular continuity in the AP radiographs of the shoulder in internal and external rotation, as well as in the axillary and scapular Y radiographs. ON was diagnosed when radiographs demonstrated subchondral bony defects with or without a crescent sign or articular collapse, as previously described [5]. All radiographs were reviewed by the leading author (JDB) and a fellowship-trained shoulder and elbow surgeon (JSS) who was blinded to the clinical outcome of the patients, and consensus was achieved. There were no cases where healing could not be assessed. Reduction was considered satisfactory when the head-shaft angle was between 40° and 55° and there was anatomic reduction of the tuberosities within 5 mm.

We computed the average (± SD) for continuous variables.

Results

None of the 35 patients required immediate or delayed reoperation. Two patients (6%) suffered a perioperative myocardial infarction; both were managed medically with satisfactory outcome. Both had a medical history of severe coronary artery disease. Another patient (3%) developed a perioperative extremity deep venous thrombosis with some skin ulcerations. This was treated medically with resolution of symptoms. No patients had wound dehiscence or infection.

Satisfactory reduction was obtained in 31 of 35 fractures (89%). Four fractures were considered in excessive valgus (11%). All fractures healed. At last followup, four patients (11%) had partial ON. Two of these patients were asymptomatic and two complained of moderate pain with activity. Of these two symptomatic patients, one responded to nonoperative management, while one was offered arthroplasty but died during preoperative medical workup.

At last followup, the average visual analog pain score was 2.5 (± 2.3), compared with 1.8 (± 1.7) in the contralateral, uninjured extremity (Fig. 4). Average elevation was 141° (± 47°). Average abduction was 132° (± 46°). Average internal rotation was to L1 (± two levels) and average external rotation was 36° (± 24°) (Table 1). No patient had a decrease in his or her ability to perform activities of daily living. The average ASES score was 67.5 (± 25.6) in the operative extremity, compared with 76.9 (± 20.1) in the contralateral extremity. The average QuickDash was 25.1 (± 19.1). The Simple Shoulder Test averaged 7.9 (± 3.1) in the operative extremity, compared to 9.7 (± 2.4) in the nonoperative extremity.

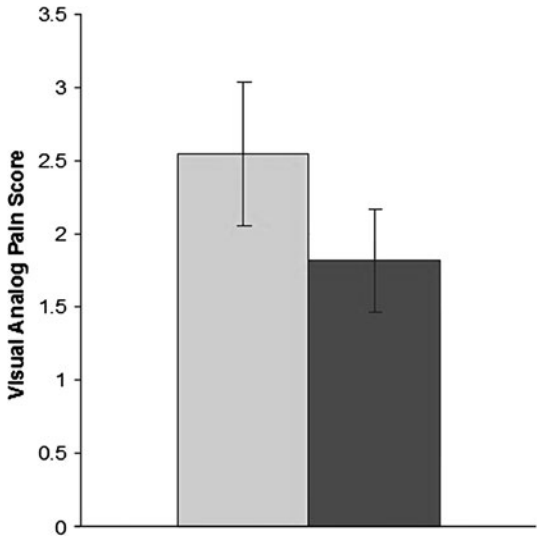


Fig. 4 The chart demonstrates visual analog pain score at last followup. The light bar represents the operative extremity, while the dark bar represents the contralateral extremity. Values are expressed as mean (bars) and SD (error bars).

Table 1. ROM in operative and nonoperative extremities at final followup

ROM	Operative extremity		Contralateral extremity	
	Mean	SD	Mean	SD
Elevation	141°	47°	172°	25°
Abduction	132°	46°	163°	32°
Internal rotation	L1	2 levels	T8	2 levels
External rotation	36°	24°	47°	22°

Discussion

Continued controversy remains regarding the optimal treatment for proximal humerus fractures in the elderly. Hemiarthroplasty is often complicated by tuberosity nonunion or malunion and decreased postoperative ROM [11]. Nonoperative treatment is effective in minimally displaced fractures, but poor outcomes have been documented in more complex fractures [20]. ORIF has been recently popularized, along with the introduction of precontoured proximal humeral locking plates. However, several recent reports have indicated unacceptable immediate and delayed failure rates. We evaluated a systematic approach to proximal humeral fracture fixation to determine whether (1) ORIF could be safely performed by evaluating immediate and delayed complications of this technique, (2) reduction of these fractures could be maintained over time by evaluating long-term radiographs and visual analog pain scores, and (3) 6 weeks of immobilization of these fractures did not lead to disabling stiffness by evaluating postoperative motion and functional scores.

There were several limitations to the study. First, this study involved a selected series of patients without a control group. An attempt to minimize the inherent bias of this study design was made by enrolling a consecutive group of patients meeting the study criteria. Second, there was a relatively high rate of study dropout. High rates of dementia and death are inherent to the study population (patients older than 75 years). To minimize the number of patients lost to followup, all available resources were utilized to contact all patients. Two surveys were mailed and patients were called. Finally, the followup method of this study was through a survey in addition to clinical examinations. For this reason, only well-validated outcome measures were used. This was an attempt to reduce the inherent subjectivity of patient responses.

In this case series, ORIF was quite safe. Recent reports in the literature of ORIF of proximal humerus fractures have demonstrated high complication rates. Solberg et al. [16] documented a 16% reoperation rate, with 8% of these being within 24 hours of the initial operation. A large study conducted by Sudkamp et al. [17] demonstrated primary screw penetration in 14% of patients and an overall complication rate of 34%. In our study, there were no cases of reoperation. The most important steps for minimizing the possibility of this complication included ensuring adequate intraoperative fluoroscopy before preparing and draping the patient and carefully assessing each screw placed with internal and external rotation views of the joint to confirm the hardware was not intra-articular. In addition, contrary to previous reports, short screws were utilized to engage the humeral head. Previous series have used long screws penetrating into the subchondral bone of the humeral head. This may be a cause of early and delayed intra-articular screw penetration.

Fracture reduction was maintained in most of the shoulders in our study. The reduction obtained in this series was adequate in 89% of patients and led to healing in all instances. This result is in contrast to reports of high rates of varus malreduction (up to 36%), which leads to early hardware failure [16]. Intraoperative comparison with the contralateral shoulder radiographs was an important step in reducing the frequency of malreductions. In addition, adequate reduction and humeral head support were attained before placement of the plate. This is in contrast to previous reports using the plate as a reduction tool [10]. There were no cases of varus malreduction, which emphasizes the attention paid to ensuring adequate valgus alignment. In addition, previous studies have documented ON in up to 37% of patients [19]. We had four patients (11%) with ON. Two of these patients had no or minimal pain and one responded to nonoperative management. The average visual analog pain score of the operative extremity was less than 1 point higher than the contralateral (unaffected) extremity (2.5 versus 1.8), indicating reliable pain relief at last followup.

Six weeks of immobilization did not lead to disabling stiffness in this series. While prolonged immobilization may be detrimental in young patients, this patient population seems not to be prone to develop stiffness despite immobilization. Patients in this study were kept strictly immobilized. This may be one reason for the absence of nonunions in this series. The mean postoperative motion of these patients included elevation of 141° and abduction of 132°. This compares favorably with the study by Sudkamp et al. [17], which emphasized early motion (within 2 days postoperatively). Their patients averaged 132° of elevation and 122° of abduction. Both of these groups of patients have better motion than is consistently obtained in hemiarthroplasty. Recent studies on hemiarthroplasty for proximal humerus fracture have reported elevation of 100° to 105° and abduction of 92° [1, 11]. In addition to the objective motion obtained in this patient group, it should be emphasized the demands of patients older than 75 years are different from those of younger patient populations. None of our patients had a decrease in ability to perform activities of daily living secondary to their fracture compared to preoperatively.

By utilizing a strict, systematic approach to proximal humerus fractures in the elderly, we were able to obtain satisfactory clinical and radiographic results with ORIF. In addition, 6 weeks of immobilization did not lead to disabling stiffness in those patients who followed up with us. These data are in contrast to several recent reports of high complication rates and frequent reoperations after ORIF. The results of this series compare favorably with those of patients who have undergone hemiarthroplasty but with seemingly better postoperative motion. ORIF followed by extended immobilization should be considered for elderly patients with displaced proximal humerus fractures.

Acknowledgments We thank the Orthopedic Research Study coordinators for their help in facilitating this project.

Appendix 1

Patient Survey

Patient Name: Date of Surgery:
Mayo Clinic Number: Shoulder:
Date:

Answer all questions by filling in the appropriate circle(s). (Sample: Like ● not like ⊘ or ∅.)

1. Dominant Hand
○ Right ○ Left

2. Current Employment Status
○ Work Full Time (40 hrs/wk) ○ Permanently disabled ○ Unemployed
○ Work Part Time (< 40 hrs/wk) ○ Temporarily disabled

3. What is/was your occupation?
○ Laborer Heavy ○ Laborer Light ○ Manager, Educator ○ Professional ○ Homemaker ○ Student ○ Retired

4. Medication
○ No
○ Yes, NSAIDS
○ Yes, Narcotics
○ Oral Steroids

5. Current Activity Level
○ None
○ Sedentary (no sports or lifting more than 15 lbs)
○ Light (Light recreational activities such as golf, light gardening)
○ Moderate (Activities such as racquet sports or landscaping)
○ Strenuous (Overhead or contact sports, heavy lifting)

6. Sports Participation
○ Yes ○ No

7. List Sports
○ Weight lifting ○ Swimming
○ Contact Sports ○ Aerobics
○ Throwing ○ Golf
○ Racquet Sports
○ Other _____

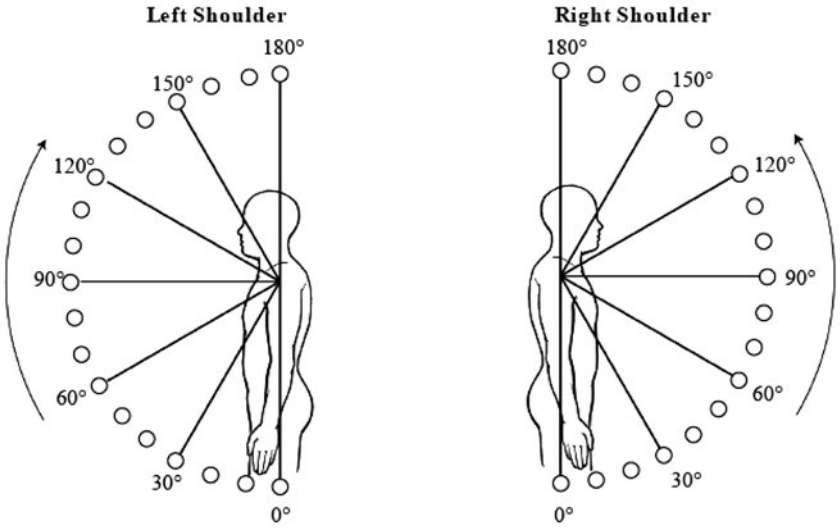
8. Past Activity Level (Prior to shoulder problem)
○ None ○ Moderate
○ Sedentary ○ Strenuous
○ Light

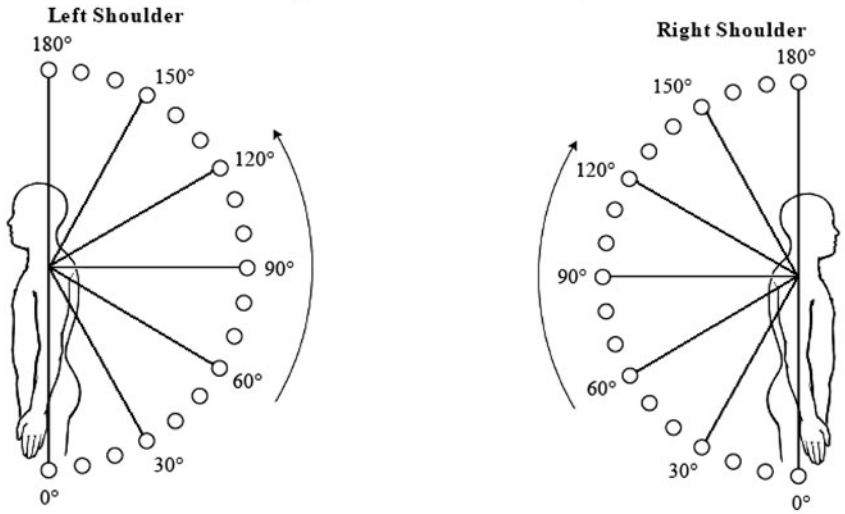
For the following questions, please indicate answers for ***both*** shoulders on a scale from 1 to 10.

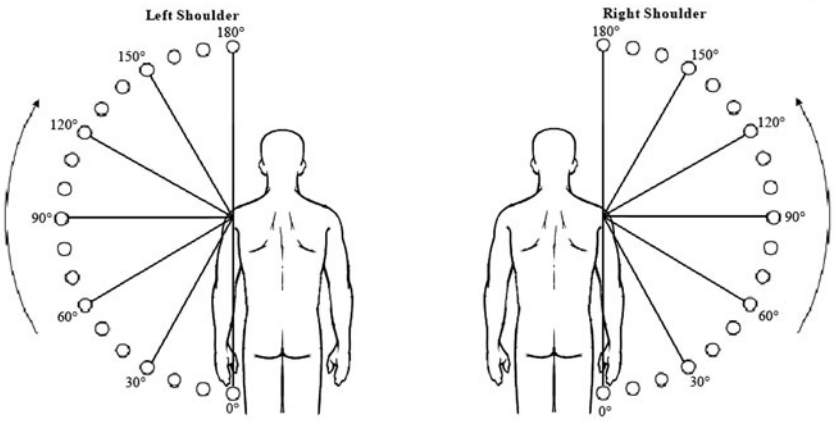
	Left Shoulder											Right Shoulder										
	No Pain		Slight		Occasionally Moderate		Moderate			Severe			No Pain		Slight		Occasionally Moderate		Moderate			Severe
9. Level of pain overall	○	○	○	○	○	○	○	○	○	○	10.	○	○	○	○	○	○	○	○	○	○
	1	2	3	4	5	6	7	8	9	10		1	2	3	4	5	6	7	8	9	10
11. Level of pain at night	○	○	○	○	○	○	○	○	○	○	12.	○	○	○	○	○	○	○	○	○	○
	1	2	3	4	5	6	7	8	9	10		1	2	3	4	5	6	7	8	9	10
13. Pain without activity	○	○	○	○	○	○	○	○	○	○	14.	○	○	○	○	○	○	○	○	○	○
	1	2	3	4	5	6	7	8	9	10		1	2	3	4	5	6	7	8	9	10
15. Pain with activity	○	○	○	○	○	○	○	○	○	○	16.	○	○	○	○	○	○	○	○	○	○
	1	2	3	4	5	6	7	8	9	10		1	2	3	4	5	6	7	8	9	10
Do your shoulders feel unstable (as if they are going to dislocate)?																						
17. Stability	Stable		Feels unstable		Slips (subluxates)			Very unstable (dislocates)				Stable		Feels unstable		Slips (subluxates)			Very unstable (dislocates)			
	○	○	○	○	○	○	○	○	○	○	18.	○	○	○	○	○	○	○	○	○	○
	1	2	3	4	5	6	7	8	9	10		1	2	3	4	5	6	7	8	9	10
Please rate the overall strength of ***both*** shoulders?																						
19. Strength	Normal		Good		Fair		Poor		Very poor	Paralysis		Normal		Good		Fair		Poor		Very poor	Paralysis	
	○	○	○	○	○	○	○	○	○	○	20.	○	○	○	○	○	○	○	○	○	○
	1	2	3	4	5	6	7	8	9	10		1	2	3	4	5	6	7	8	9	10

For the following questions, please indicate your level of motion for ***both*** shoulders.

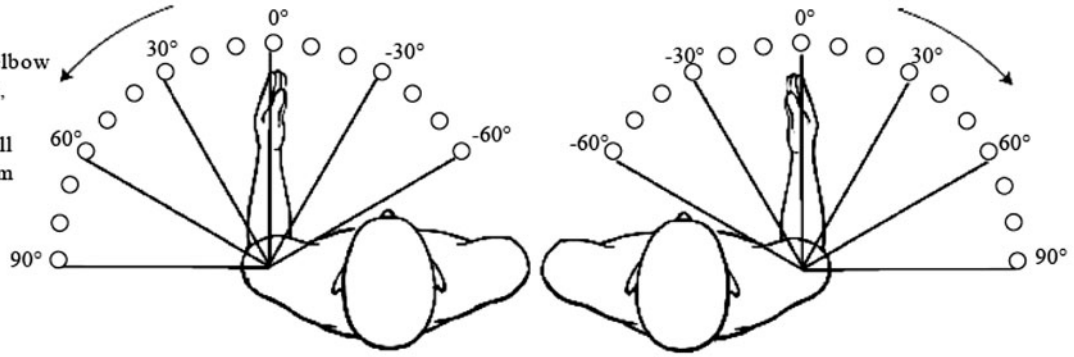
21-22. How high can you raise your arm without assistance?



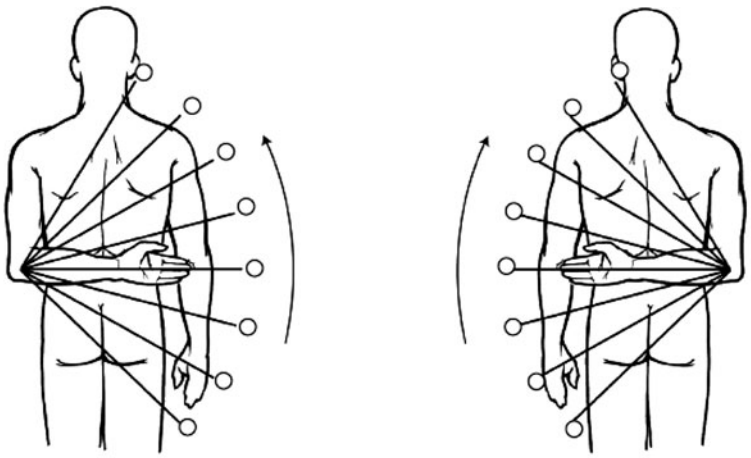




23-24. With your elbow at your side, how far outward will your forearm go?



25-26. How far inward and upward behind your back can you reach?



For ***all*** the following questions, please indicate your ability to do the following activities with ***both*** shoulders

		Left Shoulder		Right Shoulder	
		Yes	No	Yes	No
27-28.	Does your shoulder allow you to sleep comfortably?	○	○	○	○
29-30.	Is your shoulder comfortable with your arm at rest by your side?	○	○	○	○
31-32.	Can you wash the back of your opposite shoulder?	○	○	○	○
33-34.	Can you place your hand behind your head with the elbow straight out to the side?	○	○	○	○
35-36.	Can you reach the small of your back to tuck in your shirt with your hand?	○	○	○	○
37-38.	Can you lift 8 pounds to the level of your shoulder without bending your elbow?	○	○	○	○
39-40.	Can you lift 1 pound to the level of your shoulder without bending your elbow?	○	○	○	○
41-42.	Can you place a coin on a shelf at the level of your shoulder without bending your elbow?	○	○	○	○
43-44.	Do you think you can toss a softball overhand 20 yards?	○	○	○	○
45-46.	Would your shoulder allow you to work full time at your regular job?	○	○	○	○
47-48.	Do you think you can toss a softball underhand 20 yards?	○	○	○	○
49-50.	Can you carry 20 pounds at your side?	○	○	○	○

For *all* the following questions, please indicate your ability to do the following activities with *both* shoulders	Left Shoulder: No difficulties	Some difficulties	Very difficult	Unable to do	Right Shoulder: No difficulties	Some difficulties	Very difficult	Unable to do
51-52. Put on a coat?	○	○	○	○	○	○	○	○
53-54. Sleep on your side?	○	○	○	○	○	○	○	○
55-56. Wash back/ do up bra in back?	○	○	○	○	○	○	○	○
57-58. Manage toiletting?	○	○	○	○	○	○	○	○
59-60. Comb hair?	○	○	○	○	○	○	○	○
61-62. Reach a high shelf?	○	○	○	○	○	○	○	○
63-64. Lift 10 lbs. above shoulder?	○	○	○	○	○	○	○	○
65-66. Throw a ball overhand?	○	○	○	○	○	○	○	○
67-68. Do usual work?	○	○	○	○	○	○	○	○
69-70. Do usual sports?	○	○	○	○	○	○	○	○

Please indicate if your shoulder feels stable doing the following activities:	Left Shoulder: Yes	No	Right Shoulder: Yes	No
71-72. Lifting an object.	○	○	○	○
73-74. Throwing an object.	○	○	○	○
75-76. Pounding an object.	○	○	○	○
77-78. Pushing an object.	○	○	○	○
79-80. Holding an object overhead.	○	○	○	○

Please indicate if you are able to reach the following locations:	Left Shoulder: Yes	No	Right Shoulder: Yes	No
81-82. Your mouth.	○	○	○	○
83-84. Your belt buckle.	○	○	○	○
85-86. Your opposite armpit.	○	○	○	○
87-88. The top of your head	○	○	○	○
89-90. Location of a bra strap	○	○	○	○

For the following questions, please indicate your level of satisfaction for *both* shoulders on a scale from 1 to 10.

	Left Shoulder										Right Shoulder									
	Poor		Fair (Same)		Good (Better)		Very good (Much better)			Excellent	Poor		Fair (Same)		Good (Better)		Very good (Much better)			Excellent
91. Before surgery	○	○	○	○	○	○	○	○	○	○	92. ○	○	○	○	○	○	○	○	○	○
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
93. After surgery (if this has occured)	○	○	○	○	○	○	○	○	○	○	94. ○	○	○	○	○	○	○	○	○	○
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10

For the following questions, please answer *every question* based on your condition *the last week*, by circling the appropriate number. If you did not have the opportunity to perform an activity listed, please make your best estimate of which response would be most accurate. It doesn't matter which arm or hand you use to perform the activity; please answer based on your ability regardless of how you perform the task.

Please rate your ability to do following activities last week by filling in the circle below with the appropriate response:	No Difficulty	Mild Difficulty	Moderate Difficulty	Severe Difficulty	Unable
95. Open a tight or new jar	○	○	○	○	○
96. Do heavy household chores (e.g., wash walls, floors)	○	○	○	○	○
97. Carry a shopping bag or briefcase	○	○	○	○	○
98. Wash your back	○	○	○	○	○
99. Use a knife to cut food	○	○	○	○	○
100. Recreational activities in which you take some force or impact through your arm, shoulder, or hand (e.g., golf, hammering, tennis, etc.)	○	○	○	○	○

	Not at all	Slightly	Moderately	Quite A Bit	Extremely
101. During the past week, *to what extent* has your arm, shoulder or hand problem interfered with your normal social activities with family, friends, neighbors or groups	○	○	○	○	○

	Not At All	Slightly Limited	Moderately Limited	Very Limited	Unable
102. During the past week, were you limited in your work or other regular daily activities as a result of your arm, shoulder or hand problem?	○	○	○	○	○

Please rate the severity of the following symptoms in the last week:	None	Mild	Moderate	Severe	Extreme
103. Arm, shoulder or hand pain	○	○	○	○	○
104. Tingling (pins and needles) in your arm, shoulder or and	○	○	○	○	○

	No Difficulty	Mild Difficulty	Moderate Difficulty	Severe Difficulty	So Much Difficulty That I Can't Sleep
105. During the past week, how much difficulty have you had sleeping because of the pain in your arm, shoulder or hand?	○	○	○	○	○

References

1. Antuna SA, Sperling JW, Cofield RH. Shoulder hemiarthroplasty for acute fractures of the proximal humerus: a minimum five-year follow-up. *J Shoulder Elbow Surg.* 2008;17:202–209.
2. Banco SP, Andrisani D, Ramsey M, Frieman B, Fenlin JM Jr. The parachute technique: valgus impaction osteotomy for two-part fractures of the surgical neck of the humerus. *J Bone Joint Surg Am.* 2001;83(Suppl 2 Pt 1):38–42.
3. Bastian JD, Hertel R. Osteosynthesis and hemiarthroplasty of fractures of the proximal humerus: outcomes in a consecutive case series. *J Shoulder Elbow Surg.* 2009;18:216–219.
4. Beaton DE, Wright JG, Katz JN. Development of the Quick-DASH: comparison of three item-reduction approaches. *J Bone Joint Surg Am.* 2005;87:1038–1046.
5. Creuss RL. Experience with steroid-induced avascular necrosis of the shoulder and etiologic considerations regarding osteonecrosis of the hip. *Clin Orthop Relat Res.* 1978;130:86–93.

6. Egol KA, Ong CC, Walsh M, Jazrawi LM, Tejwani NC, Zuckerman JD. Early complications in proximal humerus fractures (OTA Types 11) treated with locked plates. *J Orthop Trauma.* 2008;22:159–164.
7. Guy P, Slobogean GP, McCormack RG. Treatment preferences for displaced three- and four-part proximal humerus fractures. *J Orthop Trauma.* 2010;24:250–254.
8. Hanson B, Neidenbach P, de Boer P, Stengel D. Functional outcomes after nonoperative management of fractures of the proximal humerus. *J Shoulder Elbow Surg.* 2009;18:612–621.
9. Jakob RP, Miniaci A, Anson PS, Jaberg H, Osterwalder A, Ganz R. Four-part valgus impacted fractures of the proximal humerus. *J Bone Joint Surg Br.* 1991;73:295–298.
10. Konrad G, Bayer J, Hepp P, Voigt C, Oestern H, Kaab M, Luo C, Plecko M, Wendt K, Kostler W, Sudkamp N. Open reduction and internal fixation of proximal humeral fractures with use of the locking proximal humerus plate: surgical technique. *J Bone Joint Surg Am.* 2010;92(Suppl 1 Pt 1):85–95.
11. Kontakis G, Koutras C, Tosounidis T, Giannoudis P. Early management of proximal humeral fractures with hemiarthroplasty: a systematic review. *J Bone Joint Surg Br.* 2008;90:1407–1413.
12. Lippit SB, Harryman DT, Matsen FA 3rd. A practical tool for evaluating function: the simple shoulder test. In: Matsen FA 3rd, Fu FH, Hawkins RJ, eds. *The Shoulder: A Balance of Mobility and Stability*. Rosemont, IL: American Academy of Orthopaedic Surgeons; 1993:501–518.
13. Neer CS 2nd. Displaced proximal humeral fractures. Part I. Classification and evaluation. 1970. *Clin Orthop Relat Res.* 2006;442:77–82.
14. Orthopedic Trauma Association. Fracture and Dislocation Classification Compendium, 2007. Available at: http://www.ota.org/compendium/2007JOTFractureCompNew/97042.3Humerus%20S7-S18.pdf. Accessed October 17, 2010.
15. Richards RR, An KN, Bigliani LU, Friedman RJ, Gartsman GM, Gristina AG, Iannotti JP, Mow VC, Sidles JA, Zuckerman JD. A standardized method for the assessment of shoulder function. *J Shoulder Elbow Surg.* 1994;3:347–352.
16. Solberg BD, Moon CN, Franco DP, Paiement GD. Locked plating of 3- and 4-part proximal humerus fractures in older patients: the effect of initial fracture pattern on outcome. *J Orthop Trauma.* 2009;23:113–119.
17. Sudkamp N, Bayer J, Hepp P, Voigt C, Oestern H, Kaab M, Luo C, Plecko M, Wendt K, Kostler W, Konrad G. 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 Surg Am.* 2009;91:1320–1328.
18. Torchia M. Technical tips for fixation of proximal humeral fractures in elderly patients. *Instr Course Lect.* 2010;59:553–561.
19. Wijgman AJ, Roolker W, Patt TW, Raaymakers EL, Marti RK. 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.
20. Zyto K. Non-operative treatment of comminuted fractures of the proximal humerus in elderly patients. *Injury.* 1998;29:349–352.