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Minimally displaced fractures of the greater tuberosity: outcome of non-operative treatment

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Background: Minimally displaced (<3 mm) and non-displaced fractures of the proximal humerus are a common source of disability; nevertheless, there is no agreement on the recommended rehabilitation program in these patients. The purpose of this study was to evaluate the outcome of this group of patients and describe the rehabilitation protocol we have used for the treatment of this injury.

Methods: We retrospectively analyzed the records of patients diagnosed with minimally displaced (<3 mm) fractures of the greater tuberosity who were admitted to our institute between June 2007 and May 2008. Patients were treated with a three-phase protocol. In the first phase, patients were immobilized in a sling for 3 weeks. In the second phase, pendular and active assisted exercises were begun 3 to 6 weeks after the injury. In the third phase, active exercises were commenced starting 6 weeks after injury.

Results: Sixty-nine patients matched our inclusion and exclusion criteria. At an average follow-up of 31 months (range, 26-41 months), the average Constant score improved from 40 points (range, 33-58 points) to 95 points (range, 75-100 points). Average satisfaction score improved from 4.2 of 10 (range, 2-6) to 9.5 of 10 (range, 7-10). The reported average duration of pain and decreased range of motion from the time of injury was 8.1 months (range, 1-24 months).

Conclusions: When the diagnosis of a minimally displaced fracture of the proximal humerus is made, the patient can be reassured that a favorable outcome is anticipated with a staged rehabilitation protocol. Nevertheless, clinicians and patients should be aware that full recovery from the injury may take an average of 8 months.

Level of evidence: Level IV, Case Series, Treatment Study.

Keywords: Minimally displaced; non-displaced; fracture; greater tuberosity; rehabilitation

Fractures of the proximal humerus comprise approximately 5% of all fractures and almost half of all humeral fractures.[13] Isolated fractures of the greater tuberosity account for approximately 20% of all proximal humeral fractures[3,8] and often result from a fall on the outstretched hand due to an impaction of the proximal humerus against the lower surface of the acromion or superior glenoid.[5,7]

Neer et al[17] recommended nonoperative treatment of patients with an isolated greater tuberosity fracture and <1 cm displacements. These recommendations have been challenged lately by other authors who have recommended

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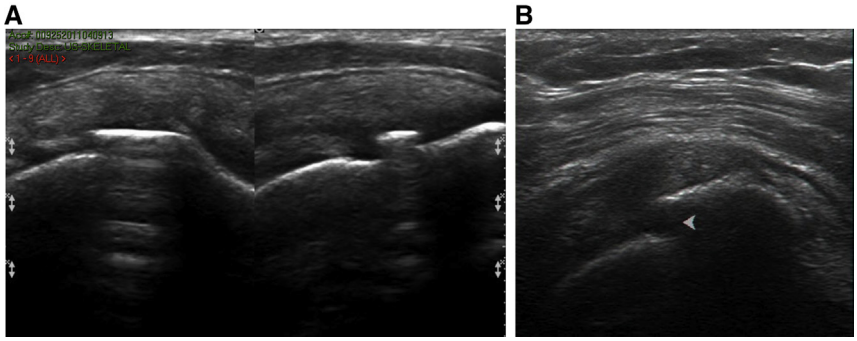

Figure 1 (**A** and **B**) Ultrasound images show signs of a greater tuberosity fracture (*arrowhead*).

operative treatment for fractures with >5 mm of displacement in the general population or >3 mm of displacement in active patients who are involved in frequent overhead activity.[1,20,22]

The diagnosis of minimally and non-displaced greater tuberosity fracture might be challenging and can be easily missed on plain radiographs[19]; nevertheless, magnetic resonance imaging (MRI),[15,23,27] computed tomography (CT),[2,10] and ultrasound imaging[21,24] were found to have high accuracy in diagnosing these fractures.

Although minimally and non-displaced fractures of the greater tuberosity are well recognized and frequently described, only a few studies have evaluated the clinical course and outcome of these injuries.[9,27] In addition, there is no agreement among the authors of these reports on the recommended rehabilitation program and whether to immobilize the shoulder to decrease the disability and discomfort[9] or to encourage rapid regain of full range of motion and strength to avoid stiffness.[27]

We have identified in our practice a group of patients with minimally (<3 mm) and non-displaced fractures of the greater tuberosity who were treated with a standard rehabilitation protocol. The purpose of this study was to evaluate the clinical outcome of these patients and describe the rehabilitation protocol we have used for the treatment of this injury.

Materials and methods

We retrospectively analyzed the clinical records of all patients diagnosed with minimally (<3 mm) and non-displaced fractures of the greater tuberosity who were admitted to our institute between June 1, 2007, and May 31, 2008. Our inclusion criteria were recent trauma and a greater tuberosity fracture confirmed by x-ray imaging (full trauma series), ultrasound assessment (Fig. 1), CT scan (Fig. 2), or MRI scan (Fig. 3). Our exclusion criteria were a concomitant fracture of the proximal humerus, displacement >3 mm, and shoulder symptoms before the injury.

Patients were treated with a three-phase protocol. In the first phase, patients were immobilized in a sling for 3 weeks. In the second phase, pendulum and active assisted exercises were begun 3 to 6 weeks after the injury. In the third phase, active exercises were commenced starting 6 weeks after the injury.

Patients were examined after the injury at 3 weeks, 3 and 6 months, 1 year, and then yearly. Outcome measures included a Constant score (CS) and a patient satisfaction score that was determined by use of a visual analog scale ranging from 0 to 10 points, in increasing order of satisfaction.

Statistical analysis

Statistical tests of significance were carried out using χ^2 and the Student t test when appropriate, with $P < .05$ considered significant. The Spearman correlation coefficient was used to determine the correlation between variables. SPSS 19 software (IBM, Armonk, NY, USA) was used for all analyses.

Results

Sixty-nine patients (38 men, 31 women) matched our inclusion and exclusion criteria. Eight were involved in a motor vehicle accident, 6 sustained a direct contusion to the shoulder, and 55 fell on the outstretched hand. Patients were an average age of 46.1 years (range, 17-85 years), with an average follow-up of 31 months (range, 26-41 months).

The average CS improved from 40 points (range, 33-58 points) to 95 points (range, 75-100 points). Average satisfaction score improved from 4.2 of 10 (range, 2-6) to 9.5 of 10 (range 7-10). All patients made good clinical recovery, with an average duration of pain and decreased range of motion of 8.1 months (range, 1-24 months).

Fractures were non-displaced in 22 patients and minimally displaced (<3 mm) in 47. There was no statistical difference between these 2 groups in age, sex, final CS, patient satisfaction, or time for recovery. Negative correlation was found between age and final CS (Spearman correlation coefficient = −0.339).

Discussion

Our three-phase rehabilitation protocol for patients with a minimally displaced (<3 mm) and non-displaced isolated fracture of the greater tuberosity had an excellent clinical outcome.