Arthroscopic Fixation Technique for Comminuted, Displaced Greater Tuberosity Fracture

Jong-Hun Ji, M.D., Mohamed Shafi, M.S.(Ortho), In-Soo Song, M.D., Young-Yul Kim, M.D., Edward G. McFarland, M.D., and Chang-Yun Moon, M.D.

Purpose: The purpose of this retrospective study was to evaluate the early results of arthroscopic treatment in patients with comminuted, displaced greater tuberosity (GT) fractures using the arthroscopic double-row suture anchor fixation (ADSF) technique. **Methods:** Between August 2004 and December 2007, we used the ADSF technique in 16 cases of isolated comminuted, displaced GT fractures. The early clinical results were evaluated in these patients at a mean of 24 months (range, 16 to 51 months) after surgery. There were 11 male and 5 female patients with a mean age of 56.5 years (range, 27 to 82 years). These 16 cases had at least 5 mm of displacement of the fracture fragments in any plane. For measurement of clinical outcomes, we assessed range of motion and evaluated the visual analog scale score; the University of California, Los Angeles (UCLA) rating scale; and the shoulder index of the American Shoulder and Elbow Surgeons. **Results:** At final follow-up, the visual analog scale score improved from 9.4 (range, 8 to 10 points) to 1.2 (range, 0 to 4 points), the mean UCLA score improved to 31 points (range, 21 to 35 points) postoperatively, and the American Shoulder and Elbow Surgeons score improved to 88.1 points (range, 81.5 to 100 points). According to the UCLA score, there were 3 excellent results, 11 good results, and 2 poor results. Mean forward flexion was 148.7° (range, 120° to 170°), mean abduction was 145° (range, 120° to 170°), mean external rotation in the neutral position was 24° (range, 10° to 40°), and internal rotation improved to the first lumbar vertebral level (from L3 to T7) at last follow-up. **Conclusions:** The early results of the ADSF technique used for displaced, comminuted GT fractures are encouraging, and arthroscopists should attempt to expand the indications for arthroscopic treatment of these fractures. **Level of Evidence:** Level IV, therapeutic case series.

Of fractures of the proximal humerus, 13% to 33% are accompanied by greater tuberosity (GT) fractures.[1] Isolated GT fractures have been reported in 17% to 21% of cases,[2] and GT fractures were accompanied by shoulder dislocations in 15% to 30% of cases.[3,4] Bahrs et al.[2] reported findings from a radiographic analysis that showed that 83% of 59 patients who sustained a fracture as part of a traumatic anterior shoulder dislocation had comminuted fractures and 57% (25 of 44 cases) with isolated GT fractures had comminuted fractures. Kim et al.[5] reported that isolated GT fractures of the proximal humerus were different demographically, and their treatment and classification should be considered separately from those for other proximal humeral fractures. Isolated GT fractures occur as a result of several different mechanisms of injury. Isolated GT fractures can occur as an impaction, avulsion, or shearing injury.[2]

Isolated comminuted, displaced GT fractures are a challenge with respect to decision making and operative technique. Generally, simple radiographic views

From the Department of Orthopedic Surgery, College of Medicine, The Catholic University, Daejeon St Mary's Hospital (J-H.J., M.S., Y-Y.K., C-Y.M.); Sun Hospital (I-S.S.), Daejeon, South Korea; and Johns Hopkins University (E.G.M.), Baltimore, Maryland, U.S.A.

The authors report no conflict of interest.

Received January 15, 2009; accepted September 10, 2009.

Address correspondence and reprint requests to Chang-Yun Moon, M.D., Department of Orthopedic Surgery, Daejon St Mary's Hospital, The Catholic University of Korea, 520-2, Deahung-dong, Joong-ku, Daejon 302-803, South Korea. E-mail: osmcy@naver.com

0749-8063/10/2605-0925$36.00/0

doi:10.1016/j.arthro.2009.09.011

cannot define the accurate fracture configuration of these comminuted GT fractures, so 3-dimensional (3D) computed tomography (CT) scans are very useful. Open or percutaneous reduction methods for these GT fractures have been commonly used[6,7]; however, cannulated screw fixation of the GT fractures can lead to further comminution, migration, and poor fixation of the fracture fragments, especially in osteoporotic bone. With recent advancements in arthroscopy, arthroscopic treatment of GT fractures is now being performed. The reduction of a fracture under arthroscopic guidance and percutaneous screw fixation has been reported,[8,9] yet there are limited published follow-up data on the surgical treatment of these fractures.

A double-row fixation with suture anchors in a rotator cuff repair provides a tendon-bone interface better suited for biological healing and restoration of the normal anatomy.[10-17] Bhatia et al.[18] reported an open technique for the reduction and internal fixation of isolated comminuted and displaced GT fractures using a double-row suture anchor technique; the long-term results showed satisfactory outcomes in most patients. Recently, Ji et al.[19] reported good results with an arthroscopic double-row suture anchor fixation (ADSF) technique in patients with displaced GT fractures. In addition, some authors reported using a similar technique for arthroscopic reduction and fixation with suture bridges for GT fractures.[20,21] We attempted to use this ADSF technique and to expand the indications for arthroscopic treatment of GT fractures to include those with comminution and then assess the early results. Our hypothesis was that we would be able to achieve fixation using arthroscopic suture anchors about the GT fragment. The purpose of this retrospective study was to evaluate the usefulness and the early clinical results of arthroscopic fixation for comminuted, displaced GT fractures using this ADSF technique.

METHODS

Sixteen patients who had isolated displaced, comminuted GT fractures were treated by the ADSF technique between August 2004 and December 2007. All patients had a displacement of at least 5 mm but less than 20 mm in any plane. We performed careful evaluation of the shoulder trauma series of radiographs, which included anteroposterior, scapular Y, and axillary views at the time of the initial injury and which were used to assess the displacement of the tuberosity fragments (Figs 1A, 1B, and 1D). All measurements were carried out on a picture archiving and communication system with a 1,024 × 1,024–pixel monitor (PACS; GE Healthcare, Buckinghamshire, England). A simple radiographic view could not accurately define the fracture configuration of these comminuted GT fractures, so a 3D CT scan was very useful to identify the state of the comminution of the GT fracture. All patients underwent 3D CT to assess the size of the fragments and the degree of comminution (number of fracture fragments), as well as the amount of displacement (Fig 1C). Patients having a minimally displaced fracture (<5 mm) or a severely displaced fracture (>20 mm) were excluded from this study. In those with minimally displaced fractures, we performed conservative treatment, and in those with severely displaced fractures (>20 mm), we preferred open reduction–internal fixation using open suture anchor fixation methods.[18] All patients underwent surgery by a 2-surgeon team (J.-H.J. and I.-S.S.), using the operative indications and surgical technique of Ji et al.,[19] as reported previously.

The study group included 11 male and 5 female patients with a mean age of 56.5 years (Table 1). The ages ranged from 33 to 82 years. Seven patients had acute shoulder fracture-dislocation injuries that were reduced before the CT evaluation at our institution; the other nine had no history of shoulder dislocation. The cause of injury was as follows: 6 motor vehicle accidents, 4 sports injuries (bicycling, roller skating, mountain biking, and playing soccer), 4 falling injuries, and 2 slipping injuries. The mean interval between injury and surgery was 7 days (range, 3 days to 3 weeks). Among these patients, the arthroscopic examination showed 5 Bankart lesions, 1 partial articular rotator cuff tear, 1 capsular tear, 2 SLAP lesions, and 4 partial tears of the long head of the biceps. Associated procedures performed at the time of surgery included Bankart repair in 5 patients, as well as biceps tenotomy in 1 patient and soft-tissue biceps tenodesis in 3 partials with 4 partial tears of the long head of the biceps.

After arthroscopic surgery, we performed radiologic assessment of the adequacy of fracture reduction: true anteroposterior radiographs of the glenohumeral joint were obtained to determine the step off (in millimeters) of the tuberosity head relation and the union. At the final follow-up visit, all patients were evaluated with a visual analog scale (VAS); the University of California, Los Angeles (UCLA) rating scale; and the shoulder index of the American Shoulder and Elbow Surgeons (ASES). A UCLA score of 34 to 35 points was considered excellent, 28 to 33 points was good, 21 to 27 points was fair, and 0 to 20 points was poor. All patients were evaluated postop-