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Functional and structural comparisons of the arthroscopic knotless double-row suture bridge and single-row repair for anterosuperior rotator cuff tears

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Background: We compared the outcomes of knotless double-row suture bridge and single-row repairs in patients undergoing arthroscopic repair for anterosuperior rotator cuff tears.
Methods: We included 61 full-thickness anterosuperior rotator cuff tears treated by arthroscopic repair, namely, single-row repair (group 1: 25 shoulders; mean patient age, 64 years) and the knotless double-row suture bridge repair (group 2: 36 shoulders; mean patient age, 62 years). Preoperative and postoperative magnetic resonance imaging was performed for all shoulders. Clinical outcomes were evaluated for mean follow-up periods of 81 months (range, 72-96 months) in group 1 and 34 months (range, 24-42 months) in group 2, using the University of California, Los Angeles and Japanese Orthopaedic Association assessments.
Results: At the final follow-up, both groups showed improvement in the average University of California, Los Angeles and Japanese Orthopaedic Association scores and range of motion, although no intergroup differences were observed. Both groups showed improved abduction strength, and the average score was higher in group 2 ($P = .0112$). The lift-off and belly-press test results were improved in both groups. Postoperatively, the incidence of positive lift-off tests tended to be lower ($P = .075$) and that of positive belly-press tests was lower in group 2, $P = .049$). The repair failure rate tended to be lower in group 2 (14% [5 of 36]) than in group 1 (32% [8 of 25]; $P = .0839$).
Conclusions: Arthroscopic knotless double-row suture bridge repair of anterosuperior rotator cuff tears yielded functional outcomes equivalent to those of single-row repair and may be useful for improving subscapularis function, abduction strength, and tendon healing.
Level of evidence: Level III, Retrospective Cohort Design, Treatment Study.

Keywords: Knotless double-row suture bridge repair; single-row repair; anterosuperior rotator cuff tear

This study was approved by the Kumamoto University Investigational Review Board (Approval No. 1318).
UMIN Clinical Trials Registry ID: UMIN000014758.

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To differentiate between coexisting subscapularis and supraspinatus tears or subscapularis, supraspinatus, and infraspinatus (3-tendon) tears from posterosuperior rotator cuff tears (RCTs), the term anterosuperior RCT was introduced by Warner et al[35] in 2001. Several authors[1,3-5,7,19,22-24,27,33,35] have reported the outcomes of arthroscopic or open repair for anterosuperior RCT; arthroscopic single-row repair was useful and the repair integrity correlated with the clinical results; however, a relatively high rate (30%) of failed subscapularis repair was also noted.[19]

The primary advantage of the transosseous-equivalent (TOE) repair technique, which was introduced in 2006 by Park et al,[29] is its ability to overcome the challenge of failed repairs of combined tears. Biomechanical tests have shown that the TOE repair technique is superior to the unlinked double-row and single-row methods for the repair of the supraspinatus[30,32] and subscapularis.[36] However, to our knowledge, no study comparing the outcomes of arthroscopic TOE and single-row repairs of anterosuperior RCTs has yet been published. Thus, the purpose of this study was to compare the outcomes of TOE and single-row repairs in patients undergoing arthroscopic repair of anterosuperior RCTs. We hypothesized that arthroscopic TOE repair would result in better clinical outcomes and reduce the rates of failed repairs compared with single-row repair.

Methods

This investigation was a retrospective cohort comparison study of the outcomes after arthroscopic TOE repairs in patients with an anterosuperior RCT.

Inclusion and exclusion criteria

Our inclusion criteria included (1) patients undergoing arthroscopic single-row repair (group 1) or TOE repair (Group 2) for a full-thickness RCT in the subscapularis combined with a tear in the supraspinatus or tears in the supraspinatus and infraspinatus, (2) availability of preoperative and postoperative magnetic resonance imaging (MRI) of the affected shoulder joint, and (3) a follow-up of more than 2 years. We excluded patients with (1) an irreparable RCT, (2) a partial rotator cuff repair, (3) stage 3 or 4 fatty infiltration of 2 or more rotator cuff muscles on MRI scans,[34] (4) cuff tear arthropathy on preoperative plain radiographs,[25] (5) a concomitant Bankart repair, and (6) a revision rotator cuff repair. We considered a tear to be reparable if we could restore the tendon to or within 10 mm of its footprint. When proper tendon positioning was not possible, we identified and released the sites at which the tendon mobility was limited. Torn tendons that could not be mobilized adequately or were absent were recorded as irreparable lesions.

Since 2001, we have treated anterosuperior RCT arthroscopically. For subscapularis repair, we mainly used the single-row technique until 2009 and have performed TOE repair since 2010. Between 2007 and 2009, the conventional double-row technique was mainly used for supraspinatus and infraspinatus repairs. Between 2005 and 2007, one author (J.I.) performed 143 consecutive arthroscopic single-row repairs on 143 patients with RCT. Between 2010 and 2012, the same surgeon performed 162 consecutive arthroscopic TOE repairs on 160 patients with RCT. The study included 61 patients with full-thickness anterosuperior RCTs treated by arthroscopic repair (25 patients from group 1 and 36 from group 2) who met all inclusion criteria. Patient demographics are reported in Table I. There were no significant intergroup differences in age, sex, affected side, and symptom duration. The prevalence of trauma history was significantly higher in group 2 than in group 1 ($P = .038$), and the follow-up duration was significantly longer in group 1 than in group 2 ($P < .0001$).

Clinical assessment

The preoperative and postoperative clinical assessments consisted of an interview, a physical examination, and evaluation using the University of California Los Angeles (UCLA) and Japanese Orthopaedic Association (JOA) scores.[15-18] The JOA shoulder score (maximum 100 points) includes a rating of the level of pain; shoulder function, including abduction strength; and range of motion. The outcomes were deemed to be excellent, good, fair, and poor if the total scores were >90, 81 to 90, 71-80, and <71 points, respectively. Clinical assessments obtained preoperatively, 3, 6, and 12 months after surgery, and at the latest follow-up were recorded.

Physical examination

The range of motion assessment included measurements of elevation in the sagittal plane, external rotation with the arm at the patient's side, and internal rotation recorded as the highest vertebral spinous process attained. Manual muscle strength, Neer and Hawkins impingement, supraspinatus,[20] infraspinatus,[12] lift-off,[9,19] belly-press,[9,19] and Speed tests were performed. All patients were evaluated at the latest follow-up by an orthopedic surgeon other than the primary surgeon.

Radiographic evaluation

Anteroposterior and axillary radiographs as well as MRI scans were obtained for all shoulders before and after surgery. We measured the acromiohumeral interval (AHI), defined as the shortest distance between the dense cortical bone marking the undersurface of the acromion, and the most proximal articular cortex of the humeral head on anteroposterior radiographs (in mm). Plain radiographs and MRIs were obtained at a mean of 12.8 months (range, 10-14 months) after the operation. The repair integrity, including the subscapularis tendon, was evaluated on MRI. When a fluid-equivalent signal appeared or when the tendon could not be visualized in at least 1 section of a fluid-sensitive sequence, full-thickness RCT was diagnosed.

Classification of subscapularis tears

Full-thickness subscapularis tears were classified based on their size and the amount of tendon retraction upon arthroscopic examination.[19] A previous anatomic study of the subscapularis footprint indicated that the tendon portion occupied the superior