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REVIEW ARTICLE

Clinical and structural outcomes after arthroscopic single-row versus double-row rotator cuff repair: a systematic review and meta-analysis of level I randomized clinical trials

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Background: The purpose of this study was to perform a systematic review and meta-analysis of all available level I randomized controlled trials comparing single-row with double-row repair to statistically compare clinical outcomes and imaging-diagnosed re-tear rates.
Methods: A literature search was undertaken to identify all level I randomized controlled trials comparing structural or clinical outcomes after single-row versus double-row rotator cuff repair. Clinical outcomes measures included in the meta-analysis were the American Shoulder and Elbow Surgeons, University of California–Los Angeles, and Constant scores; structural outcomes included imaging-confirmed re-tears. Meta-analyses compared raw mean differences in outcomes measures and relative risk ratios for imaging-diagnosed re-tears after single-row or double-row repairs by a random-effects model.
Results: The literature search identified a total of 7 studies that were included in the meta-analysis. There were no significant differences in preoperative to postoperative change in American Shoulder and Elbow Surgeons, University of California–Los Angeles, or Constant scores between the single-row and double-row groups ($P = .440$, .116, and .156, respectively). The overall re-tear rate was 25.9% (68/263) in the single-row group and 14.2% (37/261) in the double-row group. There was a statistically significant increased risk of sustaining an imaging-proven re-tear of any type in the single-row group (relative risk, 1.76 [95% confidence interval, 1.25-2.48]; $P = .001$), with partial-thickness re-tears accounting for the majority of this difference (relative risk, 1.99 [95% confidence interval, 1.40-3.82]; $P = .039$).
Conclusion: Single-row repairs resulted in significantly higher re-tear rates compared with double-row repairs, especially with regard to partial-thickness re-tears. However, there were no detectable differences in improvement in outcomes scores between single-row and double-row repairs.
Level of evidence: Level I, Meta-analysis.

Keywords: Single row; double row; rotator cuff repair; systematic review; meta-analysis

Advances in arthroscopic technique have allowed most rotator cuff tears to be repaired all-arthroscopically. Numerous methods of tendon-bone repair have been reported; however, controversy exists about the superiority of

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either single-row or double-row fixation constructs with regard to subjective, objective, and structural outcomes.

Biomechanical studies have demonstrated increased mechanical strength, decreased gap formation, improved tendon to bone contact, increased footprint coverage, and watertight isolation of the healing zone interface from the synovial fluid environment in double-row repairs.[2,8,22,26,28,29,32-34,36,37,42,46,47] These favorable biomechanical properties are thought to aid in the healing process while also allowing more aggressive postoperative physical therapy.[2,8]

However, clinical evidence comparing the efficacy of single-row versus double-row repair has been inconsistent. Whereas some studies report no clinical or anatomic differences between these techniques,[1,7,9,13,17,20,24,38,40,41,48] others have shown significantly improved subjective, objective, or radiographic outcomes after double-row repair compared with the single-row method.[6,10,11,14,16,25,30,39,43,45] These conflicting results bring into question the cost-effectiveness of double-row repair, given its increased expense and time to perform compared with the single-row method.[3,19]

Several systematic reviews and meta-analyses have compared the two techniques.[11,13,16,38,40,41] However, the inclusion of level II and III studies inhibits the interpretation of these studies. Therefore, the purpose of this study was to perform a systematic review and meta-analysis of all available level I randomized controlled trials comparing single-row with double-row repair to statistically compare their clinical outcomes and imaging-diagnosed re-tear rates. We hypothesized that there would be no statistically significant differences between techniques in this study.

Methods

Study design

This research was conducted in accordance with the 2009 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement[35] and the research protocol described by Wright et al[50] in 2007. In January 2013, the authors conducted a systematic review and meta-analysis in which only published, full-text, English-language, level I randomized controlled clinical trials comparing clinical or structural outcomes after arthroscopic single-row and double-row rotator cuff repairs were included. All other studies that did not fit these strict criteria were excluded.

Literature search

Two independent reviewers searched the PubMed and Ovid MEDLINE databases using the search terms "single row rotator cuff," "double row rotator cuff," and "single row double row rotator cuff." Major orthopaedic journals were also queried with the same search terms. All of the resulting titles and abstracts were screened for possible inclusion. After this initial search, the citations of included articles were carefully examined to locate further studies. In addition, the literature search was repeated in September 2013 to identify any new includable studies that had become available between the time of the initial search and completion of the study.

Data extraction

Two independent reviewers separately and in duplicate extracted data from the included studies. Data included study characteristics, clinical and radiographic follow-up intervals, patient demographics, initial tear sizes, and complications along with clinical and radiographic outcomes. Clinical outcomes measures included preoperative and postoperative American Shoulder and Elbow Surgeons (ASES),[23] University of California–Los Angeles (UCLA), and Constant-Murley (Constant) scores[12] at final follow-up; structural outcomes included all reported imaging-diagnosed re-tears at final radiographic follow-up. Physical examination findings such as range of motion and strength at final follow-up were not included in the meta-analysis because no more than 2 studies reported these variables in a similar fashion. In general, data for a given variable were included in the meta-analysis when 3 or more studies similarly measured that variable such that data could be pooled and meaningful comparisons could be made.

Quality appraisal

Evaluation of each study for potential risk of bias was undertaken. Two reviewers independently reviewed each of the included studies for selection bias, performance bias, detection bias, and attrition bias along with any other limitation that may inhibit study interpretation.

Synthesis of results

Meta-analyses were performed comparing arthroscopic single-row with double-row repairs in terms of (1) the raw mean differences of preoperative to postoperative change in ASES, UCLA, and Constant scores, (2) the overall relative risk ratio for development of an imaging-diagnosed re-tear, and (3) the overall relative risk ratio for development of a full-thickness or partial-thickness imaging-diagnosed re-tear.[4] The change in outcomes scores (θ) was defined as the difference between preoperative and postoperative outcomes scores for both the single-row and double-row groups.

A random-effects model,[15] estimated by the restricted maximum likelihood method, was chosen to combine the treatment effects for subjective outcome scores and imaging-diagnosed re-tear rates from each study. This method was chosen over the fixed-effects model for several reasons. First, formal heterogeneity tests are substantially underpowered for the number of studies in our review.[5] Second, although there were minimal statistical differences in population characteristics between the single-row and double-row groups (Table I), there were considerable differences in experimental methodology and sample demographics among the included studies (Tables II and III). Thus, we did not rely on statistical heterogeneity testing to make our modeling decisions; however, estimates of I^2, the proportion of variability attributable to heterogeneity among the included studies, along with corresponding 95% confidence intervals are provided.[44] Third, random-effects models allow better generalizability of conclusions when differing surgical techniques and patient populations are included.[21] The software