Systematic Review

Graft Augmentation Versus Bridging for Large to Massive Rotator Cuff Tears: A Systematic Review

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Purpose: To systematically review the literature on the healing rates and clinical outcomes of the 2 different graft indications (i.e., augmentation vs bridging) during rotator cuff repair. **Methods:** A systematic literature review was performed for clinical studies of rotator cuff repair using grafts for large to massive tears. The primary outcome was tendon healing on either magnetic resonance imaging or ultrasound. The secondary outcomes included visual analog scale for pain, American Shoulder and Elbow Surgeons score, and University of California at Los Angeles score, and forward elevation. Studies were divided into augmentation and bridging groups, and outcomes were compared statistically. **Results:** Twelve studies with 13 study groups were included: 167 repairs in the augmentation group and 247 repairs in the bridging group. For augmentation and bridging groups, the mean age was 62.2 and 62.8 years and the mean follow-up was 28.5 and 37.7 months, respectively. The estimated healing rates were 64.0% for augmentation and 77.9% for bridging. Although both procedures had improved clinical outcomes, no statistical difference between groups was detected except lower visual analog scale in the bridging group at follow-up. **Conclusions:** Bridging grafts had no significant difference in healing or clinical outcomes when compared with a graft used for augmentation. Bridging grafts may be considered for this difficult patient population with large to massive rotator cuff tears. **Level of Evidence:** Level IV, systematic review of Level II to IV studies.

Successful surgical repair of large to massive rotator cuff tears remains a challenging procedure, particularly with respect to healing.[1] Although a complete primary repair is ideal, this may not be achievable due to poor tendon quality or mobility. Furthermore, for larger tears where a primary repair is not possible or likely to fail, a variety of other options exist. These options include debridement,[2] partial repair,[3] interval slides,[4] margin convergence,[5] superior capsular reconstruction,[6] latissimus dorsi tendon transfer,[7] and reverse total shoulder replacement.[8] Each has been reported to provide reasonable outcomes.[8-10]

The use of grafts to reinforce completely reparable tears is another viable option. Since its initial description by Neviaser et al. in 1978,[11] a number of studies have reported the use of graft materials in large to massive tears to improve tissue quality, promote biologic tendon healing, and enhance the biomechanical integrity of the repaired tendon.[9,10,12] Graft materials include autograft (e.g., fascia lata), allograft (e.g., human dermis), xenograft (e.g., porcine dermis), and synthetic (e.g., poly-L-lactide acid) materials, which can be introduced either by open or arthroscopic approaches. Some authors have shown improved clinical outcomes, and the usage of grafts has become an accepted option for larger rotator cuff tears.[9,10,12]

In general, grafts may be used in 2 different scenarios: augmentation of a reparable tear[13] or bridging an irreparable defect.[14] Despite the fact that most graft devices are currently only Food and Drug Administration approved to augment full repairs (or for defects <1 cm),[10] many surgeons have used grafts to bridge

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larger defects. In this scenario, the graft is used to "replace" the rotator cuff tendon (bridging),[15] when inadequate excursion of the native tendon is present.

Although there are a number of studies reporting successful clinical outcomes of rotator cuff repair using grafts in either an augmentation or bridging fashion, the results including tendon healing rates are inconsistent.[13,14,16-25] Currently, there is no general consensus as to which indication provides superior tendon healing or clinical outcomes. Therefore, the purpose of this study was to systematically review the literature on the healing rates and clinical outcomes of the 2 different graft indications (i.e., augmentation vs bridging) during rotator cuff repair. We hypothesized that both augmentation and bridging grafts would lead to improved clinical outcomes after surgery but augmentation grafts would have superior clinical and healing results when compared with bridging grafts.

Methods

Systematic Review

A systematic literature review was performed following the Preferred Reporting Items for Systemic Reviews and Meta-Analyses checklist and flow diagram[26] (Fig 1). Literature search was conducted by 2 independent reviewers (Y.O., D.A.D.H.) of the following databases: PubMed, Medline, Embase, and Cochrane Library. The search terms used in various combinations included "rotator cuff," "repair," "graft," "patch," "scaffold," "augmentation," "reinforcement," "bridging," "interposition," "replacement," and "spanning."

Studies were systematically reviewed if they met the following inclusion criteria: (1) Level I to IV clinical studies of rotator cuff repair, (2) either an open or arthroscopic procedure, or both, (3) use of "free" grafts as either augmentation or bridging, (4) tendon healing was assessed by magnetic resonance imaging (MRI) or ultrasound (US) postoperatively at 6 months or later for at least 70% of the cases, and (5) English language. To ensure a similar population profile, only clinical studies of rotator cuff repair using grafts for tears with the size defined by "larger than 3 cm" or "large to massive" (including at least some massive tears) were included.

The exclusion criteria included: (1) nonclinical (e.g., cadaver, animal, basic science, biomechanical) studies, (2) scientific meeting abstracts and/or proceedings, (3) Level V studies, (4) review or meta-analysis articles, (5) studies reporting less than 10 cases, (6) studies not specifying the timing of postoperative MRI and/or US, (7) using nonfree grafts (e.g., tenotomized biceps, humeral periosteum flap), (8) including only large tears or smaller (i.e., no massive tears), and (9) non-English language. The studies using autografts were eventually excluded because autograft materials were only used for bridging indications and not for augmentation.

Two independent investigators (Y.O., D.A.D.H.) each conducted separate searches, each reviewing the abstract of each publication and extracting the data from each relevant article. The final literature search was conducted on August 31, 2015. In addition, we cross-referenced all references of included studies to avoid omitting relevant studies not included in the original search. In the event there was disagreement regarding the inclusion of a study, the senior author (I.K.Y.L.) made the final decision. For studies using duplicate patient populations, only the most recent publication was used for analysis.

Quality Assessment

Levels of evidence were determined using the guide outlined by the Oxford Centre for Evidence Based Medicine.[27] Quality of studies was assessed using Coleman Methodology Score.[28] The assessments were performed by one orthopaedic fellow (Y.O.) and one orthopaedic resident (J.M.W.) independently. Any discrepancies in given scores were discussed between the raters. In case there was any disagreement, the senior author (I.K.Y.L.) made the final decision.

Outcome Measures

The primary outcome was tendon healing on postoperative MRI or US. Healed or intact repairs were classified as "healed" tears. However, partially healed, partially retorn, retorn, loss of tendon (or tendinograft) continuity, or nonhealed tears were all classified as "retorn." Secondary outcomes included visual analog scale (VAS) for pain, American Shoulder and Elbow Surgeons (ASES) and University of California at Los Angeles (UCLA) scores, and forward elevation range (FE). If the study reported a pain score as a portion of Constant score, the scores were translated in a negative linear fashion into the scale for VAS. Severe pain in Constant score (0 point) was regarded as 10 (worst pain) in VAS, whereas no pain in Constant score (15 points) was rated as 0 in VAS. The studies were divided into subgroups depending on the surgical indication used as follows: augmentation group and bridging group. Reported complications were also extracted and assessed. Retears were not included as complications and reported separately.

Statistical Analysis

Healing rates were analyzed using a random effects model and clinical outcomes were analyzed using fixed-effects models weighted by sample size. The selection of fixed-effect models for clinical outcome measures was due to insufficient standard deviations and confidential intervals provided from included studies. Heterogeneity of the studies was not the reason for the selection because all the studies were case series and therefore heterogeneity could not be assessed. The combined