A systematic review of the clinical outcomes of single row versus double row rotator cuff repairs

George J. Trappey IV, MD*, Gary M. Gartsman, MD

Fondren Orthopedic Group, Houston, TX, USA

Rotator cuff tears are a ubiquitous cause of shoulder pain and disability. Full thickness rotator cuff tears are present in 19-21% of the general population, and their prevalence increases with age.39,64 The incidence of this problem is exacerbated by the ever advancing age of our patient population. Thankfully, with advances in arthroscopic rotator cuff repair, this has become a treatable problem with low morbidity, few complications, and good success. Although patients can do well in the face of a persistent or recurrent rotator cuff tear after arthroscopic repair, several studies have documented better subjective and objective results when the rotator cuff tear has been documented to heal.3,16,18,19,27,30-33,57,58

It is for this reason that much emphasis and many resources have been dedicated to improving the success of rotator cuff healing after arthroscopic repair. Several areas have been explored as possible solutions to this complex problem. Proposals have included improving patient factors such as smoking cessation.38 Improving the local milieu with various growth factors and scaffolds has also been suggested.44 However, the 1 factor that has probably received the most attention to date is improving the initial fixation strength and recreating the anatomic footprint of the rotator cuff to ameliorate this problem.

Traditional open rotator cuff repairs using transosseous bone tunnels had the advantage of reapproximating the rotator cuff tendon solidly onto the greater tuberosity while increasing the area available for healing.44 Unfortunately, this came at the expense of increased pain and decreased range of motion postoperatively from violating the deltoid. As arthroscopic techniques improved and suture anchors became available, single row rotator cuff repairs became fashionable due to easier rehabilitation postoperatively. Most of these techniques relied on simple sutures through the rotator cuff with less reliable compression of the rotator cuff tendon onto the tuberosity.50 As arthroscopic techniques became more sophisticated and implants improved, it became possible for surgeons to employ double row repair techniques that afford the compression of traditional open bone tunnels through minimally invasive arthroscopic procedures.

This review article examines the currently available literature regarding single versus double row suture anchor repair for arthroscopic rotator cuff repair. Interpreting this literature, however, is fraught with difficulty. The difficulty lies in the fact that what defines a single row repair and what defines a double row repair is fairly ambiguous. For example, is a single row repair, where the anchors are placed on the lateral aspect of the footprint, the same construct as a single row repair, where the anchors are placed medial along the articular margin (Fig. 1)? Likewise, should traditional double row repairs and transosseous equivalent repairs be considered together in the same category as “double row” repairs (Figs. 2 and 3)?

As will be shown, there is mounting basic science biomechanical data that double row suture anchor repairs seem to offer a stronger time zero construct.1,2,6,7,24,26,28,34-36,41-43,48,50,51,55,59,63 What is less clear is the role this plays clinically. While there is still much uncertainty surrounding rotator cuff repairs, 1 thing is certain: very few definitive scientific clinical conclusions can be drawn from the
available literature due to the paucity of Level I evidence and multitude of different uncontrolled variables.

**Biomechanical data**

There have been a number of basic science studies comparing single and double row suture anchor repairs for rotator cuff tears. These studies have included cadaveric specimens, as well as animal specimens such as rabbit, bovine, ovine, and porcine.

The majority of the available basic science data suggest that double row repairs have greater footprint coverage, improved contact area and pressure, better initial fixation strength and stiffness, decreased gap formation, and higher load to failure when compared to single row repairs. However, there are studies to the contrary. Mazzocca et al performed a cadaveric study on 20 fresh frozen shoulders. The single row repairs had similar load to failure, cyclic displacement, and gap formation when compared to double row repairs; however, double row repairs did restore a larger percentage of the anatomic footprint. Mahar et al showed in 18 bovine shoulders that double row repairs did not have a biomechanical advantage over single row repairs. Finally, using 6 matched pairs of ovine shoulders, Nelson et al demonstrated that although double row repairs restore a greater percentage of the anatomic footprint, the time zero biomechanical strength was not significantly different from single row repairs.

Although the 3 above-referenced studies show no biomechanical advantage to using double row repairs for arthroscopic rotator cuff surgery, 2 of the studies do show better recreation of the anatomic footprint of the rotator cuff on the humerus. This greater footprint coverage alone may be advantageous for rotator cuff healing. While the 3 studies mentioned above show equivocal biomechanical results, clearly the majority of the published basic science literature supports the argument that double row repairs are stronger biomechanical constructs that better recreate the normal anatomic footprint of the rotator cuff. What is more difficult to demonstrate is whether this translates into superior clinical results.

**Clinical data**

The majority of patients show significant improvement in shoulder functional outcomes and a high rate of patient satisfaction with both single and double row arthroscopic rotator cuff repairs. So, why bother with double row repairs, knowing that double row repairs are more expensive and time consuming? The time and money may be worthwhile, because several studies have documented better subjective and objective results after rotator cuff repairs when the tendon has been documented to heal.

Therefore, if double row repairs are superior to single row repairs in terms of biomechanical performance, as well as improved contact area and pressure, one would expect better healing rates and, therefore, better outcomes. Surprisingly, this has been difficult to prove clinically.

Sugaya et al demonstrated that arthroscopic rotator cuff repairs yielded successful functional outcomes without a significant difference between single and double row repairs. Brady et al showed intraoperatively that double row repairs offered over twice the footprint coverage yielded by single row repairs. Charousset et al also found no significant difference in clinical results; but, anatomic tendon healing rates were better with the double row repairs based on computed tomographic (CT) arthrography.

Several others, including Aydin et al, Buess et al, Reardon et al, and Wall et al have noted equivalent clinical outcomes after comparing single and double row repairs. Park et al made an interesting observation when comparing small to medium rotator cuff tears (≤3 cm) with large to massive rotator cuff tears (≥3 cm). They noted that when rotator cuff
tears $\geq 3\, \text{cm}$ were repaired using a double row technique, they had better American Shoulder and Elbow Surgeons (ASES) and Constant scores postoperatively as compared to single row repairs. This was the first study to show a clinical difference between single and double row repairs, and it was strictly in these larger sized tears.\textsuperscript{49}

In spite of the fact that the single versus double row question has yet to be answered definitively, researchers have already begun to compare double row constructs. The 2 most commonly studied constructs are traditional double row repairs and transosseous equivalent or bridging repairs. Traditional double row repairs do not have the potential tendon-bone interface pressure benefits demonstrated by transosseous equivalent repairs.\textsuperscript{5,17} Park et al showed, using biomechanical comparisons between double row and transosseous equivalent repairs, that the mean ultimate load to failure was, statistically, significantly greater for the transosseous equivalent repairs.\textsuperscript{50} Frank et al went on to demonstrate with MRI that transosseous equivalent repairs had equivalent or improved healing rates when compared to historical controls with satisfactory outcomes and excellent function at 1 year after surgery.\textsuperscript{21}

Recently, however, Cho et al brought to light an interesting finding regarding these transosseous equivalent repairs. He noticed an unusual pattern of tendon failures at the musculotendinous junction of rotator cuffs repaired with this method.\textsuperscript{15} Therefore, while there appears to be theoretical benefits to transosseous equivalent repairs, the significance of this medial failure is not yet known, and clearly needs to be addressed in future studies on this technique.

**Review articles**

Of late, several review articles have been published on the topic of single versus double row arthroscopic rotator cuff repairs. The consensus of these review articles is that while double row repairs seem to offer biomechanically sound constructs that may decrease retear rates, this leads to few advantages clinically. Duquin et al showed in their systematic review of the literature that double row repair methods lead to significantly lower retear rates, when compared with single row methods for tears greater than 1 cm.\textsuperscript{18} Saridakis et al pointed out in another systematic review that there appears to be a benefit of structural healing when an arthroscopic rotator cuff repair is performed with double row as opposed to single row fixation. There was little evidence to support any functional differences between the 2 techniques, except possibly for patients with large or massive rotator cuff tears ($\geq 3\, \text{cm}$).\textsuperscript{53} In a review article by Dines et al, the authors noted that clinical studies have not yet demonstrated a substantial improvement when using double instead of single row repairs with regard to either the degree of structural healing or functional outcomes.\textsuperscript{17} In the most recent systematic review, Nho et al conclude that there are no clinical differences between single and double row repair techniques for arthroscopic rotator cuff repairs.\textsuperscript{47}

**Level I evidence**

Franceschi et al pointed out that single and double row repairs provide comparable clinical outcomes at 2 years. Double row repairs did appear to produce superior mechanical constructs with better restoration of the anatomic footprint on MR arthrography; however, the difference was not statistically significant. In the first randomized controlled trial on this subject, 60 patients were randomized into either a single or double row repair group. Four patients in each group did not return for final 2-year follow-up. There was no statistically significant difference at 2 years in the University of California Los Angeles (UCLA) score or range of motion between groups. Postoperative MRI at 2 years did favor the double row group with intact rotator cuffs in 18 patients, partial-thickness defects in 7, and full-thickness defects in 1. In comparison, there were 14 patients with intact rotator cuffs, 10 patients with partial-thickness defects, and 2 patients with full-thickness defects in the single row group. An interesting side note was made regarding the operative times. The mean operative time for the single row group was 42 minutes compared to 65 minutes for the double row group. This difference was statistically significant (Table).\textsuperscript{20}

A second randomized clinical trial was performed by Grasso et al. This study involved 80 patients randomized into either the double or single row repair group. Follow-up was 2 years, with 8 patients lost to follow-up. No significant difference in clinical outcomes was apparent between the single and double row groups at 2 years. Imaging was not used to verify the integrity of the repairs.\textsuperscript{25}

Most recently, Burks et al published a randomized controlled trial. In this study, 40 patients were randomized...
to either single or double row arthroscopic rotator cuff repairs, with no patients lost to follow-up. Patients were followed with clinical measures as well as magnetic resonance image (MRI) to 1 year postoperatively. There were no significant differences in any of the clinical parameters at 1 year. There were 2 retears at 1 year in each group, with an additional 2 cases in the double row group demonstrating severe thinning. Per MRI, there was no significant difference between the single and double row groups with regards to the structural integrity of the repairs. The conclusion from this study was that there is no clinical or MRI differences between single and double row arthroscopic rotator cuff repairs.12

Finally, in a prospective randomized trial that is currently in press and has been presented at both the open meeting of the ASES and Nice shoulder course, Gartsman et al used ultrasound to evaluate rotator cuff integrity at 1 year comparing single and double row arthroscopic rotator cuff repairs. This study included 90 patients randomized to either single or double row repair using the transosseous equivalent technique. Eighty-three patients had complete data to allow their inclusion in the study. Follow-up ultrasound was performed at an average of 10 months to evaluate cuff integrity. Clinical outcomes and function was not evaluated in this study. Forty of 43 patients (93%) had intact repairs in the double row repair group. Thirty-two of 40 patients (80%) had intact repairs in the single row group. This difference was found to be statistically significant.23

**Authors’ preferred approach**

Although the biomechanical time zero construct strength is an important factor when repairing rotator cuff tendon tears arthroscopically, it is certainly not the only factor to consider when deciding between a single or double row repair construct. Patient factors have to be considered as well. Many of the decisions regarding the appropriate construct need to be made intraoperatively after seeing the rotator cuff tear, assessing the tissue, and feeling the tension. It is the authors’ collective opinion that a low tension environment is critical for rotator cuff healing. If given the choice between an anatomically positioned double row repair under undue tension or a tension-free single row repair at the articular margin, it is our practice to choose the low tension environment preferentially.

Our treatment algorithm is subjective, but our goal is to obtain the most biomechanically sound construct in the lowest tension environment. If the patient has an easily reducible tear with reasonable tendon quality, it is our practice to perform a double row repair using the transosseous equivalent technique. If, however, the tendon only reduces to the articular margin, and the tendon quality is suspect, we prefer to perform a single row repair at the articular margin, as we believe this gives the tendon the best chance to heal.

**Conclusion/discussion**

Given the paucity of Level I evidence on this topic, it is difficult to make many definitive conclusions. Suffice it to say that the available literature indicates that arthroscopic double row suture anchor rotator cuff repairs appear to be biomechanically superior to single row repairs. This fact, however, does not appear to translate into superior functional or clinical outcomes. Proponents of arthroscopic double row rotator cuff repairs concede that current studies do not demonstrate superiority over arthroscopic single row repairs. They argue, however, that more sophisticated outcome analyses will more accurately discriminate the superiority of double row repairs. Well-designed large prospective randomized studies are needed in the future to definitively settle this debate. Until this happens, arguments can be made on either side to justify single or double row arthroscopic suture anchor rotator cuff repairs.

**Disclaimer**

Neither author, their immediate families, nor any research foundation with which they are affiliated...
received any financial payments or other benefits from any commercial entity related to the subject of this article.

References


32. Liem D, Bartl C, Lichtenberg S, Magosch P, Habermeyer P. Clinical outcome and tendon integrity of arthroscopic versus mini-open supraspinatus tendon repair: a magnetic resonance imaging...
Single row vs double row rotator cuff repairs


