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Review article

Transtendinous repair of partial articular sided supraspinatus tears is associated with higher rates of stiffness and significantly inferior early functional scores than tear completion and repair: A systematic review

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ABSTRACT

Introduction: Transtendon repair (TTR) and tear completion and repair (TCR) are common repair techniques for partial thickness rotator cuff tears (PTRCTs). Previous systematic reviews have not demonstrated any advantage of either but have not specifically addressed early recovery.
Aim: To compare the outcomes of these two techniques in treating PTRCTs with respect to post-operative stiffness, delay in functional recovery and re-tear rates.
Material and methods: A systematic review of the Medline and EMBASE database was performed in accordance with the PRISMA guidelines. Both cases series and comparative studies reporting functional outcomes, post-operative stiffness or re-tear rate after either TTR or TCR for PTRCTs were included.
Results: The search strategy identified 21 studies ($n = 797$); 4 comparative studies ($n = 214$), 15 TTR ($n = 511$) and 2 TCR case series ($n = 72$). All four comparative studies included were randomised controlled trials. One RCT reported early outcomes and demonstrated significantly slower recovery in the TTR group at 3 months (ASES $p = 0.037$, Constant score $p = 0.019$ and pain $p = 0.001$). Similarly, data from the case series suggested that the rate of post-operative stiffness was higher in the TTR group. All comparative studies demonstrated no significant difference at final follow up in terms of pain, range of motion or functional score.
Discussion: The results of this systematic review suggest that transtendinous repairs are associated with more pain and worse function during the first 3 months. This suggests that tear completion and repair should be the preferred option, as comparative studies do not demonstrate any long-term advantage of transtendinous repair.
Level of evidence: II, systematic review.

1. Introduction

Partial thickness rotator cuff tears (PTRCTs) were first described by Codman [1] and later classified by Ellman according to the depth and location of the tear [2]. PTRCTs may occur on the articular side, within the tendon, or on the bursal side, with articular-sided tears being 2–3 times more common than bursal-sided tears [3,4]. Possible pathogenesis of tears includes intrinsic degeneration, extrinsic impingement and trauma [5]. Partial tears are shown to have a variable rate of progression with 28–40% eventually becoming full thickness tears [6–8].

While many patients with cuff tears that involve under 50% of the tendon improve clinically with non-operative treatment modalities, surgical repair may be indicated if tears exceed 50% or in those who have failed non-operative treatment [9,10]. Weber reported that arthroscopic debridement and acromioplasty alone was associated with a higher reoperation rate than observed in those that underwent repair when the tear extended to over 50% [10]. Similarly, Ellman reported a high (25%) reoperation rate in patients treated with only debridement and acromioplasty [2]. This has led to a trend in repairing lesions that extend to more than 50% of the tendon thickness [2,10–12]. Two common treatments are the

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transtendon repair technique and formal repair after completion of PTRCTs.

The theoretical advantages of transtendinous repair are maintenance of the intact part of the tendon and improved biomechanical properties (less gapping and higher mean ultimate failure strength) [13–16]. However, there is concern that the tendon can become overtensioned [15,16], as repair of the articular side may cause bunching of the bursal layer of the cuff resulting in unbalanced tendon tension and residual discomfort [17]. The alternative technique is to convert the PTRCT to a full thickness tear before repair and this has the potential advantages of better access to the tendon footprint for preparation of the bony bed and removal of degenerative tissue [10,18]. However, the procedure involves removal of structurally sound bursal-sided tendon and may potentially lead to a higher re-tear rate [19]. Although previous reviews and meta-analysis have demonstrated that both techniques can provide similar improvement in shoulder function [20,21], the risk of post-operative stiffness and delay in functional recovery have not been thoroughly evaluated. The aim of this study was to compare the two surgical techniques for treating articular-sided PTRCTs, with respect to the association with these adverse early outcomes and also an evaluation of the re-tear rate at long-term follow-up.

2. Methods

A systematic review of the literature was conducted in accordance with the PRISMA guidelines [22] using the online databases Medline and EMBASE. The review was registered on the PROSPERO database on 25th March 2017 (Reference CRD42017060207). The searches were performed independently by two authors on the 18th of March 2017 and repeated on the 25th of April 2017 to ensure accuracy. The Medline search strategy is illustrated in Table 1.

Only studies that were published in English were included. Both cases series and comparative studies reporting outcomes after either transtendinous repair (TTR) or tear completion and repair (TCR) of PTRCTs were included. Studies reporting outcomes of patients with partial subscapularis or infraspinatus tears were excluded. Only arthroscopic repairs were included but any surgical technique was acceptable. The study must have reported the American Shoulder & Elbow Shoulder Surgeons Evaluation Form (ASES) or the Constant Score, and/or the incidence of post-operative stiffness and/or re-tear rate. In addition, only primary research was considered for review with any abstracts, comments, review articles and technique articles excluded.

Data from comparative studies and case series were presented together as a narrative synthesis of each individual outcome measure. The studies were appraised independently by two authors using the tool developed by the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) Working Group [23]. In addition, the robustness of study methodology was appraised using the Methodological index for non-randomized studies (MINORS) [24].

Table 1
Search strategy for Medline.

Number	Search term	Results
1	Partial thickness tear.mp.	100
2	PASTA.mp.	1313
3	Articular side.mp.	92
4	Partial supraspinatus tear.mp.	4
5	Rotator cuff tear.mp. or rotator cuff injuries/	4530
6	Arthroscopy/	19,961
7	Shoulder/	11,315
8	6 and 7	425
9	Transtendon.mp.	35
10	Completion.mp.	68,633
11	Conversion.mp.	137,234
12	1 or 2 or 3 or 4 or 5 or 8	6238
13	9 or 10 or 11	205,126
14	12 and 13	79

3. Results

The search strategy identified 21 studies eligible for inclusion; 4 comparative studies [19,25–27], 15 TTR case series [14,17,18,28–39] and 2 TCR case series. [40,41]. A flow chart of the search strategy is shown in Fig. 1. The total number of participants in all studies was 797. A total of 214 participants were included in the comparative studies with sample sizes ranging from 32 to 74 [19,25–27]. The TTR case series included 511 patients and the TCR case series 72. Concise details of the included studies are given in Tables 2–5.

3.1. Functional outcomes

Three comparative studies reported functional scores; the Constant score in all three and the ASES in two studies. All demonstrated statistically significant improvement in functional outcomes with both surgical techniques as demonstrated in Table 2. However, there was no difference between the groups at final follow up [19,25,26]. Only one comparative study reported functional outcomes in the early post-operative period, demonstrating a significantly slower recovery in the TTR group at 3 months [19]. After 3 months, the ASES had improved significantly more in the TCR group (49.2 to 64.6) compared to the TTR group (50.8 to 54.9), ($p = 0.037$). Similarly, the Constant Score ($p = 0.019$) had significantly improved more in the TCR group (59.0 to 70.8) compared to the TTR group (54.8 to 57.9). Early recovery was not reported in the other three comparative studies. The evidence reviewed relating to functional outcomes was of moderate quality (see Table 6).

In the TTR case series, a variety of functional outcome measures were used with the most common being the ASES in 6 studies and the Constant score in 3 studies. All case series reviewed reported improvement in functional outcomes after TTR as shown in Table 3. The ASES was reported in both TCR case series, which demonstrated statistically significant improvement as demonstrated in Table 4. However, the studies lacked information on early functional recovery with outcomes reported at final follow up only; mean range of follow up was 12 to 62 months in the TTR case series and 24 to 38 months in the TCR case series.

3.2. Pain

Two comparative studies reported improvements in pain using the VAS score (see Table 2); Shin demonstrated a rise of 4.1 in the TTR group and 4.2 in the TCR group whilst Castagna et al. a rise of 3.4 and 3.6 respectively [19,25]. Only Shin reported early pain relief where pre-operative pain had worsened in the TTR group from 5.5 to 5.9 and reduced from 5.3 to 2.8 in the TCR group ($p = 0.001$) [19]. However, these authors report that from six months onwards, there was no statistical difference between the groups [19]. Nine TTR and one TCR case series reported pain with improvements ranging from 3.8 to 6.7 after TTR and being 5.7 after TCR [17,18,28,31–33,36–38,40] (see Tables 3 and 4).

3.3. Re-tear

The re-tear rate was reported in three comparative studies and four TTR case series, these results are demonstrated in Table 5. In the comparative studies, the re-tear rate ranged from 0 to 5.9% in the TTR group and from 0 to 8.3% in TCR group [19,26,27]. None of the comparative studies demonstrated any statistically significant difference between the groups at final follow up (mean range: 19

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