International Journal of Orthopaedics

Online Submissions: http: //www.ghrnet.org/index.php/ijo
doi: 10.17554/j.issn.2311-5106.2022.09.473

Int. J. of Orth. 2022 December 28; **9(5)**: 1699-1703
ISSN 2311-5106 (Print), ISSN 2313-1462 (Online)

REVIEW

Rotator Cuff Partial-Thickness Tears: Review of Current Surgical Management

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Conflict-of-interest statement: The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

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Received: October 10, 2022
Revised: November 6, 2022
Accepted: November 9 2022
Published online: December 28, 2022

ABSTRACT

Rotator cuff partial-thickness tears are a common cause of shoulder pain and disability affecting mainly the middle age group of active population. Despite improvements in diagnosis and surgical techniques, treatment has remained controversial. Over the last decade however, results of randomised controlled trials have become available and offer an evidence-based guidance on the selection of the appropriate surgical technique. We review the epidemiology, natural history and treatment of rotator cuff partial-thickness tears and discuss the results of recent studies and the current trends in the surgical management of this debilitating condition.

Key words: Rotator cuff tear; Partial-thickness tears; Surgical management; Partial thickness rotator cuff tear

Anestis I, George T, Liam R, Mohamed A, Lena AH. Rotator Cuff Partial-Thickness Tears: Review of Current Surgical Management. *International Journal of Orthopaedics* 2022; **9(5)**: 1699-1703 Available from: URL: http://www.ghrnet.org/index.php/ijo/article/view/3357

INTRODUCTION

Rotator cuff partial-thickness tears (PTTs) are more common than full thickness tears, with an overall prevalence of 20% and increasing with age. They are a common cause of shoulder pain and disability affecting mainly the middle age group of active population. Repair of the tendon is recommended after initial failure of non-operative treatment by either completion of the tear and repair (CR) or trans-tendon repair (TTR). Despite improvements in diagnosis and surgical techniques, the treatment of PTTs has remained controversial. Over the last decade however, results of randomised controlled trials, systematic reviews and long-term case series studies have become available and offer an evidence-based guidance on the selection of the appropriate surgical technique according to the depth and location of the partial thickness tear. We therefore review the epidemiology, natural history and treatment of PTTs and discuss the results of recent studies and the current trends in the surgical management of this debilitating condition.

PREVALANCE

Rotator cuff partial-thickness tears (PTTs) are mainly seen in the supraspinatus tendon [Fukuda 2003] and their prevalence ranges from 13% to 32% of cases[1-3]. PTTs are more common than full-thickness rotator cuff tears (FTTs). Reilly et al (2006) in a review of 2553 cadaveric shoulders (mean age of 70 years) reported 18.5% PTT and 11.8% FTTs. Review of magnetic resonance imaging (MRI) findings in 271 asymptomatic rotator cuff tears (mean age of 43.6 years) showed a prevalence of 15.87% PTTs and 10.33% FTTs[4]. Similarly, Sher et al (1995), in an MRI study of 96 asymptomatic cases, showed an overall prevalence of 20% of PTTs and 15% of FTTs and observed that the prevalence of PTTs increases with age, from 4% in patients under the age of 40, to 24% between the ages 40 and 60 and to 26% in patients over the age of 60[5].

LOCATION, DEPTH, AND CLASSIFICATION OF ROTATOR CUFF PARTIAL-THICKNESS TEARS

PTTs were first described by Codman and classified by Ellman according to their location and depth[6,7]. The Ellman classification system is based on arthroscopic findings in 120 arthroscopic procedures. Taking into consideration the location of the tear (articular, bursal or intratendinous) and the depth of the tear expressed in mm or calculated as a percentage of the thickness of the tendon. Grade I: < 3 mm deep (< 25% of tendon thickness), Grade II: 3-6 mm deep (< 50%), and Grade III: > 6 mm (> 50% of the tendon thickness) [7]. The clinical application of the Ellman classification is practical as it is easy to assess the depth of PTTs intraoperatively with a calibrated probe. This classification is commonly used to determine the treatment options. Articular PTTs are 2 to 3 times more common than bursal-sided tears[3,8-10]. Partial tears can be more painful than full-thickness tears and bursal tears were found to be the most painful[1,11].

NATURAL HISTORY OF PTTS: TEAR PROGRESSION AND TEAR CONVERSION TO FTT

Natural history studies inform on the rate of disease progression over time, allowing assessment of the appropriate timing of intervention. The natural history of partial-thickness tears is a gradual increase in size with time, as demonstrated by histological, biomechanical and clinical studies of patients treated nonoperatively. Histological studies revealed that PTTs have limited potential for spontaneous healing[12]. A biomechanical study by Reilly et all [2003] reported that there is a difference in strain between the joint and bursal sides of the supraspinatus tendon with static loading and during abduction and suggested that shearing between the layers of the supraspinatus tendon, initiated by high joint side strains, causes propagation of the tendinous defects and result in a full-thickness tear[13]. In another biomechanical study, Mazzocca et al (2008) demonstrated that partial-thickness tears increase the strain of the remaining intact tendon and lead to tear progression. It was shown that defects of more than 50% of the tendon thickness, substantially increased the strain on the remaining tendon. Following tendon repair however, the strain levels returned close to the intact state[14].

A number of clinical studies have reported the tear progression rate in asymptomatic and symptomatic PTTs treated nonoperatively. In some studies tear progression was defined as an increase in tear size[15,16]. Yamamoto et al (2017) in his study of 83 symptomatic PTTs, reported that the tear size progressed in 41% of cases at 19 months, with a mean speed of progression of 2.0 mm per year in width[15]. Lo et al (2018) in 37 symptomatic PTTs reported an overall 24% tear progression at a mean of 3.8 years, although the tear progression rate was higher in high-grade tears than low-grade tears (55% vs 14%) respectively[16].

Other studies however, have defined tear progression as the time to conversion to a full thickness tear, which is a more useful surgical end point[17,18]. Keener et al (2015) in a prospective study of 54 asymptomatic PTTs, showed that 44% converted to full thickness tear with a median time to conversion of 3.3 years[17]. Oh et al (2020), treated conservatively 52 patients with symptomatic high-grade articular or bursal PTTs and reported that overall, 31% of partial tears progressed to full thickness tears at a median time of 2.6 years, regardless of the location of the tear (articular or bursal side). The Kaplan-Meier plotting, indicated a full thickness conversion rate of 4.5% at 1 year, 23.2% at 2 years, 33 % at 3 years, and 64% at 4 years. The authors suggested that regular monitoring of tear progression should be considered after conservative treatment of high-grade PTT[18].

The above studies confirm the progressive nature of the degenerative rotator cuff disease, and demonstrate that PTTs treated nonoperatively are likely to convert to FTT within 3 years in 33% to 44% of cases.

OPERATIVE MANAGEMENT OF PTTS

Treatment of Ellman Grade II (< 50%) PTTs: Arthroscopic debridement and selective acromioplasty

In a systematic review, Straus et al (2011) reported that tears that involve less than 50% of the tendon can be treated with good results by debridement of the tendon with or without acromioplasty, and warned that subsequent tear progression may occur[19]. Dwyer et al (2018) in a study of 76 patients with a mean age of 55 years, demonstrated that good outcomes can be achieved with arthroscopic debridement and selective acromioplasty among patients with articular or bursal sided PTT of < 50% tendon thickness, at 2-year follow-up regardless of the tear location[20].

Long term results however may be compromised due to tear progression as reported by two studies[21,22]. Kartus et al (2006), in a study of 26 patients treated with decompression and debridement, reported that 35% of patients had a full-thickness tear conversion on ultrasound scan at 5 years minimum follow-up[21], whereas Liem et al (2008) in his study of 46 patients demonstrated that only 6.5% tears progressed to full thickness on ultrasound scan at a mean of 4 years follow-up[22].

The results of the above studies demonstrate that arthroscopic rotator cuff debridement and selective acromioplasty in patients with intermediate grade partial tears (Ellman Grade II), do not protect the rotator cuff from further degeneration. They do however, appear to delay tear progression and deterioration of clinical results for 4 to 5 years.

Treatment for Ellman Grade III (> 50%) PTTs: Rotator cuff repair techniques

Surgical repair is indicated when conservative management fails, in symptomatic patients with high grade PTTs (> 50% of the tendon thickness or 6 mm in depth). Completion of the tear and repair (CR) and transtendon repair (TTR) are the two main arthroscopic rotator cuff repair techniques for PTTs.

Fukuda et al 1994 and Wright et al (1996) reported satisfactory results in patients with partial tears treated with open cuff repair and acromioplasty[12,23]. Weber et al (1999) first reported a significantly worse outcome in patients with tears ≥ 50% of the thickness of the rotator cuff treated with arthroscopic debridement alone and recommended rotator cuff repair[24]. Straus et al (2011) in a systematic review, reported successful results of rotator cuff repair in high grade PTTs[19].

Snyder (1999) and Lo et al (2004) proposed the transtendon arthroscopic repair technique in an attempt to avoid removing the remaining intact cuff tissue. Restoring the medial aspect of the footprint while preserving the intact lateral tendon was thought to minimise any length-tension mismatch of the repaired cuff[25,26].

Completion of the tear and repair (CR) vs Transtendon repair (TTR)

Biomechanical studies comparing the two repair techniques showed that the gap formation was smaller and the ultimate tensile load was higher in TTR than CR[27]. Despite the TTR's biomechanical advantages, four recent randomised and controlled trials, reported favourable medium term clinical results regardless of the repair technique used, with no statistical differences in clinical and functional outcomes at final follow-up between 19 to 36 months[28-31]. Three of these studies compared both repair techniques for high-grade articular sided PTTs[28-30].

Shin et al (2012), in a study of 49 patients reported that the arthroscopic repair provided satisfactory pain relief and functional outcomes, regardless of the repair technique at six months and these results were maintained at a mean of 31 months' follow-up with high healing rate in 96% of cases. Interestingly however, during the first 6 months the transtendon repair (TTR) showed less pain relief and slower functional recovery than the Completion and repair (CR) technique. Pain relief, range of motion and functional scores in the CR group occurred significantly faster at 3 months whereas in the TTR group this was achieved at 6 months postoperatively[28].

Franceschi et al (2013) studied 60 patients with a follow-up of 3 years. Both the groups were significantly improved for clinical scores without any significant difference in clinical scores, rate of tendon healing (94% in TTR vs 96.5% in CR) and postoperative stiffness (9% in TTR vs 10.7% in CR). However, in 6% of TTR patients shoulder stiffness was persistent at six months and required arthroscopic capsular release[29].

Castagna et al (2015) in a study of 74 patients with high grade articular side PTTs, showed a statistically significant improvement in the scores and no differences in terms of pain and functional improvement regardless of the cuff repair technique at 2 years minimum follow-up[30].

Kim YS et al (2015) studied 92 patients with high-grade articular or bursal sided PTTs. At a mean time of 19 months both repair techniques provided satisfactory pain relief, range of motion and functional outcomes with high tendon healing rates (84% in CR vs 95.7% in TTR). The retear rate for bursal-sided PTT was higher in the CR than the TTR (23% vs 3.3%), however, the retear rate for the articular-sided PTT was not statistically different (0% CR vs 5.9% TTR)[31].

Similarly, two recent systematic reviews by Kathagen et al (2018) and Jordan et al (2018) have reported that both arthroscopic repair techniques provide equally satisfactory medium term clinical and functional improvements at final follow-up[32,33]. However, Jordan et al (2018) concluded that early functional recovery and pain relief after CR was superior when compared to TTR[33].

Choice of rotator cuff repair technique in PTTs

The advantages of the tear completion and repair technique are its simplicity and familiarity with a standard arthroscopic rotator cuff repair technique in the subacromial space. Recent results of the completion and repair technique by Fama et al (2021) in a study of 87 patient and follow-up of 5 years reported satisfactory pain relief, range of motion and functional outcomes with high tendon healing rates in 94.3% and stiffness in 8% of cases that responded to physical therapy[34].

In contrast the transtendon repair is mainly an intraarticular technique with higher degree of difficulty and requires advanced arthroscopic skills. The theoretical advantage of the transtendinous repair in preserving the remaining intact tendon, has recently been questioned. The intact tendon has been shown to demonstrate histopathologic changes consistent with degeneration in over 90% of cases, supporting the removal of the residual intact tendon[35].

There are also increasing concerns with clinical outcomes during the first three to six months following transtendon repair. persistent stiffness and residual pain. Particularly with respect to persistent stiffness and residual pain

Sheen (2012) and Fanceschi (2013) reported slower recovery of TTR compared to that of CR[28] and persistent stiffness, over the first six months post repair[28,29]. Vinanti et al (2016) in the largest study of transtendon repair in 100 patients with median follow-up 3.3 years, reported stiffness rate of 18% at 3 months which recovered by the sixth month. 2% of patients complained of residual shoulder pain interfering with their activities, and 32% complained of occasional discomfort with overhead activities[36]. Similarly, Castagna et al (2009) in a study of 54 transtendon repair of PTTs, reported that 2% of patients complained of persistent shoulder pain during overhead activities, while 41% of patients complained of occasional activity-related shoulder discomfort. This study showed that residual shoulder discomfort was linked to a large initial tendon tear retraction[37].

The above studies show that both rotator cuff repair techniques have similar medium term results, however at short-term CR technique results in an earlier functional recovery with less pain and stiffness than the TTR technique. These findings tend to favour the CR as the preferred technique.

CONCLUSION

On the basis of the available evidence over the last decade, we conclude that rotator cuff PTTs treated nonoperatively are likely to convert to FTT within 3 years in 33% to 44% of cases. Ellman Grade II PTTs (< 50%) can be successfully treated with debridement and selective acromioplasty although they have to be closely monitored as tear progression may occur within 4 to 5 years in 6.5% to 35% of cases. For Ellman Grade III (> 50%) partial-thickness tears the CR technique appears to be the repair procedure of choice, as it can provide significantly better and faster functional recovery than the TTR with less pain and post-operative stiffness in the first three to six months, particularly when there is no difference in outcomes between the two repair techniques at medium term follow-up.

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