

Research Article

Midterm outcomes after arthroscopic repair of partial rotator cuff tears: A retrospective study of correlation between partial tear types and surgical technique

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ABSTRACT

Objective: Patients who underwent arthroscopic repair for partial rotator cuff tears were evaluated retrospectively. This study purposed to assess the postoperative clinical results of arthroscopic treatment of intratendinous rotator cuff tears and to investigate the effect of the tear type on the postoperative clinical outcomes.

Methods: Overall, 60 patients [36 women and 24 men; mean age: 48.6±12.2 years (range 33–67 years)] who underwent arthroscopic repair of Ellman stage 3 partial rotator cuff tear were evaluated retrospectively. These patients were grouped into the following three groups: articular-sided tears, bursal-sided tears, and intratendinous tears, with 20 patients included in each group. Subacromial decompression, acromioplasty, and tear repair without transforming to full-thickness tear were applied to the bursal-sided tears. The same technique was performed for intratendinous ruptures, with the only technical difference was that the capsular tissue was preserved during debridement of intratendinous tears. The articular-sided tears were transformed to complete tears and repaired arthroscopically. The preoperative and postoperative ASES scores and range of motion improvements were evaluated in all patients. The mean follow-up time was 44±6.5 months (range: 36–62 months).

Results: No significant intergroup differences were observed concerning the age and the mean follow-up duration ($p=0.524$, $p=0.665$). A similar increase in ASES scores was observed for all three types of tears (bursal-sided tears: 31.09–82.65; articular-sided tears: 35.50–84.00; intratendinous tears: 34.01–83.49). Statistically, no significant intergroup difference was observed concerning ASES score improvement ($p=0.585$). An increase in mean forward flexion, abduction, and external rotation were observed, especially, a statistically significant increase in flexion ($p=0.001$) and abduction ($p=0.001$) in all three types of tears. No patient experienced any intraoperative or postoperative complications.

Conclusion: The results of arthroscopic treatment of intratendinous tears were similar to the other types of partial tears, and the results of arthroscopic treatment of grade 3 partial rotator cuff tears revealed satisfactory outcomes, regardless of the type of the tear.

Level of Evidence: Level III, Therapeutic study

Partial-thickness rotator cuff tears can occur in different clinical situations and can be asymptomatic or cause pain and loss of function, affecting daily life. Partial-thickness tears have a higher incidence rate compared with full-thickness tears, and interestingly, they tend to be more painful than full-thickness tears (1). Symptoms resulting from partial tears are thought to be the consequence of non-physiologic tension created within the remaining intact rotator cuff fibers (2).

Based on the different structural characteristics, partial rotator cuff tears can be divided into the

following three subgroups: bursal-sided, articular-sided, and intratendinous tears (3-5). These tear patterns tend to be the eventual consequence of several pathophysiologic mechanisms, which can be either intrinsic or extrinsic factors (6-9). Traditionally, the first 50% of the part consists of the joint capsule. Hence, tears larger than 50% of the footprint are recommended to be repaired (50% rule) (10).

The conventional treatment modalities are active surveillance, oral pain medication, steroid or tenoxicam injection, shoulder exercises, and sur-

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gical treatment (11-13). The effectiveness of conservative treatment is not inferior to arthroscopic repair for patients with less than medium-sized rotator cuff tear in terms of pain and range of motion (14). Therefore, patients who did not benefit from conservative treatment were included in this study.

Intratendinous tears are the least common and typically diagnosed at the advanced stage (15). Arthroscopic diagnosis is challenging because of the absence of tears on both the bursal and articular sides. Generally, the diagnosis is made using the “balloon sign” on magnetic resonance (MR) images. Notably, the probe is used arthroscopically to reveal the tear delamination (16). Nevertheless, only few studies are available in the literature regarding intratendinous ruptures. Therefore, this comparative study will contribute to the literature on arthroscopic treatment of intratendinous ruptures. Moreover, we have described our repair technique in this study. Notably, it is not necessary to convert to full-thickness tears because an intact capsule helps to nourish the tear.

Our purpose was to evaluate the results of arthroscopic treatment of intratendinous rotator cuff tears and investigate the effect of the tear type on postoperative clinical outcomes. We hypothesized that the postoperative clinical results of intratendinous tears were as good as that of other partial tears.

Materials and Methods

Overall, 60 patients who underwent arthroscopic repair of Ellman stage 3 partial rotator cuff tear between 2011 and 2014 were evaluated retrospectively. These patients were divided into the following three groups: articular-sided tears, bursal-sided tears, and intratendinous tears, with each group comprising 20 patients. Notably, the exact diagnosis of patients was discerned intraoperatively. Patients were consecutively included in the three groups. All patients had a history of failed conservative treatment (active surveillance, oral pain medication, steroid or tenoxicam injection, and physiotherapy), as well as persistent shoulder pain before the surgery (Table 1). Patients aged between 40 and 60 years were included in the study. Furthermore, patients whose postoperative follow-up period was longer than 3 years were included in the study to avoid bias. Patients who had stage 1 and 2 partial rotator cuff tears, tears extending into other rotator cuff tendons, previous surgical history, glenohumeral instability, and adhesive capsulitis were excluded.

Preoperative and postoperative ASES (The American Shoulder and Elbow Surgeons) Shoulder Scores that were recorded in the archive were evaluated. ASES is a clinical test that is often used in the literature to measure the effect of a patient’s daily work on the pain level. Additionally, the preoperative and postoperative forward flexion, abduction, and external rotation range of motions were measured in all patients. The questionnaires and examinations were administered in the office by the same researcher.

Preoperative MR images of all patients were evaluated. The diagnosis of intratendinous tears was made using MR images because of the difficulty of an arthroscopic diagnosis. MR imaging typically exhibits signal changes within the tendon without extending to the articular or bursal surfaces, which is called a balloon sign. MR findings were used to help locate the intratendinous tears arthroscopically.

Patients and their credentials were assessed by the same researcher.

Surgical technique

All patients were operated under interscalene block or hypotensive general anesthesia in the lateral decubitus position by the same surgeon. Standard glenohumeral arthroscopy was performed to assess the intra-articular rotator cuff disease, including partial rotator cuff tear and associated injuries. If the patient was diagnosed with articular-side partial-thickness tears, a tagging suture was placed at the tear site to evaluate the continuity of the tear to the bursal side. After glenohumeral arthroscopy, subacromial arthroscopy was performed to examine the bursal-side rotator cuff disease, coracoacromial ligament (CAL), acromion, and bursa. In the case of an accompanying biceps pathology, the standard biceps tenotomy was performed.

Tear repair without transforming to full-thickness tear was performed for the bursal-sided tears and intratendinous tears, whereas the articular-sided tears were converted to complete tears and repaired arthroscopically. In addition, subacromial decompression and acromioplasty were added to the arthroscopic treatment of bursal-sided tears.

Notably, subacromial decompression and acromioplasty were added to the treatment of all bursal-side tears because of the possibility of the presence of subacromial impingement syndrome. Subsequently, the modified lateral tension band technique was used for tear repair. In this technique, free sutures (FiberWire® Suture-Arthrex) were passed through the anterior and posterior sides of the tear. The sutures were then knotted in the subacro-

Table 1. Demographic characteristics of patients

	Bursal side	Articular side	Intratendinous
Number of patients	20	20	20
Age, yr, mean ± SD	47.6±12.1	48.9±13.8	49.9±12.4
Follow-up duration, mo, mean±SD	43.1±4.8	42.4±4.5	44.8±6.0
Sex, M/F, n	8/12	10/10	6/14
Dominant side, n (%)	14 (70)	15 (75)	12 (60)
Ellman grade 3, n (%)	20 (100)	20 (100)	20 (100)
Acromioplasty, n (%)	20 (100)	0 (-)	0 (-)

F: female; M: male; yr: year; mo: month; SD: standard deviation

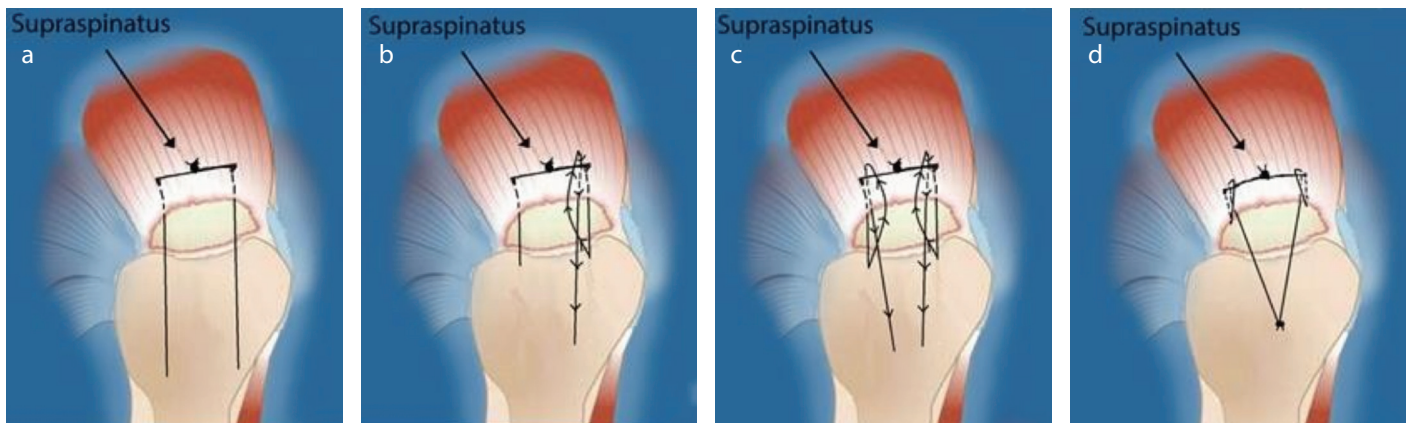


Figure 1. a-d. Surgical technique of bursal-side partial tear. Free sutures are passed through anterior and posterior side of the tear (a). The sutures are knotted in the subacromial region (b). The other untouched ends are passed through the tendon again (c). Finally, a modified lateral tension band technique is applied with the help of one anchor (d)

mial region. This knotting results in medial depression of the tendon to the footprint. The other untouched ends were passed through the tendon again. Finally, a modified lateral tension band technique was performed using one anchor (Figure 1).

This technique was also performed for intratendinous ruptures, with the only technical difference being the preservation of capsular tissue during the debridement (Figure 2). In intratendinous tears, the capsule is sturdy. Hence, leaving the capsule intact helps to nourish the tear. Therefore, we did not transform the partial tear into a full-thickness tear. Furthermore, superficial debridement was performed to the bursal-sided partial tears.

Articular-sided tears were converted to complete tears because of the degeneration of the rest of the tears and repaired arthroscopically. After debridement, double-row repair with two independent knotless anchors was performed to repair these tears.

Statistical analysis

Patient samples were determined based on the tear type. Preoperative and postoperative non-parametric data from both groups were analyzed using the Wilcoxon-signed rank test. The range of motion improvements were analyzed using the paired t-test. Significance was set at a level of 0.05, with 95% confidence intervals. The power analysis was performed for detecting an adequate patient number for groups. A sample size of 20 patients was shown to be needed to be able to reject the null hypothesis with a type I error set at 0.05 and to exhibit significant power greater than 80% for all the variables tested.

Results

The mean age of patients at the time of surgery was 48.6 years (range: 43–60 years). The mean age of patients was 47.6 years in the bursal-sided tears group, 46.9 years in the articular-sided tears group, and 49.9 years in the intratendinous tears group. No significant intergroup difference was observed concerning the age and gender ($p=0.524$ and $p=0.552$, respectively) (Table 1).

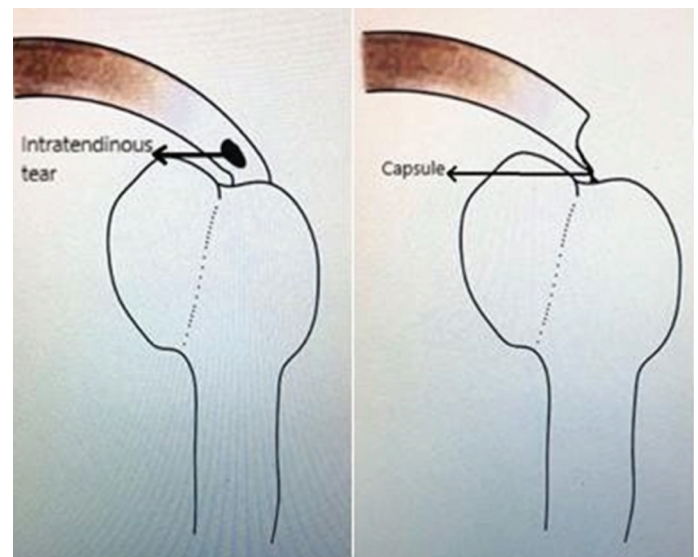


Figure 2. Capsular tissue was preserved when performing debridement in intratendinous tear

The mean follow-up time of patients was 44 ± 6.5 months (range: 36–62 months) (Table 1), with no significant intergroup difference regarding the follow-up period ($p=0.665$).

Preoperative mean ASES score was 31.0 for bursal-sided tears group, 35.5 for articular-sided tears group, and 34.0 for intratendinous tears group, with the postoperative mean ASES scores being 82.6, 84.0, and 83.4, respectively. A similar increase in ASES scores was noted after surgery for all three types of partial tears (bursal sided: 51.6, articular sided: 48.5, and intratendinous: 49.4). Statistically, no significant intergroup difference was observed regarding the ASES score improvement ($p=0.585$) (Table 2).

Furthermore, an increase was observed in the mean forward flexion, abduction, and external rotation, especially, a statistically significant increase in flexion ($p=0.001$) and abduction ($p=0.001$) for all three tear types. On the other hand, no intergroup difference was observed regarding the mean values (Table 3).

Table 2. Clinical results of patients

	Preoperative ASES Score, mean points	Postoperative ASES Score, mean points
Bursal side	31.09	82.65
Articular side	35.50	84.00
Intratendinous	34.01	83.49

ASES: The American Shoulder and Elbow Surgeons Shoulder Score

Table 3. Range of motion improvements

	Flexion	External rotation	Abduction
Bursal	18	4	21
Articular	15	8	16
Intratendinous	14	2	16
p	0.001	0.102	0.001

No intraoperative or postoperative complications occurred, as well as no complications owing to the anesthesia.

Discussion

In this study, patients who underwent arthroscopic repair for different types of stage 3 partial rotator cuff tears were evaluated from a functional point of view. The most striking result of this study was no difference among the three tear types in terms of postoperative clinical outcomes. Therefore, these results confirmed our hypothesis. Only few studies in the literature have compared the arthroscopic repair of tears, and only one of these trials included all three types of partial tears (17). Other studies either did not pay attention to the stage of tears or did not examine intratendinous tears (8-18). Therefore, we believe our comparative study will contribute to the literature further, especially concerning the clinical consequences of intratendinous partial tears.

This study mainly provides information regarding the arthroscopic repair results of intratendinous tears, which is nonexistent in the literature. Notably, intratendinous tears of the supraspinatus tendon are rare and difficult to diagnose. The literature has limited studies regarding the arthroscopic treatment of intratendinous tears (15-19). Uchiyama et al. treated intratendinous partial cuff tears with open repair technique and followed up for an average of 92 months. They observed an increase in the mean ASES score from 37.1 to 91.0 (19). Park et al. treated patients with arthroscopically confirmed intratendinous tears by using transtendon suture bridge repair and followed up for an average of 56 months (16). Xiao et al. specified that the average UCLA score increased from 16.7 to 32.5, and the Constant score increased from 66.2 to 92.4. They followed up their study patients for an average of 15.2 months after surgery, and 81.5% of patients exhibited radiological evidence of a healed tendon. The mean ASES scores improved significantly from 51.4 to 90.6 (20). In our study, we evaluated patients who underwent the tear completion repair technique, with an improvement in the mean ASES score from 34.0 to 83.4. Moreover, our study results were similar to that of the repair results of

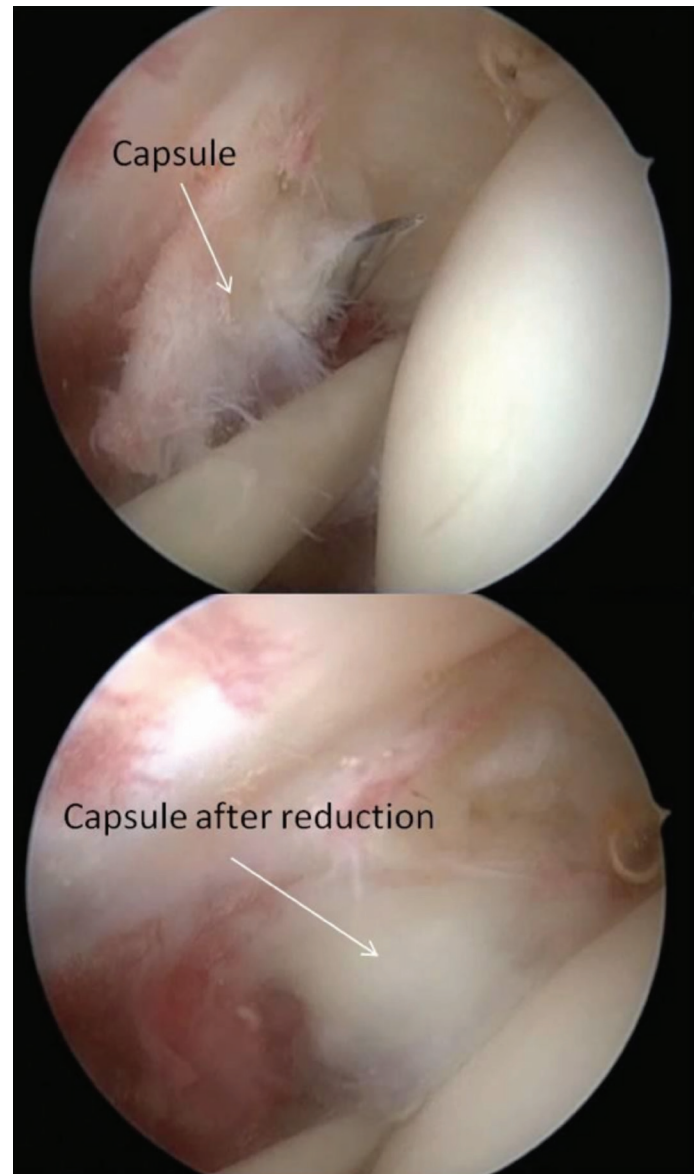


Figure 3. Articular-side tear associated with capsule. This is not a grade 3 partial tear and he was excluded from the study

articular-sided, bursal-sided, and intratendinous partial tears in the literature (16, 19, 21, 22). In addition, this data was similar to the results of similar studies in the literature (17).

Capsule tears typically do not exceed 3–5 mm in size, have a degenerative appearance, and can be treated adequately with debridement (Figure 3). Traditionally, tears that are larger than 50% of the footprint is recommended to be repaired (50% rule) (3, 4, 10). Millstein and Snyder have called these lesions as PASTA lesions (Partial Articular Supraspinatus Tendon Avulsion) (23). In patients diagnosed with articular-side partial-thickness tears, a tagging suture is placed at the tear site to evaluate the continuity of this tear from the bursal side (Figure 4). Notably, there are two surgical techniques for these lesions, namely trans-tendinous or tear completion and repair. Nevertheless, no significant differences were observed between the two methods regarding the

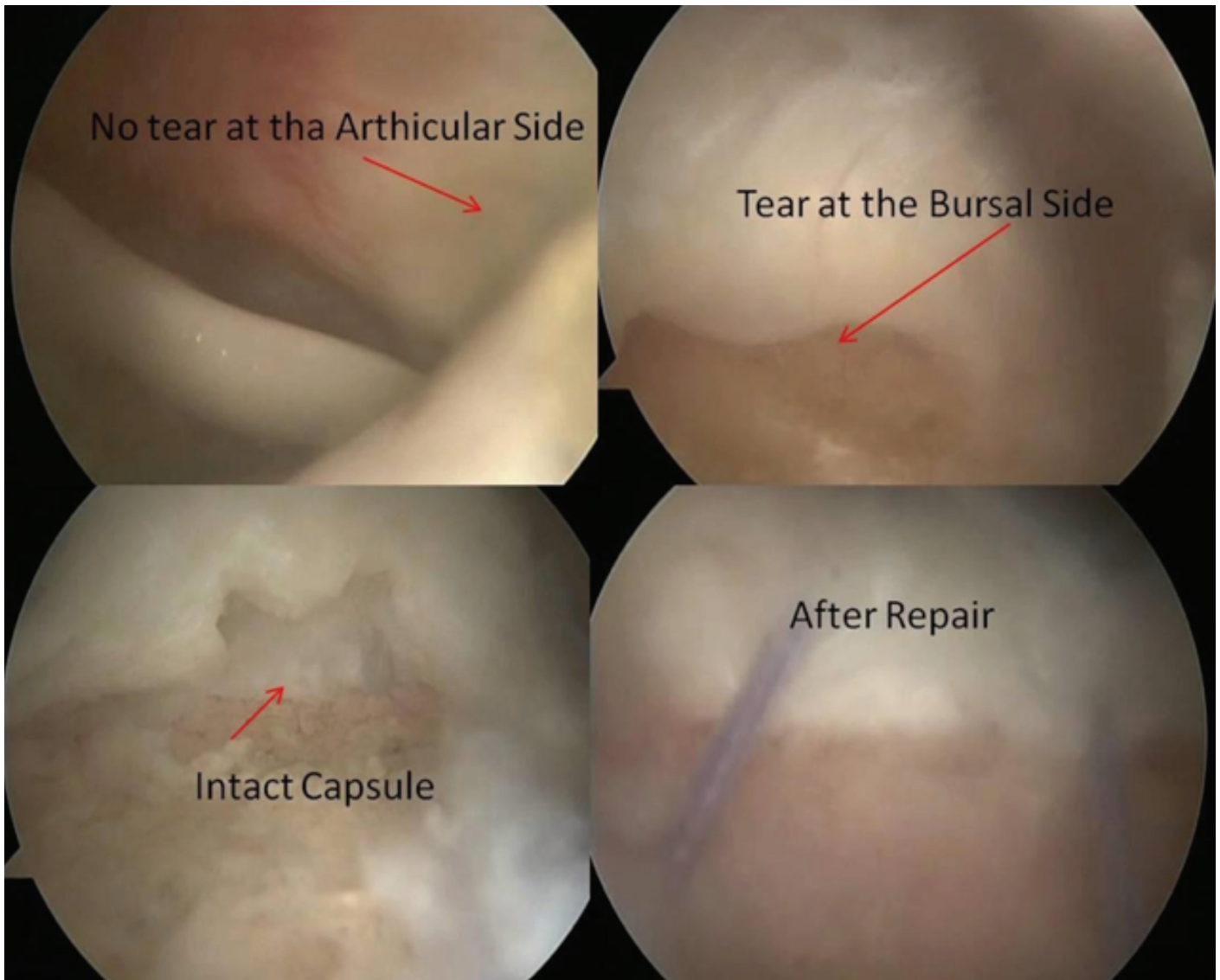


Figure 4. Articular side is intact and bursal-side tear is seen. Modified lateral tension band technique was performed

postoperative outcomes in randomized controlled trials (24, 25). Histology studies revealed a degeneration rate of 90% in intact tendons after articular-side tears debridement (26). Considering this information, tear completion and repair technique was preferred in this study for the repair of articular-side tears.

Notably, studies on bursal-side tears are rather rare in the literature. Fukuda specified that the subacromial impingement is the most significant reason for these tears (10). A tear completion repair technique is not preferable in these tear types because tendon degeneration is less in intact, healthy tissue. The functional results of the surgical repair of bursal-side tears are reported to be better than the articular-side tears (24). Our findings revealed that the modified lateral tension band technique, which does not convert partial tear to full-thickness tear, exhibited excellent clinical outcomes.

The literature lacks data regarding the etiology of partial-thickness rotator cuff tears compared with full-thickness tears. CAL degeneration

has been reported to be a well-known indicator of subacromial impingement. The relationship between the advanced stage CAL degeneration and bursal-side partial rotator cuff tears have been demonstrated (27). However, the same relationship was not observed with partial articular-side tears. For this reason, in this study, acromioplasty was also added to the treatment of bursal-side tears after evaluating the grade of CAL degeneration.

Nonetheless, our study had some limitations. Concomitant pathologies, such as biceps pathologies and subacromial impingement, were not the same for each patient. If there is an accompanying biceps pathology, the standard biceps tenotomy was performed. Acromioplasty procedure was performed in only the bursal-side tear group because of the relationship between bursal-side partial tears and subacromial impingement syndrome. Therefore, these differences may have affected the results. Another limitation was that the radiological results were not studied. Therefore, we could not determine the tear healing rates.

In conclusion, the present study supports the evidence in the literature that the arthroscopic treatment is the recommended choice in the management of high-grade partial rotator cuff tears. The results of arthroscopic treatment of grade 3 partial rotator cuff tears revealed excellent outcomes, regardless of the tear type. The results of arthroscopic treatment of intratendinous tears were identical to that of other partial tears. Use of modified lateral tension band technique in the repair of intratendinous tears produced results that were as good as the tear completion repair technique.

Ethics Committee Approval: N/A.

Informed Consent: Written informed consent was obtained from the parents of the patients who participated in this study.

Author Contributions: Concept - U.K., T.A.; Design - M.O., M.C., Supervision - U.K., M.B.A., M.O., Data Collection and/or Processing - U.K., M.B.A., T.A., M.Ç., M.Ö., T.K.E., Analysis and Interpretation - T.A., T.K.E., Literature Search - M.Ç., T.A., M.Ö., T.K.E., Writing Manuscript - U.K., T.A., M.O., T.K.E.

Conflict of Interest: The authors have no conflicts of interest to declare.

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