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Location and thickness of delaminated rotator cuff tears: cross-sectional analysis with surgery record review

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Background: To facilitate better treatment, we analyzed morphologic features of delamination from the viewpoint of the location of delamination and the thickness of each layer.

Materials and Methods: Of 270 shoulders that consecutively underwent arthroscopic rotator cuff repair, 210 were included. During the operation, the surgeon assessed the size of the rotator cuff tear, determined the presence and location of delamination, and compared the thickness between superficial and deep layers if delamination was present. Immediately after the operation, the surgeon wrote down the data in the record form. The authors retrospectively referred to these surgical records to investigate those items.

Results: Delamination was found in 111 of 210 shoulders. The overall preoperative Constant score did not significantly differ between the 2 groups. In terms of the location, 7.2% cases had delamination in the anterior part, 74.8% in the posterior part, and 18.0% in both parts (Fleiss $\kappa = 0.9$). The larger the rotator cuff tear, the more frequently the delamination was limited to the posterior part (trend $P = .001$). As for layer thickness comparison, 40.0% of the shoulders with small tears, 38.8% with medium tears, 66.0% with large tears, and 80.0% with massive tears had a thicker deep layer than superficial layer (Fleiss $\kappa = 0.9$). The larger the size of the rotator cuff tear, the more frequently the deep layer was thicker than the superficial layer (trend $P = .001$).

Conclusions: The larger the rotator cuff tear, the more carefully shoulder surgeons should observe and treat the posterior and deep part of delamination.

In terms of treatment of rotator cuff tears, precise perception of the anatomy of the rotator cuff insertion is an important element and facilitates correct repair, according to the shape of the torn site, thereby improving the prognosis. Although delamination, defined as “distal layer separation and normal horizontal retraction of the deep layer” (Fig. 1), is one of the negative prognostic factors,[2,7,8,18] its pathologic process remains unclear. In various approaches to diagnosis of delamination, the prevalence of delamination has been reported to vary among studies from 5.2% (magnetic resonance imaging by Walz et al[24]) to 92.0% (arthroscopic surgery by Han et al[9]).[3,7,12,20] To date, clinical features of delamination are still unclear because of the paucity of previous reports. Clark and Harryman[4] noted that the deepest layer of the normal rotator cuff consisted not only of musculotendinous units but also of the capsule of the shoulder joint. Nimura et al previously reported that the width of the capsular attachment on the humerus varies according to the location.[17] Based on these facts, the deep layer of delamination should consist of both the musculotendinous and capsular structures, and the histologic composition of the deep layer should differ from that of the superficial layer. Thus, we hypothesized that the occurrence of delamination varies according to the anteroposterior location, and the thickness of each layer is changed in relation to the expansion of the torn site of the rotator cuff tendon. The objective of this study was to analyze the morphologic features of delamination by retrospectively reviewing surgical records from the viewpoint of the location of the delamination and the thickness of

This study was approved by the Institutional Review Board of Funabashi Orthopaedic Hospital (No. 2015038), and all of the patients provided informed written consent.

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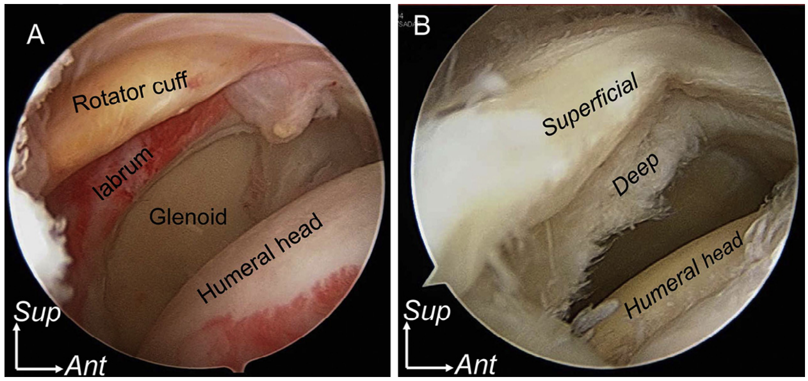


Figure 1 Representative pictures of the torn site of the rotator cuff as arthroscopically viewed from the posterolateral portal. (**A**) Nondelaminated rotator cuff tear of the right shoulder. (**B**) Delaminated rotator cuff tear of the right shoulder. Distal separation and horizontal retraction of the deep layer were observed.

each layer to better understand the pathologic process of delamination.

Materials and methods

Patient selection

The study flow chart is shown in Figure 2. A total of 270 patients underwent arthroscopic repair for rotator cuff tear between August 2011 and February 2013 by the senior surgeon (H.S.) or under his direction. The repair operation was performed on 160 men and 110 women. The average age at the time of the operation was 62 years (range, 28-81 years). All of the patients had a history of chronic shoulder pain that had been treated with medication or physical therapy before resorting to surgery. The indication for surgical repair included pain and functional disability refractory to conservative care. The criterion for inclusion in this investigation was a cuff repair performed solely by the use of arthroscopic techniques. The exclusion criteria included the presence of an isolated subscapularis tear, incomplete rotator cuff tears (only a partial tear), acute traumatic tears, and revision cases (52 cases were excluded). In addition, we retrospectively reviewed the preoperative information including the Constant scores, which were acquired before the operation from 210 patients (data of 8 cases were lost). Thus, we excluded 60 patients, leaving 210 patients for this study.

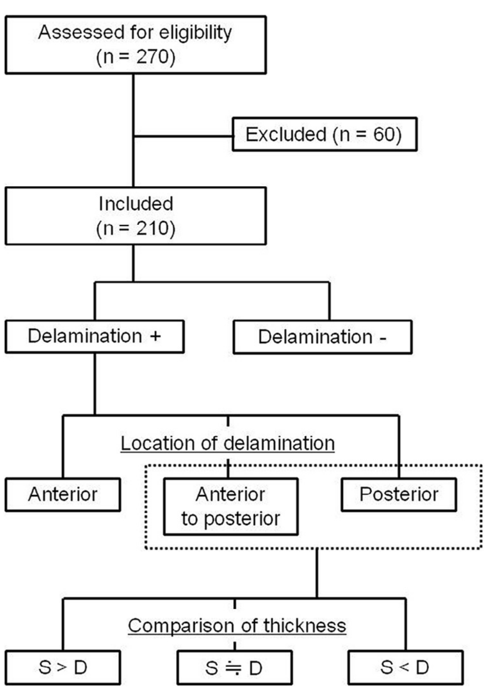


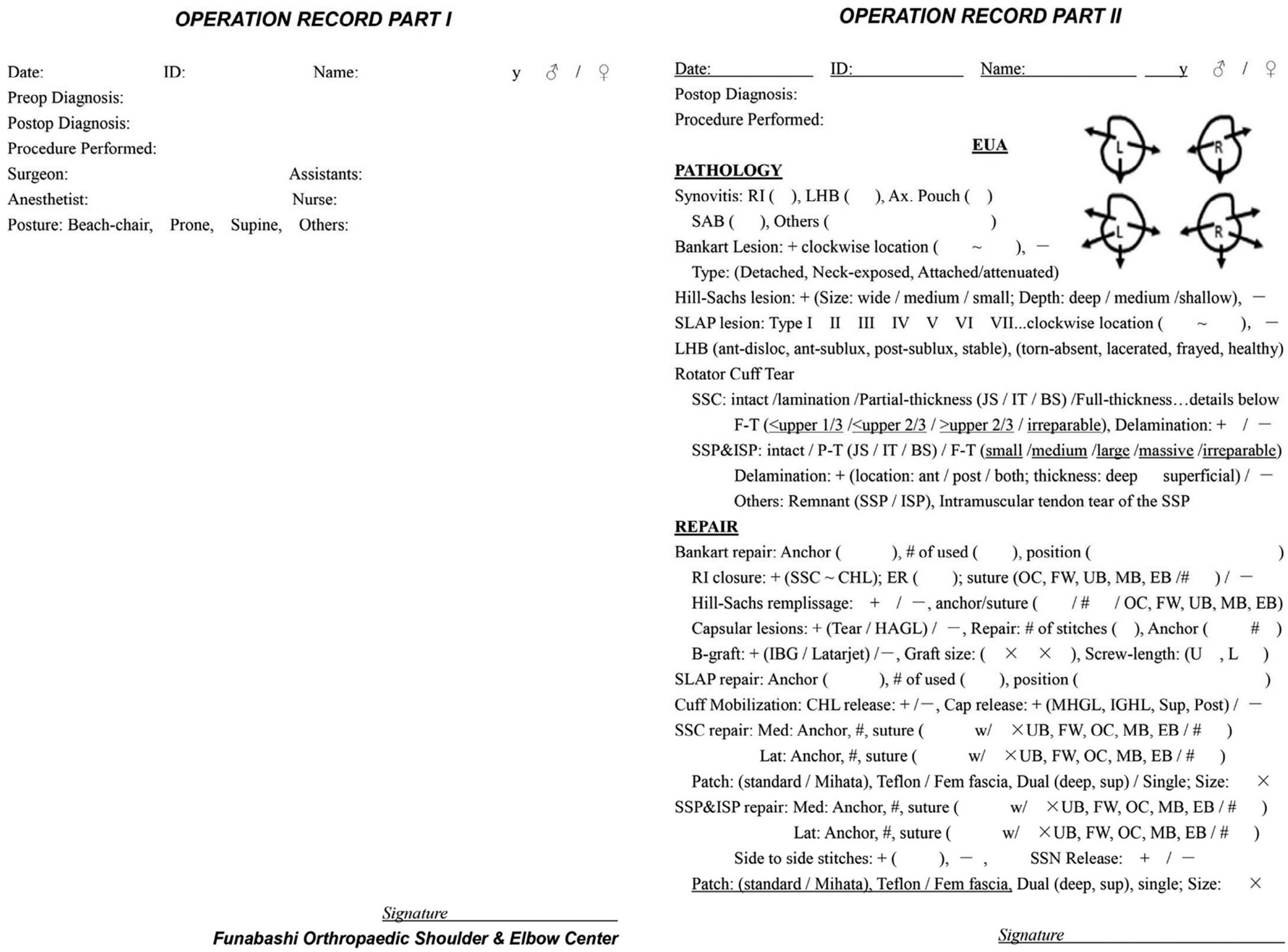
Figure 2 Study flow chart. *S > D*, superficial layer was clearly thicker than the deep layer; *D > S*, deep layer was clearly thicker than the superficial layer; *S≒D*, both layers were of nearly an equivalent thickness.

Surgical techniques and recording of operative notes

The operation was performed in the beach chair position with general anesthesia.[22] A radiofrequency ablator (VAPR; DePuy Mitek, Westwood, MA, USA) was introduced into the anterolateral portal, and a thorough bursectomy with removal of any subdeltoid adhesions was performed. A posterolateral portal was made approximately 1 cm from the inferior border of the lateral acromion. The surgeons assessed the rotator cuff tear using the posterolateral portal as the viewing portal with a 30° arthroscope. For clear visualization of the torn site of rotator cuff tendons, the surgeon removed synovial tissues from around the torn site by using a shaver (DYONICS; Smith & Nephew, Andover, MA, USA) and radiofrequency ablator. During the operation, the surgeon assessed the size of the rotator cuff tear and determined the presence and location of delamination as described later. In addition, if delamination of the torn site was present, the surgeon compared the thickness of the delaminated layers between the superficial and deep ones. In each operation, an arthroscopic video was made to film the operation. Immediately after the operation, the surgeon routinely recorded the results on a form (Fig. 3). We retrospectively referred to those records to investigate the following items.

Classification of the size of rotator cuff tear

The extent of the tear was determined intraoperatively under direct arthroscopic visualization in the posterolateral portal after débridement of the degenerative tendon edges and bursal tissues. Evaluation of the tear size was carried out according to the system described by DeOrio and Cofield.[5] The length of the greatest diameter of the tear, in either the coronal or sagittal plane, was defined as small if the tear was <1 cm in diameter, medium if the tear was ≥1 cm but <3 cm in diameter, large if the tear was ≥3 cm but <5 cm in diameter, and massive if the tear was ≥5 cm in diameter. The surgeon assessed the sizes of all tears using a calibrated probe during surgery and recorded the results immediately after the operation.



OPERATION RECORD PART I

Date: ID: Name: y ♂ / ♀
Preop Diagnosis:
Postop Diagnosis:
Procedure Performed:
Surgeon: Assistants:
Anesthetist: Nurse:
Posture: Beach-chair, Prone, Supine, Others:

Signature
Funabashi Orthropaedic Shoulder & Elbow Center

OPERATION RECORD PART II

Date: ID: Name: y ♂ / ♀
Postop Diagnosis:
Procedure Performed:

PATHOLOGY
Synovitis: RI ( ), LHB ( ), Ax. Pouch ( )
SAB ( ), Others ( )
Bankart Lesion: + clockwise location (~), −
Type: (Detached, Neck-exposed, Attached/attenuated)
Hill-Sachs lesion: + (Size: wide / medium / small; Depth: deep / medium /shallow), −
SLAP lesion: Type I II III IV V VI VII...clockwise location (~), −
LHB (ant-disloc, ant-sublux, post-sublux, stable), (torn-absent, lacerated, frayed, healthy)
Rotator Cuff Tear
SSC: intact /lamination /Partial-thickness (JS / IT / BS) /Full-thickness…details below
F-T (≤upper 1/3 /≤upper 2/3 / ≥upper 2/3 / irreparable), Delamination: + / −
SSP&ISP: intact / P-T (JS / IT / BS) / F-T (small /medium /large /massive /irreparable)
Delamination: + (location: ant / post / both; thickness: deep superficial) / −
Others: Remnant (SSP / ISP), Intramuscular tendon tear of the SSP

REPAIR
Bankart repair: Anchor ( ), # of used ( ), position ( )
RI closure: + (SSC ~ CHL); ER ( ); suture (OC, FW, UB, MB, EB /#) / −
Hill-Sachs remplissage: + / −, anchor/suture (/# / OC, FW, UB, MB, EB)
Capsular lesions: + (Tear / HAGL) / −, Repair: # of stitches ( ), Anchor (#)
B-graft: + (IBG / Latarjet) /−, Graft size: (× ×), Screw-length: (U , L)
SLAP repair: Anchor ( ), # of used ( ), position ( )
Cuff Mobilization: CHL release: + /−, Cap release: + (MHGL, IGHL, Sup, Post) / −
SSC repair: Med: Anchor, #, suture (w/ ×UB, FW, OC, MB, EB / #)
Lat: Anchor, #, suture (w/ ×UB, FW, OC, MB, EB / #)
Patch: (standard / Mihata), Teflon / Fem fascia, Dual (deep, sup) / Single; Size: ×
SSP&ISP repair: Med: Anchor, #, suture (w/ ×UB, FW, OC, MB, EB / #)
Lat: Anchor, #, suture (w/ ×UB, FW, OC, MB, EB / #)
Side to side stitches: + ( ), − , SSN Release: + / −
Patch: (standard / Mihata), Teflon / Fem fascia, Dual (deep, sup), single; Size: ×

Signature

Figure 3 The form of the operative notes.

Morphologic assessment of delamination

The surgeons carefully investigated the configuration of the distal end of the torn cuff to determine the presence and location of delamination from the posterolateral portal as a routine or with an accessory anterolateral portal (Fig. 1). We compared the preoperative Constant scores in terms of the presence and absence of delamination. The surgeons classified the location of delamination into 3 groups in reference to the anterior-posterior center as the boundary of the torn site: anterior, if the delamination was limited anterior to the boundary; posterior, if the delamination was limited posterior to the boundary; and anterior-posterior, if the delamination straddled the boundary. To support the validity of the location of the delamination, the authors retrospectively reviewed the arthroscopic videos. When the findings of the operative notes were compared with those of the author based on independent review of the videos, the Fleiss κ was 0.9 (95% confidence interval, 0.8-1.0). For the group of anterior location of delamination, a comparison of thickness was difficult because the superficial layer was adherent to the coracohumeral ligament that arises from the coracoid process,[1] and the prevalence of delamination in the anterior group was low. Thus, we compared the thickness of each layer in the anterior-posterior and posterior delamination groups (Fig. 1). During the operation, for comparison of the thickness of each layer, the surgeons classified the delaminated cases into 3 categories by integrating information of both the optical comparison and the sense of grasping with the grasper (alligator grasper, Acufex; Smith & Nephew), as follows: S > D, if the superficial layer was clearly thicker than the deep layer; S < D, if the deep layer was clearly thicker than the superficial layer; and S≒D, if both layers were of nearly an equivalent thickness and the difference of thickness could not be identified with either optical or grasping comparison or decisions based on optical assessment and a sense of grasping were inconsistent (Fig. 4). Immediately after the operation, the surgeon recorded the results. To support the validity of the thickness comparison, the authors retrospectively reviewed the arthroscopic videos in the S > D and S < D groups, after excluding cases in the S≒D group, because findings in the S≒D group were unclear based on retrospective review of the videos. When the findings for thickness were compared between the operative notes of the surgeons and the independent review of videos by the authors after exclusion of the S≒D group, the Fleiss κ was 0.9 (95% confidence interval, 0.8-1.0), indicating substantial agreement.

Statistical analysis

The Cochran-Armitage test was used to compare the presence of delamination, the location of delamination, and the thickness of the 2 layers with respect to the size of the rotator cuff tear. The

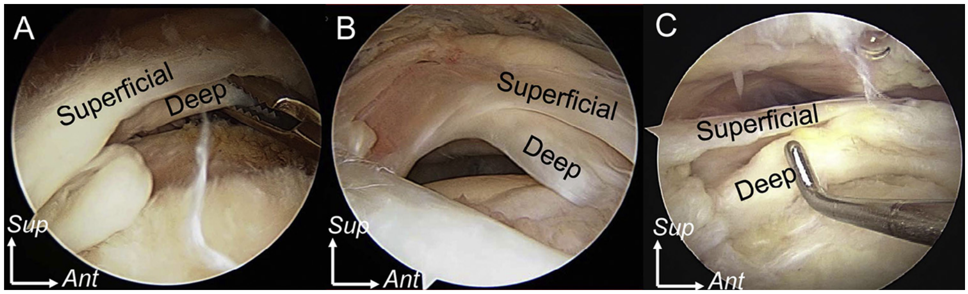


Figure 4 Comparison of the thickness between the superficial and deep layers for each size of delaminated rotator cuff tear. We reviewed surgical videos retrospectively and compared the thickness between the superficial layer and deep layer of the torn site of the delaminated rotator cuff tear. Representative pictures of right shoulders, as arthroscopically viewed from the posterolateral portal, show shoulders in which the superficial layer was thicker than the deep layer (**A**), both layers were of equal thickness (**B**), and the deep layer was thicker than the superficial layer (**C**).

Cochran-Armitage test is used in categorical data analysis in consideration of the ordinal data (eg, low, medium, and high doses of the medicine). For comparison of preoperative Constant scores, the 2 groups were compared using Student test. A *P* value < .05 was considered significant in all comparisons. The Fleiss κ[6] was calculated to determine the interobserver reliability between the surgeon and author in reference to their findings for the thickness comparison after exclusion of the S≒D group. To assess the extent to which a given characterization of a subject is reliable, a number of subjects classified by more than 1 rater is required. The κ coefficient is a measure of the agreement between raters. In this study, we applied the Fleiss κ to assess the agreement, as the Cohen κ does not consider the ordered categorical data. Landis and Koch[11] proposed the following standards for strength of agreement for κ coefficient: poor, 0.01-0.2; slight, 0.2-0.4; fair, 0.4-0.6; moderate, 0.6-0.8; and substantial, 0.8-1.0.

The statistical analyses were carried out using JMP 13 (SAS Institute, Cary, NC, USA).

Results

The prevalence and location of delamination tear according to size

Delamination was present in 111 (52.9%) of 210 shoulders with complete rotator cuff tear. The prevalence of the delaminated rotator cuff tear included 8 shoulders with small tears (20.5%), 40 shoulders with medium tears (53.3%), 48 shoulders with large tears (67.6%), and 15 shoulders with massive tears (60.0%). The increasing prevalence of the delamination was not significant across the largeness of the torn site (trend *P* = .07; Table I). The overall preoperative Constant score was not significantly associated with the presence of delamination (51.4 vs. 55.4; *P* = .10; Table II). In contrast, the Constant subscore for activity in the delamination group was significantly lower than that in the nondelamination group (3.0 vs. 3.7; *P* = .01).

Table I
Tear sizes and the prevalence of delamination

		Delamination	
Size	Total	+	–
Small	39	8 (20.5%)	31 (79.5%)
Medium	75	40 (53.3%)	35 (46.7%)
Large	71	48 (67.6%)	23 (32.4%)
Massive	25	15 (60.0%)	10 (40.0%)
Total	210	111 (52.9%)	99 (47.1%)

The increasing prevalence of delamination was not significant across the largeness of the torn site (trend *P* = .07).

For small tears, delamination was observed at the anterior part of the torn site in 3 shoulders (37.5%), at the anterior-posterior part in 2 shoulders (25.0%), and at the posterior part in 3 shoulders (37.5%) (Table III). For medium-size tears, delamination was observed at the anterior part of the torn site in 4 shoulders (10.0%), at the anterior-posterior part in 9 shoulders (22.5%), and at the posterior part in 27 shoulders (67.5%). For large tears, delamination was observed at the anterior part of the torn site in 1 shoulder (2.1%), at the anterior-posterior part in 8 shoulders (16.6%), and at the posterior part in 39 shoulders (81.3%). For massive tears, no delamination was observed in the anterior part of the torn site; however, delamination was observed at the anterior-posterior part in 1 patient (6.7%) and at the posterior part in 14 shoulders (93.3%). The larger the size of the rotator cuff tear, the more frequently the appearance of delamination of the torn site was limited to the posterior part compared with the anterior and anterior-posterior parts (trend *P* = .001; Table III).

Table II
Comparison of preoperative Constant scores in patients with and without delamination

	Delamination		
	+	–	*P* value
Sample number	111	99	
Overall score	51.4	55.4	.10
Subscores			
Pain	5.8	6.9	.15
Activity	3.0	3.7	**.01**
Mobility	28	29.4	.12
Strength	14.6	15.5	.15

Boldface indicates statistically significant difference.

Table III
Location of delamination

Size	Total	Anterior	Anterior-posterior	Posterior
Small	8	3 (37.5%)	2 (25.0%) 5 (62.5%)	3 (37.5%)
Medium	40	4 (10.0%)	9 (22.5%) 13 (32.5%)	27 (67.5%)
Large	48	1 (2.1%)	8 (16.6%) 9 (18.7%)	39 (81.3%)
Massive	15	0 (0.0%)	1 (6.7%) 1 (6.7%)	14 (93.3%)
Total	111	8 (7.2%)	20 (18.0%) 28 (25.2%)	83 (74.8%)

Anterior, delamination was limited anterior to the boundary; *Posterior*, delamination was limited posterior to the boundary; *Anterior-posterior*, delamination straddled the boundary.
The larger the rotator cuff tear, the more frequently the appearance of delamination of the torn site was limited to the posterior part (the posterior group) compared with the anterior and anterior-posterior groups (trend *P* = .001).

Table IV
Comparison of thickness between the superficial and deep layers from anterior-posterior to posterior site for each size tear

<table>
<tr><th>Size</th><th>Total</th><th>S > D</th><th>S≒D</th><th>S < D</th></tr>
<tr><td rowspan="2">Small</td><td rowspan="2">5</td><td>1 (20.0%)</td><td>2 (40.0%)</td><td rowspan="2">2 (40.0%)</td></tr>
<tr><td colspan="2">3 (60%)</td></tr>
<tr><td rowspan="2">Medium</td><td rowspan="2">36</td><td>11 (30.6%)</td><td>11 (30.6%)</td><td rowspan="2">14 (38.8%)</td></tr>
<tr><td colspan="2">22 (61.2%)</td></tr>
<tr><td rowspan="2">Large</td><td rowspan="2">47</td><td>5 (10.6%)</td><td>11 (23.4%)</td><td rowspan="2">31 (66.0%)</td></tr>
<tr><td colspan="2">16 (34.0%)</td></tr>
<tr><td rowspan="2">Massive</td><td rowspan="2">15</td><td>0 (0.0%)</td><td>3 (20.0%)</td><td rowspan="2">12 (80.0%)</td></tr>
<tr><td colspan="2">3 (20.0%)</td></tr>
<tr><td rowspan="2">Total</td><td rowspan="2">103</td><td>17 (16.5%)</td><td>27 (26.2%)</td><td rowspan="2">59 (57.3%)</td></tr>
<tr><td colspan="2">44 (42.7%)</td></tr>
</table>

S > D, the number of cases in which the superficial layer was clearly thicker than the deep layer; *S≒D*, both layers had an approximately equal thickness; *S < D*, the deep layer was clearly thicker than the superficial layer.
The larger the rotator cuff tear, the more frequent the cases in which the deep layer was thicker than the superficial layer (the S < D group) than S > D and S≒D (trend *P* = .001).

Comparison of thickness between the superficial and deep layers

For small tears, the superficial layer was thicker than the deep layer in 1 shoulder (20.0%), both layers were of equal thickness in 2 shoulders (40.0%), and the deep layer was thicker than the superficial layer in 2 shoulders (40.0%) (Table IV). For medium tears, the superficial layer was thicker than the deep layer in 11 shoulders (30.6%), both layers were of equal thickness in 11 shoulders (30.6%), and the deep layer was thicker than the superficial layer in 14 shoulders (38.8%). For large tears, the superficial layer was thicker than the deep layer in 5 shoulders (10.6%), both layers were of equal thickness in 11 shoulders (23.4%), and the deep layer was thicker than the superficial layer in 31 shoulders (66.0%). For massive tears, both layers were of equal thickness in 3 shoulders (20.0%), the deep layer was thicker than the superficial layer in 12 shoulders (80.0%), and there was no shoulder in which the superficial layer was thicker than the deep layer. The larger the size of the rotator cuff tear, the cases in which the deep layer was thicker than the superficial layer (S < D group) were more frequent than in the S > D and S≒D groups (trend *P* = .001).

Discussion

In this study, we revealed that the larger the size of the rotator cuff tear, the more frequently the appearance of delamination was limited to the posterior part. In addition, we also showed that the larger the size of the rotator cuff tear, the more frequent were cases in which the deep layer was thicker than the superficial layer. These findings seem to be related to unique characteristics in the posterior and deep part of the torn site.

In previous studies regarding delamination of rotator cuff tears, the prevalence of delamination in cases of rotator cuff tears varied widely from 33.3% to 92.0%, depending on the surgical methods and the number of cases. The prevalence of delamination seems to be lower in this study than in previous reports that were evaluated using an arthroscopic approach. Han et al[9] described that the viewpoint alternated between the posterolateral and lateral portals for the purpose of analysis of delamination; in contrast, we consistently evaluated the sites of rotator cuff tear through only the posterolateral portal. That might be one reason that the presence of delamination in this study was lower than in the report of Han et al.[9] To date, the precise location of delamination remains unclear because of the paucity of published articles. Matsuki et al[13] reported that delamination frequently occurred in the posterior part of the torn site rather than in the anterior site. Han et al[9] noted that delamination occurred in the posterior part of the torn site in 88.0% of cases and in the anterior part in 42.0% of cases. In this study, delamination occurred in the posterior part of the torn site in 74.8% of the cases, in the anterior-posterior part in 18.0% of the cases, and in the anterior part in 7.2% of the cases. In addition, the larger the size of the rotator cuff tear, the more frequent was the appearance of the torn site delamination in the posterior part compared with the anterior part. Regarding the normal layer structure of rotator cuff tendons, Clark and Harryman[4] noted that the rotator cuffs at the anterior part of the greater tubercle of the humerus consist of the musculotendinous part of the rotator cuff, the articular capsule, and the coracohumeral ligament and that they are closely intermingled.[4] Thus, we speculated that because of the differences in anatomic features, the connections between layers seemed to be tighter at the anterior part of the tear than at the posterior part. That might be one reason that the delamination was more frequent in the posterior than in the anterior part.

There are few reports discussing the thickness of each layer of delamination. Matsuki et al[13] reported that the deep layer was thicker than the superficial layer in delamination. Based on the results of this study, the deep layers in the large and massive tears were more frequently thicker than the superficial layers, in comparison with the small and medium tears. Therefore, we speculated that the larger the size of the torn site, the thicker the deep layer became in comparison with the superficial layer. The reason for this hypothesis seems to be related to the histologic differences between the 2 layers. Although some authors reported that delamination generally occurs between layers of differing collagen fiber orientation,[21] it has been unclear in which layer the delamination is found. Between the layers composing the delamination, whichever they may be, there is no doubt that the deep layer consists of the joint capsule.

Previously, Nimura et al[17] reported that the superior capsule of the shoulder joint has the thickest attachment at the margin between the infraspinatus and the teres minor. Mochizuki et al[15] also stated that the thick joint capsule underlies the rotator cuffs, and the deep layer could be mainly composed of the joint capsule. Based on the findings of this study, the delamination was mainly observed in the posterior part of the torn site. Therefore, the deep layer might predominantly correspond to the thick attachment of the detached capsule. This could be a reason for the discrepancy in the thickness between the 2 delamination layers in the large and massive tears. Based on the clinical and anatomic findings, we speculated that the pathologic course of the delamination is as follows (Fig. 5). In smaller tears, the superficial layer, which mainly contains the muscular part of the rotator cuff, could maintain the thickness before muscle atrophy (Fig. 5, *B*). After expansion of the torn site, the superficial layer thins because of muscle atrophy. In contrast, the deep layer, which might mainly contain the joint capsule that consisted of the collagenous matrix lacking cell bodies, could maintain the thickness without any muscle atrophy (Fig. 5, *C*).

Based on previous reports regarding the clinical results of repairs of delaminated rotator cuff tears, the clinical results of the series in which each layer was separately repaired have been better compared with those in which both layers were repaired together as a single layer.[10,16,22,23] In other reports, rotator cuff tears with delamination are often described as having a high rate of postoperative tear, which occurs at the articular side.[19] As for clinical implication based on this study, we could propose that the larger the size of the rotator cuff tear, the more careful shoulder surgeons should be when treating the posterior and deep part of delamination in order not to misdiagnose it and furthermore to precisely repair it. Repair of the deep layer, based on the anatomy of the capsular attachment, may contribute to the prevention of postoperative retears of the deep layer and to the improvement of the prognosis. Mochizuki et al[14] proposed that a method of independent repairs of the infraspinatus and the joint capsule could restore both the dynamic function of the rotator cuffs and the

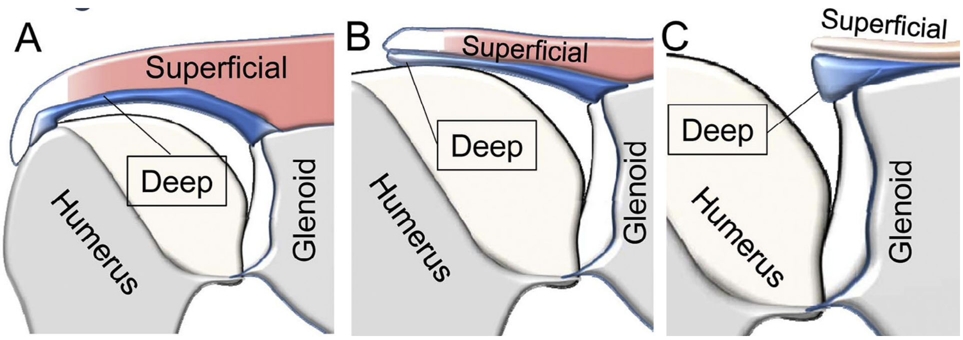


Figure 5 Schemes that illustrate the hypothesis of the transition in the thickness of the superficial and deep layers. (**A**) In a healthy shoulder, the supraspinatus and infraspinatus (*pink*) cover the superior joint capsule (*blue*). (**B**) In small tears, the superficial layer, which mainly contains the muscular part of the rotator cuff, could maintain the thickness. (**C**) After expansion of the torn site, the superficial layer thins because of muscle atrophy. In contrast, the deep layer, which may contain the construct of the joint capsule, could maintain the thickness without any muscle atrophy.

static function of the joint capsule and thereby lead to good clinical results.

There are several limitations associated with our retrospective comparative study. First, because this study was based on the cross-sectional survey of 1 term, the natural expansion process of each layer was actually unclear. Second, because the posterolateral portal, which was solely used as a viewing portal, was insufficient to evaluate delamination, the prevalence of delamination in the small tear may have been overlooked. Third, regarding the comparison of the thickness of each layer of delamination, we have not quantitatively measured the thickness of each layer. Fourth, we could not define the histologic features of the deep layer because of the lack of histologic examination of the tendon edges. Fifth, there might be a considerable selection bias of the prevalence of delamination. Only patients with reparable rotator cuff tears were included in this study, and patients who were not eligible for operation were not included. Sixth, we did not evaluate the prevalence of delamination with magnetic resonance imaging because the imaging conditions were not controlled for in the retrospective study. We thought that the sensitivity of magnetic resonance imaging to detect delamination was low in comparison with operative observations previously reported by Walz et al.[24]

Conclusion

The larger the size of the rotator cuff tear, the more frequently the appearance of delamination was limited to the posterior part, and the cases in which the deep layer was thicker than the superficial layer were more frequent. This study suggests that the larger the size of the rotator cuff tear, the more carefully shoulder surgeons should observe and treat the posterior and deep part of delamination to anatomically repair it.

Disclaimer

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