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Trans-cuff portals heal by 6 weeks: an ultrasonography-based study

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Background: Various arthroscopic portals have been described for repair of superior labrum anterior-posterior (SLAP) lesions. The difficulty in doing repair through the rotator interval and the problems in direction and placement of anchors still persist. Functional outcomes of the patients after treating them using trans-cuff portal are well established in literature, but the actual healing of the portal is not clear. We made a sincere effort to identify healing of the trans-cuff portal with ultrasound guidance and functional outcome using American Shoulder and Elbow Surgeons Shoulder Score (ASES score), Constant Shoulder Score, and Oxford Shoulder Score.

Material and methods: Twenty-two patients with SLAP or labral tears and normal contralateral shoulders were included. Surgery was performed using the trans-cuff portal as a viewing or working portal for biceps repair and labral repair. Rehabilitation was initiated from day 1 and followed up on 6 weeks, 3 months and, 6 months with a maximum follow-up duration of 2 years. Ultrasound was used to measure the depth of healing and graded at 6 weeks of follow-up postoperatively. Functional outcomes were measured using ASES score, Constant Shoulder Score, and Oxford Shoulder Score measured at 6 months.

Results: Seventeen patients were of grade 1 (complete healing); 1 patient was of grade 2 (more than 50% healing); 1 of grade 3 (less than 50% healing), and 3 were lost to follow-up. Fourteen patients out of 19 had excellent ASES scores, 4 patients had good scores, and 1 patient was considered as poor with an average ASES score of 84.51 (range 93–48) and standard deviation of 10.37. The ASES score indicated that healing of the rotator cuff portal is directly related to the functional outcome of the shoulder. The Constant Shoulder Score and Oxford Shoulder Score on the contrary were statistically not significant indicating no relation of the Oxford and Constant scores with healing of the rotator cuff portals.

Conclusion: Trans-cuff portal is safe, gives proper angle for insertion of anchors, and can be used for repair of SLAP lesions with ease. Ultrasonography helps in confirming the healing of portal.

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Trans-rotator cuff portal (TCP) is described as a portal made through the tendinous or muscular portion of the rotator cuff. It is used for labral repairs especially for superior labrum anterior-posterior (SLAP).^{6,18} The SLAP lesion and its management was described by Snyder et al¹⁵ in 1990, it has evolved over years, and many different techniques have been described by various authors since then. Conventionally, 3 portals have been used in SLAP repair: a posterior viewing portal, an anterior portal located just above the lateral border of the subscapularis tendon, and an anterosuperior portal just lateral to the anterolateral corner of the acromion;

The Institutional Review Board of Bangalore Shoulder Institute approved this study.

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however, access to the posterosuperior quadrant in posterior SLAP lesions is problematic with a conventional anterosuperior portal.^{2,12,17} Burkhart et al insisted on importance of repair of posterior SLAP lesions as an important procedure in SLAP repairs for good clinical outcomes especially considering throwers' SLAP lesions.²

The use of different portals such as Nevasiers portal,¹¹ Wilmington portal, transacromial portal, and recently trans-cuff portal¹² has been described. All these portals have their own benefits and drawbacks. The Nevasier and the transacromial portals were developed but less used because of the potential complications such as damage to the suprascapular nerve during the use of the portals.¹¹ O'Brien et al described the usage of TCP while using posterior capsular repair in case of SLAP lesions and explained ease of use and decreased complications and chances of cuff tears by using a localization technique using a needle for placement of portal.¹² They opine that this will help in placing portal through the

muscular portion of the muscle.¹² There is a discrepancy over the usage of TCP and its healing and making new tears if not placed properly.⁷ Daniel et al in their study explained the occurrence of rotator cuff tears with the placement of superior portal or the TCP because of wrong placement of the portal through the tendinous portion of the supraspinatus muscle and lack of experience of the surgeons.¹⁶

Oh et al first described the healing of the portal using computed tomography (CT) arthrogram explaining no leakage into the sub-acromial space thereby concluding complete healing of the portal.¹³ There is no further study regarding the healing of portal in literature. As CT arthrogram is a costly procedure with the usage of contrast and related complications of contrast, it is difficult for the postoperative patients to undergo CT arthrogram if they have comorbidities or any history of allergy.

The purpose of this study was to assess the healing of TCP with ultrasound guidance as an outpatient department procedure on follow-up and to assess functional outcome of the operated shoulder when compared to the unaffected side by using functional outcomes such as American Shoulder and Elbow Surgeons Shoulder Score (ASES), Constant Shoulder Score, Oxford Shoulder Score, muscle power, and range of motion.

Materials and methods

The present study was conducted at the Bangalore Shoulder Institute during the period of 2018-2020. After obtaining proper institutional and ethical board approval, 22 patients were included in the study, who were diagnosed with SLAP tear associated with or without Bankart lesions of the shoulder and normal contralateral shoulder. Patients with bilateral shoulder pain and patients with all types of rotator cuff tear were excluded. The opposite shoulder was examined for its normality clinically so that there was no bias while comparing with operative shoulder during follow-ups. The patients were examined clinically and radiologically along with appropriate laboratory study. Once the patients were cleared for surgery by the inhouse anesthetist, they were taken up for surgery after explanation of the procedure and with proper consent. All the patients were examined under anesthesia again by the operating surgeon. Standard lateral position was used, and blood pressure was adequately controlled for the entire surgery. We used arthroscopy pump for better visualization. A same surgeon operated all cases and was involved in preoperative and postoperative clinical evaluation and follow-ups. A standard posterior portal was made, and diagnostic evaluation done. The other portals made were anterior midglenoid portal and TCP as viewing portals. In some patients, an additional posterolateral portal was made to address posterior labrum and capsule. The TCP was made by inserting an 18-gauge spinal needle close to the acromion midway between the lateral border of acromion and under vision; it was passed into the joint as medially to glenoid as possible through the muscular portion of the rotator cuff. The surgical blade was introduced on a spinal needle parallel to the direction of muscle fibers, and a Wissinger rod was introduced under vision. Patients underwent arthroscopic repair surgery for the SLAP tear or Bankart lesions involving the superior labrum tears. After surgery, patients were put on an arm sling, and physiotherapy started as per protocol from day 1. The patients were regularly followed up at 6 weeks, 3 months, and 6 months with a maximum follow-up duration of 2 years. All the patients were made to undergo ultrasound scanning at the time of each visit to know the healing of the TCP. The healing of the portal incision is graded as grade I-IV corresponding to the stage of healing based on sonography, and the classification was named as Bangalore Shoulder Institute sonography classification of rotator cuff. We graded the healing sonographically as grade I (Fig. 1) complete healing of

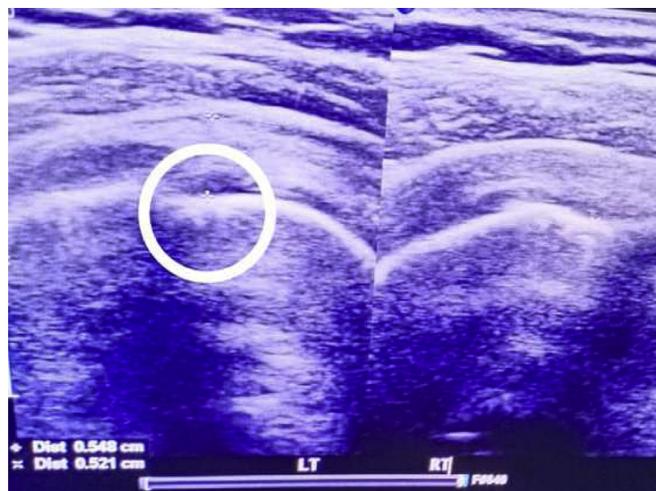


Figure 1 Grade 1 healing.

the portal in terms of echotexture and depth of tear in the muscle when compared to the normal shoulder, grade II meaning healing (Fig. 2) of normal echotexture of the muscle with more than 50% healing of the depth of the tear in the muscle when compared to normal shoulder, grade III (Fig. 3) is a hypochoic type of healing of the muscle with less than 50% of healing of depth of the tear when compared to the normal shoulder, and grade IV is considered as hypochoic lesion with no healing of depth of the muscle on ultrasound when compared to normal shoulder. All patients underwent the same physiotherapy protocol during the follow-up period. The healing of portals was studied at 6 weeks by sonography and the ASES score, Constant Shoulder Score, Oxford Shoulder Score, power of the affected shoulder, and range of motion of the affected shoulder as compared to normal shoulder at 6 months. The radiological examination and scoring were performed by an independent observer who was blind for the ongoing study. Clinical examination regarding power and range of motion were assessed by the operating surgeon who is the senior author. The physiotherapy protocol was as per shoulder SLAP repair protocol or Bankart repair protocol which eliminates bias of the physiotherapist who was blinded for the study. All the data were collected and tabulated and statistically analyzed by an independent observer using statistical software SPSS 2.0 (IBM, Armonk, NY, USA) and Microsoft Excel (Microsoft, Redmond, WA, USA).

Results

Twenty-two patients were included in the study out of which 4 were female and 18 were male with a ratio of 1:4.5 (f:m) and an age range of 40- 58 years with a mean age of 52 years. Out of these 22 patients, 3 patients were lost to follow-up leaving 19 patients in the study. The healing of rotator cuff was graded according to the healing when compared to the opposite side and graded as I, II, III, and IV, respectively. One patient of 19 was of grade II, one patient of grade III, and remaining 17 were of grade I (Table 1) with more than 95% of the patients with excellent results which is significant. There was no patient in grade IV. With regard to the ASES score, 14 patients out of 19 were excellent, 4 patients good, and 1 patient was considered as poor with an average score of 84.518 (93-48) and standard deviation of 10.378; considering 2 degrees of freedom and chi-square of 5.75. A *P* value is significant with 0.05 indicating the healing of the rotator cuff portal is directly related to the functional outcome of the shoulder. The Constant Shoulder Score and Oxford

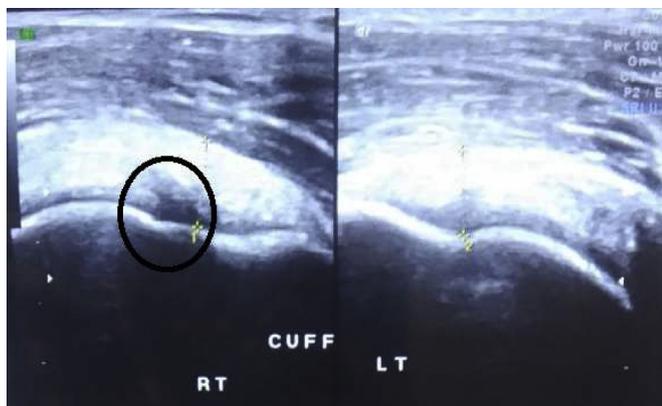


Figure 2 Grade 2 healing.



Figure 3 Grade 3 healing.

Shoulder Score on the contrary were statistically not significant indicating no relation of the Oxford and Constant Scores with healing of the rotator cuff portals (Table III). The average power of the affected shoulder was 4.7 (4-5), and the average range of motion was abduction 175.26 degrees (16-180), external rotation 62.51 degrees (25-70), internal rotation (T12-L1), and forward flexion 176.842 degrees (180-120) (Table II).

Discussion

The literature describes a number of portals such as the posterior portal, anterior portal, and anterosuperior portal; Neviaser portal; and Wilmington portal for the repair of SLAP lesions during shoulder arthroscopy, of which the latter two are used in SLAP repair. The Neviaser portal is made at the convergence of the clavicle, acromioclavicular joint, and the scapular spine.¹⁰ Haughton et al in their anatomic study for the placement of superior anchors using Neviaser portal explained that out of 60 patients (scapulae) included in the study, they were able to achieve the ideal angle of insertion (0-30 degrees) in only 1 scapula as explained by Neviaser, hence proving this portal unfeasible for application of the superior glenoid anchor.⁸ Coen et al in their anatomical study of the transacromial portal explained that there is loss of acromion integrity in 25%-85% of patients by using transacromial portal

making the shoulder activity limited after using the portal.³ Warner et al first described about the usage of TCP for repair of SLAP lesions.¹⁸ Costouros et al described TCP for the repair of the labrum with the superior portal being the viewing portal in posterior capsulorrhaphy.⁵ They described 5 patients with full recovery without any complications.⁶ Daniel et al described in their study that the TCP is difficult to use because of the chance of passing the portal through the tendinous portion leading to fresh tears of the supraspinatus muscle.¹⁶

This created a debate regarding the healing of TCP after treating the SLAP repair. Many studies have been published on the functional outcome of the patients using TCP in favour and otherwise, but surprisingly publications regarding the healing of portal in terms of radiological outcomes are quite rare. Oh et al¹³ in their study explaining the outcome of 58 patients with SLAP tear first described the healing of the portal using CT scan. They injected contrast into the joint and looked for the leakage into the subacromial space. They concluded that if there is no leakage into the subacromial space, there is complete healing of the TCP. They also mentioned that patients older than 45 years and patients with previous rotator cuff tears have high potential for nonhealing of the portal and thereby leakage of the contrast into the subacromial space. The use of CT scan for evaluation exposes the patient to unnecessary radiation. The reactions and complications of using contrast can also be there if there are any preexisting medical comorbidities such as renal pathology. Most of the patients with SLAP tears will be middle-aged people; hence, we used ultrasound to confirm the healing of the potential which is a cheap, reliable procedure that can be performed without any complications and with good comparable results in the hands of an experienced sonologist and on outpatient basis. Functional outcomes of the surgery were measured with ASES score, Constant Shoulder Score, and Oxford Shoulder Score. Our study explains that ASES score, Constant Shoulder Score, and Oxford Shoulder Score post-operatively at the end of 6 months and found them to be comparable to those of a normal shoulder. This is because of the complete healing of the pathology treated, which we confirmed by ultrasound scanning of the operated shoulder and comparing that with the normal side. Most of our patients had good results with complete healing, and compared to the study by Oh et al, we did not find any cuff tears probably because, in our study, we excluded any type of cuff tear and also their CT angiogram study was carried out at the end of one year which we feel is a long duration and that there are chances of fresh cuff tears in such long time.

Acar et al in their study while assessing healing of portals in knee scopy by ultrasound concluded that anteromedial and anterolateral portal tracts healed with an average 47 days and 28 days, respectively.¹ We did not find any such article in literature for shoulder portal healing, but while comparing, in knee, the portals are in nonmuscular part, and the trans-cuff portal we made was through the muscular portion. So, we can safely say that 6 weeks of postoperative time is adequate for healing for the muscular portion of the TCP.

Milchtem et al, in 2016, in their study in patients involving collision and limited contact sport athletes, which is the second largest series till now, explained the functional outcome after arthroscopic Bankart repair using an average ASES score of 91.7/100 postoperatively. They opined that arthroscopic Bankart repair remains viable for treating highly active patient athletic population, thereby highlighting the need to complete repair of torn labrum.⁹

Turhan et al in their cadaveric study to determine the relation of TCP to surrounding structures concluded the mean distance between the trans-muscular portal and the axillary and suprascapular nerves was 55.5 mm ± 6.0 mm and 61.2 mm ± 7.0 mm, respectively. There was no drill penetration of the suprascapular nerve, axillary

Table I
Ultrasound grading of all patients in study.

S. no.	Diagnosis	Surgery	Ultrasound grading	ASES scoring	Constant scoring	Oxford scoring
1.	Anterior instability with Bankart and Hill-Sach	Bankart repair + remplissage	Grade1	92	95	47
2	Anterior instability with Bankart	Bankart repair	Grade 1	93	95	48
3	Anterior instability with Bankart + slap	Bankart repair + slap repair	Grade 1	92	96	48
4	Anterior instability with Bankart lesion	Bankart repair	Grade 1	85	86	40
5	Anterior instability with Bankart	Bankart repair	Grade 1	90	90	45
6	Anterior instability with Bankart	Bankart + remplissage	Grade 1	91	95	47
7	Bankart lesion	Bankart repair	Grade 1	91	94	45
8	Slap lesion	Slap repair	Grade 1	92	93	46
9	Anterior instability of rt shoulder	Bankart repair + remplissage + rotator interval closure	Grade 1	90	91	46
10	Slap + liberal tear + loose body rt shoulder	Slap + Bankart + microfracture for glenoid ocd	Grade 1	91	91	46
11	Anterior instability of rat shoulder with slap tear + Bankart lesions	Slap + Bankart repair + rotator interval closure	Grade2	90	90	45
12	Slap lesion left shoulder	Slap repair	Grade 1	91	92	46
13	Anterior instability with Bankart	Bankart repairs	Grade 1	93	95	47
14	Anterior instability with Bankart + Hill-Sach's lesions and slap lesion of right shoulder	Slap + Bankart repair + remplissage + rotator interval closure	Grade 1			
15	Anterior instability with Bankart lesion left shoulder	Bankart + remplissage + rotator interval closure	Grade3	45	33	23
16	Anterior instability with Bankart lesion	Bankart repair	Grade 1	92	95	48
17	Anterior instability with Bankart	Bankart + remplissage	Grade 1	89	91	46
18	Anterior instability	Bankart repair + remplissage	Grade 1	92	95	47
19	Anterior instability with Bankart and Hill-Sach's lesion	Bankart + remplissage	Grade 1	91	95	46

ASES, American Shoulder and Elbow Surgeons Shoulder Score; ocd, osteochondral dessicans; rt, right.

Table II
Range of movement and strength of the shoulder for all patients in study postoperatively.

S. no.	Strength	Abduction	Forward flexion	External rotation	Internal rotation
1	5	180	180	70	T10
2	5	180	180	70	L1
3	5	180	180	70	T10
4	5	160	180	60	L5
5	5	180	180	70	T10
6	5	180	180	70	T12
7	5	180	180	65	L1
8	5	180	180	70	L1
9	5	180	180	70	T10
10	5	180	180	70	T10
11	5	180	180	70	L1
12	5	180	180	70	L1
13	5	180	180	70	T10
14	5	180	180	60	L1
15	4		120	25	
16	5	180	180	70	T12
17	5	180	180	60	L1
18	5	180	180	70	T12
19	5	180	180	60	L1

Table III
Statistical analysis.

	ASES	Constant Shoulder Score	Oxford Shoulder Score	Power	Abduction	Forward flexion	External rotation
Standard deviation	10.3787	13.5814	5.519043	0.223297	16.01592	13.39781	10.32035
Mean	84.51894	85.77907	42.57595	4.711165	175.2632	176.8421	62.51602
Maximum	93	96	48	5	180	180	70
Minimum	45	33	23	4	16.01592	120	25
Range	48	63	25	1	70	60	45

nerve, and/or supraspinatus tendon in any of the samples. The mean distance between the trans-muscular portal and the biceps tendon, supraspinatus tendon, and anterior acromial edge was 28.5 mm ± 4.6 mm, 2.8 mm ± 1.5 mm, and 16.3 mm ± 1.2 mm, respectively.¹⁴

Colemen et al (2007) described the treatment of SLAP tears using TCP and routine rotator interval portal dividing the patients into 2 groups.⁵ They observed no difference in the functional outcome of both groups.⁵ Cohen et al (2006) indicated poorer outcome and rotator cuff tears with the use of TCP and describe the

placement of portal during the making of portal is an important factor for overall patient outcome and that improper placement leads to tears.⁴ Even though they described the usage of TCP as a factor in decreasing the functional outcome, they did not explain the cause as a radiological evidence for the same.⁴

In our study, we radiologically evaluated all the patients for healing of the portal. We graded the healing radiologically as grade I complete healing of the portal in terms of echotexture and depth of tear in the muscle when compared to the normal shoulder, grade II healing is normal echotexture of the muscle with more than 50% of the depth of the tear in the muscle when compared to normal shoulder, grade III healing is hypoechoic type of healing of the muscle and less than 50% of the depth of the tear being unhealed when compared to the normal shoulder, and grade IV is considered as a hypoechoic lesion with no healing of depth of the muscle on ultrasound when compared to normal shoulder. In our study, 18 of 19 patients were of grade I or II and had excellent results in healing of the portal, thus confirming the usage of TCP during repair of SLAP or Bankart lesions a safe and reliable portal with no differences in the functional outcome as explained previously. Advantages of using ultrasound are that it is a safe, noninvasive procedure and easily tolerated by the patients, can be advised to every patient on outpatient basis, and is a faster procedure than those in other investigations. Furthermore, sonography is a dynamic investigation, and it will add more value to study the shoulders postoperatively.

We have some limitations of the study such as the number of patients in the study is comparatively less. Interobserver variation is a factor which plays a key factor while reading and performing ultrasound, which we tried to address making the radiologists completely blind of study.

Conclusion

The use of TCP in shoulder surgery does not affect the functional recovery, and portals almost completely heal by six weeks. The ultrasonography scoring of the TCP healing confirms the safety and efficacy of using this portal. TCP is a safe portal for the repair of SLAP lesions and Bankart repair and gives proper angle for the placement of anchors.

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