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Arthroscopic subscapularis repair using the subscapularis interlocking (SICK)-stitch technique leads to restoration of clinical function with low complication and revision rates

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Background: The purpose of this study is to determine the mid-term outcome after arthroscopic subscapularis tendon (SCP) reconstruction using the subscapularis interlocking (SICK)-stitch technique. The hypotheses are that arthroscopically repaired SCP lesions using the SICK-stitch show a good restoration of shoulder function with low complication and failure rates.

Methods: This is a retrospective monocentric study of n = 199 patients (n = 106 female) with arthroscopically treated SCP tears with the interlocking (SICK) stitch technique from July 2013 to October 2018. Inclusion criteria: minimum follow-up of 2 years. Exclusion criteria: irreparable and massive cuff tears, osteoarthritis, and fractures. The postoperative assessment consisted of the range of motion, constant score, simple shoulder test, simple shoulder value, disability of the shoulder and arm score, short form 12, and patient satisfaction.

Results: Mean age was 61 years (25-83); n = 4 (2%) patients were lost to follow-up with mean follow-up time of 63.6 months (36-96). Additional supraspinatus tendon lesions (n = 147) were repaired in n = 101 cases. SCP grading (n = 69) (35% traumatic) (Fox/Romeo): n = 113 grade II, n = 71 grade III, n = 11 grade IV. A positive preoperative lift-off test (n = 132, 68%) was corrected in n = 124 (94%) of cases. Ninety seven percent of patients would undergo surgery again with a mean satisfaction score of 14.4/15. Results at final follow-up (data: mean pre; post; *P* value): lexion (130; 166; .001), abduction (123;159; .001), external rotation (35;82; .001), internal rotation (52; 68; .07), constant score (50; 82; .001), disability of the shoulder and arm score (40; 19; .001), simple shoulder test (5; 10; .001), and simple shoulder value (44; 83; .001) significantly improved. The mean physical health scale short form 12 was 46 (24-63) and 51 (15-66) for mental health. Age, body mass index, SCP-grading, and supraspinatus tendon repair did not significantly affect any outcome parameter. Three (1.5%) patients underwent revision surgery, of which 1 (0.5%) had an infection.

Conclusion: Two years after arthroscopic SCP repair using the SICK-stitch technique, we observed excellent restoration of clinical function with low complication and revision rates. The SICK-stitch technique thus represents a good and reliable therapeutic option for the arthroscopic repair of SCP lesions.

The subscapularis muscle (SCP) is a multipennate muscle that has a fundamental role as a dynamic stabilizer of the shoulder.[25] Its collagen fibers and tendinous insertion overlap and ran parallel to the anterior joint capsule as well as the middle and inferior glenohumeral ligament and provide additional passive stability. This is especially relevant in lower abduction angles and hanging arm positions.[31,33,35] The SCP functions as the main internal rotator of the shoulder joint and also assists in abduction and adduction

The study was approved by the Ethics committee of the Medical Faculty of the Heinrich-Heine-University Düsseldorf.

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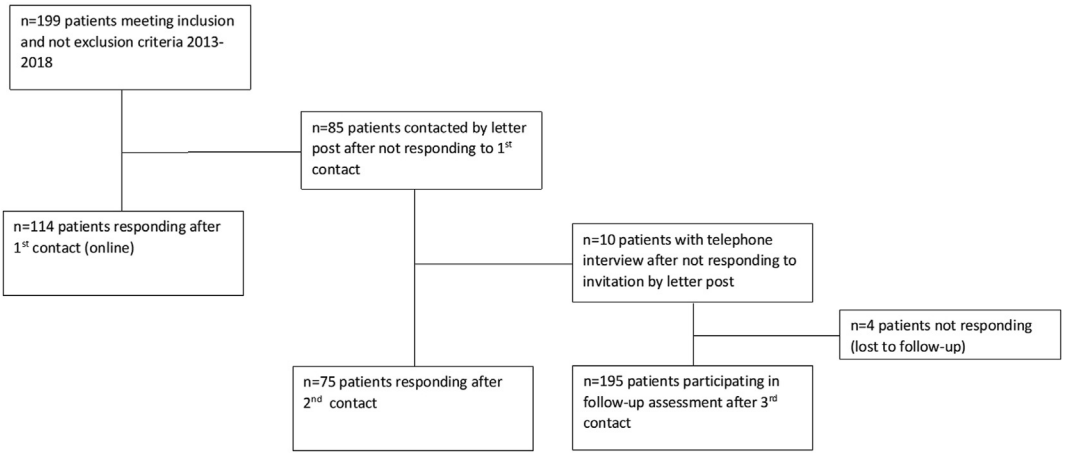

Figure 1 Flow chart of patients included, excluded, and lost to follow-up.

depending on the joint position.[25,35] In the past, SCP lesions were believed to be rare but recently several studies have underlined that SCP lesions make up a considerable part of rotator cuff tears that impair one's shoulder function significantly.[1,10,17,18,38] Throughout the years, many open and arthroscopic refixation approaches have been presented.[3,4,16,20,23,29,38,39,48,53] The arthroscopic repair with conventional vertical mattress sutures is likely to cut through the tendon because they are in line and not perpendicular to the direction of forces and orientation of the fibers. The use of interlocking stitches is biomechanically superior to conventional and other stitch configurations.[36,44]

Successful repair of a subscapularis tendon lesion has a great impact on the restoration of shoulder function and the long-term outcome of rotator cuff repair.[2,5,8,9,19,30,37,42,48,50-52] Anatomic reconstruction of the tendon, especially of the most superior tendinous part, is paramount for an optimal biomechanical position in relation to the insertion site at the lesser tuberosity.[11,32,48]

Therefore, the subscapularis interlocking (SICK)–stitch technique for arthroscopic SCP reconstruction was developed to increase pullout strength and avoid cutting through the horizontally oriented fibers. It consists of a running interlocking stitch and a vertical mattress suture using a double-loaded suture anchor.[34] The purpose of this study is to determine the mid-term outcome after arthroscopic SCP reconstruction using the SICK-stitch technique. The hypotheses are that arthroscopically repaired subscapularis tendon (SCP) lesions using the SICK-stitch show a good restoration of shoulder function with low complication and failure rates.

Methods

In this retrospective monocentric single-surgeon study from July 2013 to October 2018, 199 patients (n = 91 female) with arthroscopically treated SCP tears were investigated. Inclusion criteria were arthroscopically repaired SCP lesions using the SICK-stitch technique and a minimum follow-up time of 2 years. Exclusion criteria were the presence of irreparable and massive cuff tears, cuff tear arthropathy (definition: Hamada grade 2 or more), glenohumeral osteoarthritis (definition: Samilson and Prieto grade 1 or more), and fractures.

The preoperative and postoperative assessment was performed by the first, second, and fourth author and consisted of the range of motion (ROM), constant score, simple shoulder test (SST), simple shoulder value (SSV), disability of the shoulder and arm score (DASH), patient health status with the short form 12, and patient satisfaction. All patients meeting the inclusion criteria were contacted and asked to participate in the follow-up assessment (either online or by post). Online evaluation was performed using the noncommercial SoSci-Platform (SoSci Survey, Munich, Germany); otherwise, written handouts were sent by post. Non-responders were personally recontacted by phone by the first author in 2 rounds if necessary (Fig. 1).

Ultrasound was performed by the senior author using a linear transducer in standard anterior and lateral planes postoperatively to assess the tendon integrity of the repaired SCP (E-CUBE 8 LE, Alpinion Medical Germany, Hallbergmoos, Germany).

The study was approved by the ethics committee and patients signed informed consent.

SPSS software (IBM SPSS Statistics for Windows version 28.0; IBM Corp., Armonk, NY, USA) was used for statistical analyses. The statistical significance level was set at 5% (P values < .05). Measurement values were reported as mean values ± standard deviation, median, value range, and 95% confidence intervals. The normality of data was tested by visual inspection using boxplots and scatterplots and statistically using the Kolmogorov-Smirnov and Shapiro-Wilk tests. As the normality assumption was uncertain in portions of the data, the U-test according to Mann-Whitney and the Wilcoxon rank test were used to compare means and categorical data. Spearman's rank test was used to perform correlation analysis.

Surgical technique

Patients were operated in a beach-chair position starting with a standard posterior portal for diagnostic arthroscopy in general anesthesia (Fig. 2). Small partial tendon tears and avulsions from the very upper insertion were brought into view by slight internal rotation of the humerus which can easily be achieved by lifting the elbow a few centimeters. After a standardized arthroscopic assessment, pathologies were treated in the following order, if appropriate: the long head of the biceps tendon (LHBT), SCP lesions, subacromial spur and bursa, and supraspinatus tendon (SSP) lesion. In cases with LHBT pathology, decision was made for either tenotomy (n = 136) or suprapectoral tenodesis (n = 35) using a 6.25 mm BioSwivelock (Arthrex, Naples, FL, USA).[47]

Two additional portals were created with the arm in neutral rotation and mild flexion of about 60°. The antero-inferior standard portal was used for anchor placement and suture passage through the SCP tendon. An antero-supero-lateral (ASL) portal entered the joint in the interval between the SSP and SCP leaving the rotator cable and the biceps tendon intact if present.

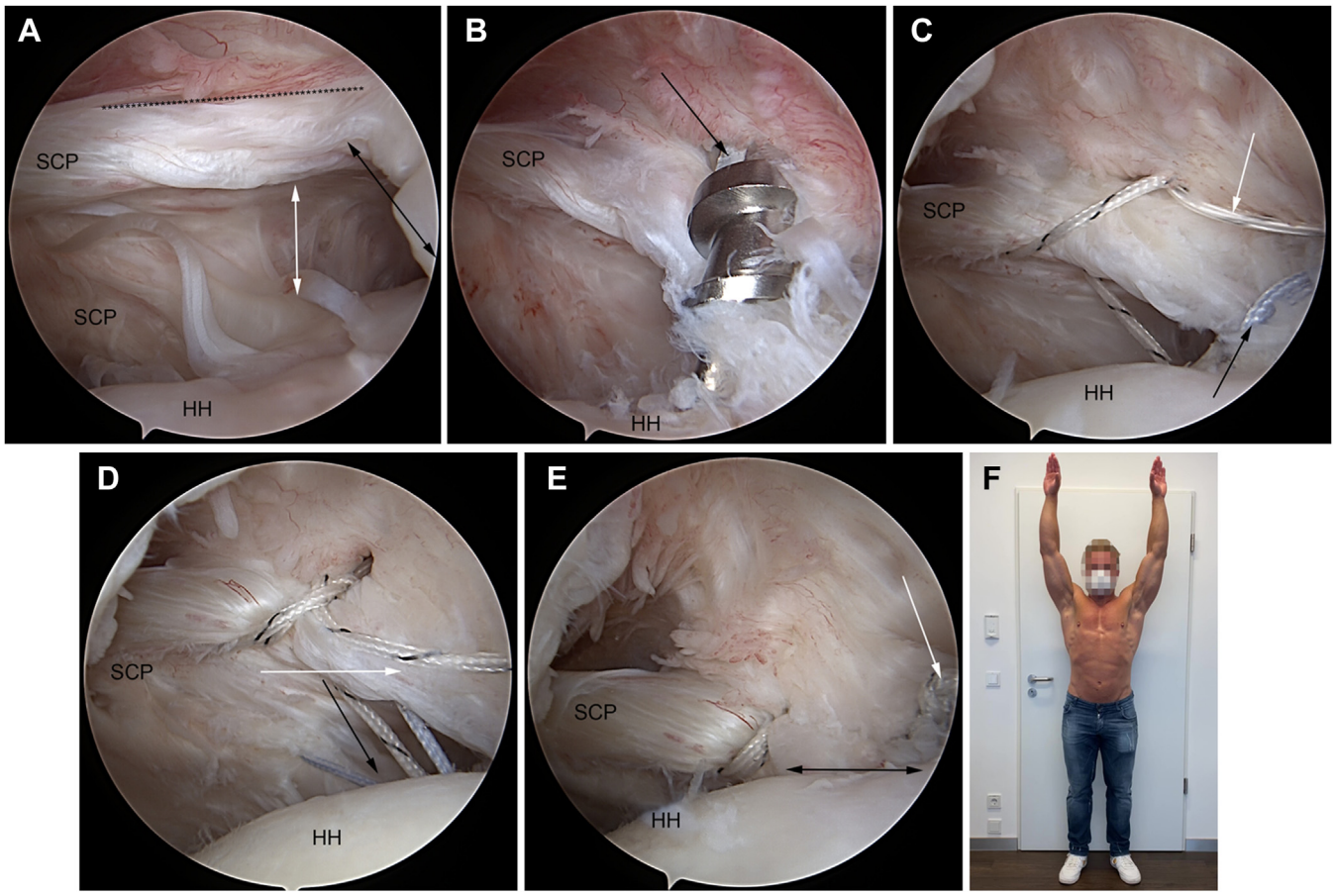

Figure 2 Arthroscopic pictures of a 35-year-old bodybuilder with a Fox/Romeo Grade II-III subscapularis tendon tear of the *Right* shoulder. Standard equipment, posterior viewing portal. 2A: The black asterisks mark the superior border of the subscapularis tendon (SCP), which is detached from the insertion site at the humeral head (HH) (black double arrow) and presents with an additional horizontal split (white double arrow). 2B: A double-loaded 5.5 mm Corkscrew (Arthrex, Naples, FL, USA) suture anchor (black arrow) is inserted at the *Upper* facet of the insertion site of the SCP tendon at the minor tubercle via an antero-superior portal. Sutures are passed to an antero-lateral portal just above the biceps tendon. 2C: After passing the first running suture limb (white tiger, white arrow) through the *Upper* SCP tendon in an interlocking fashion, the second (blue) pair of sutures (black arrow) is still unused. Pulling the first pair of sutures (white tiger) would reduce the SCP onto the insertion site. 2D: The second (blue) pair of sutures is passed in a retrograde fashion through the SCP tendon in a vertical mattress suture configuration. Pulling these sutures tight after the first pair (white tiger) will result in firm radial compression (direction of force illustrated by black arrow) of the already reduced tendon (white arrow marks the direction of reduction) onto the minor tubercle, thus avoiding gap formation during rotational movement. 2E: After tightening the knots (white arrows), these will be positioned outside the track of the rotator cuff tendons, especially the SCP tendon, which is now firmly anatomically reduced and stable on minor tubercle (black double arrow). 2F: Full range of motion and return to heavy weightlifting after 12 months postoperatively.

The SCP tendon was repaired using one double-loaded suture anchor (5.5 mm Corkscrew Titanium, Arthrex, FL) in the most upper facet of the SCP footprint.[54] The first suture pair was passed through the upper tendinous part of the tendon using a shuttle relay technique with a yellow 20G spinal needle (Braun, Melsungen, Germany) and a number 1 PDS-II-suture (Ethicon, Norderstedt, Germany) through the anterior and the ASL portal with a King-Fisher (Arthrex, Naples, FL, USA).[34] Fine tuning of the rotational position of the arm by the assistant surgeon was used to achieve the best angle for tendon penetration. An interlocking stitch configuration with 1 or more loops was created by passing the suture repetitively depending on the size of the lesion and retraction of the tendon.

The second suture pair was used to create a vertical mattress suture with the same instruments and portals to provide increased contact area of the repaired tendon and to avoid the unfolding of the tendon from the bone bed in internal rotation. The penetration of the tendon was slightly medial to the most medial interlocking loop to ensure that the suture does not cut through the tendon but locks itself into the existing passed suture limbs of the first pair of sutures. The 2 free ends were transferred to the ASL portal outside of the glenohumeral contact area but inside the joint and knotted there to leave the anterior capsule and interval unviolated.[34]

Arthroscopic acromioplasty was performed in all cases in a combination of the techniques described by Ellman and Caspari to achieve a flat undersurface of the acromion without any anterior spur.[6,12]

Additional SSP tendon repair was performed in the Mason-Allen-Technique using a double-loaded suture anchor (5.5 mm Corkscrew Titanium; Arthrex, Naples, FL, USA) in the lateral part of the tendon footprint for small tears (n = 18) or in a double-row suture bridge configuration for larger tears (n = 83) using 1 double-loaded suture anchor (5.5 mm Corkscrew Titanium; Arthrex, Naples, FL, USA) at the medial bone-cartilage border of the footprint in combination with a laterally placed second resorbable knotless anchor (3.5 mm BioSwivelock; Arthrex, Naples, FL, USA).[41,49]

Postoperative rehabilitation

The shoulder was immobilized in a 15° abduction brace for 3 weeks during which passive motion was permitted. Week 3 to 6, the patients were encouraged to gain an active ROM under shoulder height, with the supervision of a physiotherapist. After week 6,

Table I
Preoperative demographic data (age in years, height in centimeter, weight in kg, and body mass index) presented as mean, minimum (min), maximum (max), and standard deviation (SD).

	All (n = 195)				Male (n = 104)				Female (n = 91)				*P*
	Mean	Min	Max	SD	Mean	Min	Max	SD	Mean	Min	Max	SD	
Age	61.1	83.2	25.2	10.3	60.2	25.2	80.1	10.8	62.1	32.4	83.2	9.7	.252
Height	172.5	194.0	152.0	9.9	178.5	160.0	194.0	7.5	164.9	152.0	180.0	6.8	.001
Weight	79.0	128.0	46.0	16.2	87.4	54.0	128.0	13.6	68.4	46.0	93.0	12.6	.001
BMI	26.4	42.9	17.3	4.2	27.4	20.6	42.9	4.1	25.1	17.3	34.2	4.1	.001

BMI, body mass index; *Min*, minimum; *Max*, maximum; *SD*, standard deviation.
Group comparison between male and female according to Mann-Whitney (P).

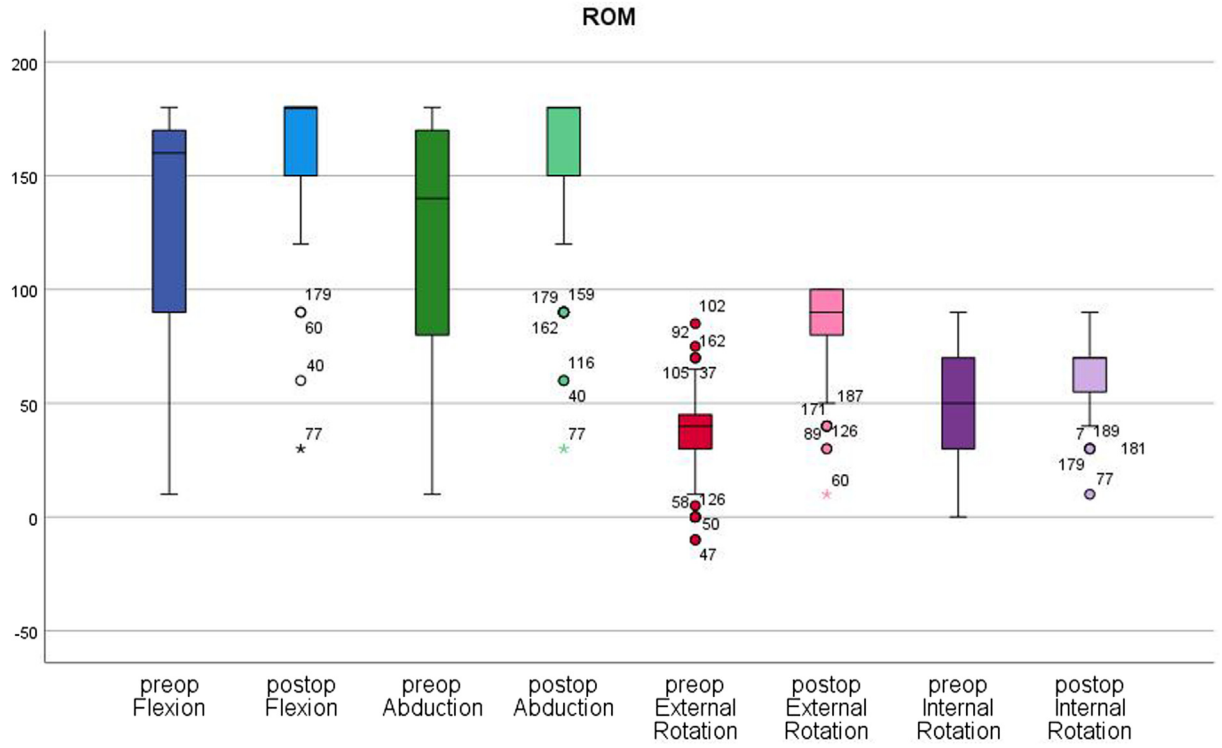

Figure 3 Box plot diagram illustrating preoperative and postoperative range of motion in degree (y axis) flexion, abduction, external, and internal rotation (x axis) (horizontal lines display median and the first and third quartiles and vertical lines indicate maximum and minimum values). The numbers in the plot refer to specific patients and are not relevant.

unrestricted full ROM was allowed. Movement and exercises against resistance were permitted at 3 months postoperatively. Full return to sports and heavy manual labor was allowed 6 months after surgery.

Results

The mean age of the patients was 61 years (25-83) with a mean body mass index of 26 (17-43). Among the 199 patients who underwent arthroscopic SCP reconstruction using the SICK-stitch technique, 4 (2%) patients were lost to follow-up and 80% presented with complete records. The mean follow-up time was 63.6 months (range, 36-96 months) (Table I).

The dominant side was affected in 118 patients (61%). Included patients were n = 48 with isolated SCP tendon tears and n = 147 with additional SSP lesions that needed repair in n = 101 cases. The cohort consisted of n = 69 (35%) cases with a traumatic event.

Intraoperatively, 113 (58%) patients had a Fox/Romeo[14] grade 2 lesion, 71 (36%) grade 3, and 11 (6%) grade 4 lesion. A Pulley Lesion according to Habermeyer et al[24] Grade 2 was identified in 7 patients (4%), Grade 3 in 3 patients (20%) and 142 patients (73%) had a grade 4 lesion. Therefore, a tenotomy of the LHBT was performed in 136 cases (69%) and a LHBT tenodesis in 35 cases (18%).

A positive preoperative lift-off test was present in n = 132 (68%) patients which became negative in n = 124 (94% of affected shoulders) (*P* = .001). Ninety seven percent of patients would have done the surgery again and the mean satisfaction score postop was 14.4 of 15.

The results at final follow-up were (data: mean pre; post; *P* value): ROM: flexion (130; 166; .001), abduction (123; 159; .001), external rotation (35; 82; .001), internal rotation (52; 68; .07) (Fig. 3), constant score (50; 82; .001), DASH score (40; 19; .001), SST (5; 10; .001), and SSV (44; 83; .001) (Fig. 4) significantly improved after the operation (Table II and Table III).

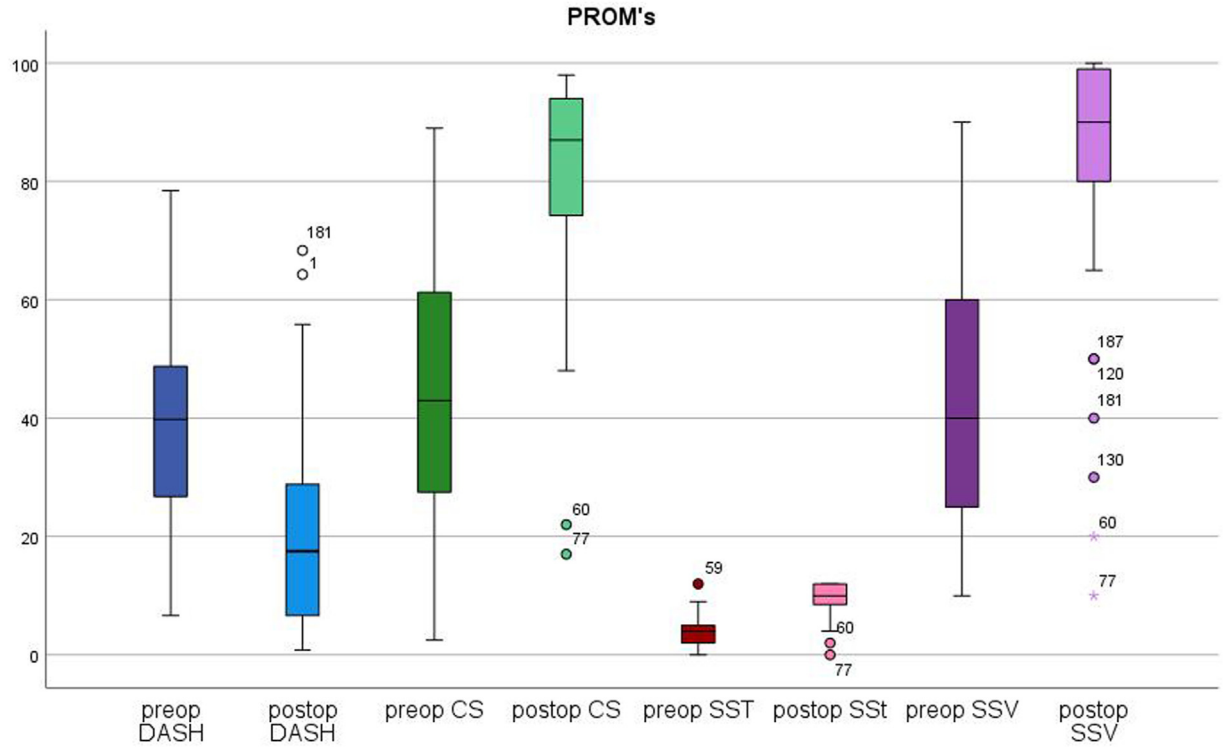

Figure 4 Box plot diagram illustrating PROMs in points (y axis) for Constant-Murley Score, Simple Shoulder Test, Simple Shoulder Value, and DASH score (x axis) (horizontal lines display median and the first and third quartiles and vertical lines indicate maximum and minimum values). The numbers in the plot refer to specific patients and are not relevant.

Table II
Preoperative range of motion data (top) presented as mean, minimum (min), maximum (max), and standard deviation (SD) and postoperative data at the bottom presented similarly.

Preoperative	All (n = 195)				Male (n = 104)				Female (n = 91)				*P*	preoperative vs. postoperative
	Mean	Min	Max	SD	Mean	Min	Max	SD	Mean	Min	Max	SD		
Active Forward Flexion	129.8	10	180	50.69	132.3	30	180	50.40	126.9	10	180	51.14	.302	
Active Abduction	122.5	10	180	53.70	126.1	20	180	53.78	118.2	10	180	53.60	.246	
Active External Rotation	34.7	−10	85	16.08	34.7	0	70	15.40	34.8	−10	85	16.90	.543	
Active Internal Rotation	52.2	0	90	25.04	56.3	10	90	25.00	47.5	0	90	24.39	.011	
Postoperative														
Active Forward Flexion	166.1	30	180	25.00	168.8	90	180	20.61	163.1	30	180	28.97	.269	<.001
Active Abduction	158.6	30	180	30.65	160.7	60	180	28.79	156.4	30	180	32.62	.447	<.001
Active External Rotation	82.1	10	100	17.83	81.9	10	100	19.06	82.4	30	100	16.48	.852	<.001
Active Internal Rotation	67.5	10	90	15.34	68.6	30	90	15.23	66.4	10	90	15.49	.381	<.001

Min, minimum; *Max*, maximum; *SD*, standard deviation.
Group comparison between male and female according to Mann-Whitney (P) second to last row; Group comparison between preoperative and postoperative values for all patients according to Mann-Whitney (P) last row.

The mean physical health scale of the short form 12 at final follow-up was 46 (24-63) and 51 (15-66) for mental health.

Age, body mass index, and grading of lesion size did not significantly affect any outcome parameters. Older patients were significantly more likely to need additional SSP repair. Patients with isolated SCP lesions were not significantly different in any outcome parameter from patients with additional SSP tears.

Imaging

At 1 year postoperatively, n = 30 patients were available for ultrasound examination of the operated shoulder using a linear transducer in standard anterior and lateral planes (E-CUBE 8 LE, Alpinion Medical Germany, Hallbergmoos, Germany) (Fig. 5). All patients showed intact SCP refixation without signs of failure or gap formation during the dynamic examination.

Complications

Three patients (1.5%) underwent revision surgery, of which 1 patient (0.5%) had an infection, 1 patient underwent reverse total shoulder arthroplasty, and 1 patient gave no information about the type of revision. The patient who needed revision underwent surgery due to infection 6 weeks after SCP repair after acute purulent bronchitis. Intraoperative specimens were positive for *Cutibacterium acnes*.

Discussion

The main finding of the study is that the refixation of the SCP tendon using the SICK-stitch technique resulted in favorable postoperative outcomes with significantly improved ROM and patient-reported outcome measures in most patients with a very

Table III
Preoperative PROM's data (top) presented as mean, minimum (min), maximum (max), and standard deviation (SD) and postoperative data bottom presented similarly.

Preoperative	All (n = 195)				Male (n = 104)				Female (n = 94)				*P*	Preoperative vs. postoperative
	Mean	Min	Max	SD	Mean	Min	Max	SD	Mean	Min	Max	SD		*P*
DASH score	40.5	7	78	16.19	37.0	7	78	16.61	45.4	15	72	14.41	.012	
Constant-Murley Score	47.5	2.5	114.0	21.52	48.7	2.5	92.0	21.50	46.3	2.5	114.0	21.59	.481	
Simple Shoulder Test	4.2	0	12	2.82	4.2	0	12	2.75	4.2	0	12	2.92	.869	
Simple Shoulder Value	42.8	0	90	21.53	43.9	0	90	20.76	41.4	0	90	22.42	.401	
Postoperative														
DASH score	19.9	0.8	68.3	18.07	19.8	0.8	68.3	18.30	20.0	0.8	68.3	17.95		<.001
Constant-Murley Score	82.0	17.0	100.0	15.91	83.1	22.0	100.0	15.17	80.8	17.0	99.0	16.75		<.001
Simple Shoulder Test	9.6	0	12	2.69	9.7	0	12	2.59	9.4	0	12	2.81		<.001
Simple Shoulder Value	84.9	10	100	18.41	86.0	20	100	16.53	83.6	10	100	20.35		<.001

DASH, disability of the shoulder and arm; *Min*, minimum; *Max*, maximum; *SD*, standard deviation.
Group comparison between male and female according to Mann-Whitney (P) second to last row; Group comparison between preoperative and postoperative values for all patients according to Mann-Whitney (P) last row.

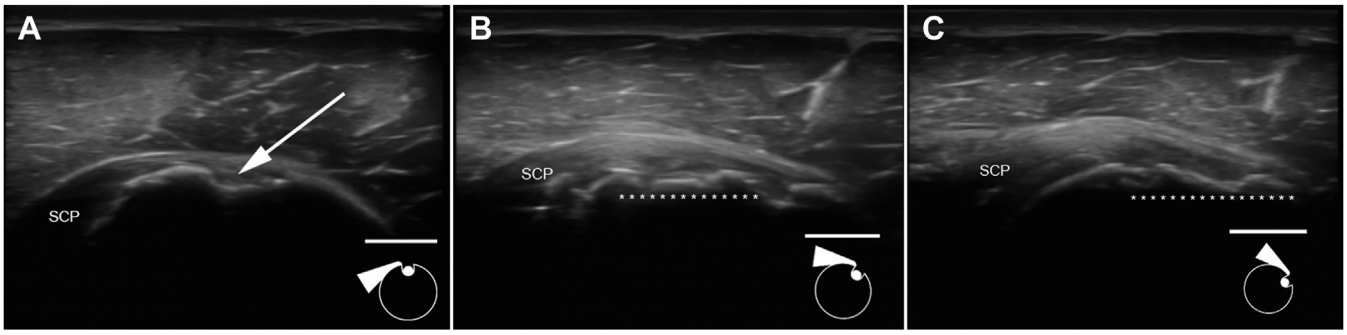

Figure 5 Ultrasound pictures of a 35-year-old bodybuilder (same patient as in Fig. 2) 12 months after subscapularis tendon (SCP) refixation of the right shoulder taken with a 7.5 MHz linear transducer in a standard anterior horizontal plane in neutral rotation (A) and external rotation (B and C). The white pictogram in the *Lower Right* corner of each figure illustrates the position of the humeral head and its rotation in relation to the ultrasound transducer (white bar). In neutral rotation at the level of the lesser tuberosity (A), the surface of the tendon is intact with normal shape of the inserting tendon up to the bicipital groove (white arrow). External rotation (B) moves the insertion site of the SCP tendon (white asterisks) into direct view; the bone surface with slight irregularities due to imaging artefacts related to suture and suture anchor material. Further external rotation (C) shows an intact SCP tendon with normal appearance up to the musculotendinous junction medially.

low failure and complication rate. With a very low drop-out rate and a comparatively large patient sample, these favorable mid-term results significantly add to the published literature.

A positive preoperative lift-off test was present in n = 132 (68%) patients which became negative in n = 124 (94%) ($P = .001$). This contrasts with the series of many other clinical studies (Table IV) where only Heikenfeld et al, Nove-Josserand et al, and Deutsch et al reported a complete normalization of the lift-off test in their series.[10,27,45,46] This may be attributable to the used technique of combining a running interlocking stitch with the first pair of suture strands that provide optimal reduction with excellent pullout strength and the second suture strand used to compress the entire construct onto the footprint at the lesser tuberosity.[34] Other constructs such as simple and mattress stitches tend to cut through the tendon.[21,22,43] This is especially true, when there is a high amount of external rotation of the humeral head, even after a thorough release of SCP which tends to peel off the refixed tendon from the underlying bone. We observed this phenomenon frequently during combined SCP-SSP/ISP reconstructions when the SCP lesion was addressed at the beginning of surgery. A thorough inspection revealed some insufficiency of the repaired SCP tendon-to-bone interface just by the maneuvers necessary for postero-superior cuff reconstruction at the end of the procedure. This observation has led to the development of the new technique used in this study. The technique is reproducible with a steep learning curve for experienced shoulder surgeons at comparable technical demands and costs.

Comparing postoperative with preoperative mean values, the improvement for the DASH score, Constant Murley Score, SST, and SSV was 20.6, 34.5, 5.3, and 42.1 points, respectively, without significant differences for male and female patients (17.2, 34.4, 5.5, and 42.1 vs. 25.4, 34.5, 5.1, and 42.2, respectively). The minimal clinical important difference for the DASH score was reported to be between 10.2 and 10.8 and the patient acceptable symptom state with 43, which were met by this study.[15,26] Minimal clinical important difference values for the Constant Murley score were reported to be 4.6-10.4 and for the SST 4.3 which were met by the results of our patient group.[7,26,28]

We had a mixed group of traumatic (35 %) and degenerative lesions with only 25% isolated SCP lesions. This fact should be noted when interpreting and comparing our results with other studies. However, we believe our SICK-stitch technique is beneficial to both traumatic and degenerative SCP tears.

Many surgeons might consider ultrasound less valuable for the assessment of rotator cuff lesions compared to magnetic resonance imaging (MRI). In a clinical multicenter study comparing ultrasound examination by a trained shoulder surgeon and arthroscopy as the gold standard compared to reports by musculoskeletal radiologists using standard MRI, a high number of false-negative reports was observed, especially for smaller lesions.[40] Zhu et al were able to prove a significantly higher sensitivity of ultrasound (78%) compared to MRI (50%) for the detection of arthroscopically confirmed SCP lesions, especially partial lesions.[55]

The usefulness of ultrasound to assess SCP lesions is underlined by the study of Farin et al who showed that dynamic sonographic imaging with the arm externally rotated and slightly abducted correlates with intraoperative findings of SCP lesions in 82% of the cases.[13]

Table IV
Published results after open and arthroscopic subscapularis tendon repair.

Author	Type	Isolated vs. combined	LOE	n	FU m	Age y	Trauma %	Time to surgery	Pre CS	Post CS	Lift-off pre	Lift-off post
Kamijo et al 2022	Arthroscopic	Isolated	IV	38	36 (24-96)	59 (25-77)	84	-	ASES 56	ASES 89	Bear hug 36	Bear hug 20
Gedikbas et al 2022	Open/ arthroscopic		IV	34/ 36	66.7 (12-103)	60.6/65.1	68/77	12.6 (1-48)	53.7/48.9	88.7/84.6	29/20	11/7
Shen et al 2020	Arthroscopic	Combined	IV	32	28.8 (24-34)	53 (32-69)	-	-	46.0	80.5	-	-
Shibayama et al 2018	Arthroscopic	Combined	IV	101	14 (12-58)	66 (32-85)	-	-	ASES 53	ASES 92	Bear hug 89	Bear hug 19
Katthagen et al 2017	Arthroscopic	Isolated	IV	33	4.1 (2.0-8.0)	54.8 (36-71)		54.8 (36-71)	ASES 54.1	ASES 90.8		
Seppel et al 2016	Arthroscopic		IV	17	98	46 (13-73)	71	5 (0.3-26)	47.8 (32-57)	74.2 (30-95)		3
Grueninger et al 2014	Arthroscopic		IV	11	12	45 (32-65)	90	3.7	43.5	89.3	11	7
Mancuso et al 2014	Arthroscopic		IV	10	17.7				37.3	86.7		
Lanz et al 2013	Arthroscopic		IV	6	24	62 (45-81)			46.2	77.3	31	14
Nove-Josserand et al 2012	Arthroscopic		IV	22	35.7 (25-49)	55 (46-74)			66.4	85.2 (70-95)	4	0
Nove-Josserand et al 2012	Open		IV	13	47.8 (36-57)	49.5 (22-62)			67.7	88.4 (54-96)	2	
Heikenfeld et al 2012	Arthroscopic		IV	20	24	42 (31-56)	95		39.7	81 (61-95)	13	0
Bartl et al 2011	Arthroscopic		IV	21	27 (24-36)	44 (18-61)	91	6 (0.2-14)	50.3 (39-62)	82.4 (65-98)	16	1
Bartl et al 2011	Open		IV	30	46.2 (25-72)	43 (15-64)	100	6 (0.2-15)	51.3 (39-62)	82.2 (65-98)	17	3
Lafosse et al 2007	Arthroscopic		IV	17	29 (24-39)	47 (29-59)	77	24 (3-44)	52	84.9		
Fuchs et al 2006	Open		IV	10	38 (24-53)	59 (40-75)			51.8	72.9		
Edwards et al 2005	Open		IV	84	45.2 (24-132)	53 (23-77)	68	13 (0-108)	55 (14-84)	79.5 (25-101)	60	17
Kreuz et al 2005	Open		IV	16	36 (24-48)	46 (27-64)	100		44 (35-65)	88.7 (79-98)	13	
Bennett et al 2003	Arthroscopic		IV	8	(24-48)	57 (32-76)			43.3 (32-51)	74.2 (66-88)		
Deutsch et al 1997	Open		IV	14	24 (19-48)	38 (18-64)	100				14	0
Gerber et al 1996	Open		IV	16	43 (24-84)	50 (33-60)	100	15 (1-56)		82	13	3

Type, arthroscopic or open surgery; *LOE*, level of evidence; *FU m*, follow-up period in months; *Age y*, age at surgery in years, time to surgery in months; *Trauma %*, percentage of patient with traumatic event as reason for surgery; *time to surgery*, time from trauma or clinical presentation until operation in months; *pre CS*, preoperative Constant-Murley Score; *post CS*, postoperative Constant-Murley Score; *lift-off pre* n, number of patient with positive lift-off test before operation; *lift-off post n*, number of patient with positive lift-off test after the operation.

Limitations

This study has a number of limitations that should be noted.

This is a retrospective study with no comparison group; therefore, it is impossible to compare this technique with other conventional techniques or conservative treatments.

Only 30 patients were available for ultrasound examination due to restrictions for patients to physically come to the hospital during the pandemic.

The results are from a single surgeon in a single institution and therefore are biased in that way.

Conclusion

Two years after arthroscopic SCP repair using the SICK-stitch technique, we observed excellent restoration of clinical function with low complication and revision rates. The SICK-stitch technique thus represents a good and reliable therapeutic option for the arthroscopic repair of SCP lesions.

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