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ORIGINAL ARTICLE

Clinical and Functional Outcomes of Using Double-Row Transosseous Fixation Material in Advanced Age Treatment of Rotator Cuff Tears

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Abstract

Background: Rotator cuff tears are the most common cause of shoulder pain in the elderly. Various techniques have been used in the treatment of rotator cuff tears. This study discusses the clinical and functional outcomes in patients in whom rotator cuff tears have been repaired using double-row transosseous fixation material.

Methods: The study is carried out on 37 elderly patients who underwent mini-open arthroscopy-supported transosseous repair between February 2017 - March 2019. Age and gender of the patients as well as the tear development mechanism, tear grade, fatty degeneration grade, acromion type, and the University of California - Los Angeles (UCLA) Shoulder Scale and Constant-Murley functional and clinical scores (CMS) before and six months after the surgery were recorded.

Results: Mean patient age was 61.19±6.74 (range: 52-76). 17 (45.9%) were female, and 20 (54.1%) were male. The mean preoperative CMS score was 37.68±8.64, and the mean UCLA score was 14.19±8.64. Mean postoperative CMS and UCLA scores were 76.84±9.57 and 28.14±3.02, respectively. Preoperative and postoperative CMS and UCLA scores were statistically significantly different ($p<0.001$).

Conclusions: Arthroscopy-aided transosseous method using Sharc-FT instrument both prevents open surgery complications and results in lower infection rates and less muscular power loss. Considering both its functional and clinical outcomes, Sharc-FT is a utilizable instrument.

Key words: Rotator Cuff Rupture, Advanced Age, Mini-Open, Transosseous Fixation, Arthroscopy.

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INTRODUCTION

The shoulder joint has the most comprehensive range of motion in the body, and most of its functionality is provided by rotator cuff muscles. Since most daily life activities require a normal shoulder joint range of motion, tears of this muscle group substantially impact shoulder functions and quality of life (1).

Rotator cuff tears are the most common cause of shoulder pain and have a strong relationship with advanced age (2). These ruptures may be traumatic or degenerative. The humeral head cannot be centralized in the glenoid due to rotator cuff tear, and pain with muscular weakness develops, eventually leading to superior migration. The dominant side is usually affected—patients present with nighttime pain, a difficulty raising the arm, and pain. Despite being able to accomplish most of the daily activities, patients frequently cannot perform overhead moves. The objective of the treatment is to reduce pain, increase function, and prevent rotator cuff arthropathy. Surgical treatment within six weeks is recommended for acute traumatic tears. For chronic degenerative ruptures, surgical treatment is recommended for patients who do not benefit from 3 to 6 months of conservative treatment (3, 4).

Rotator cuff tears used to be diagnosed and treated with open techniques using traditional methods. Transosseous open repair, defined by Codman in 1911, had been the gold standard of treatment for many years (5). In time, closed treatment of rotator cuff tears using anchors was introduced to develop minimally invasive methods alongside arthroscopy in shoulder pathologies. Over these years, single-row, double-row, and double-row bridge methods had been performed by an arrangement of anchor configurations. Utilization of double-row suture remained at the forefront in trials except for tears smaller than 1 cm (6, 7). However, re-occurrence of tears and anchor problems in massive tears with low bone quality and high amount of degeneration, especially those accompanied by tuberculum majus cysts, prompted transosseous repair methods again these types of ruptures (8, 9).

This study targeted demonstrating the advantages and use of the double-row transosseous repair technique as a new method.

MATERIALS AND METHODS

The study was conducted in accordance with the principles of the Declaration of Helsinki and the protocol was approved by the ethics committee of Atatürk University Medical Faculty (Date: 15.02.2018; Decision Number: 38)

Thirty-seven elderly patients who did not benefit from a previous six months of conservative treatment and underwent arthroscopy-aided mini-open transosseous repair after being admitted to the Department of Orthopedics and Traumatology of Atatürk University Faculty of Medicine Research Hospital for shoulder pain and movement restriction between February 2017 and March 2019 and receiving the diagnosis of rotator cuff tear after a physical examination and radiological studies (direct X-ray and MRI) were included in this study. Patients with partial rupture of the rotator cuff, those under the age of 50 with rotator cuff tear, patients with very advanced fatty degeneration as well as patients treated with biceps tenotomy, operated by a different surgical team, treated with an additional surgical procedure, and those failed to attend final controls were excluded from the study.

Data recorded included age, gender, mechanism of tear development, tear grade, the grade of fatty degeneration, acromion type, superior migration of humeral head, symptoms of glenohumeral arthritis, whether additional acromioplasty is performed or not, and the University of California - Los Angeles (UCLA) Shoulder Scale and Constant-Murley functional and clinical scores (CMS) before and six months after surgery.

UCLA evaluates pain, function, patient satisfaction, flexion muscle strength, and flexion angle on a total of a 35-point scale. Each ache and function is evaluated on a scale of 1 to 10. Each of the active flexion angles, flexion muscular strength, and patient satisfaction are assessed on a scale of 1 to 5. A total point of 34-35 is considered excellent, 29-33 as good, and points under 29 are regarded as poor.

The Constant-Murley rating system is a full scale of 100 points with 15 points for pain, 20 for function, 40 for active range of motion, and 25 for muscle strength. Total Constant score includes four groups as excellent (90-100), good (80-89), moderate (70-79), and poor (<70).

Surgical Technique

All patients were operated on at beach chair position under general anesthesia. The upper limbs of the patients were stained three times with batticon and covered with double layers of the green sheet. Shoulder joints were assessed by arthroscopy. Rotator cuff tears were confirmed for each patient by adequate subacromial bursectomy.

Following the arthroscopic assessment of shoulder joints, the margin between cartilage and bone was reached by crossing the tissues through a mini-incision of 3 cm on the portal used to laterally stitch rotator cuff projection of rotator cuff tear was cleaned using a shaver. Thus, the surface where the tendon will be identified was cleaned until reaching the tissue with hemorrhage. The distal edge of Taylor Stitcher was placed on the footprint of the rotator cuff. The targeting needle was placed using a targeting guide, and the needle was removed from the base area by checking that its tip is pointing to the desired exit site. We prepared two tunnels by repeating this procedure twice. Suture edges that come out of the tunnels were passed through the cuff and tied. One out of two strings in each knot was passed through Sharc-FT (NCS Lab Medical Devices Factory, Carpi (MO), Italy) that is placed on the lateral cortex, and a double-row-like fixation was achieved by tying the tips left on the top (Figure 1-2).

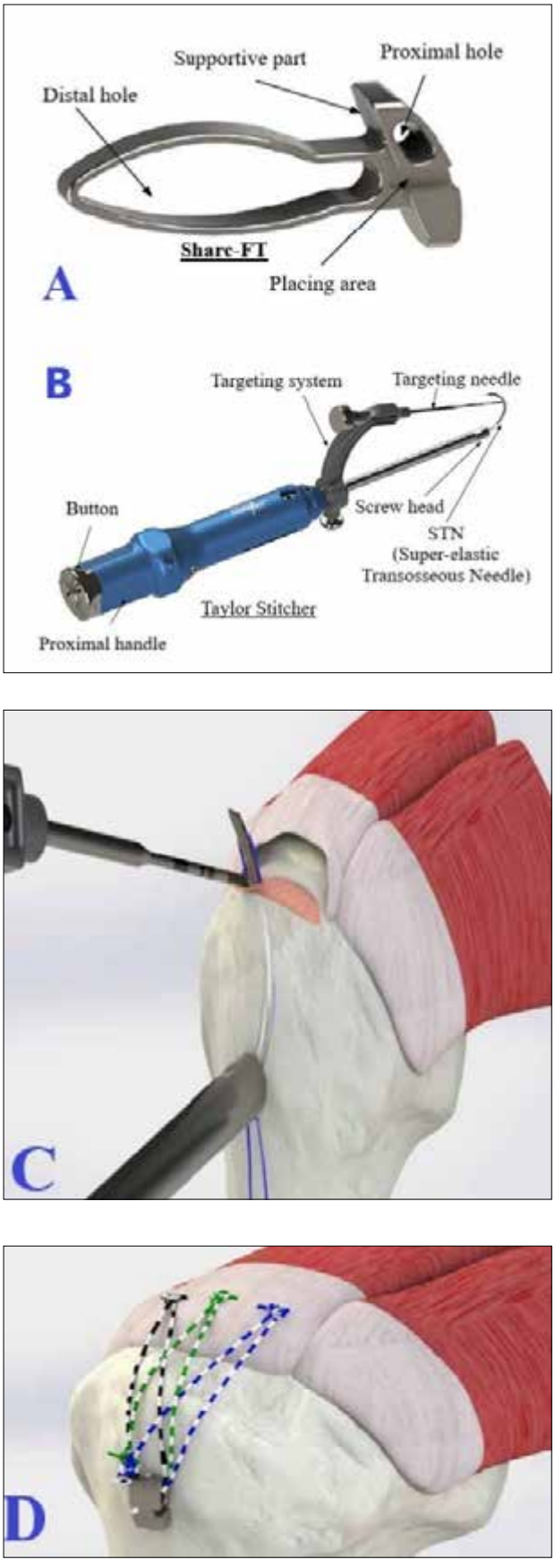

Figure 1. Sharc-FT (A), Taylor Stitcher (B), Targeting needle are removed from the rotator cuff footprint, and carrying strings are passed. The other carrying string is passed, leaving a gap of at least 1 cm (C). Final view of the rotator cuff tear after being repaired using Sharc-FT instrument (D) (Source: SHARC-FT AND TAYLOR STITCHERNCS Lab Medical Devices Factory)

Figure 2. Rotator cuff repair during surgery. The arthroscopic portals had been marked before the operation began (A). Sutures were made with a mini-open incision (B). Rotator cuff repair has been successfully done with the Sharc-FT (C).

Postoperative Follow-up

The patients were followed up for three weeks under shoulder sling with abduction support. Passive exercises were started at three weeks and active exercises at six weeks. Wound site dresses were changed every three days, and stitches were removed at 15 days if no problem is observed. The stitches were removed on day 21 for overweighed and diabetic patients.,

Statistical Analysis

Demographic data and others were reported as frequency and percentages. The arithmetic means±standard deviation was calculated for the numerical variables. The distribution characteristics of the data were determined by the Shapiro-Wilk test, while Levene's test calculated the homogeneity of variances. Statistical analysis was performed using SPSS for Windows 23.0 (IBM Corp., Armonk, NY, USA). Categorical data were analyzed by using Fisher exact or chi-squared tests. Parametric data were analyzed by using the Paired-Samples t-Test. $P < 0.05$ was considered statistically significant.

RESULTS

The mean age was 61.19 ± 6.74 for the 37 subjects included in the study (range: 52-76). 17 (45.9%) were female, and 20 (54.1%) were male. The rotator cuff tear was small, moderate, large, and massive in 4 (10.8%), 19 (51.4%), 8 (21.6%), and 6 (16.2%) of the subjects, respectively. The data regarding fatty degeneration, patte classification, acromion types, and the presence of migration and arthritis are presented in the table (Table 1)

Table 1. Demographic and clinical data of patients

		Number of Patients	Percentage (%)
Gender	**Female**	17	45.9%
	Male	20	54.1%
Fatty degeneration	**Grade 1**	16	43.2%
	Grade 2	21	56.8%
Patte Classification	**Grade 1**	20	54.1%
	Grade 2	17	45.9%
Acromion Types	**Type 1**	6	16.2%
	Type 2	17	45.9%
	Type 3	14	37.8%
Rupture Size	**Minor (<1 cm)**	4	10.8%
	Intermediate (1-3 cm)	19	51.4%
	Large (3-5 cm)	8	21.6%
	Massive (>5 cm)	6	16.2%
Migration	**None**	34	91.9%
	Present	3	8.1%
Arthritis	**None**	33	89.2%
	Present	4	10.8%

The assessments revealed that mean Constant and Murley shoulder scores (CMS) were 37.68±8.64 points before the surgery and 76.84±9.57 points after the surgery. The lowest and highest preoperative CMS scores were 23 and 56, respectively. The lowest and highest postoperative CMS scores were found to be 60 and 94, respectively. There was a statistically significant difference between the preoperative and postoperative CMS scores ($p<0.001$) (Table 2). In addition, classification of the subjects by postoperative CMS scores revealed 3 (8.1%) excellent, 14 (37.8%) good, 12 (32.4%) moderate, and 8 (21.6%) poor outcomes at six months (Table 3).

Table 2. Preoperative and postoperative functional results of patients

	Pre-operative (mean ± SD)	Post-operative (mean ± SD)	p-value
CMS	37.68±8.64	76.84±9.57	*<0.001**
UCLA	14.19±4.04	28.14±3.02	*<0.001**

CMS: Constant and Murley shoulder scores**; UCLA:** University of California-Los Angeles Shoulder Scale**; SD:** standard deviation

Table 3. Postoperative clinical results of the patients

	Number of patients	Percentage (%)
Poor	8	21.6%
Moderate	12	32.4%
Good	14	37.8%
Excellent	3	8.1%

The mean preoperative and postoperative UCLA shoulder scores were found to be 14.19±8.64 and 28.14±3.02 points, respectively. The lowest and highest preoperative UCLA shoulder scores were 8 and 26, respectively. The lowest and highest postoperative UCLA shoulder scores were found to be 22 and 34, respectively. There was a statistically significant difference between the preoperative and postoperative UCLA shoulder scores ($p<0.001$) (Table 2).

No subjects exhibited symptoms of infection or re-rupture during the postoperative period. 6th month MRI control revealed partial recovery in 4 subjects and full-thickness healing in 33 subjects.

DISCUSSION

This study showed that the results of rotator cuff tear repair, which we performed with a new device that we could perform double-row trans-osseous repair, provided structural integrity similar to other successful methods in the literature, and were associated with good clinical results (10-12).

Rotator cuff tears are most frequently seen in individuals between 40 to 70 years of age. Many factors may play a role in the etiology of the rotator cuff tears. The most commonly considered causes include tendon tensile tension and the excessive load on the rotator cuff. Acute trauma develops in almost all subjects over the age of 60 due to overload onto the rotator cuff. Repeated shoulder

movements constitute another cause of the rotator cuff tears. It has been reported that larger rotator cuff tears are seen in individuals with advanced age and that weakening occurs at the point of attachment to the bone, which becomes more frequent by age (4, 13).

Mini open or arthroscopic methods are used to repair rotator cuff tears surgically. Although these methods are reported to demonstrate good clinical and functional outcomes in both the short and long term, the best technique to repair full-thickness rotator cuff tears is still a matter of debate (14).

Some studies in the literature compare mini-open methods with full arthroscopic techniques and claim that full arthroscopic methods have benefits such as less morbidity during the surgical procedure and faster postoperative recovery of joint motions (15, 16). However, some investigators found no difference between the full arthroscopic and mini-open methods in clinical and functional terms (17).

When the studies on the infection rate were examined, it was observed that the infection rate was between 0.27% and 1.9% in the operations performed with mini-open and fully open methods. On the other hand, this rate varied between 0.04% and 0.23% in operations performed with the arthroscopic technique (18-21). These studies also showed that there was no severe infection rate among all methods. We did not encounter any infection in any of the patients, but this might relate to the short follow-up period.

Zhang et al. achieved a significant increase in muscle strength in subjects undergoing full arthroscopy, while the rate of re-rupture was higher (22). In this study, we observed a lower need for analgesics and a more straightforward postoperative rehabilitation process. We did not prefer a fully open surgery approach due to higher infection rates, deltoid dysfunction, and difficult postoperative rehabilitation. Today, the fixation quality in open surgery can be achieved by mini-open arthroscopy-aided surgery. The success rates are similar in the literature. Considering that complication rates in the arthroscopy-aided mini-open method are not as high as open surgery, we have chosen this method.

Various tendon fixation methods have been reported in the literature for rotator cuff repair. These include suture anchor (single-row, double-row, double-row transosseous and equivalents) and transosseous plans. Today, surgical methods based on the double-row fixation technique over the rotator cuff footprint have been developed to prevent repeated ruptures based on the hypothesis that single-row fixation does not generate a natural tendon attachment, leading to insufficient recovery. Apreleva et al. found in their study assessing the rotator cuff footprint in 3D in the normal rotator cuff. After many different rotator cuff repair methods, single-row fixation restores 67% of the original rotator cuff footprint. The same study demonstrated that transosseous simple suture repair restores approximately 85% of the surface area. The authors indicated that a broader footprint repair might enhance recovery and the mechanical endurance of the repaired tendons, which cannot be achieved using a single-row repair method (13).

Kim et al. demonstrated that double-row repair significantly reduces gap formation and that the addition of medial row anchors increases repair toughness by 46% and final insufficiency strength by 48% (23).

The success of the rotator cuff repair depends on high fixation strength, small gap formation, preservation of mechanical stability, and the maintenance of biological recovery at the tendon-bone interface. Many surgical techniques have been developed due to these factors. One of the said techniques is the transosseous method. Studies have demonstrated that transosseous repair results in small gap formation and the highest resistance. The literature suggests that the transosseous process provides stronger fixation than double-row repair (24, 25). Combining the transosseous method with double-row repair ensures a much steadier fixation in elderly patients with more inadequate muscle and bone quality. None of our subjects experienced re-rupture.

The limitations of our study were that it was a retrospective study, it was not comparative with other methods, the number of our patients was not very large, and the relatively short duration of 6 months. The low complication rate might be related to the short duration of the study. There were also no comparative group of patients repaired with a different technique, such as the traditional trans-osseous technique.

In conclusion, our method allowed for avoiding the complications of fully open surgery. Moreover, a fully arthroscopic method provided benefits like lower infection rates and less muscular strength loss, resulting in a steadier and safer fixation. This study showed that it is appropriate to implement the arthroscopy-aided transosseous method considering the functional and clinical outcomes.

Declarations

The authors received no financial support for the research and/or authorship of this article. There is no conflict of interest.

The study was conducted in accordance with the principles of the Declaration of Helsinki and the protocol was approved by the ethics committee of Atatürk University Medical Faculty (Date: 15.02.2018; Decision Number: 38)

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