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Midterm functional outcomes after arthroscopic trans-osseous rotator cuff repair

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Abstract: **Purpose:** Symptomatic rotator cuff tears can now be treated with arthroscopic trans-osseous (TO) rotator cuff techniques. From a biological as well as biomechanical perspective, TO sutures are considered superior. This study analyzed midterm functional outcomes of arthroscopic TO rotator cuff repair using special needles called giant needles.

Methods: 36 patients (14 females and 22 males with a mean age of 59.3 years) underwent arthroscopic TO rotator cuff repair for symptomatic full-thickness tears. Pre- and post-operative range of motion (ROM) and constant shoulder (CS) score of the affected shoulders were recorded. Patients were followed up at 6, 12, and 24 months after surgery.

Results: The mean pre-operative CS score improved from 43.54 to 87.52. The mean flexion range improved from 96° to 158° while the mean external rotation range improved from 33° to 68°. We recorded two cases of intra-operative tunnel failure, two cases with post-operative stiffness and one case of infection. One case underwent arthroscopic revision of rotator repair for a traumatic cuff re-tear.

Conclusion: The arthroscopic TO giant needle rotator cuff repair is an effective technique with satisfactory midterm outcome scores. Further radiological evaluation for healing rates is needed.

Keywords: *Arthroscopy, Trans-osseous, Rotator cuff tears, Giant needle*

Introduction

As one of the most common causes of shoulder pain and disability, the rotator cuff tear (RCT) has become one of the most commonly diagnosed diseases especially in patients over the age of 50(1). There are a variety of symptoms associated with RCT, from mild discomfort up to severe disabling pain, weakness, and restriction of range of motion (ROM)(2).

Surgical management for full-thickness tears of the rotator cuff has long been based on the use of open trans-osseous (TO) sutures, first described by Codman in 1911. Through the development of modern arthroscopic surgical techniques, surgeons have been able to achieve excellent fixation strength and outcomes(3).

In recent reports, a double-row (DR) and trans-osseous equivalent (TOE) repair technique have been described as an effective methods for repairing RCTs, however, the rate of pull out with poor bone stock and failure at tendon level are still high(4).

There has been a recent advance in arthroscopic anchorless TO techniques that combine the minimal invasiveness of arthroscopy with the biomechanical advantages of TO sutures(5).

One of the first techniques used to perform arthroscopic TO repair of RCT was the giant needle technique described by Fleega in 2002(6) (Fig. 1). Using a modified TO giant needle technique, this study evaluated its feasibility, clinical outcomes, potential complications, and failure rate.

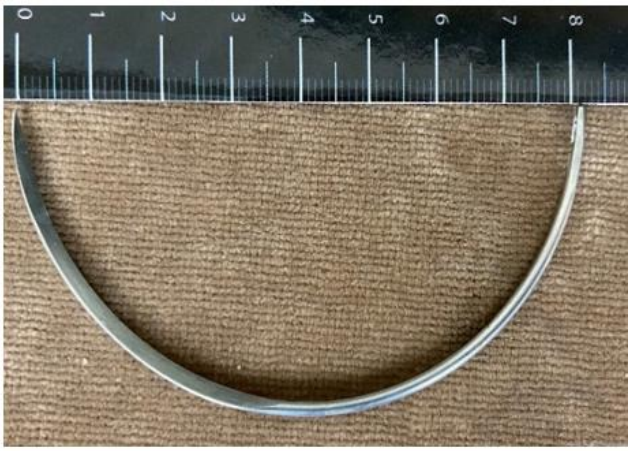

Fig. 1 Giant needle used for making tunnels in arthroscopic TO rotator cuff repair

Materials and methods

A total of 36 patients (14 males, 22 females) with an average age of 59.3 years (range from 44 to 76) suffered from symptomatic RCT, 1 to 3 cm wide based on MRI measuring, were treated from March 2021 to August 2022 (Table 1).

Table 1 Demographics of the study population

Number of patients	36
Average age in years ± SD	59.3 ± 6.86
Sex	
- Males	14
- Females	22
Degenerative vs. Traumatic RCTs	
- Degenerative	7
- Traumatic	29
Side	
- Right	25
- Left	11
Average duration of symptoms in months ± SD	5.29 ± 4.84

The procedure is indicated for patients with supraspinatus rotator cuff tears without advanced retraction (Patte grade 1 & 2)(7) or fatty infiltration (Fuchs grade 1 & 2)(8). Advanced glenohumeral osteoarthritis and rotator cuff arthropathy are relative contraindications, as these patients may suffer from inadequate post-operative pain relief.

Detailed information regarding the shoulder injury should include its origin (traumatic or degenerative), timing, and earlier conservative or operative treatment. A patient should also be prepared for a change to an open procedure if unexpected intra-operative findings occur, such as poor arthroscopic vision.

In addition to assessing shoulder anteroposterior and lateral axillary X-ray images, magnetic resonance imaging (MRI) was used to measure the tears' length and width.

Meticulous local examination of both shoulders was done for each patient regarding range of motions (using a goniometer) and special tests for each rotator cuff muscle. A constant score (0–100 points) was calculated for all the patients during the pre-operative phase and at 6, 12 and 24 months after the operation(9).

Operative technique

After general anaesthesia & interscalene block, the procedure was performed with the patient in the beach chair position. The glenohumeral joint examination, subacromial bursectomy, rotator cuff mobilization, and footprint preparation by an acromionizer were carried out in a standard fashion through standard arthroscopic portals (Fig. 2).

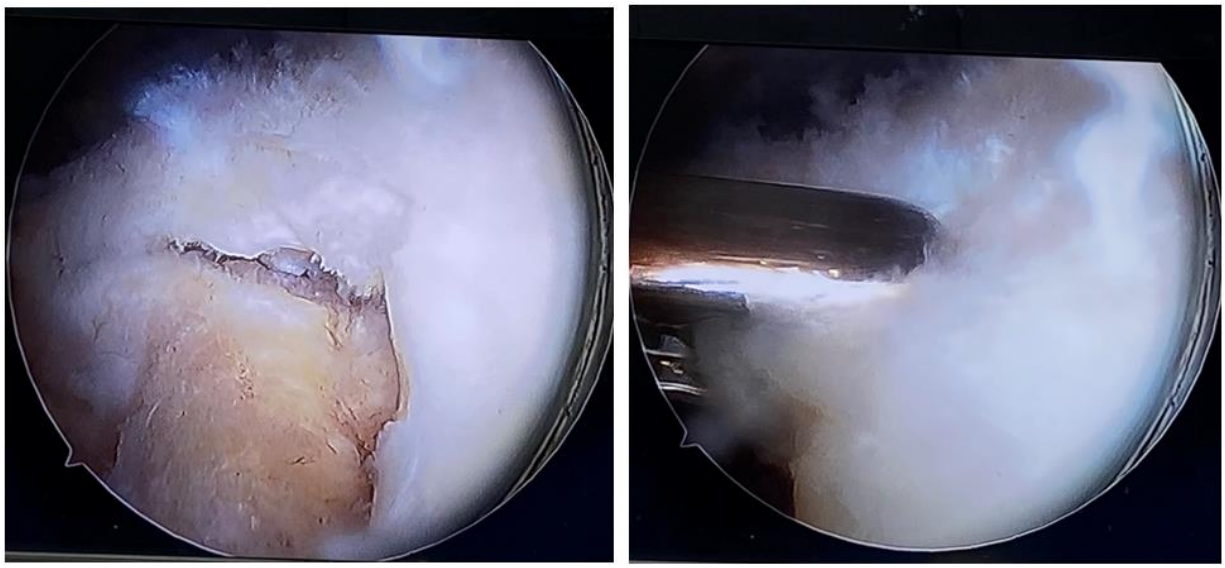

Fig. 2 Arthroscopic photo of footprint preparation (Lt.) and checking reducibility of the tendon (Rt.)

Using an awl, giant needle entry holes were made just lateral to the cartilage. We planned to made a hole for each 1.5 centimetre of the tear size.

Afterward, the arm is extended and slightly abducted until the giant needle is passed percutaneously to the desired hole (Fig. 3).

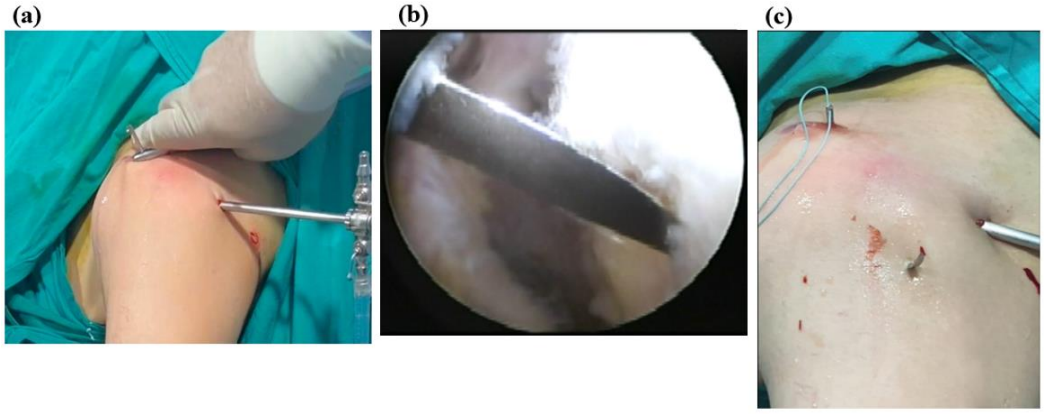

Fig. 3 (a) Intra-operative photo of entry of the needle through the skin (b) Arthroscopic view of entry of the needle through the made hole (c) Intra-operative photo of exiting of the giant needle through the skin

The arm was then rotated in alternating rotations from the elbow as the needle was pushed until it passed through the lateral cortex.

The giant needle was then loaded with a shuttling suture which was used to pass 2 to 3 high-strength sutures through the tunnel (Fig. 4). The lateral limbs of the sutures were brought out by using of a hook. The medial limbs were passed through the cuff tendon with a suture passer. A sliding knot of any type was used to tie the medial and lateral ends together (Fig. 5).

An assessment of the joint was carried out after repair to ensure passive range of motion, documentation was made, and routine skin closure was carried out.

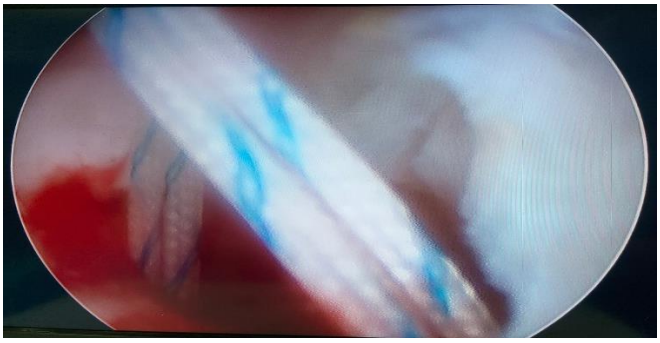

Fig. 4 Arthroscopic view of sutures within the tunnels before passed through the cuff

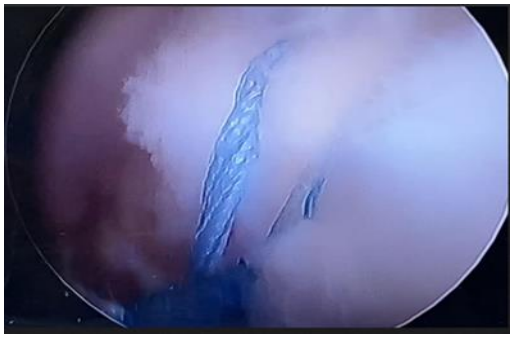

Fig. 5 Arthroscopic view of the final repair

Post-operative management

Immediately following the surgery, all patients were required to wear an arm sling with their arms at their sides for 6 weeks. In the first few days after surgery, we began passive and active assisted elbow, wrist, and hand motion exercises, in addition to kinetic scapular exercises. Shoulder ROM started after 2 weeks. We began with passive flexion, abduction and external rotation in the supine position and gradually progress based on the size of the tear and quality of tendons. At week 7, active range of motion (including internal rotation) began, and gentle strengthening started by week 12. All patients were evaluated at 6, 12, and 24 months post-operatively to assess and document the CS score and ROM of the affected shoulder.

Statistical method

Data were statistically described in terms of mean ± standard deviation (± SD), median and range, or frequencies (number of cases) and percentages when appropriate. IBM SPSS (Statistical Package for the Social Science; IBM Corp, Armonk, NY, USA) release 22 for Microsoft Windows was used for all statistical analyses.

Results and follow-up

Intra-operative data:

We performed tenotomy for long head biceps on 30 patients, while it was preserved in 6 patients. In the majority of patients (34 case) 2 bone tunnels were created with 2 to 3 sutures in each one. One bone tunnel was sufficient in 2 cases.

Tunnel failure (suture cut-out) occurred in 2 patients. Revision of tunnel creation was made in one patient while another patient required revision by an anchor.

Post-operative data:

Average flexion range was improved from 96° pre-operative to 158° at the most recent follow-up (FU), while average external rotation was improved from 33° to 68°. The average CS score of the affected shoulders improved from 43.54 pre-operative to 87.52 at 24 months FU (Table 2).

Four post-operative complications were documented. Two patients had post-operative stiffness at three months FU. Physiotherapy and sonographic-guided shoulder injections were provided to these patients, along with pain management. A one-year FU resulted in significant improvement for those patients.

In another patient, persistent drainage from the anterior portal led to arthroscopic irrigation, debridement, and parenteral antibiotic management for 6 weeks.

There was one patient who underwent a revision rotator cuff repair one year after the original surgery for a recurrence of the tear due to traumatic event.

Table 2 Pre- and post-operative outcomes of CS score of the patients included in the study

	Pre-operative		**Six months FU**		**One year FU**		**Two years FU**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
CS score	**43.54**	6.21	**81.47**	5.17	**84.76**	2.19	**87.52**	4.07

Discussion

Generally, rotator cuff repairs focus on providing pain relief, improving function, and tendon healing. A good rotator cuff repair should has high initial strength, allow for minimal gap formation, and remain stable until solid healing is complete(10).

While there are many different techniques to repair the rotator cuff tears, whether open or arthroscopic, the ideal method of repair remains controversial. In arthroscopic rotator cuff surgery, suture anchors are by far the most commonly used technique. Anchor-based repair methods such as single-row, double-row, and TOE have been well described in the literature, and their clinical outcomes have been consistent with good healing rates(11,12). Currently, the most significant complications are the migration and pullout of these implants, especially in patients with a poor bone stock(13).

In terms of biological and biomechanical properties, the TO repair is well suited to rotator cuff repair nowadays. In fact, it is a highly effective technique for reducing the formation of tendons–bone gaps, taking into account the fact that any displacement of 3 mm can be considered as a failure of the repair(14).

Upon estimating the maximum load to failure, it appears that there are no differences between repairs with anchors and those with TO techniques(15).

In terms of both biological factors, some authors consider TO methods to be superior to suture anchors in rotator cuff repair. During the healing process, bone tunnels in the foot print of the cuff increase blood flow to the repaired cuff tendon(16).

It is necessary to keep in mind that in patients with poor bone quality, the anchor pull-out could pose a problem during the rotator cuff repair. A cautious application of TO techniques may avoid this complication(17).

This study evaluated the functional outcomes (ROM and CS of the affected shoulders) following arthroscopic TO rotator cuff repair using the giant needle. Our results demonstrated significant improvement regarding ROM (flexion and ER) as well as the CS.

There are a number of studies in the literature that have documented considerable results after TO rotator repair. Baudi et al (2013) found in their study on 34 patients with average age of 63.24 years that the CS of the affected shoulders improved from 24.5 to 83.2 (at 6 months) and 86.9 (at 12 months)(18). Also, *Firat et al* (2020) found an improvement of CS of affected shoulders of TO group from 31.59 to 88.56 over an average follow up of 33.72 months(19). While Randelli et al (2017) found an improvement of CS of the affected shoulders of the TO group from 64.3 to 69.9(5).

There are some limitations relevant to this study. Further studies need to be performed to evaluate the long-term clinical and radiographic outcomes of this technique and compare it to the TOE anchor repair.

Conclusion

In our experience, arthroscopic TO rotator cuff repair using the giant needle technique is associated with significant improvements in range of motion at the midterm and a satisfactory midterm constant shoulder score with low rates of complication and failure.

- Ethical approval: This study was approved by our Institutional Ethics Review Board.
- Consent to Participate: All patients provided informed consent to participate in this study.
- Consent to Publish: All participants provided informed consent for the publication of this study.
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- Competing Interests: The authors declare that they have no conflict of interest.
- Availability of data and materials: Not available.
- Code availability: Not available.

- Authors' Contributions:

All authors whose names appear on the submission

1) made substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data; or the creation of new software used in the work;
2) drafted the work or revised it critically for important intellectual content;
3) approved the version to be published; and
4) agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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