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ORIGINAL ARTICLE

Does a brace influence clinical outcomes after arthroscopic rotator cuff repair?

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Abstract
Purpose The goal of this study was to report the clinical effects of two different braces after rotator cuff repair.
Methods Forty patients who underwent an arthroscopic rotator cuff repair were prospectively allocated in this study. Twenty patients were immobilized in 15° external rotation brace (ER Group), and twenty were immobilised in an internal rotation sling (IR Group). For all patients, four surveys were done: in the immediate pre-operative period (T0), at 1 month (T1), at 3 months (T2) and at 6 months after surgery (T3). Range of motion and pain were evaluated by an independent physician. Self-Assessment Scales [(University California Los Angeles Shoulder Rating Scale (UCLA), Disability of the Arm Shoulder and Hand (DASH), Visual Analog Scale (VAS), Simple Shoulder Test (SST) and Physician Assessment Scale (Constant)] were also administered.
Results Abduction and ER2 (external rotation with arm in abduction) were significantly greater in the ER group at T1, T2 and T3, ER1 (external rotation with arm at side) was significantly greater in the ER group at T1 and T2, IR2 (internal rotation) was significantly greater in the ER group at T1, and FFL (forward flexion) was significantly greater in the ER group at T1. VAS was significantly lower in the ER group at T1 and T2 and T3. About the Self-Assessment Shoulder Scales after 3 and 6 months, no differences were found. SST showed a lesser functional limitation for the ER group at T3.
Conclusions Patients operated with isolated superior or posterosuperior rotator cuff tear immobilised with brace in 15° of ER position showed less pain and a better passive range of motion at short time after surgery.

Keywords Brace · Rotator cuff · Shoulder

Introduction

Shoulder immobilisation is recommended in the acute phase after rotator cuff surgery to protect the repair, as clinical results are positively correlated with repair healing [1]. The use of a brace with an abductor pillow at average 30° in the scapular plane appears to reduce the tensile force on the repaired superior cuff [2]. Similarly, the tensile force in the superior cuff also increases with internal rotation [3]. High passive tension within the rotator cuff has been suggested as a cause of repair failure; consequently, the positioning of immobilization in the immediate postoperative time could assume a critical role to determine the repair integrity. Furthermore, it is likely that the stress to which the repaired tendons are eligible may vary with different patients arm setup and also in response to pain. The positioning of the immobilisation could also influence postoperative pain and so the capacity of patients to accomplish the physical therapy exercises in the first postoperative period. The aim of this study was to highlight the clinical effects of two different braces after surgical repair of the rotator cuff. The hypothesis was that using a brace with 15° of external rotation, the postoperative pain can be reduced, patients are more comfortable, and this can result in better clinical outcomes in a short time period.

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Materials and methods

In a 1-year period, 752 patients underwent an arthroscopic rotator cuff repair in our institute. Of these, 40 patients (27 females and 13 males) were randomly and prospectively allocated in this study. All patients gave written informed consent to take part. Twenty patients were immobilized with a brace in external rotation of 15° (ER group—Fig. 1), and twenty were immobilised with a sling in internal rotation of 15° (IR group—Fig. 2). The duration of immobilisation was 6 weeks.

The sample assignment to a group was chosen random in double-blind trial. The inclusion criteria were as follows: isolated C2–C3 tears of supraspinatus according to Snyder criteria [4] and/or associated tear of the upper part of the infraspinatus, no previous surgery at the same site, good patients compliance and age between 50 and 70 years.

Fig. 1 The setup for ER group patients

Fig. 2 The setup for IR group patient

Patients with a subscapularis tendon tear, associated labral tear, were excluded. Also patients with some co-morbidities such as diabetes mellitus or associated capsulitis were excluded.

The mean age of patients was 62.3 (range 45–68 years) and 59 years (range 42–70), respectively, for ER and IR group. All the patients were operated on in a lateral decubitus position under interscalene block. Rotator cuff was arthroscopically repaired using one or two non-absorbable triple-loaded suture anchors with a single-row technique. In all cases, a biceps tenotomy and an additional subacromial decompression were done. All the surgical procedures were carried out by the same surgeon.

After surgery, all the patients took anti-inflammatory and analgesic drugs for 10 days according to our protocol.

The patients were asked to keep a diary of the pain score at home on weekly basis.

The rehabilitation program for both groups was similar: in the first 5 weeks, they had to wear the sling (in ABD 15° and ER or IR 15° according to the respective group) day and night and were advised to perform at home pendular exercises and supine passive motions exercises to maximum 90° of elevation and 30° of external rotation. No active motion was allowed for 6 weeks. Then, the patients underwent to a similar outpatient rehabilitation protocol supervised by a professional therapist.

For all patients, four surveys at different times were done: in the immediate pre-operative period (T0), at 1 month (T1), at 3 months postoperatively (T2), and at 6 months after surgery (T3). All the evaluations were done by an independent physician.

Patients underwent to a functional test series [No. 5 range of passive range of motion such as ER1 (external rotation with elbow at side), ER2 (external rotation with arm in abduction) IR 2 (internal rotation) ABD (abduction) and FFL (forward flexion)], and four Self-Assessment Scales (UCLA, DASH, VAS, Simple Shoulder Test) and one Physician Assessment Scale (Constant).

A statistical analysis to evaluate the differences over time between the two groups was done. All differences were checked with Wilcoxon rank-sum tests for two sample data or the Wilcoxon signed-rank tests for one sample data. Type I error rate was set to 0.05.

Results

No intra- or postoperative complications were observed in the two groups of patients.

No patient was lost during the time of study.

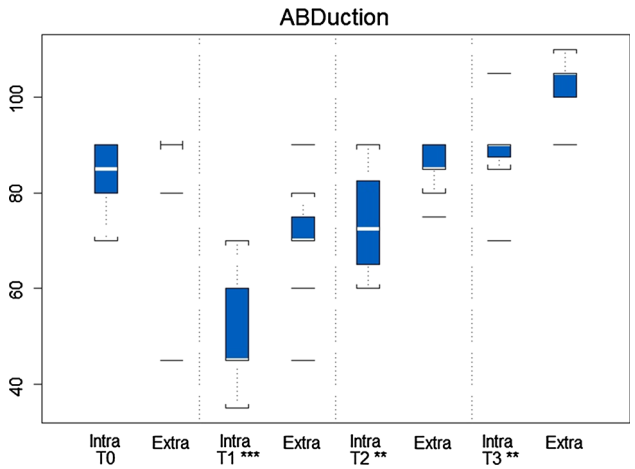

Fig. 3 Abduction was significantly greater in the ER group at T1 and T2 and T3

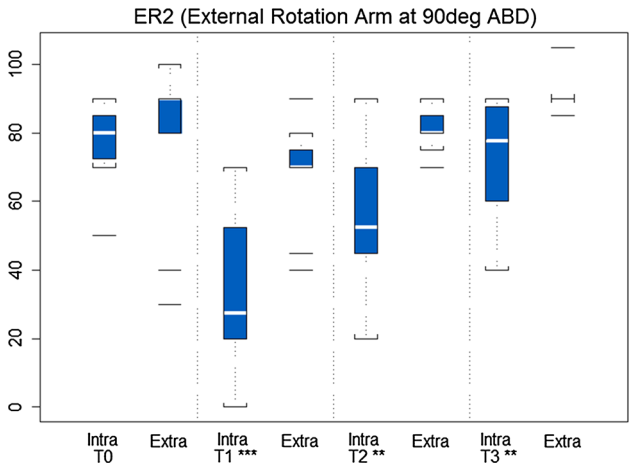

Fig. 5 ER2 was significantly greater in the ER group at T1 and T2 and T3

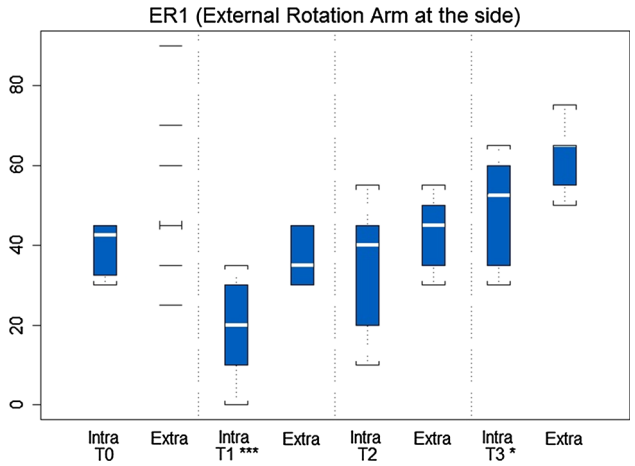

Fig. 4 ER1 was significantly greater in the ER group at T1 and T2, but not at T3

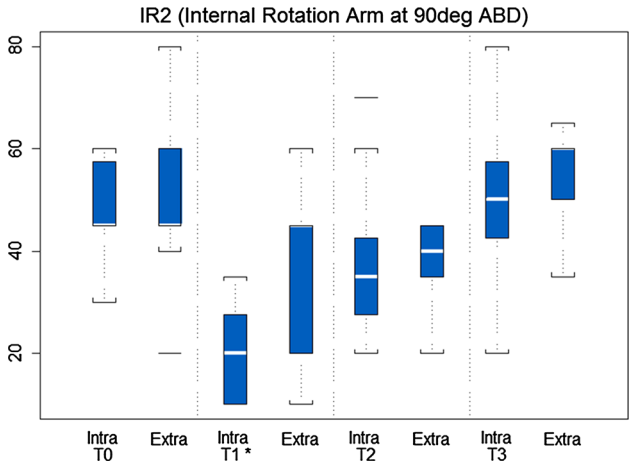

Fig. 6 IR2 was significantly greater in the ER group at T1, but at T2 and T3, no differences were observed

Figures 3, 4, 5, 6 and 7 show the mean value ± SD of the PRoM (passive range of motion) tests over time comparing ER group against IR group (level of significance shown as * or ** or *** depending on p value compared to the set value of 0,05).

We observed that ABD was significantly greater in the ER group at T1 and T2 and T3 (Fig. 3), ER1 was significantly greater in the ER group at T1 and T2 (Fig. 4), ER2 was significantly greater in the ER group at T1 and T2 and T3 (Fig. 5), IR2 was significantly greater in the ER group at T1 (Fig. 6), and FFL was significantly greater in the ER group at T1 (Fig. 7).

The statistical analysis of data shows that there are significant differences at short time after surgery, indicating that the immobilization brace in external rotation has some advantages compared to the classical internal rotation, at least at short time.

Particularly, given the trend of the parameters tested in each group, we observed a better recovery of passive range of motion at 3 months in the ER group compared to IR group.

Also about pain, patients with an ER brace referred significantly less pain during the early postoperative time. VAS was significantly lower in the ER group at T1 and T2 and T3 (Fig. 8).

About the Self-Assessment Shoulder Scales (UCLA, DASH) and Physician Assessment Scale (Constant) after 3 and 6 months, no differences were found between the two groups.

Only the SST showed a lesser functional limitation for the ER group at T3 (Fig. 9).

From the clinical point of view, the ER group patients showed less pain and more passive motion at 1 and 3 months after surgery; then, the conditions become

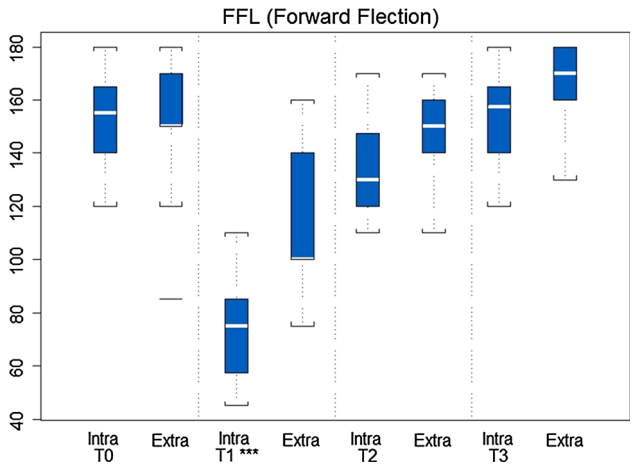

Fig. 7 FFL was significantly greater in the ER group at T1, but not at T2 and T3

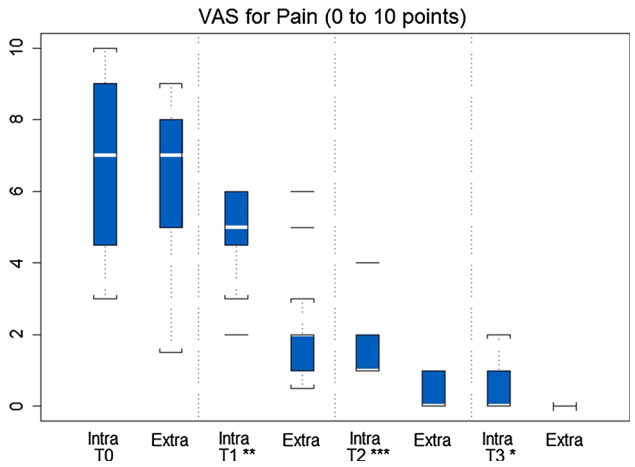

Fig. 8 Patients with an ER brace had a significant less pain during the early postoperative time

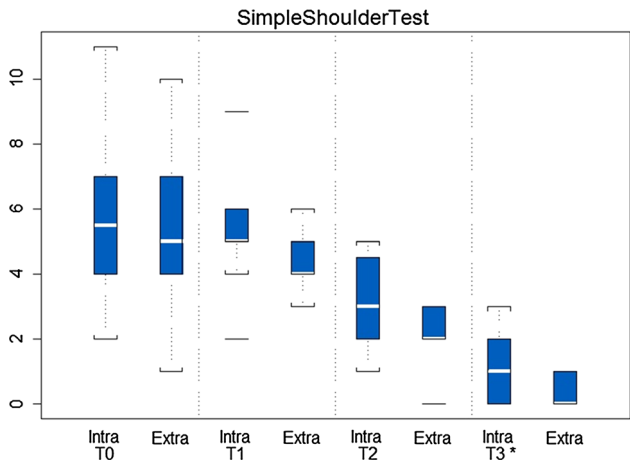

Fig. 9 SST showed a lesser functional limitation for the ER group at T0, T1, T2 and T3

increasingly similar, with a slight advantage in mobility for the ER group.

Discussion

The findings of this study suggest that at short time after arthroscopic surgery for repair of isolated supraspinatus and also associated tear of infraspinatus, patients immobilised with brace in 15° of ER position showed less pain and a better passive range of motion, while at 6 months of follow-up, there are not significant functional differences, although patients immobilised in ER brace still showed a slight advantage in range of motion, particularly in abduction and in ER2.

The best time and position of immobilisation after rotator cuff repair in literature has to be established and probably could be related to the type of repair [5]. In a study made on a rat model, some authors showed that in the rodents with rotator cuff repair immobilized, there was a markedly higher collagen orientation, more nearly normal extracellular matrix and increased quasi-linear viscoelastic properties than did the tendons from subjects that were exercised [6]. It is clear, however, that proper positioning of the arm during the early healing phases is important to reduce the stress on the repaired cuff and the use of a brace with an abductor pillow at average 30° in the scapular plane has been reported to reduce the tensile force on the repaired superior cuff [2]. Furthermore, the arm adducted at side could result in a hypovascularity of the supraspinatus [7] and then eventually compromise the repair. Howe et al. [8] showed a twofold increase in load between the anterior and posterior suture when the arm was placed in a 30° external or internal rotation, respectively, compared to the arm in neutral position. Kulwicki et al. [9] have shown that placing the arm in 45° external or internal rotation will place enormous strain on the anterior or posterior anchors, respectively, with the load increased by 125 %. We can suppose that the relative ischemia and over-tensioning on the repaired tendons can be responsible of more pain observed in the group of patients using the sling in the postoperative period. Although an aggressive early motion that stresses the repair and exceeds the mechanical strength of the repair construct should be avoided after rotator cuff repair; however, some controlled passive motion should be carried out to avoid a postoperative stiffness. In this way, it is very important that patients are comfortable and painless. This evidence can explain the better results in terms of pain and passive range of motion in the group of patients wearing the ER brace at 1 and 3 months after surgery.

This study had some weakness. First of all, the small number of patients, furthermore the physician who

evaluated the patients during follow-up time, observed the type of brace used by the patients, and in consequence could be influenced during the evaluation of data. Another point is related to the compliance of patients to take the oral medications out after 10 days. In fact, it is impossible to understand whether the patients really stopped the use of the anti-inflammatory and analgesic drugs after 10 days as counselled and this could create another bias.

However, this study also has some strengths related to the fact that the two groups of patients were well homogeneous, surgical technique was the same in all the patients and made by the same surgeon, the postoperative rehabilitation in the first postoperative time was supervised every 3 days by three well-experienced physiotherapist that observed and taught patients to do exercises.

This is the first attempt in literature to verify the compliance of patients to wear different braces after arthroscopic rotator cuff repair and if brace itself can influence clinical outcomes at short and medium term.

The current literature agrees that after surgery patients should be immobilised in a position able to reduce the tension on the repaired cuff so to better maximizes rotator cuff healing during early postoperative period. In our study, we did not evaluate the healing of rotator cuff; however, we noted that brace in ER position and slight abduction, that is reported by literature to better reduce the tensioning on posterior and superior cuff, resulted in a better compliance, clinical score and reduced pain at short and medium term after surgery.

Conclusions

Patients operated with isolated superior or posterosuperior rotator cuff tear immobilised with brace in 15° of ER position showed less pain and a better passive range of motion at short time after surgery. This is a very important point for the patients because they need less physical therapy and less time to obtain a satisfactory clinical outcome after this surgery.

Conflict of interest The authors declare that they have no conflict of interest.

Human and animal rights This article does not contain any studies with human or animal subjects performed by any of the authors.

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