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Original Article

Clinico-radiological evaluation of retear rate in arthroscopic double row versus single row repair technique in full thickness rotator cuff tear

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ABSTRACT

Background: Rotator cuff tear is most troublesome issue in shoulder surgery. Retear is seen in arthroscopically repaired rotator cuff tear.
Purpose: The functional outcome and retear rate in primary full thickness rotator cuff tear operated by single and double row repair technique.
Methods: 56 cases with full thickness tear of rotator cuff operated by single or double (28 each) were studied. Retear rate is evaluated after at least 6 months after surgery.
Results: There was a statistical difference in retear rate between double row and single row repair (p value <0.01).
Conclusion: Retear rate is low in double row repair technique.

1. Introduction

The purpose of surgery in full thickness rotator cuff tear is to achieve anatomical footprint of the rotator cuff and to relieve pain and restore shoulder function. The integrity of repair site is shown to correlate with clinical improvement, particularly return of strength. Open repair was commonly practiced but recently arthroscopic repair is widely accepted with equal or better results.[1] Retear may occur even after arthroscopic rotator cuff repair due to poor quality of tissue, poor pull out strength of anchor, suture breakage and inappropriate rehabilitation. In 2004, Galatz[24] reported high incidence of retear rate in arthroscopically repaired rotator cuff. The double row repair method has shown to restore anatomical footprint of rotator cuff and also achieves better healing.[9] The purpose of this study is evaluate retear rate in single and double row repair method. The purpose of this study is to evaluate retear rate and to assess functional outcome of both repair techniques.

2. Methods

Among patients who had undergone arthroscopic repair for the treatment of full thickness rotator cuff tear 56 patients were enrolled for the study.

Computer based randomization of cases was done which consisted of 28 cases of each single and double row repair method. All patient had routine follow up for 6 months after surgery. Preoperative clinical scoring and MRI of affected shoulder is done which is a routine part of management in our hospital. Post surgery clinical scoring at 3 and 6 months is done by UCLA and ASES.[10] Post op MRI is done at the end of 6 months. It is a prospective type of study. All patients in 30–70 year age group with full thickness rotator cuff tear who have undergone single or double row repair technique and willing to participate in study are included. Patient with SLAP tear, revision surgery, symptomatic acromioclavicular joint arthritis, cuff tear arthropathy, biceps tendon pathology and adhesive capsulitis are excluded. History was elicited from patients regarding age, sex duration of pain, side, hand dominance and loss of function. Patients were clinically examined for range of movement, strength of rotator cuff muscles, etc. Preoperative UCLA and ASES were documented for all patients. Physical examination consisted of measurements of range of motion and manual muscle strength test. The range of motion assessment included measurement of forward flexion in sagittal plane and strength of forward flexion. Jobe's empty can test was used for assessment of supraspinatus: In this test, the arm is placed in 30° of forward flexion and 90° of abduction in plane of scapula with the elbow fully extended and thumb pointing down (empty can) towards floor. The patient is asked to raise the arm against resistance applied by the examiner over the forearm. If the arm flops down with pain, it is indicative of rotator cuff tear. This is often referrred to as "Drop arm sign" and though diagnostic of full

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thickness rotator cuff tear. It is occasionally seen severe inflammation of cuff and large partial cuff tear. Jobe's full can tear was also used for assessment of supraspinatus. In this, the same test is repeated with the thumb pointing up towards ceiling. The deltoid shares the load of the supraspinatus and it is performed with ease. In the presence of a full thickness tear both the empty can and full can test will be positive. In supraspinatus tendinitis, calcific tendonitis and partial tears of rotator cuff full can test will be negative. The full can test is more specific for the diagnosis of a full thickness tear. Resisted external rotation tests were used for infraspinatus and teres minor together. In this test, patient is asked to tuck the elbow near his waist in 90° of flexion at the elbow and rotate the forearm externally against the resistance. Radiological evaluation consists of pre-op radiological evaluation involved true AP view and MRI of involved shoulder. Final diagnosis was done on the basis of intraoperative findings. Repeat MRI is done at the end of 6 months for retear. Assessment scores consists of UCLA and ASES scores (Figs. 1 and 2).

Surgical technique:

1. Double row repair
2. Single row repair

2.1. Operative procedure

All the procedures are performed by the same surgeon under regional or general anesthesia, with the patient in the floppy lateral position. In both groups posterior, anterior and 2 lateral portals are established for each patient. The posterior portal is used as the viewing portal; the anterior portal and the lateral portals are used as the working portals. Posterior portal is used to locate position of tear with scope. Shoulder joint is visualized through anterior portal. Shaver is used for freshening margins of tear. Briefly, for single row repair knotless suture anchor are placed in the greater tuberosity. Sutures are passed through the cuff with a suture passer and tied with a simple knot and a mattress knot for each anchor. Double row repair is performed according to the "double row pulley technique". Briefly, suture anchors are placed very close to the articular cartilage to form the medial row. Then, threads are passed through the cuff with a suture passer, and thread of one color are tied together with a simple knot and an outside-in knot. One thread of the other color is retrieved from each anchor, placed into a self-locking anchors and fixed to the anterolateral part of the greater tuberosity.

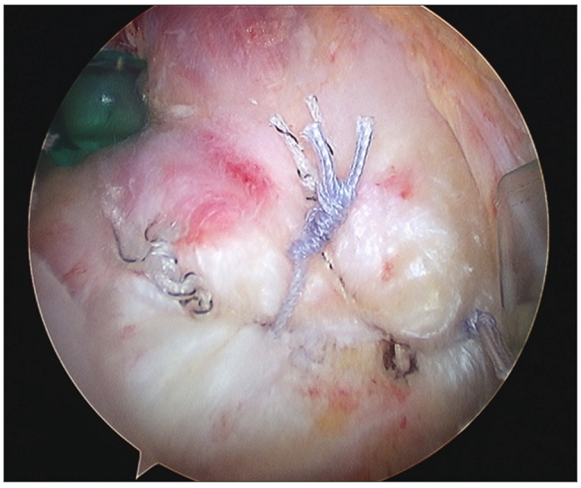

Fig. 1. Arthroscopic image of double row rotator cuff repair.

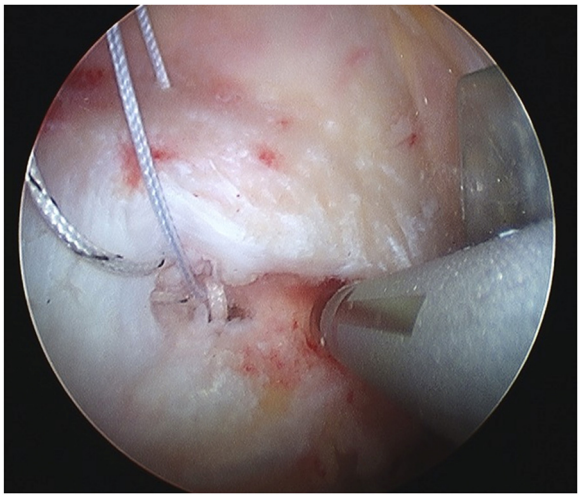

Fig. 2. Arthroscopic image showing placement of anchors.

The same procedure is repeated with the last two thread that are fixed with a self-locking anchors to the posterolateral aspect of the greater tuberosity. For both single row and double row repair, only one strand of the suture is passed on the tendon at each time so as to avoid creating large holes through the cuff.

2.2. Postoperative protocol

All the patients followed the same postoperative protocol lasting about 6 months. Briefly, they wore a brace 24 h a day with the operated shoulder at 15° of abduction and in neutral rotation. During this early phase, bracing was discontinued only for bathing or taking a shower. Subsequently, a scheduled program of passive physical therapy 2–3 times a week was started. Only after complete passive range of motion had been achieved, active assisted exercises and progressive muscle strengthening were begun. Patients returned to their normal activities of daily living 3–6 months after surgery.

2.3. Consent

Consent will be taken a day before surgery. Patient will be explained about the study procedure orally and in writing, in a language best understood by them, and signed consent obtained. Details shall be collected according to a defined format of questions and examination, administered by the investigator.

3. Results

3.1. Sample size

The sample size is calculated using method described by DuPont and Plummer (1990) for continuous response measures in 2 independent groups. We are planning a study of a continuous response variable from independent control and experimental subjects with 1 control(s) per experimental subject. In a previous study the response within each subject group was normally distributed with standard deviation 5. If the true difference in the experimental and control means is 5, we will need to study 22 experimental subjects and 22 control subjects to be able to reject the null hypothesis that the population means of the experimental and control groups are equal with probability (power) 0.9. The Type I error probability associated with this test of this null hypothesis is 0.05.

We are planning a study of a continuous response variable from independent control (Double row rotator cuff repair) and experimental subjects (Single row rotator cuff repair) with 1 control(s) per experimental subject. In a recently published previous study (McCormick F et al., 2014) the response of ASES scores within each subject group was normally distributed with standard deviation of 5 at the end of study. If the true difference in the experimental and control means is 5, we will need to study 22 experimental subjects and 22 control subjects to be able to reject the null hypothesis that the population means of the experimental and control groups are equal with probability (power) 0.9. The Type I error probability associated with this test of this null hypothesis is 0.05 (α).

Considering 20% of patients will be dropout during follow-up period of study, the final sample size is 28 patients per study group (N = 56).

3.2. Statistical analysis

Qualitative data will be represented in the form of percentages. Quantitative data will be calculated using mean ± SD and/or median with range. Analysis of quantitative data between a qualitative variable with two subgroups will be done using unpaired *t*-test if data passes 'Normality test' and by Mann-Whitney test if data fails 'Normality test'. Chi-Square test will be used for proportions. Results will be represented graphically. MS Office 2013 and SPSS version 17 will be used for most analysis. p Value <0.05 will be considered significant (Figs. 3–5).

The clinical outcomes of the arthroscopic single row repair group and the double row repair group were compared. In single row group, the mean ASES score increased from 44.93 to 86.75 in single row and 43.82to 89.54 in the double row group [Table 6]. The mean UCLA score increased from the preoperative 17.46 to 30.14 in single row group and from 17.29 to 31.50 in double row group [Table 5]. For both methods, there was a significant improvement after repair compared to the preoperative state for the full thickness rotator cuff tears ($p < 0.001$) at the end of six month. The average UCLA score improved significantly to 30.19 in the single-row and to 31.50 in the double row group. The ASES shoulder index improved significantly to 86.74 in the single-row group and to 89.54 in the double row group. However, there was statistical difference between the groups in the postoperative scores. We analysed the data by age and sex. There was no significant differences between the two repair methods detected by patient age. Next, we evaluate retear rate in both double and single row repair method. we found that percentage of retear rate in single row (39.3) is more common than double row (7.1) and it is statistically significant as p value is <0.05 [Table 1].

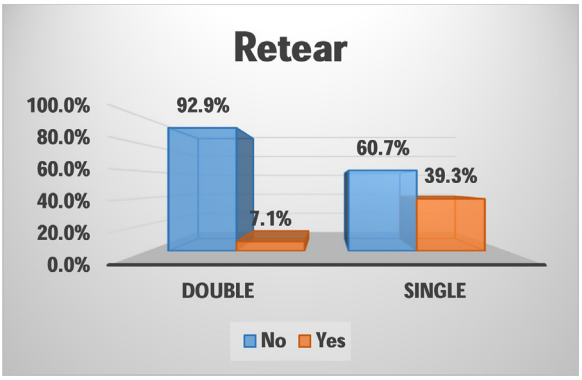

Fig. 3. Retear rate in double row is 7.1% and in single row 39.3% and it is statistically significant.

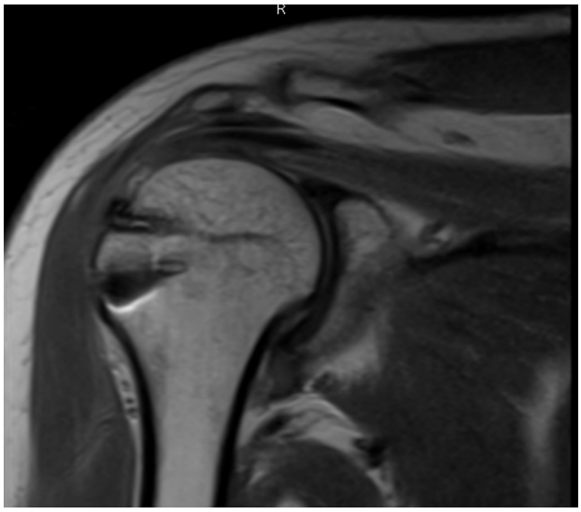

Fig. 4. 47 yr. old male Coronal MRI views of the operated shoulder (DOUBLE ROW group), at 6 month follow-up, showed a continuous supraspinatus tendon without muscular retraction. The humeral head was not superiorly migrated. Clinical results were excellent with UCLA SCORE 33 and ASES SCORE 95.

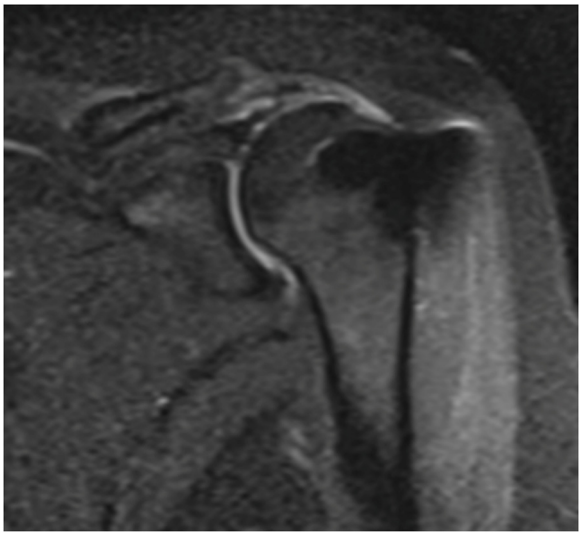

Fig. 5. 60 yr. old female coronal MRI view of the right shoulder (SINGLE ROW group), at 6 month follow up, showed a defect in supraspinatus footprint with retraction.

4. Discussion

Complete rotator cuff repair will not heal. Complete ruptures require surgery to achieve optimum function. Boileau et al.[2] showed that arthroscopic repair of cuff tears do heal, whereas Galatz et al.[24] found less evidence off healing between 1997 and 2000. With double row repair technique and increased clinical expertise, we believe that cuff tears have increased chances of healing.[22,23] Double row repair has shown to be biomechanically superior to single row fixation has been shown to restore

Table 1
Both groups contain 28 patient each.

Group	N	%
Single	28	50.0%
Double	28	50.0%
Total	56	100.0%

footprint of the rotator cuff, increasing the contact area for healing.[11,25,26,28,30,31]

In our study, we found that both technique achieve significant clinical improvement. We identified statistically significant difference at the end of 6 months in UCLA and ASES score. We found these surgical techniques to be different in terms of retear rate and footprint restoration. We found that double row technique have higher rate of tendon healing, low rate of recurrence and greater muscle strength. Our study has shown complete tendon healing in double row repair technique, however no clinically significant differences were found except at the end of 6 month in UCLA and ASES score. Several studies done have shown that double row rotator cuff repair provides greater mechanical strength, especially during late recovery phase therefore may be translated into improved clinical outcome. Secondly, the degree of rotator cuff healing after repair does not necessarily affect clinical outcome. Studies have shown that improved pain and shoulder function does not always correlate with repair integrity. However, patient with better tendon healing are more likely to experience improved clinical outcome. Tendon healing is also affected by other factors like age,education, activity osteoporosis and concomitant condition in the affected shoulder.

Rotator cuff tears are among the most common conditions affecting the shoulder. Despite their ubiquity, there is substantial debate concerning their management. Arthroscopic repair of rotator cuff tears is technically demanding and is still in the developmental phase, large tears might even benefit more than small ones.

Factors affecting the results of surgery. The outcome of rotator cuff repairs may be influenced by a variety of factors.

1 Age:

The average age of the patients in our study was 57.18 yr. for double row and 55.89 yr. for single row [Table 4]. We found no statistical significant relation between the age of the patient and the postoperative net results. Similarly, Bennet reported no difference in the outcome based upon the age as a variable. Stollsteimer and Savoie showed also no difference in the outcome noted among patients of different ages, suggesting that the arthroscopic repair is equally effective in all age groups. On the other hand, Boileau et al. reported that the age was clearly a factor influencing tendon healing. They found that the patients who had a healed tendon were, on the average, ten years younger than those in whom the tendon did not heal. They concluded that the chance of tendon healing decreased to 43% when the patient was more than sixty five years old. However, they stated that the absence of tendon healing (or only partial healing) did not necessarily compromise pain relief and patient satisfaction.

2 Sex:

There is little commentary in the literature with respect to sex for outcomes of rotator cuff disease. They also shared that there was no significant relation between the sex of the patient and the postoperative net results. On the other hand, in the study performed by Watson et al., they identified a small, but statistically significant difference between male and female patients with regard to overall satisfaction, improvement in the functions of activity of daily livings and performance of usual work. However they stated that “what does exist does not support a sex difference”. Harryman et al. evaluated patient satisfaction, functional outcome, and ultrasonographic cuff integrity after 105 rotator cuff repairs and found no significant correlation of patient sex with the outcomes. In our study we found no statistical difference in sex involvement [Table 2].

Table 2
No statistical difference was found in male and female sex involvement in rotator cuff tear.

Gender	Group		Total
	Double	Single	
Female	7	10	17
	25.0%	35.7%	30.4%
Male	21	18	39
	75.0%	64.3%	69.6%
Total	28	28	56
	100.0%	100.0%	100.0%

p-Value—0.383.

3 Dominant shoulder & side involved:

In the present study we found no significant relation between the dominant shoulder or side involved and the postoperative outcome. Cofield et al. reported similar result [Table 3].

Clinical data from studies by Goutallier et al. supported the concept that the longer a patient had symptoms of a rotator cuff tear, the more extensive the fatty degeneration of the torn rotator cuff muscle. The authors also reported that surgical intervention when there is minimal fatty degeneration of the muscle reduces the rate of retears. These data suggest that early operative intervention would facilitate improved outcomes for patients. Additional support for this statement was reported in the study done by Harryman et al. In contrast, Cofield et al. reported that the time from the beginning of symptoms to surgery did not have a significant effect on the outcome. Similarly, Burkhart et al.[3] reported that the delay from injury to surgery, even of several years, did not adversely affect the surgical outcome and was not a contraindication to arthroscopic rotator cuff repair [Table 7].

The outcome of arthroscopic rotator cuff repair has improved over the years.[4] However, despite the development of new repair techniques, the retear rate of repaired cuffs develops very often.

Table 3
No statistical difference was found in side involvement.

Side	Group		Total
	Double	Single	
Left	12	12	24
	42.9%	42.9%	42.9%
Right	16	16	32
	57.1%	57.1%	57.1%
Total	28	28	56
	100.0%	100.0%	100.0%

p-Value—1.0.

Table 4
Mean age (in years) for double row is 57.18 and for single row is 55.39.

	Surgery	N	Mean	SD	p-Value
Age	Single	28	55.39	7.13	0.389
	Double	28	57.18	8.22	

Table 5
UCLA score is statistically significant at the end of 6 month.

UCLA	Surgery	N	Mean	SD	p-Value
Pre-op	Double	28	17.29	5.02	0.89
	Single	28	17.46	4.61	
3 months	Double	28	26.86	2.27	0.596
	Single	28	27.14	1.69	
6 months	Double	28	31.50	1.77	<0.01
	Single	28	30.14	1.58	

Table 6
ASES score is statistically significant at the end of 6 month.

ASES	Surgery	N	Mean	SD	p-Value
Pre-op	Double	28	43.82	8.82	0.55
	Single	28	44.93	4.12	
3 months	Double	28	61.04	5.73	0.679
	Single	28	61.64	5.17	
6 months	Double	28	89.54	3.96	<0.01
	Single	28	86.75	3.09	

Table 7
High retear rate in double row than single row repair technique.

Retear	Group		Total
	Double	Single	
No	26	17	39
	92.9%	60.7%	69.6%
Yes	2	11	17
	7.1%	39.3%	30.4%
Total	28	28	56
	100.0%	100.0%	100.0%

p-Value < 0.01.

Torn cuff tissue is often degenerative and retracted; various factors are associated with the failure of rotator cuff repair. Recently, methods to reconstruct the rotator cuff footprint, by the double-row repair method, are in vogue.[4] Currently, the double row repair method has been widely adopted for cuff repair.[5]

Initially, Alpreleva et al.[31] introduced the traditional trans-osseous repair method or the arthroscopic single row repair method, which does not restore the original footprint. Park et al.[9] reported that in comparison with the suture anchor method, the trans-osseous repair method increases the contact surface more, and thus the distribution of pressure is better, resulting in stronger and faster healing in the footprint area. Milano et al.[12] reported that the double row cuff repair technique recovered with a larger footprint and that the biological healing of the tendon repair could be improved. Kim et al.[4] reported that the footprint reconstruction of the rotator cuff, using a double-row repair, improved the initial strength and stiffness; in addition, it decreased gap formation and strain over the footprint when compared with the single-row repair. Other mechanical studies showed that the double-row technique produced the greatest contact area and the second-highest contact pressure.[6,8]

Contrary to the biomechanical studies,[7] there are debates about clinical outcomes when the single and double row repair techniques are compared. Fealy et al.[13] reported that in 75 patients, using the mini-open double row fixation method, small, moderate and large tears were sutured and good results were reported. Sugaya et al.[14] retrospectively studied 80 shoulders in consecutive patients who had undergone rotator cuff repairs. At a mean follow-up of 35 months (range, 24–60 months), there was no difference between the groups based on the ASES and UCLA rating scales. MRI evaluation of cuff integrity did show better structural outcomes with the double row repair in small- to medium-sized tears ($p < 0.05$). In addition, they found a significant difference in the postoperative strength scores of the UCLA score between the two groups.[27] Anderson et al.[15] reported that the arthroscopic two-row rotator cuff repair produces excellent functional outcomes and repair integrity comparable with previously reported open repairs.

Similarly, in our study the two measurement scores, the ASES and UCLA scores, result in similar clinical outcomes for the two techniques. According to the age and size of the torn cuff, there was no significant difference between the two methods. That is, the double row repair method resulted in greater strength and improved patient satisfaction. Strength is known to influence patient satisfaction after rotator cuff repair. Although this study showed no preference for either one of the two repair methods, greater satisfaction of the patients and restoration of muscle power favoured the double row repair method. For optimal results, tendon repairs require initial tension-free or low-tension fixation. If this is not possible and high tensions are imposed, the repair will be overloaded and the fixation will fail.

The double row repair technique requires a longer surgical time and is a technically more demanding procedure. However, the time difference between the two procedures is about 30 min in our study; further, we believe that the surgeon can reduce surgical time by improving his or her technical skills, which is primarily a learning curve issue. Another concern regarding arthroscopic double row repair is its cost. We believe that the benefit of arthroscopic repair for patients more than overcomes the cost issue if we can provide better structural and functional outcomes with higher patient satisfaction.

The most important limitation of the study number of anchors.[34] In single row repair technique uses one to two anchors while double row repair technique uses 4 anchors. further more double row repair demand more surgical skills and takes longer time than single row repair. Other limitation is that radiologist was not blinded to the repair technique. But we have to consider that, in every study setting which compares the radiographic results of SR and DR repair, the radiologist cannot be really blinded about the surgical technique. In fact, he/she can count on MRA/MRI/CT scans the number of suture anchors placed in the footprint and determine whether they are in a SR or DR fashion. This introduces a potential, significant bias in the results reported by the radiologist even in prospective and “well-done” studies, which cannot be avoided. In addition, there were a small number of patients in each subgroup (small, medium, large tear) because we excluded partial, massive and irreparable cuff tears and subscapularis and biceps tendon tears. Patients were followed for only a period of six months. This timeframe showed the improvement in clinical features but longer follow up is needed for both groups for more definitive results. Our study also has some strengths. It is a single-surgeon series, with uniform surgical skills; we adopted rigid inclusion and exclusion criteria. In summary the two repair methods, single row and double row repair techniques, showed good clinical results for full thickness rotator cuff tears. However, when comparing the two methods, the double row repair group showed better clinical results for strength recovery and patient satisfaction.

5. Conclusion

The current evidences suggests that use of the double-row technique for rotator cuff repair decreases the incidence of retear, especially partial-thickness re-tears, compared with the single-row technique.[13–21,29,32,33] In our study, there was significant difference in functional outcome between the 2 techniques only at the end of 6 months. The double row repair technique restores anatomical footprint of rotator cuff tear and has low retear rate. To improve the structural outcome of the repaired rotator cuff, surgeons should use the double-row technique. Nevertheless, future long-term randomized control trials on this topic are needed.

Conflict of interest

The authors have none to declare.

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