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Research Paper

Clinical Outcomes of Massive Rotator Cuff Tear Repair With Concomitant Biceps Tenodesis: A 13-year Retrospective Study

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ABSTRACT

Background: Massive rotator cuff tears are challenging to treat and often result in significant pain and functional impairment. Rotator cuff repair combined with biceps tenodesis may improve shoulder function and pain relief, but long-term clinical outcomes and complication rates require further evaluation.

Objectives: This study aimed to evaluate the clinical outcomes of rotator cuff repair with concomitant biceps tenodesis in patients with massive rotator cuff tears, focusing on shoulder function, pain, muscle strength, postoperative analgesic use, reoperation rates, and complications.

Methods: This retrospective observational study included 54 patients (25 men and 29 women; mean age, 62.7 years) who underwent rotator cuff repair with concomitant biceps tenodesis between 2011 and 2024 at a tertiary referral center. Demographic characteristics, tear characteristics, and follow-up duration (mean, 32.9 months) were obtained from medical records. Outcome measures included the Constant–Murley score (CMS), visual analog scale (VAS) pain score, manual muscle testing (MMT), analgesic use at 3 months postoperatively, reoperation rate, and postoperative complications, including infection and thromboembolic events. Statistical analyses were performed using SPSS software, version 27.

Results: The mean postoperative CMS was 76.1±17.9, and 74% of patients achieved excellent or good outcomes. The median VAS pain score was 1 (interquartile range, 0–2). Muscle strength was better preserved in internal rotation (median MMT=5) than in external rotation and Jobe tests (median MMT=4). At 3 months postoperatively, 42.6% of the patients required analgesics and had significantly higher pain scores than those who did not ($P<0.001$). The overall reoperation rate was 14.8%, including 3.7% who underwent revision rotator cuff repair and 11.1% who required conversion to shoulder arthroplasty. One patient (1.9%) developed a postoperative infection, and no thromboembolic events were observed. A strong negative correlation was found between VAS and CMS ($\rho=-0.71$, $P<0.001$), indicating that lower pain levels were associated with better shoulder function.

Conclusion: Rotator cuff repair combined with biceps tenodesis is a safe and effective treatment for massive rotator cuff tears, providing substantial improvements in shoulder function and pain relief with acceptable complication and reoperation rates. These findings support its use as a reliable surgical option for managing complex rotator cuff pathologies.

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Introduction

Massive rotator cuff tears represent one of the most challenging conditions in shoulder surgery, accounting for a substantial proportion of chronic shoulder pain and functional disability, particularly among older adults [1, 2]. These lesions are typically defined as tears measuring greater than 5 cm or involving two or more tendons and are frequently associated with tendon retraction, muscle atrophy, and fatty infiltration, all of which adversely affect tendon healing and functional recovery [3].

In addition to rotator cuff pathology, disorders of the long head of the biceps tendon (LHBT) are commonly observed in patients with massive tears. The biceps tendon is a recognized source of anterior shoulder pain, and its involvement may contribute to persistent symptoms even after successful rotator cuff repair [4]. Walch et al. reported that a significant proportion of patients undergoing surgery for rotator cuff disease demonstrate macroscopic or histological biceps tendon abnormalities, highlighting its clinical relevance [5]. Consequently, addressing biceps pathology has become an integral component of surgical management strategies for complex rotator cuff injuries.

Several surgical approaches have been proposed for the management of biceps tendon pathologies, including tenotomy and tenodesis. Although tenotomy is a simpler procedure, it may be associated with cosmetic deformity (Popeye sign) and cramping pain in some patients. In contrast, biceps tenodesis is generally preferred in active patients due to better functional outcomes and reduced risk of postoperative complications related to muscle contour and strength [6, 7]. Frost et al. demonstrated that tenodesis provides superior patient-reported outcomes compared to tenotomy in selected populations, particularly when performed in conjunction with rotator cuff repair [6, 7].

Rotator cuff repair has evolved significantly over the past decades, with improvements in arthroscopic techniques and fixation methods leading to better structural and functional outcomes. However, healing rates in massive tears remain variable, with reported re-tear rates ranging from 20% to 40%, depending on patient-related and tear-related factors [8]. Factors, such as advanced age, tendon retraction, and poor muscle quality, have been identified as predictors of inferior outcomes [9].

Given the multifactorial nature of massive rotator cuff tears and the frequent coexistence of biceps tendon pathologies, combined surgical approaches have gained increasing attention. Addressing both rotator cuff integrity and biceps pathology in a single procedure may improve pain relief, restore shoulder biomechanics, and enhance functional recovery [10].

Despite growing evidence supporting combined procedures, there remains ongoing debate regarding optimal surgical strategy, particularly in terms of functional outcomes, pain control, and reoperation rates in real-world clinical settings. Therefore, this study aimed to evaluate the clinical and functional outcomes of rotator cuff repair combined with biceps tenodesis in patients with massive rotator cuff tears treated at a tertiary referral center over a 13-year period.

Methods

Study design and setting

This retrospective observational study was conducted at ShafaYahyaeian Hospital, Tehran, Iran, a tertiary academic referral hospital for orthopedic patients, between 2011 and 2024. This study evaluated patients who underwent arthroscopic rotator cuff repair combined with biceps tenodesis for massive rotator cuff tears. The study protocol was approved by the Institutional Ethics Committee and conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all patients.

Patient selection

Medical records of eligible patients were systematically reviewed from the hospital records. A total of 54 patients (25 males and 29 females) with a mean age of 62.7 years and a mean follow-up duration of 32.9 months were included.

Inclusion criteria

Patients were included if they met the following criteria:

Age between 18 and 80 years; diagnosis of massive rotator cuff tear confirmed intraoperatively and/or by imaging; underwent arthroscopic rotator cuff repair with concomitant biceps tenodesis; availability of complete clinical records and minimum follow-up data.

Exclusion criteria

Patients were excluded if they met the following criteria:

Previous surgical intervention on the affected shoulder; prior pathology or rupture of the LHBT; neurological or psychiatric conditions affecting functional assessment Incomplete follow-up data or loss to follow-up.

Clinical and functional assessment

Postoperative outcomes were assessed using validated clinical scoring systems and standardized examination protocols. Shoulder function was evaluated using the Constant–Murley score (CMS), which incorporates pain, activities of daily living, range of motion (ROM), and strength, with a maximum score of 100 indicating optimal function. Pain intensity was assessed using the visual analog scale (VAS) at 24 h postoperatively and at a minimum follow-up of 6 months. Muscle strength was evaluated using manual muscle testing (MMT) for internal rotation (IR), external rotation (ER), and the Jobe test, graded on a 0–5 scale. ROM was measured using a standard goniometer with patients in a standardized clinical position.

Complications and secondary outcomes

Postoperative complications, including surgical site infection and thromboembolic events, were identified through chart review. Reoperation was defined as any subsequent surgical intervention in the affected shoulder, including revision rotator cuff repair or conversion to shoulder arthroplasty. Analgesic consumption at 3 months postoperatively was recorded and categorized as ongoing or discontinued use of nonsteroidal anti-inflammatory drugs or opioid medications.

Statistical analysis

Data were analyzed using SPSS software, version 27 (IBM Corp., Armonk, NY, USA). Continuous variables were reported as Mean±SD, while categorical variables were expressed as frequencies and percentages. The independent t-test, chi-square test, and one-way analysis of variance (ANOVA) were used where appropriate. Pearson correlation analysis was performed to assess relationships between continuous variables. Statistical significance was set at $P<0.05$.

Results

Baseline characteristics of participants

A total of 54 patients were included in the final analysis. All patients completed the CMS assessments. The mean age of the patients was 62.7±9.4 years (range: 40–85 years). Of the included patients, 29(53.7%) were female, and 25(46.3%) were male. The mean height was 170.7±10.7 cm, and the mean body weight was 74.2±14.0 kg. The mean follow-up duration was 32.9±14.4 months. The mean tear size of the rotator cuff was 20.9±5.2 cm² (Table 1).

Reoperation rate and revision surgery analysis

Of the 54 patients, two (3.7%) underwent revision rotator cuff repair, while six patients (11.1%) required conversion to shoulder arthroplasty. Overall, eight patients (14.8%) underwent at least one reoperation, including either revision repair or prosthetic replacement. The median age of patients who did not undergo reoperation was 64 years compared to 67 years in those who required reoperation; however, this difference was not statistically significant (P=0.58). Regarding sex distribution, 16% of male patients and 13.8% of female patients required

Table 1. Demographic and baseline clinical characteristics of patients

Variables		Mean±SD/No. (%)
Age (y)		62.7±9.4
Sex	Female	29(53.7)
	Male	25(46.3)
Height (cm)		170.7±10.7
Weight (kg)		74.2±14.0
Follow-up (months)		32.9±14.4
Rotator cuff tear size (cm²)		20.9±5.2

reoperation, with no statistically significant association between sex and reoperation rate (P=1.00). The median rotator cuff tear size was 20 cm² in patients who did not undergo reoperation and 24 cm² in those who underwent reoperation. This difference was not statistically significant (P=0.21) (Figure 1).

Postoperative analgesic consumption at 3 months

At 3-month follow-up, 31 of 54 patients (57.4%) reported no use of analgesic medications, while 23 patients (42.6%) continued to use painkillers. Among analgesic users, nine patients used medications daily, one patient every other day, two patients once weekly, seven patients twice weekly, and four patients three times per week. Sex-based analysis showed that 32% of males and 51.7% of females were in the analgesic-use group; however, this difference was not statistically significant (P=0.23). The median VAS pain score was 0 in the non-analgesic group and 2 in the analgesic group, indicating significantly higher pain levels among patients requiring medication (P<0.001). The median age was comparable between the non-use and use groups (65 vs 64 years, P=0.91). Similarly, the median rotator cuff tear size was 20 cm² in the non-use group and 24 cm² in the analgesic group, with no statistically significant difference (P=0.17) (Figure 2).

Visual analog scale score assessment

The visual analog scale (VAS) was used to quantify postoperative pain intensity on a 0–10 scale, where 0 indicates no pain, and 10 represents the worst imaginable pain. Due to the non-normal distribution of pain scores, non-parametric statistics were applied for analysis. Overall, the median VAS score in the entire cohort was 1, with an interquartile range (IQR) of 0–2. Pain scores ranged from 0 to 8 across patients. Correlation analysis revealed no significant association between age and pain intensity (ρ=0.13, P=0.360). Similarly, no significant difference in median VAS scores was observed between male and female patients, with both groups demonstrating a median value of 1 (P=0.920). No significant correlation was found between rotator cuff tear size and pain severity (ρ=0.13, P=0.360). In contrast, a strong and statistically significant inverse correlation was observed between VAS score and CMS (ρ=−0.710, P<0.001), indicating that lower pain levels were associated with significantly better shoulder function.

Shoulder function assessment based on Constant–Murley score

The distribution of Constant–Murley score (CMS) did not show a significant deviation from normality; therefore, parametric statistics (Mean±SD) were used for analysis. The mean CMS in the study population was 76.1±17.9, with a median of 78 (IQR: 69–89.3). The scores ranged from 34 to 100. Based on the CMS classification system, 22 patients (40.7%) achieved excellent outcomes (score >85), 18 patients (33.3%) had good function (70–85), 7 patients (13%) were classified as fair (50–70), and 7 patients (13%) demonstrated poor function (30–50). None of the patients fell into the very poor category (<30). Correlation analysis showed no significant association between CMS and age (ρ=−0.04, P=0.76). Similarly, no significant relationship was found between CMS and rotator cuff tear size

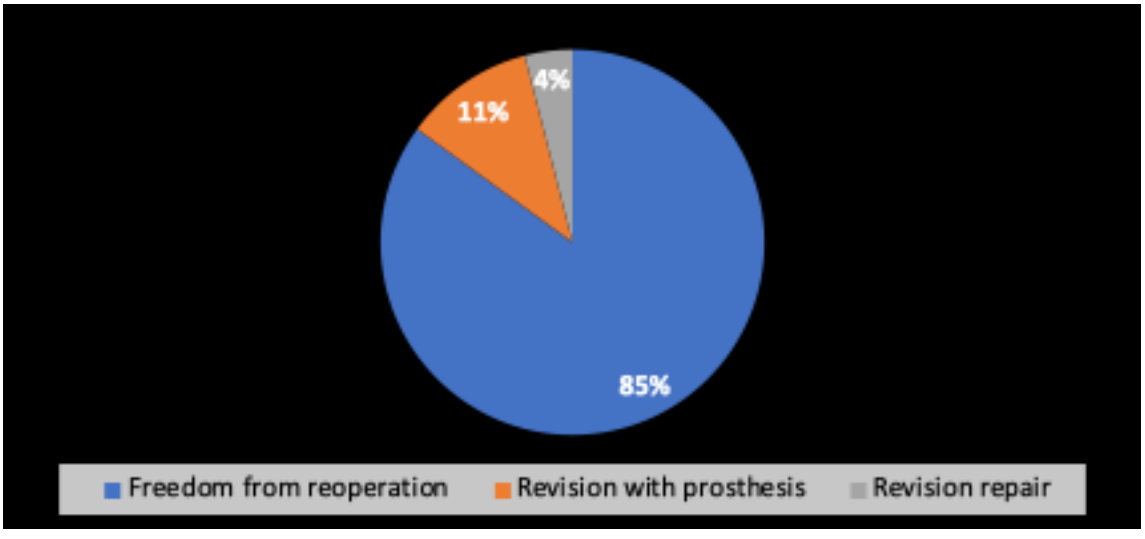


Figure 1. Rate of reoperation and no reoperation among patients

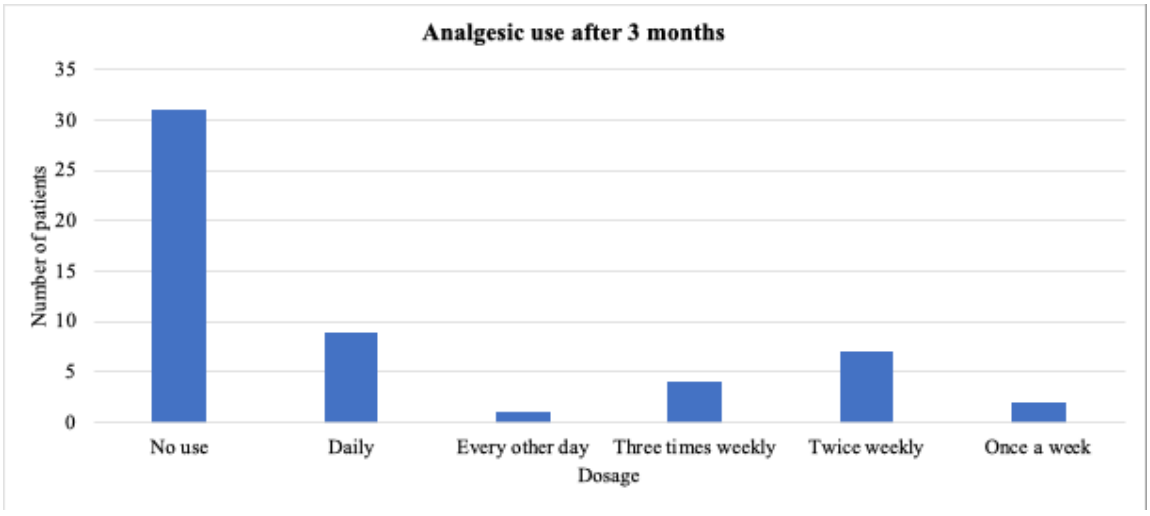


Figure 2. Frequency distribution of patients according to postoperative analgesic use at 3 months

(ρ=−0.17, P=0.210). Mean CMS was slightly higher in males (78.5±15.7) than in females (74.1±19.5), but this difference was not statistically significant (P=0.36). In contrast, significant positive correlations were observed between CMS and muscle strength measurements. CMS was significantly correlated with ER strength (r=0.51), Jobe test strength (r=0.54), and IR strength (r=0.46) (P<0.001). These findings indicate that higher muscle strength is strongly associated with better overall shoulder function (Figure 3).

Postoperative complications (infection and embolism)

Among the 54 patients included in the study, only one case of postoperative infection was recorded, corresponding to 1.9% of the total cohort. No thromboembolic events were observed during the follow-up period. A single infection occurred in a 65-year-old male patient, whose age was close to the median age of the study population. Due to the extremely low incidence of complications, inferential statistical analysis was limited. However, comparative evaluation between sexes showed no

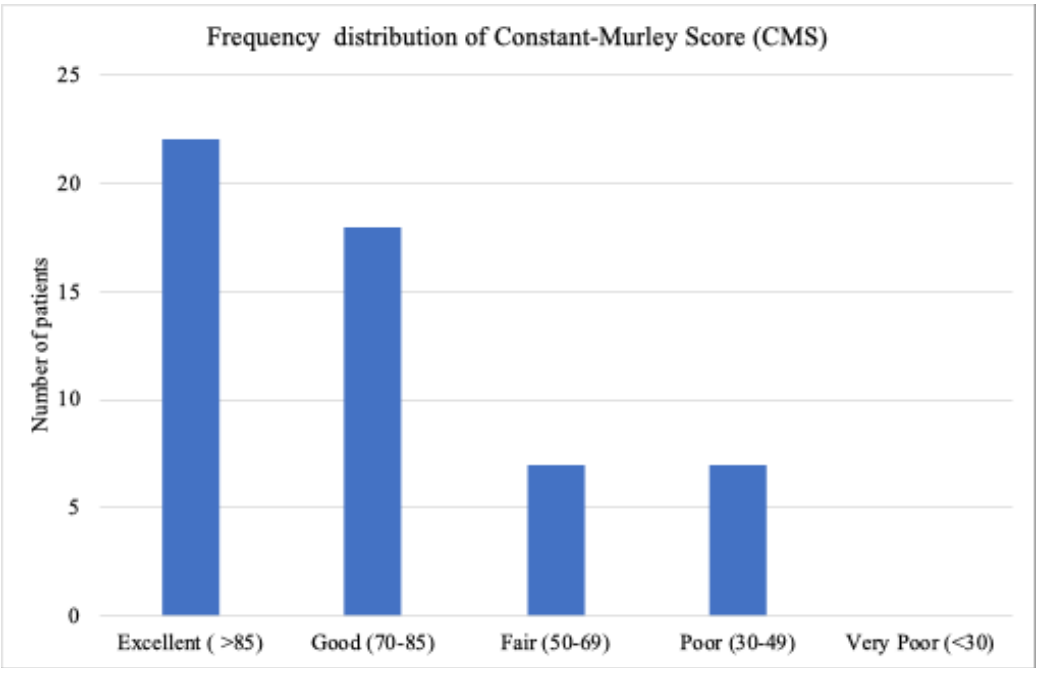


Figure 3. Frequency distribution of shoulder function based on CMS

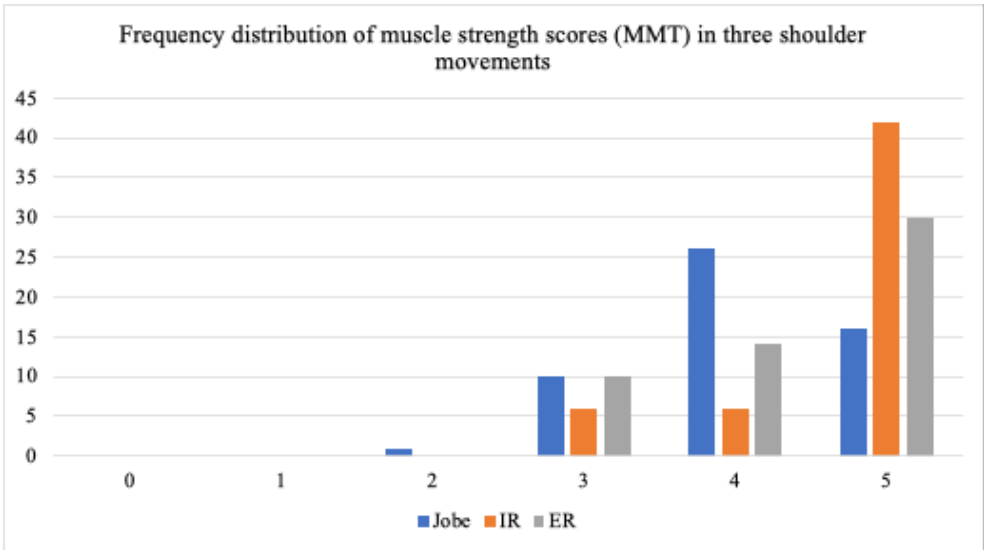


Figure 4. Frequency distribution of MMT in three shoulder movements

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significant association between gender and infection rate (P=0.46), indicating a low and non-differential risk profile across subgroups.

Muscle strength assessment based on manual muscle testing

Muscle strength outcomes demonstrated relatively favorable postoperative recovery across evaluated shoulder movements. In ER, the median score was 4 with an IQR of 4–5, and the mode was 5, observed in 30 patients. In the Jobe test, the median was 4 (IQR: 4–5), with a mode of 4 in 26 patients. IR showed the best performance, with a median score of 5 (IQR: 4–5) and a mode of 5 observed in 42 patients. Correlation analysis revealed no significant relationship between muscle strength scores and rotator cuff tear size. P were 0.81 for ER, 0.42 for the Jobe test, and 0.97 for IR, indicating no statistically meaningful association. Similarly, no significant correlation was found between age and muscle strength outcomes. The correlation coefficients were −0.10 (P=0.45) for ER, −0.12 (P=0.38) for the Jobe test, and −0.04 (P=0.76) for IR. These findings suggest that neither age nor tear size significantly influenced postoperative muscle strength recovery in this cohort (Figure 4).

Discussion

The present study evaluated the clinical outcomes of arthroscopic rotator cuff repair combined with concomitant biceps tenodesis in patients with massive rotator cuff tears. Overall, the results demonstrated favorable functional recovery, acceptable complication rates, and low reoperation risks, supporting the effectiveness of this combined surgical strategy.

In the current cohort, the reoperation rate was 14.8%, including revision repair (3.7%) and conversion to shoulder arthroplasty (11.1%). This rate is slightly higher than that reported by Hughes et al. (7.2%) in a large systematic review of massive rotator cuff tears involving 3,363 patients [11]. However, variability in reoperation rates across the literature is well documented, with reported ranges between 3.8% and 15.4%, which places our findings within the expected spectrum [12]. The relatively higher rate observed in the present study may be attributed to longer follow-up duration, smaller sample size, and more severe baseline pathology.

Importantly, recent large-scale evidence suggests that concomitant biceps tenodesis may have a protective role in reducing revision risk. Pearson et al. reported a 23% reduction in overall reoperation risk when tenodesis was performed alongside rotator cuff repair (odds ratio: 0.77) [13]. This finding supports the combined surgical approach used in the present study and suggests that addressing biceps pathology concurrently may contribute to improved surgical durability.

Postoperative analgesic consumption at 3 months remained present in 42.6% of patients, a finding that aligns with established pain management literature in rotator cuff repair. The procedure specific postoperative pain management (PROSPECT) guidelines recommend multimodal analgesia and emphasize opioid-sparing strategies [14]. In our study, a strong correlation between VAS pain scores and analgesic use was observed (P<0.001),

reinforcing the clinical validity of pain assessment tools. However, the absence of association between analgesic use and tear size or age suggests that pain perception is influenced by multifactorial variables beyond structural severity.

Pain outcomes in this study were favorable, with a median VAS score of 1. These findings are comparable to previous reports by Henry et al. who documented a reduction from 5.9 to 1.7 following rotator cuff repair [15], and Shih et al. who reported improvement from 6.8 to 0.9 [16]. The slightly superior pain control observed in the current study may be partially attributed to the adjunctive effect of biceps tenodesis. Ihsan Kilic et al. similarly demonstrated significant pain reduction following combined procedures [17]. The strong inverse correlation between VAS and CMS further highlights the interdependence between pain relief and functional recovery.

Functional outcomes were also encouraging, with a mean CMS of 76.1 and over 74% of patients achieving excellent or good results. These findings are consistent with prior systematic reviews reporting similar postoperative improvements [15]. Importantly, studies have shown that concomitant biceps tenodesis does not adversely affect shoulder outcomes and may contribute to improved structural and biomechanical stability [18, 19]. The absence of significant associations between CMS and age or tear size suggests that the surgical technique may mitigate traditional prognostic factors.

Muscle strength recovery, as assessed by MMT, demonstrated relatively preserved function, particularly in IR. No significant relationship was found between strength outcomes and either age or tear size, suggesting that functional restoration is primarily driven by surgical repair quality rather than baseline demographic or structural variables. These findings are consistent with previous literature indicating that biceps tenodesis does not compromise postoperative strength and may improve elbow flexion and supination mechanics [17, 18].

Complication rates were low, with only one infection (1.9%) and no cases of thromboembolism. These findings align with previously reported infection rates following arthroscopic shoulder surgery, which typically range between 0.03% and 3.4% [20, 21]. No venous thromboembolic events is also consistent with literature demonstrating the rarity of thromboembolic complications after shoulder arthroscopy [21, 22]. Overall, the safety profile of the procedure appears acceptable and comparable to established benchmarks.

Conclusion

Arthroscopic rotator cuff repair combined with concomitant biceps tenodesis is a safe and effective surgical strategy for the management of massive rotator cuff tears. The procedure provides favorable functional outcomes, significant pain reduction, and acceptable complication and reoperation rates. The current findings suggest that addressing biceps pathology concurrently may enhance clinical outcomes without increasing surgical risk. Functional recovery, pain relief, and muscle strength restoration were satisfactory and largely independent of patient age and tear size. However, the observed reoperation rate, although within the reported range, highlights the complexity of massive rotator cuff pathology and the need for careful patient selection and long-term monitoring. Future prospective, multicenter studies with control groups are necessary to further validate these findings and optimize surgical indications and rehabilitation protocols.

Ethical Considerations

Compliance with ethical guidelines

The ethical code for this study was obtained from the Research Ethics Committee of Iran University of Medical Sciences, Tehran, Iran (Code: IR.IUMS.REC.1403.476).

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Authors' contributions

All authors contributed equally to the conception and design of the study, data collection and analysis, interpretation of the results, and drafting of the manuscript. Each author approved the final version of the manuscript for submission.

Conflict of interest

The authors declared no conflict of interest.

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