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Surgical treatment options for AC joint dislocation: Comparison of clinical outcomes of TightRope and hook plate methods

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Abstract

Acromioclavicular (AC) joint dislocations frequently occur in young and active individuals, resulting in pain, restricted movement, and functional limitations. Among surgical treatments, TightRope and hook plate methods are commonly used. However, their comparative effectiveness remains a topic of debate. To retrospectively compare the clinical outcomes of TightRope and hook plate methods in the surgical treatment of AC joint dislocations, focusing on complication rates, recovery time, and functional outcomes. This retrospective study included 60 patients (30 TightRope, 30 hook plate) treated between 2018 and 2023 for Rockwood Type III-V AC joint dislocations. Complication rates, time to return to daily activities and sports, and Constant-Murley Shoulder Scores were analyzed. Data were statistically evaluated using chi-square and independent t-tests, with significance set at $p<0.05$. The TightRope group exhibited a significantly lower complication rate (10%) compared to the hook plate group (20%, $p<0.05$). Patients treated with TightRope returned to daily activities and sports faster (8 and 12 weeks, respectively) than those treated with hook plates (10 and 16 weeks, $p<0.05$). Functional outcomes, as measured by Constant-Murley Shoulder Scores, were superior in the TightRope group (85.3±4.6 vs. 79.7±5.2, $p<0.05$). The TightRope method demonstrated advantages over the hook plate method in terms of lower complication rates, faster recovery, and better functional outcomes. However, the hook plate remains a viable option for patients requiring greater mechanical stability. Future studies with larger sample sizes and long-term follow-up are recommended to validate these findings.

Keywords: Acromioclavicular joint dislocation, TightRope method, hook plate, surgical outcomes, Rockwood classification, functional outcomes

Introduction

The acromioclavicular (AC) joint, an extremely important structure that supports the stability and range of motion of the shoulder, is a joint that is frequently exposed to trauma. AC joint dislocations, especially in young and active individuals, are associated with high-energy falls, direct blows to the shoulder, and sudden movements during sports activities [1]. AC joint dislocation not only leads to localized pain and restricted movement but can also result in functional losses and serious limitations in daily life activities [2].

AC joint dislocations are assessed in six different types using the Rockwood classification according to the severity of the injury and the condition of the affected structures [3]. This classification serves as a basic guide to direct treatment strategies. Type I and II injuries are usually managed successfully with conservative treatment, whereas there is a debate between surgical or conservative approaches in the treatment of Type III injuries [4]. Types IV, V, and VI injuries are usually high-grade dislocations with severe tissue damage and require surgical intervention [5].

Surgical treatment options include traditional and modern approaches. The spread of minimally invasive techniques in recent years has led to significant innovations in surgical treatment options. The TightRope method is a modern technique that offers an anatomical repair by supporting the natural function of the coracoclavicular ligaments [6]. The low complication rate and rapid rehabilitation process have made

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this method a popular option. On the other hand, the hook plate method is preferred, especially in individuals with heavy physical activity, due to its high stability. However, this method has disadvantages, such as requiring plate removal and limiting shoulder range of motion in long-term use [7].

Taking into account the advantages and disadvantages of both methods, it is controversial which technique is more effective in terms of clinical outcomes and patient satisfaction. This study aims to retrospectively compare the short- and mid-term results of the TightRope and hook plate methods used in the surgical treatment of acromioclavicular joint dislocation and evaluate the efficacy of both methods.

Material and Methods

This study was performed with a retrospective design. Malatya Turgut Özal University Non-Interventional Clinical Research Ethics Committee approval has been received. Ethics committee approval number is E-30785963-020-271010, date: 18.12.2024. The data of patients who underwent surgical treatment for acromioclavicular joint dislocation performed from 2018 to 2023 were analyzed. The patients included in the study consisted of individuals with Type III-V dislocations according to the Rockwood classification [2].

In the study, a power analysis to compare the complication rates between the two groups revealed that 30 patients were required for each group. This analysis was performed with 80% power and a 5% significance level [8]. It was calculated that the study would yield clinically meaningful results with a total of 60 patients (30 TightRope, 30 hook plates).

As the inclusion criteria, it was determined to be diagnosed with Rockwood Type III-V grade acromioclavicular joint dislocation [3], to have undergone surgical treatment with TightRope or hook plate methods, and to be followed up regularly for at least 6 months postoperatively.

Exclusion criteria were patients with previous shoulder surgery, patients with acute infection or inflammatory rheumatic disease, and patients with incomplete or irregular follow-up data.

The patients included in the study were divided into two groups according to the surgical technique applied:

Group 1 (TightRope): Patients treated with the TightRope method. In this technique, AC joint stabilization was achieved by using a double button system to support the function of the coracoclavicular ligaments [5].

Group 2 (Hook Plate): Patients treated with the Hook plate method. This method enabled mechanical stabilization of the AC joint by means of a plate placed in the clavicle [7].

As the evaluation criteria, Complication Rate, Recovery Time and Functional Outcomes were evaluated. In Complication Rate, complications such as postoperative infection, implant loosening, implant fracture, or re-dislocation were recorded for both groups. During Recovery Period, the time to return to daily activities and physical activities such as sports was measured. In Functional Outcomes, Shoulder function was evaluated using the Constant-Murley Shoulder Score [9]. Patient satisfaction and range of motion were also noted clinically.

Surgical Method: The TightRope technique in our study was performed using a mini-open approach, which allowed for direct visualization while minimizing soft tissue disruption. The procedural steps were as follows: A 3-4 cm skin incision was made over the distal clavicle, centered at the coracoclavicular ligament attachment site. The deltotrapezial fascia was carefully incised and elevated, ensuring minimal disruption to the surrounding soft tissue. The coracoid process was identified under direct visualization, which helped prevent misplacement of the implant. A 2.4 mm guidewire was inserted percutaneously through the clavicle and center of the coracoid process, avoiding medial cortical penetration, which has been reported as a risk factor for coracoid fractures. A 4.0 mm cannulated drill was then used to create the tunnel for TightRope passage.

The TightRope implant, a double-button construct, was inserted, with one button positioned under the coracoid and the other resting on the superior clavicle.

The AC joint was manually reduced while gradually tensioning the TightRope system to ensure anatomical alignment. Fluoroscopy was used to confirm adequate reduction before securing the final fixation. The tensioning mechanism of the TightRope allowed for dynamic stabilization, mimicking the physiological function of the coracoclavicular ligaments. The deltotrapezial fascia was meticulously repaired to maintain soft tissue integrity [10,11].

A standardized rehabilitation protocol was implemented, with early passive range-of-motion exercises initiated at 2 weeks, followed by active exercises at 6 weeks [12].

This mini-open approach was preferred over an arthroscopically assisted technique, as it provides direct visualization of anatomical landmarks, minimizes surgical time, and reduces the risk of iatrogenic complications, such as iatrogenic coracoid fractures or excessive tunnel widening [13]. Tight rope is shown in Figure 1. Hook plate shown in Figure 2.

Figure 1. TightRope

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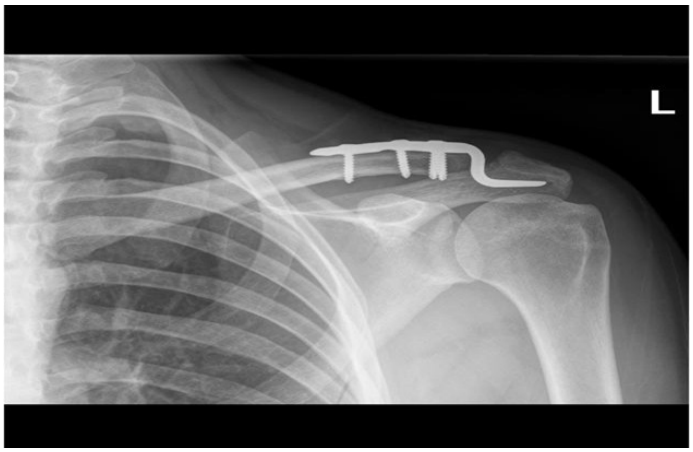

Figure 2. Hook plate

The data obtained were analyzed using SPSS (Statistical Package for the Social Sciences) software [14]. A chi-square test was used for complication rates between the two groups. Continuous variables, such as recovery time and functional scores, were evaluated by independent t-test. The significance level was accepted as $p<0.05$.

Results

A total of 60 patients were included in the study. The TightRope group consisted of 30 patients (mean age: 28.5±5.2 years) and the hook plate group consisted of 30 patients (mean age: 29.1±4.8 years). There was no significant difference between the two groups in terms of age, gender, and mechanism of injury ($p>0.05$). The average follow-up duration for patients in our study was 12.4±3.2 months. Table 1 illustrates these results.

There was no statistically significant difference between the two groups in terms of AC joint dislocation type distribution ($p>0.05$), indicating that both groups had comparable baseline characteristics regarding injury severity. The distribution of AC joint dislocations according to groups is given in Table 2.

In our study, all reported complications were classified as minor, and no major complications were observed in either group. The complications were distributed as follows:

Minor Complications: Hook Plate Group (n=6, 20%)

- Superficial infection (n=2, successfully treated with oral antibiotics, no surgical intervention required).
- Mild motion restriction (n=2, resolved with physical therapy).
- Implant discomfort (n=2, resolved without additional treatment).

TightRope Group (n=3, 10%)

- Implant loosening (n=2, monitored clinically, no additional surgical intervention required).
- Mild implant irritation (n=1, resolved spontaneously).

Major Complications

While no major complications were observed in our study, previous literature suggests that the following major complications may occur with these surgical techniques:

- **Hook Plate:** Deep infection requiring surgical debridement, hardware failure necessitating reoperation, coracoacromial impingement, or permanent motion restriction [15,16].
- **TightRope:** Significant implant migration, coracoid fractures, or hardware failure requiring revision surgery [17,18].

Since all complications in our study were minor and successfully managed without major interventions, the findings suggest that both techniques are safe.

Table 1. Demographic data and complication rates

Parameter	TightRope group	Hook plate group	p-value
Number of patients (n)	30	30	—
Average age (years)	28.5±5.2	29.1±4.8	0.56 (NS)
Male patients (%)	70	72	0.78 (NS)
Female patients (%)	30	28	0.78 (NS)
Complication rate (%)	10	20	<0.05
Types of complications	Implant loosening (2), minimal displacement (1)	Infection (2), implant breakage (2), motion restriction (2)	—

Table 2. Distribution of AC joint dislocations according to groups

Rockwood type	TightRope group (n=30)	Hook plate group (n=30)	p-value
Type III	12 (40%)	11 (36.7%)	0.78
Type IV	10 (33.3%)	9 (30%)	0.85
Type V	8 (26.7%)	10 (33.3%)	0.72

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Recovery Time and Rehabilitation Patients treated with the TightRope method returned to daily activities in an average of 8 weeks and returned to sports in 12 weeks. The average time to return to daily activities in patients treated with the Hook plate was 10 weeks, and the average time to return to sports was 16 weeks. A significant difference was found between the two groups in terms of recovery time and rehabilitation process; the TightRope group showed a faster recovery process compared to the hook plate group ($p<0.05$). Table 3 illustrates these results.

In Functional Outcomes, the mean Constant-Murley Shoulder Score of the TightRope Group patients was 85.3±4.6. The mean Constant-Murley Shoulder Score of the Hook Plate Group patients was 79.7±5.2. In terms of functional score, the TightRope group scored higher than the Hook Plate group and showed better results in terms of shoulder range of motion ($p<0.05$). Table 2 illustrates these results.

In our study, the primary range of motion (ROM) differences between the groups were observed in forward flexion and abduction. TightRope Group: Patients exhibited better forward flexion and abduction angles, with a greater degree of mobility compared to the hook plate group. This may be attributed to the minimal soft tissue disruption associated with the TightRope technique. Hook Plate Group: Some patients experienced mild limitations in abduction due to mechanical constraints imposed by the implant. This limitation is consistent with previous literature suggesting that hook plates may cause subacromial impingement and shoulder motion restriction [1,3].

Not all 60 patients in our study were engaged in sports before their injury. Below is the breakdown of sports participation and return-to-sports rates. Pre-injury Sports Participation: 43 out of 60 patients (72%) were active in sports prior to the injury. The remaining 17 patients (28%) were not involved in sports but required normal functional recovery for daily activities or occupational tasks. Return to Sports Rates: In TightRope Group; 38 out of 43 patients (88%) successfully returned to their previous level of sports activity. In Hook Plate Group; 31 out of 43 patients (72%) returned to sports.

Reasons for Not Returning to Sports: Persistent discomfort or movement restriction (n=6, more common in the Hook Plate group). Personal preference/lifestyle change (n=4, evenly distributed between both groups).

Table 3. Functional and rehabilitation outcomes

Parameter	TightRope group	Hook plate group	p-value
Return to daily activities (weeks)	8	10	<0.05
Return to sports (weeks)	12	16	<0.05
Constant-murley shoulder score	85.3±4.6	79.7±5.2	<0.05
Patient satisfaction (%)	90	80	0.04

Discussion

AC joint injuries, particularly Rockwood Type III–V dislocations, remain a clinical challenge regarding the choice of surgical treatment. While both TightRope and hook plate techniques are widely used, their long-term efficacy and complications continue to be debated. Our study provides a comparative analysis, showing that the TightRope technique results in fewer complications, faster recovery, and better functional outcomes compared to hook plate fixation.

The fact that the TightRope method is associated with a lower complication rate may be due to the minimally invasive nature of this method. The TightRope technique offers a structure that supports the anatomical stability of the coracoclavicular ligaments while causing minimal damage to the surrounding soft tissues. On the other hand, the hook plate method is based on an implant placed directly into the clavicle, and prolonged mechanical stress can lead to restricted motion and even implant fracture. In the literature, the need for a second surgical intervention has been reported frequently in patients treated with the hook plate method [1]. Bi et al. [19] performed a network meta-analysis, evaluating different surgical techniques for Rockwood Type III–V AC dislocations. Their findings concluded that coracoclavicular and acromioclavicular fixation (AC) with graft augmentation and cortical button (CB-GR) techniques yielded the best functional outcomes and the lowest complication rates

Early return to function is a critical factor in AC joint injuries. Our study found that TightRope patients resumed daily activities within 8 weeks and returned to sports by week 12, whereas hook plate patients required 10 and 16 weeks, respectively. Tauber et al. [3] similarly reported earlier functional recovery in TightRope-treated patients, suggesting that the minimally invasive approach reduces soft tissue disruption and preserves shoulder biomechanics. Similarly, Wang et al. [15] conducted a meta-analysis, confirming that suture button fixation provided better functional recovery, less pain, and lower complication rates compared to hook plate fixation

Despite these advantages, the hook plate method remains a viable option in specific cases. Vascellari et al. [7] emphasized that hook plates provide superior initial mechanical stability, which may be beneficial in high-contact sports athletes or heavy laborers. However, long-term functional outcomes generally favor TightRope fixation.

The results of the Constant-Murley Shoulder Score revealed that the TightRope method was superior to the hook plate method

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in terms of functional performance. The TightRope method shows better performance in long-term results by preserving the natural range of motion of the shoulder joint, especially in young and active individuals [20]. Although the hook plate method provides high stability, it may adversely affect functional performance by limiting joint movements. These results are in line with other studies in the literature [7]. Our findings align with previous studies demonstrating favorable outcomes for the TightRope technique. Yapıcı et al. [21] compared the double-button technique and hook plate fixation in Rockwood Type III/V dislocations and found that the double-button group had a higher Constant-Murley Shoulder Score (CMS) (92.1±3.4 vs. 88.3±4.2) and lower complication rates (23.8% vs. 54.6%). Li et al. [22] compared TightRope and hook plate fixation in 136 patients and reported lower complication rates and higher Constant-Murley scores in the TightRope group, consistent with our findings. Similarly, Stein et al. [5] conducted a meta-analysis and found that hook plate fixation resulted in significantly more implant-related complications and postoperative motion restriction.

Biomechanical studies further support this difference. Venjakob et al. [10] showed that the TightRope technique allows dynamic stabilization, permitting physiological micromovements that enhance ligament healing and reduce implant-related stress. In contrast, Scheibel et al. [11] found that hook plates create a rigid construct, increasing the risk of subacromial impingement and requiring routine implant removal.

Our study reported a 10% complication rate for the TightRope group and a 20% rate for the hook plate group, consistent with prior findings [5]. Notably, no major complications (deep infections, coracoid fractures, or implant failures requiring reoperation) were observed. Similarly, Wang et al. [23] performed a retrospective study comparing hook plate fixation and arthroscopic TightRope fixation for Rockwood Type III/IV AC dislocations. Their study demonstrated that the TightRope group had significantly higher CMS scores, lower VAS pain scores, and fewer postoperative complications

The implant removal rate is one of the key differences between the two techniques. Choi et al. [13] noted that 60–90% of patients undergoing hook plate fixation require implant removal, often due to pain or impingement symptoms. Longo et al. [12] reported that TightRope fixation rarely requires hardware removal, potentially explaining the faster return to function observed in our study.

It is recommended to carry the results of this study further and to better understand the efficacy of both methods in the long term. Further studies with larger and more diverse patient groups by conducting Studies with Large Sample Groups will increase the generalizability of these results. Long-term follow-up studies with follow-up periods of 5 to 10 years are necessary to examine the long-term effects of both methods. Randomized Controlled Trials (RCTs) with prospective, randomized controlled trials may provide methodologically stronger evidence [8]. Biomechanical and Imaging Studies Detailed analysis of anatomical healing can be performed using postoperative MRI and CT. Through Economic Analyses, the cost-effectiveness of both methods can be evaluated and recommendations for patients and healthcare systems can be presented.

This study has several important limitations. First, due to the retrospective design, the data are based on past records, which may increase the risk of bias. Small sample size limits statistical power, although our results are consistent with prior studies. Mid-term follow-up (12.4±3.2 months), preventing evaluation of long-term degenerative changes or chronic pain. Future prospective, multicenter trials with larger patient cohorts are needed to validate these findings. Additionally, studies evaluating long-term complications, implant durability, and patient-reported outcomes (e.g., SF-36) would provide further insights into the optimal surgical approach. One of the limitations of this study is the absence of Visual Analog Scale (VAS) scores, which could have provided a more precise evaluation of postoperative pain levels. However, pain assessment was indirectly included within the Constant-Murley Shoulder Score, and functional recovery was assessed through return-to-activity and return-to-sports data. Future studies should incorporate VAS as a standard outcome measure to better quantify postoperative pain and patient comfort.

Conclusion

The results of this study indicate that the TightRope method provides an advantage over the hook plate method with lower complication rates, faster healing times, and better functional results. However, the hook plate method remains a viable option in individuals with high stability requirements or heavy physical load bearing. Future studies should provide additional evidence to support these findings with larger patient groups and long-term follow-up periods.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
Malatya Turgut Özal University Non-Interventional Clinical Research Ethics Committee approval has been received. Ethics committee approval number is E-30785963-020-271010, date: 18.12.2024.

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