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Prospective study of combined endo button and suture anchor technique for stabilization of acromioclavicular joint dislocation

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Abstract
Background: Acromioclavicular (AC) joint dislocations account for 12% of shoulder girdle injuries. While endobutton fixation provides vertical stability in Rockwood type III and V dislocations, augmentation with suture anchors may improve overall fixation, reducing complications and improving outcomes.
Objectives: This study prospectively evaluates functional and radiological outcomes following combined endobutton and suture anchor fixation in patients with acute Rockwood III and V AC joint dislocations, assessing shoulder function and complication profiles at 12 months postoperatively.
Methods: Fifteen patients (9 females, 6 males) with acute (<7 days) Rockwood III/V dislocations underwent surgery using a double endobutton construct reinforced with a suture anchor. Mean age was 46.9 ± 11.1 years. Outcomes were measured using the Constant-Murley Score (CMS), American Shoulder and Elbow Surgeons (ASES) score, Visual Analog Scale (VAS) for pain, Simple Shoulder Test (SST), and Acromioclavicular Joint Instability (ACJI) score before surgery and at 12 months post-op. Radiological evaluation assessed reduction maintenance. Statistical analysis utilized paired t-tests and Wilcoxon signed-rank tests.
Results: Using Wilcoxon signed-rank test, significant improvements were observed in CMS ($p < 0.001$), ASES ($p < 0.001$), VAS ($p = 0.001$), and SST ($p = 0.006$) scores at 12 months postoperatively. The ACJI score showed a non-significant change ($p = 0.095$). Radiological reduction was maintained in 66.7% (10/15) patients; complications included no issues in 53.3%, residual pain in 20%, and stiffness in 26.7%.
Conclusion: Combined endobutton and suture anchor fixation yields significant functional and radiological improvements with acceptable complications for acute high-grade AC dislocations.

Keywords: Acromioclavicular joint, dislocation, Endobutton, suture anchor, Rockwood classification, shoulder function, prospective study

Introduction

Acromioclavicular (AC) joint dislocations are a common cause of shoulder pain and dysfunction, particularly in young and active populations exposed to contact sports and high-energy trauma such as road traffic accidents [1]. Recent global analyses report a high incidence of traumatic shoulder injuries and a persistent burden of shoulder pain and disability across regions [1].

Epidemiologic studies that specifically address AC joint injuries estimate an incidence in the general population on the order of ~2.0 per 10,000 person-years, with higher rates among younger males and athletes — highlighting that AC joint dislocations, while not the most frequent shoulder injury, represent a clinically meaningful subgroup because of the functional demands of affected patients [2].

In India, although large national registries for AC joint injuries are lacking, single-centre series and regional reports indicate that the pattern of injury mirrors global trends: young, working-age adults presenting after falls and road traffic collisions, many of whom have high functional demands and expect rapid return to work or sport [3].

Management of high-grade AC joint dislocations (Rockwood type III — selected cases — and type V) is contentious. A spectrum of operative techniques exists: hook plate fixation, coracoclavicular screw fixation, coraco- and acromioclavicular ligament reconstructions, cortical suture-button systems (EndoButton/TightRope/TightRope-like constructs), and various hybrid approaches [2]. Cortical button devices have gained popularity owing to smaller incisions, avoidance of prominent metalwork and generally good restoration of vertical stability [5]. Several meta-analyses and comparative reviews suggest suture-button systems often achieve similar or better functional results and fewer implant-related complications compared with hook plates, although heterogeneity in techniques and short follow-up limit definitive conclusions [4].

However, isolated coracoclavicular stabilization (i.e., restoring primarily vertical stability) does not always address horizontal (antero-posterior) instability caused by acromioclavicular ligament disruption; residual horizontal laxity has been associated with pain, weakness and unsatisfactory subjective outcomes in some series [5].

Need For The Study

Although acromioclavicular (AC) joint dislocations are common in young, active individuals, evidence guiding the optimal surgical management of high-grade injuries remains inconsistent. Much of the available literature is based on retrospective studies with heterogeneous cohorts, variable surgical techniques, and non-uniform outcome measures.

Recent systematic reviews have highlighted the increasing use of suture-button–based fixation systems but also emphasize the lack of consensus regarding optimal reconstruction strategies, particularly in addressing horizontal instability and long-term functional outcomes [6].

Biomechanical studies support anatomic coracoclavicular reconstruction and demonstrate superior stability with double-button constructs compared with non-anatomic or rigid fixation methods [7]. However, isolated coracoclavicular stabilization may fail to restore horizontal stability due to persistent acromioclavicular ligament insufficiency, which has been associated with residual pain and inferior functional outcome [8].

Furthermore, most comparative analyses pool international data and include few prospective single-technique cohorts from the Indian subcontinent, where differences in injury mechanisms, occupational demands, and rehabilitation access may influence outcomes. Therefore, a prospective evaluation of combined EndoButton and suture-anchor reconstruction for acute Rockwood type III and V AC joint dislocations is warranted to generate context-specific evidence and clarify its functional and radiological effectiveness using standardized outcome measures.

Objectives

1. To evaluate functional outcomes following combined EndoButton and suture anchor fixation in patients with acute Rockwood type III and V acromioclavicular joint dislocations at 12 months postoperatively.
2. To assess radiological maintenance of reduction and postoperative complications associated with the combined fixation technique.

Methodology

Study Design

This was a prospective cohort study.

Study Setting

The study was conducted in the Department of Orthopaedics at K.V.G. Medical College & Hospital, a tertiary care teaching hospital and referral centre for trauma and shoulder injuries serving Dakshina Kannada district and adjoining regions.

Study Period

18 months from March 2024 to September 2025

Study Population

All consecutive patients presenting with acute acromioclavicular (AC) joint dislocation and fulfilling the eligibility criteria were included.

Inclusion Criteria

- Age ≥18 years
- Acute AC joint dislocation < 3weeks old
- Rockwood type III or type V dislocation
- Willingness to undergo surgical treatment and comply with follow-up

Exclusion Criteria

- Chronic AC joint dislocations >3weeks old
- Associated fractures of the clavicle, scapula, or proximal humerus
- Previous pathology or surgery involving the affected shoulder
- Polytrauma patients or associated neurovascular injury
- Inability or unwillingness to complete follow-up

Sample Size Estimation

The present study was designed as a single-arm prospective observational study evaluating functional improvement following combined EndoButton and suture-anchor fixation for acute acromioclavicular joint dislocation. The primary outcome variable was defined as the change in Constant–Murley Score (CMS) from preoperative baseline to final follow-up.

Sample size estimation was based on previously published data by Hu *et al*. (16) in a prospective study of EndoButton-based stabilization for Rockwood type III and V acromioclavicular joint dislocations, which reported a mean improvement in Constant score from 45.5 ± 8.0 preoperatively to 93.8 ± 2.3 postoperatively. As the standard deviation of the paired change was not explicitly reported, a conservative standard deviation (σ) of 12 points was assumed for the change score, consistent with shoulder outcome literature.

The sample size for a paired continuous outcome was calculated using the formula:

Where:

- Two-sided $\alpha = 0.05$ ($Z_{1-\alpha/2} = 1.96$)
- Power $(1-\beta) = 80\%$ ($Z_{1-\beta} = 0.84$)
- Minimal clinically important difference (Δ) = 10 points
- Assumed standard deviation (σ) = 12

Substituting these values:

Thus, a minimum of 12 patients was required. To account for an anticipated 10% loss to follow-up, the final planned sample size was increased to 14 patients. Ultimately, 15 patients were enrolled and completed follow-up, thereby satisfying the sample size requirement.

Study Procedure

Preoperative Assessment

- All patients underwent a detailed clinical evaluation, including history of injury, mechanism of trauma, side involved, and functional limitation of the affected shoulder.
- Radiological assessment was performed using standard anteroposterior (AP) and Zanca views of the shoulder.
- Injuries were classified according to the Rockwood classification system based on clinical and radiographic findings.
- Baseline functional assessment was carried out preoperatively using validated outcome measures, including the Constant–Murley Score (CMS), American Shoulder and Elbow Surgeons (ASES) score, Simple Shoulder Test (SST), Visual Analog Scale (VAS) for pain, and Acromioclavicular Joint Instability (ACJI) score.

Fig 1: Pre operative clinical and radiological images

Surgical Technique

- All patients underwent combined coracoclavicular and acromioclavicular stabilization using a double EndoButton construct augmented with a suture anchor.
- Surgical procedures were performed under general anesthesia, with the patient positioned in the beach-chair position.
- Coracoclavicular fixation was achieved using a double cortical button construct, aimed at restoring the native coracoclavicular distance.
- Acromioclavicular joint augmentation was subsequently performed using a suture anchor to address horizontal (anteroposterior) instability.
- Adequacy of reduction and stability was confirmed intraoperatively, using direct visualization and fluoroscopic assessment where required.
- All surgeries were performed by experienced Orthopaedic surgeons following a standardized operative protocol.

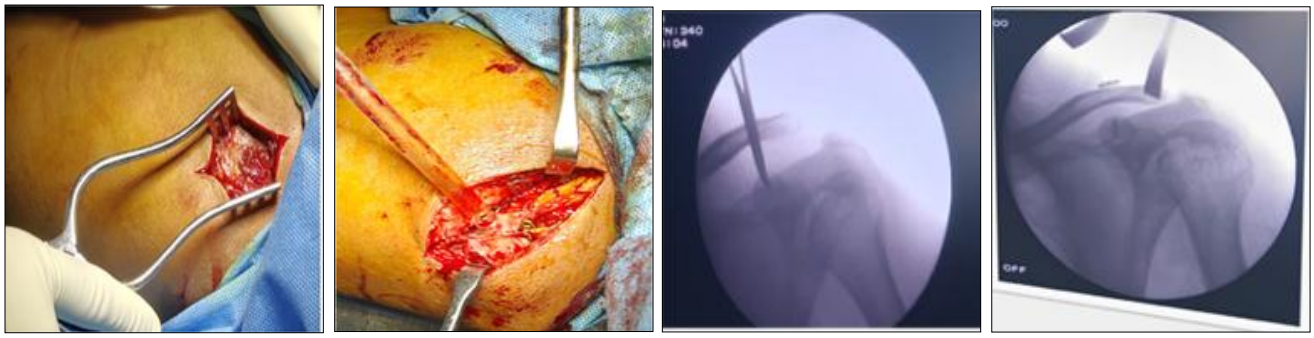

Fig 2: Intra operative images

Postoperative Rehabilitation

- Postoperatively, the operated limb was immobilized in a sling.
- A standardized rehabilitation protocol was followed for all patients.
- Passive range-of-motion exercises were initiated in the early postoperative period.
- This was followed by active-assisted and then active range-of-motion exercises in a phased manner.
- Strengthening exercises were introduced in the later stages of rehabilitation, as tolerated by the patient
- **0–2 weeks :** Arm sling immobilization, Hand/elbow ROM.
- **2–6 weeks:** Passive → assisted shoulder ROM.
- **6–12 weeks:** Active ROM + strengthening.
- **After 3months:** Return to sports/heavy work gradually.

Fig 3 : Case 1- pre operative, post operative and 12th month radiographic images of a 40 years old male patient

Fig 4: Case 2- pre operative,post operative and 12th month radiographic images of a 50 years old female patient

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Jamovi statistical software (version2.6.22). Continuous variables were initially assessed for normality using the Shapiro–Wilk test.All statistical tests were two-tailed, and a p-value < 0.05 was considered statistically significant.

Outcome Measures

Clinical and radiological outcomes were assessed preoperatively and at 12 months postoperatively using validated, widely accepted shoulder-specific outcome measures. These instruments were selected to comprehensively evaluate pain, function, strength, stability, and patient-reported shoulder performance following surgical stabilization.

1. Constant–Murley Score (CMS) [9]

The Constant–Murley Score is a composite shoulder assessment tool that evaluates both subjective and objective components of shoulder function. It includes four domains: pain (15 points), activities of daily living (20 points), range of motion (40 points), and strength (25 points), with a maximum score of 100, where higher scores indicate better shoulder function.

In this study, CMS was used to assess overall functional recovery of the shoulder following combined EndoButton and suture anchor fixation. Improvement in CMS reflects reduced pain, increased range of motion, improved strength, and better functional use of the shoulder in daily activities.

2. American Shoulder and Elbow Surgeons (ASES) Score [10]

The ASES score is a patient-reported outcome measure that evaluates shoulder function and pain. It consists of two components: pain assessment (50 points) and functional assessment (50 points), yielding a total score out of 100, with higher scores indicating better shoulder status.

The ASES score was used to assess patient-perceived functional improvement and pain relief following surgery. It provides insight into how patients perceive their shoulder performance in daily activities and complements clinician-based assessments such as the CMS.

3. Visual Analog Scale (VAS) for Pain [11]

Pain intensity was assessed using the Visual Analog Scale, a unidimensional measure of pain ranging from 0 (no pain) to 10 (worst imaginable pain). The VAS score reflects the subjective severity of pain experienced by the patient.

In this study, VAS was used to specifically evaluate pain relief following surgical stabilization. Reduction in VAS scores at follow-up indicates effective pain control achieved by restoration of joint stability and reduction of mechanical irritation.

4. Simple Shoulder Test (SST) [12]

The Simple Shoulder Test is a patient-reported functional questionnaire consisting of 12 yes/no questions assessing the patient's ability to perform specific shoulder-related tasks. Each affirmative response scores one point, with a maximum score of 12, where higher scores indicate better shoulder function.

The SST was included to assess practical, task-based shoulder function from the patient's perspective. It reflects functional capabilities in real-life situations and is particularly useful for evaluating recovery in activities requiring overhead motion and shoulder strength.

5. Acromioclavicular Joint Instability (ACJI) Score [13]

The ACJI score is a joint-specific outcome measure designed to assess symptoms related to acromioclavicular joint instability, including pain, perceived instability, functional limitation, and cosmetic concerns. Lower scores represent better joint stability and fewer symptoms.

In this study, the ACJI score was used to specifically evaluate residual AC joint instability following combined coracoclavicular and acromioclavicular stabilization. Changes in ACJI scores help determine the effectiveness of the surgical technique in addressing horizontal and vertical instability components.

6. Radiological Assessment

Radiological evaluation was performed using standard shoulder radiographs at final follow-up to assess maintenance of acromioclavicular joint reduction. Reduction was considered maintained when coracoclavicular distance and joint alignment were comparable to immediate postoperative radiographs. Radiological assessment was used to identify loss of reduction, which was correlated with clinical outcomes.

Interpretation of Outcome Measures

Improvement in CMS, ASES, SST, and reduction in VAS scores were interpreted as successful functional recovery and pain relief following surgery. The ACJI score specifically provided insight into residual joint instability, while radiological assessment evaluated the structural

durability of fixation. Together, these outcome measures offered a comprehensive assessment of both clinical function and anatomical restoration after combined EndoButton and suture anchor fixation.

Ethical Considerations

Ethical clearance was obtained from the Institutional Ethics Committee (IEC) of KVG Medical College and Hospital, Sullia. Written informed consent was obtained from all participants before enrollment. Confidentiality of patient information was maintained throughout the study.

Results

Baseline Demographic and Injury Characteristics :

A total of 15 patients with acute acromioclavicular joint dislocations were included in the final analysis. The mean age of the study population was 46.9 ± 11.1 years, with the majority of patients belonging to the 31–50 years (40.0%) and 51–70 years (40.0%) age groups. Females constituted 60.0% (n = 9) of the cohort, while males accounted for 40.0% (n = 6).

The mean body mass index was 30.2 ± 4.5 kg/m², and the mean injury-to-surgery interval was 4.3 ± 1.9 days, indicating early surgical intervention in most cases. Right-sided injuries were slightly more common (53.3%) than left-sided injuries (46.7%). Road traffic accidents were the most frequent mechanism of injury (46.7%), followed by falls (26.7%) and sports-related injuries (26.7%).

According to the Rockwood classification, type III injuries constituted two-thirds of cases (66.7%), while type V injuries accounted for 33.3% of the study population. Baseline demographic and injury characteristics are summarized in Table 1 and illustrated in Figure 1.

Table 1: Baseline Demographic and Injury Characteristics of the Study Population (N = 15)

Variable	Category	n (%)
Age (years)	Mean ± SD	46.9 ± 11.1
	18–30	3 (20.0)
	31–50	6 (40.0)
	51–70	6 (40.0)
Sex	Female	6 (40.0)
	Male	9(60.0)
Body Mass Index (kg/m²)	Mean ± SD	30.2 ± 4.5
Injury-to-surgery interval (days)	Mean ± SD	4.3 ± 1.9
Side of injury	Right	8 (53.3)
	Left	7 (46.7)
Mode of injury	Road traffic accident	7 (46.7)
	Fall	4 (26.7)
	Sports injury	4 (26.7)
Rockwood classification	Type III	10 (66.7)
	Type V	5 (33.3)

All functional outcome measures demonstrated improvement at 12 months postoperatively when compared with preoperative baseline values (Table 2, Figure 2). Due to non-normal distribution of several variables, comparisons were performed using the Wilcoxon signed-rank test.

The Constant–Murley Score (CMS) showed a statistically significant improvement from 35.40 ± 5.28 preoperatively to 68.60 ± 10.44 at 12 months ($p < 0.001$). Similarly, the ASES score improved significantly from 30.87 ± 5.93 to 45.00 ± 6.19 ($p < 0.001$).

Pain, assessed using the Visual Analog Scale (VAS), decreased significantly from a mean preoperative score of 7.60 ± 0.91 to 4.20 ± 2.40 at final follow-up ($p = 0.001$), indicating substantial pain relief following surgery. The Simple Shoulder Test (SST) score also showed a significant improvement from 4.73 ± 1.53 to 6.40 ± 2.10 ($p = 0.006$).

The Acromioclavicular Joint Instability (ACJI) score demonstrated a numerical improvement from 2.73 ± 0.59 preoperatively to 2.33 ± 0.49 at 12 months; however, this change did not reach statistical significance ($p = 0.095$).

Table 2: Comparison of preoperative and 12-month postoperative functional outcomes (N = 15)

Outcome measure	Preoperative Mean ± SD	12-month Mean ± SD	p-value*
Constant–Murley Score (CMS)	35.40 ± 5.28	68.60 ± 10.44	<0.001
ASES score	30.87 ± 5.93	45.00 ± 6.19	<0.001
VAS (pain)	7.60 ± 0.91	4.20 ± 2.40	0.001
Simple Shoulder Test (SST)	4.73 ± 1.53	6.40 ± 2.10	0.006
ACJI score	2.73 ± 0.59	2.33 ± 0.49	0.095

Radiological evaluation at 12 months demonstrated maintenance of reduction in 10 patients (66.7%), while 5 patients (33.3%) showed loss of reduction (Table 3, Figure 3). Despite radiological loss of reduction in a subset of patients, functional improvement was observed across the cohort.

Postoperative complications were minimal. Eight patients (53.3%) had no reported complications. Residual shoulder pain was observed in 3 patients (20.0%), while shoulder stiffness was noted in 4 patients (26.7%). Importantly, there were no cases of implant failure or surgical site infection during the follow-up period (Figure 4).

Table 3: Radiological outcomes and postoperative complications at 12 months (N = 15)

Outcome	Number (%)
Radiological outcome	
Maintenance of reduction	10 (66.7)
Loss of reduction	5 (33.3)
Postoperative complications	
No complications	8 (53.3)
Residual shoulder pain	3 (20.0)
Shoulder stiffness	4 (26.7)
Implant failure	0 (0)
Surgical site infection	0 (0)

Summary of Study Results

This prospective observational study evaluated the functional and radiological outcomes of combined EndoButton and suture anchor fixation in patients with acute high-grade acromioclavicular (AC) joint dislocations at 12 months follow-up.

A total of 15 patients were included in the analysis. The mean age of the study population was 46.9 ± 11.1 years, with the majority of patients belonging to the 31–50 years (40.0%) and 51–70 years (40.0%) age groups. Males

constituted 60.0% (n = 9) of the cohort, while Females accounted for 40.0% (n = 6). The mean body mass index was 30.2 ± 4.5 kg/m², indicating a predominantly overweight population. The average injury-to-surgery interval was 4.3 ± 1.9 days, reflecting early surgical intervention. Right-sided injuries were slightly more common (53.3%) than left-sided injuries (46.7%). Road traffic accidents were the most frequent mechanism of injury (46.7%), followed by falls (26.7%) and sports-related injuries (26.7%). According to the Rockwood classification, type III injuries accounted for 66.7%, while type V injuries accounted for 33.3% of cases (Table 1, Fig. 1).

Functional outcomes demonstrated significant improvement at 12 months following surgery. The Constant–Murley Score improved from a preoperative mean of 35.40 ± 5.28 to 68.60 ± 10.44 at final follow-up ($p < 0.001$). Similarly, the ASES score showed a statistically significant increase from 30.87 ± 5.93 preoperatively to 45.00 ± 6.19 at 12 months ($p < 0.001$). Pain levels, assessed using the Visual Analog Scale, decreased significantly from 7.60 ± 0.91 to 4.20 ± 2.40 ($p = 0.001$). Functional improvement was also reflected in the Simple Shoulder Test, which increased from 4.73 ± 1.53 preoperatively to 6.40 ± 2.10 at follow-up ($p = 0.006$). Although the Acromioclavicular Joint Instability (ACJI) score showed a numerical improvement from 2.73 ± 0.59 to 2.33 ± 0.49, this change did not reach statistical significance ($p = 0.095$) (Table 2, Fig. 2).

Radiological assessment at 12 months demonstrated maintenance of AC joint reduction in 66.7% (n = 10) of patients, while loss of reduction was observed in 33.3% (n = 5). Despite radiological loss of reduction in a subset of patients, functional improvement was observed across the cohort (Table 3, Fig. 3).

Postoperative complications were limited and predominantly minor. More than half of the patients (53.3%) experienced no complications. Residual shoulder pain was reported in 20.0%, and shoulder stiffness in 26.7% of patients. Importantly, there were no cases of implant failure or surgical site infection during the follow-up period (Table 3, Fig. 4).

Overall, the results indicate that combined EndoButton and suture anchor fixation for acute Rockwood type III and V AC joint dislocations results in significant functional improvement and pain reduction at 12 months, with an acceptable radiological maintenance rate and a low incidence of major complications

Discussion

This prospective observational study evaluated the clinical and radiological outcomes of a combined EndoButton and suture anchor fixation technique in patients with acute Rockwood type III and V acromioclavicular (AC) joint dislocations. The principal findings demonstrate that this hybrid construct resulted in significant functional improvement and pain reduction at 12 months postoperatively. Statistically significant improvements were observed in the Constant–Murley Score, ASES score, VAS for pain, and Simple Shoulder Test, indicating meaningful recovery in shoulder function and patient-reported outcomes. Although the ACJI score showed numerical improvement, this did not reach statistical significance, suggesting that subtle residual instability symptoms may persist despite overall functional gains.

Radiological assessment showed maintenance of reduction in two-thirds (66.7%) of patients, while one-third demonstrated loss of reduction. Importantly, radiological loss of reduction did not uniformly correlate with poor functional outcomes, as clinical improvement was observed across the cohort. The complication profile was acceptable, with no implant failure or surgical site infection, and complications were limited to residual pain and shoulder stiffness in a minority of patients.

The functional improvements observed in this study are consistent with previous reports on cortical button–based fixation for acute AC joint dislocations. Systematic reviews and network meta-analyses have shown that suture-button constructs provide functional outcomes comparable to, or better than, hook plate fixation, while avoiding implant-related complications such as subacromial impingement and need for implant removal (5). The significant improvement in CMS and ASES scores in the present study aligns with these findings.

Biomechanical studies have demonstrated that isolated coracoclavicular reconstruction effectively restores vertical stability but may inadequately control horizontal instability, (5,10)dissatisfaction (7,13). Cadaveric and experimental studies have shown superior translational and rotational stability when acromioclavicular ligament repair or augmentation is added to coracoclavicular fixation (11,14). The rationale for combining EndoButton fixation with a suture anchor in the present study was based on this biomechanical evidence.

Clinically, smaller case series and pilot studies have reported satisfactory short-term outcomes with combined constructs, though most have been retrospective and heterogeneous in technique (4,6). The radiological maintenance rate of 66.7% in the present study is comparable to reported rates in the literature, where partial loss of reduction remains a recognized issue even with modern fixation techniques. Importantly, similar to previous studies, radiological loss of reduction did not necessarily translate into inferior functional outcomes, supporting the concept that clinical function and patient satisfaction may not strictly depend on perfect radiographic alignment.

Clinical Implications

The findings of this study suggest that combined EndoButton and suture anchor fixation is an effective option for managing acute high-grade AC joint dislocations, offering significant functional improvement, pain relief, and an acceptable complication profile. The hybrid construct addresses both vertical and horizontal instability, which may be particularly relevant in patients with high functional demands.

The absence of major complications such as implant failure or infection supports the safety of this technique when performed using a standardized protocol. Furthermore, the observation that functional outcomes can remain favorable despite partial loss of reduction highlights the importance of incorporating patient-reported outcome measures rather than relying solely on radiological endpoints when evaluating treatment success.

Strengths and Limitations

The strengths of this study include its prospective design, use of validated functional outcome measures, standardized surgical technique, and uniform follow-up at 12 months. The comprehensive assessment of pain, function, joint-specific instability, and radiological outcomes provides a balanced evaluation of clinical and anatomical success.

However, several limitations must be acknowledged. The small sample size limits statistical power and generalizability. The absence of a comparison or control group precludes direct comparison with other surgical techniques. The follow-up duration, although adequate for short-term outcomes, does not allow assessment of long-term durability, late instability, or development of post-traumatic AC joint arthritis. Additionally, radiological assessment relied on standard radiographs without dynamic or stress views, which may underestimate subtle instability.

Conclusion

Combined EndoButton and suture anchor fixation for acute Rockwood type III and V acromioclavicular joint dislocations results in significant functional improvement and pain reduction at 12 months, with acceptable radiological maintenance of reduction and a low rate of major complications. While partial loss of reduction was observed in a subset of patients, this did not negate clinical improvement. This hybrid technique represents a reliable surgical option for acute high-grade AC joint dislocations. Larger comparative studies with longer follow-up are warranted to further define its long-term effectiveness and comparative superiority.

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