Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/4may2s25

LONG TERM FUNCTIONAL OUTCOME AFTER ACROMIOCLAVICULAR JOINT RECONSTRUCTION USING MINIMALLY INVASIVE KNOTLESS ADJUSTABLE LOOPS

Dr Baban Kumar Ojha[1*], Dr Biswajit Sahu[2], Dr.Diptiranjan Sahoo[3]

[1]Orthopaedic Specialist, Orthopaedics, Medical College- Capital Hospital, Bhubaneswar
[2]Professor, Department-Orthopaedics, Medical College-PGIMER & Capital Hospital, Bhubaneswar
[3*]Resident, Department-Orthopaedics, Medical College-PGIMER & Capital Hospital, Bhubaneswar

***Corresponding Author:** Dr.Diptiranjan Sahoo
*Resident, Department-Orthopaedics, Medical College-PGIMER & Capital Hospital, Bhubaneswar

ABSTRACT

Background: Acromioclavicular (AC) joint dislocations are found in about 12% of all shoulder injuries, and Rockwood type III–VI lesions frequently need to be treated operatively. Conventionally used fixation techniques have risks of hardware complications and soft tissue disruption. This article compares the clinical and radiologic results of a minimally invasive reconstruction method using a knotless adjustable double loop Endobutton device.

Methods: A prospective observational study was performed from December 2022 to December 2023 on five patients aged 20–40 years with acute Rockwood type III–V AC dislocations. Percutaneous coracoclavicular reconstruction with a double loop Endobutton system was performed in the patients. Postoperative rehabilitation consisted of passive range of motion at two weeks and return to full activity by 3–4 months. Outcomes were measured clinically with the Constant and UCLA scores, and radiologically to assess reduction maintenance.

Results: All patients showed progressive improvement in shoulder function, with Constant and UCLA scores of 87 and 31, respectively, at one-year follow-up. No redislocation, suture loosening, or infection was noted. One patient had an implant cut-out without compromising stability or revision requirement. 1 patient had residual subluxation.The technique afforded consistent reduction, minimal soft tissue trauma, and stable fixation during follow-up.

Conclusion: The knotless adjustable double loop Endobutton method is a secure and effective means of treating acute AC joint dislocations. It reduces soft tissue damage, preserves long-term reduction, and facilitates early functional recovery with low complication rates.

Keywords: Acromioclavicular dislocation, Endobutton, coracoclavicular reconstruction, minimally invasive surgery, shoulder instability, loop fixation.

I. INTRODUCTION

Acromioclavicular (AC) joint injuries are frequently seen in the clinical experience, especially among sports and physically active persons(age 20 to 40 years) with high-demanding activities. AC joint injuries present in about 12% of shoulder injuries and most frequently arise due to direct lateral shoulder trauma, especially in contact sports or falling (Stein et al., 2018) [6]. AC joint stability and mobility of the upper limb are of paramount significance, and disruption can produce severe pain, loss of function, and disability if not managed properly.

Historically, a variety of surgical methods have been employed to manage acute and chronic AC joint dislocations. The traditional methods involve the application of hook plates, Bosworth screws, suture fixation, and the Weaver-Dunn procedure, each with their respective strengths and limitations (Faggiani et al., 2016; Stein et al., 2018) [2,6]. Although the methods can yield satisfactory short-term results, they generally do not restore a normal joint biomechanical and are problematic due to hardware irritation, reduction loss, and the requirement for implant removal (Behrens et al., 2024) [1].

To address these demands, arthroscopically assisted and minimally invasive procedures have gained greater popularity in recent years. Such procedures have advantages of less disturbance to soft tissue, faster recovery, and superior cosmetic outcomes (Behrens et al., 2024; Faggiani et al., 2016) [1,2]. Among these, the use of cortical fixation devices, such as the Endobutton system along with tightrope, has demonstrated excellent biomechanical and clinical results in coracoclavicular (CC) ligament reconstruction. Double Endobutton loop technique, in turn, has been found to offer improved stabilization in high-grade injuries compared to single-button constructs (Xu et al., 2018) [3]. There have been recent studies evaluating the effectiveness of arthroscopic and mini-open techniques using double-button constructs for the return to function and restoration of joint stability. Excellent clinical and MRI outcomes following arthroscopic CC reconstruction with a double-button device had been previously reported by Loriaut et al. (2015) [4]. Hashiguchi et al. (2018) [5] and Mori et al. (2024) [8] also indicated good long-term outcomes, pointing out the value of anatomical ligament reconstruction in the achievement of long-term results.

In spite of increasing evidence favoring these methods, there has been no consensus regarding the best technique, particularly regarding long-term functional and radiographic outcomes. In addition, advances in implant technology have introduced knotless, adjustable-loop systems that may improve fixation strength with fewer complications from knot impingement or progressive elongation [7].

This research attempts to evaluate the long-term clinical and radiologic outcomes of a novel minimally invasive technique with a knotless adjustable loop double Endobutton device along with Tightrope for the reduction of acute AC joint dislocations. By evaluating patient-reported outcomes, radiographic alignment, and complication rates, we intend to determine the efficacy and reproducibility of this technique in restoring shoulder function and joint stability in the long term.

II. METHODS

Study Design and Duration

The study was conducted as a prospective observational study to assess the functional and radiological results after minimally invasive reconstruction of acute acromioclavicular (AC) joint dislocation with a knotless adjustable loop double Endobutton technique. The study was conducted for one year from December 2022 to December 2023 at a tertiary care orthopedic center.

Patient Selection

Five patients with acute AC joint dislocation were enrolled in the study. Patients were chosen according to strict inclusion and exclusion criteria to maintain the homogeneity and reliability of the clinical findings. Inclusion criteria involved patients aged between 20 to 40 years with Rockwood type III to VI AC joint injuries acquired within three weeks before presentation. Patients aged less than 20 years or greater than 40 years, Rockwood type I or II injury patients, and those with presenting injuries greater than three weeks old were excluded. These inclusion criteria were selected in order to select specifically the acute, high-grade AC dislocations that could be addressed with surgical reconstruction and to avoid the confounding influences of chronic injuries or skeletal immaturity.

Surgical Technique

All the surgeries were conducted by the same surgeon team.

Patient positioning-

The patient was under general anaesthesia and placed in beach chair position and the shoulder pad was placed under the affected side to tilt the shoulder 30° towards healthy side.The fluoroscopic machine was placed over the top from the opposite side to take AP and scapula outlet view during surgery.

Placement of guide wire-

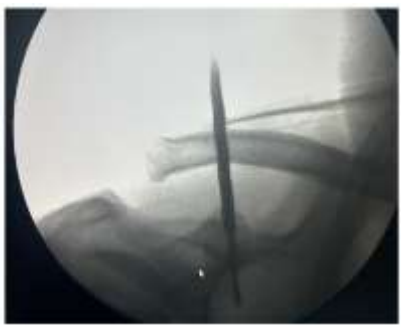
A longitudinal skin incision given over the superior aspect of clavicle placed 3 cm medial to the AC joint.A 2mm guidewire was placed over the middle part of clavicle between anterior and posterior border and aimed towards the coracoids process with 15° anterior angulation of guide wire.The exact placement of guide wire through the coracoids process is confirmed under fluoroscopy i.e. at the centre of coracoids in the AP view and slightly towards the base in scapula outlet view.

Quadricortical drilling and endobutton insertion-

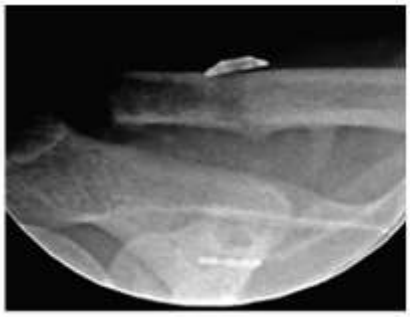
The clavicle is drilled with the help of 4.5mm cannulated drill and the coracoids is drilled with 4.0mm cannulated drill. Drilling of all the 4 cotex(2 of clavicle and 2 of coracoid) confirmed with feel and fluoroscopy. The endobutton construct done with tightrope and sliding knot is introduced in the tunnel with the help of suture retrievers.AC joint reduction done manually with external maneuvers and the knot is secured after placing the clavicular endobutton.

Patient positioning and skin incision

Proper placement of guide wire



Drilling of tunnel through clavicle and coracoid



Instrument used for button insertion Reduction of joint and button tightening

Figure 1: Intraoperative photograph of the surgical method

Postoperative Protocol

After surgery, the shoulder was immobilized in a shoulder arm pouch for a period of two weeks to allow soft tissue healing. Passive range-of-motion was then started under supervised physiotherapy, building up to active movements by the fourth week after surgery. Strengthening and progressive return to full activity were encouraged from the eighth week onwards, subject to individual recovery and functional ability.

Follow-Up and Outcome Assessment

Patients were assessed clinically and radiographically at appropriate intervals postoperative—two weeks, six weeks, three months, six months, and one year. Clinical assessments were measured through the use of validated grading scales, such as the Constant-Murley Shoulder Score and University of California Los Angeles (UCLA) Shoulder Rating Scale. Radiographic examination was undertaken in the form of anteroposterior and Zanca shoulder views to analyze joint reduction, implant positioning, and longitudinal preservation of alignment. Any of the complications like implant migration, infection, or recurrence of dislocation were also recorded.

III. RESULTS

Demographic and Clinical Profile

During the 12-month study period, five patients that satisfied inclusion criteria received reconstruction of the acromioclavicular joint with knotless adjustable loop double Endobutton technique. The patients were male with a mean age of Thirty-two years (range: 20–40 years). All the injuries were acute, within three weeks of trauma, and were classified as Rockwood type III to V dislocations. The leading limb was affected in four cases, and the mechanism of injury was high-energy trauma, which was most commonly due to road traffic accidents and contact sports.

Postoperative Recovery and Rehabilitation

All patients tolerated the surgery appropriately without intraoperative complications. Passive ROM exercises were started two weeks after surgery, and everyone progressed to active movement and strengthening as per protocol. Complete return to activities and sports was seen between 12 to 16 weeks after surgery. Radiographic assessment documented anatomical reduction in four out of five cases at final follow-up. One of the patients had implant cut-out at the 10th week, but joint stability was not affected and no additional surgery needed to be performed.1 patient had post operative subluxation which did not increase gradually.

Functional and Radiological Outcomes

Functional outcomes were measured using the Constant-Murley Shoulder Score and UCLA Shoulder Rating Scale at six months and at the final one-year follow-up. Both scoring systems indicated good to excellent results in all patients. There were no cases of postoperative infection, redislocation, suture loosening, or residual instability. Cosmetic satisfaction and pain control were reported as favorable by all participants.

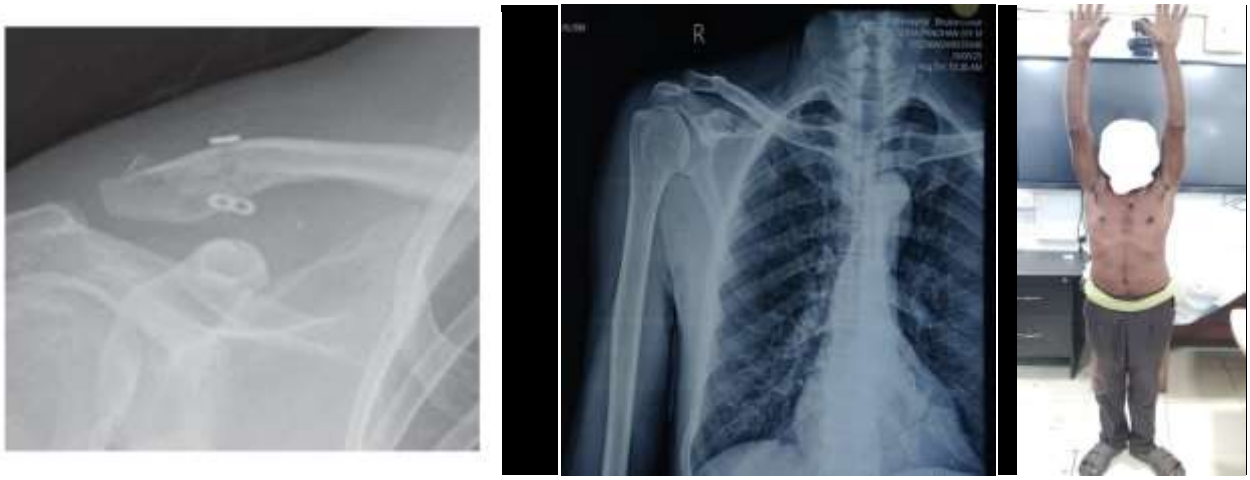
Table 1: Demographic and Clinical Characteristics of the Study Population

Parameter	**Value**
Number of patients	5
Age range (years)	20–40
Mean age (years)	32
Gender	All Male
Dominant side involvement	4 patients
Rockwood type (III–V)	2 Type III, 2 Type IV, 1 Type V
Injury duration before surgery	<3 weeks

Table 2: Postoperative Outcomes and Complications

Outcome Parameter	**Value**
Passive ROM started (weeks)	2
Return to full activity	3–4 months
Redislocation	0
Suture loosening	0
Residual symptoms (Sub luxation)	1
Surgical site infection	0
Implant cut-out	1
Mean Constant Score at 12 months	87
Mean UCLA Score at 12 months	31

Functional and Radiological outcome after 1 year follow up



Implant cut out due to improper placement Residual subluxation without functional impairment

Graphs

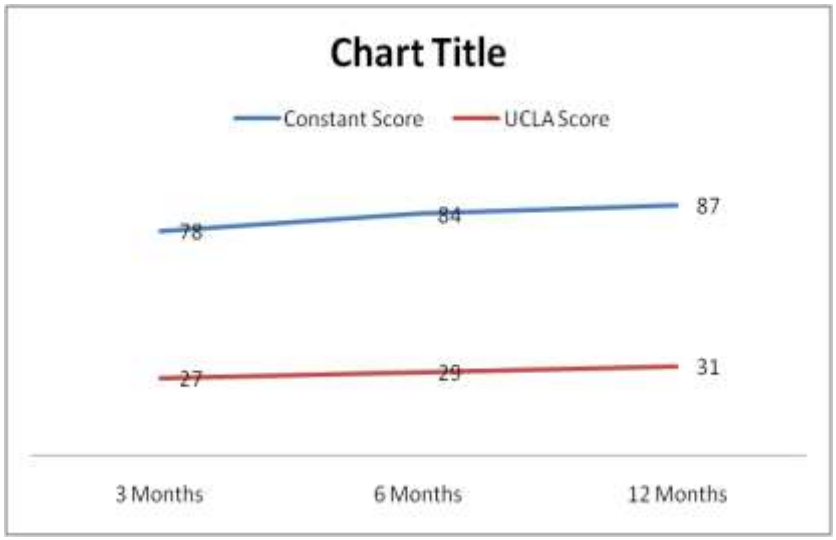


Figure 2: Line graph showing improvement in Constant and UCLA Scores over time

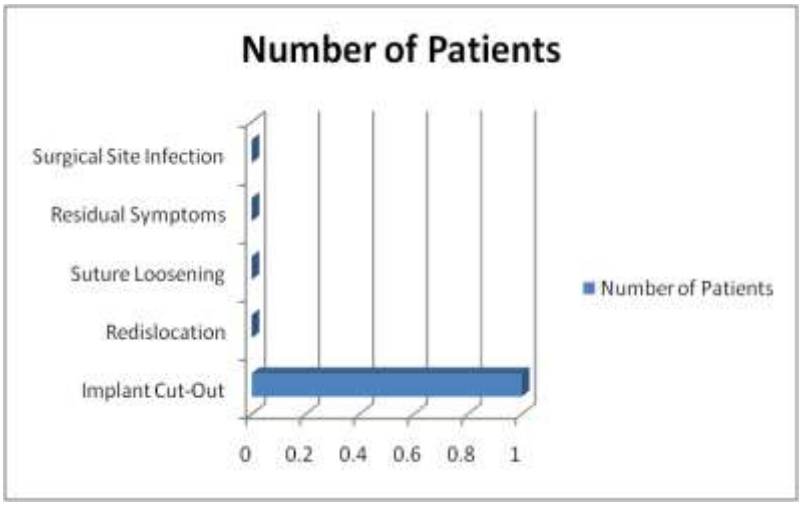


Figure 3: Bar chart showing distribution of complications and adverse events

IV. DISCUSSION

The results of this prospective observational study prove that acromioclavicular joint reconstruction with a minimally invasive knotless adjustable loop with a double Endobutton system provides satisfactory long-term functional and radiological results in patients with acute Rockwood type III to V dislocations. In all five patients, early postoperative rehabilitation was tolerated and progressive improvement in range of motion and shoulder strength was noted, as evidenced by rising Constant and UCLA scores during the 12-month follow-up. Notably, no redislocation, loosening of sutures, or infection occurred, with only one case of implant cut-out, which did not require revision surgery.

These results are consistent with and contribute to the body of literature in favor of contemporary coracoclavicular fixation methods, specifically those using suspensory loop constructs. For instance, Jiang et al. (2022) [9] found satisfactory results with a triple Endobutton plate modified by them in Rockwood type III dislocations, with much improvement in shoulder function and radiologic stability, even though their procedure was arthroscopically assisted and used multiple fixation sites. The current investigation, with a less invasive percutaneous technique and a reduced double Endobutton construct, had equally excellent functional results and anatomical preservation. This implies that loop-based fixation can be successful even when using minimal exposure surgery if it is undertaken in select acute situations.

Kimmeyer et al. (2025) [10] compared horizontal stabilization techniques and observed that clinical results did not differ significantly with anteroposterior instability, stressing the importance of stable vertical stability in successful reconstructions. Our observations concur with this opinion, since vertical stabilization provided by the adjustable loop mechanism was adequate to avoid dislocation or subluxation, even in the absence of direct horizontal stabilizers.

Anatomical studies have shown that the proximal end of the conical ligament attaches posteromedially below the clavicle surface, usually 4.5 cm from the AC joint (47.2 mm in men and 42.8 mm in women), while the proximal end of the trapezoid attaches to the anterolateral aspect of the inferior clavicle, approximately 2.5 cm from the AC joint (25.4 mm in men and 22.9 mm in women). XU et al. demonstrated that the loss of postoperative joint reduction is closely related to the widening of the clavicle tunnel and the angle of the CC tunnel. A straight CC tunnel angle results in better reduction and minimizes postoperative reduction loss. Based on the above, we chose to insert the needle vertically at the clavicle about 2.0-3.0 cm from the AC joint, which is close to the midpoint of the center point of the trapezoid ligament and the conical ligament

The current research also aligns with the study of Koch et al. (2023) [12], comparing mini-open and arthroscopic double TightRope reconstructions. Although their investigation aimed at return to sports activity and had high functional scores in both approaches, the mini-open group recovered

slightly quicker in certain instances. Our outcomes, utilizing a minimally invasive but not completely arthroscopic approach, provided similar results, and thus, it appears that with meticulous technique and early mobilization, the less invasive method does not fall behind while still achieving adequate recovery timeframes.

Studies by Bajnar et al. (2013) [11] and Kraus et al. (2013) [14] have highlighted the biomechanical superiority of the TightRope and Double-TightRope devices, the latter of which compared drill hole positioning and observed no statistically significant differences in results. In our case, a simple vertical tunnel direction and loop course was adequate, circumventing the technical challenge of multiple or angled tunnels and decreasing the risk of fracture of the coracoid or clavicle. Such simplifications of design could play a role in the safety and reproducibility of the technique in lower-resource or general orthopedic environments.

Comparative outcomes from Tauber et al. (2016) [13] similarly elucidate advantages for multiple-bundle reconstructions for chronic conditions but were in a study using chronic dislocations that are different from the tissue potential for healing, as well as instability patterns of the dislocations treated within our cohort. Again, Feichtinger et al. (2021) [15] drew attention to definitive benefits to the patient through surgery in Rockwood type IV injury, but with type III still being questionable. In our experience, both type III and higher-grade injuries uniformly had positive results with surgical treatment, highlighting that minimally invasive reconstruction is a viable treatment choice even in borderline surgical indications when activity level and stability needs of the patient are taken into consideration.

Novelty of the study-

- ❖ Single tunnel procedure-Decreases the risk of iatrogenic clavicular fractures\
- ❖ Percutaneous procedure-Better cosmetical tolerance with less soft tissue dmage
- ❖ Tightrope construct-Can withstand higher loads i.e 715N (similar to intact CC ligaments)
- ❖ Double endobutton-all the loads are equally distributed over the buttons rather than bones and cause no hardware irritation
- ❖ Knotless loop-better biomechanical performance

This procedure is not completely free of challenges i.e.

- More fluoroscopic exposure compared to open/arthroscopic methods
- High learning curve for instrumentation
- Exact placement of guide wire through coracoid process needs expertise
- If done improperly may injure neurovascular structures

Overall, our findings confirm the safety and efficacy of the knotless adjustable loop double Endobutton technique in acute AC joint dislocations. Although sample size was small and follow-up only one year, lack of serious complications, high functional scores, and radiological stability indicate that this technique provides a reproducible and consistent choice in properly chosen patients. Larger series with longer follow-up would be useful to further confirm these results and to determine whether complications such as hardware migration or late-onset degeneration of the joint might occur. However, this research adds significant clinical evidence for minimally invasive coracoclavicular fixation to the emerging context of AC joint reconstruction.

V. CONCLUSION

In conclsuion, application of the knotless adjustable double loop Endobutton technique for acute acromioclavicular joint dislocation provides a minimally invasive, biomechanically sound, and clinically effective means of coracoclavicular reconstruction. This technique permits accurate anatomical reduction with minimal disruption of soft tissues and consistently maintains reduction over time, as evidenced by good functional results and a low complication rate in this series. By removing the hazards of knot slippage or suture rupture, the loop device creates a secure

environment that is favorable to vigorous soft tissue healing, and thus it is a promising substitute for conventional fixation techniques in the surgical treatment of acute AC joint dislocations.

VI. REFERENCES

1. Behrens A, Behrendt P, Heintzen MJ, Finn J, Seekamp A, Mader K, Lippross S, Klatte TO. Mid-term clinical and sonographic outcomes of minimally invasive acromioclavicular joint reconstruction: mini-open versus arthroscopically assisted. Arch Orthop Trauma Surg. 2024 Feb;144(2):807-814. doi: 10.1007/s00402-023-05110-7. Epub 2023 Nov 8. PMID: 37940713; PMCID: PMC10822806.
2. Faggiani M, Vasario GP, Mattei L, Calò MJ, Castoldi F. Comparing mini-open and arthroscopic acromioclavicular joint repair: functional results and return to sport. *Musculoskelet Surg*. 2016;100(3):187-191. doi:10.1007/s12306-016-0411-6
3. Xu J, Liu H, Lu W, et al. A retrospective comparative study of arthroscopic fixation in acute Rockwood type IV acromioclavicular joint dislocation: single versus double paired Endobutton technique. *BMC Musculoskelet Disord*. 2018;19(1):170. Published 2018 May 24. doi:10.1186/s12891-018-2104-9
4. Loriaut P, Casabianca L, Alkhaili J, et al. Arthroscopic treatment of acute acromioclavicular dislocations using a double button device: Clinical and MRI results. *Orthop Traumatol Surg Res*. 2015;101(8):895-901. doi:10.1016/j.otsr.2015.09.024
5. Hashiguchi H, Iwashita S, Abe K, Sonoki K, Yoneda M, Takai S. Arthroscopic Coracoclavicular Ligament Reconstruction for Acromioclavicular Joint Dislocation. *J Nippon Med Sch*. 2018;85(3):166-171. doi:10.1272/jnms.JNMS.2018_85-24
6. Stein T, Müller D, Blank M, et al. Stabilization of Acute High-Grade Acromioclavicular Joint Separation: A Prospective Assessment of the Clavicular Hook Plate Versus the Double Double-Button Suture Procedure. *Am J Sports Med*. 2018;46(11):2725-2734. doi:10.1177/0363546518788355
7. Cerciello S, Corona K, Morris BJ, et al. Hybrid coracoclavicular and acromioclavicular reconstruction in chronic acromioclavicular joint dislocations yields good functional and radiographic results. *Knee Surg Sports Traumatol Arthrosc*. 2022;30(6):2084-2091. doi:10.1007/s00167-021-06790-7
8. Mori D, Nishiyama H, Haku S, Funakoshi N, Yamashita F, Kobayashi M. Coracoclavicular and acromioclavicular ligament reconstruction with a double-bundle semitendinosus autograft and cortical buttons for chronic acromioclavicular joint dislocations: clinical and imaging outcomes. *J Shoulder Elbow Surg*. 2024;33(9):e507-e518. doi:10.1016/j.jse.2024.01.019
9. Jiang H, Tong J, Shen L, Jin G, Zhu R. Clinical Outcomes of Arthroscopy-Assisted Modified Triple Endobutton Plate Fixation in Rockwood Type III Acute Acromioclavicular Joint Dislocation: A Retrospective Study. *Orthop Surg*. 2022;14(10):2436-2446. doi:10.1111/os.13448
10. Kimmeyer M, Rapp K, Rentschler V, et al. Comparative study of two different horizontal stabilisation methods in arthroscopically assisted coracoclavicular stabilisation for acute acromioclavicular joint dislocations-Good clinical outcome and no correlation to recurrent anteroposterior instability. *Knee Surg Sports Traumatol Arthrosc*. 2025;33(2):716-727. doi:10.1002/ksa.12374
11. Bajnar L, Bartoš R, Sedivý P. Artroskopická stabilizace akutní akromioklavikulární luxace implantátem TighRope [Arthroscopic stabilisation of acute acromioclavicular dislocation using the TighRope device]. *Acta Chir Orthop Traumatol Cech*. 2013;80(6):386-390.
12. Koch M, Werner A, Engel G, Huth J, Mauch F. Mini-open vs. arthroscopic double tight-rope reconstruction after acute AC-joint dislocation: a comparison in functional outcome and sports activity. *Arch Orthop Trauma Surg*. 2023;143(9):5491-5500. doi:10.1007/s00402-023-04828-8

13. Tauber M, Valler D, Lichtenberg S, Magosch P, Moroder P, Habermeyer P. Arthroscopic Stabilization of Chronic Acromioclavicular Joint Dislocations: Triple- Versus Single-Bundle Reconstruction. *Am J Sports Med*. 2016;44(2):482-489. doi:10.1177/0363546515615583
14. Kraus N, Haas NP, Scheibel M, Gerhardt C. Arthroscopically assisted stabilization of acute high-grade acromioclavicular joint separations in a coracoclavicular Double-TightRope technique: V-shaped versus parallel drill hole orientation. *Arch Orthop Trauma Surg*. 2013;133(10):1431-1440. doi:10.1007/s00402-013-1804-8
15. Feichtinger X, Dahm F, Schallmayer D, Boesmueller S, Fialka C, Mittermayr R. Surgery improves the clinical and radiological outcome in Rockwood type IV dislocations, whereas Rockwood type III dislocations benefit from conservative treatment. *Knee Surg Sports Traumatol Arthrosc*. 2021;29(7):2143-2151. doi:10.1007/s00167-020-06193-0
16. Yun-fei Yu1, Song-he Yan1,Xiao-fen Liu1,Mao Wu A technique for a More Accurate and Convenient in Coraco-Clavicular Ligament Reconstruction in Acromioclavicular Joint Dislocation.Research Square 2022
17 .Daniel P. Berthold1,2*, Lukas N. Muench1, Felix Dyrna3, Augustus D. Mazzocca4, Patrick Garvin4, Andreas Voss5, Current concepts in acromioclavicular joint (AC) instability – a proposed treatment algorithm for acute and chronic AC-joint surgery *BMC Musculoskeletal Disorders (2022) 23:1078*