ADJUSTABLE LOOP TECHNIQUE VERSUS CLAVICULAR HOOK PLATE FOR TREATMENT OF ACROMIOCLAVICULAR JOINT DISLOCATION: A SYSTEMATIC REVIEW AND META-ANALYSIS

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ABSTRACT

Background: High-grade acute (4 weeks) acromioclavicular (AC) joint separation (types III–VI) treatment is still debatable. Hook plate fixation and coracoclavicular (CC) ligament fixation employing a suspensory loop device (tightrope, synthetic ligament, or absorbable polydioxansulfate sling) are now the two modern procedures that are frequently utilised. Both of these methods are said to produce better clinical results.It is debatable if the tight-rope (TR) approach and clavicular hook plate (CHP) are effective in treating acute acromioclavicular joint dislocation. Which approach to treatment for AC joint dislocation is best? That was the goal of this meta-analysis. **Methods:** We systematically searched the PubMed, EMBASE, Scopus, ISI Web of Science, from 2000 to January 2020 using the search term "acromioclavicular joint dislocation and hook plate." All prospective and retrospective controlled trials that had compared functional scores, pain scores, reduction loss rates, coracoclavicular (CC) distances, and complications between TR and CHP for AC joint dislocation were identified. A total of 10 of 587 studies with 732 patients were included. TR was preferential to CHP for AC joint dislocation given its higher Constant–Murley score, lower Visual Analog Scale pain score, and comparable reduction loss rate and CC distance. **Results:** The TR technique appears to be associated with better functional recovery and less pain than CHP. In addition, it does not require removal of the internal fixation. **Conclusions:** Thus, Results indicated that for AC joint dislocation, the TR technique may be preferential.

Keywords: acromioclavicular joint dislocation; tight-rope technique; Endobutton; hook plate; Constant–Murley score; systematic review.

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INTRODUCTION

About 9% of all shoulder injuries are Acromio-clavicular (AC) joint dislocations, a common injury. (1) With a higher prevalence among athletes, it comes in second place only to glenohumeral joint dislocation. Males are harmed more frequently than females, with a male: female ratio of roughly 5:1. Younger people (35 y) also suffer more AC injuries, partly because they engage in more high-risk activities. The majority of AC joint injuries in men are partial ligament tears, and they most frequently occur in those who are in their second to fourth decades of life. (2)

Dislocations of the AC joint are treated using a variety of methods. a variety of hardware fastening methods, including the Bosworth screw and hook plate. The repaired CC ligament in conventional techniques, such the Weaver-Dunn procedure, may be significantly weaker and more loose than the natural ligament, which contributes to the reported high failure rate.(3)Few research have been documented on AC ligament reconstruction, while the majority of previous treatments centre on CC ligament reconstruction to restore the stability of the AC joint. Additionally, biomechanical studies show that partial ligament repair cannot fully restore the AC ligament's horizontal stability. (4) More recently, the end button approach for treating total AC joint dislocations was introduced. (5) Using this method, it is possible to repair the CC ligament as anatomically as possible. The theoretical strength of the fixation is likewise greater than the CC ligaments' initial strength.

MATERIALS AND METHODS

- **Study design:**

After receiving approval from the research ethics committee, a retrospective observational study was carried out for patients with acromioclavicular dislocation identified by routine X-ray from November 2021 to the end of November 2022. Secondary data from published investigations and a meta-analysis were used.

- **Search Strategy and Articles Selection:**

Acromioclavicular joint, acromioclavicular joint dislocation, acromioclavicular joint fixation, hooked plate, tight rope, treatment outcome, and outcome were the keywords used to search PubMed (Medline), Cochrane Central Register of Controlled Studies (CENTRAL), Scopus (ELSEVIER), and Egyptian Knowledge Bank databases.

- **Inclusion Criteria**

1. Researches and trials published in English.
2. Published from 2000 to 2020.
3. Conducted on human subjects.
4. Articles include Patients with 18 years and older with an Acromioclavicular dislocation
5. Articles that compare patients who underwent fixation of AC dislocation by tightrope and hooked plate followed by post-operative rehabilitation.
6. Articles with at least 12 months follow up duration.

- **Exclusion criteria:**

1. Patients less than 18 years old.
2. Patients with degenerative arthritis of acromioclavicular joint.
3. Patients with Rheumatoid arthritis of the glenohumeral joint.
4. Patients with adhesive capsulitis.
5. Patients with a shoulder fracture.
6. Patients that underwent previous shoulder surgery.
7. Patients with un controlled diabetes mellitus
8. The patient failed to undergo a post-operative rehabilitation program.
9. Studies wrote in languages other than English.

- **Evaluation of articles:**

1. Relevancy
2. Study design

- **Data Extraction:**

After the duplicates were eliminated, titles and abstracts were reviewed to identify pertinent papers for the full-text review and to enable the elimination of irrelevant studies. After that, articles were chosen for inclusion in this evaluation by reading their whole and comparing them to the inclusion/exclusion criteria outlined above.

STATISTICAL ANALYSIS:

All data was analyzed using meta-analyst software using the Mantel Haenszel method.

RESULTS

Research characteristics

Of the 587 relevant studies, 318 were redundant and 259 did not meet the inclusion criteria. Ultimately, 10 studies were included as shown in figure1

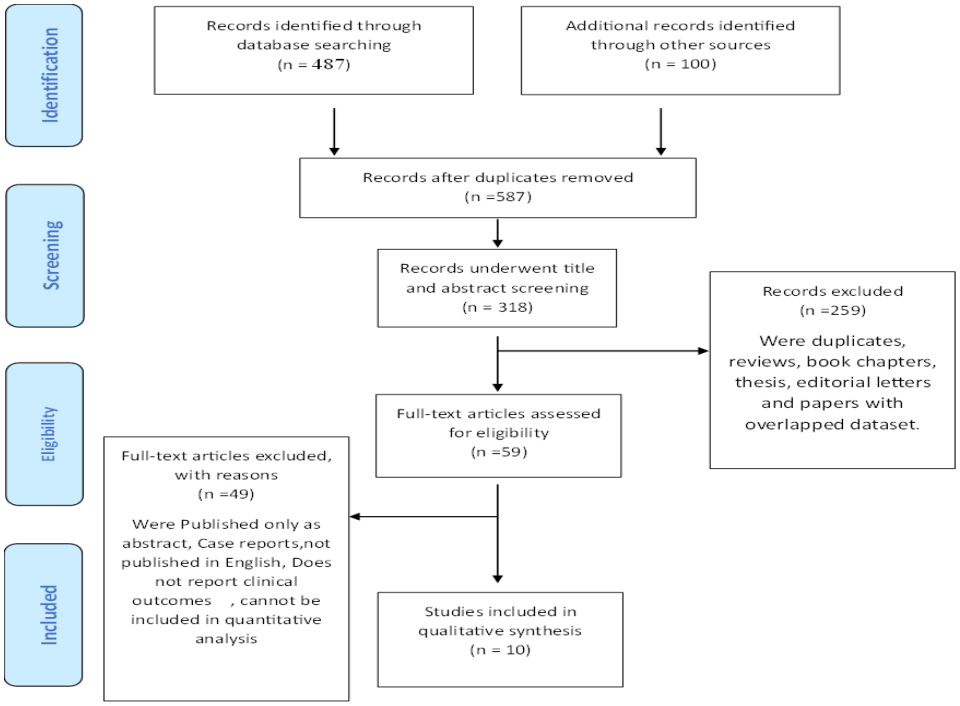

Figure 1: PRISMA flow diagram showing process of studies selection

10 studies included 8 were retrospective studies and 2 were prospective, A total of 498 cases were included with mean age 40.8 years and m\f was 258\ 84, As regard mean Time from injury to operation was 7.25 days in hook plate vs 7.3 days in tightrope loop plate, mean surgical duration was 53.05 mins in hook plate vs 53.3 mins in tightrope loop plate, mean Incision length (cm) was 6.6 in hook plate vs 5.2 in tightrope loop plate, mean Intraoperative blood loss (ml) was 65.7 in hook plate vs 67 in tightrope loop plate and as regard mean follow up was 24.5 months in both groups as shown in table1

As regard complications founded 40 times in hook plate in form of infection, neural injury, plate/screw breakage or loosening, pain and acromial erosion, in tightrope loop plate was 15 times in form of poor healing,acromial erosion and tip fracture requiring tension band wiring , as regard fixation failure was in 11 cases in hook plate vs 9 in tip fracture requiring tension band wiring as shown in table2

Table1. study characteristics

author	type of study		number	age	m\f	Time from injury to operation	Surgical duration (minutes)	Incision length (cm)	Intraoperative blood loss (ml)	follow up \mn
	retrospective	hook plate	14	41.8	13\1		35.71			
Gültaç E et al.,2022 (6)	retrospective	tightrope loop plate	21	39.2	19\2		50.57			
	retrospective	hook plate	39	41.8	29\10	3.1± 2.7	54.5± 9.4	3.9± 0.5	43.3± 14.6	12
Liu S et al.,2022 (7)	retrospective	tightrope loop plate	32	39.6	23\9	3.4± 2.1	42.2± 7.6	9.6± 0.7	83.2± 15.3	12
	retrospective	hook plate	84	36		9.3± 4.3	66.1± 9.2	8.3± 1.1	93.1± 22.1	32.9
Nie S et al.,2021 (8)	retrospective	tightrope loop plate	28	35.9		9.1± 4.1	63.9± 10.1	3.9±0.83	57.1± 8.25	33.1
	retrospective	hook plate	22	48.2	16\6					41.3
Fosser M et al.,2021 (9)	retrospective	tightrope loop plate	22	40.5	20\2					32.2

	retrospective	hook plate	19	40.2	10 \9	7.1 ± 2.2				27
Shen **G et al.,2021(10)**	retrospective	tightrope loop plate	16	44.9	11 \ 5	6.8 ± 3.1				27
	prospective	hook plate	10	49.2	9\1	8 ± 5	58 ± 15			
Bin AbdRazak HR et al.,2018 (11)	prospective	tightrope loop plate	16	41.4	15\1	9 ± 3	75 ± 18			
	prospective	hook plate	39	41.79	26\13	4.67 ± 2.03	45.85 ± 8.52	7.77 ± 1.25	36.00 ± 8.24	
Cai L et al.,2018 (12)	prospective	tightrope loop plate	30	42.8	19\11	4.33 ± 1.58	42.67 ± 8.28	2.37 ± 0.57	60.90 ± 10.81	
	retrospective	hook plate	10	35.3	9\1	2.3±1.87				11.7
Sokkar SM et al.,2016 (13)	retrospective	tightrope loop plate	10	35.1	6\4	2.3±1.87				11.3
	retrospective	hook plate	24	38.8	19\5	9.6 ± 7.3				
Yoon JP et al.,2015(14)	retrospective	tightrope loop plate	18	42.2	14\4	10.0 ± 9.3				
	retrospective	hook plate	20			14	36.2 (±15.3)			
Metzlaff **S et al.,2014 (15)**	retrospective	tightrope loop plate	24			14	45.6 (±12.7)			

Table 2. Complications

author		complications	infection	neural injury	osteolysis	plate/screw breakage or loosening	posterior instability	poor healing	fixation failure	pain	acromial erosion	tip fracture requiring tension band wiring
	hook plate	0										
Gültaç E et al.,2022 (41)	tightrope loop plate	0										
	hook plate	2							1	1		
Liu S et al.,2022 (42)	tightrope loop plate	1						1				
	hook plate	12	2						10			
Nie S et al.,2021 (43)	tightrope loop plate	2							2			
	hook plate	0										
Fosser M et al.,2021 (44)	tightrope loop plate	1							1			
	hook plate	1									1	

Shen **G et al.,2021(45)**	tightrope loop plate	1							1			
	hook plate	2				1					1	
Bin AbdRazak HR et al.,2018 (46)	tightrope loop plate	2									1	1
	hook plate	5	3	1		1						
Cai L et al.,2018 (47)	tightrope loop plate	3							3			
	hook plate	4	2		2							
Sokkar SM et al.,2016 (48)	tightrope loop plate	1							1			
	hook plate	9									9	
Yoon JP et al.,2015(49)	tightrope loop plate	0									0	
	hook plate	5					5					
Metzlaff **S et al.,2014 (50)**	tightrope loop plate	4					3		1			

META ANALYSIS

Surgical duration (minutes)

6 studies were included comparing surgical duration showed that there was significant higher in **Tightrope loop** vs **Hook plate** regarding surgical duration p value <0.0001. The tightrope has more surgical duration time than hook plate fig2.

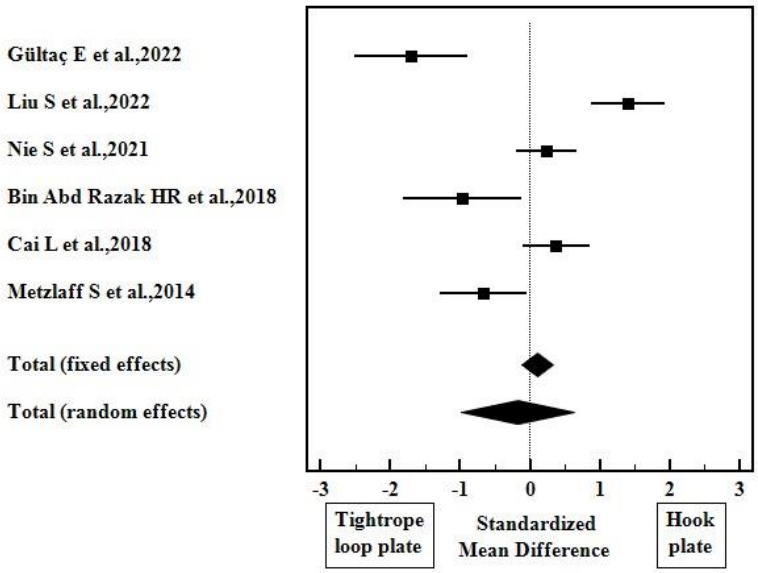

Figure (2): Forest plot for surgical duration (minutes)

Incision length (cm)

3 studies were included showed significant differences in Hook plate vs Tightrope loop plate regarding Incision length (cm) p value <0.0001. The hook plate has more incision length than tight rope fig 3.

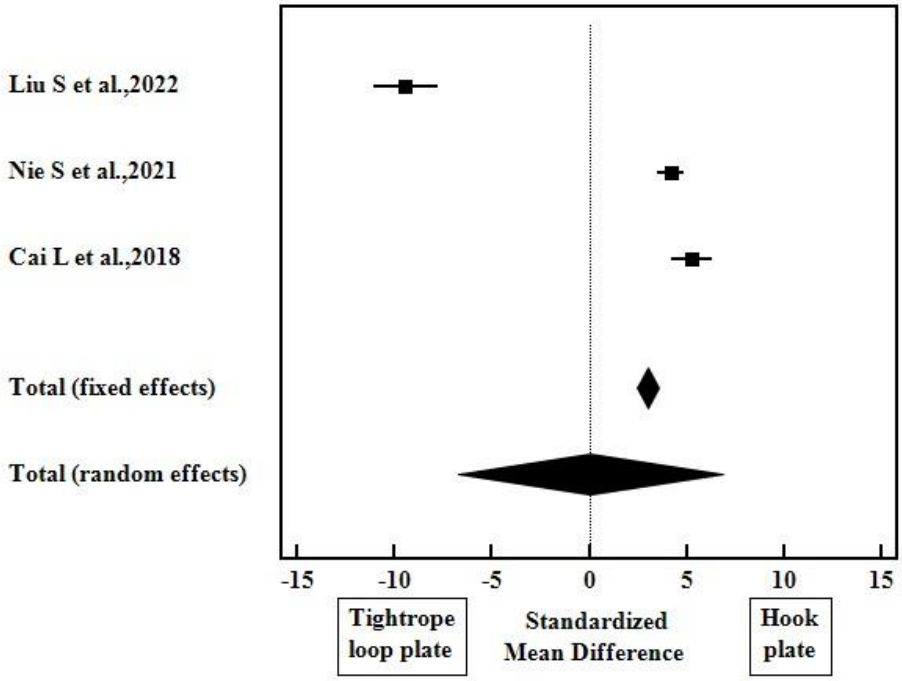

Figure (3): Forest plot for Incision length (cm)

Intraoperative blood loss

3 studies were included showed significant higher in Tightrope loop plate vs Hook plate regarding Intraoperative blood loss. The hook plate has higher intra operative blood loss than tight rope table3.

Table (3): Meta-analysis for Intraoperative blood loss (ml)

Study	Hook plate		Tightrope loop plate		SMD	SE	95% CI
	No.	**Mean ± SD.**	**No.**	**Mean ± SD.**			
Liu S et al.,2022	39	43.3± 14.6	32	83.2± 15.3	-2.645	0.324	-3.292 – -1.999
Nie S et al.,2021	84	93.1± 22.1	28	57.1± 8.25	1.822	0.249	1.329 – 2.314
Cai L et al.,2018	39	36.0 ± 8.24	30	60.90 ± 10.81	-2.608	0.327	-3.261 – -1.956
Total (fixed effects)					-0.574	0.169	-0.906 – -0.241
Total (random effects)					-1.138	1.598	-4.286 – 2.010
		Test for heterogeneity					
Q		172.4705					
DF		2					
Significance level		<0.0001*					
I^2 (inconsistency)		98.84%					
95% CI for I^2		98.05 – 99.31					

Q: Total variance for heterogeneity; SMD: Standardized Mean Difference; I2: Observed variance for heterogeneity; CI: Confidence interval (LL: Lower limit –UL: Upper Limit)

VAS

6 studies were included showed insignificant differences between Hook plate vs Tightrope loop plate regarding VAS last follow up p-value 0.0573

UCLA

2 studies were included showed insignificant differences between Hook plate vs Tightrope loop plate regarding UCLA score p-value 0.8034

Constant-Murley score last follow up

8 studies were included showed insignificant differences between Hook plate vs Tightrope loop plate regarding Constant-Murley score last follow up p-value 0.0652

Coracoclavicular distance (mm) at last follow up

5 studies were included showed insignificant differences between Hook plate vs Tightrope loop plate regarding Coracoclavicular distance (mm) at last follow up p-value 0.5763

Complications

10 studies were included showed insignificant differences between Hook plate vs Tightrope loop plate regarding Complications p-value 0.7808 table4

Table (4): Meta-analysis for complications

Study	Hook plate	Tightrope loop plate	RR	95% CI
Gültaç E et al.,2022	0/14	0/21	–	–
Liu S et al.,2022	2/39	1/32	1.641	0.156 – 17.285
Nie S et al.,2021	12/84	2/28	2.000	0.476 – 8.396
Fosser M et al.,2021	0/22	1/22	0.333	0.0143 – 7.764
Shen G et al.,2021	1/19	1/16	0.842	0.057– 12.417
Bin AbdRazak HR et al.,2018	2/10	2/16	1.600	0.266 – 9.619
Cai L et al.,2018	5/39	3/30	1.282	0.332 – 4.945
Sokkar SM et al.,2016	4/10	1/10	4.000	0.537 – 29.806
Yoon JP et al.,2015	9/24	0/18	14.44	0.895 – 232.90
Metzlaff S et al.,2014	5/20	4/24	1.500	0.464 – 4.849
Total (fixed effects)			2.003	1.138 – 3.526
Total (random effects)			1.721	0.954 – 3.106
Test for heterogeneity				
Q	4.7799			
DF	8			
Significance level	0.7808			
I^2 (inconsistency)	0.00%			
95% CI for I^2	0.00 – 41.50			

Fixation failure

10 studies were included showed insignificant differences between Hook plate vs Tightrope loop plate regarding Fixation failure p-value 0.6215 table5

Table (5): Meta-analysis for fixation failure

Study	Hook plate	Tightrope loop plate	RR	95% CI
Gültaç E et al.,2022	0/14	0/21	–	–
Liu S et al.,2022	1/39	0/32	2.475	0.104 – 58.765
Nie S et al.,2021	10/84	2/28	1.667	0.388 – 7.153
Fosser M et al.,2021	0/22	1/22	0.333	0.014– 7.764
Shen G et al.,2021	0/19	1/16	0.283	0.012 – 6.511
Bin AbdRazak HR et al.,2018	0/10	0/16	–	–
Cai L et al.,2018	0/39	3/30	0.111	0.006– 2.065

Sokkar SM et al.,2016	0/10	1/10	0.333	0.015– 7.323
Yoon JP et al.,2015	0/24	0/18	–	–
Metzlaff S et al.,2014	0/20	1/24	0.397	0.017– 9.239
Total (fixed effects)			0.652	0.282 – 1.508
Total (random effects)			0.711	0.274 – 1.848
Test for heterogeneity				
Q	4.4092			
DF	6			
Significance level	0.6215			
I^2 (inconsistency)	0.00%			
95% CI for I^2	0.00 – 60.93			

DISCUSSION

According on radiographic criteria, the Rockwood classification system divides acromioclavicular joint injuries into categories I through VI. Rockwood's classification is frequently used as a reference for treating ACJ dislocation.(16)

The recommendation in the guideline is typically for conservative therapy for type I and II graded lesions and surgical intervention for IV-VI damage. The therapeutic therapy of type III injuries, however, is still debatable. For this sort of injury, some experts recommend conservative therapies, while others have documented positive clinical results when using operational methods. (16)

The clavicular hook plate (CHP), which guarantees precise reduction and tight fixation, was previously the treatment of choice for acute AC joint dislocation. The implant may need to be removed in order to complete rehabilitation activities because it may also result in activity restrictions and excruciating pain. Due to the high level of stress between the acromion and CHP, subacromial osteolysis, acromial fracture, and rotator cuff injuries have also been recorded. (17)

The End button plate procedure, which uses the tight-rope (TR) technique and ligament repair with an autograft, allograft, or synthetic ligament, has recently come under the attention of researchers. (18)

Our study's key findings were that there was no discernible difference in the two surgical procedures' VAS, UCLA, Constant Score, CCD, fixation failure, or complication rates

Our findings suggested that both procedures could be effective in reducing dislocation discomfort and enhancing ACJ function on a clinical and radiological level. Adjustable loop fixation, as opposed to hook plate, demonstrated superiority in terms of incision length (cm) and intraoperative blood loss

Conclusion and Recommendations

In conclusion, the current investigation showed that both approaches produced positive clinical results in reducing dislocation discomfort and enhancing ACJ function.Adjustable loop fixation, however, outperformed hook plates in terms of surgical time and incision length (cm).Therefore, the surgical approach should be determined by the surgeon's experience when treating patients with ACJ dislocations. To confirm our findings, more RCTs with a bigger sample size are required

REFERENCES

1. Mazzocca AD, Arciero RA, Bicos J. Evaluation and treatment of acromioclavicular joint injuries. Am J Sports Med 2007, 35:316–329.
2. Rockwood CA Jr, Green DP, Bucholz RW, Heckman JD. Fractures in Adults.4th ed. Philadelphia, Pa: Lippincott-Raven; 1996.
3. Weaver JK, Dunn H. Treatment of acromioclavicular injuries, especially complete acromioclavicular separation. J Bone Joint Surg Am. 1972, 54:1187–1194.
4. Debski RE, Parsons I, Woo SL, Fu FH. Effect of capsular injury on acromioclavicular joint mechanics.J Bone Joint Surg Am. 2001, 83:1344–1351.
5. Lim YW. Triple endobuttton technique in acromioclavicular joint reduction and reconstruction. Ann Acad Med Singapore.2008; 37:294–299.
6.Gültaç E, Can Fİ, Kılınç CY, et al. Comparison of the Radiological and Functional Results of Tight Rope and Clavicular Hook Plate Technique in the Treatment of Acute Acromioclavicular Joint Dislocation. J Invest Surg. 2022 Mar;35(3):693-696.
7.Liu S, Li S, Song Z, et al. Comparison of open reduction and fxation with hook plate and modifed closed reduction and fxation with tightrope loop plate for treatment of rockwood type III acromioclavicular joint dislocation. BMC Musculoskeletal Disorders .2022;23:301
8.Nie S, Lan M. Comparison of clinical efficacy between

arthroscopically assisted Tight-Rope technique and clavicular hook plate fixation in treating acute high-grade acromioclavicular joint separations. J Orthopedic Surg (Hong Kong). 2021 May-Aug;29(2):23094990211010562.

9.Fosser M, Camporese A. Operative treatment of acute acromioclavicular joint dislocations graded Rockwood III-V: a retrospective and comparative study between three different surgical techniques. Acta Biomed. 2021 Nov 5;92(5): e2021325.

10.Shen G, Sun S, TangC,et al. Comparison of the TightRope system versus hook plate in acute acromioclavicular joint dislocations: a retrospective analysis.Scientifc Reports .2021; 11:11397

11.Bin AbdRazak HR, Yeo EN, Yeo W, et al. Short-term outcomes of arthroscopic TightRope® fixation are better than hook plate fixation in acute unstable acromioclavicular joint dislocations. Eur J Orthopedic SurgTraumatol. 2018 Jul;28(5):869-875.

12.Cai L, Wang T, Lu D, et al. Comparison of the Tight Rope Technique and Clavicular Hook Plate for the Treatment of Rockwood Type III Acromioclavicular Joint Dislocation. J Invest Surg. 2018 Jun;31(3):226-233

13.Sokkar SM, Radwan MA, Toreih AA. Hook plate versus tightrope for acute grade III acromioclavicular dislocation. Egypt Orthopedic J 2016; 51:137-42

14.Yoon JP, Lee BJ, Nam SJ, et al. Comparison of Results between Hook Plate Fixation and Ligament Reconstruction for Acute Un stable Acromioclavicular Joint Dislocation. Clinics in Orthopedic Surgery 2015; 7:97-103

15.Metzlaff S,Rosslenbroich S,Forkel PH, et al. Surgical treatment of acute acromioclavicular joint dislocations: hook plate versus minimally invasive reconstruction. Knee Surg Sports TraumatolArthroscope. Knee Surg Sports Traumatol Arthrosc.2014

16.Pan X, Lv RY, Lv MG, et al. TightRopevsClavicular Hook Plate for Rockwood III-V Acromioclavicular Dislocations: A Meta-Analysis. Orthopedic Surg. 2020 Aug;12(4):1045-1052.

17.Qi W, Xu Y, Yan Z, et al. The Tight-Rope Technique versus Clavicular Hook Plate for Treatment of Acute Acromioclavicular Joint Dislocation: A Systematic Review and Meta-Analysis. Journal of Investigative Surgery.2019;1–10.

18.Rolf O, Hann von Weyhern A, Ewers A, et al. Acromioclavicular dislocation Rockwood III-V: results of early versus delayed surgical treatment. Arch Orthopedic TraumSurg, 2008, 128: 1153–1157.