RESEARCH ARTICLE

Treatment of acromioclavicular joint dislocation with looped steel plate and clavicular hook steel plate: recent therapeutic observation

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Abstract

Objective: To compare the clinical efficacy of Endobutton-looped steel plate and clavicular hook steel plate in the treatment of acromioclavicular joint dislocation.

Method: The retrospective case-control study was conducted at the Baoding Forensic Hospital, Hebei University, China and comprised data from January 2022 to June 2023 of adult inpatients of either gender with acromioclavicular joint dislocation. The data was divided into intervention group A and control group B. Group A patients had been treated with Endobutton-looped steel plate, while those in group B had been treated using clavicular hook steel plate. Clinical efficacy, clinical indicators, Karlsson score for shoulder joint function, range of motion of the shoulder, and complications during 6-month follow-up were compared between the groups. Data was analysed using SPSS 26.

Results: Of the 50 patients, there were 25(50%) in group A; 15(60%) males and 10(40%) females with mean age 37.75±6.24 years (range: 19-58 years) and mean dislocation-to-visit time 2.52±0.61 days (range: 0-7 days). There were 25(50%) patients in group B; 16(64%) males and 9(36%) females with mean age 38.24±6.30 years (range: 18-59 years) and mean dislocation-to-visit time 2.47±0.58 days (range: 0-6 days). The groups showed no significant differences ($p>0.05$). Clinical efficacy of group A was higher than that of group B ($p<0.05$). Group A showed shorter surgical duration and incisional length, and lower average treatment cost compared to group B($p<0.05$). The shoulder joint function in group A was significantly better than group B ($p<0.05$). Post-treatment, the range of motion of abduction, external rotation and internal rotation in group A were superior to group B ($p<0.05$). Complications in the two groups showed no significant difference ($p>0.05$).

Conclusion: Compared to clavicular hook steel plate, Endobutton-looped steel plate presented higher clinical efficacy, shorter surgical duration, smaller incision and lower treatment cost, which promoted the recovery of shoulder joint function and contributed to high therapeutic safety.

Key Words: Looped, Steel, Plate, Clavicular, Hook, Acromioclavicular joint, Dislocation.

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Introduction

Acromioclavicular (AC) joint dislocation is a common orthopaedic issue, which is usually caused by traffic or sports injuries, and is clinically manifested as activity limitations, pain, myasthenia and muscular atrophy of the shoulder joint, seriously affecting patients' daily work and life[1]. Currently, the ailment is mainly treated surgically which involves restoring AC mobility through surgical reduction of the dislocated joint. Common surgical methods include clavicular hook steel plate, Endobutton with tape and steel plate method, etc., but their efficacy varies[2]. It has been found that[3] clavicular hook steel plate, as a commonly used surgical method for AC joint dislocation, can meet the needs of most patients, but it is highly prone to subacromion osteolysis, subacromial impact, rotator cuff injury, and steel plate fixation for peripheral fractures after surgery. Some studies have pointed out that[4] Endobutton-looped steel plate can reconstruct an anatomical structure similar to the coracoclavicular ligament between the clavicle and the coracoid process, achieving high stability in both longitudinal and transverse directions. In addition, it has no need for secondary surgery to remove the internal fixation, with minimal surgical traumas and low incidence of complications. However, after surgery, it is not possible to effectively provide horizontal stability, and, as such, dynamic instability in the horizontal direction may occur after the recovery of shoulder joint movement, and there is a possibility of backward translation of the distal clavicle because, due to its short-term clinical application, there is a lacks of enough clinical data in support.

The current study was planned to compare the clinical

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efficacy of Endobutton-looped steel plate and clavicular hook steel plate in the treatment of AC joint dislocation.

Materials and Methods

The retrospective case-control study was conducted at Baoding Forensic Hospital, Hebei, China and comprised data from January 2022 to June 2023 of adult inpatients of either gender with AC joint dislocation. After approval from the institutional ethics review committee of Baoding Forensic Hospital, China, the sample size was calculated using Epi-Info calculator[5] with the help of shoulder range of motion (ROM) as an estimation indicator. The calculated sample was inflated by 25%. The data was retrieved and divided into intervention group A and control group B according to therapeutic regimens. Written informed consent had been obtained from all the patients. Group A patients had been treated with Endobutton-looped steel plate, while those in group B had been treated using clavicular hook steel plate.

Data was included for patients having simple AC joint dislocation diagnosed with X-ray and clinically, with Rockwood typ >III[6], dislocation-to-visit time <7 days and postoperative follow-up for >6 months.

Data was excluded for patients having AC joint dislocation combined with fractures of the shoulder and other parts, complicated with severe hepatic, renal or cardiac dysfunction, combined with vascular and nerve injuries of the upper limbs, a previous history of shoulder surgery, speech disorders and mental disorders, coagulation disorders and traumas of other body parts.

Group A patients had been treated with Endobutton-looped steel plate (CanXerox Limited, USA, Specification: 72200149, Model: 30mm). Under cervical plexus block or general anaesthesia (GA), the patient was placed in a supine position, with the affected shoulder elevated, routinely disinfected, draped, and an incision was made on the outer segment of the affected clavicle. The skin, subcutaneous tissue, and deep fascia were incised to expose the affected AC joint. Haematoma was removed. A hole was drilled on the back side at a distance of 2-4cm from the distal clavicle, and two locking loop steel plates were placed on the back side. High-strength wire wraps were used around the base of the coronoid process to ensure anatomic reduction of the AC joint. Kirschner wire was temporarily fixed, and the fluoroscopy revealed anatomical reduction of the AC joint. The high-strength wire was tightened on the locking loop steel plate and a knot was tied. The Kirschner wire was removed, and the AC joint was repaired with ETHIBOND EXCEL No. 5 non-absorbable suture (Smith & Nephew Co., Ltd, USA). The wound was rinsed with physiological saline, and was sutured layer by layer.

Group B patients were treated by clavicular hook steel plate (WEGO Group Co., Ltd, China). Under cervical plexus block or GA, each patient was placed in a supine position. The affected shoulder was elevated to fully expose the AC joint and distal clavicle. The soft tissue of the AC joint disc was thoroughly removed, and then a clavicle hook steel plate was used with a matching length to insert into the posterior lower part of the patient's shoulder peak along the back of the AC joint. Shoulder joint screws were used for anatomical reduction and fixation, the shoulder joint was passively moved to confirm that the fixation was firm, and there was no impact or sensation of movement. The AC ligament was repaired with ETHIBOND EXCEL No. 5 non-absorbable suture (Smith & Nephew Co., Ltd, USA), and finally the wound was thoroughly rinsed and sutured.

The clinical efficacy of the two groups after the treatment was evaluated as remarkably effective, effective and ineffective [6]. Remarkably effective meant the upper limb strength had returned to normal, shoulder joint activities were not limited, and there was no pain in the AC area. Effective meant the upper limb strength was lower than the normal strength, shoulder joint activities were partially limited, and there was mild pain in the AC area. Ineffective meant the upper limbs were weak, shoulder joint activities were limited, and there was severe pain in the AC area. Total effective rate was the sum of remarkably effective and effective rates.

Clinical indicators comprised average surgical duration, incisional length and average treatment cost that were compared between the groups.

Using Karlsson score[7], shoulder joint function was classified into excellent, good and poor categories. Excellent shoulder joint function meant there was no pain in the AC joint, and the joint could move freely. X-ray showed that the AC joint had undergone reduction or the gap was <5mm. Good shoulder joint function meant there was mild pain in the AC joint, and the joint had a ROM of 90-180°. X-ray showed that the AC joint had a gap of 5-10mm. Poor shoulder joint function meant the pain had aggravated and the ROM of the joint in various directions was <90°. X-ray showed that the AC joint was still dislocated.

The ROM of the shoulder joint, including abduction, external rotation and internal rotation, was measured in the two groups before and after treatment using the Constant-Murley scoring system [8], with a maximum score of 100. A higher score indicated a larger ROM.

The subjects had been followed up for a minimum of 6

months postoperatively, and complications, including acromial dislocation, foreign body sensation, pain and stress fractures, were noted compared between the groups.

Data was analysed using SPSS 26. Data were expressed as mean ± standard deviation or as frequencies and percentages, as appropriate. Independent sample-t test and chi-square test paired t-test were used where necessary. P<0.05 was considered statistically significant.

Results

Of the 50 patients, there were 25(50%) in group A; 15(60%) males and 10(40%) females with mean age 37.75±6.24 years (range: 19-58 years) and mean dislocation-to-visit time 2.52±0.61 days (range: 0-7 days). There were 25(50%) patients in group B; 16(64%) males and 9(36%) females with mean age 38.24±6.30 years (range: 18-59 years) and mean dislocation-to-visit time 2.47±0.58 days (range: 0-6 days). The groups showed no significant differences (p>0.05).

Table-1: Intergroup comparison of clinical efficacy.

Group	Remarkably effective	Effective	Ineffective	Total effective rate
Observation group (n = 25)	9 (36.00)	15 (60.00)	1 (4.00)	24 (96.00)*
Control group (n=25)	4 (16.00)	14 (56.00)	7 (18.00)	18 (72.00)
x2				5.357
P				0.021

*P < 0.05.

Table-2: Intergroup comparison of clinical indicators.

Group	Surgical duration	Incisional length	Average treatment cost
Observation group (n = 25)	97.14±6.23*	7.26±0.61*	18745.21±843.36*
Control group (n = 25)	65.45±5.27	9.10±0.72	22459.38±929.68
T	19.418	9.749	14.795
P	0.000	0.000	0.000

*P < 0.05.

Table-3: Intergroup comparison of shoulder joint function score.

Group	Excellent	Good	Poor	Excellent and good rate
Observation group (n = 25)	8 (32.00)	14 (56.00)	3 (12.00)	22 (88.00)*
Control group (n = 25)	5 (20.00)	10 (40.00)	10 (40.00)	15 (60.00)
x^2				5.094
P				0.024

*P < 0.05.

Table-4: Intergroup comparison of range of motion (ROM) of the shoulder.

Group	Abduction		External rotation		Internal rotation	
	Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Observation group (n = 25)	33.45±5.47	78.81±6.49*[a]	48.78±3.43	81.18±2.56*[a]	60.22±4.21	77.84±4.70*[a]
Control group (n = 25)	34.12±5.32	64.49±7.25[a]	47.96±3.38	70.20±2.29[a]	61.17±3.73	69.05±4.14[a]
t	0.439	7.358	0.851	15.984	0.844	7.017
P	0.663	0.000	0.399	0.000	0.403	0.000

Table-5: Intergroup comparison of complications.

Group	Acromial dislocation	Foreign body sensation	Pain	Stress fractures	Adverse reaction rate
Observation group (n = 25)	1 (4.00)	1 (4.00)	1 (4.00)	0 (0.00)	3 (12.00)
Control group (n=25)	2 (8.00)	1 (4.00)	1 (4.00)	1 (4.00)	5 (20.00)
x^2					0.595
P					0.440

Clinical efficacy of group A was higher than that of group B (p<0.05) (Table 1). Group A showed shorter surgical duration and incisional length, and lower average treatment cost compared to group B (p<0.05) (Table 2). The shoulder joint function in group A was significantly better than group B (p<0.05) (Table 3). At baseline, no significant differences were found in ROM of various joints between the groups (p>0.05). Post-treatment, the ROm of abduction, external rotation and internal rotation in group A were superior to group B (p<0.05) (Table 4). Complications in the two groups showed no significant difference (p>0.05) (Table 5).

Discussion

The AC joint is the amphiarthrodial joint between the lateral clavicle and the medial acromion of the scapula, which can maintain the stability of the AC area [9]. AC joint dislocation is mainly caused by injuries involving shoulder and upper limbs, with an incidence of about 12% in shoulder injuries, accounting for 4.40-5.98% of systemic joint dislocations[10]. In clinical

practice, reduction and internal fixation of the coracoclavicular ligament and the joint with broken AC ligament is generally achieved through surgery to maintain its stability[11]. It has been shown that[12] the sternoclavicular joint serves as the axis of the AC joint participating in shoulder girdle activities, and the clavicle as the connecting axis. When subjected to external force impact, the load-bearing capability of the coracoclavicular ligament is almost vertical. As a result, its torque is relatively high. Additionally, the angle between the force of the AC ligament and the longitudinal axis of the clavicle is small, and the corresponding torque is also low. Therefore, compared to the AC ligament, the repair and reconstruction of the coracoclavicular ligament is more conducive to increasing the stability of the connection between the clavicle and the scapula. Studies have also confirmed that[13-14] the coracoclavicular ligament plays a prominent role in maintaining the stability of the AC joint, indicating that the effect of looped steel plate is more significant than that of clavicular hook steel plate. In the present study, it was found that the excellent and good rate of shoulder joint function and clinical efficacy in the observation group were both higher than those in the control group ($P < 0.05$), suggesting that the use of Endobutton looped steel plate for AC joint dislocation can effectively improve shoulder pain and restore its mobility, and has significant clinical efficacy. The reason may be that the application of Endobutton-looped steel plate can reconstruct the conical and trapezoid ligaments, and repair the injured coracoclavicular ligaments, achieving immediate and long-term stability of the AC area. On this basis, the repair of trapezius and deltoid plays an important role in stabilising and restoring the dynamic system of the AC joint, and the stability after repair is more consistent with the requirements of human anatomy and physiology. In addition, looped steel is a titanium alloy material composed of polyethylene terephthalate. It has been confirmed that[15] the strength and stiffness of the looped steel plate are 40% higher than those of the human ligaments, and its elasticity is higher as well. The tension after tightening is equivalent to that of the coracoclavicular ligament, ensuring a relatively stable healing environment for the soft tissues between the AC and coracoclavicular areas. Therefore, adopting this surgical method is beneficial for promoting the recovery of upper limb strength in the patients, and reducing their incidence of postoperative shoulder pain and activity limitations. It is in line with the findings of earlier studies[16].

In the current study, group A showed shorter surgical duration and incisional length, and lower average treatment cost compared to group B, indicating that the use of looped steel plate for the treatment of AC joint dislocation resulted in shorter surgical duration, smaller surgical incision, and lower treatment cost. This may be because the surgical method with Endobutton steel plate has a smaller implant and a corresponding surgical incision, which can achieve minimal invasion and small postoperative scar. In addition, its stress distribution is relatively balanced, so it less prone to stress fractures. Due to less intraoperative bleeding, shorter surgical duration, and higher biocompatibility of the material, secondary surgery for its removal is not needed, leading to lower corresponding economic cost. The current findings were consistent with earlier research[17]. Furthermore, the current study demonstrated that after treatment, the ROM of abduction, external rotation and internal rotation in group A were all superior to group B, indicating that treatment with looped steel plate could improve the ROM of the AC joint. It may have been because providing looped steel plate to patients with AC joint dislocation has little impact on the subacromial space, which can reduce the pain and loss of shoulder joint mobility caused by the implant. It is helpful for patients in terms of early functional exercise, and promotes their recovery of shoulder joint activities. The current findings were consistent with literature[18].

As for complications, there were more cases of acromial dislocation and stress fractures with clavicular hook steel plate than those with looped steel plate. It may have been related to the contact and friction between the hook end of the clavicular hook steel plate involving the subacromial space and the acromion. In the current study, both groups had complications, mainly acromial dislocation, foreign body sensation, pain and stress fractures, and there was no significant difference in the incidence of adverse reactions between the two groups, which may have been because of certain factors, such as small sample size and short follow-up time, which were limitations of the current study, and could have led to data bias.

Conclusion

Compared to clavicular hook steel plate, Endobutton-looped steel plate in the treatment of AC joint dislocation presented higher efficacy, shorter surgical duration, smaller incision and lower treatment cost, which promoted the recovery of shoulder joint function.

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Conflict of Interest: None.

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Authors' Contribution:
DL, XW: Design and responsible and accountable for the accuracy or integrity of the work and final approval.
ZZ: Data collection, analysed clinical data, revision and final approval.