

Original Article

A comparative study of the effects of endobutton and clavicle hook plate on patients with severe AC joint dislocations from pain intensity, shoulder joint function and adverse reactions

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Abstract: Objective: this study was designed to explore the effects of Endobutton and Clavicle Hook Plate on patients with severe AC joint dislocations (Rockwood types III, IV and V) from the perspectives of pain intensity and shoulder joint function, and to analyze the adverse reactions related to the treatment. Methods: In total, 78 patients treated in our hospital for severe AC joint dislocations were included and divided into the Endobutton Group (EG, n=41), and the Clavicle Hook Plate Group (CHPG, n=37) according to the surgical method. The 2 groups were compared for scores of VAS and SSV before and after the surgery, the Constant score for shoulder joint function before, at 3 months and 6 months after the surgery, and diaplasis loss at 3 d, 3 months and 6 months after the surgery. The incidences of adverse reactions after treatment were also analyzed. Results: (1) The data of the EG for surgery time, intraoperative bleeding, incision length, diaplasis loss at 3 months and 6 months after the surgery, and the incidences of adverse reactions were significantly lower as compared with those of the CHPG ($P<0.05$). (2) Without statistical difference before treatment ($P>0.05$), the EG yielded higher scores of VAS and SSV after treatment as compared with the CHPG ($P<0.05$). (3) The Constant scores at 3 months and 6 months after the surgery were also significantly higher in the EG ($P<0.05$). Conclusion: the application of Endobutton in patients with severe AC joint dislocation has achieved affirmative internal fixation effects as seen by the successful postoperative recovery of shoulder joint function and low incidences of adverse reactions.

Keywords: Endobutton, clavicle hook plate, AC joint dislocation, pains, shoulder joint function, adverse reactions

Introduction

As an amphiarthrosis connecting the clavicle and the scapula, the AC joint consists of the acromion joint of scapula and the articular surface of acromial extremity of clavicle. It is externally enveloped by loose articular capsules attached to the circumferentia of the articular surface, and functionally consolidated by the external ligamenta coracoclaviculare. As a plane joint, the AC joint is capable of movement in various directions [1, 2]. However, in a superficial position of the shoulder, and surrounded by less muscles, it is prone to injury caused by external force [3]. Clinical studies have revealed that AC joint dislocations are quite common injuries related to shoulder

motion and traffic accidents, accounting for about 12% of all shoulder injuries, and about 3% of the systematic joint dislocation. In recent years, with the development of traffic incidences and the emergence of the body-building movement in China, the incidence of AC joint dislocation is increasingly rising [4, 5].

As mentioned before, the AC joint is a major amphiarthrosis in the upper extremities. It participates in the associated movement of the shoulder joint, and functions as a key balance pivot point for movements of the upper extremities. In the case of dislocation, patients not only suffer from deformity, pain and swelling in the distal end of the clavicle, but also are greatly weakened on the injured side due to

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Table 1. Comparison between the 2 groups for general clinical data ($\bar{x} \pm s$)/[n (%)]

Group	N	Gender		Diseased extremity		Cause of disease		Average age (y)
		M	F	Left	Right	Injury by falling	Injury by traffic accidents	
EG	41	23	18	22	19	20	21	32.06±2.65
CHPG	37	20	17	19	18	19	18	31.98±2.55
t/X ²	-	0.033		0.042		0.051		0.136
P	-	0.856		0.839		0.821		0.892

Table 2. Comparison between the 2 groups for general surgical indexes ($\bar{x} \pm s$)

n	N	Surgery time (min)	Intraoperative bleeding amount (ml)	Incision length (cm)
EG	41	40.26±4.11	51.36±4.36	5.23±0.62
CHPG	37	46.59±3.98	83.51±3.65	7.51±0.51
t	-	6.895	35.101	17.623
P	-	<0.001	<0.001	<0.001

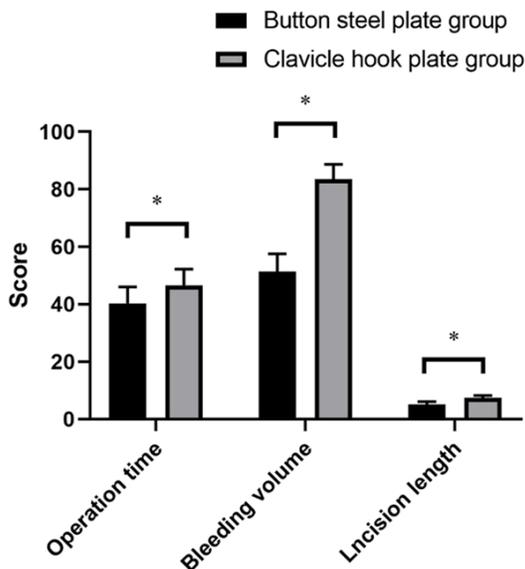


Figure 1. Comparison between the 2 Groups for General Surgical Data. In comparison with the CHPG, the EG demonstrated shorter surgery time and incision length, and lower intraoperative bleeding amount ($P < 0.05$). *indicates $P < 0.05$ as compared between the 2 groups for the same index.

the loss of the balance pivot; which affects their normal life. Therefore, timely treatment becomes a significant factor [6, 7]. So far, clinically AC joint dislocations are generally categorized by the Rockwood method and the Tossy method. The Tossy method is based on imag-

ing, and the Rockwood method focuses on anatomy and pathology for more detailed and accurate descriptions, and is extensively applied in the clinic [8, 9]. According to the Rockwood method, AC joint dislocations include 6 types. Conservative treatment is recommended for patients with type I and II dislocations, while a surgery is necessary for patients with type III, IV and V in order to recover their anatomic structure and joint function as soon as possible, so as to avoid a stiff joint shoulder, and loss of the function of the upper extremities [10-12].

Endobutton and Clavicle Hook Plate are commonly adopted for severe AC joint dislocations, but their effects and postoperative adverse reactions are disputed [13]. To provide more data for the selection of surgeries, the data of 78 patients receiving treatment in our hospital due to severe AC joint dislocations were retrospectively analyzed. The effects of the 2 surgeries were compared and the Endobutton proved its affirmative internal fixation effects through successful postoperative recovery of shoulder joint function and low incidences of adverse reactions.

Materials and methods

General materials

In total, 78 patients treated in our hospital for severe AC joint dislocations were included and divided into the EG ($n=41$) and the CHPG ($n=37$) according to the surgical method.

Inclusion criteria: Patients meeting following conditions were included: (1) A history of injury within 1 week; (2) Typical clinical syndromes of AC joint dislocation, including shoulder pain, swelling and limitation of motion; (3) Projecting extremitas acromialis clavicularae at the diseased side with organ point signs when pressed; (4) Severe AC joint dislocations diagnosed by imaging; (5) Clear enough in con-

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Table 3. Comparison between the 2 groups for preoperative and postoperative pain intensity and self scores ($\bar{x} \pm s$)

Group	n	VAS		SSV	
		Before treatment	After treatment	Before treatment	After treatment
EG	41	7.81±1.15	4.03±0.26	56.39±6.32	86.95±6.32
CHPG	37	7.68±1.26	5.36±0.37	57.04±5.14	72.16±5.22
T	-	0.476	18.509	0.495	11.198
P	-	0.635	<0.001	0.622	<0.001

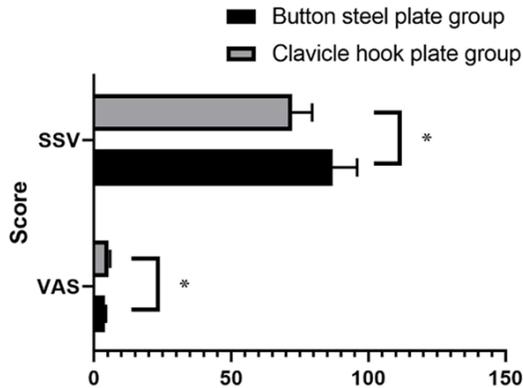


Figure 2. Comparison between the 2 Groups for Post-operative VAS and SSV Scores. As compared with the CHPG, the VAS score was lower and the SSV score was higher in the EG after the surgery ($P < 0.05$). * indicates $P < 0.05$ as compared between the 2 groups for the same index.

sciousness to cooperate with the investigation; (6) Complete case data; (7) This study was approved by the Ethics Committee of Chengyang People's Hospital; (8) Informed consent from patients.

Exclusion criteria: Some patients were excluded as they were (1) complicated with mental disorders, malignant tumors, severe organ diseases, coagulation disorders or fractures at the external extremity of clavicle, coracoids or acromions, (2) pregnant or lactating, (3) with a history of shoulder joint surgery or injury, (4) previous history of chronic pains in the shoulder joint, and (5) failure to return during the follow-up period or withdrew during the investigation were removed.

Methods

EG: lying on the back with the diseased side elevated by 20 to 30°, patients in the EG were given general anesthesia or at the brachial

plexus block. After identification of the dislocation position, their heads were turned to the healthy side. Subsequently, the skin was routinely disinfected and a curved incision was made, and tissue was separated with the anadesma to expose the AC joint. Damaged cartilaginous opereulum was removed as the case needed, and the joint space was cleaned. A vertical incision was made

underneath the coracoids to separate the muscles and soft tissues. In such a process, attention was paid to the peripheral coracoid nerves and blood vessels. As the coracoid root was exposed, a bone tenaculum was used for diaplasis and a 3.0 mm Kirschner wire used for fixation. The effects were observed through a C-arm machine and then the bone channel was broadened with a 4.00 mm hollow boring bit, and a ring Endobutton was placed underneath the coracoids through the inner side of the clavicle to tighten and fix the hole for the wire at the side of steel plates. Next, the Endobutton was horizontally inserted and locked, and the injured ligaments were repaired and the incision was sutured.

CHPG: the preoperative preparation and exposure mode were the same as the EG's. The damaged articular disc and joint space were cleaned after exposing the AC joint. The AC joint was manually anatomized, restored, provisionally fixed with a 3.5 mm Kirschner wire, and observed through a C-arm machine. Afterward, the surrounding ligaments were repaired with absorbable wires, and a pre-bent Clavicle Hook Plate was adopted to position the hook tip in close contact with the acromions. After anatomy and diaplasis, the position was confirmed through a C-arm machine again, followed by drilling, screwing and suturing.

Observation indexes and criteria

General surgical indices: The surgery time, intraoperative bleeding amount and incision length were recorded and compared between the 2 groups.

Preoperative and postoperative VAS and SSV scores: All patients were evaluated for pain intensity and self-scored with the VAS and the

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Table 4. Comparison between the 2 groups for preoperative and postoperative scores of shoulder joint function ($\bar{x} \pm s$)

Group	N	Before surgery	3 months after surgery	6 months after surgery
EG	41	37.59±3.65	76.36±3.66	90.65±3.22
CHPG	37	38.19±3.06	65.26±4.05	81.56±2.69
t	-	0.782	12.716	13.449
P	-	0.437	<0.001	<0.001

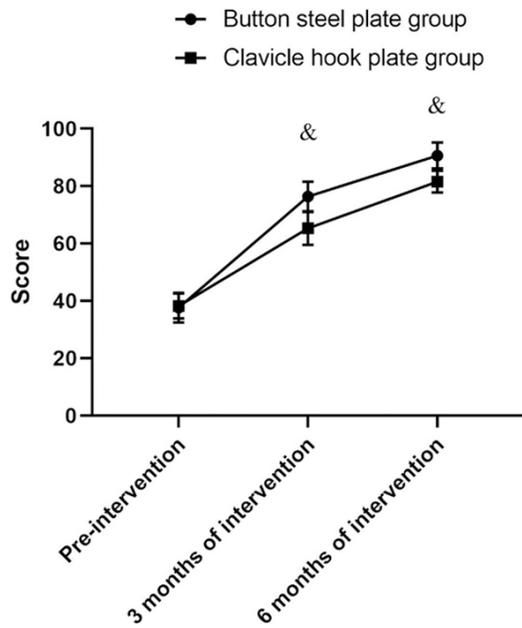


Figure 3. Comparison between the 2 Groups for Pre-operative and Postoperative Shoulder Joint Function. Before surgery, the 2 groups had no statistical difference in shoulder joint function ($P > 0.05$); at 3 months and 6 months after the surgery, the shoulder joint scores were higher in the EG as compared with the CHPG ($P < 0.05$). & indicates $P < 0.05$ as compared between the 2 groups for the same index.

SSV. On a paper, a 10 cm line was drawn with one end marked as 0 to represent no pain, and the other end as 10 to represent the worst pain. Patients were required to mark on the line subjectively to evaluate their pain intensity. This method is more sensitive and comparable; a SSV was adopted for patients to score their shoulder junction function subjectively, with the full mark 100 indicating completely normal functions [14].

Preoperative and postoperative scores for shoulder joint function: The shoulder joint function was measured with the Constant scale

before, at 3 months and 6 months after the surgery. The Constant scale is one of the commonly used scales to evaluate the condition of shoulder joints in orthopedics. With a full mark of 100, it consists of pain intensity, impact on daily life, range of shoulder joint motion, and force. A higher score represents better shoulder joint function [11].

Postoperative diaphysis loss: An actinogram based on Zanca bit slice was performed on the AC joints of all patients at 3 d, 3 months and 6 months after the surgery to evaluate their diaphysis loss.

Incidence of complications: During the 6-month follow-up, incidences of complications were recorded, including shoulder pain, infection of incisional wound, and foreign body sensation; and compared between the 2 groups.

Statistical analysis

Statistical analysis was performed with SPSS 22.0. In case of numerical data it was expressed as Mean \pm Standard Deviation, comparison studies were carried out through independent-samples *t* test for data which were normally distributed; in the case of nominal data expressed as [n (%)], comparison studies were carried out through χ^2 test for intergroup comparison. Intragroup comparison at multiple points was carried out through ANOVA. For all statistical comparisons, significance was defined as $P < 0.05$.

Results

Comparison between the 2 groups for general data

Through evaluation and comparison, the 2 groups' clinical data: including gender, age, time elapsed from injury to the surgery, cause of diseases and diseased extremities, was not statistically different ($P > 0.05$) but comparable (**Table 1**).

Comparison between the 2 groups for general surgical indices

According to statistics and comparison, indices including surgery time, intraoperative bleeding amount and incision length were lower in the EG as compared with the CHPG ($P < 0.05$, **Table 2** and **Figure 1**).

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Table 5. Comparison between the 2 groups for postoperative diaphysis loss ($\bar{x} \pm s$) (mm)

Group	N	3 d after the surgery	3 months after surgery	6 months after surgery
EG	41	23.96±2.35	25.03±2.15	26.36±2.16
CHPG	37	23.86±2.44	28.64±2.61	29.56±1.51
t	-	0.184	6.692	7.505
P	-	0.854	<0.001	<0.001

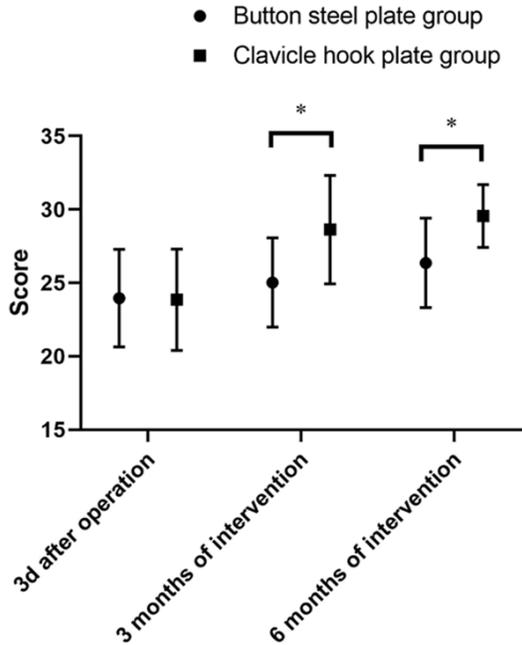


Figure 4. Comparison between the 2 Groups for Post-operative Diaphysis Loss. Three days after the surgery, the 2 groups demonstrated no statistical difference in the diaphysis loss ($P>0.05$). At 3 months and 6 months after the surgery, the diaphysis loss was lower in the EG as compared with the CHPG ($P<0.05$).

Comparison between the 2 groups for preoperative and postoperative pain intensity and self scores

Evaluation showed that the 2 groups' VAS and SSV scores were not statistically different before surgery ($P>0.05$). VAS scores declined and SSV rose after the surgery ($P<0.05$), which were significantly more prominent in the EG ($P<0.05$) (Table 3 and Figure 2).

Comparison between the 2 groups for preoperative and postoperative scores of shoulder joint function

Evaluation found that, the Constant scores of the 2 groups were not statistically significant

before the surgery ($P>0.05$), but at 3 months and 6 months after the surgery a more sharp rise in pain was reported in the EG as compared with the CHPG ($P<0.05$) (Table 4 and Figure 3).

Comparison between the 2 groups for postoperative diaphysis loss

Through evaluation and comparison, no statistical difference was demonstrated between the 2 groups at 3 d after the surgery in terms of diaphysis loss ($P>0.05$), but significantly lower values were observed in the EG at 3 months and 6 months after the surgery ($P<0.05$) (Table 5 and Figure 4).

Comparison between the 2 groups for postoperative incidences of adverse reactions

Evaluation and comparison showed that the incidence of adverse reactions were significantly lower in the EG as compared with the CHPG ($P<0.05$, Table 6 and Figure 5).

Discussion

As an amphiarthrosis and a unique bony structure in the human body, the AC joint can move forward and backward, upward and downward, and rotate. It connects with our skeleton through the clavicle and participates in the associated movement of shoulder joints as a prominent joint in the upper body [15]. Clinical studies have pointed out that when it is surrounded by less muscles, the sophisticatedly structured AC joint is prone to dislocation due to direct or indirect external forces, leading to local swelling and pain, which affect patients' normal life.

AC joint dislocations are divided into types. The Tossy or the Rockwood method is mostly adopted. Compared with the imaging-based Tossy method, the Rockwood method divides the AC joint dislocations into 6 types from the perspectives of anatomy and pathology, and its description is more detailed and accurate. Conservative treatment is suggested for minor AC joint dislocations (Rockwood types I and II), and surgical treatment for severe cases [16]. As one of the commonly used fixation methods for AC joint dislocations, Clavicle Hook Plate has shown advantages in some studies. On the one hand, it can fix the dislocated or fractured clavicle at the original position by leveraging the stiff steel plates for better diaphysis

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Table 6. Comparison between the 2 groups for the incidences of postoperative adverse reactions [n (%)]

Group	n	Shoulder pain	Second dislocation	Foreign body sensation	Total incidence
EG	41	1 (2.44)	0 (0.00)	1 (2.44)	2 (4.88)
CHPG	37	5 (13.51)	2 (5.41)	2 (5.41)	9 (10.81)
χ^2	-	-	-	-	4.077
<i>P</i>	-	-	-	-	0.043

lasis, and on the other hand, it provides a tension-free healing environment for the ligamenta coracoclaviculare and the ligamenta acromioclaviculare of patients with severe AC joint dislocations through a unique hook structure sliding in the acromion, allowing patients to carry out functional recovery exercises after the surgery as soon as possible, and reducing the incidence of postoperative traumatic arthritis [17-19]. However, while further popularized in the clinic in recent years, Clavicle Hook Plate has been frequently reported for a high incidence of postoperative complications, of which, postoperative pain dominates. Some studies suggested the possible reason is the tip of the Clavicle Hook Plate as it is inserted into the gap below the acromions. When patients lift or outwardly expand their shoulders, friction occurs between the acromions and the steel plate, and the soft tissues under the acromions are hooked, causing impaction and friction pain. Data has shown that the postoperative incidence of shoulder pain is around 30%, severely affecting patients' postoperative functional exercise and recovery of shoulder joint function [20, 21]. Furthermore, according to some studies, the failure of manually repairing ligamenta coracoclaviculare resulted in the tensile strength of wound scar healing to be as low as about 60% of the normal ligaments. Therefore, patients may still face the risk of a second dislocation as the internal fixation is removed [22]. In this study, the incidence of shoulder pain was 13.51% in the CHPG and 2.44% in the EG. In the meanwhile, postoperative follow-up revealed a higher incidence of dislocations of 5.41% in the CHPG.

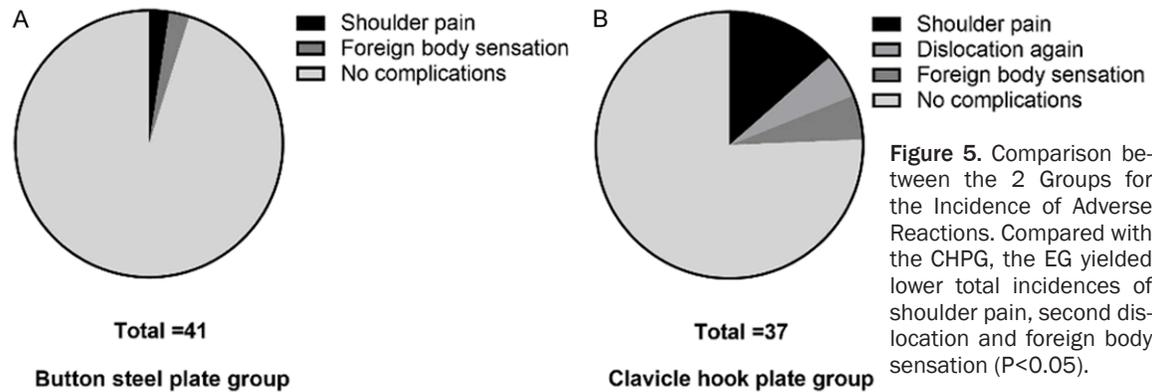
Endobutton internal fixation is one of the most widely used surgeries for patients with severe AC joint dislocations. Many studies have testified to its better effects in treating AC joint dislocations as compared with the Clavicle

Hook Plate [23, 24], and so did this study, including a shorter surgery time and operative incision, and lower intraoperative bleeding amount. Through scoring and comparison, a lower score of pain intensity, and a higher score of shoulder joint function were both demonstrated in the EG. According to some studies, almost all patients with severe AC joint dislocations were tortured by breakage of ligamenta

coracoclaviculare and ligamenta acromioclaviculare, with severely damaged and irreparable local stability of the shoulder joint. Without surgery, patients may be limited in shoulder associated movement, and suffer from amyotrophy and myophagia at the deltoid and cucullaris. Endobutton helps rebuild the coracoid ligament and the ligamenta trapezoideum, and repair the ligamenta capsulare complex of AC joint [25] to recover its biological stability and facilitate postoperative recovery of shoulder joint function [25]. In addition, some studies also point out that Endobutton plays a role in the recovery of anatomic structure and mechanical equilibrium. During the surgery, it is not required to expose the acromions purposely so there is zero intraoperative trauma, and to implant foreign body under the acromion to avoid any stimulation, so as to reduce the incidence of shoulder pain and foreign body sensation [26]. These facts have been supported by the low scores of postoperative pain intensity and incidences of foreign body sensation in the EG. Besides, according to our study results, patients in the EG were also seen with clear low diaphysis loss. From this study, there is increasing attention to the importance of ligamenta coracoclaviculare and the fixation effects in an Endobutton surgery, and the reduced impact on the anatomic structure of the AC joint to ensure greater advantage in the repair and healing of joint capsules and ligaments, which explains the lower diaphysis loss in the EG after the surgery.

In conclusion, this study affirmed the effects of Endobutton internal fixation in patients with severe AC joint dislocation based on their successful postoperative recovery of shoulder joint function and low incidences of adverse reactions. However, fewer subjects were included and the study results were not comprehensively analyzed, leading to less representa-

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tive conclusions. Future studies shall be based on greater numbers, integrity and comprehensiveness of the analysis to make sure the results can provide more advantageous theoretical support to clinical practice.

Disclosure of conflict of interest

None.

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References

- [1] Dong D, Yu M and Gu G. Simultaneous bilateral midshaft clavicle fractures with unilateral dislocation of the acromioclavicular joint: a case report. *Medicine* 2017; 96: e6975.
- [2] Abat F, Gich I, Natera L, Besalduch M and Sarasquete J. Clinical factors that affect perceived quality of life in arthroscopic reconstruction for acromioclavicular joint dislocation. *Rev Esp Cir Ortop Traumatol* 2018; 62: 121-126.
- [3] Moura DL, e Reis AR, Ferreira J, Capelão M and Cardoso JB. A combined technique for acromioclavicular reconstruction after acute dislocation-technical description and functional outcomes. *Rev Bras Ortop* 2018; 53: 67-74.
- [4] Emary P, Watkins K and Taylor J. Grade V acromioclavicular joint separation in a 57-year-old mountain biker. *J Can Chiropr Assoc* 2017; 61: 68-71.
- [5] Xu D, Luo P, Chen J, Ji L, Yin L, Wang W and Zhu J. Outcomes of surgery for acromioclavicular joint dislocation using different angled hook plates: a prospective study. *Int Orthop* 2017; 41: 2605-2611.
- [6] Tang G, Zhang Y, Liu Y, Qin X, Hu J and Li X. Comparison of surgical and conservative treatment of rockwood type-III acromioclavicular dislocation: a meta-analysis. *Medicine* 2018; 97: e9690.
- [7] Zuo Y and Ma Z. Outcomes and complications of Tightrope button plate for repairing acromioclavicular dislocation. *Zhongguo Gu Shang* 2017; 30: 946-951.
- [8] Chaudhury S, Bavan L, Rupani N, Mouyis K, Kulkarni R, Rangan A and Rees J. Managing acromio-clavicular joint pain: a scoping review. *Shoulder Elbow* 2018; 10: 4-14.
- [9] Agarwal A, Bhandari A and Maheshwari R. Tuberculosis of acromioclavicular joint. *J Clin Diagn Res* 2017; 11: RD03.
- [10] Ringenber JD, Foughty Z, Hall AD, Aldridge JM 3rd, Wilson JB and Kuremsky MA. Interobserver and intraobserver reliability of radiographic classification of acromioclavicular joint dislocations. *J Shoulder Elbow Surg* 2018; 27: 538-544.
- [11] Younis F, Ajwani S, Bibi A, Riley E and Hughes P. Operative versus non-operative treatment of grade III acromioclavicular joint dislocations and the use of surgilig: a retrospective review. *Ortop Traumatol Rehabil* 2017; 19: 523-530.
- [12] Kibler WB, Sciascia AD, Morris BJ and Dome DC. Treatment of symptomatic acromioclavicular joint instability by a docking technique: clinical indications, surgical technique, and outcomes. *Arthroscopy* 2017; 33: 696-708.
- [13] Cisneros LN and Reiriz JS. Prevalence of remaining horizontal instability in high-grade acromioclavicular joint injuries surgically managed. *Eur J Orthop Surg Traumatol* 2017; 27: 323-333.
- [14] Bin Abd Razak HR, Yeo EN, Yeo W, Yeo W and Lie TD. Short-term outcomes of arthroscopic TightRope® fixation are better than hook plate fixation in acute unstable acromioclavicular joint dislocations. *Eur J Orthop Surg Traumatol* 2018; 28: 869-875.

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- [15] Boutsiadis A. Editorial letter for thematic issue on shoulder pathology. *Open Orthop J* 2017; 11: 64-0.
- [16] Braun S, Martetschläger F and Imhoff A. Arthroscopically assisted reconstruction of acute and chronic AC joint separations. *Oper Orthop Traumatol* 2014; 26: 228-236.
- [17] Borozda IV, Danilov MA and Golokhvast KS. Treatment of patients with acromioclavicular joint injuries (Rockwood II-VI) with modeled Kirschner wire and cortical screw. *Asian Pac J Trop Biomed* 2015; 5: 579-584.
- [18] Balke M, Schneider MM, Shafizadeh S, Bähris H, Bouillon B and Banerjee M. Current state of treatment of acute acromioclavicular joint injuries in Germany: is there a difference between specialists and non-specialists? A survey of German trauma and orthopaedic departments. *Knee Surg Sports Traumatol Arthrosc* 2015; 23: 1447-1452.
- [19] Boffano M, Mortera S, Wafa H and Piana R. The surgical treatment of acromioclavicular joint injuries. *EFORT Open Rev* 2017; 2: 432-437.
- [20] North AS. Rockwood grade I and II acromioclavicular injuries: as benign as commonly believed? *Joints* 2016; 4: 171-173.
- [21] Huang SG, Chen B, Lv D, Zhang Y, Nie FF, Li W, Lv Y, Zhao HL and Liu HM. Evaluation of shoulder function in clavicular fracture patients after six surgical procedures based on a network meta-analysis. *Disabil Rehabil* 2017; 39: 105-112.
- [22] Kawasaki Y, Hirano T, Miyatake K, Fujii K and Takeda Y. Safety screw fixation technique in a case of coracoid base fracture with acromioclavicular dislocation and coracoid base cross-sectional size data from a computed axial tomography study. *Arch Orthop Trauma Surg* 2014; 134: 913-918.
- [23] Xu X and Liu H. Clinical analysis of cervical posterior internal fixation titanium plate and silk suspension internal fixation cervical spondylosis. *Zhonghua Wai Ke Za Zhi* 2017; 55: 214-219.
- [24] Varghese V, Smitham P, Howell S, Edwards S and Rickman M. POWIFF-prospective study of wrist internal fixation of fracture: a protocol for a single centre, superiority, randomised controlled trial to study the efficacy of the VRP (2.0) distal radius plate (austofix) versus the VA-LCP (depuysynthes) for distal radius fractures. *BMC Musculoskelet Disord* 2018; 19: 131.
- [25] Xu B, Wang Q, Jin H, Li J, Liu H, Mao Y and Wei J. Internal fixation and hemiarthroplasty for the treatment of displaced femoral neck fracture: a cost-utility analysis. *Zhonghua Yi Xue Za Zhi* 2017; 97: 1650-1654.
- [26] Li H, Yang Y, Zhang D and Gu G. Particle impaction bone graft and plate internal fixation for the treatment of proximal femoral bone tumor or tumor lesion. *Zhongguo Gu Shang* 2017; 30: 647-650.