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Percutaneous double-button fixation method for treatment of acute type III acromioclavicular joint dislocation

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Objective: The aim of this study was to evaluate the functional and radiological results of patients treated with the percutaneous double-button technique for acute acromioclavicular (AC) joint dislocation.

Methods: A retrospective evaluation was performed of 13 patients surgically treated for acute Type III AC joint dislocation with the percutaneous double-button fixation method. The coracoclavicular (CC) distance of the affected side was compared with that of the healthy side on anterior-posterior radiographs obtained at the final follow-up. In the functional evaluation, Disabilities of the Arm, Shoulder and Hand (DASH), Constant, and visual analog scale (VAS) scores were used.

Results: The 13 patients in the study included 12 males and 1 female with a mean age of 43.4 years (range: 22–60 years). The mean follow-up period was 13.61 months (range: 9–24 months). The mean CC distance on the operated side was 9.23 mm (range: 8–15 mm), and when compared with the healthy side, no statistically significant difference was observed. Preoperative Constant scores of a mean of 30.3 (range: 18–42) increased to 84.4 (range: 70–90) at the final follow-up. Preoperative DASH scores had a mean of 14.1 (range: 11–28) and decreased to 0.4 (range: 0–3) at the final follow-up ($p<0.001$). Mean preoperative VAS score was 6.0 (range: 5–8), which decreased to 0.6 (range: 0–3) at the final follow-up ($p<0.001$).

Conclusion: The percutaneous double-button fixation technique is a safe, practical, and effective fixation method that can be used as an alternative to arthroscopic and open methods for acute Type III AC joint dislocations.

Keywords: Acromioclavicular joint; dislocation; double-button fixation; percutaneous.

The acromioclavicular (AC) joint is one of the most important stabilizers of the shoulder and serves crucial functions in shoulder and arm movement.[1] AC joint dislocation may cause permanent pain and joint dysfunction in some patients.[2,3] Injuries of the AC joint are often seen in the active population.[4]

The AC joint classification system first described by Rockwood in 1984 is still in use today.[5] According to

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this classification, while conservative treatment is recommended for Type I and II dislocations, surgery is an accepted treatment method for Type IV–VI dislocations. However, no consensus has been reached regarding treatment of Type III dislocations.[6,7]

Although studies have reported success rates of 80–90% with conservative treatment for Type III AC joint dislocations,[8,9] other studies have reported residual symptoms following conservative treatment and the development of pain and weakness.[10,11] Among the advantages of surgical treatment compared to conservative treatment following a Type III AC joint dislocation are better functional results, fewer complications, and earlier return to daily life activities.[7,12]

Both dynamic and static fixation methods are used to surgically treat AC joint dislocations. Pinning, hook plates, and coracoclavicular (CC) screws are applied to the AC joint as static fixation methods. However, these rigid fixation methods have disadvantages such as excessive tightness, implant failure, pin migration, and required removal of the implant.[13]

Various anatomical fixation methods have been described. The reliability of these minimally invasive fixation methods, which allow reconstruction of the CC ligament in an anatomic position, has been demonstrated in clinical and biomechanical studies. These fixation methods can be applied arthroscopically or with open methods. Percutaneous AC joint double-button fixation is a method that can be applied with a minimally invasive technique as an alternative to arthroscopic and open surgery for anatomic reconstruction of an AC joint dislocation. The aim of this study was to evaluate the short-term radiological and functional results of patients who underwent percutaneous double-button fixation for a Type III AC joint dislocation.

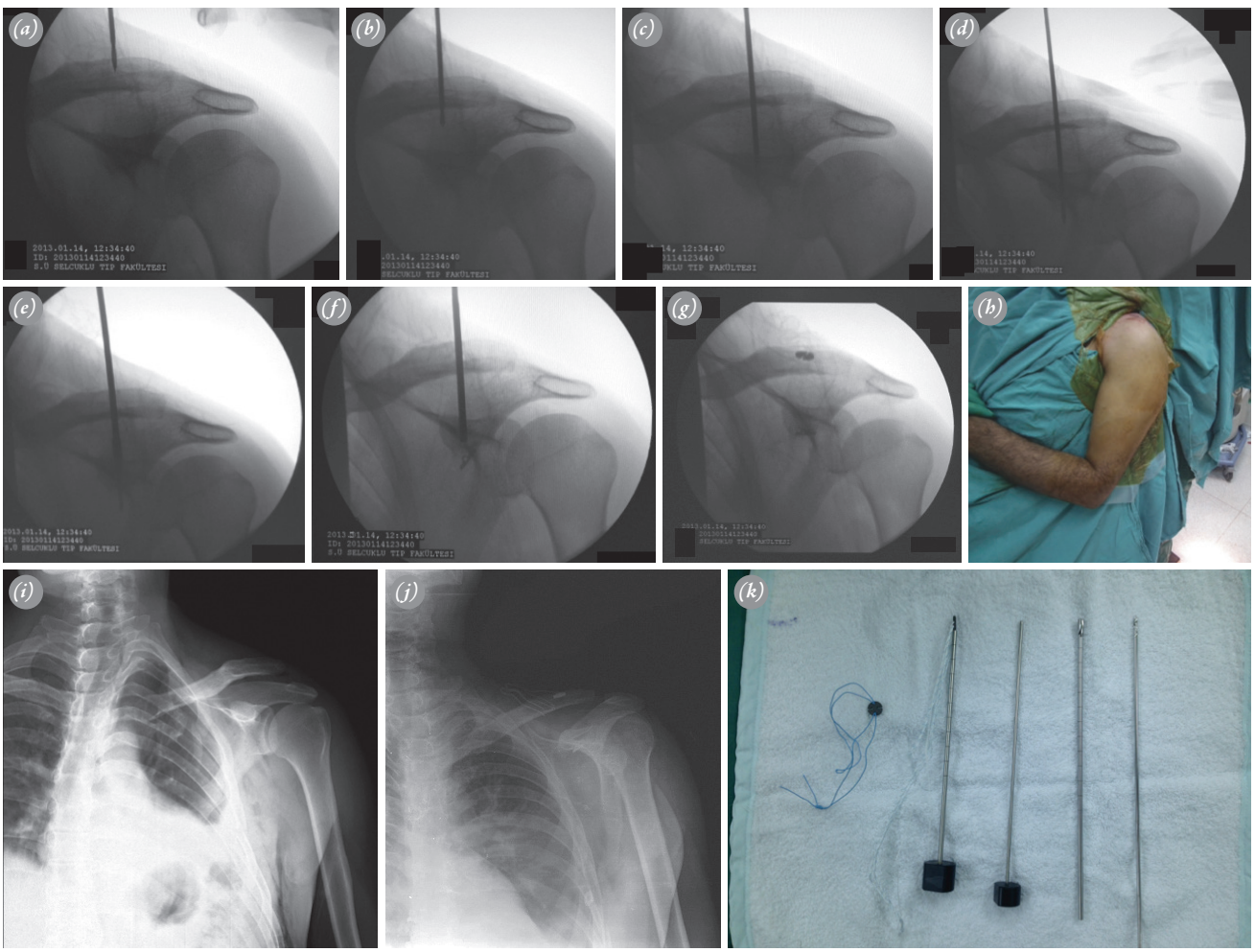

Fig. 1. Intraoperative fluoroscopy view **(a–g)**, intraoperative position **(h)**, preoperative X-ray **(i)**, postoperative X-ray **(j)**, ZipTight fixation device **(k)**. [Color figures can be viewed in the online issue, which is available at www.aott.org.tr]

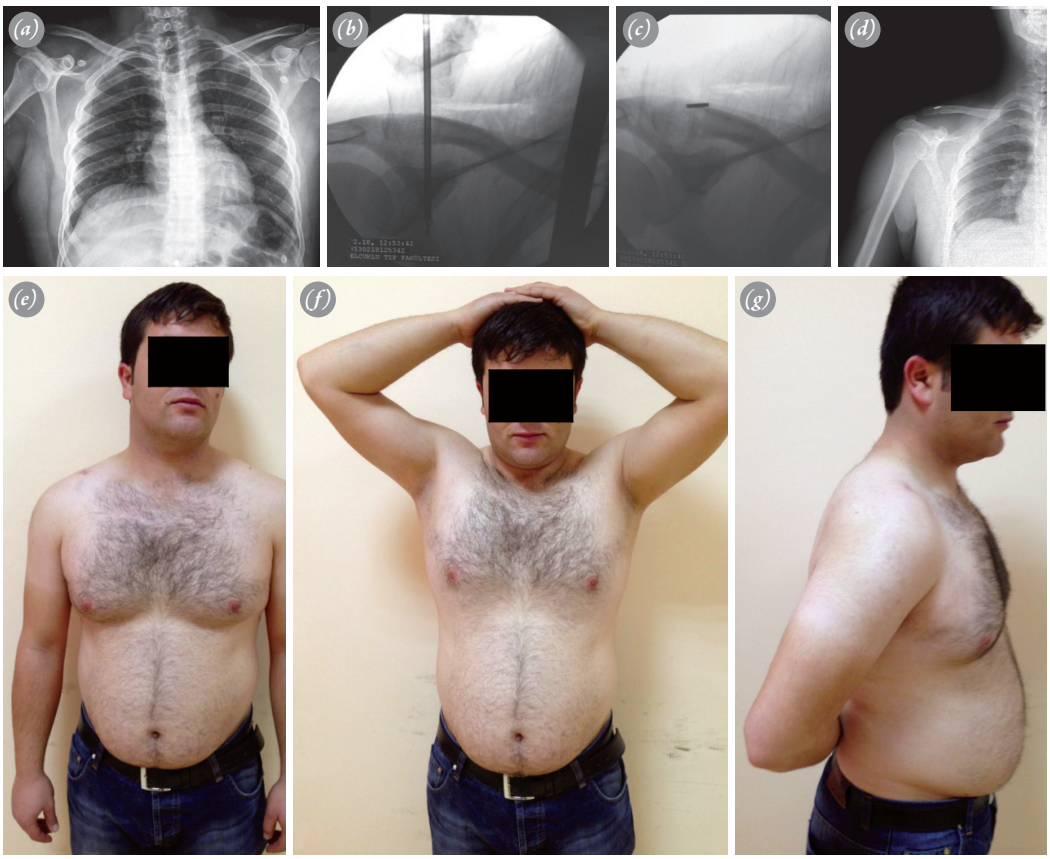

Fig. 2. Case no. 4; 24-year-old male MVA Type III AC joint dislocation preoperative, intraoperative, and postoperative X-rays **(a–d)** and final clinical results **(e–g)**. [Color figures can be viewed in the online issue, which is available at www.aott.org.tr]

Patients and methods

This study was approved by the Research Ethics Committee of Selçuk University and was conducted in accordance with the Declaration of Helsinki. An initial review of all patients with acute Type III AC joint dislocation was performed. The study was comprised of patients with acute Type III AC joint dislocations to whom percutaneous double-button fixation was applied between February 2012 and April 2013 with a minimum 6-month follow-up. Patients with Rockwood Type III AC joint dislocation diagnosed according to anterior-posterior, axillary, and Zanca radiographs and where the dislocation was acute (occurring less than 3 weeks after injury) were included. Patients with previous shoulder injury or shoulder surgery were excluded.

Age, gender, dominant hand, mechanism of injury, range of movement (ROM) of the affected shoulder, time from injury to surgery, time from surgery to return to work, and follow-up period were obtained from patient records. In addition, a functional evaluation was performed on all patients preoperatively and at all postoperative follow-up examinations by an independent researcher using Disabilities of the Arm, Shoulder and Hand (DASH), Constant, and visual analogue scale (VAS) scores. The vertical distance between the superior border of the coracoid process and the anteroinferior border of the clavicle (CC distance) was measured on the preoperative anterior-posterior radiographs and at final follow-up, and the distances of both shoulders were compared.

The operations were conducted under general anesthesia with the patient in the beach chair position. A single dose of prophylactic antibiotic was administered preoperatively. The percutaneous entrance over the clavicle was indicated by taking an intraoperative Zanca image. A 5–10 mm transverse incision was made from the entrance site of the guide wire approximately 2.5 cm medial to the AC joint over the clavicle. Under fluoroscopic guidance, a 2.4 mm guide wire was sent from the clavicle keeping the coracoid process central by feeling the 4 cortices. Drilling was performed from the clavicle towards the coracoid process with a 4.5 mm ToggleLoc™

drill (Biomet, Warsaw, IN, USA) over the guide wire. A ZipTight™ Fixation Device (Biomet, Warsaw, IN, USA) together with the ToggleLoc™ probe under fluoroscopic guidance was rolled under the coracoid by pushing towards the underside of the coracoid process, the round button was placed on the clavicular surface, and the ZipLoop™ system was tightened by applying tension to the hanging system. Anatomic reduction of the AC joint was assessed under fluoroscopy and the operation was completed (Figure 1).

Shoulders were immobilized in a shoulder sling for 3 weeks postoperatively. Exercises were then started to strengthen and increase the joint range of movement (Figures 2–4). Patients were allowed to return to daily activities after 3 months.

All statistical analyses were conducted using the SPSS ver. 16.0 (SPSS Inc., Chicago, IL, USA) statistical software. Functional scores were compared using the paired t-test. In the radiological evaluation, comparisons were performed using the independent 2-sample t-test and Mann-Whitney U test. In all evaluations, a $p<0.05$ was considered to indicate statistical significance.

Results

The study was comprised of 13 patients operated on for a Type III AC joint dislocation. The patients' characteristics are shown in Table 1. The patients were comprised of 12 males (92.3%) and 1 female (7.7%) with a mean age at time of surgery of 43.38 years (range: 22–60 years). The right shoulder was operated on in 7 patients and the left in 6. The dominant side was affected in 6 patients and the non-dominant in 7. The mechanism of injury was a traffic accident in 9 cases (69.2%) and a fall in 4 cases (30.8%). The mean time from injury to surgery was 7.92 days (range: 1–20 days), and the mean follow-up period was 13.61 months (range: 9–24 months). All patients were operated on by the same surgeon.

No restriction of movement developed in the shoulder in any patient postoperatively. The comparison of the preoperative DASH, Constant, and VAS scores with those at the final follow-up is shown in Table 2. The preoperative and final follow-up mean DASH scores were 14.15±4.5 and 0.46±1.1, respectively; the difference was significant ($p=0.001$).

The preoperative and final follow-up mean Constant

Fig. 3. Case no. 5; 53-year-old male MVA Type III AC joint dislocation preoperative, intraoperative, and postoperative X-rays **(a–d)**, and final clinical results **(e–h)**. [Color figures can be viewed in the online issue, which is available at www.aott.org.tr]

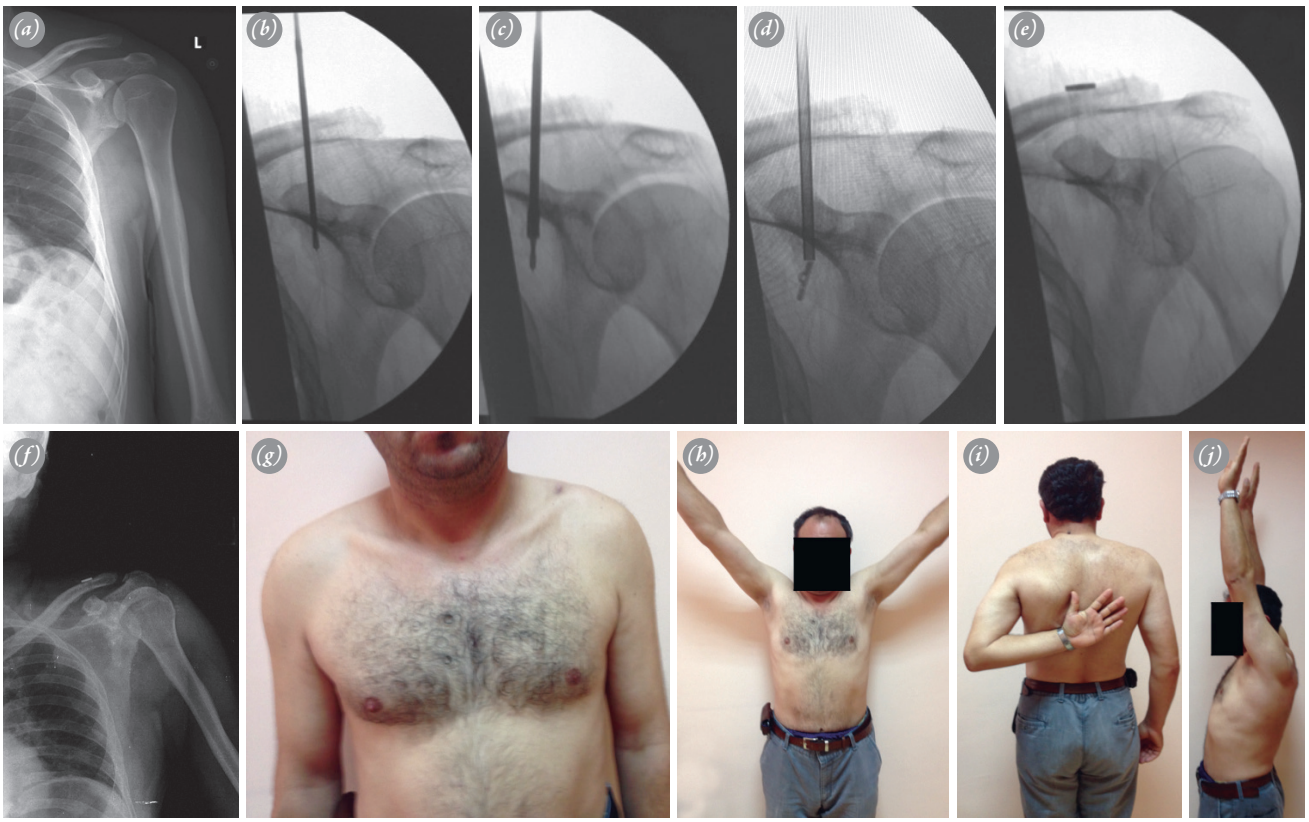

Fig. 4. Case no. 9; 42-year-old male MVA Type III AC joint dislocation preoperative, intraoperative, and postoperative X-rays **(a–f)** and final clinical results **(g–j)**. [Color figures can be viewed in the online issue, which is available at www.aott.org.tr]

scores were 30.3±5.5 and 84.46±5.5, respectively; this difference was significant (p=0.001). Similarly, the mean VAS scores significantly decreased from 6.0±0.9 preoperatively to 0.69±1.3 at the final follow-up (p=0.001). At the final follow-up, the VAS score was 3 in 3 patients and 0 in the other 10 patients.

The preoperative and final follow-up CC distances were 18.23±3.4 and 9.23±2.1, respectively. No significant difference was observed between the final follow-up CC distance and that of the contralateral shoulder (p=0.336).

While sending the button under the coracoid process during surgery in 1 patient, it became trapped in the tunnel; the patient was transferred to open surgery for fixation.

All patients returned to work after a mean of 9.1 weeks (range: 6–12 weeks). Other than 1 patient transferring to open surgery, no other complications developed, and there was no requirement for any procedure due to recurrent AC joint dislocation.

Discussion

We evaluated the clinical results of the percutaneous double-button fixation method for treatment of Type III AC joint dislocation. At the end of the mean 9.5-month follow-up period, significantly more successful functional results were recorded in all patients when compared to those of the preoperative period. No complications developed, and there was no need for a further operation due to AC joint dislocation in any patient. No restriction of movement developed postoperatively in any patient, which supports the view that this treatment method can be used safely for Type III AC joint dislocations.

AC joint dislocations are frequently detected, particularly in sportsmen and women. While Type I and II AC joint dislocations are treated conservatively, surgical treatment is preferred for Type IV–VI. In the management of AC joint injuries, Type III injuries remain controversial. No information exists in the literature indicating a clear superiority of surgical and non-surgical techniques. Press et al.[14] evaluated the results of 26 patients with Type III AC joint separation who were treated conservatively or surgically. The non-surgery group showed advantageous results in terms of return to work, return to athletics, and duration of immobilization. On the other hand, the surgery group was advantageous in terms of time to attain work completely, pain-free status,

Table 1. Patients' demographic data.

No.	Gender	Age (year)	Side	Time interval (Day)	Dominant side	Etiology
1	Male	60	R	1	Right	Fall
2	Male	36	R	5	Right	MVA
3	Male	38	L	2	Right	MVA
4	Male	24	R	2	Right	MVA
5	Male	53	L	7	Right	MVA
6	Male	60	L	20	Right	MVA
7	Female	53	R	1	Right	MVA
8	Male	57	R	18	Left	MVA
9	Male	42	L	11	Right	MVA
10	Male	29	R	3	Right	Fall
11	Male	48	R	20	Right	Fall
12	Male	42	L	10	Right	MVA
13	Male	22	L	3	Right	Fall

subjective impression of pain, ROM, functional limitations, cosmesis, and long-term reported satisfaction. Careful patient selection should remain an important aspect of treatment for this controversial injury.[14–16] In another study, Gstettner et al.[12] compared results of 41 patients with Type III AC injury in which 24 patients were treated surgically using hook plate and 17 cases were treated conservatively. According to this study, the surgery group demonstrated better results in terms of functional and clinical outcomes. According to Larsen et al.,[17] operation should be considered in Type III AC dislocations in thin patients who have a prominent lateral end of the clavicle, in those who do heavy work, and in patients whose daily work requires that the shoulder often be held in approximately 90° of abduction and flexion. In a recent study of 203 orthopedists in Germany, 73% preferred surgical treatment for Rockwood Type III injuries. The most preferred surgical method was the hook plate (44%), followed by arthroscopic TightRope® (Arthrex, Naples, FL, USA) (27%).[18] In our study, 7 patients (53.8%) from the surgically-treated 13 cases with Type III AC joint dislocation were active workers under 45 years old. Four patients underwent operation after an average of 16.2 days due to prominent lateral end of clavicula. Two patients were operated on because they elected not to receive the conservative treatment option.

Providing horizontal stability during treatment of AC joint dislocations ensures more satisfactory results. In addition, the CC ligament is the primary stabilizer of the AC joint. Therefore, methods that provide horizontal stability, such as the arthroscopic double-button method, have increased in popularity.[19] In a study by Glanzmann et al., the arthroscopic double-button fixation method was used to treat Type III and Type IV AC joint dislocations, which provided horizontal stability and full shoulder function, and was associated with high patient satisfaction.[20] Beris et al.[21] conducted a retrospective evaluation of data of 8 patients with Type III and 4 patients with Type IV AC joint dislocations who were treated with double-button fixation using the mini-open method and the TightRope® system. Defoort et al.[22] performed open surgical treatment method with double-button fixation. Conversely, Murena et al.[23] used arthroscopic CC double-button fixation for Type III and IV acute AC joint dislocations. Both authors reported excellent clinical results. In the current study, the double-button system fixation method was applied, as in the studies by Glanzmann and Beris et al., and satisfactory functional and cosmetic results were obtained.

Paul et al.[2] prospectively investigated possible accompanying intraarticular injuries in patients with high-grade AC joint separation. They found traumatic intraarticular lesion (all occurred in Type V injuries) in 15% of 40 high-graded AC separations (Rockwood Type III: n=3; IV: n=3; V: n=34). In this aforementioned study, 14 patients were managed with open AC joint repair, whereas 26 patients were treated with arthroscopic approach using a double tight-rope technique. In a similar study, Tischer et al.[4] investigated intraarticular pathologies of patients with AC dislocation graded between Type III–V. In this study, 14 of 77 patients (18.2%) had superior labral anterior posterior (SLAP) lesions. Nineteen percent of Rockwood Type V lesions were associated with SLAP lesions, whereas only 3.4% of Rockwood Type IV lesions showed SLAP lesions. In summary, acute high-grade AC joint separations may be accompanied by concomitant injuries in the shoulder girdle. These 2 studies have indicated that the

Table 2. Patients' results.

No.	Return to work (weeks)	Follow-up (month)	ROM	DASH Preop	DASH Postop	CONSTANT Preop	CONSTANT Postop	VAS Preop	VAS Postop	KKD Preop	KKD Postop	KKD (opposite side)
1	8	19	FULL	16	0	30	81	6	0	20	8	8
2	6	15	FULL	13	0	28	88	5	0	21	10	10
3	12	24	FULL	11	0	36	85	6	0	22	13	12
4	12	10	FULL	12	0	42	88	7	0	20	11	9
5	8	14	FULL	13	0	34	90	6	0	25	10	8,5
6	10	12	FULL	15	3	28	84	5	3	14	6	6
7	12	11	FULL	28	0	18	70	8	3	17	9	8
8	8	14	FULL	16	0	30	88	5	3	14	7	7
9	12	11	FULL	11	0	32	90	6	0	15	9	9
10	10	9	FULL	13	0	31	88	7	0	18	10	10
11	8	17	FULL	13	3	31	81	6	0	19	11	8
*12	6	10	FULL	11	0	26	80	5	0	18	8	7
13	7	11	FULL	12	0	28	85	6	0	14	8	8
Mean value	9.15±2.30	13.61±4.25		14.15±4.50	0.46±1.12	30.30±5.57	84.46±5.51	6.0±0.91	0.69±1.31	18.23±3.41	9.23±2.19	8.50±1.55

*Open surgery applied patient.

possibility of accompanying intraarticular injury is low in Type III injury in contrast to high-grade AC dislocations. As a result, we believe percutaneous AC stabilization may be used as an alternative option to arthroscopic method in Type III AC injury when surgery is necessary.

This is the 1st study reporting the results of percutaneous double-button technique in acute AC joint dislocations. In the acute Type III AC joint dislocations in this study, the ZipTight™ Fixation Device was applied percutaneously in a minimally invasive procedure, which was less damaging to soft tissue. This technique does not require arthroscopic experience, and anatomic fixation is achieved. Furthermore, compared to the mini-open double-button technique, the incision is of a size sufficient for the button to pass over the clavicle, and there is no requirement for a second operation to remove screws, K-wires, or hook plates implanted for fixation. The satisfactory cosmetic results are a significant advantage of this technique.[24–26] However, it has several disadvantages such as the increased need for use of a C-arm compared to open and arthroscopic methods. Additionally, when the button system is passed under the coracoid process percutaneously, it may become trapped in the tunnel; if this occurs, the operation must be changed to open method.

The limitations of this study were its retrospective design and the lack of open double-button or arthroscopic double-button fixation groups for comparison. The number of patients included in this study was low, and long-term results were not reported.

In conclusion, CC joint stabilization is 1 of the most important options in the treatment of Type III AC joint dislocations. Various methods are used to this end, but the percutaneous double-button fixation method is rapid, straightforward, and cost-effective. Moreover, strong results are obtained via this method in terms of low complication rates and high functional recovery rates. To fully define the role of percutaneous double-button fixation method in treatment, there is a need for further studies of a more extensive nature and with longer follow-up using this treatment method in cases of Type III AC joint dislocation.

Conflics of Interest: No conflicts declared.

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