碩士學位論文

急性 肩峯 鎖骨 脫臼에서 最小 侵習的 烏口 鎖骨 安定化

濟州大學校 大學院

醫 學 科

姜賢成

2014 年 8月

Minimally Invasive Coracoclavicular Stabilization with Double Augmentation for Acute Acromioclavicular Dislocation

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A thesis submitted in partial fulfillment of the requirement for the degree of Master of Medicine.(Orthopaedic Surgery)

June, 2014

This thesis has been examined and approved.

Department of Medicine

GRADUATE SCHOOL

JEJU NATIONAL UNIVERSITY

급성 견봉 쇄골 탈구에서 최소침습적 오구 쇄골 안정화

지도교수 최성욱

강현성

이 논문을 석사 학위 논문으로 제출함

2014년 6월

강현성의 의학 석사 학위 논문을 인준함

심사위원장	서규범	㊞
위 원	최성욱	㊞
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제주대학교 대학원

2014년 6월

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ABSTRACT

-국문초록-

서론

급성 견봉 쇄골 관절 탈구의 치료 목적은 통증이 없는 강하고 운동성을 갖는 손상 이전의 견관절 기능을 회복하는 것이다. 고정나사, 강선, hook plate를 이용한 치료 및 오구 쇄골 봉합 loop 보강술은 여러 합병증이 나타났고, 오구 견봉 인대나 주변 건을 이용한 치료는 원구조물의 손상을 주며, 정적 안정성의 결여로 정복유지가 어려운 결과를 보였다.

이러한 주변 건 이전술에 불안정성을 보안하기 위해 suture anchor를 이용한 오구 쇄골 인대 보강술이 발표되었고, 최근에는 동종 및 자가 인대를 이용한 오구 쇄골 인대 재건술이 소개되고 있다. 또한 suture anchor나 double flip button을 이용한 최소침습적 오구 쇄골 인대 보강술이 여러 논문에서 좋은 결과로 발표되었다. 하지만, 현재 견봉 쇄골 관절 탈구에 대한 이상적인 치료에 대해서는 논란이 많다. 따라서 이 연구는 급성 견봉 쇄골 관절 탈구의 치료로 suture anchor 및 double flip button을 이용한 오구 쇄골인대 재건술의 술기를 기술하고, 이 술기의 임상적 효용성을 평가하고자 하였다.

대상 및 방법

2002년 8월부터 2010년 12월까지 급성 견봉 쇄골 관절 탈구를 진단받고 suture anchor 및 double flip button를 이용하여 치료받은 43명의 환자를 대상으로 하였고, 평균 추시기간은 59.6개월이었고, 손상 형태는 Rockwood 분류법 4형이 8명, 5형이 35명이었고, 손상기전은 미끄러짐이 24명으로 가장 많았다.

수술 후의 임상적 평가는 Constant score 및 UCLA score와 술후 이학적 검사, 환자의 만족도로 평가하였고, 방사선학적 평가로 수술전과 추시시 쇄골 전-후방 방사선 사진에서 오구 쇄골 골간격을 측정하여 건측과 비교하였고, 액와 방사선 사진에서 견봉과 쇄골의 상대적인 위치 비교를 통해 정복 유지 여부를 비교 분석 하였다.

결과

임상적 평가 결과는 견관절 주위 통증과 기능에 대해 마지막 추시에서 Constant score는 평균 91.2점이었고, 43명 중 41명(95.3%)이 매우 만족(n = 26) 또는 만족(n = 15)한다고 하였다.

방사선학적 평가 결과는 수술 직 후 전-후방 방사선 사진에서 오구 쇄골 간격은 건측에 비해 약간 과교정(93.4%)된 소견이었으나, 마지막 추시결과

건측에 비해 오구 쇄골 간격이 113.8%로 증가된 소견을 보였다. 34명의 환자(79.1%)에서 견봉 쇄골 관절의 정확한 정복 상태를 얻었으며, 8명(18.6%)에서 경도의 정복 소실, 1명(2.3%)이 정복 소실이 확인 되었다.

결론

급성 견봉 쇄골 탈구에서 치료의 원칙은 해부학적으로 정복이 되어야 하고, 손상된 연부조직의 회복이 이루어 질 때까지 정복이 유지되어야 한다는 것이다. Suture anchor 및 double flip button을 이용한 오구 쇄골 인대 간접적 재건술은, 최소침습적이고 시술이 상대적으로 용이하고, 추후 내고정물의 제거를 위한 수술이 필요 없다. 또한 견봉 쇄골 관절의 견고한 수평 및 수직적 안정성을 제공할 수 있고, 환자의 조기 견관절 운동 및 조기 일상생활로의 복귀를 가능하게 하는 유용한 방법이라고 생각된다.

Key words

Acromioclavicular joint, dislocation, double augmentation, coracoclavicular stabilization

INTRODUCTION

The dislocation of the acromioclavicular(AC) joint is increasing due to variable reasons. The most common trauma mechanism is a direct fall on shoulder with the arm in adduction.

The treatment option is depended on dislocation severity. Dislocation of the AC joint was classified into 6 types by Rockwood and Green.[1] Surgical treatment can be considered for acute AC joint dislocations classified as Rockwood type IV to VI and in acute Rockwood type III injuries among younger, active patients, particularly high-level athletes and manual laborers.[2]

Treatment of type III is the subject of greater debate[3, 4] and varies from functional treatment to sometimes complex surgical repair.[5] Although for some there was the potential for chronic instability and pain, non-operative treatment often recovered excellent clinical results and painless shoulder functions[6, 7] Operative treatment of type III acromioclavicular joint dislocations resulted in a better cosmetic outcome, but a greater duration of sick leave compared to non-operative treatment.[8] There was no difference between the two interventions in terms of strength, pain, and throwing ability.[8] Therefore, we reasoned that

Rockwood type III should be treated non-operatively, and were excluded in this study.

The purpose of treatment of acute AC joint dislocation should be to return the patient to the level of function prior to the injury, with a pain-free, strong and mobile shoulder. But Ideal treatment for AC joint dislocation is currently controversial. Numerous techniques have been introduced for the treatment of acute AC joint dislocation,[1, 9-15] but there is still a controversy and debate surrounding the management.

The authors reported previously that minimally invasive coracoclavicular stabilization with 2 suture anchors is effective for acute AC dislocation.[13] Previous study has showed good results and patient satisfaction was also high. We compared the clinical and radiologic outcomes with operative techniques of two suture anchors and additional suture-button devices and reported midterm follow-up results of previous study for the treatment of acute AC joint dislocation.

MATERIALS AND METHODS

1. Patients selection

Fourty-three patients, who underwent surgery using a suture anchor or a double flip button for an acute AC joint dislocation, were followed up for an average 59.6 months(range, 24-97). They were enrolled from among 67 patients with a diagnosis of AC dislocation and operated by the same surgeon between August 2002 and December 2010. 24 of the 67 patients were lost during follow-up and were excluded from this study.

Excluding the 5 cases of type III among the 20 cases of former study, 5 cases were lost from follow-up and midterm follow-up were possible for 10 cases. A total of 47 cases of additional surgery from June 2005 to December 2010 was performed. By excluding 7 cases of type III and and follow-up loss 7 cases resulted in a 33 cases and with the addition of 10 cases of former study, the total number of cases of this research was 43.

All medical data were reviewed retrospectively. Follow-ups were fulfilled using questionnaires and by performing physical and radiographic shoulder examinations. To all patients, preoperative and intraoperative records were available

There were 40 males and 3 females. The average age at the time of surgery was 42.63 (range, 23-73) years; young, active patients (age 20-50, 30 cases [69.8%]) and relative older patients (age > 50, 13 cases [30.2%]. The duration between the time of injury and the date of surgery varied from 1 to 61 days, averaging at 11.2 days. Eight patients (18.6%) had Rockwood type IV injuries; and 35 (81.4%) had type V.(Table 1.)

Trauma was associated with slip down accident in 24 (55.8%), traffic accident in 10 (23.3%), and sports injury in 9 (20.9%) patients.

Based on surgical techniques, all patients were divided in to two groups : group S using 2 corkscrew suture anchors(suture anchor with #2 FiberWire and #2 Tigerwire, Arthrex, Naples, Florida); and group B using a corkscrew suture anchor and a double flip-button device(TightRope, Arthrex, Naples, Florida).

2. Clinical evaluation

Every patient was assessed clinically and radiographically after the procedure(routine clinical follow-up visit). At follow-up, all patients received a detailed physical examination for shoulder deformity, AC joint pain on palpation or AC joint pain during cross-arm adduction testing. According to the Constant scores[16], evaluation included measurements of pain, activity, range of motion, and strength. The UCLA(University of California at Los Angels) shoulder rating scale was also evaluated. It assigns a score to patients based on pain, function, active forward flexion, power, and overall satisfaction.[17]

Overall individual satisfaction was rated on a qualitative scale as “very satisfactory”, “satisfactory”, or “unsatisfactory”.

3. Radiologic evaluation

Initial preoperative radiographs included standard AP and axillary view with bilateral stress view to assess classification of the AC joint separation according to Rockwood et al.[1] AP and axillary views were taken for both sides at all follow-ups. Distance between the highest position on the upper surface of the coracoid process and opposing clavicular undersurface were measured in the AP stress view for both shoulders : coracoclavicular(CC) distance. In this study, the percentage of difference was better than the actual measurement. As a slope of radiography or the tester was not standardized, the angle of beam could be different and the actual value can differ even in the same patient. Thus, it is assumed that comparison percentage with unaffected side is more accurate comparison value. According to the Rockwood classification[1], the author defined an increase of 25-90% of CC distance compared to the unaffected shoulder as slight reduction loss and greater than 90% increase in CC distance as complete reduction loss. Less than 25% increase in CC distance compared to the unaffected shoulder was defined as complete reduction.

4. Surgical Technique

The surgical technique was descriped in the previous study.[13] In summary, the patient is placed in a semi-sitting position under general anesthesia. Make the skin incision, locate the coracoid process and then prepare the clavicle. After making a manual reduction, mark the anatomical position of conoid and trapezoid ligament with a K-wire. Make 2 holes along the marked K-wire.

Two holes are drilled through the clavicle and through the coracoid using a 3.5-mm drill bit for anatomical replacement of the conoid and trapezoid ligaments.

The patients were randomly subjected either to 2 corkscrew suture anchors or to a corkscrew suture anchor and a double flip-button device. These devices are placed into the base of the coracoid process following the previously placed guide pins.

In group S, two suture anchors were inserted to conoid and trapezoid ligaments attachment sites(Figure 1).

In group B, trapezoid ligament is replaced with one suture anchor and conoid ligament is replaced with one double flip-button device instead of medial suture anchor(Figure 2).

Maintenance of the clavicle in a slightly over reduced position is crucial. Tied sutures provide a full range of motion for shoulder ensuring success in surgical outcome. The deltotrapezius muscle fascia is repaired.

5. Rehabilitation

Postoperative rehabilitation started immediately by pendulum exercise. After 2 days of procedure, continuous passive motion(CPM) exercise was initiated to obtain all of the joints range of motion in 8 weeks. After the first postoperative week, active forward flexion exercise was permitted and encouraged in the supine position. The arm sling was removed at 8 weeks and flexion and abduction were allowed over 90°. At 8 weeks, gradual resistance exercises were begun to enhance muscle power. But heavy lifting was avoided for at least 12 weeks.

RESULTS

1. Clinical results

At last follow-up, the mean Constant score for the 43 patients was 91.2 (range, 74-100). (Table 2.)

There was a case of suture breakage three months postoperatively, leading to recurrence of the deformity in whom had suffered in a car accident. The suture breakage necessitated revision surgery with open reduction and acromioclavicular ligament transposition with Weaver & Duun technique.

One patient had died of cardiovascular disease. All patient except 2(group S) cases were very satisfactory(n = 26 [60.47%] ; S = 13, B = 13) or satisfactory(n = 15 [34.88%] ; S = 10, B = 5).

2. Radiologic Results

On AP stress views, Overall CC distance was at an average of 19.73 mm (range, 12.04-28.76) preoperatively. This measured CC distance compared to the contralateral equivalent value as a percentage was at 264.15 ± 51.46%. Therefore, overall CC distance rate significantly decreased to 93.35 ± 22.70% at immediately postoperative.($p < 0.001$)

As shown table 3, Group S postoperative CC distance rate was 98.37 ± 25.07% and group B was 86.36 ± 17.22%. There was no significant difference in postoperative radiologic findings between the two groups.

At immediate postoperation, the CC distance was slightly overcorrected. But at final follow-up, the overall CC distance measured an average of 8.81mm (range, 3.43-13.58) and CC distance rate significantly increased to 113.79 ± 23.38%($p < 0.001$)

With radiological examination (both AP and axillary view x-ray) complete reduction of the AC joint achieved on 34 patients (79.1%,S = 19, B = 15) and 8 patients (18.6%,S = 7, B = 1) showed slight loss of reduction : however the functional outcomes was good. 1 patient (2.33%, group S) had showed complete loss of reduction because of car accident.

3 patients (8.1%) were observed with posttraumatic ossification of the coracoclavicular ligaments but it did not affect the functional outcome.

3. Complications

There were no neurovascular complications or soft-tissue infections observed.

TABLES & FIGURES

Table 1. Configuration of Group S and B

		Group S(2 suture anchors)	Group B(1 suture anchor + 1 DFB)	Total
Roockwood type	V	21	14	35
	IV	4	4	8
Side	Rt	14	10	24
	Lt.	11	8	19

Table 2. Clinical results and postoperative satisfaction

	Group S	Group B	p-value	Total
Post Constant score	89.52 ± 8.25	92.89 ± 6.68	0.169	91.16 ± 7.69
Post UCLA	31.12 ± 3.43	31.83 ± 3.60	0.514	31.42 ± 3.48
Very satisfactory	13	13		26
Satisfactory	10	5		15
Unsatisfactory	2	0		2
total	25	18		43

Table 3. Radiologic results

	Overall	Group S (N=25)	Group B (N=18)	P-value
Age(yr)	42.63 ± 14.22	43.56±15.20	41.33±13.07	0.618
Preop. CC distance	19.73 ± 5.23	19.38 ± 3.61	19.93 ± 6.13	0.808
Unaffected side CC	7.31 ± 1.77	7.42 ± 1.92	7.16 ± 1.59	0.640
Preop. CC distance(%)	264.15 ± 51.46	283.75 ± 52.32	252.71 ± 49.53	0.214
Postop. CC distance	6.80 ± 2.32	7.26 ± 2.56	6.15 ± 1.82	0.123
Postop. CC distance(%)	93.35 ± 22.70	98.37 ± 25.07	86.36 ± 17.22	0.087
F/U CC distance	8.81 ± 2.39	9.36 ± 2.35	8.04 ± 2.28	0.081
F/U CC distance (%)	113.79 ± 23.38	118.19 ± 28.49	107.58 ± 13.38	0.109

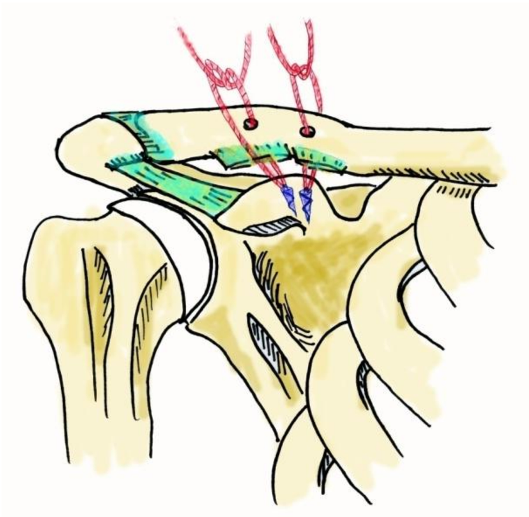

Figure 1. 2 suture anchor group(group S)

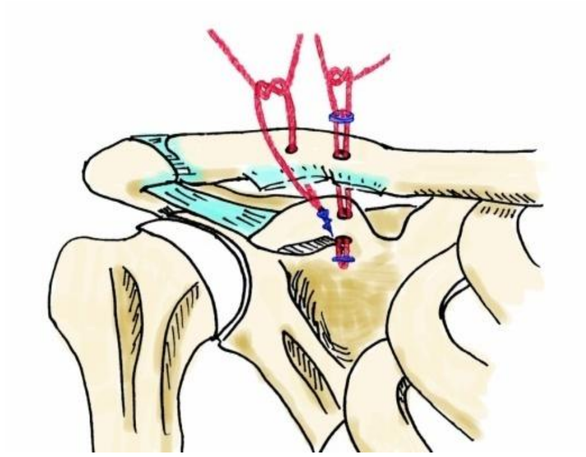

Figure 2. 1 suture anchor and 1 double flip button group(group B)

DISCUSSION

Previous paper[13] was emphasizing minimally invasive, anatomical reduction with horizontal and vertical stability is achieved by precisely placing 1 pair of suture anchors in the anatomic position of coracoclavicular ligaments, and this is also similar.

In order to pass the 2 DFB(double flip button device) through the coracoids process base, two 3.5 mm drill holes must be made. However due to the small anatomy of the coracoid, either 2 suture anchors or one suture anchor and 1 DFB was used. According to several anatomic studies of the coracoid, the mean coracoid length was 42.6 ± 0.26 mm[18], 45.2 ± 4.1 mm[19], and 45.6 ± 4.2 mm[20]. However, the insertion site for DFB or suture anchor is at the anatomic CC ligament attachment region. When the length between the tip of coracoid and CC ligament (osteotomy site for Latarget operation) is subtracted from the total length of coracoids, the attachment site would be 16.2 – 24.9 mm[18-20]. These studies were from whites or African-Americans. The mean coracoid length is reported to be 40.5 ± 4.0 mm and attachment site is reported to be 10.7 ~ 14.7 mm in Asian population.[21] Since the coracoids process is small in Asians, the holes can be overlapped or fractured if the distance of the two drill holes are too close. The authors assumed that it is not appropriate for Asians due to this anatomical difference.

Therefore, the author divided the population into two groups; two suture anchor group (group S) and one suture anchor and one DFB group (group B). In overall results, both groups showed slight over-reduction (93.35±22.70%) at immediate postoperative and statistical significance was shown at the last follow-up (113.79±23.38%, p-value <0.001). Even though there was increase in CC distance, it can be assumed successful because it was only about Rockwood grade II.

There was no statistical significance between the devices applied for reduction. However, group S tended to show higher overall CC distance rate than group B and slight loss of reduction was shown in group S mostly. This may be due to distinctive difference between the devices.

Walz et al reported a double TightRope fixation with equal or even higher maximum forces compared with native ligaments.[22] Nuchtern et al compared three common procedures (hook plate, TightRope, and Bone anchor system) in vitro biomechanical study on AC joint stability[23]. The mean load-to-failure value was 30% greater in the TightRope group (832.0±401.4 N) when compared with the Anchor System group (538.0 ± 166.1 N) and was 65% greater when compared with the Hook Plate group (248.9 ± 72.7 N)[23]. TightRope showed a superior anatomic postoperative displacement(2.04 ± 1.17 mm under the 20-N axial load and 2.83 ± 1.00 mm under the 70-N axial load), whereas the Anchor system resulted in moderate translations(5.99 ± 1.89 mm with the 20-N axial load and 6.74 ± 1.98 mm with the 70-N axial load).[23]

Since the 8 cases of slightly reduction loss patients have good clinical outcomes, this can be regarded as type III. Therefore, surgical treatment of ACJ dislocation should be for type IV and V, and non-operative treatment should be taken for type III.

Obviously, the goal of surgical treatment is to return the patient to pre-injury state of joint function. However slight reduction loss with clinically acceptable range of symptom, this can also be regarded as a successful surgical outcome.

Recently studies are trending toward anatomic reconstruction techniques for the CC ligaments. It allows the superior primary stability compared with extra-anatomic procedures [24-26]

In 3 cases, secondary ossification was seen at the CC interval and from follow ups there were no tenderness. This ossification, we believe, is from the bone marrow following the strands though the bone tunnel that was drilled to insert the anchor and DFB. These ossifications will function as the former CC ligament. Motta et al reported on possible causative factors, such as the transportation of bone fragments carried over by drilling and/or bone morphogenic protein process which results in calcium deposition in the soft tissues when the shoulder is at rest.[27]

Double augmentation is used to retain the CC interval, rather than repairing the torn ligament, scar formation will take place around the strands and ossification will take place to replace the ligament function.

The principle of stabilizing the joint in the acute phase consists of maintaining a satisfactory reduction using coracoclavicular ligament augmentation until ligament healing, particularly the conoid and trapezoid ligaments.[12, 28] Ligament reconstructions using the coracoacromial ligament (Weaver and Dunn procedure) often appear insufficient to stabilize the AC joint, which remains lax in all planes.[29, 30] Moreover, it can be criticized that the clavicle is placed in a non-anatomic position and thus, coracoacromial ligament is sacrificed.

Motamedi et al. showed that there was no significant difference in terms of rigidity and resistance between conoid, trapezoid, and braided polyethylene(Fiberwire®) ligaments.[31] The remnant AC joint subluxation does not affect the overall result.[6] These poor radiological results on reduction, however, altered the clinical results on pain and mobility only very little or not at all.

Therefore, we consider these reduction losses not as a treatment failure and a complication. Although AC joint subluxation was not associated with functional disability of the shoulder joint, precisely locating the sites of anchor insertion should produce excellent results and minimize the risk of subluxation for complete anatomical reduction and maintaining stability.

SUMMARY

Indirect reconstruction of coracoclavicular ligament using a suture anchor or double flip button is minimally invasive technique, easily performed, and does not require surgery for removal. This surgical technique is considered a useful way for early return to normal activities because it enables early joint motion.

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