Therapeutic Results of the Modified Cadenat Procedure for Acromioclavicular Joint Separations Compared with the Modified Dewar Procedure

K Takase, K Shinmura, R Kono, T Kumakura

ABSTRACT

Aim and Background: *The surgical treatment for acromioclavicular joint dislocations is recommended for Rockwood's classification types 4, 5 and 6. In this study, we evaluate the therapeutic results of the modified Cadenat procedure on type 5 acromioclavicular joint dislocation, and report on a comparative study of the modified Dewar procedure also on type 5 acromioclavicular joint dislocation.*

Subjects and Methods: *The modified Cadenat procedure was performed on 73 patients (66 males and 7 females, group C). The mean age at the time of the surgery was 35.4 years. On the other hand, the modified Dewar procedure was performed on 55 patients (51 males and 4 females, group D). The mean age at the time of the surgery was 34.5 years.*

Results: *The mean therapeutic results were 28.2 points in group C and 27.3 in group D according to the UCLA scoring system. In group C, the subluxation that represented less than 5 mm superior translation of the clavicle, occurred only in 18 of 73 patients. Meanwhile, in group D, the subluxation that represented less than 5 mm, occurred only in 14; that which represented 5 to 10 mm was in seven patients, and the complete dislocation occurred in three patients. Also, the occurrence of osteoarthritic changes in the acromioclavicular joint was nine patients in group C and 20 in group D, respectively.*

Conclusion: *The modified Cadenat procedure could provide satisfactory therapeutic results and avoid postoperative failure of reduction compared to the modified Dewar procedure. However, the modified Cadenat procedure does not aim to restore the anatomical coracoclavicular ligaments. It is believed that anatomic restoration of both coracoclavicular ligaments could best restore the function of the acromioclavicular joint.*

Keywords: Acromioclavicular joint separation, modified Cadenat procedure, modified Dewar procedure.

Resultados Terapéuticos del Procedimiento de Cadenat Modificado para las Separaciones de la Articulación Acromioclavicular en Comparación con el Procedimiento de Dewar Modificado

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RESUMEN

Objetivo y Antecedentes: *El tratamiento quirúrgico para las dislocaciones de la articulación acromioclavicular se recomienda para los tipos 4, 5, y 6 de la clasificación de Rookwood. En este estudio, se evalúan los resultados terapéuticos del procedimiento de Cadenat modificado en dislocación de la articulación acromioclavicular de tipo 5, y también se informa sobre el estudio comparativo con el procedimiento de Dewar modificado practicado sobre el tipo 5 de dislocación de la articulación acromioclavicular.*

Sujetos y Métodos: *El procedimiento de Cadenat modificado se realizó en 73 pacientes (66 varones y 7 hembras, grupo C). La edad promedio en el momento de la cirugía era 35.4 años. Por otro lado, el procedimiento de Dewar modificado se realizó en 55 pacientes (51 varones y 4 hembras, grupo D). La edad promedio en el momento de la cirugía era 34.5 años.*

Resultados: *Los resultados terapéuticos promedio fueron 28.2 puntos en el grupo C y 27.3 en el grupo D de acuerdo con el sistema de puntuación UCLA. En el grupo C, la subluxación que representó menos*

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de 5 mm de traslación superior de la clavícula, sólo ocurrió en 18 de 73 pacientes. Entretanto, en el grupo D, la subluxación que representó menos de 5 mm, sólo ocurrió en 14; la subluxación que representó de 5 a 10 mm ocurrió en siete pacientes; y la dislocación completa ocurrió en tres pacientes. También, la ocurrencia de cambios osteoartríticos en la articulación acromioclavicular fue de nueve pacientes en el grupo C y 20 en el grupo D, respectivamente.

Conclusión: *El procedimiento de Cadenat modificado podría proporcionar resultados terapéuticos satisfactorios, y podría evitar el fracaso postoperatorio de la reducción en comparación con el procedimiento de Dewar modificado. Sin embargo, el procedimiento de Cadenat modificado no esta dirigido a restaurar los ligamentos coracoclaviculares anatómicas. Se entiende que la restauración anatómica de ambos ligamentos coracoclaviculares pudiera restaurar mejor la función de la articulación acromioclavicular.*

Palabras claves: Separación de la articulación acromioclavicular, procedimiento de Cadenat modificado, procedimiento de Dewar modificado

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INTRODUCTION

There are various methods of treatment, both conservative and surgical, for traumatic acromioclavicular joint dislocations. Generally, the surgical treatment is recommended for types 4, 5 and 6, according to Rockwood's classification (1). However, there are some arguments for both surgical treatments and conservative treatments for type 3 and treatments for such have not been standardized. Even among surgical treatments, many methods have been considered and reported with no gold standard opinion at present (2−4).

Since 1980, we have been performing the modified Dewar (5) procedure for reduction of the dislocated acromioclavicular joint, using the muscle dynamic strength of the conjoined tendon. However, this procedure has various problems, including frequent damage by surgical invasion, long term immobilization, high frequency of residual subluxation or dislocation, the appearance of osteoarthritic change in the acromioclavicular joint, and postoperative restriction in the range of motion of the shoulder joint. In consideration of these problems, we performed the modified Cadenat (6) procedure which reconstructs the coracoclavicular ligaments using the coracoacromial ligaments, since 1995. In this study, we evaluated the therapeutic results of the modified Cadenat procedure for acromioclavicular joint dislocation, and report as on a comparative study that utilized the modified Dewar procedure.

SUBJECTS AND METHODS

Between 1995 and 2006, the modified Cadenat procedure was performed on 73 patients with acromioclavicular joint separations (group C). They consisted of 66 males and 7 females and the age at the time of the surgery ranged from 16 to 63 years (mean, 35.4 years). The right side was affected in 41 patients, and the left side in 32 patients. The injury was caused from road traffic accidents in about 40%, sports accident in about 25%, and accident at the workplace in about 10%. The time to the surgery from the onset of injury was less than 2 weeks (acute case) in 65 patients, 2 weeks to one month (subacute case) in five patients, and more than one month (chronic case) in 3 patients. More than 70% of these patients had participated in some sporting activity before the time of the injury, and there were 48 patients including 32 contact sport-players that engaged in high level sports activities. The duration of postoperative follow-up ranged from 1 year and 2 months to 6 years and 3 months (mean 2 years and 6 months). On the other hand, the modified Dewar procedure was performed on 55 patients with acromioclavicular joint separations (group D) between 1980 and 1994. They consisted of 51 males and 4 females, and the age at the time of the surgery ranged from 16 to 66 years (mean, 34.5 years). The right side was affected in 29 patients, and the left side in 22 patients. The duration of postoperative follow-up ranged from 2 years and 9 months to 8 years and 10 months (mean 4 years and 2 months).

In 1917, Cadenat (7) reported a technique using the coracoacromial ligaments as reconstruction ligament for acromioclavicular joint separations. We have performed the modified Cadenat procedure so that we could directly identify the coracoid process through the delto-pectoral approach. Initially, the coracoacromial ligaments at the acromial insertion site, along with a small bone tip, was detached (Figs. 1, 2, 3). The dislocated acromioclavicular joint was fixed using two Kirschner wires from 1995 to 1997 (Fig. 4) or a Wolter clavicle plate since 1998 (Fig. 5) after reduction of that joint, preserving the intra-articular disc as much as possible, and the torn capsule and acromioclavicular ligaments were sequentially repaired. Finally, the detached coracoacromial ligament with the bone tip was fixed to the anterior side of the clavicle using a screw with spike washer in a position that allowed sufficient tension to be obtained (Fig. 6). Meanwhile, we performed the modified Dewar procedure so that we could directly identify the coracoid process through the delto-pectoral approach, same as the modified Cadenat procedure. Initially, we osteomized the coracoid process at about 1.5 cm away from the tip of that process and detached that process along with the coracobrachialis muscle and the short head of biceps brachialis muscle. The dislocated acromioclavicular joint was fixed

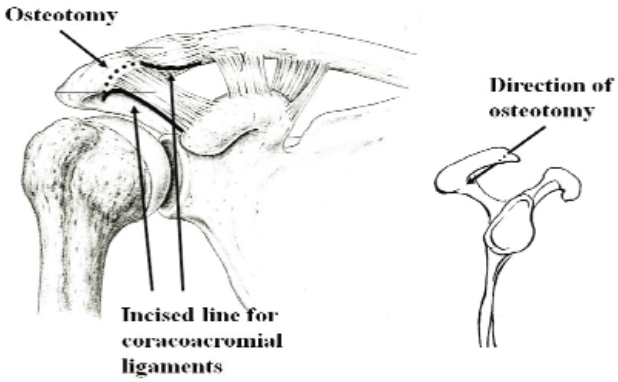

Fig. 1: Surgical approach of modified Cadenat procedure (1). The schema showed the site to incise the coracoacromial ligaments and osteomize the anterior part of the acromion, and the direction of the osteotomy for the acromion.

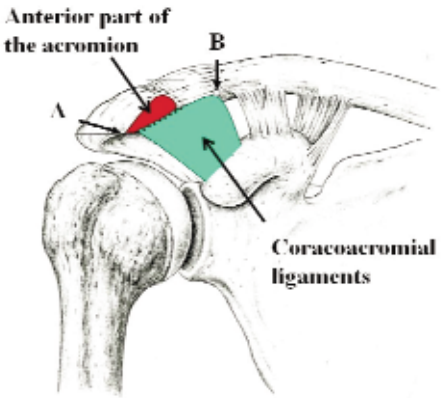

Fig. 2: Surgical approach of modified Cadenat procedure (2). This figure showed the reconstruction ligament (A point is lateral edge of the coracoacromial ligaments, and B point is medial edge of the coracoacromial ligaments).

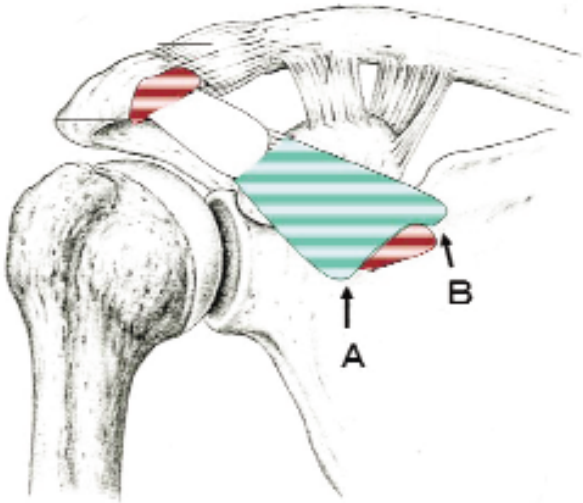

Fig. 3: Surgical approach of modified Cadenat procedure (3). The anterior part of the acromion was detached, and the coracoacromial ligaments were reversed.

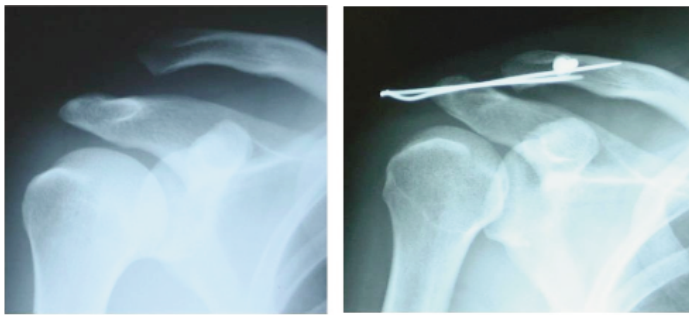

Fig. 4: Postoperative findings using Kirschner wire (modified Cadenat procedure).

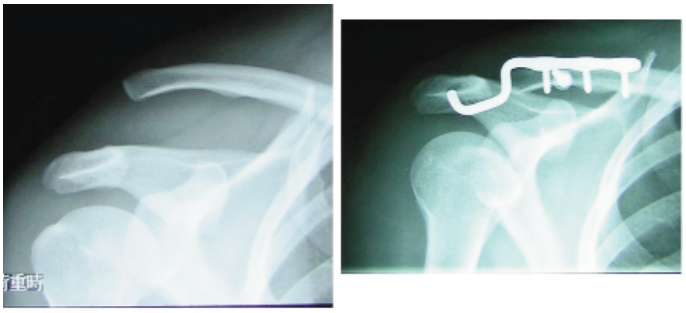

Fig. 5: Postoperative findings using Wolter clavicle plate (modified Cadenat procedure).

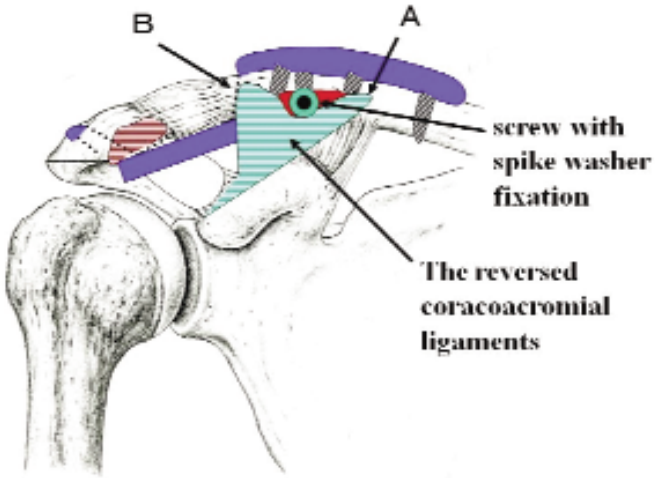

Fig. 6: Surgical approach of the modified Cadenat procedure (3). The detached coracoacromial ligament with the bone tip was reversed, and fixed to the anterior side of clavicle using a screw with spike washer in a position that allowed sufficient tension to be obtained.

using two Kirschner wires, preserving the intra-articular disc as much as possible and the torn capsule and acromioclavicular ligaments were sequentially repaired. Finally, the detached coracoid process with these muscles was fixed to the anterior side of the clavicle at about 3 cm from the distal edge of the clavicle, using a screw with spike washer (Fig. 7).

Postoperative treatments consisted of immobilization with Désault bandage for approximately two weeks. From

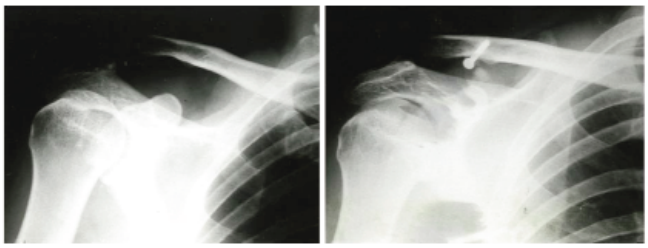

Fig. 7: Postoperative findings (modified Dewar procedure).

the third week onward, forward elevation by passive movement in the supine position and pendulum exercises were prescribed. The Kirschner wires were removed at five weeks, or the Wolter clavicle plate was removed at four months, postoperatively. Meanwhile, on the patients with modified Dewar procedure, the postoperative treatments consisted of immobilization with Velpeau bandage for approximately four weeks. From the sixth week onward, the forward elevation by passive movement in the supine position and pendulum exercises were prescribed. The Kirschner wires were removed at six weeks, postoperatively.

The therapeutic results were evaluated based on the UCLA scoring system (8) [30 points] which consisted of pain, function, range of motion and strength, excluding the patient's satisfaction. Also, we evaluated the radiographic findings including the occurrence of osteoarthritic changes and the complete reduction or not in the acromioclavicular joint. On comparison between the two groups, the static analysis was evaluated, setting the level of significance at less than 0.05, by Mann-Whitney's U test.

RESULTS

The therapeutic results were 24 to 30 (mean, 28.2) points in group C and 18 to 30 (mean, 27.3) points in group D according to the UCLA scoring system. When details of the results were examined, no significant difference between group C and D was observed in each estimated criterion. However, fatigue and decrease of endurance on the shoulder girdle during exercise was confirmed in 29 out of 55 patients in group D, as compared to 12 out of 73 patients in group C. Regarding the postoperative range of motion, 59 of 73 patients in group C recovered more than 160 degrees in forward elevation and 160 degrees in abduction at three months postoperatively, but 21 out of 55 patients in group D required approximately one year to gain that prior to injury.

The incidence of residual subluxation or dislocation in the acromioclavicular joint was evaluated with the final radiographic findings. In group C, the subluxation that represented less than 5 mm superior translation of the clavicle, occurred only in 18 (25%) of 73 patients. Meanwhile, in group D, the subluxation that represented less than 5 mm superior translation of the clavicle, occurred only in 14 (25%), that representing 5–10 mm superior translation in 7 patients (13%), and the complete dislocation occurred in three patients (5%). Also, the occurrence of osteoarthritic changes in the acromioclavicular joint was nine patients (12%) in group C and 20 patients (36%) in group D, respectively.

DISCUSSION

Acromioclavicular joint separations are frequently treated in clinical practice. The degree or direction of translation of the clavicle against the acromion depends on the type of injury of the acromioclavicular and coracoclavicular ligaments, and the detachment of deltoid or trapezius muscles from the clavicle. Rockwood *et al* (1) or Tossy *et al* (9) classified the degree or direction of displacement in the acromioclavicular joint sepa-rations into six or three types. Generally, Types 4, 5 and 6, based on Rockwood's classification, are considered to be good indication for surgical treatment. However, there are some arguments for both surgical treatments and conservative treatments for type 3, and treatments for such have not been standardized. Kurokawa *et al* (10) performed conservative treatments on 14 patients with type 3 based on Tossy's classification, and reported that they had no difficulty in activities of daily living and sports after treatments. However, they recognised weakness in muscle strength and fatigue on the shoulder girdle during exercise. On the other hand, there are many surgical treatments for acromioclavicular joint separations, including repair of the acromioclavicular ligaments [Phemister procedure (2) or Neviaser procedure (11)], fixation between the clavicle and the coracoid process [Bosworth procedure (3)], reconstruction of the coracoclavicular ligaments using the coracoacromial ligaments [Weaver-Dunn procedure (4) and Cadenat procedure], and dynamic stabilization of the coracoclavicular joint by the transferred conjoined tendon (Dewar procedure). Kanaya *et al* (12) performed the modified Neviaser procedure on 30 patients with acromioclavicular joint separations, and researched that about 50% of these patients had a residual subluxation or dislocation postoperatively. Terado (13) reconstructed the coracoclavicular ligaments using artificial ligament on six patients with type 3 based on Tossy's classification. In relation to the postoperative radiographic findings, only one patient could achieve the reduced position of acromioclavicular joint and three patients were confirmed to have erosions on the clavicle caused from the irritation of the artificial ligament. For the reconstructive procedure of the coracoclavicular ligaments which are composed of the conoid and trapezoid ligaments, Morrison *et al* (14) and Hessmann *et al* (15) used the artificial ligaments, Jones *et al* (16) and Sloan *et al* (17) used the autogenous tendons, and Dimakopoulos *et al* (18) used some braided sutures as substitute ligaments. However, their procedures were not anatomical reconstruction of the coracoclavicular ligaments (19).

In this study, we performed two different surgical procedures, which were not anatomical reconstruction of the coracoclavicular ligaments, on the patients with acromioclavicular joint separations. The modified Dewar procedure

has some disadvantages including a long period required for recovery of range of motion, and high frequency of residual subluxation or dislocation and postoperative osteoarthritic changes on the acromioclavicular joint. In particular, the high frequency of residual subluxation or dislocation and postoperative osteoarthritic changes on the acromioclavicular joint were considered to result from the dynamic stabilization of acromioclavicular joint by the conjoined tendons. Considering these disadvantages, we have performed modified Cadenat procedure on the patients with acromioclavicular joint separations since 1995. The patients with the modified Cadenat procedure needed 3.4 months to return to their own occupations such as construction work, and 3.1 months to return to sports activities. However, the modified Cadenat procedure also has some disadvantages. The mechanism of stabilization of the acromioclavicular joint was established by the coracoacromial ligaments transferred from the acromion to the clavicle. The transferred coracoacromial ligament does not anatomically reconstruct either the conoid or trapezoid ligament which composes the coracoclavicular ligaments. The conoid ligaments are anatomically attached to the conoid tubercle which is located at the posterior edge of the clavicle, and the clavicle can make an axial rotation during forward elevation of the shoulder joint. However, in the modified Cadenat procedure, it is possible that this axial rotation of the clavicle is restricted, because the transferred coracoacromial ligament is fixed to the anterior edge of the clavicle. For this reason, even if the separated acromioclavicular joint is reduced in normal position, it is still possible that the osteoarthritic changes on the acromioclavicular joint will occur. The Weaver-Dunn procedure, where the transferred coracoacromial ligaments are inserted into the distal edge of the resected clavicle, is close to the anatomical reconstruction of the trapezoid ligament. But, this procedure does not aim to reconstruct the anatomical acromioclavicular joint due to the distal clavicle resection.

CONCLUSIONS

The modified Cadenat procedure could provide satisfactory therapeutic results and avoid postoperative failure or loss of reduction of the acromioclavicular joint separations compared to the modified Dewar procedure. However, the modified Cadenat procedure does not aim to restore the anatomical coracoclavicular ligaments. We believe that the anatomical restoration of both the coracoclavicular ligaments could best restore the function of the acromioclavicular joint.

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