Clinical Outcomes of the Cadenat Procedure in the Treatment of Acromioclavicular Joint Dislocations

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Summary: We report our clinical experience using the modified Cadenat method to treat acromioclavicular joint dislocation, and discuss the usefulness of this method. This study examined 6 shoulders in 6 patients (5 males, 1 female) who were diagnosed with acromioclavicular joint dislocation and treated with the modified Cadenat method at our hospital. Average age at onset was 49.3 years (26-78 years), average time interval from injury until surgery was 263.8 days (10 to 1100 days), and the average follow-up period was 21.7 months (12 to 42 months). Post-operative assessment was performed using plain radiographs to determine shoulder joint dislocation rate and Japanese Orthopaedic Association (JOA) score. The average post-operative JOA score was 94.1 points (91 to 100 points). The acromioclavicular joint dislocation rate improved from 148.7% (72 to 236%) before surgery to 28.6% (0 to 60%) after surgery. Conservative treatment has been reported to achieve good outcomes in acromioclavicular joint dislocations. However, many patients also experience chronic pain or a sensation of fatigue upon putting the extremity in an elevated posture, and therefore ensuring the stability of the acromioclavicular joint is crucial for highly active patients. In this study, we treated acromioclavicular joint dislocations by the modified Cadenat method, and were able to achieve favorable outcomes.

Key words The modified Cadenat procedure, acromioclavicular dislocation, coracoacromial ligament

INTRODUCTION

Currently, the treatment of acromioclavicular joint dislocation consists of conservative treatment and surgical treatment. Generally, according to the Rockwood classification, conservative treatment is recommended for types I and II, and surgical treatment for types IV, V, and VI; but no consensus has been reached regarding type III [1]. Thus far, we have performed the modified Phemister method, the Neviser method, and the Weaver method, and have experienced cases in which the patients complained postoperatively of subluxation or fatigability. The Cadenat method, which consists of transferring the coracoacromial ligament with bone fragment from the acromion to the distal clavicle, was originally reported in 1917 [2]. Although modified methods using transarticular fixation with Kirshner wire (K-wire) were reported thereafter, subsequent arthritic changes of the acromioclavicular joint occurred. Therefore, since 2008 we have used a clavicular hook plate so as not to damage the joint. The purpose of this study was to examine clinical
SUBJECTS AND METHODS

The study was conducted on 6 shoulders in 6 patients (5 males and 1 female) treated in our hospital between August 2008 and October 2013 using the modified Cadenat method after having been diagnosed with acromioclavicular joint dislocation. The patients’ mean age was 49.3 years (26–78 years). According to the Rockwood classification 5 cases were type III and 1 case was type V. The average waiting period until surgery was 263.8 days (10 to 1100 days), and the average duration of follow-up was 21.7 months (12 to 42 months).

The JOA score was used for the postoperative evaluations [3]. Plain radiographs taken before surgery, before the removal of the intramedullary nails, and after surgery were used to evaluate the acromioclavicular joint dislocation rate, the presence or absence of arthropathy, and the presence or absence of ligament ossification.

Surgery was performed in the supine position under general anesthesia. Access was through a transverse skin incision measuring approximately 120 mm, centered on the acromioclavicular joint. The coracoacromial ligament was detached with a bone fragment from the anterior edge of the acromion (Fig. 1). The acromioclavicular joint was fixed with a hook plate; the anterior surface of the clavicle was refreshed; the coracoacromial ligament with attached bone fragment was fixed using a 3.5 mm cannulated cancellous screw (CCS); and finally, the anterior fibers of the deltoid muscle, which had been detached, were reattached by suture (Fig. 2). Post-operative regimen consisted of immobilization to the trunk using a sling and a band until the patient’s subjective pain level subsided. One week after surgery, passive range of motion (ROM) training was started (up to a 90° elevation). At 2 weeks after surgery, active ROM training was started (up to a 90° elevation). Fixation with a sling was maintained up to week 4 after surgery; and from week 4 onward, passive and active ROM training were conducted without restriction.

Fig. 1. The coracoacromial ligament was detached with a bone fragment from the anterior edge of the acromion.

Fig. 2. The acromioclavicular joint was fixated with a hook plate; the anterosuperior part of the clavicle was refreshed; the coracoacromial ligament with an attached bone fragment was fixated with a CCS; and the anterior fibers of the detached deltoid muscle were reattached by suture.

TABLE 1.

Variations in the rate of acromioclavicular joint dislocations

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>250</td>
<td>200</td>
<td>150</td>
</tr>
<tr>
<td>A = Before surgery</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>B = Before the removal of the intramedullary nail</td>
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<tr>
<td>C = Final follow-up</td>
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TH MODIFIED CADENAT IN ACROMIOCLAVICULAR DISLOCATION

RESULTS

Changes in the acromioclavicular joint dislocation rate were assessed by comparing values before surgery, before the removal of the intramedullary nail, and at the time of the final follow-up. The findings improved from a preoperative average of 148.7% (72-236%) to 28.6% (0-60%) at the time of the final follow-up (Table 1). The average post-operative JOA score was 94.1 points (91-100 points). One case of arthropathy was found. No ligament ossification was observed in this series (Table 2).

CASE PRESENTATION

The patient was a 41-year-old male who had worked as a construction assistant. The dislocation was determined as type III according to the Rockwood classification. The chief complaint was pain in the right shoulder. He sustained an injury to his right shoulder when he hit a car while riding a 50 cc motorbike. Conservative treatment was conducted and the patient was followed up. Since his work involved hard physical labor, however, he expressed a strong desire to undergo surgery, and therefore, one month after sustaining the

### Table 2.

<table>
<thead>
<tr>
<th>Case</th>
<th>Gender</th>
<th>Age</th>
<th>Period from injury until surgery (days)</th>
<th>Follow-up period (months)</th>
<th>JOA score</th>
<th>Arthropathy</th>
<th>Ligament ossification</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pain</td>
<td>Functions</td>
<td>ROM</td>
</tr>
<tr>
<td>1</td>
<td>M</td>
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<td>171</td>
<td>36</td>
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<tr>
<td>2</td>
<td>M</td>
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<tr>
<td>3</td>
<td>M</td>
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<tr>
<td>4</td>
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<tr>
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<td>6</td>
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<td>183</td>
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<tr>
<td>Mean</td>
<td></td>
<td></td>
<td>263.8</td>
<td>21.7</td>
<td>27.5</td>
<td>19.5</td>
<td>27.2</td>
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Fig. 3. Before surgery.

Fig. 4. Before removal of the metal.

Fig. 5. After removal of the metal.
The physical findings consisted of an active 140° elevation of the extremity, tenderness in the acromioclavicular joint, and fatigability during work. The X-ray radiographs taken at the time of the initial visit showed an acromioclavicular joint dislocation rate of 149% (Fig. 3). During the surgical procedure, the acromioclavicular joint was fixed with a clavicle hook plate (Synthes™, Bettlach, Switzerland), and the coracoclavicular ligament with a bone fragment which had been detached from the anterior edge of the acromion was fixed anteriorly to the clavicle using a 3.5 mm CCS (Fig. 4). Radiographs taken at 1 year after the removal of the intramedullary nail showed improvement, with the dislocation rate decreasing to 51% (Fig. 5).

**DISCUSSION**

The surgical treatment of acromioclavicular joint dislocations combined with a repair of the coracoclavicular ligament provides better outcomes than fixation with a K-wire or a hook plate alone, in which the procedure does not include a repair of the coracoclavicular ligaments [4,5]. In mechanical experiments using cadaver shoulders by Fukuda et al. [6] the conoid ligament had the strongest limiting effect on anterior and upward movements of the acromioclavicular joint. Although a primary repair of the coracoclavicular ligaments is the ideal treatment, ligament reconstruction is indicated in most cases because of its cicatrization. Furthermore, in such cases the shoulder joint needs to be temporarily immobilized until completion of the union of the bone with the reconstructed ligament, and to be supported in order to avoid placing excessive load on it. In the past, such a reconstruction was performed using K-wires or screws, but recently, adding the use of a plate has been found to provide the best outcome [7]. Therefore, in this study, we made sure that the coracoclavicular ligament was moved as far as possible toward the anatomical position of the conoid ligament, one of the most important coracoclavicular ligaments. In addition, until the engraftment of the reconstructed ligament was achieved, reinforcement was added by performing a plate fixation [8,9].

Using the modified Cadenat method in 25 cases, Izaki et al. reported favorable outcomes with an average postoperative JOA score of 94.9 points and a dislocation rate of 34.4% [10]. Surgical outcomes in the 6 cases that we treated using the modified Cadenat method showed similar improvements with an average postoperative JOA score of 94.1 points and a dislocation rate of 28.6%. The present findings in conjunction with such previous reports indicate that the modified Cadenat method can be considered a useful surgical procedure in the treatment of acromioclavicular joint dislocation.

As mentioned earlier, repairing the coracoclavicular ligaments is generally considered the best option, if possible [4,5]; and a previous report showed that when patients in the acute phase of acromioclavicular joint dislocation were treated by hook plate fixation alone, the postoperative MRI assessment of the coracoclavicular ligaments after the removal of the intramedullary nail showed an 88% recovery (N=42 cases) [11]. Our study did not include patients in the acute phase, namely within 1 week after injury; however, in the future, we plan to perform the modified Cadenat method on such patients for the purpose of achieving a more reliable stabilization of the acromioclavicular joint.

While conservative treatment has been reported to be good for acromioclavicular joint dislocations, some patients experience residual pain or fatigability even after treatment [12]. Gstettner et al. reported that compared with conservative treatment, surgical treatment provided better outcomes in terms of pain, fatigability, and muscle strength [1]. In addition, surgical treatment for sumo wrestlers has been reported to provide favorable outcomes in terms of muscle strength, and conservative treatment has been reported to result in a decrease in muscle strength in judo athletes [13]. In other words, these reports suggest that some cases of acromioclavicular joint dislocation require surgical interventions.

In the present study, postoperative arthritic changes occurred in one patient who had had a long waiting period until the surgery (1100 days); thus, prolonged preoperative time may affect the development of such changes. Ossification of the transferred ligament was not observed after surgery in this series. Although the reasons for this are unclear, it is conceivable that the surgery performed in our cases was less invasive than in other reports.

The number of cases treated with the modified Cadenat method in our hospital is small; however, the average two-year follow up revealed that the patients treated with the method had good JOA scores at the time of the final checkup, and their assessment using plain radiographs also showed that a good reduction had been achieved. Therefore, the modified Cadenat method can be considered a useful surgical procedure for the treatment of acromioclavicular joint dislocation in patients wishing to receive surgical treatment because of pain, fatigability, or cosmetic reasons.
REFERENCES


