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 coracoclavicularis. 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 (X ± s)/[n (%)]

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Gender</th>
<th>Diseased extremity</th>
<th>Cause of disease</th>
<th>Average age (y)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>F</td>
<td>Left</td>
<td>Right</td>
</tr>
<tr>
<td>EG</td>
<td>41</td>
<td>23</td>
<td>18</td>
<td>22</td>
<td>19</td>
</tr>
<tr>
<td>CHPG</td>
<td>37</td>
<td>20</td>
<td>17</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td>(t/\chi^2)</td>
<td>-</td>
<td>0.033</td>
<td>0.042</td>
<td>0.051</td>
<td>0.136</td>
</tr>
<tr>
<td>(P)</td>
<td>-</td>
<td>0.856</td>
<td>0.839</td>
<td>0.821</td>
<td>0.892</td>
</tr>
</tbody>
</table>

Table 2. Comparison between the 2 groups for general surgical indexes (X ± s)

<table>
<thead>
<tr>
<th>n</th>
<th>N</th>
<th>Surgery time (min)</th>
<th>Intraoperative bleeding amount (ml)</th>
<th>Incision length (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EG</td>
<td>41</td>
<td>40.26±4.11</td>
<td>51.36±4.36</td>
<td>5.23±0.62</td>
</tr>
<tr>
<td>CHPG</td>
<td>37</td>
<td>46.59±3.98</td>
<td>83.51±3.65</td>
<td>7.51±0.51</td>
</tr>
<tr>
<td>(t)</td>
<td>-</td>
<td>6.895</td>
<td>35.101</td>
<td>17.623</td>
</tr>
<tr>
<td>(P)</td>
<td>-</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

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.

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 claviculae at the diseased side with organ point signs when pressed; (4) Severe AC joint dislocations diagnosed by imaging; (5) Clear enough in con-
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 anodesma to expose the AC joint. Damaged cartilaginous operculum 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

Table 3. Comparison between the 2 groups for preoperative and postoperative pain intensity and self scores (X ± s)

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>VAS Before treatment</th>
<th>VAS After treatment</th>
<th>SSV Before treatment</th>
<th>SSV After treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>EG</td>
<td>41</td>
<td>7.81±1.15</td>
<td>4.03±0.26</td>
<td>56.39±6.32</td>
<td>86.95±6.32</td>
</tr>
<tr>
<td>CHPG</td>
<td>37</td>
<td>7.68±1.26</td>
<td>5.36±0.37</td>
<td>57.04±5.14</td>
<td>72.16±5.22</td>
</tr>
<tr>
<td>T</td>
<td>-</td>
<td>0.476</td>
<td>18.509</td>
<td>0.495</td>
<td>11.198</td>
</tr>
<tr>
<td>P</td>
<td>-</td>
<td>0.635</td>
<td>&lt;0.001</td>
<td>0.622</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Figure 2. Comparison between the 2 Groups for Postoperative 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.
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 diaplasis 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 diaplasis 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 ± 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 X² test for intergroup comparison. Intrigroup comparison at multiple points was carried out through ANVOA. 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).

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Before surgery</th>
<th>3 months after surgery</th>
<th>6 months after surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>EG</td>
<td>41</td>
<td>37.59±3.65</td>
<td>76.36±3.66</td>
<td>90.65±3.22</td>
</tr>
<tr>
<td>CHPG</td>
<td>37</td>
<td>38.19±3.06</td>
<td>65.26±4.05</td>
<td>81.56±2.69</td>
</tr>
<tr>
<td>t</td>
<td></td>
<td>0.782</td>
<td>12.716</td>
<td>13.449</td>
</tr>
<tr>
<td>P</td>
<td></td>
<td>0.437</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Effects of endobutton and clavicle hook plate

**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 diaplasis loss**

Through evaluation and comparison, no statistical difference was demonstrated between the 2 groups at 3 d after the surgery in terms of diaplasis 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 diap-
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Table 6. Comparison between the 2 groups for the incidences of postoperative adverse reactions [n (%)]

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Shoulder pain</th>
<th>Second dislocation</th>
<th>Foreign body sensation</th>
<th>Total incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>EG</td>
<td>41</td>
<td>1 (2.44)</td>
<td>0 (0.00)</td>
<td>1 (2.44)</td>
<td>2 (4.88)</td>
</tr>
<tr>
<td>CHPG</td>
<td>37</td>
<td>5 (13.51)</td>
<td>2 (5.41)</td>
<td>2 (5.41)</td>
<td>9 (10.81)</td>
</tr>
<tr>
<td>$\chi^2$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.077</td>
</tr>
<tr>
<td>$p$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.043</td>
</tr>
</tbody>
</table>

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-
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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