Coracoclavicular ligament reconstruction using a gracilis tendon graft for acute type-III acromioclavicular dislocation

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ABSTRACT

Purpose. To review the functional and radiological results of patients after coracoclavicular ligament reconstruction.

Methods. Five patients aged 21 to 50 (mean, 37) years with acute Rockwood type-III acromioclavicular dislocation underwent coracoclavicular ligament reconstruction with autogenous gracilis tendon grafts. Patients were either active in sports or heavy manual workers. Assessments on shoulder function (using the Constant score), wound size, pain (using a visual analogue scale), and reduction (using radiographs of both acromioclavicular joints) were made.

Results. The mean follow-up period was 26 (range, 15–43) months; the mean time to return to work or sports was 14 (range, 12–20) weeks. The mean Constant score was 94 (range, 90–98). The mean donor-site scar size was 3 cm and the mean pain score was 0. No major complication or donor-site morbidity was noted. There was one subluxation.

Conclusion. Coracoclavicular ligament reconstruction using an autogenous gracilis tendon graft was safe in physically active patients having acute type-III acromioclavicular dislocation.

Key words: acromioclavicular joint; ligaments; reconstructive surgical procedures; shoulder dislocation

INTRODUCTION

For younger, more active patients with type-III acromioclavicular dislocation, surgical treatment is recommended.1–3 Commonly used methods include the Weaver Dunn procedure4 and the modified Bosworth technique5 using devices such as pins,6 screws,7,8 or plates.9,10 These interventions achieve satisfactory Constant scores of 91 to 98,4,8,11 and redislocation rates of 9 to 50%.4,8,12 However, such methods have several disadvantages, namely graft infection, foreign body reactions, and the need for

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Coracoclavicular ligament reconstruction with an autogenous gracilis tendon entails no implant removal and no foreign body reaction; donor-site morbidity is the only risk.

MATERIALS AND METHODS

Records of 5 patients aged 21 to 50 (mean, 37) years who presented with acute Rockwood type-III acromioclavicular injury between June 2003 and March 2005 were retrospectively reviewed. This injury involves acromioclavicular joint dislocation with disruption of both the acromioclavicular and coracoclavicular ligaments, with the distal clavicle superior to the medial border of the acromion. The diagnosis was made on a standardised Zanca view in which the X-ray beam was aimed at the acromioclavicular joint with a 10º cephalic tilt.

All patients were either active in sports or heavy manual workers; 4 were injured during sporting activities and one in a traffic accident; all were operated on within 5 days of injury. Surgery was performed by or under the supervision of a single surgeon. Patients were placed in a beach-chair position under general anaesthesia. One dose of a first-generation cephalosporin was given before skin incision. The gracilis graft was harvested from the ipsilateral knee using a stripper.

The acromioclavicular joint was exposed by the deltid-pectoral approach. A strap incision was started from the acromioclavicular joint and extended distally towards the tip of coracoid process. The plane was developed between deltoid and pectoralis major. In patient 3, the cartilage of the acromioclavicular joint was severely damaged and therefore the distal 10 mm of the clavicle was excised. The distal clavicle was not routinely excised. To mimic the anatomy of the trapezoid and conoid ligaments on the undersurface of the clavicle, 2 drill holes were prepared on the superior cortex of the clavicle at the footprint of the original 2 ligaments, using a 4.5-mm drill bit. The 2 holes were around 1 cm apart and the lateral hole was around 2 to 2.5 cm proximal to the distal end of the clavicle. The graft was passed through the 2 drill holes and slung under the coracoid process. With the acromioclavicular joint over-reduced by 2 mm, the graft was sutured to itself with Ethibon No.2 sutures (Ethicon, Johnson & Johnson, Somerville [NJ], US). The wound was closed in layers.

After the operation, a temporary arm sling was used for one to 2 weeks until pain subsided. Under the supervision of a physiotherapist and the operating surgeon, early active and passive full-range shoulder mobilisation as tolerated was started after one week. Strengthening exercises were started 8 weeks later. Shoulder function was assessed by the Constant score; hindrance in daily activities, range of movement, and strength were scored (1–100, with 100 being highest). Assessments on the donor-site wound size, pain (using visual analogue scale), and reduction (using radiographs of both acromioclavicular joints) were made.

RESULTS

The mean follow-up period was 26 (range, 15–43) months. The mean time to return to work/sports activity was 14 (range, 12–20) weeks. The mean Constant score was 94 (range, 90–98). Radiographs showed reduction in 4 patients and subluxation in one. The mean donor-site scar size was 3-cm long and the mean pain score was 0. No major complication or donor-site morbidity was noted (Table).

DISCUSSION

The indication for surgery and choice of technique remain controversial for type-III acromioclavicular

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Age (years)</th>
<th>Injury mechanism</th>
<th>Time from injury to operation (days)</th>
<th>Constant score</th>
<th>Time to return to work/sports (weeks)</th>
<th>Follow-up (months)</th>
<th>Redislocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>21</td>
<td>Football</td>
<td>5</td>
<td>95</td>
<td>12</td>
<td>32</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>28</td>
<td>Fall from horse</td>
<td>4</td>
<td>93</td>
<td>12</td>
<td>20</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>43</td>
<td>Traffic accident</td>
<td>3</td>
<td>95</td>
<td>12</td>
<td>15</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>50</td>
<td>Tennis</td>
<td>4</td>
<td>90</td>
<td>20</td>
<td>19</td>
<td>Subluxation</td>
</tr>
<tr>
<td>5</td>
<td>45</td>
<td>Football</td>
<td>4</td>
<td>98</td>
<td>16</td>
<td>43</td>
<td>No</td>
</tr>
<tr>
<td>Mean</td>
<td>37</td>
<td></td>
<td>4</td>
<td>94</td>
<td>14</td>
<td>26</td>
<td>20%</td>
</tr>
</tbody>
</table>

Table: Patient demography and outcomes
dislocation. Early surgical repair is recommended for patients with a prominent distal clavicle or persons frequently performing heavy lifting or overhead work.\textsuperscript{1,3}

Commonly used surgical techniques include the Weaver Dunn procedure\textsuperscript{4} and the modified Bosworth technique,\textsuperscript{5} which entail various fixation devices. These techniques are reported to produce good functional Constant scores, but entail complications, including: foreign body reactions from absorbable polydioxanone suture augmentation,\textsuperscript{16} and Dacron grafts,\textsuperscript{17} as well as screw loosening.\textsuperscript{4}

Screw fixation requires a second operation for screw removal before full shoulder mobilisation. Coracoclavicular ligament reconstruction using an autogenous gracilis tendon requires no implant removal and entails no foreign body reaction. The only risk is donor-site morbidity. Both semitendinosus and gracilis tendon grafts confer superior initial biomechanical properties compared to coracoacromial ligament transfer.\textsuperscript{18} The good initial strength enables early active and passive shoulder mobilisation exercises.

A similar technique was first reported in 2001 in a 34-year-old woman. It entailed salvaging a failed acromioclavicular reconstruction with coracoclavicular ligament reconstruction using a loop of autogenous semitendinosus tendon from the ipsilateral knee.\textsuperscript{12} The failed reconstruction was complicated with anterolateral shoulder pain interfering with daily activities. Magnetic resonance imaging showed hypertrophic scar around the Gore-Tex graft and osteolysis in the clavicular region of the synthetic device. The Gore-Tex graft and associated fibrous tissue were removed and augmentation was performed with an autogenous semitendinosus graft. Pain-free, full range of movement was reported 24 months later.

In one patient with severe cartilage injury, the lateral end of the clavicle was excised (Mumford operation) to prevent future pain. We do not advocate routine excision of the distal clavicle. A study comparing acromioclavicular fixation and coracoclavicular ligament repair with or without distal clavicle excision found no difference in symptomatology, range of movement or strength, but a higher incidence of degenerative changes in patients without distal clavicle excision (4.5\% vs 24.3\%).\textsuperscript{19} Excision of the distal clavicle may cause the posterior distal clavicle to impinge onto the acromion as it arcs medially. To prevent this, the posterior and superior acromioclavicular capsular ligaments should be preserved after excision, because both ligaments contribute greatly to clavicular stability.\textsuperscript{20} Acromioclavicular capsular ligament repair plus coracoclavicular ligament augmentation were recommended to counteract the destabilising effect of clavicle resection.\textsuperscript{21}

Anatomical reconstruction of the conoid and trapezoid ligament has been attempted. The mean length from the clavicular end to the most medial insertion of the coracoclavicular ligament was 46 mm; the distance between the trapezoid ligament laterally and the conoid ligament medially was 21 mm.\textsuperscript{22} The anatomical centre of the attachment sites on the undersurface of the clavicle of the trapezoid and conoid ligaments can be delineated during surgery. The 2 drills holes were prepared with a 4.5-mm drill bit on the superior cortex of the clavicle at the foot print of the original 2 ligaments, around 1 cm apart and 2 to 2.5 cm proximal to the distal end.

The free tendon graft risks rupture, loosening, or wear over time. One patient did not comply with the rehabilitation protocol and started to play tennis 4 weeks postoperatively. He complained of mild shoulder pain and radiography revealed subluxation of the acromioclavicular joint (slight elevation of the distal clavicle end over the medial border of the acromion) due to a partial graft rupture. He was managed conservatively with a temporary arm sling followed by mobilisation after the pain subsided. Follow-up radiographs at 12 weeks did not show progression of subluxation and strengthening exercises were started. The patient only had mild pain and his strength and range of shoulder movement was comparable to that on the opposite side.

Concerning donor-site morbidity, the hamstring strength might be weaker at the deep flexion angle. Hamstring tendon grafting is not recommended for sportsmen who require to flex their knees deeply or powerfully, e.g. Judo, wrestling, or gymnastics.\textsuperscript{23}

Type-III acromioclavicular joint dislocation can be treated conservatively in sedentary workers. Further studies with a larger sample size and comparison with conservative treatment or other operative techniques should provide more information on the feasibility of such techniques.

**CONCLUSION**

Coracoclavicular ligament reconstruction with an autogenous gracilis tendon graft was feasible and safe in physically active patients with acute type-III acromioclavicular joint dislocation.
REFERENCES