



Open anatomical coracoclavicular ligament reconstruction using a tendon graft with an Endobutton loop

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We describe a technique of open anatomical coracoclavicular ligament reconstruction restoring both parts of the native ligament, aiming at achieving maximum stability of the acromioclavicular joint without disturbing the normal anatomy. Using the same anatomical principle of ligament reconstruction as in other joints, transosseous tunnels are created at the native footprints of the conoid and trapezoid ligaments. An autologous graft is fixed using an Endobutton continuous loop and a PEEK screw ; adequate healing of the ligament is ensured with an appropriate working length. Although an open procedure, this technique offers several advantages. It can be easily reproduced using basic anatomical principles and simple cost-effective instrumentation. The implant does not have to be removed, important anatomical structures are respected, normal acromioclavicular joint kinematics are restored, the scar is cosmetically acceptable and post-operative morbidity is very low.

Keywords : coracoclavicular ; conoid ; trapezoid ; acromioclavicular joint ; open reconstruction.

uration of each ligament. The functional differences of the acromioclavicular and coracoclavicular ligaments has been well documented (2,3). Those authors that have tried to perform an anatomical reconstruction by focusing on drilling the tunnel within the natural footprint of the CC ligament on the inferior surface of the clavicle and a bone tunnel socket on the coracoid (7,11). have not considered placing independent transosseous tunnels within the natural footprint on the coracoid base. This report describes a new double-bundle, 3-tunnel open anatomical reconstruction of the CC ligaments using the semitendinosus tendon combined with a long Endobutton loop. This technique is intended to be used in acute cases (within 2 weeks of injury) for Rockwood Type V AC separations and for Type III separations in high-demand patients. The technique is designed to stabilize the AC joint by recreating the exact anatomy of the coracoclavicular ligaments via a limited deltopectoral approach.

INTRODUCTION

Although more than 100 surgical techniques have been reported, there is no gold standard for the treatment of acromioclavicular (AC) joint dislocations. Recent reports have documented the use of tendon grafts (3,5,6). Many techniques reconstruct only one of the two structures (conoid or trapezoid) of the native coracoclavicular (CC) ligament, therefore not taking into account the anatomical config-

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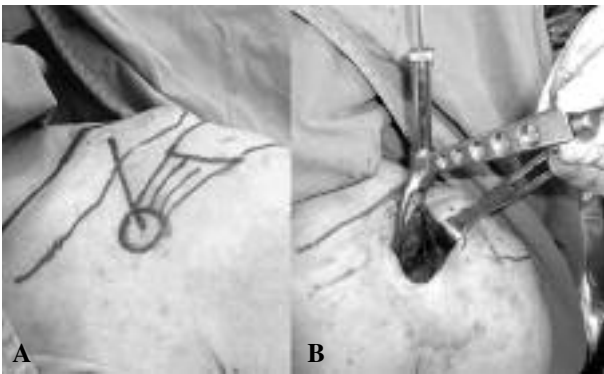


Fig. 1. — Skin Incision and technique of drilling coracoid tunnel. (A) Skin incision ; (B) drilling of coracoid tunnel using the ACL guide.

SURGICAL TECHNIQUE

The patient is placed in the beach chair position. The incision starts approximately 3 cm medial to the AC joint at the posterior aspect of the distal clavicle and extends anteriorly and distally over the coracoid process (fig 1A) to allow access to the entire coracoid process and conoid tubercle of the clavicle. The deltopectoral plane is then carefully opened to reach the base of the coracoid process and the undersurface of the clavicle and particularly the conoid tubercle which is believed to be the footprint of the native CC ligament. The optimal location for the coracoid tunnel placement is considered to be at the posterior aspect of the coracoid near its base (10,11). Therefore after exposing the entire coracoid process, an ACL guide (Smith & Nephew) (fig 1B) is hooked under the base of the coracoid arch, the clavicle is pushed posteriorly and the other end of the guide (the drill sleeve) is then placed on the posterosuperior surface of the coracoid process near the footprint of the conoid ligament. With the drill guide held in this position, a 2.4 mm guide pin is drilled through the posterosuperior surface of the coracoid to its base and this guide pin is overdrilled with a 5.5 mm cannulated reamer to create a coracoid tunnel. After this, the deltotrapezial fascia overlying the superior surface of the clavicle is incised and the soft tissues are freed with a small periosteal elevator in a horizon-

tal direction. A similar technique as for the coracoid tunnel is used for creating the clavicular tunnels. The tunnel for the conoid ligament is drilled in the posterior half of the clavicle at the point of maximal convexity about 7 mm anterior to the posterior cortex and 45 mm medial to its distal end. The 5.5 mm reamer is placed over the guide pin taking care not to encroach upon the posterior clavicular cortex. The same procedure is then repeated for drilling of the trapezoid ligament hole. This is a more anterior and lateral structure than the conoid ligament and is usually placed in the centre point of the clavicle, approximately 20 mm lateral and 5 mm anterior to the centre of the previous tunnel. Once the three tunnels are made, the semitendinosus tendon is harvested from the ipsilateral leg. All muscle fibers are removed and both ends of the tendon are tagged with baseball stitches using Fibre-wire No. 2 (Arthrex, Naples, FL, USA). The diameter of the tendon is measured to 4.5 mm using the Bio-Tenodesis Screw System (Arthrex, Naples, FL, USA) in order to accommodate an Endobutton loop. The Endobutton continuous loop (Smith & Nephew Inc.) is then introduced through the centre of the doubled graft (fig 2A), which provides a distinct advantage of giving initial mechanical strength thereby preventing early elongation of graft material. The order of graft passage is as follows : first, one limb of the graft is threaded through the conoid tunnel in the clavicle, then in the tunnel in the coracoid. The free end of the graft from the hole on the undersurface of the coracoid is then pulled through the hole of the trapezoid tunnel in the clavicle. The endobutton is then flipped, confirming its firm sitting at the orifice of the trapezoid tunnel. Following this the clavicle is reduced to its anatomical position, placing tension on the graft and pushing down on the clavicle using a punch device. While maintaining tension on the graft and Endobutton loop, a 5.5 mm PEEK screw (Arthrex, Naples, FL, USA) is used to fix the graft end in the conoid tunnel on the clavicle (fig 2B). The remainder of the Endobutton loop is terminated by cutting the top of the loop and tying each of the threads on the PEEK screw. The arm is placed in a Kenny Howard sling for 6 weeks. At the end of 2 weeks waist level pendulum exercises and after 6 weeks gradual passive and active



Fig. 2. — Graft and fixation modalities. (A) Semitendinosus graft and Endobutton continuous loop ; (B) PEEK Screw.

range of motion exercises are begun. Return to contact sports activities is allowed 6 months after the procedure.

DISCUSSION

The different orientation of the two components of the CC ligament has been thought to account for different functions (2,3). Debski reported about the conoid to be the major restraint against superior and the trapezoid against posterior loading (2).

Therefore the authors suggested that reconstruction procedures should treat these ligaments as separate structures. However the majority of the accepted techniques do not reconstruct the coracoclavicular ligament in an anatomical manner and thus do not address the functional differences of the two parts (4). Procedures that reconstruct the coracoclavicular ligament as a single structure using either a suture or synthetic graft material have been widely used to reduce the superiorly displaced distal part of the clavicle (4,6). The Weaver-Dunn and the Bosworth technique with its various modifications are currently the most popular procedures being used with various fixation methods. These procedures are reported to produce good results, but also have complications such as malpositioning of the distal clavicle, foreign body reaction to the absorbable polydioxanone suture augmentation and fixation loss from screw loosening (1,8). The coracoacromial ligament has been transferred to replace the CC ligament, but is biomechanically inferior in comparison to tendon graft reconstructions, which provide significantly increased initial strength and stiffness (6). The well known conoid sling technique consisting of a single hole drilled through coracoid and clavicle using a free allograft or autograft has been reported to cause a significant anterior displacement of the clavicle in relation to the scapula (8). Also a graft looped under the coracoid base is expected to be stretched soon because of its

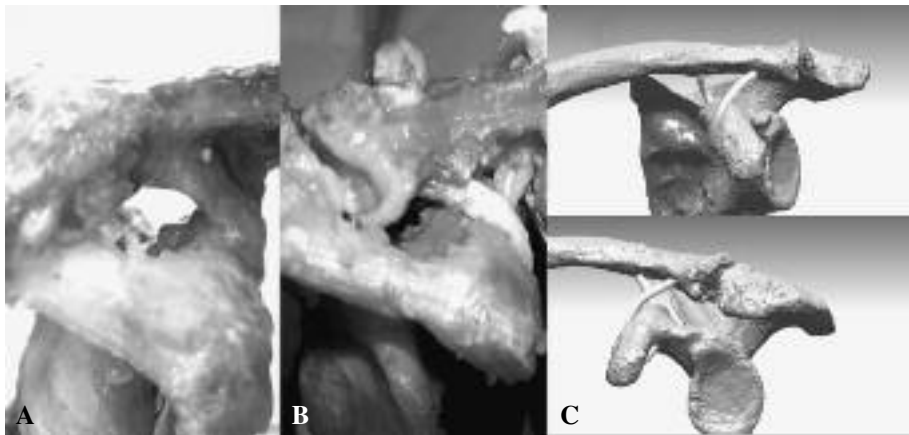


Fig. 3. — (A) Cadaveric specimen with normal C-C ligaments ; (B) After anatomical reconstruction ; (C) Graphic representation of construct.

too long working length, resulting in healing difficulty and malfunction.

Mazzocca *et al* (7) have shown that a free tendon graft placed in a more anatomic position in the clavicle to recreate the trapezoid and conoid ligament performs biomechanically similar to the native coracoclavicular ligament complex. These issues have led us to consider a new method of CC ligament reconstruction that can not only provide normal biomechanical function of the AC joint but also reduce complications after reconstructive surgery. The proposed procedure consists of restoring both the conoid and trapezoid ligaments by creating a transosseous tunnel in the posterior part of the coracoid base in a unique direction.

In conclusion our technique represents an anatomical CC ligament reconstruction of both the conoid and trapezoid ligaments with a double-bundle 3-tunnel technique. It better restores the normal distal clavicle motion by exact graft positioning and adequate working lengths. Also the unique direction of the coracoid tunnel permits easy and accurate AC reduction simply by pulling on the graft ends. The technique preserves the deltoid muscle origin and all other important structures around the AC joint. The encouraging clinical and functional results of our initial patients have prompted us to offer this technique as a valuable alternative to other existing techniques.

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