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Sternoclavicular joint reconstruction technique

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ABSTRACT

While most sternoclavicular joint (SCJ) dislocations can be managed non-operatively with closed reduction, persistent or recurrent instability associated with pain or inability to work necessitates operative management. Here, we present our preferred technique as well as a review of previously described methods for SCJ reconstruction.

KEY WORDS: Dislocation, figure of eight reconstruction, sternoclavicular joint

INTRODUCTION

While most sternoclavicular joint (SCJ) dislocations can be managed non-operatively with closed reduction, persistent or recurrent instability associated with pain or inability to work necessitates operative management [1]. Non-operative management has further been shown to result in symptomatic degenerative changes in the SCJ [2]. Reconstruction is generally indicated in the setting of symptomatic chronic anterior instability as well as recurrent posterior instability.

A multitude of options exist for SCJ reconstruction. More recently, figure-of-eight graft reconstruction has emerged as the preeminent technique. First describe by Spencer and Kuhn [3], this method is the preferred technique at our military institution with its homogenously young, highly-active male patient population. The support for this technique is based on a limited body of existing literature, consisting of case reports [4-6], small series [7-9], biomechanical studies [3,10], and expert opinion [11-13]. In this historical review, we will discuss the various methods in which the SCJ have been reconstructed in the literature.

STERNOCLAVICULAR (SC) RECONSTRUCTION

Various techniques have been proposed for the treatment of unstable SCJ dislocation. These include Kirschner wire fixation [14,15], screws [16,17], plating [18], tunneled sutures [10], tunneled sutures with suture anchors [19,20], tunneled sutures without suture anchors, and graft reconstruction [4-9,13,21,22], which have only more recently gained momentum.

Rockwood *et al.* demonstrated an alternative technique in seven cases of chronic SCJ dislocations in which the authors resected the medial head of the clavicle and secured the intra-articular ligament and disc to the superomedial portion of the remaining clavicle in an intramedullary fashion [23]. They noted inferior results compared to acute repair, but recommended this technique when the coracoclavicular ligament was not intact, as is common in chronic cases.

Application of Kirschner wires to the SCJ is described, but not generally supported due to the propensity for lethal complications [14,15]. Both Clark and Smolle-Juettner *et al.* described cases of fatal intracardiac migration of the respective hardware [14,15].

Brinker *et al.* suggested large bore screws as an alternative to Kirschner wires, given the advantage of foreseeably less hardware migration [16]. However, there are only four reported cases utilizing this technique with generally good outcomes, two of which necessitated screw removal [16,17]. Similarly, there is only one report of plating, where the authors noted adequate results after acute fixation of 10 SC dislocations [18]. The main disadvantages were the bulkiness of the hardware and

need for hardware removal in all cases within 3 months. The ideal technique would avoid the need for reoperation in such a delicate anatomic region.

Most early methods of graft reconstruction involved securing the medial clavicle to the first rib [21,24-26]. Burrows first described autograft reconstruction of the SCJ in 1951, performing a subclavius tenodesis coupled with a capsulorrhaphy [21]. The author suggested this would be the simplest and safest method of securing the SCJ, noting a lack of recurrence and a return to full function in both patients at 3 years. The sternocleidomastoid has been used in a similar manner with moderate success [8,22,27]. Booth and Roper reported a similar technique involving elevation of the sternal head of the sternocleidomastoid with manubrial periosteum, passing the graft around the first rib and securing it to itself [27]. Armstrong and Dias later described a technique also involving the sternocleidomastoid in which the tendon is freed proximally, but left attached to the sternal insertion. The slip is then woven through the clavicle and tenodesed to itself to recreate the anterior capsule [22]. At just over 3 years post-operatively, the authors found four patients that experienced transient subluxation and one that had recurrent subluxations that prohibited return to their previous activity level.

Suture fixation of the joint has also been well studied. In a cadaveric study and limited case series by Thomas *et al*., the authors found that #5 ethibond and PDS suture fixation of the first rib to the sternum demonstrated moderate success. All three patients returned to manual labor with a stable SCJ at 15 months post-operatively. However, in the cadaveric analysis, 50% of specimens experienced recurrent subluxation when 50 kg was applied to the repair [10]. This would foreseeably impose impractical restrictions in young and physically active individuals as well as manual laborers. Later, Abiddin *et al*. reviewed eight cases utilizing the same technique but with manubrial suture anchors and found no perioperative complications or recurrent instability at a mean of 4.5 years post-operatively [19]. One of the eight (12.5%) patients however had a poor outcome and was unable to return to work. Lehmann *et al*. similarly supported suture anchor fixation, due to the safety and reliability of the technique [20]. This may be sufficient in the acute situation, but unpublished data from our institution has demonstrated that these injuries are often initially missed and treated conservatively to the point of becoming chronically unstable. Further, concerns surrounding suture fixation involve erosion through the clavicle, and inferior biomechanical characteristics when compared other more robust fixation methods [3,10,28].

Figure-of-eight soft tissue graft reconstruction recently gained increasing support and acceptance following a study by Spencer and Kuhn in 2004 demonstrating its clear superiority over two other methods in an *in-vitro* biomechanical study [3]. The authors compared the techniques described by Burrows [21], and Rockwood *et al*. [23] to figure-of-eight reconstruction utilizing free semitendinosus graft and found that, while all techniques were inferior to the native SC ligaments in regard to both anterior and posterior stability, the figure-of-eight technique demonstrated the least reduction in stiffness in both the anterior and posterior directions (36.9% and 3.8% respectively), while exhibiting a peak load to failure approximately 3-times greater than the other two technique in the both the anterior and posterior directions. The most common mode of failure was clavicle or sternal fracture.

Bae *et al*. treated 15 chronic anterior SCJ dislocations, 11 of which he reconstructed with a figure-of-eight technique. Of these, nine used tendon auto graft. At a mean of 55 months follow-up, 60% were stable with a pain-free joint, 87% were without work or recreation limitation, and 13% had some degree of instability [8]. Sabatini *et al*. treated nine anterior dislocations, and one posterior dislocation with a figure-of-eight technique using tendon allograft augmented with tenodesis screws. In this high functioning cohort, 67% had some degree of activity restriction at 38 months follow-up [29]. Guan and Wolf treated six anterior dislocations with a figure-of-eight technique using hamstring auto graft. All six returned to sports or physical activity with five of the six patients scoring zero on the visual analog scale at a 40 months follow-up [7]. Singer *et al*. treated six traumatic dislocations with a figure-of-eight technique using hamstring autograft. All patients returned to full activity and had excellent DASH improvements [9].

The authors prefer the figure-of-eight reconstruction technique preferably utilizing hamstring autograft. The semitendinosus is a stouter graft choice, though a clinical advantage over gracilis autograft remains to be seen. The authors begin with an 8-10 cm curvilinear incision overlying the SCJ. Once through the skin and subcutaneous tissue, a confluent fascial layer is encountered, and the origin of the pectoralis major and insertion of the sternocleidomastoid are incised and elevated sharply. A T-shaped capsulotomy is made into the SCJ, and the capsule is elevated subperiosteally roughly 1 cm to either side of the joint line. A 4.5 mm drill is used to create two anteroposterior tunnels, one in the clavicle, and one in the sternum, roughly 1 cm from the joint line and from each other. Much care is taken to protect the great vessels posteriorly by direct palpation of the drill tip. The graft is prepared in typical fashion and then passed in figure-of-eight fashion through the tunnels. The SCJ is held reduced, and the graft is tensioned as the tails are approximated and secured to one another with non-absorbable suture. A tight layered closure is preferred. The patient is immobilized for 7-10 days in a sling, at which point the patient is seen for a wound check and initiation of a gentle range of motion exercises.

Prevailing expert opinion in support of the figure-of-eight technique is based on the few existing bio mechanical studies [3,10], case reports [4,5,6], and small non-comparative series [7-9,13], demonstrating favorable preliminary clinical outcomes. The author's institutional chart review demonstrated that with the figure-of-eight technique, three quarters of patients are able to return to military duty, while one quarter required medical discharge. Based on these reasonable results, the authors recommend soft tissue graft fixation in a figure-of-eight technique. We believe this offers the best mode of fixation, especially in the young, and active patient.

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