

Repair of sternoclavicular joint dislocations with FiberWire®

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Abstract

Purpose Up to 50% of traumatic sternoclavicular joint (SCJ) dislocations need open reduction and fixation to prevent long-term complications and complaints. We present our preferred surgical approach for acute as well as chronic SCJ dislocations, including their outcome.

Methods Five consecutive male patients with a median age of 27 (range 20–49) were treated for traumatic anterior ($n=2$) or posterior ($n=3$) SCJ dislocation. Open reduction and surgical fixation were achieved by a modified figure-of-eight sutures using Fiberwire®. In anterior dislocations, an additional reconstruction of the costoclavicular ligament was performed. Median follow-up was 11 months (range 9–48) and included clinical evaluation and the use of the DASH questionnaire.

Results Open surgical reduction and SCJ repair were successfully achieved in all patients without complications. Repair resulted in very good functional outcomes in all five patients with DASH scores of 0, 8 ($n=3$) and 5, 8 ($n=2$), respectively.

Conclusions The presented technique allowed simple, effective, and durable repair of the SCJ joint in patients with SCJ dislocations with excellent functional outcomes.

Keywords Reconstruction approach, sternoclavicular injury · Trauma · Open reduction · Sternoclavicular reconstruction · Costoclavicular reconstruction

Introduction

The sternoclavicular joint (SCJ) is the only true joint joining the upper limbs to the axial skeleton [1]. It is also the least constricted joint in the human body, and its stability depends mainly on ligament structures [2–4]. Given this fact, injuries of the SCJ are often the result of high-energy trauma and are thus rather uncommon, representing only around 3% of traumatic joint dislocations [5]. While anterior SCJ dislocation often results in painful instability, 30% of posterior dislocations are associated with tracheal, esophageal, or neurovascular compression, with a 3–4% mortality rate [6, 7].

Operative treatment is indicated in dislocations that cannot be managed by closed reduction techniques or in cases in which non-operative measures cannot release or relieve symptoms which otherwise may result in restricted shoulder and arm movement [5, 7].

This generally applies to complete anterior dislocations with complete disruption of all supporting ligaments, defined by Allman as Type 3 [5].

In case of posterior dislocations, open reduction and surgical fixation are only indicated if closed reduction fails.

Multiple different reconstruction approaches for the SCJ have been described so far [5, 8–11], but no gold standard has been established. While open reduction and internal fixation (ORIF) by means of plates and/or screws have the disadvantage of a rigid fixation with the risk of implant failure, implant migration, and the need for implant removal, reconstruction techniques using tendon grafts have the disadvantage of the need for grafting with the additional risk of atrophy and elongation of the graft which may result in recurrent joint instability [11].

Herein, we describe our preferred surgical approach for the repair of both, anterior and posterior SCJ

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dislocations with the use of Fiberwire®. Furthermore patient outcome and mid-term follow-up results are reported.

Materials and methods

From October 2011 to April 2015, five patients were treated at our department for General Thoracic Surgery for traumatic SCJ dislocation. We analyzed the course and outcome of three patients with posterior and two patients with anterior dislocations who underwent open reduction and fixation of the SCJ. Informed consent was obtained from all participants before study inclusion. Information was acquired from the patients' medical charts and clinical follow-up examinations. End-point of the study was a routine follow-up examination 9–12 months after surgery, including the completion of a DASH (disability of the arm, shoulder, and hand) score questionnaire [12]. The patient suffering from recurrent dislocations was further evaluated during another late follow-up examination 4 years after surgery. No patient was excluded.

All patients underwent the standard preoperative assessment, including preoperative history (including trauma mechanism), physical examination, chest X-ray, and computed tomography (CT) scan.

Surgical technique

All patients underwent general anesthesia, and patients were positioned supine on the operating table. For posterior dislocations, a pillow was put under the patients' back between both scapulae to facilitate SCJ reduction. An arcuate incision of approximately 5 cm length was made from the medial clavicle to the superior part of the manubrium. Open reduction of the clavicle was achieved with pointed reduction clamps. For posterior dislocations, fixation was then performed using a modified figure-of-eight suture with a doubled Fiberwire® sling (five metric, Arthrex, Naples, Florida) through a 2.5 mm drill hole in the medial end of the clavicle and the sternum, respectively. For anterior repair, an additional suture was placed around the medial end of the clavicle and the first rib, restoring the costoclavicular ligament (Fig. 1).

Outcome measures

The primary outcome measure was functional status at least 6 months after the surgical procedure, including completion of the DASH questionnaire (Fig. 2).

Postoperative care

In the postoperative course, the shoulder was immobilized in a Gilchrist bandage for 3 weeks. During that time easy

Fig. 1 Right SCJ fixation in a patient with acute traumatic anterior dislocation. **a** Demonstration of the technique using drill holes in the medial end of the clavicle and the sternum for sternoclavicular and costoclavicular ligamentous reconstruction with Fiberwire®. **b** Intraoperative view and **c** postoperative result 9 months after surgery

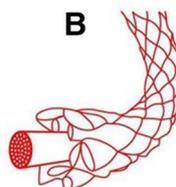
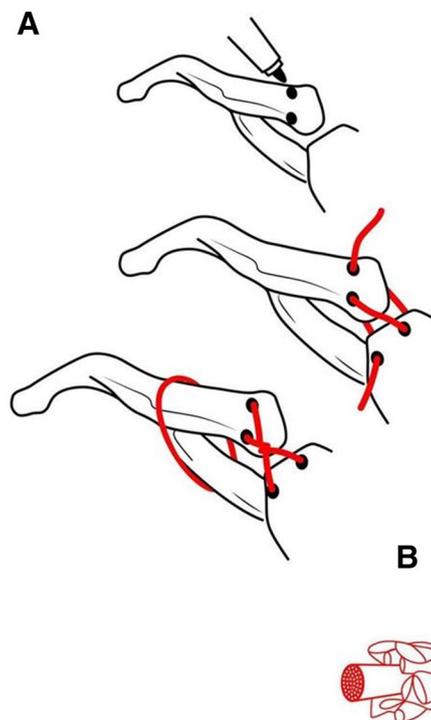
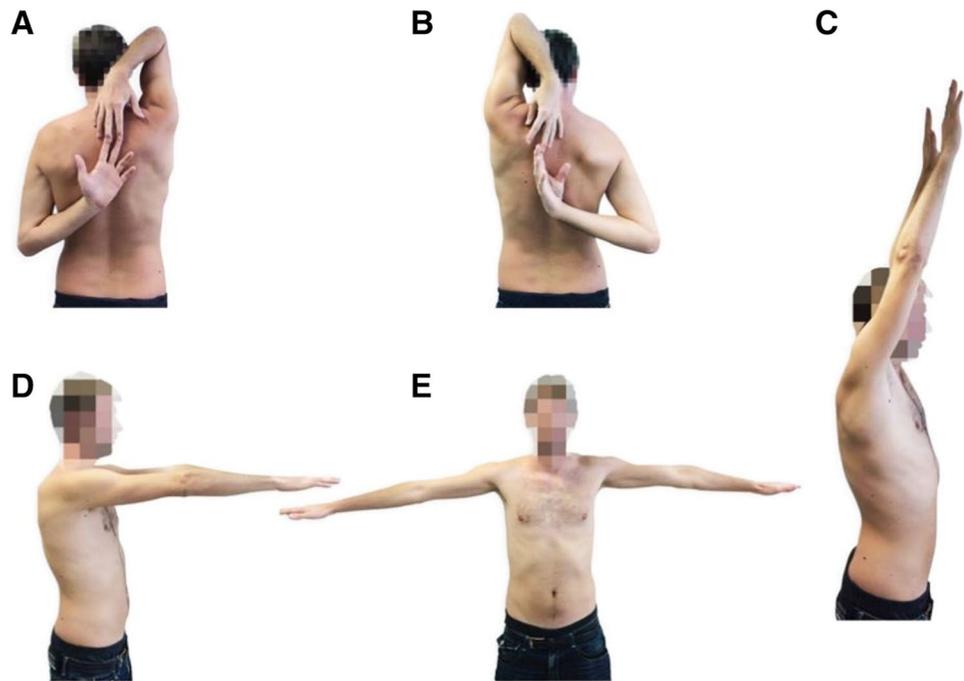


Fig. 2 Functional outcome 9 months after reconstruction of anterior sternoclavicular joint dislocation



exercises as pendulum exercises in the glenohumeral joint were permitted, progressing to active-assisted exercises with a maximal abduction up to 90°. After 3 weeks, the range of motion and weight bearing was increased according to the clinical course. Patients were encouraged to avoid sporting activities for the first 12 weeks after surgery.

Follow-up

Patients were routinely followed at 2 weeks and 9–12 months postoperatively. No significant complications occurred during follow-up.

Results

The study cohort describes five male patients, whose main characteristics and results are summarized in Table 1.

While four patients presented with acute traumatic SCJ injury, patient number five suffered from recurrent painful anterior SCJ dislocations following a minor trauma (fall on the left arm) more than 3 years ago. Three dislocations were posterior and two anterior, both with disruption of the sternocostal and costoclavicular ligaments (Allman Type 3). All acute trauma patients presented to our emergency department with strong pain in the region of the SCJ radiating into the corresponding shoulder. Patient number 4 also had several associated injuries, including serial rib fractures with concomitant right hemothorax and a burst fracture of Th1. No patient presented with signs of hemodynamic instability or neurovascular compromise.

Indication for surgery was failed attempt of closed reduction (under sedation) in all patients with posterior SCJ dislocation. Patient 4 presented with intractable, shoulder immobilizing pain, and deformation in the region of the right SCJ joint with CT scan showing complete anterior joint dislocation with intra-articular fracture of the clavicle.

Table 1 Main Patient characteristics and results

Patient	Sex/age	Direction of instability	Side	Trauma mechanism	Follow-up (months)	DASH score	Time elapsed after injury (days)	Shoulder forward flexion (°)
1	m/20	Posterior	Right	Sports accident	10	0.8	9	180
2	m/27	Posterior	Right	Skiing accident	11	0.8	2	185
3	m/23	Posterior	Right	Bobsled accident	14	5.8	1	180
4	m/49	Anterior	Right	Bike accident	9	0.8	6	180
5	m/27	Anterior	Left	Recurrent dislocation	48	5.8	Recurrent	180

Median duration of surgery was 45 min (range 37–83 min), whereas it has to be noted that in patient 4 (duration 83 min), concomitant thoracoscopic evacuation of a right-sided hemothorax was performed. Patients were discharged after a median time of 3 days after surgery (range 3–13 days); again, the patient with hemothorax was hospitalized for a period of 13 days due to the necessity for an additional vertebroplasty of TH1, while the remaining patients left the hospital 2–4 days after surgery.

All patients could reach pre-injury levels of physical activity, including sports. Functional outcomes were very good in all five cases. Patients 3 and 4 declared minimal pain during movement. Forward flexion at the end of follow-up was above 180° in all five cases.

Discussion

Almost 50% of posterior SCJ dislocations are misdiagnosed during the initial clinical examination and X-ray scan [5–7, 13, 14], as seen in one of our patients (#1). A reliable clinical diagnosis depends on a good clinical examination in combination with a CT scan [5, 6, 13, 14], which confirmed dorsal SCJ dislocation in all three patients in our cohort. Anterior dislocations are less likely missed due to obvious deformity in case of complete dislocation (Allman type 3) as seen in both our patients.

While in posterior dislocations, simple joint fixation after reduction is often sufficient [5], complete anterior dislocations require significantly better fixation techniques due to the much higher tendency for re-dislocation.

The sternoclavicular joint contributes stability to the chest wall on one hand; on the other hand, it contributes to the shoulder girdles range of motion by clavicle rotation about its longitudinal axis and elevation at the sternoclavicular joint of up to 40°. Given these characteristics, plating does not provide a good solution neither for anterior nor posterior dislocation of the SCJ due to its rigid behavior. Furthermore, an increased chance of metal fatigue and failure has to be considered as well as the soft-tissue disruption during implantation and removal of plates [5, 10, 11].

In comparison, tendon grafts provide an alternative and more physiologic option. Therefore, figure-of-eight reconstruction with a tendon graft (i.e., sternocleidomastoid, palmaris longus, gracilis, fascia lata, or semitendinosus tendon) is the preferred technique for most surgeons [11]. The main drawbacks are comorbidity known by tendon-grafting as well as the fact that tendon grafts are prone to early failure by degeneration, rupture, and elongation resulting in recurrent SCJ instability [15].

In our experience, Fiberwire® offers excellent characteristics in terms of strength and flexibility which provides an optimal replacement for damaged ligaments. With the use

of Fiberwire®, the need for tendon grafting is eliminated by at the same time avoiding the effects of tendon atrophy and elongation.

The main limitation of our study is the small sample size and its retrospective nature without the use of a control group. However, surgical reconstruction of SCJ dislocation is not a common procedure because of the rarity of injuries and the fact that open reduction and surgical fixation are not necessary in all cases.

In conclusion, figure-of-eight SCJ reconstruction using Fiberwire® proved to be safe, effective, and durable in our whole mixed cohort of patients with anterior and posterior as well as acute and chronic SDJ dislocations, respectively. Our technique allowed simple and successful repair of the SCJ joint with very good functional mid-term outcomes. Even recurrent anterior dislocation was successfully repaired using the same technique. Further controlled studies are needed to confirm our results, especially for the treatment of chronic dislocations.

Compliance with ethical standards

Conflict of interest None declared.

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