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# Reconstruction of the sternoclavicular joint in active patients with the figure-of-eight technique using hamstrings

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**Background:** Dislocations of the sternoclavicular joint are rare injuries caused by massive forces applied to the joint. A high rate of complications has been reported following this injury emphasizing the importance of an accurate diagnosis and therapy.

**Methods:** We report a series of patients with chronic anterior or posterior sternoclavicular instability treated with figure-of-eight gracilis- or semitendinosus-tendon reconstruction. Tendon grafts were collected from the patient's ipsilateral knee. Preoperative and postoperative DASH scores were compared to evaluate the outcome.

**Results:** Six patients (mean age, 22 years; range 15-46; male = 3; female = 3) were included. The patients sustained an isolated dislocation of the sternoclavicular joint resulting from a high-energy trauma. Anterior instability was observed in 3 patients, posterior instability in 2 patients and the remaining patient showed multidirectional instability. The mean time from injury to operation was 8 months (range, 4-33). The semitendinosus tendon was used in 4 patients, the gracilis tendon in 2 patients, respectively. Follow-up examination was after 22 months (range, 14-34). The DASH score improved from 54.3 points (range, 45.7-68.8) preoperatively to 28.8 points (range, 25.8-34.5) postoperatively. All patients returned to full activity without limitations including competitive contact sports.

**Conclusion:** Stabilization of the sternoclavicular joint with the figure-of-eight technique seems to be a feasible alternative for young and active patients with remaining instability following conservative treatment.

**Level of evidence:** Level IV, Case Series, Treatment Study.



**Keywords:** Sternoclavicular joint; instability; dislocation; reconstruction; hamstrings

Based on the strong ligaments, dislocations of the sternoclavicular joint (SC) are rare and account for only 2-3% of all dislocations of the shoulder girdle.[6] The injury is usually caused by massive forces applied either directly or indirectly. Traffic accidents are the most common mechanisms of injury, followed by sports accidents.[31] The injury can be classified on the basis of anatomy in posterior or anterior dislocation or of aetiology into direct trauma, indirect trauma, or atraumatic injuries.[24,27]

The anterior dislocation has been reported to be more common.[24] In contrast, the posterior dislocation is rare and may be life threatening.[30] Complications include brachial

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plexus compression,[9,17] pneumothorax, respiratory distress,[8,23] vascular injuries,[10,15] as well as tracheal and mediastineal compression injuries. Most complications are observed at the time of injury; however, late-term complications like increasing pain due to post-traumatic arthritis, dysphagia, thoracic outlet syndrome, and fatal tracheoesophageal fistula[9,17,23,30,31] have been observed with unreduced posterior dislocations.

The high rate of complications and their severity emphasize the importance of an accurate diagnosis and therapy. The clinical presentation of the patient is crucial for the diagnosis, as conventional x-rays do not always allow a definitive evaluation of the position of the clavicle.[13,14] Computed tomography (CT) is reported to be the best imaging modality for evaluation of acute and chronic traumatic injuries of the sternoclavicular joint.[31] Closed reduction, which has been reported to be successful when performed early after the injury has been described, as well as a variety of techniques, for open reduction.[2,12,20]

Techniques for open reduction involve osteosynthesis with Steinmann pins and K-wires as well as reconstruction using soft tissue. The placement of pins across the sternoclavicular joint, however, is believed to be contraindicated, as serious complications including death have been reported[1,5,7,11,21,28]. Methods involving soft tissue repair include reconstruction of the costoclavicular ligaments,[12] resection arthroplasty,[26] subclavius tendon reconstruction,[3] and reconstruction using autologous tendon-grafts placed in a figure-of-eight.[4,19,22]

Herein, we report a series of 6 patients with chronic anterior or posterior sternoclavicular instability associated with repeated dislocations, treated with figure-of-eight gracilis- or semitendinosus-tendon reconstruction.

## Patients and methods

All included patients sustained isolated dislocation of the sternoclavicular joint following trauma and were initially treated at another clinic. Conservative or operative treatment failed, instability with repeated dislocations, as well as limited range of motion remained, pain increased, and return to daily life activity including sports was impossible. At the time of the first presentation at our department, the affected SC joints were not fixed in a dislocated position but were highly unstable. The alignment of the joint in neutral position was normal, but the patients could provoke anterior, posterior, or multidirectional dislocation depending on the underlying instability. Spontaneous but painful reduction of the joint was possible. The unaffected contralateral side was stable and joint laxity without trauma was ruled out based on the history of injury. For evaluation of the joint, CT scans or magnetic resonance imaging were performed. The definitive diagnosis was made clinically (Fig. 1).

The surgical technique was a 2-step procedure. First, the tendon graft was collected from the patient's ipsilateral knee in a standard technique known for crucial ligament reconstruction. Depending on the diameter of the graft needed, either the semitendinosus or gracilis tendon was harvested. Both tendons were exposed and the cross diameter of the tendons was measured. In cases of a diameter less than 4 mm of the gracilis tendon, the semitendinosus tendon was harvested. The tendon's length was at least 14 cm. Both ends were armed with sutures.


**Figure 1** Frontal view of a 15-year-old female patient showed correct alignment of the sternoclavicular (SC) joints in neutral position (**A**). The patient suffered anterior dislocation on the left side with conservative treatment 12 months earlier. In slight retroversion and 90° abduction, the left SC joint showed anterior dislocation associated with pain (**B**). Joint instability caused a pause as a competitive swimmer.

To expose the sternoclavicular joint in a second step, a curved incision of 6-8 cm was made above the joint. Shifting the soft tissues allowed adequate overview of the operative field. The insertion of the pectoralis major and sternocleidomastoid muscles was partially detached to expose the manubrium of the sternum and medial end of the clavicle 3 cm from the joint line each. Grasping the clavicular bone with a forceps and imitating the mechanism leading to dislocation confirmed the preoperative findings, including instability of the joint with an intact but elongated capsule. After opening the anterior capsule with a T-shaped incision, the joint was exposed with the discus of the joint kept in place. Holes measuring 4.5 mm were drilled on corresponding sides into the sternum and medial clavicle at a distance of about 1 cm from the joint and 1 cm from each other. The drill holes were performed in anterior-posterior direction with a conventional drill. Both cortices on each side were perforated. To protect essential anatomical structures posterior to the joint, the detractor laryngis muscles and the subclavian muscle were partially detached from the bone by the surgeon's finger, and the index finger was kept in place inside the thorax to operate as a drill protector and prevent from life threatening complications. After this demanding step of reconstruction, a flexible wire with a loop on 1 end was inserted into the drill hole and guided with the surgeon's fingertip from inside out. In the next step, a suture was laced into the loop and then pulled back. This procedure was repeated for every drill hole (Fig. 2). At the end, the suture ran loose in the definitive position without interposed soft tissue. The dorsal capsule was kept intact. Finally, the autologous graft, linked to the guiding suture, was placed in a figure-of-eight position and reinforced with nonabsorbable sutures (Fig. 3). The thickness of the sternum and the medial clavicle was about 1 cm to 1.5 cm. The distance from 1 drill hole to the other was 2 cm. Hereby a tendon