



# Sternoclavicular reconstruction with “sternal docking” technique and suture tape augmentation in an elite gymnast: a case report

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### Current Technique

- Most symptoms of sternoclavicular instability resolve with conservative management.
- Surgical management is challenging and can involve either resection arthroplasty or reconstructive procedures with tendon graft.
- Although to date there is no standardized reconstruction technique, the sternal docking technique stated by Sánchez-Sotelo allows obtainment of a central position of the graft and avoids the prominence of the graft to improve the cosmetic outcome.

### Novel Technique

- The sternal docking reconstruction technique with suture tape augmentation offers optimal stability in sternoclavicular reconstruction for instability, allowing an early return to sport in a professional gymnast.

### Introduction

Sternoclavicular (SC) dislocation is a rare injury, compromising less than 1% of all dislocations.<sup>15</sup> To date, its actual incidence in athletes is unknown, although cases have been described in rugby and soccer players.<sup>8</sup>

Symptoms of SC instability frequently improve with conservative treatment, local cryotherapy, and immobilization. Due to

the risks inherent to the surgical procedures at the SC joint, given the proximity to critical vascular and mediastinal structures, in addition to poor cosmetic results and risks of material migration, surgical intervention is reserved for chronic posterior dislocations or symptomatic instability despite conservative management.<sup>16</sup> Different strategies have been described, from rigid nail fixation methods,<sup>4</sup> resection arthroplasty, and reconstruction procedures.

In biomechanical studies, reconstruction with tendon graft in a figure-of-8 configuration has proven to be superior to other constructs.<sup>19</sup> Sanchez-Sotelo<sup>18</sup> described a technique for reconstruction by “docking” the graft to the sternum, which maintains its central position and decreases graft prominence. Other studies have also shown that augmentation with nonabsorbable suture tapes can optimize the stability of the reconstruction.<sup>12</sup> We present the case of an elite gymnast with chronic anterior SC instability, in which a reconstruction is performed with a sternal “docking” technique augmented with nonabsorbable suture tapes in crossed configuration.

### Case description

A 23-year-old female professional gymnast presents an axial trauma on the right upper limb, in-season during competition causing a right SC dislocation. Initially she is treated conservatively with rehabilitation and corticosteroid injections. However, in spite of conservative treatment, she remained symptomatic with SC anterior instability and could not return to practice. Although she had full shoulder range of motion, she had tenderness at the SC joint. Given the persistence of symptoms and her need for a prompt return to competitive level, an SC reconstruction was indicated 6 months after the initial episode of dislocation. The patient provided informed consent for publication of this case.

Comité Clínica del Country Bogotá approved this study.

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## Surgical technique

Under general anesthesia with the patient supine with 30° inclination of the surgical table, a curved incision was made, dissecting until the SC joint and the medial end of the clavicle were exposed (Fig. 1). After positioning blunt Hohmann retractors on the clavicle to protect the mediastinal structures, a 0.5-cm resection of the medial end of the clavicle and the intra-articular disc was performed with an oscillating saw, to expose the articular aspect of the sternum (Fig. 2). To facilitate this step, forceps were used to carefully traction the clavicle anteriorly to allow safe placement of the retractors and to move them slightly away from the posterior structures. Then with a 4.0-mm drill, 4 unicortical bone tunnels were created, two at the level of the clavicle and two at the sternal manubrium, 1 cm apart (Fig. 3). A fifth oval hole was created at the level of the articular cartilage of the sternum to allow passage of the graft. The length of the graft was then determined with a suture, and an extensor hallucis tendon allograft was prepared.

Then, the graft entered through the clavicle, exiting through one of its anterior orifices and re-entering through the superior orifice, resulting in two ends through the medullary canal of the clavicle. These strands were inserted through the hole created in the articular face of the sternal manubrium, recovering them through each of the anterior orifices of the sternum (Fig. 4). Before knotting the ends of the graft on the sternum, the fixation was augmented with two ultra-high-molecular-weight polyethylene tapes in a crossed configuration between the holes of the clavicle and the sternum (Fig. 5) and performing a reduction maneuver of the clavicle and knotting them with a Nice sliding knot, to later tie the ends of the graft on the sternal manubrium, as described in the “docking” technique (Fig. 6). The stability of the fixation was confirmed, and the wound was closed.

After surgery, the use of a sling was indicated for 2 weeks, and then rehabilitation commenced, gradually resuming passive shoulder motion and allowing active mobility at the 6th week (Fig. 7). Twelve weeks after the procedure, the patient presented with full active range of motion at the shoulder and did not have any residual symptoms of SC instability. At this point, the Single Assessment Numeric Evaluation score was 75%. Six months after the procedure, she had full shoulder range of motion, normal scapulothoracic and core balance, no residual pain or instability symptoms, and fully returned to sport competition.

## Discussion

Although shoulder lesions are common in athletes, SC dislocations are infrequent. While the bony contact between the clavicle and the sternal manubrium is minimal, the surrounding capsular and ligamentous structures make this joint inherently stable.<sup>13,16</sup>

Hart described that the incidence of injury in gymnastics is 1.08 to 50.3 per 1000 hours of exposure.<sup>7</sup> While sports injuries in female gymnasts are more common in the spine and lower limbs, in male gymnasts, possibly due to the practice of rings, high bars, or horse with arches, the most frequent sports lesions occur in the shoulder. Among these, partial rotator cuff tears, labral tears, or glenohumeral multidirectional instability is common.<sup>7</sup> While cases of stress fractures of the clavicle have been reported in gymnasts,<sup>3,6</sup> no other cases of SC reconstructions in these athletes have been reported in the literature to date.

Initial treatment of SC instability is aimed at rehabilitation and pain management. Von Tongel<sup>22</sup> stated that many SC dislocations persist with residual instability after an episode of dislocation.

The approach to the SC joint represents a technical challenge given the proximity of the joint to the subclavian and

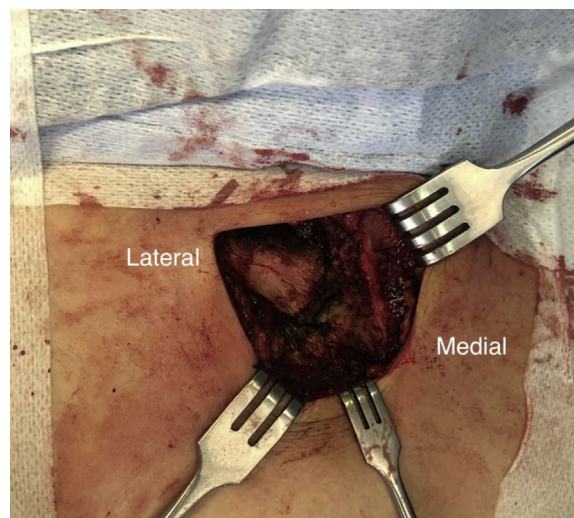


Figure 1 Initial exposure of the right sternoclavicular joint.

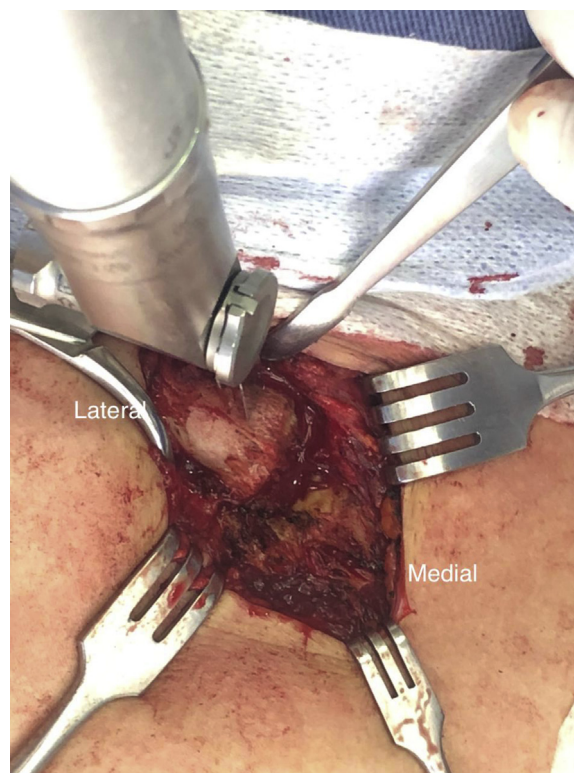
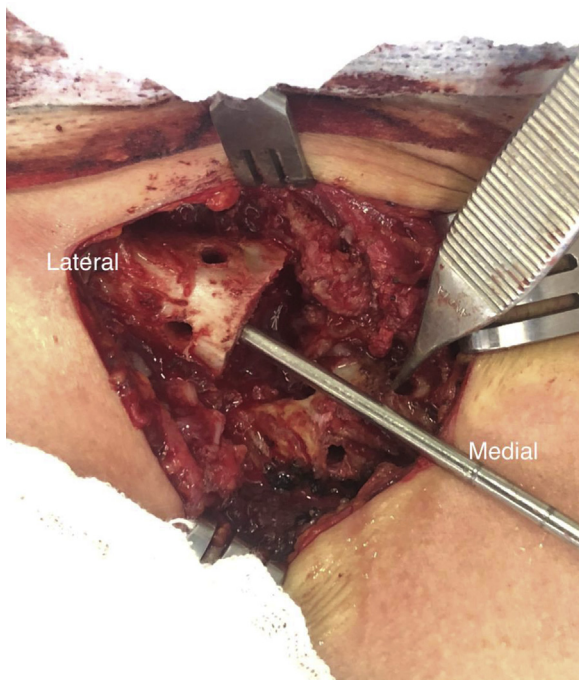


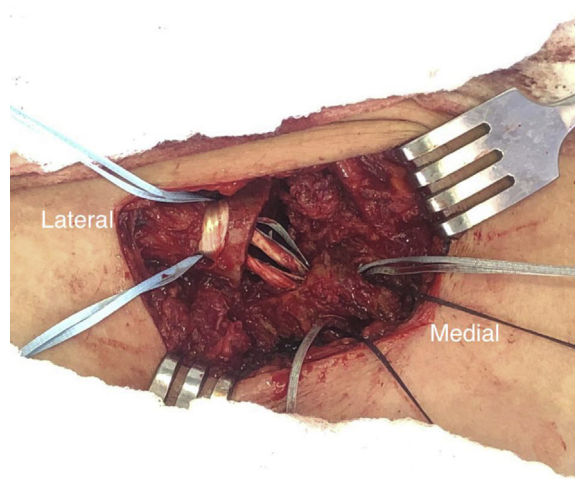
Figure 2 Oscillating saw (0.5 cm) resection of the proximal third of the clavicle.

brachiocephalic vessels, trachea, and esophagus. Although the presence of a cardiothoracic surgeon is generally recommended when approaching the SC joint, the literature so far does not report cases in which his intervention has been necessary due to an intraoperative mediastinal lesion.<sup>18</sup>

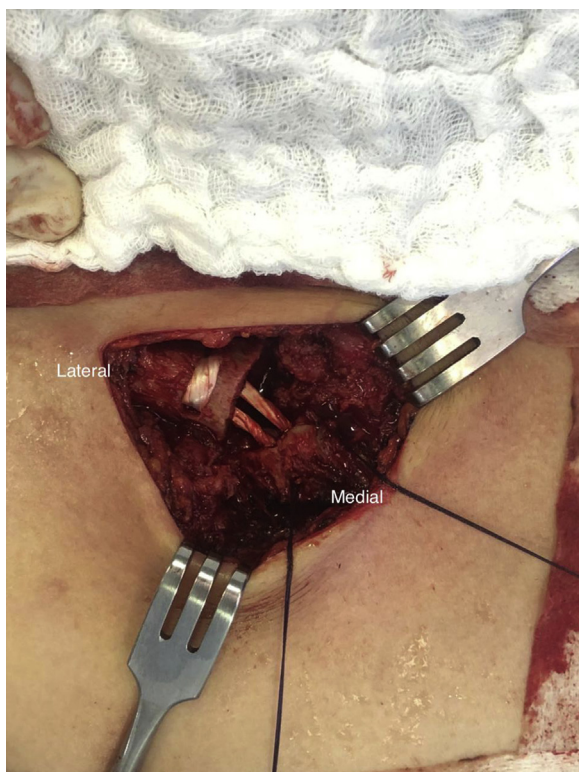
Spencer in a biomechanical analysis found that SC stabilization with a figure-of-8 configuration with allograft offers high mechanical stability by generating greater resistance to peak loads before failure.<sup>19</sup> Lacheta in a minimum follow-up of 5 years in 22 shoulders treated with reconstruction in a figure-of-8 with tendon



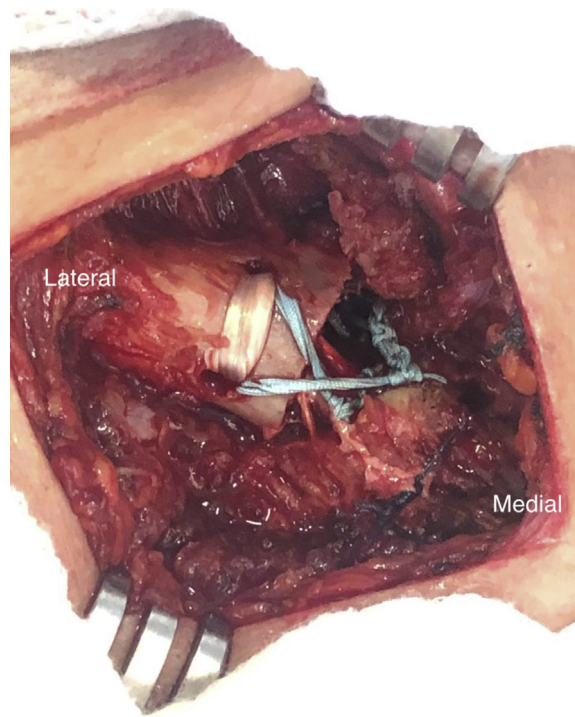
**Figure 3** Bone tunnels at the level of the clavicle and sternal manubrium. One of the tunnels at the level of the sternal manubrium is marked with a dissecting forceps. The endomedullary canal of the clavicle through which the allograft enters is marked with the suction cannula.



**Figure 5** Augmentation with ultra-high-molecular-weight polyethylene ribbons in cross configuration



**Figure 4** Extensor tendon allograft passage in sternal docking configuration.



**Figure 6** Sternoclavicular reconstruction with tendon allograft in sternal docking pattern with augmentation with cross-linked ultra-high-molecular-weight tapes knotted with a Nice knot.

graft reported 90% success and a return to previous sports level in 94% of patients.<sup>10</sup> Sabatini described SC reconstruction supplemented with tenodesis screws. He presents 10 patients, with good

outcomes and an average American Shoulder and Elbow Surgeons score of 84.7.<sup>15</sup> Other devices such as synthetic grafts and ultra-high-molecular-weight sutures have also been described to stabilize the SC joint.<sup>1,9,21</sup>

The sternal “docking” technique described by Sánchez-Sotelo keeps the tendon graft centered in the coronal plane and avoids bulky reconstructions on the sternum.<sup>17</sup> Resection of the medial



Figure 7 Range of motion 3 months after the procedure.

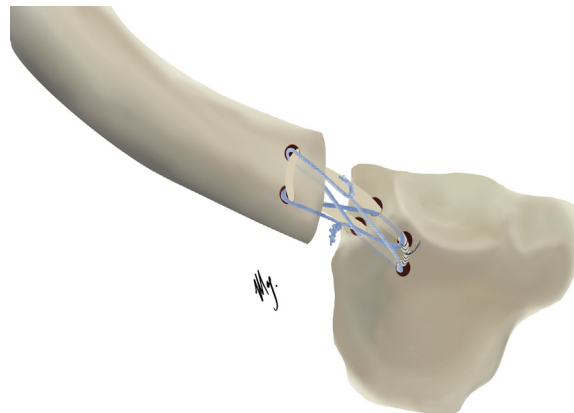


Figure 9 Sternoclavicular reconstruction with allograft in a “docking” technique, augmented with suture tape in a crossed configuration, tied with a Nice knot.

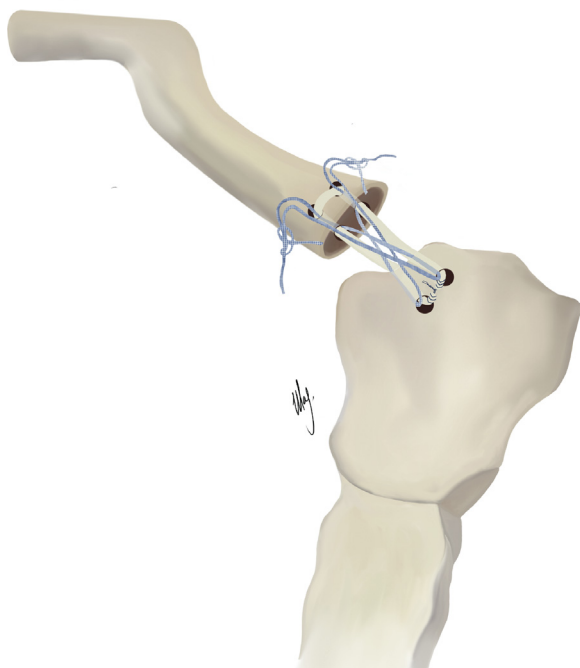


Figure 8 Sternoclavicular reconstruction with allograft in a “docking” technique, augmented with suture tape in a crossed configuration.

end of the clavicle is required, as described in the technique by Sánchez-Sotelo<sup>6</sup> to achieve a more centralized reconstruction by placing the graft in the clavicular tunnels and exiting into the medullary canal. The author assessed the results of the technique in 16 patients, regaining stability in 84% of the cases, with high patient satisfaction and an average American Shoulder and Elbow Surgeons score of 88.

Regarding the use of augmentation with sutures or tapes, Martetschläger in a biomechanical analysis found that synthetic augmentation of the graft with nonabsorbable tapes improves the stability and biological characteristics of the construct.<sup>12</sup> Although many of the case series of graft reconstructions do not use additional augmentation devices, most report older patient groups with SC osteoarthritis that possibly have a lower functional demand from highly competitive athletes. Tytherleigh-Strong reported the use of anterior capsular repair with internal bracing augmentation for acute dislocations.<sup>20</sup> However, given the chronicity of symptoms in the case presented, a repair would not have been feasible, so the most predictable procedure was a reconstruction.

To optimize the stability of the reconstruction, considering the competitive level of the patient and the functional demand of her

shoulder in gymnastics, to allow a return to competition level, we decided to complement the sternal docking technique by performing augmentation with nonabsorbable tapes (Figs. 8 and 9). The sternal docking technique allows obtaining of a central position of the graft and avoids the prominence of the graft to improve the cosmetic outcome,<sup>17</sup> which improves satisfaction in this patient of slim constitution.

The use of tapes for augmentation in reconstruction with grafts has been implemented in reconstructions of the anterior cruciate ligament, medial patellofemoral ligament, and ulnar collateral ligament of the elbow among others.<sup>14,5,11</sup> In biomechanical studies,<sup>2</sup> augmentation with ultra-high-molecular-weight tapes has demonstrated a decrease in the elongation and rupture of the graft, particularly in those of smaller size, as is the case of the graft used in this case. Although there is a potential for suture cutout at the bone tunnels, to our knowledge, this has not yet been reported when using sutures for graft augmentation, and cortical density of the sternum and the medial clavicle would make suture cutout unlikely in a young patient.

To date, this is the first case report of a reconstruction using the sternal docking technique augmented with cross tapes. The limitations of the study are inherent to its design as a single case report and a medium-term follow-up. Although clinically it is found that the stability of the graft is improved by the supplementation with tapes, biomechanical studies are required to support this statement as well as clinical studies to determine the cost-effectiveness of the use of this type of augmentation in SC reconstructions.

### Conclusion

Surgical management of SC instability represents a technical challenge due to the anatomical location of the joint. So far, there is no standardized technique for surgical reconstruction. An alternative of SC reconstruction with tendon allograft is presented, in sternal “docking” configuration augmented with crossed tapes to optimize its stability in a professional gymnast.

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