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Case Report

Joint reconstruction using sternocleidomastoid tendon autograft as a treatment for traumatic posterior dislocation of sternoclavicular joint: A case report

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ABSTRACT

Introduction: Posterior sternoclavicular joint dislocations are extremely rare and emergent injuries.

Presentation of case: We presented a case of a seventeen-year-old male patient who was diagnosed with traumatic posterior dislocation. He underwent joint reconstruction using sternocleidomastoid tendon autograft, and the operation went well.

Discussion: At four-week and fourteen-week follow-up post-operatively revealed a surgical wound that healed well, regained stable sternoclavicular joint that was marked by a normal left sternoclavicular notch, full range of movement of the left shoulder and the pain subsided.

Conclusion: These findings provide evidence that the method of joint reconstruction and augmentation may produce good outcome for posterior dislocation of the sternoclavicular joint.

Introduction

Sternoclavicular joint (SCJ) dislocation is a rare injury with potentially life-threatening consequences, especially posterior one. SCJ dislocation represents approximately 3% of the shoulder injuries. Among those, the posterior dislocation accounts for only 6% of SCJ dislocation, with the majority of them displaced anteriorly [1]. In addition, the diagnosis is easy to miss, both clinically and radiographically. With the widespread availability of CT scanning, it is now straight-forward to diagnose yet it is still frequently missed.

SCJ stability relies on the presence and function of intact capsular and costoclavicular ligaments. Although rare, direct or indirect high-energy trauma is most often responsible for the disruption of SCJ stabilizing structures thereby resulting in anterior or posterior subluxation or dislocation.

Numerous methods of surgery are available to stabilize the SCJ in patients with sternoclavicular dislocation. Techniques that attempt to reconstruct the ligamentous structures include the use of tendon grafts, fascial loops, or non-biological materials such as Dacron and carbon-fiber ligaments. Waters et al. found a good clinical outcome after performing a ligament repair on 13 patients with posterior dislocation of SCJ [2]. Other soft tissue reconstructions for the treatment of instability of the SCJ include myoplasty, tenodesis of the sternal head of the sternocleidomastoid muscle, and tenodesis of the subclavius tendon. However, a gold standard technique has yet to be defined owing to numerous described techniques and low levels of evidence.

In the present report, we presented a seventeen-year-old male patient who was admitted to our center with pain in the left chest

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Fig. 1. Physical examination of the chest showed a loss of left sternoclavicular notch (arrow) and multiple excoriations with size varying from 1 × 1 cm to 5 × 6 cm.

wall after a motor vehicle collision. He was diagnosed with posterior dislocation of the sternoclavicular joint and had undergone joint reconstruction with sternocleidomastoid tendon autograft. This work has been reported in line with the SCARE criteria and cites the following paper: Agha et al. [3].

Presentation of case

A seventeen-year-old male patient was admitted to our hospital with pain in the left chest wall after a motor vehicle collision that occurred 6 h before admission. The patient was riding a motorcycle with a moderate speed without helmet when a truck hit him from his right side. The patient fell to the left, while his left side of his face and left side of his chest hit the asphalt. At examination, the patient felt pain on the left side of his face and his left chest. There were multiple open wounds on his face and multiple excoriations on his shoulder and arms. There was no history of unconsciousness, nausea, or vomitus. After the accident, the patient was not able to move his arm due to the pain, and he felt the medial side of his collarbone. The patient had shortness of breath, without hoarseness or dysphagia. He was brought to the nearest clinic. His wound was cleaned, he was given antibiotics and was referred to our hospital for further treatment.

We performed primary survey as soon as the patient arrived at the emergency department. The patient's airway was clear. His breathing was fast and relatively deep, respiratory rate was counted 20 times/min. He did not look pale or cyanotic; blood pressure was 130/80 mm Hg and heart rate was 92 beats/min. Oxygen was then administered at 10 l/min via face mask.

On physical examination, the general state of the patient was normal except for his chest, where the patient had diminished breath sound at the lower part of his left chest which was dull on percussion. At the local state, the patient had a loss of left sternoclavicular notch and multiple excoriations with size varying from 1 × 1 cm to 5 × 6 cm (Fig. 1). There was local tenderness (visual analog scale of 2–3). The capillary refill time was under 2 s. Radial artery and ulnar artery pulsation along with distal sensorium were normal. Also, the range of motion of the shoulder was not examined due to pain, while the range of motion of the elbow, wrist, and fingers were normal.

Initial radiograph demonstrated opacity of a large area of opacity in the left hemithorax as well as inferior dislocation of left sternoclavicular joint (Fig. 2). Furthermore, all parameters in the routine blood test were within normal limits.

The patient was diagnosed with left pulmonary contusion with hematothorax, as well as closed posterior dislocation of the left sternoclavicular joint. He was had already been treated by a multidisciplinary team consisting of the thoracic surgery department and orthopaedic department. In the emergency ward, the patient had inserted by water-sealed drainage into his left chest and he wore an arm sling to immobilize his shoulder and arm temporarily.

Nine days later, the patient's condition improved progressively especially his breathing and hemodynamics then the chest tube was removed. Prior to surgery, the patient was evaluated for another radiograph as well as CT scanning to evaluate the severity of posterior displacement medial clavicle over the sternum. The chest radiograph showed that the consolidation of left hemithorax had decreased in comparison with the initial radiograph. In addition, the inferior dislocation of the left sternoclavicular joint remained to be seen (Fig. 3).

The next day, the patient underwent further radiographic evaluation by CT scan modality. 3D reconstruction of the scanning clearly demonstrated the severity of inferior and posterior displacement of the medial end of left clavicle (Fig. 4).

Nine days later, the patient underwent open reduction and tendinous reconstruction using sternocleidomastoid tendon autograft. Intraoperatively, the patient was lying in supine position, and the sternum and clavicle were projected and designed on the overlying skin. The incision was made directly over the dislocation site. Then, we visualized the medial end of the clavicle and reduced the displacement. By direct visualization, we concluded that although anterior sternoclavicular ligament was disrupted, the posterior part was actually intact. With the sternoclavicular joint reduced, we moved the patient's shoulder within its normal range of motion: internal rotation, external rotation, abduction, and forward flexion. Afterwards, two holes were drilled at both the medial end of the clavicle and at the manubrium while the sternocleidomastoid tendon was harvested and prepared. Finally, the sternoclavicular joint was reconstructed with the tendon autograft (Fig. 5).

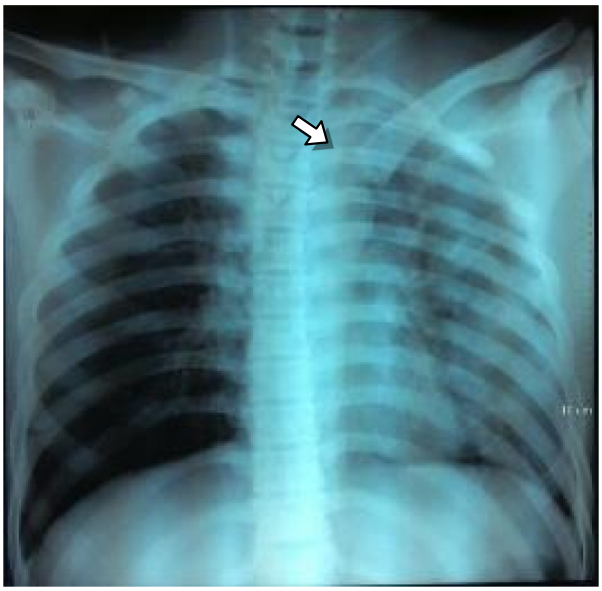

Fig. 2. Initial chest radiograph depicted opacity of the majority of left hemithorax as well as inferior dislocation of left sternoclavicular joint (arrow).

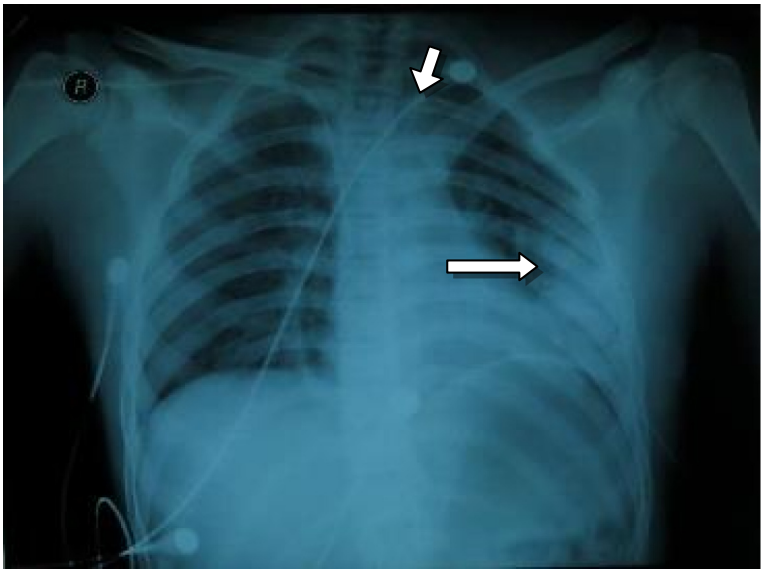

Fig. 3. Pre-operative radiograph of the chest showed a decreased opacity of left hemithorax (long arrow) in comparison with the initial radiograph. Inferior dislocation of left sternoclavicular joint (short arrow) still persisted, while the chest tube had been removed.

Afterwards, the post-operative radiograph was taken and it showed an adequate reduction of the left sternoclavicular joint (Fig. 6). Several days later the patient was then discharged from the hospital. He took analgesics and was recommended to use arm sling daily. At 4-week follow-up, the patient gained most of the shoulder movement (Fig. 7), with little pain at the ends of his limited range of movement. Internal and external rotation of his shoulder was good, but abduction and extension were limited.

At 16-week follow-up, the patient did not feel any pain, instability, or any other symptoms. On physical examination, the surgical wound healed well with a normal left sternoclavicular notch (Fig. 8). There was no tenderness on the injury site. Moreover, the patient finally got the full range of movement of his left shoulder with no pain at any motion (Fig. 9). He also regained normal function of his left shoulder to do most of his daily activity.

Discussion

Posterior dislocations of the sternoclavicular joint are rare, but important to recognize. As in this case, the mechanism is often a

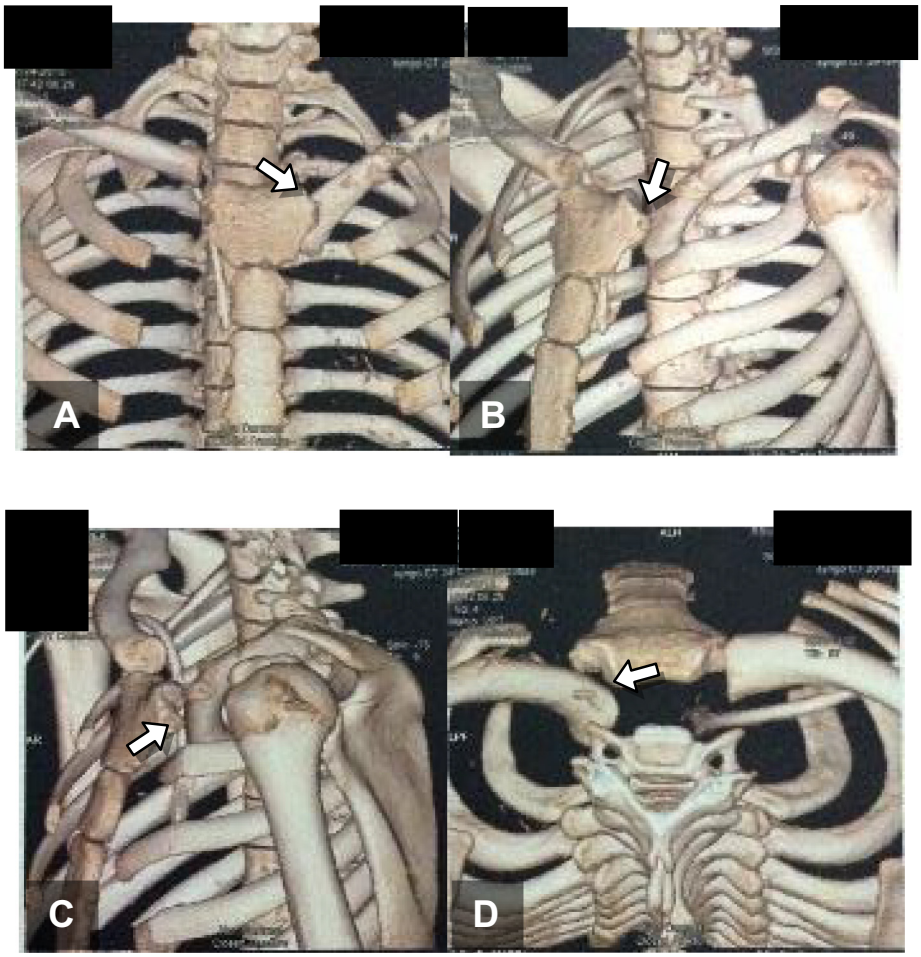

Fig. 4. CT-scan with 3D reconstruction clearly demonstrated the severity of inferior and posterior displacement of the medial end of left clavicula (arrows).

posterolateral injury to the shoulder causing a lever mechanism to the medial clavicular head, forcing displacement posterior to the sternum. Direct force to the medial clavicle is less frequently responsible for posterior dislocations. The most common causes are from sporting activities, up to 85% in one study [2], as well as motor vehicle accidents.

The potential severity of the injury is due to the proximity of the great vessels, brachial plexus, trachea, esophagus, lungs, and recurrent laryngeal nerve to the sternum. Patients will often present with pain out of proportion to physical findings and depending on the structures affected then the patient may present with a variety of symptoms: venous congestion of the upper limb (subclavian vein), dyspnea or choking (trachea), dysphagia (esophagus) and hoarseness (recurrent laryngeal nerve) [4]. Our patient was admitted with shortness of breath, without signs of edema, cyanosis, or hoarseness. These findings were probably associated with pulmonary contusion. This complication had been controlled by water-sealed drainage placement into the patient's left chest, adequate oxygen supplementation, mucolytic medication, and chest physiotherapy.

Posterior displacement of the medial end of the patient's left clavicle was readily suspected with a loss of clavicular notch and limitation of shoulder movement. Plain radiography is often sufficient for the purpose of diagnosis, and as for this case, the diagnosis of posterior dislocation of the sternoclavicular joint was readily confirmed by X-ray alone. However, the incorporation of additional views, such as the “serendipity” view and the use of conventional CT scans, had been suggested [5]. It is now generally agreed that CT scans are the optimal imaging modality, not only to precisely determine the type of fracture and dislocation but also to reveal any associated injury to adjacent structures [6]. In the current case, the patient was evaluated by CT with 3D reconstruction which clearly demonstrated the direction and severity of the displacement. It did not suggest any associated arterial, vein, or nerve injury.

Unlike anterior dislocations of the sternoclavicular joint, posterior dislocations should almost always be reduced because of the risk of late sequelae [7]. Surgical reconstruction of the sternoclavicular joint is typically indicated in cases of acute or recurrent posterior dislocation. Surgery may also be indicated in some cases of anterior instability for which non-operative treatment was unsuccessful [8]. This case represented a clear indication of surgical reconstruction of the joint. Nevertheless, the surgical procedure as the definitive treatment had to be delayed because the patient did not breathe normally and his hemodynamic was not stable initially. Hence, for the time being, the patient wore an arm sling to immobilize his shoulder and therefore to protect the underlying

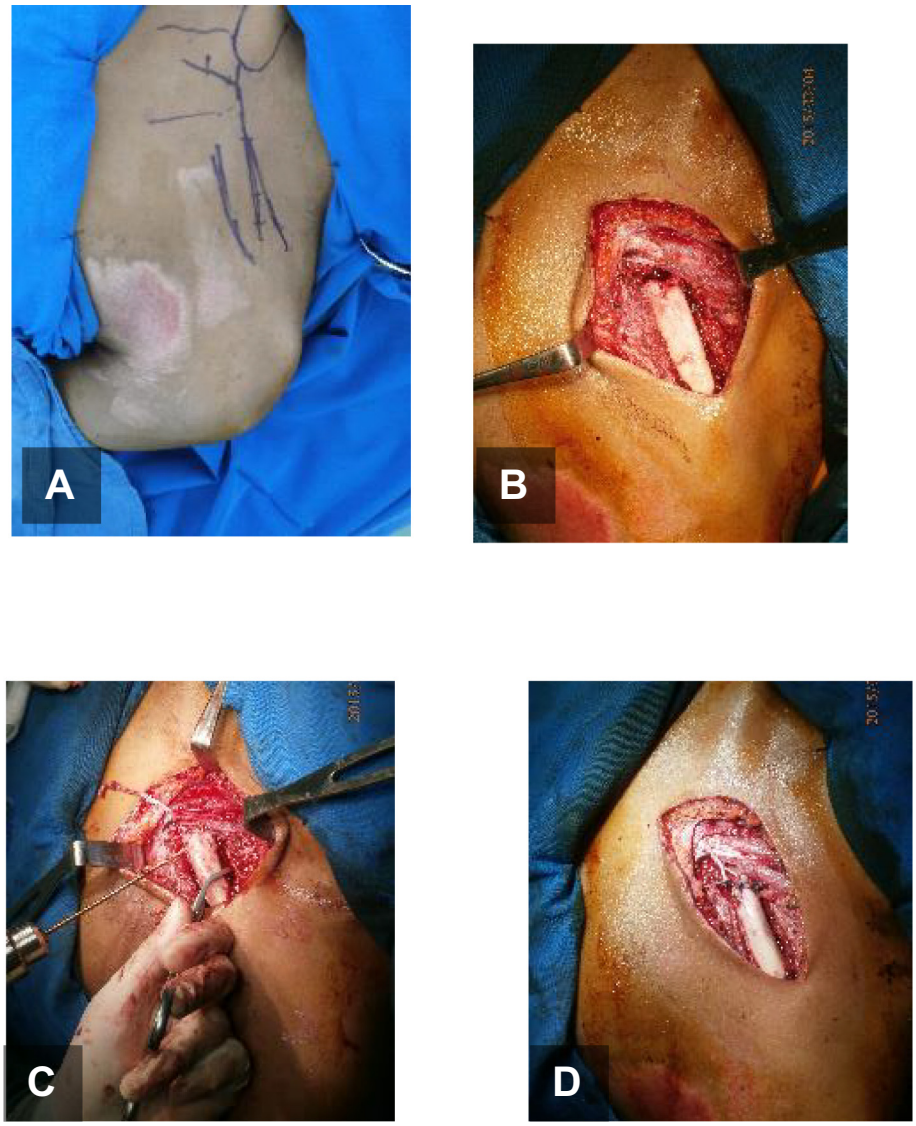

Fig. 5. Intraoperatively, the sternum and the clavicle were projected and designed on the overlying skin (A) before the incision was made. The dislocation site was visualized and reduced (B). Afterwards, both the medial end of the clavicle and the manubrium were drilled, meanwhile at the same time a sternocleidomastoid tendon autograft was harvested (C). At the end, the displacement was reduced and reconstructed by figure-of-eight method (D).

pulmonary parenchyma prior surgery. On the ninth day, when we were sure that the patient's general condition was sufficient enough to withstand the surgical procedure, the chest tube was removed and the patient was prepared to go to the operating table.

Open reduction can be achieved through a numerous procedures: pinning, tenodesis to the first rib, with or without complement sutures, stabilization utilizing the tendon of the sternocleidomastoid muscle and an additional augmentation utilizing a palmaris longus free graft, direct suture through the sternoclavicular articulation, plating the joint, open reduction and internal fixation with cannulated screws. Some authors have recommended the use of Kirschner wires or threaded Steinmann pins to hold the reduction. However, the complication rate seems to be unacceptably high as these pins and wires, as well as other methods that permit the use of metal hardware including plate and cannulated screws, have been reported to migrate into the thorax, resulting in severe and even fatal injuries [9]. In fact, several deaths due to pin migration following sternoclavicular fixation have been reported. There is a consensus within the literature that Kirschner wires and pins should not be used in the sternoclavicular joint [10].

In this case, we treated the patient with joint reconstruction and augmentation with sternocleidomastoid tendon autograft (Fig. 10). Sternocleidomastoid tendon as a graft may prevent abnormal motion of the sternoclavicular joint during shoulder motion, and the clavicle can be stabilized properly, although in a subluxated position. Furthermore, use of the ipsi-lateral sternocleidomastoid tendon obviates the need for second-site surgery with its related complications [11]. Several studies might suggest semitendinosus or gracilis tendon as graft donor site, because of their strong tensile properties which is suitable for stabilizing the relatively mobile

Fig. 6. Post-operative radiograph showed decreased opacity of the left hemithorax and adequate reduction of left sternoclavicular joint.

Fig. 7. At 4-week follow-up, the patient gained most of the shoulder movement, with only little pain at the injury site. Internal rotation (A) and external rotation (B) of the shoulder was good, but abduction (C) and forward flexion (D) were still limited.

sternoclavicular joint. Moreover, the figure-of-eight construction model had been advised lately, because it provided a relatively tight fixation between the medial end of the clavicle and manubrium, especially in the posterior direction [10]. However, we considered that the patient had a relatively stable sternoclavicular joint, as shown by the intact posterior sternoclavicular ligament, which allowed a little bit more loose stabilization using augmentation method. In addition to the advantages of avoiding graft donor site complications, the method of augmentation and reconstruction using sternocleidomastoid tendon gave familiarity and convenience in performing the procedure.

In this report, the patient had an improved shoulder movement at 4 weeks post-operatively, and finally gained full range of movement at 14-week follow-up. Guan and Wolf [12] reported on six patients with chronic sternoclavicular joint instability (post-traumatic in four and atraumatic in two) who underwent reconstruction using an autologous tendon graft (i.e., gracilis, semi-tendinosus, or palmaris longus) in a figure-of-eight fashion. At a mean follow-up of forty months, five of the six patients had no pain and all had returned to normal activities. Bae et al. [13] reported on nine patients with chronic posttraumatic instability of the sternoclavicular joint who underwent sternoclavicular joint reconstruction with a tendon graft (i.e., semitendinosus in eight patients and sternocleidomastoid fascia in one patient). At a mean follow-up of fifty-five months, 90% of the patients were able to perform all activities of daily living but had some subjective limitation in athletic or recreational activity. Armstrong and Dias [14] reported that six of seven unstable sternoclavicular joints were stable enough at the time of the forty-month postoperative follow-up to enable activity without limitation. Uri et al. [11] gave a similar result, with twenty-five of thirty-two patients who had debilitating instability

Fig. 8. Clinical examination of the chest post-operatively revealed a surgical wound that healed well and a normal left sternoclavicular notch.

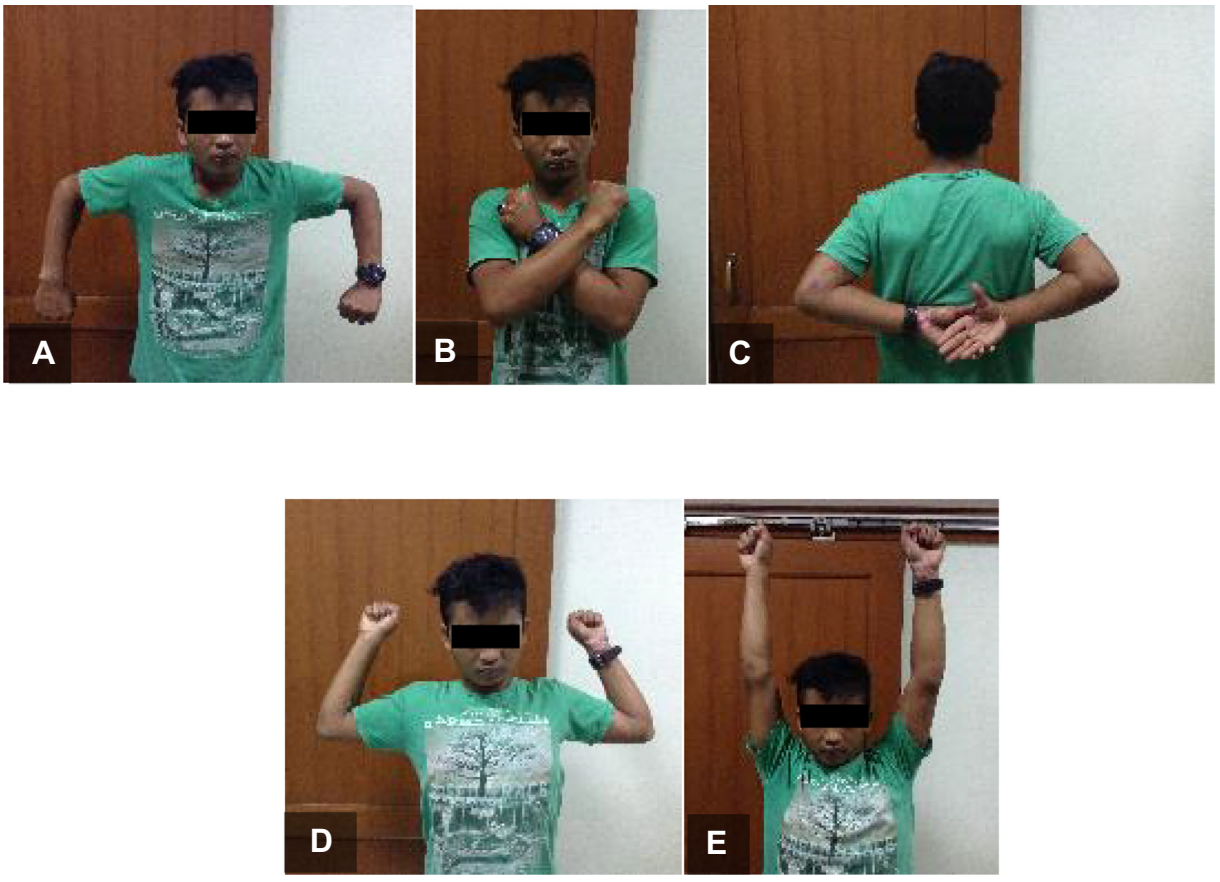

Fig. 9. At 16-week follow-up, the patient gained full range of movement of his left shoulder: internal rotation (A–C), external rotation (B), and abduction (C).

of the sternoclavicular joint before surgery achieving stability without activity limitation after surgery, independent of the etiology of the instability. The diversity in outcome assessment tools and study methodology preclude a meaningful comparison between our study and other published series.

Conclusion

In conclusion, we presented a case of a seventeen-year-old male patient with posterior dislocation of the sternoclavicular joint.

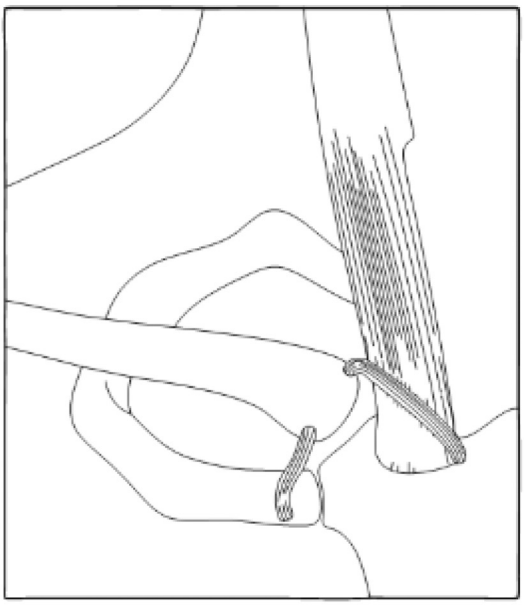

Fig. 1

A diagram demonstrating the harvest of the sternocleidomastoid tendon, kept attached at its sternal end, tubularised and passed through a drill-hole in the medial end of clavicle.

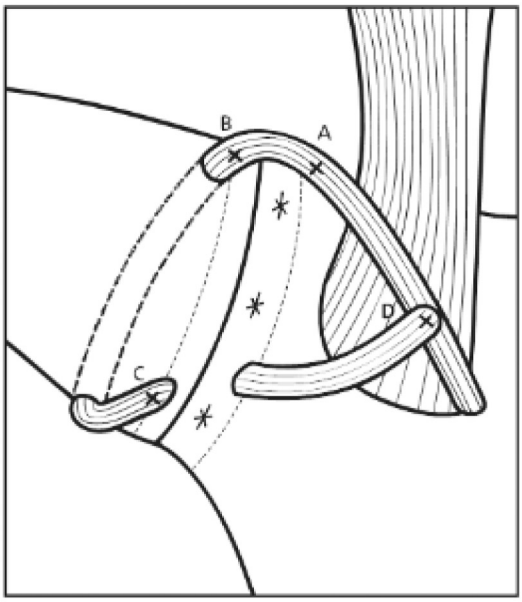

Fig. 2

A diagram demonstrating the method by which the tendon is braided through the anterior capsule to reconstruct the anterior sternoclavicular ligament. Points A to D are the places where the tendon is sutured to the underlying tissue.

Fig. 10. Figure-of-eight reconstruction method as a treatment for sternoclavicular dislocation, as demonstrated by Spencer and Kuhn. Two small holes were drilled both at the medial end of the clavicle and at the manubrium, before the figure-of-eight pattern was reconstructed using either semitendinous, gracilis, hamstring, or sternocleidomastoid tendon autograft.

The patient underwent open reduction and joint reconstruction using sternocleidomastoid tendon autograft. His pain was subsided and the shoulder movement improved significantly at 4-week and 14-week follow-up. This reconstruction method is a safe and effective surgical technique that offers reliable pain relief and functional improvement for patients with posterior dislocation of the sternoclavicular joint.

Conflict of interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

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