Case Report

Restoring a functional and mobile shoulder following reconstruction of the sternoclavicular joint with a free vascularized fibular flap

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ABSTRACT

Infection of the sternoclavicular joint (SCJ) is rare and often missed at early stage. In extensive disease with bony and soft tissue destruction, radical excision is indicated. The loss of SCJ results in exposure of vital structures of the anterior mediastinum and instability of the shoulder girdle. SCJ reconstruction using locoregional muscle flaps like the pectoralis major or latissimus dorsi flap has been well described. While these options can provide soft tissue coverage, they do not restore the structural framework of the SCJ which is important for shoulder excursion and chest wall movement. We describe a case of SCJ reconstruction using a free vascularized fibular flap following the resection of sternoclavicular tubercular osteomyelitis. The fibula bone was used to restore the clavicular strut by anchoring it to the remaining manubrium with a steel wire and by plating the lateral end to the remnant clavicle. The steel wire served as a “defunctioning” cerclage that allowed motion of the joint to induce fibrous union. A strict post-operative rehabilitation protocol keeping the shoulder adducted at the initial phase was prescribed. At one year follow up, the patient achieved good shoulder function with 140 degrees of shoulder abduction and 110 degrees flexion.

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Case report

A 39-year-old lady presented with a non-healing ulcer over her right clavicle for 3 months. The lesion initially appeared as a cutaneous abscess which failed to improve despite multiple debridements and antibiotic therapy. She denied any history of trauma or tuberculosis contact. On examination, there was an ulcer measuring $2 \times 3$ cm over her right sternoclavicular joint and the medial end of the clavicle was visible. On plain film radiography, osteolytic changes were seen over the medial end of the clavicle. Computed Tomography (CT) studies further demonstrated destruction of the right SCJ and osteomyelitic changes of the clavicle. The tissue specimen was found to be positive when tested with Tuberculous Polymerase Chain Reaction (PCR). She was diagnosed with tuberculous osteomyelitis and commenced on anti-tubercular treatment.

After two months of treatment, she was planned for en-bloc resection of the SCJ in view of the extensive bony and joint destruction. To facilitate surgical planning, a 3D bone model based on CT data was constructed preoperatively (Figure 1). The right SCJ including the medial third of the clavicle and part of the manubrium was excised and the resultant defect measured $8 \times 6$ cm. A fibular osseocutaneous flap was chosen for coverage of the defect. The left fibula flap was raised based on the peroneal vessels with careful preservation of two septocutaneous perforators. The fibula shaft was 20 cm in length with a $15 \times 8$ cm skin paddle. Using the 3D bone model as a guide, the fibula was shortened to 10 cm. Reciprocal step osteotomies of the clavicle and fibula were performed, and the fibula was secured with a 9-hole locking plate (Compact 2.4 UniLOCK, Synthes, USA) to the clavicle. At the medial end, a “new” joint was created using a 1 mm steel wire and Ethibond 1/0 suture (Ethicon, USA). First, four drill tunnels were made over the manubrium and fibula respectively. The suture was threaded through them in a figure-of-eight fashion and secured. The wire was then passed in a similar manner but kept loose initially. Microvascular anastomosis of one artery (peroneal artery to dorsal scapular artery) and two veins (two peroneal veins to external and internal jugular veins) were performed respectively with Ethilon 9/0 sutures (Figure 2). After revascularization, the lie of the vessels was checked to avoid compression and the wire then tightened.

After surgery, she was placed in an arm sling and the arm kept adducted for 3 weeks. She was refrained from reaching over the head, arm paddling and push-ups for the next 6 weeks. Her recovery was uneventful and she completed the full course of anti-tubercular therapy. Radiographic clavicol-fibular union was evident at 3 months and joint alignment of the SCJ was observed with no evidence of subluxation. The wire was noticed to have failed but the bony ends were not displaced indicating joint stability. At 13 months follow up, she returned to her usual physical activity with no signs of instability or chronic pain. She regained up to 140 degrees of shoulder abduction, 110 degrees of shoulder

Figure 1. This figure depicts the 3D bone model and the free fibula flap. We estimated the fibula bone length requirement based on the length of the contralateral clavicle. The dotted line depicts the resection margin of the diseased joint.
Figure 2. a. This schematic diagram illustrates the inset of the fibula bone. Reciprocal step osteotomies of the fibula and clavicle provided greater surface area for bony union. Osteosynthesis was achieved by a 2.4 mm mandibular locking plate. Medially, the fibula was wired to the manubrium with a figure-of-eight loop. b. Intra-operative view of the fibular flap in place. The skin paddle is reflected superiorly.
flexion, and 70 degrees of shoulder extension (Video 1). Her QuickDash assessment at 18 months was 8.62 which indicated minimal disability. She was satisfied with the final appearance of her donor and recipient sites with a satisfaction scoring of 14/20 based on the Likert Scale for flap appearance (Figure 3).

Discussion

Clavicular reconstruction with a vascularized fibula graft has been well described in literature, the most common indication being a mid-clavicular non-union with intact adjacent joints. In 2009, Taylor et al. reported a successful clavicular and acromioclavicular joint reconstruction using the free fibula flap in combination with a customized plate and biceps tendon graft. Their patient regained full shoulder function following rehabilitation. The reconstruction of sternoclavicular joint, on the other hand, is more challenging as the joint serves to connect the shoulder girdle and the chest wall. It is also intimately related to the brachiocephalic vein. The use of locoregional muscle flaps such as the pectoralis major or latissimus dorsi muscle flaps have been well described for SCJ reconstruction. While these options provide excellent soft tissue coverage, they do not restore the structural framework of the SCJ that is important for functional shoulder excursion and chest wall movement. Harvesting a pectoralis flap also further destabilizes the chest wall and diminishes shoulder flexion and adduction. The chronic immobility eventually results in a frozen shoulder which was demonstrated in one of the patients in our previous series.

Our patient is a young and active individual who exercises and swims regularly. The loss of shoulder abduction will be debilitating especially because she is right hand dominant. Hence, the goal of reconstruction for her was not merely for coverage purposes, but also to restore shoulder mobility.

In this case, the microsurgical reconstruction was routine. The two important focuses for restoration of shoulder function were at both ends of the fibular bone graft. Laterally, the aim was to achieve a stable union between the clavicle and fibula bones. This was key to facilitating load transmission from the shoulder to the axial line. The structural similarity of both bones was an added advantage, which obviated the need for intra-operative contouring. To provide greater contact surface for bone union, reciprocal 1 cm step-osteotomies of the bone were performed before plate fixation.
ally, because of the locking construct of the plate, we were able to place the screws in a monocortical manner and avoid damage to the great vessels lying beneath the flap. Radiographic bony union was evident between the clavicle and fibula on the 3rd month.

On the other hand, at the medial aspect of the construct where the new SCJ was sited, a rigid fixation was not ideal. A rigid construct restricts the shoulder girdle movement and may result in dislocation or implant migration. In a native SCJ, the joint capsule and strong ligaments provide most of the stability of the joint. With this understanding in mind, we opted for the combined method of loop suturing and wiring. Wiring was performed from inward to outward on the bone to avoid the brachiocephalic vein. The steel wire served as a “defunctioning” cerclage that was expected to fail after fibrous union was achieved. Optionally, we believe a tendon graft e.g. palmaris longus or semitendinosus tendon graft could be employed to secure the joint as in cases of chronic SCJ instability.7 Although the patient mentioned that the flap appearance bothered her, she was able to conceal the scar with necklaces and collared apparels.

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Conflicts of interest

All named authors hereby declare that they have no conflicts of interest to disclose.

Ethical approval

Not required.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jpra.2018.01.004.

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