Second Toe Metatarsophalangeal Joint Transfer for Sternoclavicular Joint Reconstruction

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Purpose We describe the anatomical basis for microsurgical reconstruction of the sternoclavicular joint using a vascularized, innervated second metatarsophalangeal joint, the surgical technique, and outcomes in 2 patients.

Methods We harvested the second metatarsophalangeal joint along with the joint capsule, portions of the metatarsal and phalanx, the flexor sheath and flexor tendon, the extensor sheath and tendon, the first metatarsal artery, and the deep peroneal nerve. This composite tissue was used for reconstruction of an excised sternoclavicular joint following infection or chondrosarcoma. The proximal phalanx was dowel-jointed into the manubrium and fixed with 1 or 2 screws; the metatarsal was plated to the remaining clavicle. The joint was oriented to allow maximal elevation and restricted depression, and the normal mediolateral laxity allowed anterior and posterior movement. Vascular anastomoses were performed to branches of the thoracoacromial axis vessels, and digital nerves were connected to a supraclavicular nerve.

Results Two patients had their excised sternoclavicular joints reconstructed using this technique. Both achieved union at the clavicular and sternal junctions. Both obtained restoration of movement of the sternoclavicular joint and upper limb. One patient developed joint subluxation and pain requiring tendon graft reconstruction of the costoclavicular ligament.

Conclusions In these 2 cases, the vascularized second toe metatarsophalangeal joint satisfactorily reconstructed the widely excised sternoclavicular joint and costoclavicular ligament and restored function. *(J Hand Surg Am. 2014;39(7):1327–1332. Copyright © 2014 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Therapeutic IV.

Key words Joint reconstruction, metatarsophalangeal joint, sternoclavicular joint.

THE STERNOCLAVICULAR JOINT IS THE only synovial articulation between the upper limb and the axial skeleton. The joint permits movement of the clavicle in elevation and depression, protraction and retraction, and axial rotation.[1,2] The sternoclavicular joint allows the lateral clavicle to elevate 30°, depress by 5° to 10°, move forward and backward 15°, and rotate 45°. The joint is saddle-shaped, separated by an articular disc, and comprises the medial clavicle, first rib, and manubrium.[3] The joint has inherently low osseous stability and is stabilized by 4 ligaments (the anterior and posterior sternoclavicular capsular ligaments, interclavicular ligament, and costoclavicular ligament) and the subclavius muscle.[3]

Injuries to the sternoclavicular joint occur rarely and classically involve anterior or posterior dislocation. Surgery may be indicated for chronic symptomatic anterior dislocation or recurrent or nonreducible posterior dislocation, and techniques have focused on ligamentous reconstruction using the joint capsule and disc, suture reconstruction, and fascia or tendon grafts with variable outcomes.[4]

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Received for publication July 11, 2013; accepted in revised form March 24, 2014.

No benefits in any form have been received or will be received related directly or indirectly to the subject of this article.

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0363-5023/14/3907-0013$36.00/0
http://dx.doi.org/10.1016/j.jhsa.2014.03.027

Patients may function reasonably well without a sternoclavicular joint provided the costoclavicular ligament and subclavius are preserved. Indeed, some authors propose resection of the medial 1 cm of clavicle to treat the arthritic sternoclavicular joint, but they need to preserve the costoclavicular ligament and subclavius.[5] Sternoclavicular joint reconstruction following resection of the medial clavicle and costoclavicular ligament, for example, after debridement for septic arthritis/osteomyelitis or malignancy, is even more challenging. Excision of the medial clavicle, costoclavicular ligament, and subclavius disrupts the ligamentous attachments of the clavicle to the chest wall and may result in chronic pain and instability.[6] There have been single case reports of mesh−bone cement sandwiches[7] and joint reconstruction by arthrodesis using metal plates or K-wires.[8] These techniques have resulted in loss of motion.

We describe a technique of sternoclavicular joint reconstruction using a vascularized, innervated second toe metatarsophalangeal (MTP) joint. The MTP joint reconstructed the movement of the sternoclavicular joint in the required 3 planes, thereby providing a reconstruction that is both stable and mobile. Vascularized transfer of the joint ensured more reliable viable transfer of the cartilaginous and bony components of the joint and maximized union prospects in a previously operated, relatively devascularized field. Innervating the joint may reduce the risk of development of a Charcot joint and future degeneration. Two patients underwent reconstruction of their sternoclavicular joint and medial clavicle; we report on their outcomes.

MATERIALS AND METHODS

MTP joint harvest

The ipsilateral second toe joint was chosen so that, when the proximal phalanx was inserted into the manubrium and the metatarsal was fixed to the clavicle, the medial pedicle would lie posterior and have unimpeded access to vessels that lie posterior to the clavicle. The second toe metatarsal and proximal phalanx were harvested through a dorsal longitudinal incision. The joint vascularity was maintained on the dorsal or plantar vessels and the saphenous vein, and we preserved its innervations from the deep peroneal nerve.[9] The joint was taken with the medial dorsal interosseous musculotendinous unit, the toe extensors, and toe flexors. The flexors were later removed, but the plantar plate was preserved to reinforce the MTP joint. The joint was excised by dividing the second metatarsal at its base and the proximal phalanx just proximal to the proximal interphalangeal joint (Fig. 1).

The donor site was reconstructed by repairing the deep transverse metatarsal ligament between the first and the third toes and placing a cerclage suture around the first and third metatarsals, as in a standard second toe harvest.

Recipient preparation and joint reconstruction

An incision parallel to the clavicle extending to the midline was made over the sternoclavicular joint and medial clavicle, through the previous resection scar where possible. The incision was continued distally over the manubrium. The pectoralis major, subclavius, sternomastoid, and infrahyoid muscles were dissected from the fibrous tissue and the manubrium. Scar tissue between the stump of the clavicle and the manubrium and from behind the manubrium was excised. With the surgeon's fingers behind and deep to the manubrium, a 2.4-mm guidewire was inserted into the manubrium starting at the center of the sternoclavicular joint and heading medially at an angle of 30° in the coronal plane and anteriorly with 10° of axial angulation (Figs. 2 and 3). The guidewire was then carefully overdrilled with 6- and 7-mm cannulated drill bits to a depth equal to the length of the proximal phalanx. The proximal phalanx was inserted into the drill hole in the manubrium and held in place by 1 or two 2.7-mm transverse fixation screws. The joint was inserted with normal orientation such that MTP joint extension was used to reconstruct elevation, and MTP joint flexion (which is inherently more limited) reconstructed clavicle depression, thereby limiting brachial plexus compression. The normal lateral laxity of the MTP joint reproduced the anterior and posterior movement of the sternoclavicular joint. The second metatarsal was fixed to the remaining clavicle using a clavicle plate. The plantar plate was sutured to the first rib to reconstruct the costoclavicular ligament.

Neurovascular connections

Through the lateral portion of the same incision, the deltopectoral groove was explored, the metatarsal artery was anastomosed end to end to a branch of the thoracoacromial axis, and the saphenous vein was anastomosed end to end to the cephalic vein. The deep peroneal nerve was coapted to a supraclavicular nerve branch.

Postoperative management

In the immediate postoperative period, flap perfusion was monitored with an implantable venous Doppler