

Clinical Paper  
Reconstructive Surgery

# Superior half of the sternoclavicular joint pedicled with the sternocleidomastoid muscle for reconstruction of the temporomandibular joint: a preliminary study with a simplified technique and expanded indications

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*M. Chen, C. Yang, Y. Qiu, D. He, D. Huang, W. Wei: Superior half of the sternoclavicular joint pedicled with the sternocleidomastoid muscle for reconstruction of the temporomandibular joint: a preliminary study with a simplified technique and expanded indications. Int. J. Oral Maxillofac. Surg. 2015; 44: 685–691.*  
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**Abstract.** The sternoclavicular joint (SCJ) has similar anatomical and physical characteristics to the temporomandibular joint (TMJ). The purpose of this article is to introduce a modified technique for the pedicled SCJ and the expanded indications for its use. During the period June 2011 to June 2014, six TMJs were reconstructed using the superior half of the SCJ pedicled with the sternocleidomastoid muscle. The inclusion criteria were (1) poor vascularization jeopardizing a non-vascularized TMJ replacement, and/or (2) a large defect of both bone and soft tissue. The average follow-up period was 14.8 months (range 7–39 months). Fracture of the clavicle occurred in one patient (16.7%). No recurrence, graft resorption, or secondary deformity was found. Reconstruction of the TMJ using the superior half of the SCJ pedicled with the clavicle head of the sternocleidomastoid muscle and sternocleidomastoid branch of the superior thyroid artery benefited patients who had a poor blood supply and a medullary condition or who had a defect in both the condyle and surrounding soft tissue.

**Key words:** pedicled sternoclavicular joint; temporomandibular joint; sternocleidomastoid muscle; height of the ramus; resorption.

Accepted for publication 13 March 2015  
Available online 2 April 2015

The condyle of the temporomandibular joint (TMJ) plays an important role in facial aesthetics and jaw function. Loss of the condyle may sometimes occur due to developmental disorders, trauma, ankylosis, osteoarthritis, idiopathic resorption, a benign or malignant pathology, or infection.<sup>1</sup> Multiple autogenous tissues and alloplastic materials have been used to reconstruct the condyle. However, due to the high cost of alloplastic materials, most countries prefer autogenous grafts, such as the coronoid process, border of the ramus, costochondral graft (CCG), sternoclavicular joint (SCJ), iliac crest, vascularized metatarsophalangeal joint, and fibular flap.<sup>2</sup>

The SCJ has similar anatomical and physical characteristics to the TMJ,<sup>3,4</sup> and the absence of the SCJ results in no obvious functional or aesthetic problems. Since the study by Wolford et al.<sup>5</sup> in 1994, recent reports have stated a preference for the free superior half of the SCJ for reconstruction of the TMJ. The key point of this technique is to place the graft on the posterior border of the mandible such that the graft can be vascularized by direct exposure of the graft marrow to adjacent soft tissue. However, for some patients with poor vascularization jeopardizing a non-vascularized TMJ replacement, the free SCJ graft may be absorbed due to ischaemia. Further, some malignant tumours may result in a defect of both the condyle and soft tissue, and the free SCJ graft may be insufficient to pack the defect. Although Siemssen<sup>6</sup> and Korula et al.<sup>7</sup> described a method for replacement of the TMJ with a muscle-pedicled SCJ, this technique was too complex and invasive to become widely accepted. In addition, all reports on the SCJ were for the indication of ankylosis.

Is there a more simplified technique for the muscle-pedicled SCJ? Could it be tried in other conditions where there is poor vascularization or a large resection area?

To answer these questions, six TMJ reconstructions using the superior half of the SCJ pedicled with the sternocleidomastoid muscle were attempted between June 2011 and June 2014. The purpose of this article is to introduce the indications for the use of the pedicled SCJ and the modified technique, and to report the preliminary effects.

## Materials and methods

The study protocol was approved by and was performed in accordance with the recommendations of the human research committee of the study institution. All patients gave written consent prior to scanning and surgical procedures.

## Patients

The inclusion criteria were (1) poor vascularization jeopardizing a non-vascularized TMJ replacement, and/or (2) a large defect of both bone and soft tissue. The prospective clinical study included six patients (six TMJs) from June 2011 to June 2014. The male to female gender ratio was 1:5 (female preponderance). The age range was 31 to 65 years, with a mean age of 51.3 years. All defects were on the right side. The preoperative diagnosis was neoplasm in four cases, osteonecrosis after septic arthritis in one case, and recurrent ankylosis after CCG reconstruction in one case (Table 1). Two patients suffered from malignant tumours, and a large resection was performed. Two patients with synovial chondromatosis had a destroyed condyle that could not be separated from the calcified mass and needed a condylectomy with resection of the mass.

## Modified surgical technique

The surgical intervention was performed under general anaesthesia. A temporal and

pre-auricular approach was used to explore the TMJ and to remove the condyle with or without the surrounding soft tissue.<sup>8,9</sup> A pedicled deep temporal fascial fat flap (DTFFF) of 5–6 mm in thickness was prepared to separate the skull base and the SCJ.<sup>10</sup> A submandibular approach was used to gain access to the ramus of the mandible and to shave the posterior border of the ramus. The mandible was secured with maxillomandibular fixation, except in the patient with recurrent ankylosis whose mandible was stabilized with an occlusal relocation splint.

The ipsilateral SCJ was harvested. An incision was made 1 to 2 cm above the clavicle. The sternocleidomastoid muscle was exposed. The periosteum and the clavicle head of the muscle attachment of the superior and medial aspect of the clavicle were protected (Fig. 1). The ligamentous attachments of the articular disc of the SCJ were maintained with the graft. The technique used to cut down the superior half of the clavicle and SCJ with half disc was identical to the Wolford technique.<sup>5</sup> The remaining half of the SCJ and the sternal head of the sternocleidomastoid muscle remained in situ. The sternocleidomastoid muscle was released until the folded muscle was long enough for the SCJ to reach the glenoid fossa. In this way, the SCJ graft pedicled with the clavicle head of the sternocleidomastoid muscle was obtained. The remaining clavicle was fixed with a thick titanium plate to avoid fracture.

The SCJ graft was transferred to the TMJ region through the subcutaneous tissue of the neck. The SCJ graft was then fixed to the posterior border of the ramus with two titanium plates, providing the best fit in the glenoid fossa (Fig. 2). The disc of the graft was sutured to the lateral pterygoid muscle or DTFFF. Finally the surgical areas were irrigated and closed. Elastic maxillomandibular fixation was placed for 1 month in order

Table 1. Patient data.

Patient no.	Gender	Age (years)	Side	Aetiology	Indication for pedicled SCJ	Symptoms
1	F	47	R	Metastatic tumour from breast	Defect both of condyle and soft tissue	Swelling
2	M	65	R	Synovial chondromatosis	Defect of condyle; age	Pain, limitation of mouth opening
3	F	56	R	Synovial chondrosarcoma	Defect both of condyle and soft tissue; age	Pain, swelling, noise
4	F	55	R	Osteonecrosis after septic arthritis	Infection; age	Pain, limitation of mouth opening
5	F	54	R	Synovial chondromatosis	Defect of condyle; age	Pain, swelling, noise
6	F	31	R	Recurrent ankylosis after CCG reconstruction	Defect both of condyle and soft tissue; scar of soft tissue	Asymmetry, swelling, limitation of mouth opening, malocclusion

SCJ, sternoclavicular joint; F, female; M, male; R, right; CCG, costochondral graft.

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