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Novel technique for harvesting the sternoclavicular graft

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ABSTRACT

Purpose: Originally introduced for mandibular reconstruction more than 40 years ago, the sternoclavicular graft (SCG) has gained widespread popularity for the reconstruction of the ramus-condyle unit (RCU) owing to its anatomic and histological likeness to the normal mandibular condyle. Conventional longitudinal osteotomy design for its harvest has been fraught with considerable complications at the donor site including fracture clavicle and major neurovascular injury. In an attempt to alleviate these ill effects, a new technique for procuring the sternoclavicular graft is presented.

Material and methods: A split-thickness cortico-cancellous graft was harvested form the sternal end of the clavicle along with the articular disk with the osteotomy cut oriented parallel to the coronal plane, with limited soft tissue dissection. Donor site complications were assessed in terms of incidence of clavicle fracture, neurovascular injury, pleural tear and radiographic healing as seen in the six-month postoperative chest radiograph.

Results: 17 patients suffering from unilateral temporomandibular joint ankylosis underwent SCG harvesting for RCU reconstruction following osteoarthrectomy. No adverse events were seen in the intra- and post-operative period in any patient and satisfactory radiographic osseous healing was observed after six months.

Conclusion: The proposed harvest technique for SCG results in reduced donor site morbidity and favourable healing and greater patient comfort.

1. Introduction

The sternal end of the clavicle has been classically used to replace the pathological mandibular condyle following its surgical resection, primarily owing to the unique likeness of the anatomy and histology of the sternoclavicular joint to the normal temporomandibular joint (TMJ) (Ellis and Carlson, 1986).

The technique for harvesting the graft has evolved from its first description by Snyder in 1971 as a whole joint graft including the manubrium, the intact capsule, and a part of the clavicle (Snyder et al., 1971a). In 1984, Reid et al. described a vascularized clavicular free flap based on the clavicular head of pectoralis major and modified the harvest deign by longitudinally splitting the clavicle, based on the observation that the entire clavicle head was too large to fit into the glenoid fossa (Reid et al., 1986). Subsequently, Wolford et al., in 1994 fashioned a split-thickness clavicular graft using the superior half of the bone for condylar reconstruction (Wolford et al., 1994).

More than two decades have elapsed since Wolford et al. described the surgical technique for harvesting the SCG for TMJ reconstruction. Although the technique is based on sound principles and continues to be popular among contemporary surgeons (Singh et al., 2011), the authors experienced unfavorable donor site morbidity, with a 10% incidence of clavicular fractures (Wolford et al., 1994). We present a novel graft design that we believe results in a superior esthetic outcome and less morbidity at the donor site.

2. Material and methods

A prospective study was conducted in 17 patients with unilateral TMJ ankylosis, who reported to the author's institution for treatment. All included patients were free of any pre-existing systemic or neurological disorder, with no history of prior injury to the clavicle or surgery to the concerned area. The prior approval of the institutional review board, permission from the local ethical committee, and written informed consent from the patients or parents were obtained.

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Table 1
Parameters for assessment of outcome.

S. no.	Intraoperative	Postoperative
1.	Clavicle fracture	Clavicle fracture ± sensorimotor deficit due to brachial plexus injury
2.	Great vessel injury	Clavicular contour deformity
3.	Pleural tear	

S. no. = Serial number.

The parameters used for assessment of the outcome using the modified harvest technique are shown in Table 1.

2.1. Surgical technique

The surgery was performed under general anesthesia. After aseptic preparation and draping of the patient, TMJ ankylosis release was performed to achieve an interincisal opening of ≥35 mm. The resected end of the temporal bone was shaped to simulate a normal glenoid fossa and lined with a partial thickness temporalis myofascial flap.

For harvesting the sternoclavicular graft, a horizontal incision was marked 1–2 cm above and parallel to the clavicle, beginning at its medial end and extending up to 5 cm laterally (Fig. 1). After local infiltration of lignocaine with adrenaline, the incision was given through the skin and subcutaneous tissue. Blunt dissection was done to create a subcutaneous pocket to facilitate closure, after which the incision was pulled down over the clavicle and soft tissues overlying the bone, including muscles and the periosteum, were incised.

Meticulous subperiosteal dissection was done to reflect the soft tissues off the entire outer (ventral) surface of the clavicle, exposing it from the superior (cephalic) to the inferior (caudal) surface, sparing the inner (dorsal) aspect (Fig. 2). Medially, exposure of the joint capsule was performed up to the clavicular end of the manubrium sterni. Throughout the dissection, extreme care was taken to stay within the periosteal envelope and to avoid inadvertent pleural laceration.

Following exposure, an osteotomy design was marked to include the outer corticocancellous half of the clavicle, splitting the superior and inferior surfaces of the bone along a cephalocaudal plane. Medially, the graft invariably incorporated the fibrocartilaginous articular disk, while the lateral extent was more flexible, being determined by the size of the harvest required to optimally reconstruct the vertical dimension of the ramus-condyle unit, usually so extending as to yield a graft of length 3–5 cm. The width of the resultant graft was variable, due to individual discrepancies in the dimensions of the clavicle.

Fig. 1. Incision marking for harvest of sternoclavicular graft.

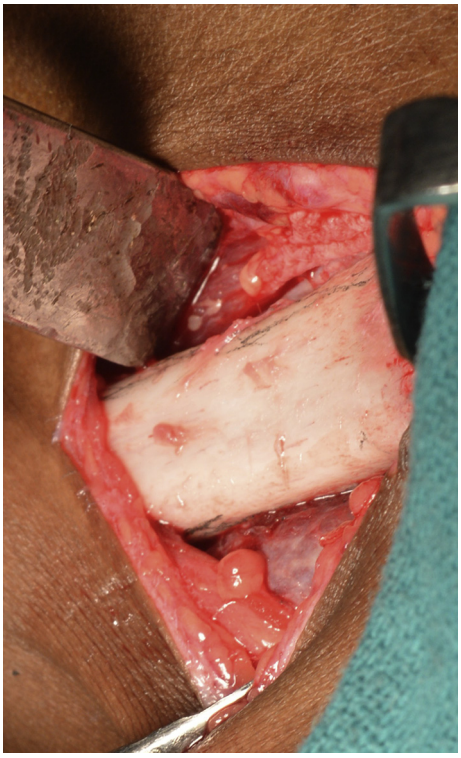

Fig. 2. Exposure of the ventral surface of the clavicle.

The osteotomy was performed along the marked design using an oscillating saw or fine rotary burs, orienting the blade or bur angle marginally outward (anteriorly) to prevent inadvertent inner cortical perforations, while carefully preserving continuity of the bone at the superior and inferior surfaces. The depth of the osteotomy was maintained such that it resulted in sectioning the clavicle into no more than half of its anteroposterior width, to maximize the quantity of remaining bone at the donor site, while gathering a favorable volume of graft. The lateral extension of the osteotomy was tapered outward to avoid creating a sharp line angle.

Next, the osteotomy was propagated using fine chisels, tethering the graft at the medial end, where the capsular attachment and the cartilaginous part of the sternal head needed to be severed using a blade to deliver the graft. The articular disk was anchored to the

Fig. 3. The harvested corticocancellous sternoclavicular graft including the articular disk (sutured to the clavicular head) showing the outer and inner surfaces.