

# Costochondral Graft Versus Total Alloplastic Joint for Temporomandibular Joint Reconstruction



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## KEYWORDS

- Temporomandibular joint replacement • Costochondral graft • Autogenous bone graft
- Alloplastic temporomandibular replacement

## KEY POINTS

- Alloplastic temporomandibular joint (TMJ) replacement devices do not require a donor site.
- Alloplastic TMJ replacement devices require less surgery time.
- Custom alloplastic TMJ replacement devices can be designed and manufactured to conform to the anatomic situation.
- Alloplastic TMJ replacement device components are not susceptible to prior failed implant foreign body particles or local or systemic pathology.
- Immediately after alloplastic TMJ replacement device implantation, patients can begin physical therapy, hastening regaining mandibular function.

## INTRODUCTION

The intricate craniofacial anatomic and functional relationships associated with the temporomandibular joint (TMJ) presents challenges to reconstruction. The function and form of the TMJ is important for mastication, speech, deglutition, airway support, facial esthetics, psychological development, and quality of life.

Considering not only these functional and form issues but also patients' neurologic, physiologic, and biological problems, as well as what can be technically achievable, the following parameters for successful reconstructive outcomes were established (**Box 1**).<sup>1</sup> The indications for TMJ replacement are shown in (**Box 2**).<sup>2</sup> The surgeon presented with any of these scenarios currently has 2 replacement options, either autogenous or

alloplastic. This article presents an evidence-based discussion of the advantages and disadvantages of autogenous and alloplastic TMJ replacement to assist both the surgeon and their patients in making that choice.

## AUTOGENOUS TEMPOROMANDIBULAR JOINT REPLACEMENT

Autogenous bone grafting has been reported to be the gold standard for the reconstruction of developmental deformities, end-stage TMJ pathology, and ankylosis using either free or vascularized bone grafts from the rib,<sup>3</sup> calvarium,<sup>4</sup> clavicle,<sup>5</sup> iliac crest,<sup>6</sup> or fibula.<sup>7</sup>

Besides the reported unpredictability of autogenous grafting,<sup>8–12</sup> complications frequently arise when transplanting autologous bone.

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**Box 1****Parameters for successful temporomandibular joint replacement outcomes**

Improvement of mandibular function and form  
 Reduction of further suffering and disability  
 Containment of excessive treatment and cost  
 Prevention of further morbidity

*Adapted from Mercuri LG. Alloplastic temporomandibular joint reconstruction. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1998;85:633; with permission.*

Complications associated with iliac crest bone harvest have been reported in up to 19% of cases and include chronic pain, skin sensitivity disorders, and complicated wound healing. These complications can lead to hypertrophic scarring or infection, fracture, and prolonged length of hospitalization, all associated with additional morbidity and medical costs.<sup>13,14</sup>

The costochondral graft has been the most frequently recommended autogenous bone graft for TMJ replacement because of its ease of adaptation to the recipient site, its gross anatomic similarity to the mandibular condyle, the reported low donor site morbidity rate, and its demonstrated growth potential in skeletally immature patients.<sup>3,15-19</sup>

Saeed and Kent<sup>20</sup> reported a retrospective review of 76 costochondral grafts undertaken to determine the outcome with respect to the extent of previous TMJ surgery. The minimum follow-up period was 2 years. The results demonstrated improvement in pain and diet scores, with a moderate increase in interincisal distance. They concluded that in patients with no previous surgery, arthritic disease, or congenital deformity, the costochondral graft performed well. However, a preoperative diagnosis of ankylosis was

**Box 2****The indications for temporomandibular joint replacement**

End-stage arthritic disease  
 Bony or fibrous ankylosis  
 Failed autogenous tissue reconstruction  
 Failed alloplastic reconstruction

*Adapted from Mercuri LG, editor. Temporomandibular joint total joint replacement – TMJ TJR – a comprehensive reference for researchers, material scientists and surgeons. New York: Springer; 2015; with permission.*

associated with a high complication rate and need for further surgery, suggesting caution in that group of patients.

Medra<sup>21</sup> reviewed the records of 55 patients with TMJ ankylosis treated with costochondral grafts followed clinically and radiographically for 7 to 10 years. He reported good remodeling in 59%, reankylosis in 9%, resorption of the graft in 25%, and overgrowth of the graft in 4%. Mouth opening was satisfactory in 58% and unsatisfactory in 18%, and the operation was a failure in 24%.

Reitzik<sup>22</sup> reported that in a situation analogous to autogenous costochondral grafting, cortex-to-cortex healing after vertical ramus osteotomy requires 20 weeks to consolidate in monkeys and probably 25 weeks in humans.

Maxillomandibular fixation (MMF) is typically maintained for some period in patients who have undergone TMJ replacement with costochondral grafts. Despite screw/plate fixation, graft micromotion will invariably occur with any early mandibular function. This micromotion results in shear stresses on the graft/host interface that potentially can lead to poor neovascularization, nonunion, or failure.<sup>23</sup>

The success of any autogenous tissue graft requires the host site have a rich vascular bed. Because of the formation of scar tissue, patients who have undergone multiple surgeries or who have long-standing end-stage TMJ pathology do not provide an environment conducive to the predictable success of free and occasionally vascularized autogenous tissue grafts. Marx<sup>9</sup> reported that capillaries can penetrate a maximum tissue thickness of 180 to 220  $\mu\text{m}$ , whereas scar tissue surrounding previously operated bone averages a thickness of 440  $\mu\text{m}$ . This finding and micromotion may account for the clinical observation that free autogenous tissue bone grafts often fail in those patients who have extreme anatomic architectural discrepancies resulting from prior surgery or pathology.<sup>24</sup>

Theoretically, autogenous costochondral grafts “grow with the patient.”<sup>15,17,25</sup> However, often this so-called growth has been reported to be unpredictable or results in ankylosis.<sup>8,26-31</sup> These complications can occur as the result of the micromotion, poor revascularization, or lack of compliance of young patients with postimplantation physical therapy.<sup>32</sup>

Recent studies have even questioned the necessity for using a cartilage-containing graft to restore and maintain mandibular growth.<sup>33,34</sup> Long-term reports of mandibular growth in children whose TMJs were reconstructed with costochondral grafts have demonstrated that excessive

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