

Reconstruction of Bilateral Mandibular Condyles Using a Single Vascularized Fibula

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Summary: Patients with end-stage temporomandibular joint (TMJ) pathology present with loss of vertical ramus height with resulting retrognathia, anterior open bite, and restricted jaw function requiring joint reconstruction. Costochondral grafts, long considered the gold standard for TMJ reconstruction, carry risks of bony ankylosis and resorption. Custom-made alloplastic TMJ prostheses show excellent objective and subjective outcomes but are also associated with complications such as infection or metal sensitivity, and necessitate hardware explantation in some cases. Revision surgeries are rare but present a real challenge. We present the case of a 50-year-old woman with longstanding TMJ arthritis, having undergone many surgical procedures to her TMJ, including explantation of failed alloplastic replacement, who presented with bilateral facial weakness as well as difficulty chewing and swallowing food. She had class II malocclusion with retrodisplacement of her mandible and anterior open bite, and moderate trismus with an inter-incisal opening of only 15 mm, consistent with fibrous ankylosis. After weighing all the reconstructive options, bilateral mandibular condyle and ramus reconstruction with a single fibula free flap (FFF) was planned with the use of preoperative virtual surgical planning (VSP) and 3D-printing of osteotomy and repositioning guides. A 2-team approach increases efficiency of the procedure and decreases operative time. The procedure and postoperative recovery were uncomplicated, and at her 2-month follow-up, she had increased range of motion and maintained the planned position of her mandible. Her masticatory function and deglutition were also improved due to the correction of her malocclusion and repair of her anterior open bite. (*Plast Reconstr Surg Glob Open* 2021;9:e3154; doi: 10.1097/GOX.0000000000003154; Published online 25 January 2021.)

End-stage temporomandibular joint (TMJ) disease commonly requires autogenous or alloplastic joint replacement to alleviate pain and improve function.¹ Costochondral grafting is the most widely used method of autogenous reconstruction though results can be unpredictable.² Despite the success of free fibula transfer for post-oncologic mandibular (including condyle) reconstruction³ and the relatively low donor site morbidity of this technique, it is used sparingly in reconstruction of the ramus and condylar unit, let alone bilateral TMJ reconstruction. We present a viable alternative for the synchronous reconstruction of bilateral condyle/ramus units using a single fibula free flap (FFF).

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CASE PRESENTATION

The patient is a 50-year-old woman with TMJ-localized arthritis since age 16. She presented with inability to fully open her mouth, bilateral facial weakness, and difficulty chewing food. Despite several surgeries, continued bilateral mandibular condylar resorption had eventually led to alloplastic bilateral total joint replacement. Hardware infection then ensued requiring device explantation. On presentation, the prostheses had been removed, with loss of ramus height resulting in class II malocclusion (Fig. 1A). She also exhibited moderate trismus with an inter-incisal opening of 15 mm.

Bilateral mandibular ramus and condylar reconstruction with a single FFF was proposed. Virtual surgical planning (VSP) using VSP Reconstruction (Stryker, Kalamazoo, Mich.) allowed for the fabrication of 3D-printed osteotomy and positioning guides. Two surgical teams worked simultaneously. Superiorly, cervicomastoid facial incisions were made to expose the glenoid fossae and mandibular rami, and to identify and protect the facial nerve. The surgical bed was prepared to receive the patient-specific

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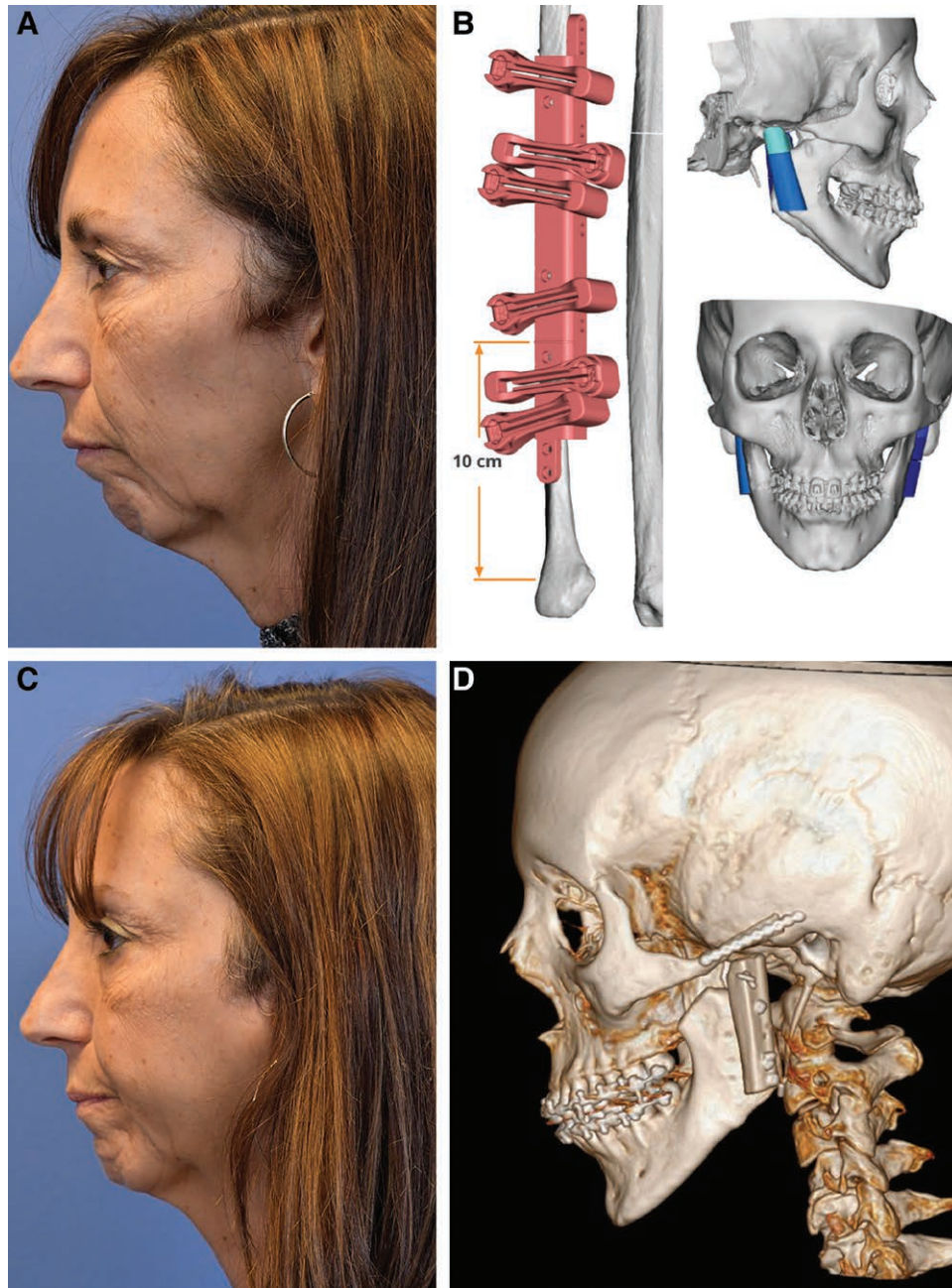


Fig. 1. Bilateral condylar reconstruction with single fibula. A, Preoperative assessment demonstrates a previously operated patient now presenting with posterior displacement of the mandible, class II malocclusion, and trismus. B, Virtual surgical planning of fibular cutting guides and free flap inset. C, At follow-up, the patient shows improved mandibular range of motion and interincisal opening with maintenance of occlusion and jaw position. D, Post-operative CT shows the TMJ reconstructed bilaterally by precise fixation of the divided fibular segments.

guides used to help reposition the transferred fibular segments (neocondyle).

The second team harvested the FFF using a novel technique: dividing it into 2 flaps each with its own vascular pedicle and associated segment of bone perforator-based skin paddle. Bone graft from the fibular remnant was used to reconstruct the zygomatic arches to restore preauricular facial contour. The neocondyle was shaped using the guide to mimic the contour of the mandibular condyle.

Each condyle-ramus construct was then positioned on the native ramus using the positioning guide to ensure proper seating of the neocondyle in the glenoid fossa. Bicortical screws were used to fix the fibula segments to the native ramus. Microvascular anastomoses were performed between the peroneal and occipital arteries bilaterally, with venae comitantes joined to branches of the external jugular vein. A portion of each of the skin paddles was de-epithelialized and placed between the head of the

neocondyle and the glenoid fossa to lessen the risk of ankylosis, while the remainder of each skin paddle was inset to allow for flap monitoring. The patient developed venous congestion of 1 flap on postoperative day 1 and returned to the OR for venous anastomosis revision. The remainder of the postoperative course was uncomplicated, and the patient was discharged home in stable condition on day 7.

At her 2-month follow up, the patient was noted to have improved range of motion of the mandible and interincisal opening of 32 mm with maintenance of occlusion and jaw position and reported improvement in masticatory function (Fig. 1B). She underwent excision of the skin paddles (flap monitors) with local tissue rearrangement 6 months after the initial procedure.

DISCUSSION

Patients with end-stage TMJ disease can benefit from total joint replacement both to re-establish mandibular height and position, and to restore temporomandibular function and range of motion. Although several suitable autogenous donor sites exist (including iliac crest, calvaria, and sternoclavicular joint), costochondral grafts (CCG) offer superior shape, easy harvest with low morbidity, and allow for the transfer of a cartilaginous cap mimicking the composition of the native condyle with potential for continued growth in pediatric patients.⁴ Complications of autogenous grafts include donor site morbidity, resorption, and ankylosis.⁴

Patient-specific TMJ prostheses represent another increasingly popular option for total joint replacement. The main advantages of these devices are the lack of donor site morbidity, shorter operating time, and the ability to initiate early postoperative physical therapy. Retrospective studies and meta-analysis showed excellent functional outcomes with significant reduction in pain and increased range of motion of the mandible.^{5,6} Device-related complications include material hypersensitivity (allergy), fretting corrosion, mechanical failure (unpredictable component wear), loosening, heterotopic bone formation leading to extra-articular bony ankylosis, and infection.²

Compared with bone grafts, vascularized flaps are less likely to resorb.² Computer-assisted planning now allows for precise positioning of the distal end of the fibula segment (neo-condyle) into the glenoid fossa with placement of an interpositional graft (fibula skin paddle) resulting in better functional outcomes.⁷ The FFF provides appropriate shape and biomechanical properties to create a vertical stop for the reconstructed ramus, helping in maintaining the position of the mandible (Fig. 1C–D). With time, the neocondyle portion of the fibula remodels by rounding off and narrowing of the end of the transplant.⁸ Lee et al. reported good aesthetic and functional outcomes in a study of 14 patients who had undergone the reconstruction of mandibular defects involving the condyle using only a free fibula graft with the help of VSP.⁷ In another report, Wang et al.⁹ reported the results of 10 patients who underwent condylar reconstruction, and concluded that the vertical height of the neomandible and facial contour were precisely predicted using preoperative computer-assisted planning. Partition of the fibula into 2 segments with independent pedicles allows for bilateral reconstruction with a

single FFF if suitable perforators can be found. CT angiography can be employed in designing an appropriate skin paddle for each osteocutaneous free flap.¹⁰

CONCLUSIONS

We present a case of a multi-operated patient with end-stage TMJ disease who, having failed alloplastic joint reconstruction, required an autogenous reconstructive alternative. Bilateral reconstruction using a single fibula split into 2 vascularized free flaps allowed for the repositioning of the mandible to restore occlusion without the unpredictable resorption and resultant loss of ramal height commonly seen with CCG. This single donor site method also avoids lengthy, or multi-stage bilateral harvest with associated additional morbidity and postoperative sequelae. VSP can be leveraged to achieve more reliable functional and aesthetic outcomes, making this technique a viable option for patients with a similar reconstructive dilemma.

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PATIENT CONSENT

The patient provided written consent for the use of her image.

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