ONLINE FIRST

Improving Aesthetic Outcomes in Pediatric Free Tissue Oromandibular Reconstruction

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Objective: To review our substantial favorable experience with oromandibular free tissue reconstruction in pediatric patients, emphasizing technical pearls, which seem to be associated with favorable long-term aesthetic and functional outcomes.

Methods: Retrospective review of a consecutive series of all free tissue transfers performed from 1997 to 2010 by the senior author (Y.D.) in patients younger than 18 years. Demographic data, techniques used, and complications were examined.

Results: A total of 51 patients were identified, and their data were available for collection. Twenty-eight were female, and 23 were male; the mean age was 10 years (range, 4-17 years). Flaps performed included 43 fibula free flaps and 8 radial forearm free flaps with successful transplantation in each case. Twenty-six patients had temporomandibular joint reconstruction as part of their initial repair. The reasons for reconstruction were trauma (in 18 cases) and oncologic (in 33 cases). Functional and aesthetic results were improved with minimal access, maximal exposure approaches as outlined.

Conclusions: Pediatric free tissue oromandibular reconstruction is associated with excellent outcomes in most patients. Specific technical modifications allowing for minimal visible scarring and improved function, particularly at the level of the joint, allow for rewarding results in young patients.

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FREE TISSUE TRANSFER IN PEdiatric patients has been performed since the beginnings of microsurgery in the 1970s. However, trepidation toward microvascular surgery in children existed owing to perceived diminutive vessel size, decreased amount of donor tissue available for transfer, and potentially increased donor site morbidity. As surgical instruments and techniques have improved, microvascular reconstruction in this population has become more common. Literature evaluating the success of free flaps in children has shown the flap survival rate, 96%, to be comparable with adult success rates.[1]

Many series evaluate diverse groups of pediatric patients with various defects and an assortment of free flaps; however, others focus specifically on head and neck reconstruction. An early review from Toronto, Ontario, Canada,[2] examined mandibular reconstruction with the fibula free flap. The authors' series of 10 flaps in children aged 5 to 17 years showed 100% flap survival with class I occlusion in all patients. Problems with soft-tissue contouring were a primary concern. While series such as this have shown viability and success of the fibula free flap in children, questions arise concerning use of this flap in a young population. For example, should reconstruction be immediate or delayed? One group[3] found that a delayed reconstruction led to worse cosmetic and functional results owing to fibrosis, and they recommended immediate reconstruction in cases of tumor removal, or soon after debridement with traumatic etiologies of tissue loss. Another question is whether the fibula flap will affect maxillofacial growth in the growing child, and if orthognathic surgery will be needed in these patients. Some recommend further surgery and planned mandibular osteotomies based on the initial age of the patient at the time of the free flap.[4,5] However, a study from M. D. Anderson Cancer Center, Houston, Texas,[6] found that malocclusion was uncommon and none of the patients included in the study needed further orthognathic surgery. The fibula flaps "accommodated" to the continued mandibular growth as long as the mandibular growth plates were not removed or injured. This group recommended removing reconstruction plates once bony union was proven in order to promote further growth/remodel-

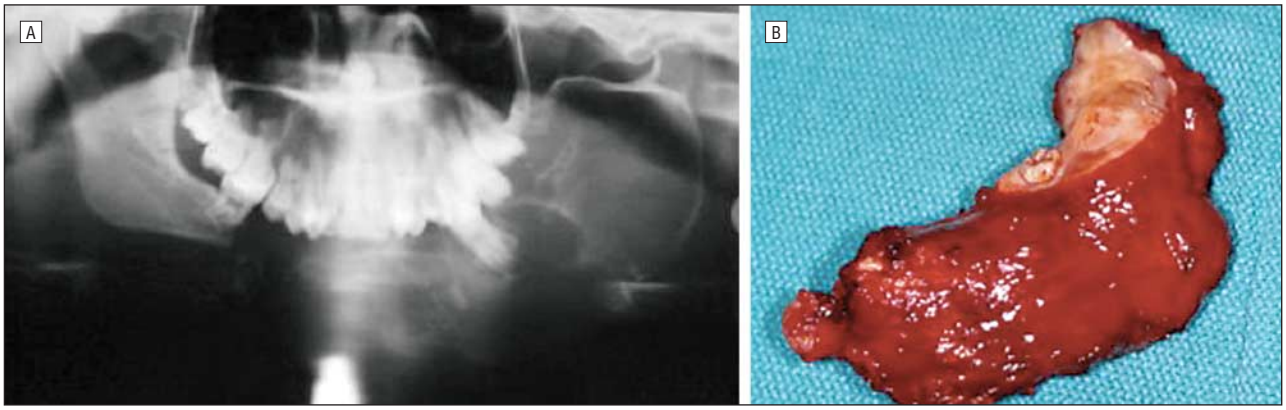

Figure 1. Preoperative panorex demonstrating recurrent ameloblastoma occupying the left mandible and condylar region. A, View across midline. B, The resected specimen includes condyle.

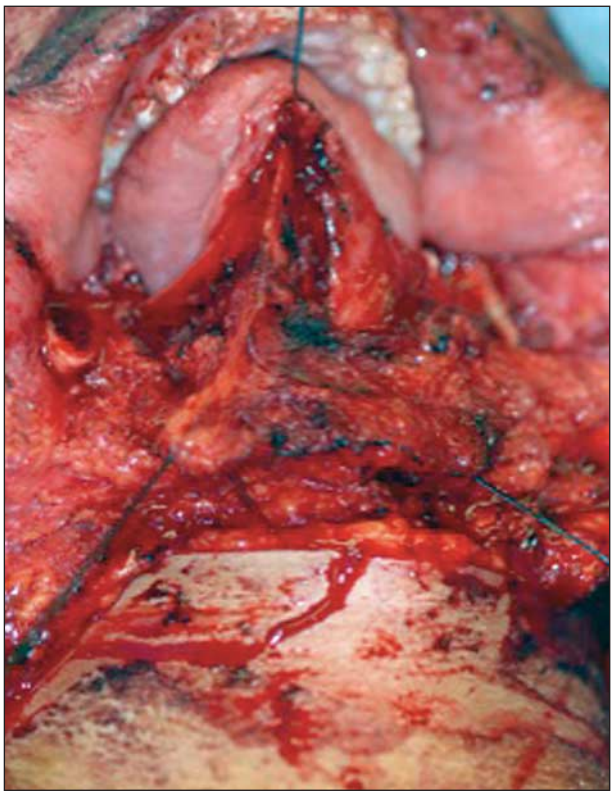

Figure 2. Suprahyoid muscles are tagged for later suspension.

ing. Herein, we will review our favorable experience in this patient population.

METHODS

This is a retrospective review of a consecutive series of all free tissue transfers performed from 1997 to 2010 by the senior author (Y.D.) in patients younger than 18 years. Demographic data, techniques used, and complications were examined. Consent was obtained for all procedures from parents or guardians.

RESULTS

A total of 51 patients were identified, and their data were available for collection. Twenty-eight were female, and

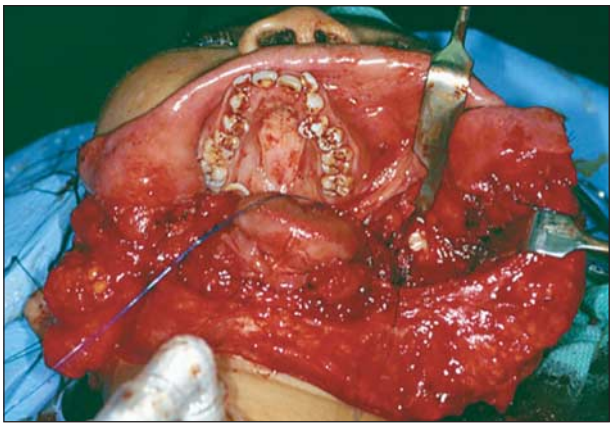

Figure 3. Pterygoid muscles are tagged for later suspension.

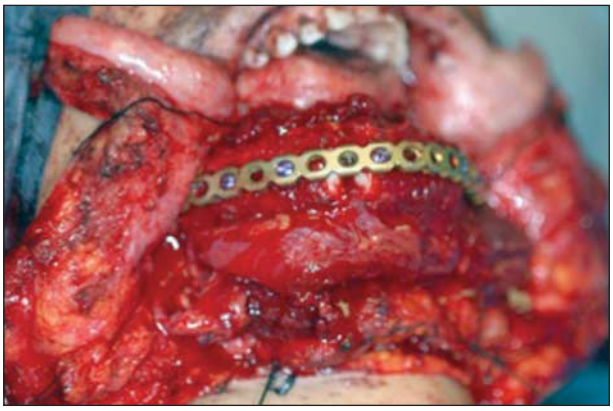

Figure 4. Flap has been inserted and suprahyoid muscles suspended to the bottom of the fibula in midline.

23 were male, with a mean age of 10 years (range, 4-17 years). Flaps performed included 43 fibula and 8 radial forearm free flaps with successful transplantation in each case (**Figures 1**, **2**, **3**, **4**, **5**, **6**, **7**, **8**, **9**, and **10**).

Twenty-six patients had temporomandibular joint reconstruction as part of their initial repair. This included condylar head prosthetic rehabilitation in 12 patients and rib graft condylar head replacement in the remaining patients. Of the 12 patients who had undergone initial prosthetic condylar head reconstruction, 9 went on to have planned secondary rib graft replacement secondarily. Patients treated

Figure 5. The patient shown in Figure 1. A, Preoperative frontal view of scanned photograph. B, Three-month postoperative view demonstrating improved mandibular contour following fibula free flap, condylar head rib graft, and muscle suspension. C, Adequate mouth opening postoperatively demonstrating good condylar construct movement and positioning.

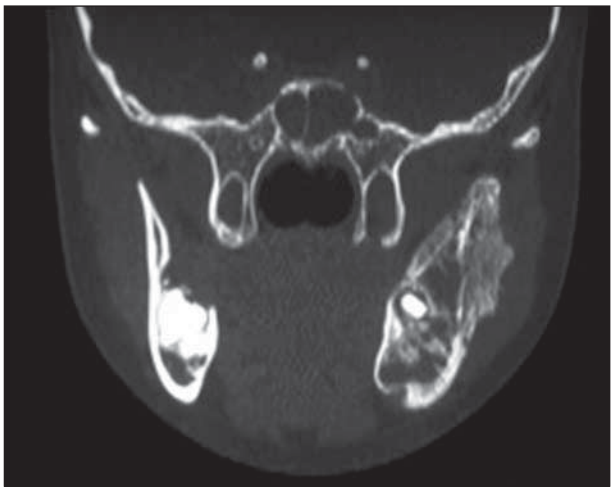

Figure 6. Coronal computed tomographic image demonstrating hemimandibular involvement by an isolated neuroblastoma.

Figure 7. Left hemimandible resected transorally.

Figure 8. Plate contoured onto a 3-dimensional model serves as a framework for the fibula free flap and rib graft, both of which have been attached to the plate.

Figure 9. Central third of temporalis muscle is attached to the superior border of the plate at the angle.

with radiation also had a higher incidence of requiring secondary soft-tissue augmentation with either acellular dermis or fat and fascia. This was performed in a total of 6 patients, 5 of whom had had radiation therapy.

Four patients had a tracheotomy preoperatively, and 5 patients underwent tracheotomy at the time of surgical reconstruction. We were able to avoid tracheotomy in the remaining patients. Of the 9 patients who underwent tracheotomy, we were able to decannulate all except 2 postoperatively. These latter 2 patients had clinically significant issues with secretion management on a chronic basis and had had tracheotomies for a mean duration of 10 years preoperatively.

Reasons for reconstruction included: trauma (in 18 cases) and oncologic (in 33 cases). Neoplasm pathologies in-

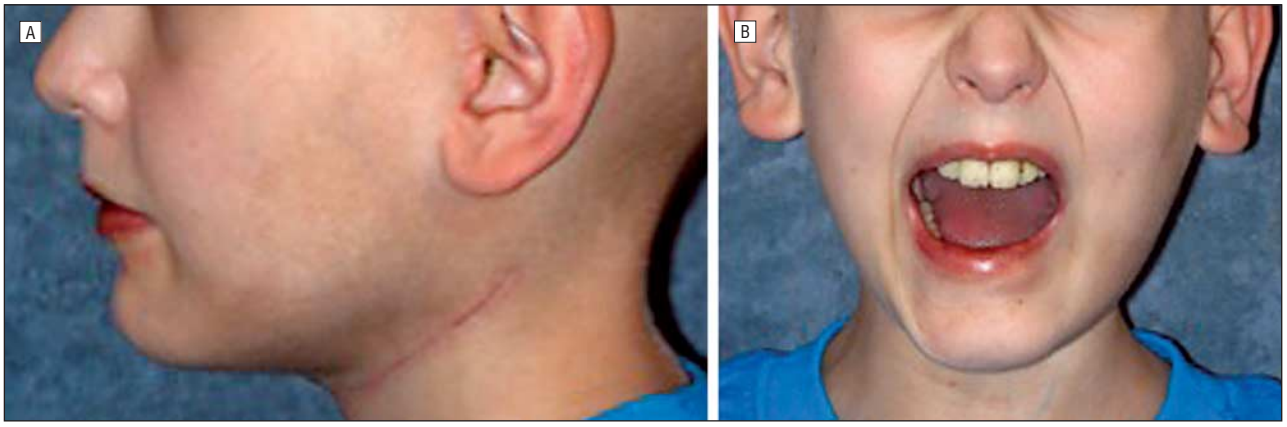

Figure 10. A young male patient. A, Twelve-month postoperative view demonstrates minimal left neck incision. Resection was performed transorally. B, Postoperative frontal view demonstrating excellent mandibular excursion and form.

cluded ameloblastoma (5 cases), ossifying fibroma (1 case), sarcoma (6 cases), neuroblastoma (7 cases), teratoma (4 cases), ganglioneuroma (1 case), squamous cell carcinoma (3 cases), metastatic thyroid carcinoma (1 case), and osteoradionecrosis/osteomyelitis (5 cases).

Occlusal relationships for mandibular reconstruction were judged as being normal at 12 months in 37 patients and abnormal in the remaining 6. The 6 patients with abnormal occlusal relationships all had severe occlusal problems preoperatively. The interincisal opening at 12 months averaged 41 mm. It should be noted that 18 of the 37 patients who ultimately had normal occlusal relationships had some bite abnormalities noted postoperatively. These were thought to be secondary to muscle pull and settled over time. The mean incision size for inserting the free flap steadily decreased over the course of the study from an average of 10 cm (range, 9-12 cm) in the first 14 patients to an average of 3.5 cm (range, 2-4 cm) in the last 37 patients.

Resections were performed transorally without the need for lip-splitting incision in 27 of 33 patients. Intraoperative external fixation was used in 18 patients. No patients had postoperative external fixation. Intraoperative maxillomandibular fixation was required in 22 patients. None required it postoperatively. Planned plate removal was performed in only 4 patients early in the study. At a mean follow-up of 6.2 years, 1 patient required plate removal for delayed exposure at 18 months. Two patients had nonunion of a portion of their graft and underwent secondary excision of the nonunion with iliac bone graft reconstruction without long-term complication.

TECHNIQUE AND PRINCIPLES

Airway Management

Patients and families are counseled preoperatively regarding the need for long-term follow-up and the potential need for touch-up procedures as the child ages. Potential effects of maxillofacial growth are discussed. Nasotracheal intubation is preferred unless the child already has undergone a tracheotomy. Perioperative tracheotomy is avoided, with a preference for prolonged intubation (3-4 days) postoperatively because we feel this is easier on both the child and the family and allows us to avoid a tracheotomy in most cases. Children younger than 12 years or immature or older children with intellectual disabilities are routinely intubated postoperatively while the remainder are judged on a case-by-case basis.

Transoral Resection and Joint Reconstruction

We prefer transoral resection even in the case of hemimandibulectomy defects involving the condylar head. If the condylar head is not involved, an external fixator is placed on either side of the proposed resection. Once the mandible has been resected, plate reconstruction is performed and the fixator removed. If the condyle is to be resected as well, we generally place maxillomandibular fixation in most of these cases as long as the occlusal relationships are reasonably good. It is not helpful otherwise. The resection is then completed transorally. In cases of condylar reconstruction, the option of condylar head prosthesis vs rib graft is chosen based predominantly on 2 factors: if the patient is scheduled to receive radiation therapy postoperatively or the reconstruction is being performed for osteoradionecrosis or osteomyelitis, then a prosthetic condylar head is attached to a plate and rib graft is deferred to a secondary procedure. Otherwise, a rib graft harvested from the contralateral side to give the appropriate angulation into the fossa is used. We do not favor placing a fibula directly into the joint, as the angulation is incorrect in these cases, negatively affecting long-term movement. If the temporomandibular joint disk is missing or resected, auricular cartilage with attached perichondrium on both sides is used to avoid placing either the rib graft or the alloplast condyle against the glenoid fossa bone.

Muscle Resuspension

It is critical to resuspend the muscles of mastication to the construct in order to give a smooth contour to the reconstruction and prevent ptosis and jaw migration outside of the joint following surgery. The pterygoids are isolated and tagged at the time of resection in the case of ramus or condylar resection and reattached with nonresorbable suture

to the condylar head construct. In the case of symphysial and mandibular body reconstruction, the suprahyoid muscles are tagged and suspended to the bottom of the neomandible. If the masseter is resected, the central third of the temporalis muscle is harvested through a small supraauricular access incision, passed deep to the zygomatic arch, and attached to the superior aspect of the plate. This improves contour and function.

Soft-Tissue Issues

Acellular dermal graft is used at the primary surgery in nonosteoradionecrosis and nonosteomyelitis cases if clinically significant subcutaneous soft-tissue deficits exist. Primary nerve grafting of the facial nerve and the inferior alveolar nerve is also performed during the initial surgery. We prefer the sural nerve graft in these cases. Subsequent secondary soft-tissue augmentation with acellular dermis or fat or fascia grafting may be required in some patients.

Transcervical Incision

A minimal access transcervical incision is placed in the upper neck, and suitable vessels are found for microvascular anastomosis. The ipsilateral submandibular gland is occasionally removed to improve vessel lay and postoperative fullness that is otherwise seen. The free flap is inserted through the neck incision and standard technique anastomosis performed.

COMMENT

Initially, in the early days of free tissue transfer, the major concern was getting the patient through a long surgery with a viable flap that was oftentimes used to simply close large defects. Because the success rates have remained high in experienced hands, there has to be an evolution in tailoring these flaps in such a way as to minimize both recipient and donor site issues. This has been the trend over the past few years.[7,8]

Young patients present unique challenges. They are surprisingly cooperative but still limited in their grasp of what is involved in these complex surgical procedures. Cooperation in the postoperative period may be an issue. This is why we advocate prolonged intubation in younger or uncooperative patients. Likewise, tracheotomy complications in young patients are well documented. Avoidance is best if at all possible. Related changes are variable. We found that early mild malocclusion settled and improved over time and postulate that it had more to do with muscle issues rather than with true osseous problems. We have noted the need for tissue touch-ups in a minority of patients as they grow. All of these had radiation therapy, and we suspect this caused some subcutaneous atrophy and fibrosis. We do not feel that the risks of general anesthesia and surgical intervention at the level of an otherwise well healed osseous flap, especially in patients treated with radiation, justify planned plate removal. Growth of the mandible may be affected by the radiation, the neoplasm, the resection, and perhaps by the plate. Secondary distraction, augmentation, or osteotomy can certainly be performed if required. Our follow-up is not long enough at this time for us to be able to make a definitive recommendation for hardware removal. We have not had any clinically significant plate-related growth issues at this point.

Technically, flap harvest and anastomosis was not difficult. Flap anatomy and vessel dimension were reasonably good in each case. Vein grafts were not needed in this patient series. We feel strongly that good muscle suspension as outlined herein is required to provide for appropriate jaw contour. Combined transoral resection and transcervical flap placement allows for the procedure to be performed through small transcervical incisions that approach 2 to 3 cm in most cases. This combination is technically challenging at times, particularly working around an external fixator, but we were able to complete it in each case without the need for a full open conversion. The joint resection and reconstruction transorally is surprisingly easier and substantially faster than a transfacial approach to the joint.

In conclusion, pediatric free tissue transfer has been found to be rewarding in terms of outcomes. Technical modifications as outlined herein have allowed us to have favorable results in most patients. These modifications, although originally developed for this patient population, have been applied with success to our adult patients as well.

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Author Contributions: Both authors had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. *Study concept and design:* Ducic. *Acquisition of data:* Young. *Drafting of the manuscript:* Ducic and Young. *Study supervision:* Ducic.
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REFERENCES

1. Konttila E, Koljonen V, Kauhanen S, Kallio P, Tukiainen E. Microvascular reconstruction in children: a report of 46 cases. *J Trauma.* 2010;68(3):548-552.
2. Iconomou TG, Zuker RM, Phillips JH. Mandibular reconstruction in children using the vascularized fibula. *J Reconstr Microsurg.* 1999;15(2):83-90.
3. Bilkay U, Tiftikcioglu YO, Temiz G, Ozek C, Akin Y. Free-tissue transfers for reconstruction of oromandibular area in children. *Microsurgery.* 2008;28(2):91-98.
4. Guo L, Ferraro NF, Padwa BL, Kaban LB, Upton J. Vascularized fibular graft for pediatric mandibular reconstruction. *Plast Reconstr Surg.* 2008;121(6):2095-2105.
5. Upton J, Guo L, Labow BI. Pediatric free tissue transfer. *Plast Reconstr Surg.* 2009; 124(6 suppl):e313-326.
6. Crosby MA, Martin JW, Robb GL, Chang DW. Pediatric mandibular reconstruction using a vascularized fibula flap. *Head Neck.* 2008;30(3):311-319.
7. Ghanem TA, Wax MK. A novel split-thickness skin graft donor site: the radial skin paddle. *Otolaryngol Head Neck Surg.* 2009;141(3):390-394.
8. Kim PD, Fleck T, Heffelfinger R, Blackwell KE. Avoiding secondary skin graft donor site morbidity in the fibula free flap harvest. *Arch Otolaryngol Head Neck Surg.* 2008;134(12):1324-1327.