

A Comprehensive Strategy for Reconstruction of a Missing Midface

Yanpu Liu, MD, DDS*†
 Qin Ma, MD, DDS*†
 Jinlong Zhao, MD, DDS*†
 Lei Tian, MD, DDS*†
 Shizhu Bai, PhD†‡
 Baolin Liu, MD*
 Yimin Zhao, PhD, DDS†‡

Summary: The loss of midface structures always leads to significant functional and cosmetic deficits, and the reconstruction work remains a challenge for surgeons. We report a rare case with severe midfacial defects involving the maxilla, nasal bone, and zygoma. This patient was treated with a comprehensive approach that included distraction osteogenesis, computer-aided surgery, a fibula bone graft, dental implantation, orthognathic surgery, and rhinoplasty. The treatment procedures required 4 years to complete, and a dramatically improved facial contour and stable occlusion were achieved. The results demonstrated the importance of a multidisciplinary approach and computer-aided design when treating severe maxillofacial deformities. Other important elements of the treatment process were the meticulous physical examination, the selection of an optimal treatment sequence, the skill of the surgeons, and more importantly, the patient-oriented mindset. (*Plast Reconstr Surg Glob Open* 2015;3:e446; doi: 10.1097/GOX.0000000000000376; Published online 6 July 2015.)

The loss of key midface structures leads to significant functional and cosmetic deficits, and the reconstruction work remains a challenge for surgeons.^{1,2} Several techniques have been developed for the treatment of such cases, such as maxillary prostheses, vascularized composite flap grafts, distraction osteogenesis (DO), computer-aided surgery (CAS), and facial transplantation (FT).²⁻⁴ The majority of physicians prefer a comprehensive approach that combines different techniques to treat complex midface defects.^{3,5,6} We report a rare case with severe midfacial defects.

The reconstructive work involved DO, CAS, fibula bone graft, dental implantation, orthognathic surgery, and rhinoplasty.

CASE REPORT

An 18-year-old Chinese girl was referred to us with a severe facial deformity that had been present since her birth. The deformity was associated with poor speech intelligibility and feeding disturbances. Clinical examination demonstrated a severe maxillary defect and bilateral zygoma hypoplasia accompanied by nose and mandible deformities. Her mouth opening was normal, and no obvious deviation of the mandible was observed. No teeth presented in her upper jaw, and the teeth in the lower jaw were intact but lingually inclined. A three-dimensional computed tomography scan clearly revealed the patient's skeletal deformity (Fig. 1). The patient's health and social life were greatly affected, and she had a high motivation to undertake any procedure that would improve her oral-facial function and appearance. In addition, the patient's family history could not be traced because she had been abandoned as a baby.

From the *Department of Cranio-facial Trauma and Orthognathic Surgery, College of Stomatology, †The Key State Laboratory of Military Stomatology, and ‡Department of Prosthodontics, College of Stomatology, Fourth Military Medical University, Xi'an, China.

Received for publication June 25, 2014; accepted April 2, 2015.

Copyright © 2015 The Authors. Published by Wolters Kluwer Health, Inc. on behalf of The American Society of Plastic Surgeons. All rights reserved. This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives 3.0 License, where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially.

DOI: 10.1097/GOX.0000000000000376

Disclosure: The authors have no financial interest to declare in relation to the content of this article. The Article Processing Charge was paid for by the authors.

We adopted a comprehensive strategy to reconstruct a new midface for the patient. After an extensive multidisciplinary discussion among the maxillofacial surgeons, orthodontists, and prosthetic teams, we began the treatment with the correction of her hypoplastic zygoma and nasal bone by performing a Le Fort III osteotomy and external DO. The distraction distance was 1.6 cm, and the girl acquired a fronted zygoma and nasal bone, and her orbital shape was also improved greatly (Fig. 2).

Because of the severe deficiency in the midface, we decided to use a fibula osteomyocutaneous flap to rebuild a new maxilla. We manufactured resin models of a facial skeleton and a fibula bone according to computed tomography data and performed model surgery. The miniplates were prebent to facilitate shaping the fibula graft and to ensure its proper placement during surgery. Then, a 19.5-cm long fibular bone with a $3 \times 8\text{-cm}^2$ skin paddle was harvested and shaped to form a U-shaped maxillary arch that was connected to the bilateral zygoma and the remnant thin maxilla (Fig. 2). The skin island and muscle were placed into the mouth to separate the nasal and oral cavities. After surgery, the patient's facial contour was dramatically improved.



Fig. 1. The front view of the patient showed an obvious facial deformity with serious hollow midface and deviated lower jaw.



Fig. 2. The three-dimensional computed tomography demonstrated that the maxilla was almost completely missing, the mandible was obviously asymmetry, and the zygomas were bilaterally hypoplasia as well.

To rebuild an appropriate occlusion and further improve the facial contour, we performed implantation in the reconstructed maxilla and mandible osteotomy (bilateral sagittal split ramus osteotomy). We designed and produced an implant guide and a special splint, which was composed of the implant guide and a mandible occlusal guide, using the computer-aided design/computer-aided manufacturing technique. Five implants were placed, and the mandible was moved backward (Fig. 3). Three months later, vestibuloplasty was performed, and the rhinoplasty was then conducted with a costal cartilage graft to improve the patient's nasal profile. The final dental prosthesis was attached with implants.

It took $3\frac{1}{2}$ years to complete the entire treatment process. The patient recovered very well, and no obvious complications were referred to us (Fig. 4). She married and gave birth to a healthy boy during the follow-up period.

DISCUSSION

The maxilla composes the main portion of the midface, and its restoration plays a central role in



Fig. 3. After reconstructive surgery was completed, the patient acquired a new maxilla formed by fibula and the augmented zygomas. Then 5 implants were inserted into the fibula bone, and bilateral sagittal split ramus osteotomy surgery was completed under the conduction of digitally designed splint.

midface reconstructive procedures. Elimination of the defect, restoration of the essential functions, the provision of adequate support for the midfacial units, and restoration of the esthetics of the facial features are the goals of maxillary reconstruction.⁷ Prosthesis can repair small maxillary defects,^{7,8} but large defects normally call for reconstruction using compound tissue flaps.^{8,9} DO has been used to repair maxillary bony defects,¹⁰ and it has been used in the zygoma to restore the low projection of the maxilla, so that prosthetic rehabilitation can be accomplished.^{11,12} Recently, FT has also been regarded as an innovation for treating a severely damaged face.^{4,13} However, considering the complicated surgical procedures, the need for life-long immunosuppression, the meticulous selection of the patient and the donor body, the unsatisfactory mortality rate, and the ethical controversy,^{4,13,14} FT still must overcome many hurdles before it will gain widespread acceptance. In our case, we proposed a comprehensive strategy that involved DO, a free composite tissue graft, orthodontic treatment, orthognathic surgery, implanted prostheses, and rhinoplasty. To the best of our knowledge,



Fig. 4. The front and lateral view of the patient after the final dental prosthesis was fitted.

this is the first case in the English literature that combined these techniques to accomplish midface reconstruction in a single patient.

To carry out this comprehensive strategy, the first issue was to determine the correct treatment sequence. Generally, bony reconstruction should be performed before soft-tissue reconstruction, followed by the esthetic repair and dental rehabilitation.^{15,16} We followed this principle and divided the treatment procedure into 4 successive steps. It should be noted that the sequence was determined based on the philosophy that the comprehensive procedure is an integrated whole, and each step should solve a main problem and lay the foundation for the next step. The incorrect sequence would prolong the therapeutic process, impair the surgical outcomes, and might result in treatment failure. To avoid this, an extensive preoperative discussion among the treatment team is particularly important.

With the development of computer technology in medicine, CAS has become a new paradigm for the treatment of craniomaxillofacial malformations, and its distinct superiority to other approaches has been demonstrated.^{17,18} For our patient, the absent maxilla, the hypoplastic zygoma, and the protruding mandible made it very difficult to properly rebuild

the maxilla. However, computer modeling was used to calculate the vectors for the augmentation of the zygoma and nasal bone, simulate the maxilla reconstruction with a virtual fibula bone graft, and manufacture a digitally designed splint for orthognathic surgery and implantation using the computer-aided design/computer-aided manufacturing technique. CAS was a key element in the achievement of a good surgical outcome in this case.

We report a comprehensive strategy for midfacial reconstruction, which restored the esthetic appearance and function of the oromandible in a patient suffering from severe maxillary loss. The excellent results reveal the importance of multidisciplinary teamwork and the use of CAS. Other elements that are important for the successful treatment of complex facial defects include meticulous physical examination, the correct treatment sequence, the skill of the surgeon, and more importantly, a patient-oriented mindset.

Yimin Zhao, PhD, DDS

Department of Prosthodontics
School of Stomatology
Fourth Military Medical University
145 West Changle Road
Xi'an 710032, China
E-mail: omsshfmmu@163.com

PATIENT CONSENT

Parents provided written consent for the use of the patient's image.

REFERENCES

- O'Connell DA, Futran ND. Reconstruction of the midface and maxilla. *Curr Opin Otolaryngol Head Neck Surg.* 2010;18:304–310.
- Jaiswal R, Pu LL. Reconstruction after complex facial trauma: achieving optimal outcome through multiple contemporary surgeries. *Ann Plast Surg.* 2013;70:406–409.
- Raposo-Amaral CE, Tong A, Denadai R, et al. A subcranial Le Fort III advancement with distraction osteogenesis as a clinical strategy to approach pycnodysostosis with midface retrusion and exorbitism. *J Craniofac Surg.* 2013;24:1327–1330.
- Siemionow MZ, Papay F, Djohan R, et al. First U.S. near-total human face transplantation: a paradigm shift for massive complex injuries. *Plast Reconstr Surg.* 2010;125:111–122; discussion 123–124.
- Hanasono MM, Silva AK, Yu P, et al. A comprehensive algorithm for oncologic maxillary reconstruction. *Plast Reconstr Surg.* 2013;131:47–60.
- Block MS, Baughman DG. Reconstruction of severe anterior maxillary defects using distraction osteogenesis, bone grafts, and implants. *J Oral Maxillofac Surg.* 2005;63:291–297.
- Chigurupati R, Aloor N, Salas R, et al. Quality of life after maxillectomy and prosthetic obturator rehabilitation. *J Oral Maxillofac Surg.* 2013;71:1471–1478.
- Brown JS, Shaw RJ. Reconstruction of the maxilla and midface: introducing a new classification. *Lancet Oncol.* 2010;11:1001–1008.
- McCarthy CM, Cordeiro PG. Microvascular reconstruction of oncologic defects of the midface. *Plast Reconstr Surg.* 2010;126:1947–1959.
- Castro-Núñez J, González MD. Maxillary reconstruction with bone transport distraction and implants after partial maxillectomy. *J Oral Maxillofac Surg.* 2013;71:e137–e142.
- Capote-Moreno AL, Naval-Gías L, Muñoz-Guerra MF, et al. Zygomatic distraction osteogenesis for correction of midfacial support after hemimaxillectomy: experience and technical considerations. *J Oral Maxillofac Surg.* 2013;71:e189–e197.
- Vega LG, Gielincki W, Fernandes RP. Zygoma implant reconstruction of acquired maxillary bony defects. *Oral Maxillofac Surg Clin North Am.* 2013;25:223–239.
- Seok Chan E. Facial transplantation surgery. *Arch Plast Surg.* 2014;41: 174–180.
- Sobnach V, Kahn D, John T, et al. A survey of medical students on their attitudes towards face transplantation. *Int J Surg.* 2014;12:45–50.
- Hofer SO, Payne CE. Functional and aesthetic outcome enhancement of head and neck reconstruction through secondary procedures. *Semin Plast Surg.* 2010;24:309–318.
- Cordeiro PG, Chen CM. A 15-year review of midface reconstruction after total and subtotal maxillectomy: part I. Algorithm and outcomes. *Plast Reconstr Surg.* 2012;129:124–136.
- Rudman K, Hoekzema C, Rhee J. Computer-assisted innovations in craniofacial surgery. *Facial Plast Surg.* 2011;27:358–365.
- Rana M, Essig H, Eckardt AM, et al. Advances and innovations in computer-assisted head and neck oncologic surgery. *J Craniofac Surg.* 2012;23:272–278.