Mandibular Fracture in a Hemifacial Microsomia Patient following Implant Failure and Hardware Infection: A Case Report

Kausar Ali, MD1,2 Rami P. Dibbs, MD1,2 Renata S. Maricevich, MD1,2

1 Division of Plastic Surgery, Baylor College of Medicine, Houston, Texas
2 Division of Hematology/Oncology, Texas Children’s Hospital, Houston, Texas

Arch Plast Surg 2022;49:642–647.

Abstract

Keywords

► hemifacial microsomia
► polyetheretherketone implant
► mandibular fracture
► mechanical strength
► biomechanics

Hemifacial microsomia (HFM) is a complex congenital condition with heterogeneous malformations of the facial skeleton that almost always involves mandibular hypoplasia. Here we introduce a unique case in which a patient with HFM had initially successful optimization of facial symmetry using a polyetheretherketone implant for mandibular augmentation. However, multiple factors associated with the intraoperative and postoperative course, including hardware failure and infection, led to diminished mechanical strength of the mandible, ultimately resulting in a mandibular fracture. In this unique case presentation of HFM, we discuss the various factors that contributed to mandibular weakness and increased susceptibility to fracture.

Introduction

Hemifacial microsomia (HFM) describes a spectrum of anomalies associated with abnormal embryological development of the first and second branchial arches.1 Among all deformities of HFM, mandibular hypoplasia followed by facial muscle hypoplasia and microtia is the most common.2 Both mandibular and soft tissue deficiencies in HFM must be addressed to achieve optimal occlusion, functional jaw movements, facial symmetry, and overall aesthetic improvement.1 Depending on the severity of mandibular hypoplasia, various management options are available, such as mandibular osteotomy and autologous fat grafting, distraction osteogenesis, temporomandibular joint reconstruction, and alloplastic implants (i.e., porous polyethylene or polyetheretherketone [PEEK] constructs).1 Regardless of operative technique, optimizing mandibular mechanical strength by ensuring appropriate hardware placement and mandibular stability as well as averting infection is imperative to minimizing bony weakness and subsequent susceptibility to postoperative fracture.

Here we present a case of a 16-year-old girl with HFM who underwent left mandibular augmentation with a PEEK implant, but subsequently developed hardware infection followed by a mandibular fracture in the bony area previously infected. To our knowledge, no known case has ever been reported in the literature regarding the susceptibility of a congenitally dysplastic mandible to fracture, particularly in an area that was previously manipulated by hardware, later resulting in hardware failure and infection. Our purpose is to discuss the factors contributing to mandibular fracture in this patient with underlying mandibular hypoplasia associated with HFM.

Received October 26, 2021
Accepted after revision March 2, 2022

DOI https://doi.org/10.1055/s-0042-1756317.
ISSN 2234-6163.

© 2022. The Korean Society of Plastic and Reconstructive Surgeons. All rights reserved.
This is an open access article published by Thieme under the terms of the Creative Commons Attribution-NonDerivative-NonCommercial-License, permitting copying and reproduction so long as the original work is given appropriate credit. Contents may not be used for commercial purposes, or adapted, remixed, transformed or built upon. (https://creativecommons.org/licenses/by-nc-nd/4.0/)
Thieme Medical Publishers, Inc., 333 Seventh Avenue, 18th Floor, New York, NY 10001, USA
Case

A 16-year-old female with congenital left HFM was referred to the craniofacial plastic surgery department for concerns regarding facial asymmetry. Clinical evaluation was notable for micrognathia with the left lower third of the face projected less anteriorly than the right. She had normal ocular and auricular features but had visible soft tissue deficits along the left nasal ala base. She had a class I occlusion with a 6-mm overjet and normal occlusal cant despite prior orthodontic treatment. Her temporomandibular joint movements were palpable bilaterally. Computed tomography (CT) imaging showed left mandibular hypoplasia (Pruzansky grade I) and a borderline dysmorphic right mandible with narrow anteroposterior dimensions (Fig. 1).

After discussion of treatment options, the patient and her family elected for left mandibular and chin contouring with a PEEK implant and autologous fat grafting to the left nasal ala base. The custom implant with predrilled holes was virtually constructed using computer-assisted manufacturing and consisted of two pieces that keyed into each other – one posterior piece for the mandible and one anterior piece for the chin (Fig. 2). To properly position the implant, a left inferior buccal sulcus incision and an extraoral stab incision along the left mandibular border were made to expose the symphysis and body of the mandible superiorly to the inferior alveolar foramen. When positioning the implant, the most lateral right screw broke inside the anterior piece after it was fixated to the bone. The screw could not be removed without sacrificing implant integrity, so the decision was made to leave the screw given there was still good implant stabilization to the bone. The two pieces of the implant interlocked very well and had excellent stabilization after complete fixation to the bone. The superiorly positioned mental nerve was neurolyzed for the sake of placing the implant and then repaired with 8–0 nylon suture. Fifty grams of fat was harvested from the neck through the extraoral incision and another submental stab incision and were injected into the left midface just deep to the left nasal ala. Soft tissue and skin were sutured in layers to achieve watertight closure.

On postoperative days 7 and 21, she had improved chin projection, good occlusion, and well-healing incisions.

Fig. 1 Three-dimensional computed tomography analysis with anteroposterior view (A), oblique view (B), superior view (C), and inferior view (D) showing left mandibular hypoplasia and borderline dysmorphic right mandible contributing to facial asymmetry.

Fig. 2 Two-piece polyetheretherketone implant, designed with computer-assisted manufacturing, interlocked together for augmentation of the hemimandible (A). Anteroposterior view (B), oblique view (C), lateral view (D), and inferior view (E). Screws are angled to avoid the dental roots and inferior alveolar nerve (F).
Fig. 3 Facial profile prior to polyetheretherketone implant placement (A, B) compared with 3 weeks postoperatively (C, D).

However, on week 5, she experienced left cheek swelling and purulent drainage from the submental incision site. CT images revealed significant lucency within the right parasymphyseal mandible around the most lateral right PEEK implant screw and a submandibular fluid collection that tracked all the way to the skin, indicating hardware infection (Fig. 4). The infected PEEK implant was completely removed and the surrounding soft tissue of a total area of 8 cm² was debrided. The mandibular bone appeared healthy and was copiously irrigated with antibiotic solution. The wound was packed with gauze strips. Bacterial cultures grew Prevotella species and Staphylococcus aureus sensitive to the antibiotic course given.

Her condition improved and incisions appropriately healed. Two months after removal of the implant, she was in a golf cart rollover accident, suffering an open right mandibular fracture. Intraoral exam was notable for open bite and open right parasymphyseal fracture between the lateral incisor and canine with an exposed tooth root. Sensation was diminished bilaterally along the mental nerve distribution, which was stable since her prior jaw surgeries. No other facial injury or palpable bony defect was found. CT imaging showed a mildly displaced right parasymphyseal mandibular fracture at the same location where bony lucency was seen on prior imaging when her implant was infected (Fig. 5).

Fig. 4 Significant lucency (A, B) within the right parasymphyseal mandible around the right most, partially broken screw of the polyetheretherketone implant. Submandibular fluid collection (C) suggests implant infection.
She underwent open reduction and internal fixation of the right mandible with intraoperative maxillomandibular fixation (MMF) to stabilize the occlusion. The right mental nerve was significantly stretched and encased in scar tissue, likely secondary to prior surgeries. Hence, the nerve was neurolyzed to safely place the plating system for mandibular repair. A 1.5-mm tension band was applied after reduction of the fracture. A 2.5-mm reconstructive plate was fixed into place along the lower mandibular border. MMF wires were then removed and occlusion was confirmed. Guiding elastics were placed on the arch bars. The wound was debrided and incisions were closed in interrupted suture layers.

Her postoperative course was unremarkable. At 2 weeks, the arch bars were removed. She had good occlusion consistent with her premorbid condition, so no orthodontic treatment was needed. Her asymmetric facial profile related to her congenital HFM was not significantly worsened after PEEK explantation or traumatic injury. Because of her residual facial asymmetry without functional deficits, a collaborative decision was made to hold off on aesthetic surgery to optimize symmetry until her swelling improved and postoperative scars had time to settle (Fig. 6).

Discussion

HFM is a challenging condition to address since diagnosis requires identification and classification of all phenotypical elements involved, including non-craniofacial structures. In general, mild deformities like Pruzansky grade I mandibular hypoplasia can be treated with mandibular osteogenesis, osteotomy, or augmentation, while more severe grade III defects typically require graft reconstruction.1 Our patient had mild mandibular hypoplasia classified as Pruzansky grade 1 with minimal soft tissue deficiencies along her left nasal ala base. Given her mild degree of HFM, mandibular augmentation with a PEEK implant and autologous fat grafting was performed with initially successful improvement in her facial symmetry. However, she developed an implant...
Hemifacial Microsomia Mandible Fracture

Ali et al.

Surgical manipulation of the hypoplastic mandible with hardware placement should also be considered as a contributing factor to fracture development. Raghoebar et al explained that multiple implant fixation sites can diminish the mechanical strength of the mandibular bone, at least temporarily. Consequently, caution must be undertaken when surgically handling a thin mandible. Although this patient’s custom-designed PEEK implant had excellent stabilization when fixed, the lateral right-most screw had broken inside the bone. When the implant became infected, CT imaging showed bony lucency of the right parasymphyseal region where this screw had broken. This same region of diminished bone density of the mandible had later fractured under traumatic forces. Thus, decreased bone density of the right parasymphyseal mandible associated with prior implant screw fixation likely made the mandible more fragile and prone to injury. Like in elderly patients with atrophic edentulous mandibles, high stress loads on a mandible with reduced bony density can ultimately lead to fracture.

Our patient had a focal area of weakness in the mandible from surgical manipulation, which was predisposed to fracture from traumatic high tensile forces in that particular anatomical point. As aforementioned, hardware infection itself and then removal of the infected implant likely reduced the structural support and stability of the mandible, increasing the susceptibility to injury from a traumatic event.

It is important to consider the traumatic mechanism resulting in the fracture. A rollover golf cart accident presents as a significant mechanism of injury that can lead to facial trauma in any patient, regardless of predisposing factors that reduce mandibular mechanical strength. For our patient, the underlying biomechanics and suboptimal stability of the hypoplastic mandible following hardware failure and implant infection increased her susceptibility to fracture.

PEEK implants by themselves do not completely resolve facial asymmetry and often require concomitant autologous fat transfer for fine cosmetic refinements, as seen in our patient. Nevertheless, PEEK implants are a viable alternative source to autogenous bone grafting for mandibular reconstruction and contouring in HFM. Our patient had initially successful results with PEEK implant mandibular augmentation, but unfortunately endured hardware infection and subsequent mandibular fracture. Any of these sequential factors – broken implant screw decreasing mandibular mechanical strength, infection and diminished bone density in that region, reduced structural support after removal of the implant, and surgical handling of thin mandibular bone – may have made our patient more prone to a mandibular injury beyond just the traumatic mechanism. Hence, significant care must be undertaken when surgically handling thin, hypoplastic mandibular bone, and postoperative complications must be managed immediately to prevent further compromise of mandibular bone integrity in patients with HFM.

Products/Devices/Drugs

None.
Authors’ Contributions
K.A. was involved in conception and design, acquisition of data, analysis and interpretation of case, and writing manuscript. R.P.D. contributed with design, acquisition of data, analysis and interpretation of case, and writing manuscript. R.S.M. was involved in conception and design, acquisition of data, analysis and interpretation of case, writing manuscript, and in final edit of manuscript.

Ethical Approval
Informed consent was obtained from the patient for surgical management.

Patient Consent
Informed consent was obtained from the patient for surgical management.

Funding
None.

Conflict of Interest
None declared.

References
1. Brandstetter KA, Patel KG. Craniofacial microsomia. Facial Plast Surg Clin North Am 2016;24(04):495–515
2. Tuin AJ, Tahiri Y, Paine KM, Paliga JT, Taylor JA, Bartlett SP. Clarifying the relationships among the different features of the OMENs classification in craniofacial microsomia. Plast Reconstr Surg 2015;135(01):149e–156e
3. Gupta S, Gupta H, Tandan A. Technical complications of implant-cause and management: a comprehensive review. Natl J Maxillofac Surg 2015;6(01):3–8
4. McGlumphy EA, Mendel DA, Holloway JA. Implant screw mechanics. Dent Clin North Am 1998;42(01):71–89
5. Lee KY, Shin KS, Jung JH, Cho HW, Kwon KH, Kim YL. Clinical study on screw loosening in dental implant prostheses: a 6-year retrospective study. J Korean Assoc Oral Maxillofac Surg 2020;46(02):133–142
6. Gratton DG, Aquilino SA, Stanford CM. Micromotion and dynamic fatigue properties of the dental implant-abutment interface. J Prosthet Dent 2001;85(01):47–52
7. Goldsmith D, Horowitz A, Orentlicher G. Facial skeletal augmentation using custom facial implants. Atlas Oral Maxillofac Surg Clin North Am 2012;20(01):119–134
8. Alonso-Rodriguez E, Cebrián JL, Nieto MJ, Del Castillo JL, Hernández-Goody J, Burgueño M. Polyetheretherketone custom-made implants for craniofacial defects: Report of 14 cases and review of the literature. J Craniomaxillofac Surg 2015;43(07):1232–1238
9. Chen Y, Zhang L, Qin T, Wang Z, Li Y, Gu B. Evaluation of neurosurgical implant infection rates and associated pathogens: evidence from 1118 postoperative infections. Neurosurg Focus 2019;47(02):E6
10. Olate S, Uribe F, Huentequo-Molina C, Goulart DR, Sigua-Rodriguez EA, Alistur JP. Mandibular angle contouring using porous polyethylene stock or PEEK-based patient specific implants. a critical analysis. J Craniomaxillofac Surg 2021;32(01):242–246
11. Cousin AS, Bouletreau P, Giaj J, Ibrahim B, Louvrier A, Sagaux N. Severity and long-term complications of surgical site infections after orthognathic surgery: a retrospective study. Sci Rep 2020;10(01):12015
12. Raghoebar GM, Stellingsma K, Batenburg RH, Vissink A. Etiology and management of mandibular fractures associated with endosteal implants in the atrophic mandible. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2000;89(05):553–559
13. Ellis E III, Price C. Treatment protocol for fractures of the atrophic mandible. J Oral Maxillofac Surg 2008;66(03):421–435
14. Melo AR, de Aguiar Soares Carneiro SC, Leal JLF, Vasconcelos BCDE. Fracture of the atrophic mandible: case series and critical review. J Oral Maxillofac Surg 2011;69(05):1430–1435
15. Mason ME, Triplett RG, Van Sickle JS, Parel SM. Mandibular fractures through endosseous cylinder implants: report of cases and review. J Oral Maxillofac Surg 1990;48(03):311–317
16. Staal F, Pluijmers B, Wolvius E, Koudstaal M. Patient-specific implant for residual facial asymmetry following orthognathic surgery in unilateral craniofacial microsomia. Craniomaxillofac Trauma Reconstr 2016;9(03):264–267