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Case Report

Synergistic benefits of hyperbaric oxygen therapy for postoperative palatal oro-nasal fistula following segmental Le Fort 1 osteotomy

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ABSTRACT

Segmental maxillary osteotomy, a surgical technique used in orthognathic surgery, involves the risk of palatal mucosa tearing, which can lead to severe complications. Herein, we report the case of a woman with Angle class II malocclusion who underwent multiple elective segmental maxillary osteotomy and augmentation genioplasty procedures for the correction of her malocclusion and the enhancement of her facial profile. A week after surgery, the patient developed a palatal ulcer. We adopted a comprehensive treatment approach involving 14-day hyperbaric oxygen therapy and conventional modalities; this approach resulted in favorable outcomes. Our case underscores the importance of immediate intervention and the synergistic potential of the comprehensive approach against oronasal fistula formation. Our findings indicate that hyperbaric oxygen therapy promotes wound healing, particularly in patients with complications arising from maxillofacial surgery.

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Introduction

Orthognathic surgery (OGS) is a complex craniofacial procedure associated with the risks of various postoperative complications, particularly when segmental osteotomy of the maxilla, mandible, or both is required. The prevalence of postoperative complications in this context is 6–9 %. Relevant complications reported in the literature include postoperative malocclusion, excessive hemorrhage, nerve injury, infection, temporomandibular joint problem, abnormal bone healing (malunion, nonunion, and bone necrosis), and dental, auditory, or ophthalmic problems.¹

Palatal mucosa tearing may occur either during segmentation sawing in Le Fort I osteotomy or during palatal expansion traction. Delayed diagnosis or treatment may lead to ulcer progression, and subsequent formation of an oronasal fistula.² This allows the passage of air, liquid, or food between the nasal and oral cavities, causing speech-related problems such as hypernasality, foul odor, abnormal taste, or upper respiratory tract infection.

Herein, we report the case of a young woman with class II malocclusion and retrognathia who developed a palatal ulcer after segmental Le Fort I osteotomy. The patient was successfully treated with liquid diet, local topical honey ointment, and hyperbaric oxygen (HBO) therapy.

Case report

A 33-year-old female with Angle class II malocclusion and maxillary protrusion was referred to our craniofacial center after orthodontic treatment at a local clinic (supplementary Fig. 1). An experienced surgical team at Chang Gung Craniofacial Center (Taoyuan, Taiwan) performed OGS, including three-piece segmental Le Fort I osteotomy for expansion, and augmentation genioplasty by using Medpor (MEDPOR Two-piece Chin Implants; Stryker, Kalamazoo, MI, USA). A linear mucosal break was identified intraoperatively; this was promptly repaired using sutures and Gelfoam (GELFOAM Sterile Compressed Sponge; Pfizer, Manhattan, NY, USA) for coverage. During her hospital stay, the patient exhibited no noticeable mucosal defect. She was discharged on postoperative day (POD) 2 without any specific discomfort.

At the first outpatient follow-up (POD 8), a palatomucosal defect (approximately 1.5 cm × 1.5 cm) was noted near the posterior midline; this defect exposed the nasal floor and surrounded palatal bone (Fig. 1). Next day, the patient was admitted and started on a liquid diet. Local wound management involved the application of Mesitran (L-Mesitran Soft Wound Gel; Maastricht, Netherlands) twice daily. Additionally, the antibiotic Amoxicillin/clavulanate was intravenously administered. To expedite healing, the patient was subjected to daily HBO therapy; each session lasted one hour. Initially, we planned for a 7-day course of HBO therapy; however, finally, a 14-day course was administered because of the



Fig. 1. Postoperative day 8; First day of hyperbaric oxygen therapy. A palatomucosal defect (size: approximately 1.5 cm × 1.5 cm) was observed near the posterior midline; the defect exposed the nasal floor and the palatal bone.



Fig. 2. Postoperative day 21; 14th day of hyperbaric oxygen therapy. The size of the palatal wound and the area of the exposed palatal bone decreased with increased granulation tissue.



Fig. 3. Postoperative day 63; 35th day after final hyperbaric oxygen therapy. The palatal wound was completely healed.

evidently observed improvement in wound recovery, such as accelerated growth of granulation tissue and improved viability of the palatal bone. After the completion of HBO therapy, the patient was discharged with reduced size of palatal wound without oronasal fistula (Fig. 2). Subsequent follow-up assessments revealed continual and smooth wound healing; complete wound healing was observed on POD 63 (Fig. 3). After 6 months from surgery, the patient had a favorable facial profile characterized by an inclination of upper teeth and a forward projection of the chin (supplementary Fig. 2).

Discussion

Through this case report, we share our experience in treating a young woman who developed a palatomucosal wound after segmental Le Fort I osteotomy. The patient was successfully managed using a comprehensive treatment approach involving oral cleansing and hygiene, targeted wound care, and HBO therapy.

Segmental maxillary osteotomy is a one-stage surgical orthodontic technique used to address various maxillary problems, such as transverse discrepancies, anterior open bite, crossbite, and severe deformities requiring intra-arch correction.³ Theoretically, three-segment osteotomy is associated with a low risk of bone necrosis, whereas four-segment osteotomy is relatively suitable for mobilization.¹

When palatal expansion is necessary, an additional tension is exerted on the palatal mucosa. The most tensed area is where the osteotomy lines are created to separate the segments, usually located in the interdental papillae within each delineated section as well as at the mucosal insertion in the maxilla. Excessive tension resulting from expansion or accidental trauma during dissection may increase the risk of mucosal tear or ulceration. If left untreated, a palatal ulcer can progress into an oroantral or oronasal fistula. In patients with cleft palate, oronasal fistula could be seen in 8.6 % and more likely to occur in the cleft lip-palate patients.⁴ Some studies have investigated the development of a palatal fistula in individuals without a cleft palate. Small fistulas (<2 mm) can spontaneously seal off, whereas medium fistulas (2–20 mm) require locoregional flaps for closure. Nezafati reported a case of palatal fistula formation four weeks after conventional Le Fort I osteotomy.⁵ This fistula developed in an unusual location (incisive papilla) and was surgically corrected after 6 months by raising a Von-Langenback flap to close the defect. The author admitted fault for the inappropriate use of intraoperative electrocautery, which led to avascular bone necrosis and subsequent fistula formation. Hernández-Alfaro et al used the buccal fat pad to seal a palatal mucosa tear.² They also reported palatal coverage with an acrylic splint to facilitate mucosal healing. Fistulas larger than 20 mm require well-vascularized tissue flaps, such as tongue or temporalis muscle flaps, and free vascularized flaps for correction.

HBO therapy involves the administration of 100 % high-pressure oxygen in a closed chamber; the minimum pressure requirement for this therapy is 1.4 atmospheres absolute, as specified by the Undersea Hyperbaric Medicine Society. At the cellular level, this therapy boosts the rate of angiogenesis during wound healing; increases the level of oxygen, which is detrimental to anaerobic bacteria; reduces the production of clostridial α -toxin and the abundance of *Pseudomonas* sp.; and prevents the release of free radicals and proteases.⁶ In maxillofacial and orthodontic domains, HBO therapy has been prescribed for decades. Notably, Eid and El Sayed demonstrated the potential of HBO therapy in improving the bony stability after one-piece Le Fort I maxillary advancement.⁷ Wilcox and Kolodny demonstrated that HBO therapy can enhance bone healing after maxillofacial osteotomy, minimizing the need for intermaxillary fixation.⁸ Anzalone et al documented their experiences in treating four pediatric patients, addressing early surgical wound breakdown after oronasal fistula and cleft palate repair.⁹ In their case series, all fistulas decreased in size after HBO therapy, with granulation tissue observed at the edges of the wound. Although our patient did not develop a fistula, we observed a similar pattern of granulation tissue growth at wound edges, along with enhanced vascularity and viability of the exposed bone area.

Studies have provided various recommendations for the prevention of fistula formation after segmental Le Fort I osteotomy.¹⁰ Essential surgical skills include gentle dissection to maintain the integrity of the nasal layer, preservation of bilateral descending palatine pedicles, and avoidance of electrocauterization. Additional strategies include the application of horseshoe or U-shaped osteotomy configurations to minimize tension, use of piezoelectric devices during osteotomy, and consideration of surgically assisted rapid palatal expansion for patients requiring significant transverse correction (exceeding 6–7 mm).

In conclusion, HBO therapy is beneficial for patients with palatal mucosa tearing or ulceration. In the future, large-scale studies with a rigorous design should be conducted to identify the indications and ideal settings, and determine the optimal duration of this therapy.

Statement of institutional review board approval

The study (IRB no: 202400101B0) was approved by the Ethics Committee for Human Research, Taoyuan Chang Gung Memorial Hospital, Taiwan.

Statement of patient consent

Written informed consent was obtained from the patient for the use of medical records and photos, as the supplementary figures are identifiable of patient's image.

Conflicts of interest and source of funding

None declared.

Authorship participation and contribution

Cristhiam Yang and Isara Limthanakul were responsible for data collection, data interpretation, manuscript writing. Pang-Yun Chou and Yu-Ray Chen were responsible for manuscript critical revisions. All authors were responsible for approval of final version.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi: 10.1016/j.jpra.2024.05.015](https://doi.org/10.1016/j.jpra.2024.05.015).

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