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Case Report

An Unusual Case of Maxillary Palatal Osteotomy Gap Necrosis after a 2-Piece Lefort Osteotomy Treated with Hyperbaric Oxygen Therapy: A Case Report

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Abstract

Orthognathic surgery of the maxilla is a common procedure performed by Oral and Maxillofacial surgeons, Otolaryngologists, and Plastic surgeons to correct a variety of defects generally caused by either trauma or congenital deformities. The maxillary Lefort osteotomy procedure is typically performed to correct deformities such as Anterior-Posterior (AP) hypoplasia, transverse hypoplasia, and a maxillary cant. Based on the diagnosis and treatment plan, surgeons will often segment the maxilla into multiple pieces to accomplish the necessary surgical moves.

The following is a case report of a female patient with maxillary anterior-posterior and transverse hypoplasia who was treated with a 2-Piece Lefort osteotomy with expansion and advancement. It was noted during surgery that she had excessive pneumatization of her maxillary sinuses that separated the nasal floor from the palate. The only normal anatomy for this procedure was the palatal suture which necessitated a single midline osteotomy as opposed to bilateral paramedian osteotomies. The case was complicated by a postoperative maxillary palatal gingival dehiscence over the maxillary expansion site, which was treated successfully with Hyperbaric Oxygen (HBO) therapy. This case illustrates a rare complication of the segmental Lefort I osteotomy and the beneficial effect that hyperbaric oxygen therapy can have in treating such a complication.

Keywords: Orthognathic surgery; Lefort Osteotomy; Multi-piece lefort osteotomy; Palatal necrosis; Hyperbaric oxygen therapy

Introduction

A twenty three years old female, an active duty United States Army Soldier, presented to the Oral and Maxillofacial Surgery (OMS) Department for evaluation and treatment by her orthodontist. She presented with complaints of malocclusion secondary to maxillary AP hypoplasia and transverse hypoplasia with a class III malocclusion. She had an otherwise unremarkable medical history, no history of previous surgery, and did not smoke or use tobacco products. Her surgical case was planned based on a panoramic radiograph, a traced lateral cephalometric radiograph, and a posterior-anterior cephalometric radiograph, mounted study models, and a full model surgery was completed.

Case Presentation

She was treatment planned and brought to the operating room for a 2-piece Lefort I osteotomy advancement and expansion under general anesthesia to correct her diagnosis of maxillary AP and transverse hypoplasia.

After the down fracture of the maxilla, the nasal floor and maxillary sinus floors were found to be deep, cavernous, uneven, and thin (Figure 1). The bony anatomy was not amenable to paramedian splits so an osteotomy was created along the midpalatal suture to achieve the planned maxillary transverse expansion of 5 mm. The descending palatine arteries were dissected free of surrounding bone and soft tissue, ligated and cut bilaterally. Allogenic osseous bone graft material was placed into the gap of the segmented maxilla from a superior direction and sealed with fibrin glue. No palatal soft tissue dehiscence was noted during the midline osteotomy and the soft tissue did not appear to be ischemic once the patient was placed into the prefabricated surgical splint resulting in the desired 5 mm transverse palatal expansion. The occlusal splint was designed with an extended palatal build up in order to leave the palatal tissue visible and reduce the risk of impinging on the tissue. The maxilla was secured in the predetermined location without complication or incident. The patient's hospital course was unremarkable and she was discharged to home the next day after getting a post-operative CT scan (Figures 2 and 3).

At the one week follow up visit a large palatal dehiscence was noted (Figure 4). The patient was started on hyperbaric oxygen therapy 4 days following the initial discovery and tracked closely in the healing period (Figures 5-8). The patient completed 30 HBO dives with complete resolution of the palatal dehiscence. She completed orthodontic therapy and had her braces removed 3 months later with no further sequelae.

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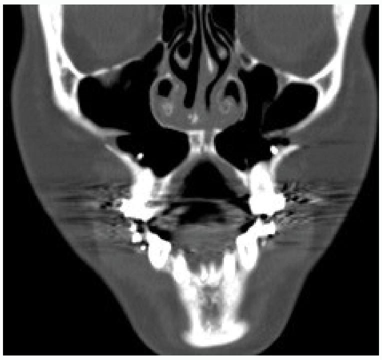

Figure 1: Post-operative CT coronal cut coincident with the 1st molars displaying unusually thin and steeply angled palatal bone.

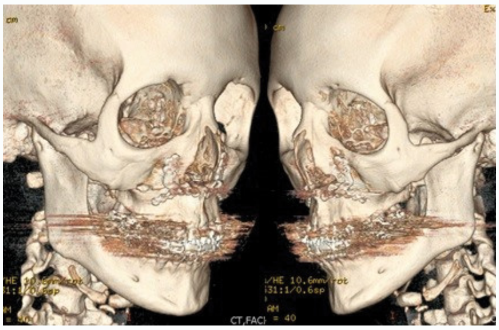

Figure 2: Three dimension reconstituted CT scan showing immediate post-operative imaging with bilateral Lindorf style advancement plates fixating the maxilla to the midface.

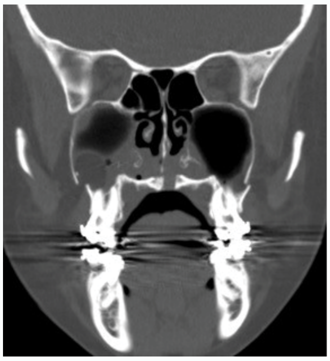

Figure 3: Immediate post-operative CT scan showing sagittal cut displaying the 5 mm maxillary transverse expansion coincident with the 2nd molars.

Figure 4: Maxillary dehiscence at post-operative day 7, prior to initiating HBO therapy.

Figure 5: Seven dives into HBO therapy.

Figure 6: Fifteen(15) dives into HBO therapy.

Figure 7: Twinty two (22) dives into HBO therapy.

Figure 8: One week after completing 30 HBO dives.

Discussion

This case describes a very unusual anatomic variant necessitating a less than optimal method of achieving a transverse expansion of the maxilla. The resulting palatal dehiscence was likely caused by a combination of factors that include increased tissue tension and decreased vascularity. The number of life threatening complications with maxillary orthognathic surgery is reported to be low, with minor intra-operative and peri-operative complications [1,2]. Common complications include bleeding, tooth injury, malocclusion, soft tissue damage, and nerve disturbance. More severe complications are possible such as significant bleeding requiring transfusion, ischemia to the maxilla resulting in partial or total necrosis, fixation failure, and damage to adjacent structures [3]. Ischemic compromise with partial or total loss of the maxilla is a rare, though feared, complication of the Lefort surgery. Interestingly, there is no published report of an entire maxilla necrosing in the English literature. Kramer et al. [4] conducted a thousand patient prospective studies on complications in 2004 and noted only two patients to have ischemic related complications. A study by Lanigan et al. [5] identified 51 cases of necrosis of the maxilla, 36 of which were detailed in the study. The majority of these were found to have been from multi-piece Lefort surgeries.

When the descending palatine arteries are ligated, the blood supply to the down fractured maxilla includes the ascending palatine branch of the facial artery, the ascending pharyngeal artery, and the soft palate vessels. Bell's [6] 1960s studies provide the initial scientific evidence showing adequate blood supply to the maxilla with ligation of the descending palatine artery. Many subsequent studies, such as Dodson et al. [7], have revisited this issue and have affirmed this finding and Turvey [8] demonstrated in 1985 in his 104 patient cohorts that multi-segment maxillary surgery was an acceptable treatment solution for hypoplasia of the maxilla in multiple dimensions. There is not standardized treatment for dealing with aseptic necrosis of the maxilla. Treatment options range from surgical intervention with debridement, HBO, hygiene, antibiotics, and anticoagulant agents.

Hyperbaric oxygen is a therapeutic tool used to a treat dive and altitude injuries, gas gangrene, carbon monoxide poisoning, osteomyelitis, crush injuries, radiation injuries, and non-healing wounds. It has been applied to and studied in a variety of medical fields and more recently popularized in the field of head and neck surgery by Marx [10] following his research on HBO treatment in cases of osteoradionecrosis of the mandible. The therapeutic benefits of hyperbaric oxygen are derived from both local environmental changes to wound tissues as well as regional signal transmission that activate the body's growth and regenerative pathways [11]. Hyperbaric oxygen affects wound healing through the modulation of angiogenesis, increased anti-microbial abilities, and a decrease in inflammation [12]. Hyperbaric oxygen therapy was initiated after the patient's first surgical follow up visit to optimize the conditions for complete hard and soft tissue healing.

Hyperbaric oxygen therapy promotes in growth of new blood vessels in wounds through the up regulation of Vascular Endothelial Growth Factor (VEGF) expression and Platelet-Derived Growth Factor (PDGF) receptor mRNA [13]. This increase in angiogenesis may be further enhanced by the recruitment of stem cells to wounds as "HBO mobilizes circulating stem and progenitor cells in both humans and mice by stimulating bone marrow endothelial nitric oxide synthase" [14]. Oxygen's role in increasing local nitric oxide content is also vital in limiting inflammation. Nitric oxide functions to decrease intercellular adhesion molecule 1, which in turn decreases capillary permeability and leukocyte margination [15]. The recruitment of these angiogenic factors and limitation of the negative effects of inflammation also improve wound repair and physical tissue growth through oxygen's role in the up regulation of fibroblasts. Fibroblasts function to increase the synthesis of collagen, which must polymerize and cross-link to be functional. This polymerization and cross linking only takes place in the presence of oxygen [16,17]. Oxygen further assists wound healing by suppressing microorganisms. Hyperbaric oxygen improves leukocyte function and encourages phagocytosis of bacteria through the production of free radicals. These free radicals produced in the presence of elevated oxygen tension exhibit both bacteriostatic and cidal effects [18,19]. Resistance to infection is paramount to heal in an open, non-sterile environment such as the oral cavity.

The Marx protocol that was specific for ORN has remained largely unchanged in all facets other than number of dives. Our patient followed the now generally accepted standard protocol of 100% oxygen, at 2.4 atmospheres, for 90 minutes [10,20-22]. She completed a total of 30 dives. The patient had therapy 5 days per week until 30 dives was reached.

Conclusion

This case demonstrates an aberrant anatomic finding that lead to a change in surgical design and resulted in a midline palatal dehiscence that was successfully treated with hyperbaric oxygen therapy. It reminds us that as practitioners we are bound to encounter complications and to keep in mind the plethora of potential benefits that hyperbaric oxygen therapy can add to wound healing.

Disclaimer

The views expressed herein are those of the authors and do not reflect the official policy of the Department of the Army, Department of Defense, or the U.S. government.

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