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Case Report

Correction of velopharyngeal insufficiency secondary to palatal gunshot wound: case presentation and review of the literature

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ABSTRACT

Reconstruction of midfacial traumatic defects secondary to a gunshot wound (GSW) is one of the most challenging head surgeries. The high impact on the functional and aesthetic quality of life, and the small margin of error to achieve a successful outcome are significant hurdles in the surgical treatment of these cases. Here we report a 33-years old patient who suffered a GSW with an entrance wound penetrating between the soft and hard palate and an exit wound on the right malar region. A description of the case and a systematic review of the literature were conducted. The treatment depends on the type of weapon used, deforming characteristics of the bullet, kinetic energy, place of impact, and general conditions of the patient. GSW generate a particular injury due to their special trauma kinematics. In this case, our patient required extensive reconstructive surgery with interposition of costal cartilage to recover velopharyngeal structure and function, patients treated with this surgical strategy develop fewer complications such as infection, shrinkage, scarring. As demonstrated by this case report, the result can be satisfactory. In order to provide the most beneficial results for the patient, surgical techniques are evolving continuously, improving both structure and function, and increasing the quality of life of the patients. Free flaps are preferred because of the good results reported. Patients treated with this surgical strategy develop fewer complications such as infection, shrinkage, scarring. As demonstrated by this case report, the result can be satisfactory.

Keywords: Palate, Gunshot wound, Velopharyngeal insufficiency, Trauma, Reconstructive surgery

INTRODUCTION

The oral cavity has traditionally been a complex site for surgery due to its constant movement during speech and feeding, its limited exposure during any procedure, and its limited tissue available for reconstruction. The palate reconstruction represents an even more challenging area due to its role in speech, resonance, swallowing, and breathing. Thus, reconstruction of the hard and soft palate is of great importance to restoring the adequate function of these structures.

Gunshot wound (GSW) generate a particular injury due to their special trauma kinematics; by crushing tissue at the site of the projectile's entrance, a permanent cavity is created by direct tissue destruction by the projectile's path, and a temporary cavity is formed by the laterally expanding shock wave and a shock wave forward stress from the passage of the projectile through the

tissue-damaging its passage through the microvasculature. Considering that, the minimum speed to pierce the skin is 50 m/s, and to affect the bone 60 m/s.[1-3]

The reconstructive ladder is important in the management of midface defects. The reconstruction principles following the reconstructive ladder have changed from a ladder approach or stepwise fashion for simple procedures to more complex ones, onto levator analogy within a reconstructive universe where the best approach is undertaken based on wound etiology, presentation, amount, and nature of tissue loss, available resources, and surgeon experience (Figure 1).[4,5]

Many plastic surgeons prefer the facial artery myomucosal flap (FAMMF) for large complex palate defects. However, the blood supply for this flap is often compromised by the surrounding soft tissue injury.[6] From a functional standpoint, vascularized free tissue transfer has been reported as the most favored procedure for maxillary reconstruction.[7]

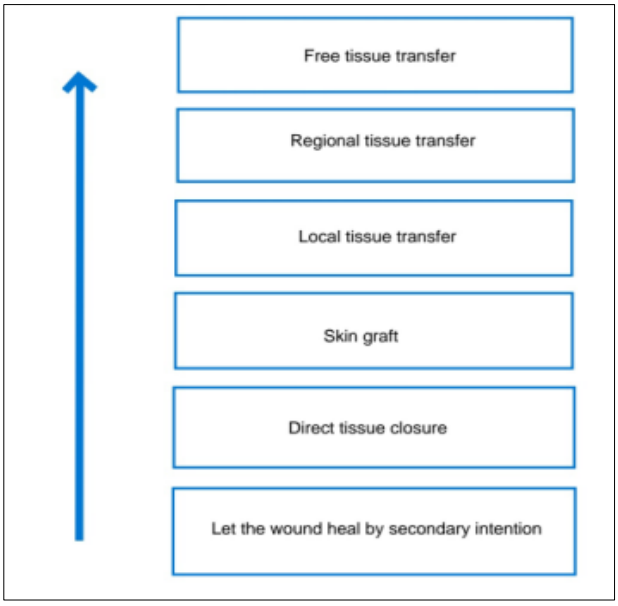

Figure 1: The reconstructive ladder. Systemic approach to facilitate decision making in the reconstruction of defects, the least complex technique is chosen to cover the need for the defect and the reconstructive objectives.

A systematic review of the literature was conducted using "PubMed" and "Google scholar" in August 2022. We made different searches using keywords: palate, gunshot wound, velopharyngeal insufficiency, surgery facial gunshot wounds, palate injury, palatal defects, palatal reconstruction, and palatoplasty. The search was limited to the studies published in Spanish, English, and French.

In total, 32 articles were found. 15 of these articles were rejected for not complying with the objectives addressed in this review. Among the other 17, the following stands out: two of these are case series on gunshot wounds and the kinematics and impact characteristics of firearms. One of them describes the anatomy of soft tissue trauma in the maxillofacial area. We included 13 articles in which cutaneous and fasciocutaneous flaps were described. These 13 articles describe palatal and velopalatal wound reconstruction techniques, also reviewing the classifications used.

CASE REPORT

We present a case of a 33-year-old patient who suffered a GSW from a 9 mm bullet.

The patient was seen at the emergency department of the Hospital Gea Gonzalez in Mexico City 11 days after the incident. He was hemodynamically stable. He presented with an entrance wound penetrating between the soft and hard palate and an exit wound on the right malar region. The patient exhibited severe hypernasality and consistent nasal emission. Hypernasality is the excessive nasal resonance and can be noted during perceptual analysis in the production of high-pressure consonants and even vowels. Nasal emission is the abnormal escape of air through the nose during speech. For this reason, his speech was practically unintelligible (Figures 2 and 3).

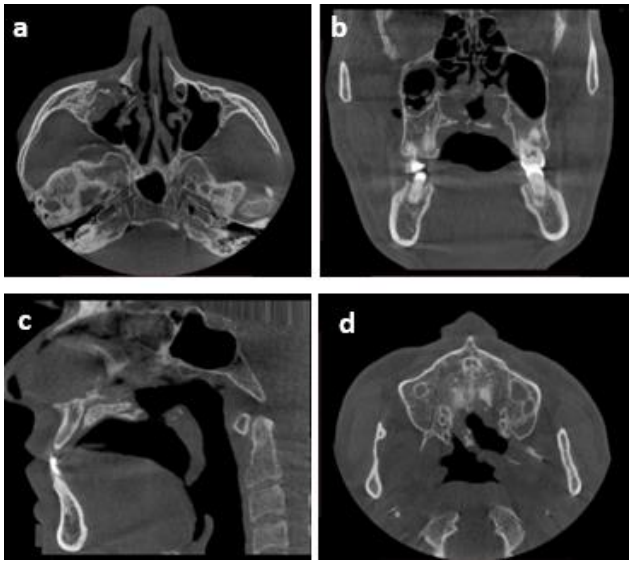

Figure 2: Tomography of the facial mass in a bone window (a) in an axial cut, where a multi-fragmented fracture of the anterior wall of the right maxillary sinus is observed, which is observed to be occupied by material with soft tissue density and by some bone fragments; (b) with coronal reconstruction, in which occupation of the right maxillary sinus is identified by material with density of soft tissues and calcium together with an air bubble adjacent to the lateral wall; (c) with sagittal reconstruction, in which a bone continuity solution is identified in the hard palate that causes a communication between the oropharynx and the nasopharynx; and (d) where the bone fragments of the hard palate are identified.

The clinical manifestations of the patient were: nasal regurgitation of food, especially liquids, oral dysphagia, pharyngeal dysphagia, and hypernasality secondary to velopharyngeal insufficiency.

The patient was scheduled for a dual ipsilateral rotational inferior myomucosal flap and superior mucoperiosteal flap with interposition of costal cartilage graft for providing to the closure site (Figure 4).

The patient was discharged the following day with a liquid diet which progressed to a soft diet after one week. The patient had follow-up visits at the plastic and reconstructive surgery outpatient clinic. The wounds healed after 15 days. A complete speech pathology evaluation demonstrated normal resonance. Nasal emission was eliminated. The speech was normal without dysarthria (Figure 5).

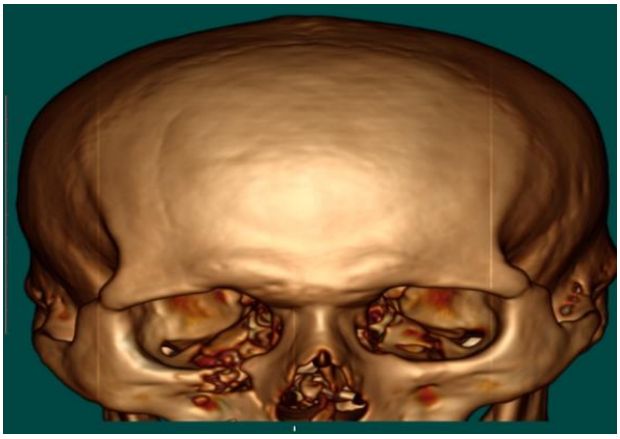

Figure 3: Skull tomography in 3D reconstruction, showing the bone fragments that compromise the right orbital floor.

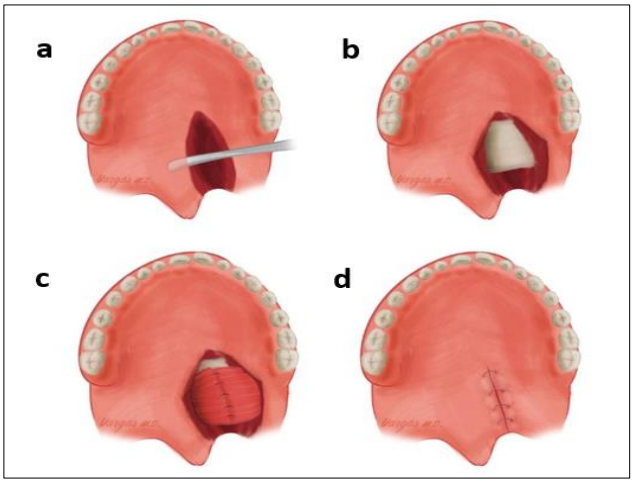

Figure 4: (a) Dissection by planes, releasing oral mucoperiosteum muscle and nasal mucoperiosteum; (b) rib segment is placed to bridge the bone defect; (c) reconstruction palatine muscles; and (d) closes by planes.

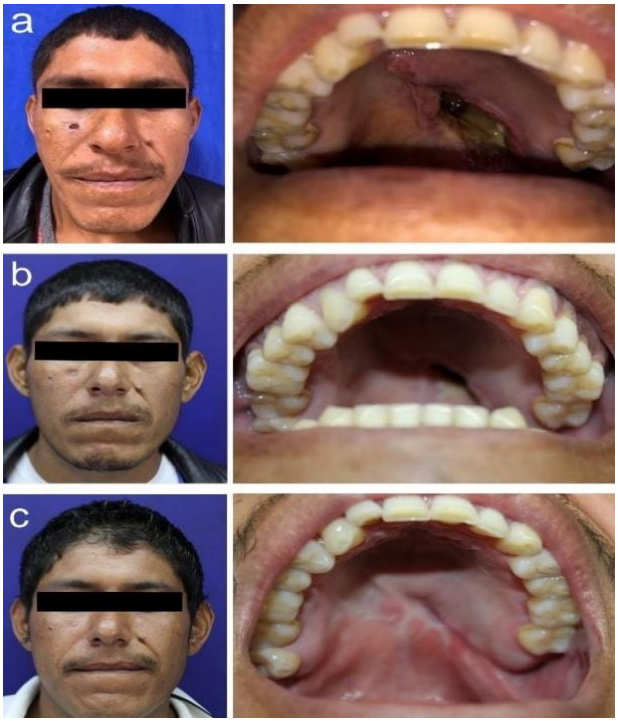

Figure 5: (a) Entry hole (between soft and hard palate) and exit hole (right malar region) of a 9 mm caliber bullet, following a trajectory from caudal to cephalic and from left to right; (b) and (c) show the postoperative period at 15 days and 3 months, respectively.

The patient recovered the proper phonation, swallowing, and breathing, and speech was normal without dysarthria, greatly improving the patient's quality of life.

DISCUSSION

Since most palatal defects are secondary to oropharyngeal cancer, most of the reports are focusing on this disorder. However, in cases of other traumatic palatal injuries not associated with cancer, the constellation of symptoms is similar. The most common symptoms include nasal regurgitation of food, especially thick and thin liquids, oral dysphagia secondary to abnormal rotary mandibular mastication movements, pharyngeal dysphagia and hypernasality secondary to velopharyngeal insufficiency, and loss of midfacial soft tissue support.[8]

Reconstructive oral and maxillofacial surgery have a long history in the treatment of facial injuries dating back to 460 BC when Hippocrates used gold wire to fixate teeth for a mandible fracture.[9]

The reconstruction of the velopharyngeal union and palate after trauma, a congenital defect, or oncologic resection, represents great complexity and a technical challenge because the palate contributes to important functions like swallowing and phonation, and it represents a technical challenge because of the difficult access to the mouth cavity.[1]

There are many methods of reconstruction, surgeons must choose the best option thinking about the particularities of each case and patient to achieve the best impact on the quality of life for our patient.

Free tissue transfer easily allows for soft tissue separation of the oral and sinonasal cavities, skeletal support of the midface, and often allows for future sinequanon point dental rehabilitation for total patient satisfaction by providing the opportunity to regain proper phonation, swallowing, and breathing, greatly increasing the capacity of patient´s quality of life.[10]

The classic methods focus on using hard palate mucoperiosteal flaps to achieve anatomical oral union of the palate halves. Dehiscence and fistulae were major concerns because of infection, ischemic necrosis, and tension of repair. Therefore, because of the design of mucoperiosteal incisions, the anatomical union is generally obtained. Therefore, the surgeons must now strive to achieve normal velopharyngeal function without causing maxillary-alveolar growth deformities.[11]

In the congenital and traumatic cases, the levator veli palatinni muscle of the palate has a normal origin on the eustachian tube and lip of the carotid canal, but they insert abnormally onto the posterior margin of the hard palate and into the tensor tendon – instead of inserting into the medial raphe of the soft palate. In effect, then, the cleft muscles have a stationary origin and insertion, making only isometric contraction possible.[11]

Normal velopharyngeal closure is primarily the result of levator muscle contraction which pulls the velum upward and posteriorly toward the pharynx. To a lesser extent, velopharyngeal closure is produced by a sphincteric action of the palatopharyngeal and superior constrictor. Patients with cleft palate and trauma show a predominant sphincteric action. The sphincteric action is a compensatory mechanism secondary to ineffective levator function. The objective of a levator sling reconstruction is to maximize velar elevation and posterior closure by establishing normal levator muscle relationships.[11]

Several surgical techniques for palatal repair following a traumatic or surgical injury have been reported.[12,13] Granulation and healing by second intention were one of the solutions frequently used, this approach requires more time for healing.[14,15] Moreover, closure of the wounds with this approach involves more care for the patient like using a nasogastric tube or Corpak tube for enteral nutrition and daily wound care for a long time. The aesthetic, anatomical, and functional outcomes of this conservative approach have not been very encouraging.[16]

Thus, this conservative option has been replaced by new techniques and it has been limited to selected cases with small defects or patients with high morbidity contraindicating major surgical procedures.[17]

The good vascularity of the oral cavity allows the design of diverse types of local flaps. There are different possibilities depending on the localization of the defect. The goal is to restore the anatomical and functional integrity of the defect. Surgical techniques have continued to evolve to improve both structure and function.

In cases of large and medium palate defects, reconstruction using local or regional flaps for restoring the anatomical and functional integrity of the palate is usually an adequate approach. The disadvantages are the small amount of tissue and bad adaptability. Thus, these techniques are usually indicated only for small defects or defects in contiguous areas.[12]

For major size defects, the use of a regional pediculated flap is indicated. The temporoparietal fascia and temporal muscle flap provide adequate adaptability and volume for closing medium and major-size defects, its disadvantages are the limitation of the pedicle and the aesthetic defect of the donor area.

Other flaps such as the nasogenian flap, the platysma muscle, and the sternocleidomastoid muscle flap have also been reported as options in these cases.[12]

The development of microsurgery techniques for post-traumatic or oncological patients has allowed achieving successful anatomical reconstructions of major size defects with acceptable aesthetic and functional results. Its disadvantages are the very long surgical times, and the morbidity of the donor side. Thus, these techniques are usually contraindicated in patients with a complex medical history and high anesthetic risk.

CONCLUSION

In conclusion, to provide the most beneficial results for the patient, surgical techniques are evolving continuously, improving both structure and function, and increasing the quality of life of the patients. Free flaps are preferred because of the good results reported. Patients treated with this surgical strategy develop fewer complications such as infection, shrinkage, scarring. As demonstrated by this case report, the result can be satisfactory.

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