

Novel Custom Maxillary Disimpaction Splint

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Summary: LeFort I, II, and III osteotomies are commonly used in complex craniofacial reconstruction. Patients requiring these procedures typically have a craniofacial cleft, other congenital craniofacial deformities, or severe facial trauma. Both the cleft and traumatized palate have poor bony support, which leads to possible complications when the disimpaction forceps are used during the downfracture of the maxilla. Such potential complications include trauma or formation of a fistula of the palatal, oral, or nasal mucosa; trauma to adjacent teeth; and fracture of the palate and alveolar bone. To help prevent these complications, we developed a custom disimpaction splint. The splint is designed to cover the palate and occlusal surfaces to increase retention and minimize splint movement during the maxillary downfracture portion of the surgical procedure. The base of the splint is fabricated from a two-layered biocryl material, and the palatal area is built with soft-cushion rebase material. This allows for a stable grip of the disimpaction forceps blades and provides protective coverage of the cleft, traumatized palate, or alveolar bone graft site during the downfracture. The custom maxillary disimpaction splint has been routinely used in our clinic from September 2019 to the present for LeFort osteotomies in patients with a compromised primary palate. No surgical complications related to the maxillary downfracture have been noted during this period of time. We conclude that the routine use of a custom maxillary disimpaction splint can result in improved outcomes and decreased complications of LeFort osteotomy procedures in patients with cleft and traumatized palate. (*Plast Reconstr Surg Glob Open* 2023; 11:e4976; doi: [10.1097/GOX.0000000000004976](https://doi.org/10.1097/GOX.0000000000004976); Published online 10 May 2023.)

INTRODUCTION

LeFort I, II, and III osteotomies are commonly used in complex craniofacial reconstruction for patients with congenital craniofacial deformities or severe facial trauma. When a LeFort osteotomy is combined with downfracture, mobilization, and repositioning, it can be used to surgically correct three-dimensional maxillary deformities.¹ The procedure is generally considered safe; however, complications can occur, specifically during the maxillary osteotomy, the pterygomaxillary separation, and the maxillary downfracture.

Bell et al provided a biological basis for downfracture by demonstrating that revascularization and bony healing occurs after bony separation.²⁻⁴ With complete maxillary mobilization, the descending palatine vessels can be disrupted, and thus, the ascending palatine and pharyngeal vessels become the primary blood supply.¹ There are many approaches to disimpacting the maxillary segment, including digital pressure to the dentoalveolus, disimpaction forceps, bone hooks or spreaders, and other instruments.⁵ One of the more commonly used methods for downfracture is the use of Rowe disimpaction forceps, which is applied routinely at our center.

The Rowe disimpaction forceps allow significant amounts of force for disimpaction and repositioning of the maxilla and midface. The goal is to render the maxilla mobile, which may require significant up-down and side-to-side movements of the forceps. Severe complications can occur with this technique if special attention is not given to each individual's fracture pattern and correct placement of the forceps. Poor maxillary bony support

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Received for publication December 20, 2022; accepted March 15, 2023.

Presented at American Cleft Palate-Craniofacial Association, April 27–May 1, 2021, Raleigh, North Carolina (poster presentation), and at Cleft 2022, July 11–15, 2022, Edinburgh, Scotland, UK (oral presentation).

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DOI: [10.1097/GOX.0000000000004976](https://doi.org/10.1097/GOX.0000000000004976)

Disclosure statements are at the end of this article, following the correspondence information.

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can lead to decreased stability of the lower forceps blades used during downfracture, especially in patients with a cleft, other congenital craniofacial deformities, or in cases of severe facial trauma. This leads to increased risk of complications, including trauma to palatal, oral, or nasal mucosa; fracture of the palate, alveolar bone, and bone graft; formation of an oronasal fistula; disruption of the palatal blood supply; or damage to the dentition and surrounding structures. As three such complications occurred early in the senior author's practice, to reduce future complications, we developed a protective custom splint. The addition of the splint allowed a more stable purchase of the disimpaction forceps and protection of the cleft or traumatized palate and surrounding structures during the maxillary downfracture.

METHODS

The custom disimpaction splint is fabricated by a craniofacial orthodontist from a mold taken during a routine 1–2 weeks preoperative visit or intraoperatively. The splint is designed to cover the palate and occlusal surfaces to increase retention and control of the disimpaction forces during the surgical procedure. The base of the disimpaction splint has two layers, which are vacuumformed onto the presurgical model. The first layer is a 0.9-mm soft thermoplastic material (Sof-Tray Sheet, Ultradent, South Jordan, Utah) that contacts the palate and protects the palatal mucosa from shear forces (Fig. 1). The second layer is fabricated from a 2-mm clear splint Biocryl material (Great Lakes Dental Technologies, Tonawanda, N.Y.) that provides support and stability to the splint. The clear splint is trimmed to cover the occlusal surfaces for a passive fit. The palatal area is built with soft cushion relined material (Soft Chairside Reline, Henry Schein, Melville,



Fig. 1. The making of the thermoplastic layer over the maxillary mold.

Takeaways

Question: Is there an efficient, noninvasive way to protect the palate of patients during LeFort osteotomies?

Findings: Using a maxillary disimpaction splint is a safe and effective way to protect the palate when using Rowe forceps during downfracture.

Meaning: Protecting the palate of patients during downfracture leads to fewer complications.

N.Y.), which is contained with a wax barrier until the material is set (Fig. 2). The relined material is leveled to the occlusal surface with a slight curvature to mimic normal palatal anatomy for a better grip on the lower blade of the disimpaction forceps (Fig. 3). Once the splint is fabricated and inserted (Fig. 4), it provides a protective cover for the palatal and alveolar region during the maxillary downfracture.

RESULTS

The maxillary disimpaction splint has been routinely used in our center by all craniofacial surgeons since September 2019 for LeFort osteotomies in patients with a compromised palate. Since then, there have been 110 patients on whom the disimpaction splint has been successfully used, with 98 of those being cleft cases and 12 cases of trauma. No surgical complications related to the use of the splint, including alveolar bone graft fractures, palatal trauma, or formation of oronasal fistulas,

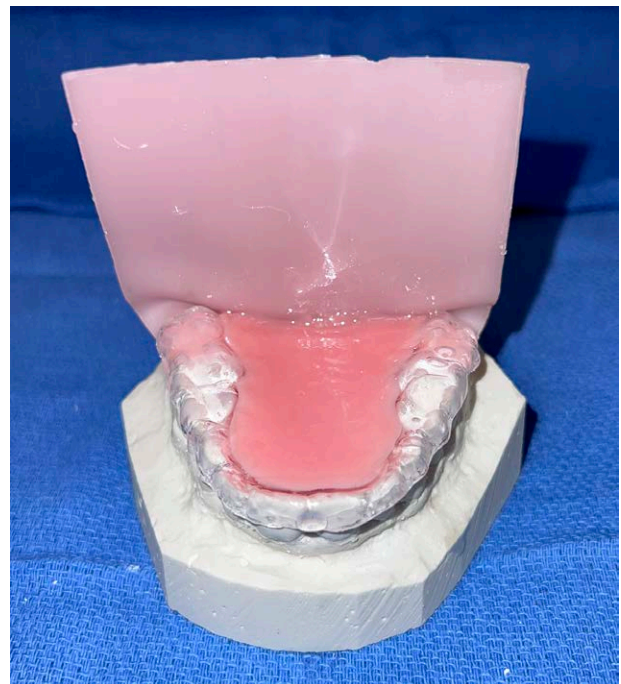


Fig. 2. The application of the soft relined material using a wax barrier. The wax barrier is removed before trimming of the splint but is shown to demonstrate the making of the splint.



Fig. 3. The disimpaction splint with the Rowe forceps applied, demonstrating the protection provided to a potentially vulnerable maxilla.



Fig. 4. The maxillary disimpaction splint in place before downfracture.

have been recorded. During a 1-year period before the implementation of the disimpaction splint in which there were 30 cases where protection of the palate was not used—27 cleft cases and three trauma cases—there were three complications that prompted the creation of a protective splint. One complication occurred in a complex trauma patient with concomitant displaced LeFort and palatal fractures during the disimpaction done without

protection. Rupture of the mucoperiosteum of the palate resulted in a large oronasal fistula. The other two complications occurred in cleft patients during disimpaction without protection. Fracture of the level of the alveolar cleft with instability of the maxilla was noted in both cases. Two videos demonstrating the splint placement (Video 1) and maxillary downfracture with the splint in place (Video 2) are presented. (See Video 1 [online], which shows a demonstration of the placement of the maxillary disimpaction splint.) (See Video 2 [online], which shows a demonstration of downfracture with the maxillary disimpaction splint in place.)

DISCUSSION

Currently, the existing literature regarding modalities for maxilla protection during maxillary downfracture is limited. Transpalatal support with modified palatal holding arches and inter-arch appliances has been described.⁶ McNulty et al introduced the Glasgow splint in the setting of cleft palate patients specifically to address the vulnerability of the maxilla during the downfracture process.⁷ Their splint consists of an acrylic molding with two channels that are cut into the occlusal or palatal surface to allow for the disimpaction forceps to engage positively with the splint. The current three-layer design of our splint represents a stepwise evolution, starting with a one-layer splint and steadily improving on the design to eliminate all encountered shortcomings. The first layer of our splint provides a protective, soft material against the palatal mucosa and teeth. The middle acrylic layer gives stiffness and stability to the splint. The outer layer is made from a grippy material and built up to eliminate the curvature of the palate by filling in the material to the level of the occlusal plane. Both characteristics improve the stability and prevent gliding of the Rowe forceps during disimpaction. This prevents any undesirable movement of the Rowe disimpaction forceps during maxillary disimpaction and gives the surgeon full control in manipulating the mobile maxilla.

This splint can be fabricated by an onsite orthodontist or other trained personnel from a plaster or three-dimensional printed model. There is minimal to no impact on operative time, adding no more than 15 minutes in unplanned trauma cases. For all cases, we bill the cost of the splint to the patient's insurance through the hospital billing service. Although more extensive studies are needed to assess the generalizability of this type of splint, we have successfully used it for 3 years for protecting the palate when maxillary downfracture is necessary. We conclude that the routine use of a custom maxillary disimpaction splint can result in improved outcomes and decreased complications of LeFort osteotomy procedures in patients with cleft and traumatized palate.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

ACKNOWLEDGMENTS

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Informed consent was obtained from all patients for being included in the study. Additional informed consent was obtained from all patients for whom identifying information is included in this article.

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