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A Simple and Effective Palatal Splint to Improve Stability of Segmental Lefort I Osteotomy: Technical Note

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Abstract

The segmental LeFort I osteotomy allows the correction of a wide range of skeletal malocclusions in one surgery. However it is well recognised that the correction of both transverse and vertical discrepancies through this procedure is unstable and has a high risk of relapse.

Appropriate surgical technique in combination with postoperative retention of the dento-osseous segments are crucial to enhance stability.

Previousy descibed methods to maintain segments position post-operatively are all plagued by limitations.

A modified surgical splint for multi-piece maxillary osteotomy is presented.

The splint is made of acrylic resine, is thin and fits on a tiny part of the palatal surface of the upper teeth. It is inexpensive, easy to clean, and allows visualization of the entire palate whilst causing minimal patient discomfort. Moreover it is suitable for either two and three-piece maxillary osteotomies surgery.

Keywords: Palatal Splint; Segmental Lefort I Osteotomy; Stability Of Multi-Piece Maxillary Osteotomies Surgery; Transverse Maxillary Discrepancy; Open Bite; Skeletal Malocclusion

Introduction

A multi-piece maxillary osteotomy surgery allows multidirectional movements simultaneously. The main advantage is that one surgical procedure can both correct vertical, sagittal and transverse maxillary deformities concurently.

However, its stability is still a concern among surgeons [1-5].

Maxillary widening and the treatment of anterior open bite with segmental LeFort I osteotomy are reported to be the most unpredictable procedures with an increased risk of relapse among all orthognathic surgical modalities [4-7].

Surgical technique is crucial to enhance stability.

Turvey [8] described all the surgical steps to assure good results. The key points are: 1) Use two para-midline palatal osteotomies rather than one midline osteotomy; 2) If the osteotomy site is too large, insertion of bone grafts or allografts [8,9] will control the tendency of the segments to tilt.

Additionally, postoperative retention of dento-osseous segments plays a significant role in preventing relapse [10] and several methods have been described: interosseous wires [8,11], titanium [12] or biodegradable plates [13] at the palatal vault, interocclusal splints [14], palatal bars [9,15,16], and palatal splints [9, 14, 15, 17-19].

However each of these techniques has some disadvantages or limitations including lack of rigidity, use restricted to paramidline osteotomy of the palate, occlusal interfereces, risks for vascularization, costs, and problems with speech, food intake and poor oral hygiene.

The aim of this technical note is to describe a new palatal surgical splint that overcomes all those constraints.

Material and Methods

Model surgery on dental casts is done one to two weeks before surgery. An inverted bimaxillary sequencing (mandible first) is simulated. Two sets of articulated casts (one that is cut and one not cut) are needed for the following steps: I) Position one maxillary cast into final position on articulator (after segmentation) and fabricate the palatal splint (Figure 1); II) Move the mandibular cast into occlusion with repositioned maxillary cast; III) fabricate an interim splint (Figure 2) between the unoperated maxillary cast and the repositioned mandibular cast.

The appliance is made of chemically cured acrylic resin that partially covers the palatal surface of all the upper teeth so it is comfortable for the patient and it doesn't interfere with occlusion.

It is approximately 3 mm thick and is reinforced internally by a wire to prevent the risk of breakage during intraoral insetting or chewing (Figure 3).

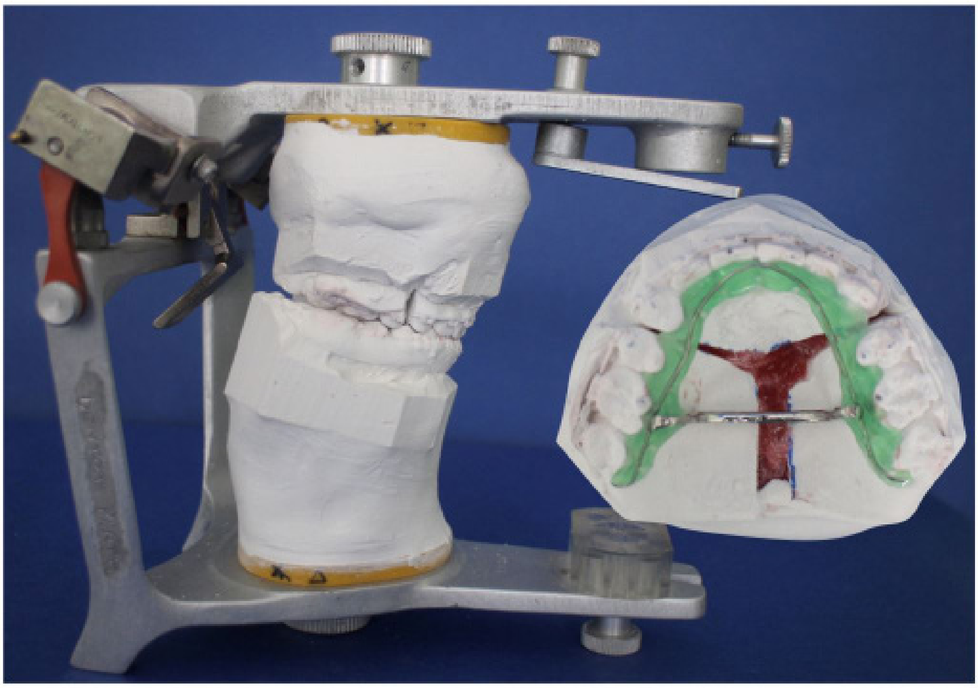

Figure 1: The palatal splint is fabricated on a preoperative cast on which transverse and vertical discrepancies have been previously corrected

Figure 2: A mandible first sequence is simulated on the articulator: an interim splint is fabricated between the unoperated maxillary cast and the repositioned mandibular cast

Figure 3: The splint is made of acrylic resine. A steel wire is inserted inside and a stainless steel palatal bar is attached to the splint in the molar region to enhance its rigidity

A single stainless steel palatal bar is bent traspalatally in the molar region, following the palatal curvature and bonded at both ends to the lateral parts of the splint and connected with the internal wire to provide additional transverse resistance and to control both posterior segments inclination (Figure 3).

Care is taken to maintain at least 1-2 mm distance between the bar and the cast in the midpalatal region to avoid possible compression of the palatal mucosa (Figure 4).

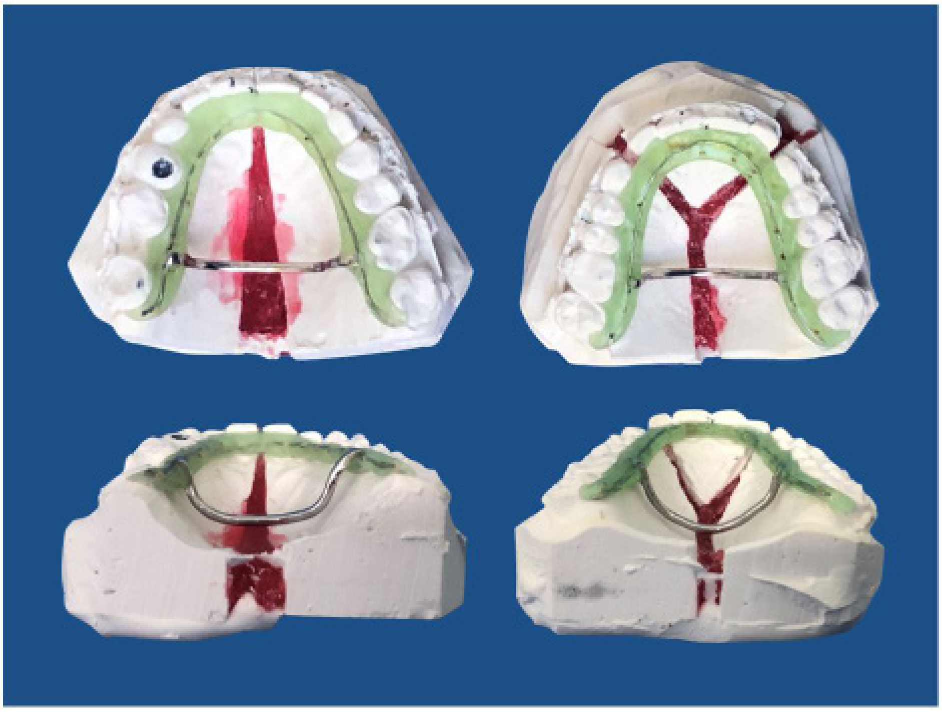

Figure 4: The splint is thin, it fits a tiny part of the palatal surface of the upper teeth and it is suitable for either two and three-piece maxillary osteotomies surgery. The palatal bar respects the natural shape of palate and it must not be kept in contact with the palatal mucosa in order not to compromise the vascularization

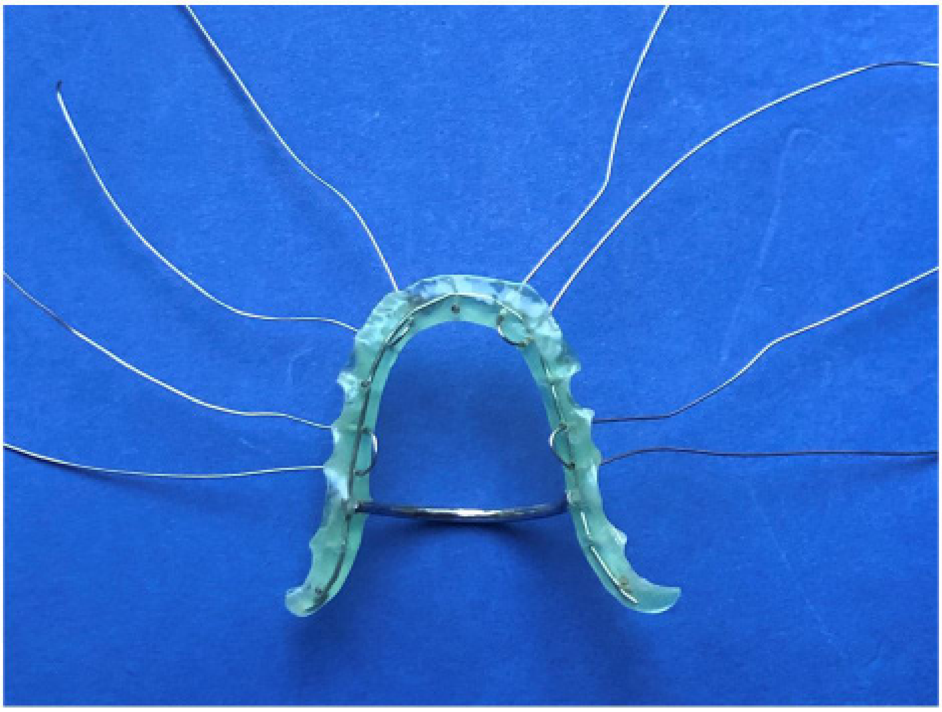

Figure 5: After completing maxillary segments mobilization, four 0.4-mm wires are inserted on the interproximal holes of the splint to allow its fixation on teeth

Interproximal holes are made using a 1 mm diameter tungsten carbide bur to allow splint fixation with 0.4-mm circumdental wires after completing mobilization of the maxillary segments and passive adaptation to the splint (Figure 5)

Postoperatively, the splint is maintained in place for 4 to 8 weeks.

Splint removal is routinely accompanied by a prompt return to the orthodontist for placement of a continuous archwire to secure the segments. Furthermore a transpalatal archwire is normally recommended and preferred to the over-riding labial archwire, despite the necessity for banded molars with palatal sleeves, to maintain marked skeletal expansion without interfering with the commencement of orthodontic detailing.

Results

We routinely use the palatal splint since 2009. During these twelve years, 180 patients underwent the surgical procedure that we described in the present paper. We never had breaking of the splint or vascular compromise of the palatal tissues.

In 6 patients minor lacerations (2-4 mm) of the palatal mucosa were observed. The perforations were easly inspect with the splint left in place and resolved spontaneously in about three weeks. None of the patients complained about the splint that is left in place on average six weeks. Long-term postoperative observation (1 - 12 years) showed a clinically stable occlusal situation.

Discussion

Following segmental LeFort I osteotomy and widening of the maxilla, the use of a palatal splint is widely recommended to ensure a good long-term transverse and vertical stability [15,18,19].

Bays, *et al.* [17] in 1978 described the first alternatives methods to intermaxillary fixation to stabilized osteotomized maxillary segments such as different types of orthodontic appliances, Daultrey's modified arch bar, Schuchardt arch bar, acrylic splints, cast splints.

In the last recent years orthognathic surgery has seen tremendous advancement in technology, including virtual surgical planning and customized hardware.

On this path, Stokbro, *et al.*[14] in 2017 and Ismail, *et al*. [15] in 2019 introduced custom, virtually designed palatal appliances. These methods are usefull in maintenance of surgical expansion without all the disadvantages of the old occlusal and palatal splints but they required the assistance of an engineer and higher cost for software and production.

Therefore the different designs of palatal splint featured in literature all have some weaknesses that can hinder the final surgical result [9, 14, 15, 17-19].

To sum up, pre and intraoperative problems associated with the use of a maxillary splint include: breaking of the splint at insertion, premature contacts, inability to visualize the teeth directly, inability to determine whether the splint is fully seated, vascular compromise of the palatal tissues owing to a poorly fitting palatal borne splint and high cost.

Postoperative consequences include: worse hygiene, poor speech mechanics, cracking of the splint, hypoperfusion followed by necrosis of the bone segments, difficulties in monitoring of a palatal perforation and lack of stability.

The key features of our splint are:

1) hand made of acrylic resin;

2) thin without palatal flanges;

3) reinforced internally with a steel wire;

4) tailored to the palatal surface of all the upper teeth;

5) presence of a stainless-steel palatal bar in the molar region, following the palatal curvature but without any mucosa contact.

Each of those gives the following advantages:

1) cost-effective and simple to manufacture;

2) comfortable to eat and talk, easy to clean and suitable for both two and three-piece maxillary osteotomies. The absence of full palatal coverage allows complete visualization of the palatal tissues and to inspect a palatal perforation and, when required, to manage it with an obturator.

1) resistant to breakage;

2) absence of occlusal interferences;

3) additional resistance and further control of posterior segments inclination without compromising the vascularization.

The described palatal splint circumvents many of the problems with previous splint design whilst providing a cost-effective alternative to stabilize the bone fragments of a segmental LeFort I osteotomy.

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