The Composite Cone Technique: an Effective Tool for Enhancing Transverse Maxillary Stability in Multisegmental Le Fort I Surgery

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“This technique helps to achieve transversal stability after maxillary surgical expansion”

Abstract

Stability of the transverse dimension of the maxilla is difficult to achieve clinically in patients undergoing segmental osteotomy. The likelihood of relapse is directly associated with the gain in maxillary width. New methods are needed to avoid or reduce transverse relapse.

This study describes the preliminary results in two patients of a technique designed to avoid or reduce transverse relapse after segmented Le Fort I osteotomies. The technique includes the preoperative construction of higher than normal cusps, built using flow composite filling material in the non-functional cusps of the molar teeth, including the lingual cusps of the lower molars and the buccal cusps of the upper molars.

In the first patient, the correction of a dual occlusal plane by multisegmental Le Fort I osteotomy increased the upper dental arch width between mesiobuccal (MB) cusps of second molars from 54 mm to 56 mm, with the width remaining stable 1 year after surgery. In the second patient, the transverse dimension of the upper dental arch, measured at the MB cusp of the first molar, increased after surgery from 58 mm to 63 mm between MB cusps of second molars, remaining stable for 3 years.

These preliminary results indicate that the “composite cone technique” can control transverse relapse after segmental Le Fort I osteotomy.

Keywords
Maxillary, surgical expansion, stability

INTRODUCTION AND LITERATURE REVIEW

Transverse maxillary deficiency, whether isolated or associated with other dentofacial deformities, results in aesthetic and functional impairment.

Patients may have difficulty chewing due to unilateral or bilateral transverse discrepancy and dental crowding, or a deep palatal vault and nasal blockage, leading to oral breathing and apnea[1].

These problems may be solved more easily in growing than in non-growing patients with orthopedic maxillary expansion. Although these deficiencies can also be solved in non-growing patients with mild orthodontic problems, patients with moderate to severe discrepancies require orthognathic surgery. If the problem is just transverse, it may be solved by surgically assisted rapid palatal expansion (SARPE)[2,3]. Correcting discrepancies in the vertical and/or sagittal planes, however, requires conventional orthognathic surgery. In most patients, a segmental Le Fort I osteotomy can correct discrepancies in the transverse dimension, although some cases require a midline mandibular osteotomy, a combination of these two methods, or distraction osteogenesis[3,4].

Although achieving correct transverse dimensions intraoperatively is not challenging, postoperative relapse may occur, probably due to the tension of palatal fibromucosae. Many methods have been developed to avoid relapse[5-8].

This study describes a new technique designed to avoid or reduce transverse relapse in maxillary expansion after segmented Le Fort I osteotomies. The method consists of building non-functional, higher than normal megacusps in the molars that lock occlusions intraoperatively, thus avoiding transverse relapse postoperatively.

TECHNICAL AND SURGICAL PROCEDURE

Prerequisites for the successful use of the composite cone technique: protocol for building higher than normal cusps (megacusps)

The first step consists of making plaster models of the teeth (*Fig. 1*). Molar cusps are increased by free-hand augmentation (*Fig. 2*). Impressions are taken of the dental arches, followed by model casting. The model of the upper jaw is segmented, and the segments of the upper jaw model are fitted onto a model of the lower jaw; areas that require additional augmentation or reduction are marked.

The cusps in the mouth are reduced and augmented according to the models (*Fig. 3*). The impression taking, model casting and segmenting as well as fitting steps are repeated until the segmented model of the upper jaw can be seated perfectly on top of the model of the lower jaw, with deep intercuspation of the megacusps and with functional cusps in occlusion.

Although indirect bonding of the

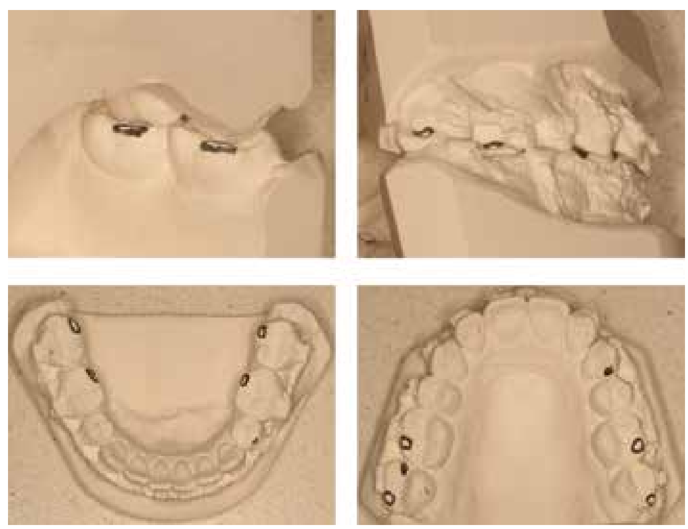

Figure 1: Fitting of a maxillary segment on top of a lower dental arch reveals the best position for the megacusp. The location is marked in black.

Figure 2: Free-hand augmentation of the molar cusp in the mouth. Acid etching, bonding and augmentation with flow composite material results in the megacusps

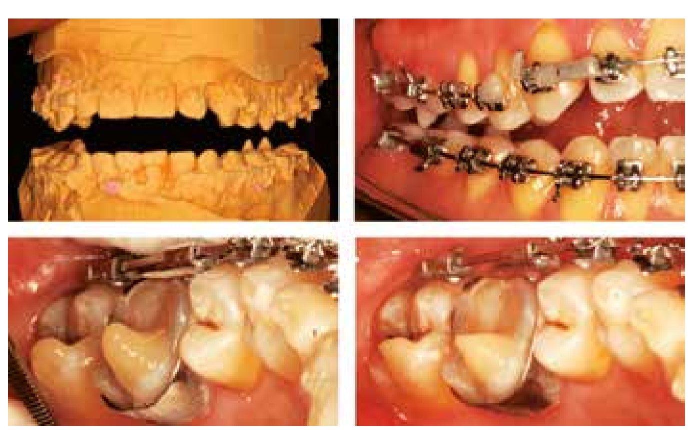

Figure 3: Following the final occlusion on the models, the megacusps are reduced or augmented as required in the mouth.

megacusps would provide accurate final occlusion, it would add significant laboratory expenses to the costs of treatment.

SURGICAL PROCEDURE

Since the megacusps cannot prevent active relapse forces, the maxilla must be mobilized adequately, and all of its segments must be passive to the extent that no excessive force should be needed to push the segments into the right position on the lower dental arch. The maxilla must be totally freed from the pterygoid plates, and all bone behind the descending palatine artery must be removed. Maxillary passivity can be tested by effortless posterior downward mobilization with a Turvey spreader. The maxilla can then be segmented by performing two parasagittal osteotomies in the floor of the nose and connecting them with a transverse osteotomy extended into the dentoalveolar process. The transverse passivity of the lateral maxillary segments can be tested using a Turvey spreader. The mobility of the segments can be checked by palpation and manual checking to ensure that the segments have separated adequately at the dentoalveolar level where they are attached to the intact mucosa.

Vertical control of the maxillary segments must be precise. The patient should not have a posterior open bite after surgery. Accurate posterior plate bending, passive osteosynthesis, and gentle condyle seating are prerequisites for good vertical control of the posterior maxilla. If postoperative posterior open bite occurs, the megacusps cannot prevent transverse relapse.

Stable osteosynthesis and the wedging of posterior maxillary bone defects with grafts or synthetic material are required to avoid surgical relapse. The megacusps can prevent only transverse relapse at the level of the teeth, with a proper surgical technique ensuring stability at the bone level.

In constructing plaster models, the ideal position for cusp enlargement was designed with the models in final occlusion. High cusps were constructed of flow composite filling material, according to the rules of restorative dentistry, and were built up incrementally in each patient's mouth just before the acquisition of the impressions for model surgery and splint fabrication. If a patient had a temporary or ceramic crown, acrylic resin or other materials were used instead of flow composite. Alternatively, if adherence is questionable, the crowns could be replaced with the new ones with megacusps augmented in the laboratory.

The cusps are usually positioned on the non-functional cusps of the molars, including on the lingual cusps of inferior molars and the buccal cusps of upper molars. These cusps may be made of a filling material, in a different shade, to facilitate their safe removal at the end of treatment. During the healing process, these cusps prevent transverse relapse and stabilize expanded maxilla at the level of the teeth. A final splint was not used, so the final interdigitation of upper and lower teeth was not inhibited.

Megacusps were removed at the time of reinsertion of continuous archwire after surgery, most usually 3–4 months postoperatively when the bone segments have healed completely. In many patients with worn out dental anatomy and a poor fissure-cusp relationship, however, the megacusps were retained until the end of orthodontic treatment. Alternatively, if patients are unwilling to undergo reconstruction of dental anatomy, the megacusps were kept in throughout the retention period. The megacusps are subsequently ground to half-size in order not to interfere with functional jaw movements but can still assist in maintaining the transverse dimensions of the upper dental arch.

DESCRIPTION OF THE CASES

The first patient had an upper dental arch width between the MB cusps of the second molars of 54 mm. The planned expansion was 2 mm. Transverse dimensions were measured after 1, 6, and 12 months, with the occlusion being stable 1 year after the end of treatment (*Figs. 4–6*).

The second patient had an upper dental arch width between the MB cusps of the second molars of 58 mm. The planned expansion was 5 mm. Transverse dimensions, measured after 1, 6, 12, and 36 months, remained stable throughout follow-up. The remaining non-functional megacusps on the upper molars continued to act as retention devices 3 years after the end of treatment (*Figs. 7–9*).

Although the technique is a promising and reliable tool for achieving transverse stability following the multisegmental Le Fort I procedure, it had a few drawbacks; for example, it required additional chair time of about 40 minutes for the construction of the megacusps, as well as the additional use of dental facilities. This method requires taking a series of impressions and cast moldings to ensure that the cusps are placed properly. Moreover, they must be trimmed to a size, such that they are unable to interfere with the final occlusion when the model of the upper jaw is segmented and placed onto the model of the lower jaw. This technique is also inconvenient for patients. The megacusps raise the bite, obliging patients to switch to a soft diet even before surgery. To minimize this period, the megacusps are constructed 2 to 3 days before surgery; however, this also shortens the interval needed for surgical planning. Since the megacusps open the bite preoperatively, all surgical planning must be started only after the megacusps are in place. Therefore, surgical planning is somewhat more difficult since the bite is converted to an open bite. Planning must therefore allow for some autorotation of the lower jaw. Since the megacusps can collide with the antagonizing teeth during model block surgery, the lower jaw may have to be opened wider during treatment planning to create space for an intermediate splint. This may increase the incidence of error due to undetermined and arbitrary rotation axis of the mandible.

DISCUSSION

Relapse is the main problem in transverse expansion with Le Fort I osteotomy. If relapse occurs in the posterior part of the maxilla, constriction of the maxilla may lead to premature contacts, which could open

Figure 4: Patient 1. Sequence of orthodontic treatment.

Figure 6: Patient 1. CT coronal views before surgery and 1 week and 1 year after surgery (top to bottom).

Figure 5: Patient 1. Facial front and profile views before and after surgery.

the bite. Since the fibromucosae on the palatal side are deemed responsible for relapse[2-7], overcorrection has been recommended to protect the transverse dimension from relapse[7]. Since most of this expansion occurs during bimaxillary orthognathic surgery, it is very important to achieve the most accurate occlusion.

Several techniques have been reported to prevent relapse following segmented Le Fort I osteotomies. For example, initial SARPE surgery has been reported to increase transverse dimensions, with any sagittal or vertical problems being corrected during the second surgery[2,3]. Although these results are stable, patients must undergo two operations. Another technique consists of splint fixation to the upper arch for 1 month to prevent the collapse of the upper arch[8].

Although these splints are as thin as possible, they still prevent the upper and lower teeth from coming into occlusion, which may prevent the control of final occlusion. Another method includes the use of a palatal bar during the osteotomy healing period, thus preventing palatal tilting of the lateral segments[9-13]. Insertion of a palatal bar is a simple procedure but may actively displace maxillary segments and produce a shift in final occlusion or the loss of overbite.

Other techniques include acrylic on the arch, a new archwire with overcorrection, cross-elastics, and palatal splints. Regardless of the retention device chosen, it must be totally passive, should not interfere with the final interdigitation of teeth, and should not result in accumulated plaque formation or impingement of oral hygiene. Reconstruction of dental anatomy before proceeding to segmental maxillary osteotomies has been recommended to ensure deep cusp-fissure contacts and stable occlusion after surgery.

To date, however, no studies have assessed the implementation of higher than normal megacusps for postoperative retention.

CONCLUSIONS

Optimal postoperative management of the transverse dimension in patients undergoing a multisegmental Le Fort I osteotomy remains unclear. Our findings suggest that achieving a good occlusion with megacusps may be the best retention technique. These megacusps prevent transverse relapse at the level of the teeth alone, while a proper surgical technique ensures stability at the level of the bone. Stable osteosynthesis and the wedging of bone defects with grafts in the posterior maxilla must be performed to avoid surgical relapse.

Use of this method yielded stable results after 12 months in one patient and after 36 months in the second. Although these results may be promising, further research is needed to determine the indications and limitations of this technique.

Figure 7: Patient 2. Sequence of orthodontic treatment.

Figure 9: Patient 2. CT coronal views before surgery and 1 week and 3 year after surgery (top to bottom).

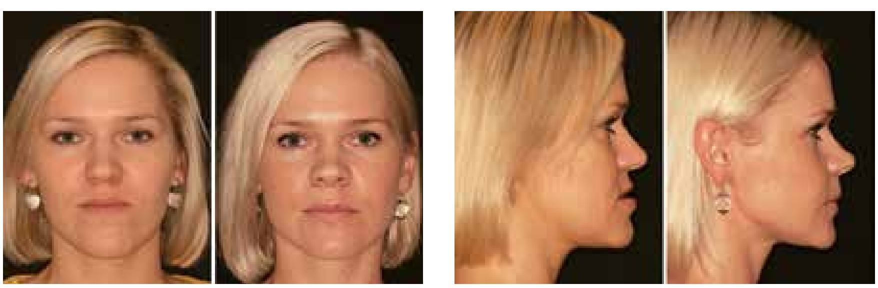

Figure 8: Patient 2. Facial front and profile views before and after surgery.

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