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CLINICAL RUBRIC

Maxillary expansion using a miniscrew retained expansion device during lingual orthodontic treatment

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1 – INTRODUCTION

A deficiency in transverse basal development of the maxilla can lead to an arch length and/or a width discrepancy. Limited alveolus bone volume, which directly depends on the underlying basal bone, creates an upper dental arch that is too narrow in relation to the lower arch creating unilateral or bilateral posterior crossbite(s).

The cause of this maxillary deficiency is often related to abnormal nasal breathing associated with abnormal tongue function that compromises the volume of expansion of the maxilla during the growth period.

The two maxillary bones determine the volume of the alveolar bone, and also the volume of the inferior area of the nasal fossae due to their palatal processes, worsening nasal breathing, which is often already deficient.

Treating this maxillary deficit can require a surgical-medical case management of malfunctions by an ENT which can possibly involve maxillary expansion performed orthopedically before the mid-palatal suture becomes ossified in children (synostosis at approximately 15 years of age), or done as a surgically-assisted procedure for adults.

Classically, the expander transmits, by the intermediary of the dentition, horizontal forces which make it possible to progressively expand the two halves of the maxilla by distraction and thus progressively to create bone and soft tissue on the median zone of the palatal processes of the maxilla.

This type of expander usually causes no problems for adults who receive orthodontic treatment using traditional dental brackets because the dental pressure of the expander uses the same braces that are supporting the brackets placed on the posterior teeth.

It is a very different matter when using the lingual technique whose additional cost and complexity is justified when the patient demands esthetic treatment. The use of a classic expander that is attached to the palatal surfaces of first molars will interfere with the system of lingual bonding, which is located on these same surfaces. Therefore, it is difficult to simultaneously perform both treatments.

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In order to avoid using the palatal surfaces as the support zone for the expander, we used the (Benefit®) anchorage system with 4 titanium miniscrews positioned directly on the palate. The expander is anchored to the miniscrews.

2 – MATERIAL AND METHODS

The medical team, consisting of an orthodontist, an ENT and a maxillofacial surgeon, managed the treatment of a 22 year old female patient presenting maxillary dental crowding as well as a posterior cross bite in a hyperdivergent class II malocclusion and arch length discrepancy (Fig. 1a to 1e). The initial functional diagnosis also reveals a nasal breathing malfunction, in part related to the brachyfacial tendency.

The chosen treatment plan following the orthodontic assessment indicated an ortho-surgical maxillary expansion (surgically assisted expansion) in order to correct the dental crowding by harmonizing the maxillary

Figures 1a to 1e

Clinical case: 22 year old female patient presenting maxillary dental crowding as well as a posterior cross bite in a hyperdivergent class II malocclusion:

a: profile view
b: lower occlusal view
c: 3/4 right occlusal view.
d: frontal occlusal view.
e: 3/4 left occlusal view

dimensions. This dental crowding was the main reason that our patient consulted us.

Since the profession of this patient involved constant contact with people, she opted for the lingual orthodontic treatment, which is not very compatible with ''esthetically'' managing transverse maxillary deficits without first doing extractions. But these extractions performed on an already deficient maxilla, would only worsen the transverse direction and would open a nasolabial angle with esthetic values that are already at their limit (Fig. 1a).

For us, management of the upper jaw will require a surgical expansion in order to solve the functional and esthetic problems of this patient.

To accomplish this, we used an expander that we designed for patients presenting advanced periodontal diseases which contra-indicates devices that exert force on the teeth.

Figure 2
Insertion of the Benefit® miniscrews 21 days before the surgery, makes it possible to ensure a satisfactory stabilization before loading the implants.

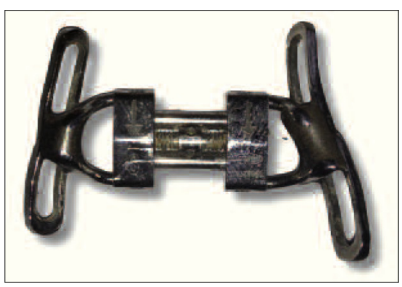


Figure 3
View of the expander. This expander is made with an opening of 1 mm in order to close that distance when it is inserted in the mouth to compensate the 1 mm height of the heads of the miniscrews. The two lateral slides have a certain maneuvering margin in the antero-posterior direction when it is inserted.

Figure 4
View of the expander when it is secured to the 4 analogs of the miniscrews used in the laboratory. The cover screws make it possible to secure the expander to the miniscrews.

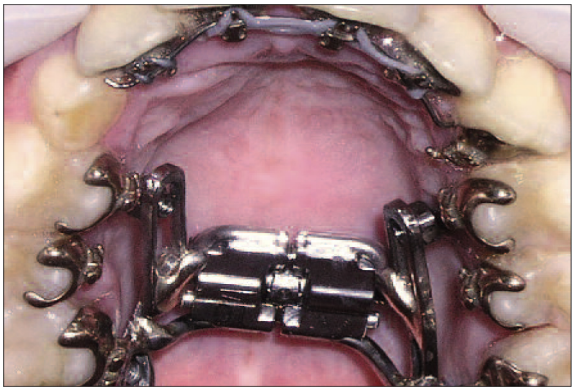


Figure 5
The expander is placed in the mouth 48 hours before surgery. The cover screws will be inserted after positioning of the expander in order to stabilize it.

This expander is anchored on 4 miniscrews (Fig. 2) positioned in each sector between the two maxillary premolars and distally from the first molar at the height of the palate.

The lingual technique that we used is the one developed by Dr. Dirk Weichmann and sold by 3M under the brand name Incognito®.

Impressions that make it possible to fabricate the lingual device are made before the insertion of the miniscrews.

During the surgical insertion of miniscrews, a silicone impression is made with four transfer copings in order to fabricate the expander in the lab, on the miniscrews (Fig. 3 and 4).

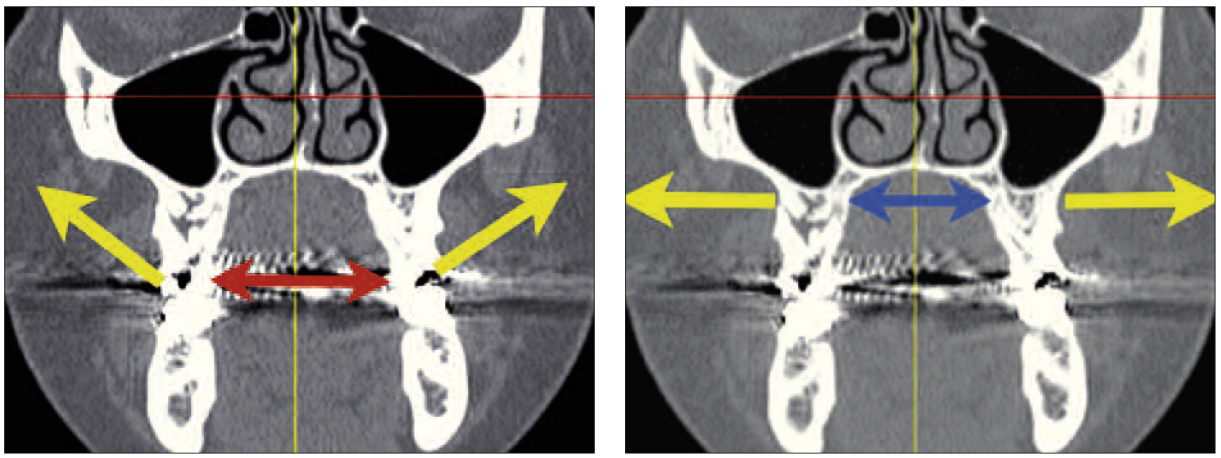
Two horizontal glides used as a support for the expander make it possible to adjust the anteroposterior position of the expander during its insertion onto the heads of the miniscrews. The height and discrepancy of the axes of the heads of the anchorage screws requires us to open the

Figure 6
View after expansion of 36 turns (9 mm).

expander of the expander 1 mm in the lab during the fabrication of the expander. This allows us to insert the disjuncture in to the mouth on the miniscrews. It is secured to the miniscrews with 4 cover screws (Fig. 5).

Inserting the lingual brackets takes place the day the expander is adjusted after the practitioner verifies the stability of the expander. An interior sectional archwire will be positioned in the maxillary lingual brackets from cuspid-to-cuspid in order to limit the

Figure 7
View after partial closing of interincisal gap.



Figures 8a and 8b
Scanographic coronal views showing the vectors of distractions (blue and red arrows) and the osseous movements achieved (yellow arrows);
a: classic expander.
b: expander with miniscrews.

Figure 9
Palatal view after insertion of the expander. The two anterior miniscrews are left in place temporarily in order to provide additional bone anchorage.

anterior space from appearing during the expansion of 9 mm, because patients undergoing the lingual technique find it unpleasant to live with this gap.

After verifying the stability of the expander in the mouth, the practitioner will insert the expander in the mouth the same day that surgical expansion is performed with piezoelectric surgery.

During this procedure, the expander is activated to the amount of the desired expansion at the end of activation, then reclosed leaving 2 mm of activation.

The activation of the expander begins on the 10th day after the surgical procedure: this activation is ¼ turn morning and night for 14 days (Fig. 6) (28 turns is the equivalent of around 7 mm of activation).

3 – RESULTS

The activation of the expander began on the 10th day and made a transverse gain of 9 mm possible. The expander was left in place for three months in order to ensure bone healing. In fact, in case of relapse, if the expander is removed too soon, repositioning the expander can be compromised by discrepancies of the axes of the heads of the screws.

The miniscrews are removed two weeks after the expander is removed, except in this case for the two anterior miniscrews, which can be used for bone anchorage for the lingual technique system in the course of orthodontic treatment.

Having achieved an increase in maxillary bone by distraction makes it possible to attain secondary orthodontic alignment of the maxillary arch by using the lingual technique (Fig. 7).

Gingival healing occurred during the 7 days following removal of miniscrews with no sequelae.

4 – DISCUSSION

In adults, the presence of a maxillary arch length discrepancy is often related to a defect in transverse growth of the maxilla in relation to nasal breathing malfunction and/or tongue malfunction during the growth period.

Dental eruption on the osseous bases that are too narrow can therefore lead to dental crowding.

The right and left halves of the maxilla, because of the palatal processes, are equally involved in the floor of the nasal fossae. A defect in transverse growth, will consequently diminish the volume of the nasal fossae, which then makes nasal breathing malfunction chronic.

Managing these defects in maxillary growth in adults and older adolescents is made possible by coordinating orthodontic and surgical treatment, to reestablish the volume of the maxilla in order to correct malocclusions and avoid alternate treatment with dental extractions that does not correct the basal osseous anomaly.

Dental extractions certainly make dental alignment possible, but they do not solve orofacial malfunctions and they can have a negative impact on the esthetics of the face depending on the sites of the extractions.

Palatal expansion makes it possible to solve this problem.

Lingual techniques require an indirect bonding procedure using transfer trays. A classic expander on the bracket eliminates lingual access to maxillary molar brackets and the arms of the expander are very occlusally located hindering access to the lingual faces of the teeth. These technical constraints involve a complicated management of the surgical maxillary expansion along with orthodontic treatment using the lingual technique.

The maxillary expander with endosseous supports with miniscrews makes it possible to avoid these

obstacles and to obtain moderate independence of these two devices which generally are antagonistic. Osseous anchorage by way of minscrews avoids extruding the teeth on the right and left sides of the maxilla in the course of transmitting horizontal force with the expander during maxillary expansion.

The apical position of the miniscrews makes it possible to transmit horizontal forces from the expander closer to the center of resistance of the maxilla, thus diminishing the tilting and rotating effects of the distracted right and left halves of the maxilla. This high position of distraction makes it, therefore, in theory possible to move the two halves of the maxilla more horizontally in comparison with the movements obtained during classic distraction with dental pressure points (Fig. 8a and 8b).

Using titanium miniscrews seems to us to be more appropriate than using dental mini-implants. In fact, we are particularly trying to create primary stability of these temporary screws rather than osteointegration, which will cause problems when the device is removed. Because of the shape of the palate, the axis of insertion of the miniscrews is very horizontal. This is an advantage compared to other distraction systems applied on the teeth because the application of forces is exerted on the axis of the screws, rather than perpendicularly when the forces are applied to the teeth in systems with dental attachment (therefore, no moment of force is developed and the device, as a result, is much more stable).

These two stage miniscrews make it possible to maintain the slides while stabilizing the median screw far from the mucous tissues, therefore avoiding any risk of tissue necrosis due to prolonged pressure and tension from the slides on the palatal mucous tissues.

The individualized construction of the expander using the impression with the miniscrews installed earlier makes it possible to perfectly adapt the system and totally respect the oral environment especially the dental roots; the miniscrews are inserted in each patient in an individualized manner and necessarily, because of this, far from the dental roots.

The ability to take impressions of the heads of the screws by using tranfers and copings of the implants with the Benefit® system makes it possible to fabricate an individualized expander in the lab, which adapts perfectly to the emergences of the miniscrews. In fact, positioning the expander more palatally requires fabrication of a narrower expander, which must be adapted to each patient. This stage of lab preparation therefore requires that the two surgical procedures be performed in two phases, the first under local anesthesia in order to insert the miniscrews and to take the impressions, which will make it possible to fabricate the expander in the lab. The second procedure is done under general anesthesia in order to perform the surgical separation.

The practitioner will remove the miniscrews three months later, to allow for necessary bone healing.

When positioning the expander in the mouth, the practitioner must take into account the volume and height of the head of the miniscrews. Horizontal slides give us the necessary margin for maneuvering in order to manage the anteroposterior dimension during the insertion of the expander. In the lab, the technician makes the expander with the median actuator open 1 mm, making it possible to easily position it on the heads of the miniscrews by closing it beforehand then reopening it after the expander is inserted in order to stabilize it on the heads of the miniscrews.

The absence of pressure from the expander on the dental surfaces makes it possible to install a facial multi-bracket system but is more particularly suited to the lingual system because there is no interference between the systems. This compatibility makes it notably possible to continue dental orthodontic movements during the phase of distraction and osteointegration, which reduces overall treatment by three to four months.

During the planned surgical procedure under general anesthesia, we do not want to leave anything to chance. Prior to the day of the surgical procedure, the technician shall make and check the disjunctor. This way there will not be any unpleasant surprises. In addition, the initial positioning of the miniscrews will obviate any alteration of the dental roots.

The two anterior miniscrews will next be used for osseous anchorage if it is necessary following orthodontic treatment; these screws seem more stable than the miniscrews classically used for orthodontics (Fig. 9).

5 – CONCLUSION

The use of a maxillary expander with endosseous brackets on miniscrews makes it possible for us to use the lingual orthodontic technique, which is inserted before surgical disjunction, and its activation can begin during the period of distraction. The independence of these two systems makes it possible to manage the different phases of treatment and therefore to shorten the time of treatment and to improve the results.

Restoring osseous volume of the maxilla by maxillary expansion with orthodontic and surgical procedures makes it possible to improve malfunctions, which improves the prospects of a lasting result over time.

Therefore, we were able to treat our 22-year-old female patient by using a system of lingual orthodontics because of cooperation and coordination among the maxillo-facial surgeon, the ENT, the orthodontist and the orthodontic technician, whereas a classic expansion device would have required using a multi-bracketed facial appliance.

The increase in the quality of treatment (a major concern of the periodontist), good working space for the orthodontist and an earlier closing of the unattractive interincisal space make the choice of this type of expander an obvious one.

Cooperation and multi-disciplinary teamwork are the key words for the success of restoring the adult masticatory system.

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