

# Use of orthodontic miniscrews in asymmetrical corrections

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## Abstract

**Introduction:** Anchorage control is of paramount importance in ensuring orthodontic treatment success, particularly in asymmetry corrections, where it is even more critical. The conventional anchorage methods currently used to treat these types of anomalies are rather complex and can trigger undesirable movements in the reaction unit, or even be rejected by patients on account of the esthetic compromise they entail. The use of microscrews as anchorage units, as well as averting undesirable side effects, helps to streamline orthodontic mechanics while providing greater treatment result predictability, reducing treatment time and allowing the correction of missing teeth cases by affording direct anchorage. **Objective:** This study aims to undertake a review of today's literature covering dental asymmetry treatment with the use of orthodontic titanium microscrews as anchorage and provide some clinical examples.

**Keywords:** Microscrews. Mini-implants. Orthodontic anchorage procedures. Facial asymmetry.

## INTRODUCTION

One of the key objectives of orthodontic treatment consists in establishing intraarch and interarch symmetry. Determining the appropriate position for the median line is pivotal not only in light of esthetic considerations but also because the position of the posterior teeth is at stake<sup>5</sup>. Asymmetrical extractions can be indicated for treating slight dental and skeletal asymmetries. However, mechanics complexity, anchorage control and undesirable side effects often get in the way of treatment<sup>7,8</sup>.

Most conventional anchorage devices are

symmetrical, such as the transpalatal bar, face-bow headgear, labioactive plate, Nance button, Nance lingual arch wire, among others. The difficulty in finding devices to correct asymmetrical occlusal relationships by moving malpositioned teeth without affecting well positioned teeth renders asymmetry treatment a serious challenge to orthodontists<sup>6,22</sup>.

In seeking a solution to anchorage control problems, microscrews have emerged as an extremely useful alternative in dental asymmetry treatment. Given their small size, these screws can be inserted in a variety of sites on the al-

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veolar and basal bones, thereby creating an absolute anchorage system which allows teeth to be moved only where such movements are desired. Thus, more predictable and controllable movements are achieved without any side effects and the use of simpler orthodontic mechanics<sup>23,26</sup>.

Among the causes of teeth asymmetries, the following are noteworthy: Deciduous molar ankylosis; permanent unit ectopic eruptions; unilateral loss of leeway space; congenital absence of teeth; supernumerary teeth; habits and premature loss of deciduous or permanent teeth<sup>9</sup>. For a proper asymmetry diagnosis a judicious evaluation of the patient's dental and skeletal features should be conducted<sup>21</sup>. Facial soft tissue evaluation provides an insight into existing skeletal problems. It should be carried out by means of a clinical examination and the use of photographs<sup>3,4</sup>.

The evaluation of a patient's frontal symmetry is the primary aspect of any diagnosis since it is the angle patients most often see themselves<sup>2</sup> in. Initially, right and left hand side symmetry can be observed by drawing a true vertical line (glabella – nose tip – lip) perpendicularly to the vision line (true horizontal), which divides the face into two parts. An adequate asymmetry, which may result in a slight difference between the two sides, should be distinguished from a significant chin or nose mismatch<sup>21</sup>. Mandible asymmetries can be viewed clinically through frontal view by observing the relationship between the mentum and the other facial structures<sup>3</sup>.

The upper and lower dental median lines are expected to coincide and show an adequate position with regard to the face<sup>18</sup>. When these lines fail to coincide with each other or the facial median line, the cause can be traced back to a skeletal asymmetry due to inappropriate positioning of units in the arch<sup>1,4</sup>.

The median line can be assessed radiographically, either using a PA radiograph, or clinically. The clinical assessment can be conducted using some dental floss to join the glabella or nasion,

subnasal and pogonion points. Mandibular deflections or a failure in identifying these points can lead to wrong results since these three points will not correspond. Thus, the center of the labial philtrum can serve as orientation in locating the facial median line<sup>4</sup>.

Assessment of occlusal conditions should be performed in a centric relationship since mandibular deflections can either mitigate or aggravate asymmetry when the patient is placed in centric occlusion<sup>13</sup>.

Vertical occlusal asymmetry can be diagnosed through a clinical evaluation of the patient. To this end, the patient is instructed to bite on a blade, which represents the occlusal plane. Any lack of parallelism between this plane and the bipupillary plane would disclose an inclination on the occlusal plane and, consequently, an asymmetry<sup>3,19</sup>.

The axial inclinations of posterior teeth should be measured against the occlusal plane. Mesiodistal inclination assessment is not sufficient to distinguish dentally from skeletally derived asymmetries since teeth might have drifted prematurely, thereby producing little inclination. In such cases, other guidelines can be followed, such as the rotation of upper molars and the amount of bone present in the posterior region of the tuberosity or branch. Additionally, it is important to match the dental axial inclinations on the right and left hand sides of the arches<sup>4</sup>.

The proper treatment of asymmetries depends on diagnostic accuracy. It is essential to determine whether the factors that caused the asymmetry are skeletal, dentoalveolar or both, with a view to administering the most suitable treatment<sup>18</sup>.

By coordinating the median lines – both upper and lower, between the two and with respect to the facial median line – and by imparting facial symmetry, treatment goals, such as the following, are more likely to be met<sup>27</sup>. Maximum intercuspitation, result stability and enhanced occlusal and

facial esthetics<sup>8</sup>. The acceptance of slight deflections on the median line depends on individual factors and a personal evaluation of the asymmetry. In general, however, deflections of 2mm or more can be easily detected by most individuals<sup>1</sup>.

Skeletal asymmetries are preferably addressed with ortho-surgical treatment. Discreet dental and/or skeletal asymmetries are more often treated with orthodontic therapy. Choosing the proper orthodontic appliance is crucial since any attempt to sort out an asymmetry with unsuitable appliances often compounds the asymmetry itself<sup>20</sup>.

The use of microscrews and anchorage elements helps to streamline orthodontic appliances while minimizing side effects from undesirable forces<sup>12,14,24</sup>. This opportunity to choose the most convenient site for installation of an anchorage point allows an adequate force system to be used for each case and, as a result, dental movements become more predictable<sup>2,11,23</sup>. In this manner, it becomes possible to drive the action force line towards the resistance center of the tooth or group of teeth, in accordance with the desired movement<sup>11,25</sup>.

Microscrews can be employed successfully in various types of dental asymmetries, such as: Occlusal plane inclination, median line deflection, asymmetric molar relationship and unilateral posterior crossbite<sup>27</sup>. One of the advantages of using microscrews versus cross elastics is the possibility of acting upon each arch discretely, thereby avoiding deleterious effects to the opposite arch, such as, for example, extrusive forces<sup>14,15,16</sup>. In like manner, it is possible to achieve group unilateral distalization without affecting the other hemiarch while concurrently correcting the molar to median line relationship. An additional advantage to molar retraction using a microscrew lies in controlling the mandibular plane, determined by the vertical position of the implant, which allows the intrusive component to be incorporated whenever necessary<sup>10,17</sup>.

## CLINICAL CASE #1

### Occlusion plane correction

Female patient, 40 years of age. A facial assessment disclosed a heightened facial convexity with a slight mentum projection deficiency; lower third of the face slightly increased and an asymmetry of the lower third with drift of the mentum towards the right.

An occlusal assessment revealed that several lower arch posterior dental units were missing, a class II cuspid relationship, median line deflected to the left, upper and lower occlusal plane asymmetry with extruded upper left posterior and a lingual occlusion of the lower right posterior teeth. An ortho-surgical planning was drawn up for this case, where the orthodontic treatment would focus on correcting the upper and lower occlusal plane asymmetries, followed by a surgical advancement of the mandible. This type of prior orthodontic intervention is meant to minimize the ensuing surgical act since any attempt to surgically correct the asymmetries would necessarily entail combined maxilla and mandible surgeries – one for correcting the maxillary asymmetry and one to correct the mandibular asymmetry – in addition to the recommended mandibular advancement.

The orthodontic treatment was started by leveling the upper archwire without including the second left-hand molar since it was overly extruded (Fig. 1). To achieve molar intrusion two microscrews were implanted in the mesial region of the second molar, one via the buccal side and one through the palate. The choice of the microscrew sites aimed to achieve intrusion with full buccolingual control, resulting in a translatory movement (Fig. 2). Initially, to attain an individualized intrusion, force was applied to the second molar (Fig. 3). When this movement had been achieved, force was applied to the archwire in order to intrude the segment (Fig. 4). Forces were continuously applied both buccally and palatally, thereby affording the necessary con-



FIGURE 1 - Initial upper leveling without second molar embedding.



FIGURE 2 - Two microscrews being used – one through buccal, one palatally - to achieve individual intrusion of upper second molar.



FIGURE 3 - After Intrusion of upper left second molar and space closure between cuspid and lower right second bicuspid.



FIGURE 4 - Force being applied to arch segment to correct upper occlusal plane asymmetry.

trol to achieve tooth translation (Fig. 5). On the lower arch, planning focused on leveling and correcting the median line while closing the space between the right hand side cuspid and second bicuspid. Lower arch asymmetry was corrected by installing a microscrew between the right cuspid and second bicuspid, buccally. To generate

intrusion along with proclination (Fig. 6), force was applied buccally. The asymmetry of the upper and lower occlusal planes was corrected in a straightforward and efficient manner with the use of microscrews. This movement streamlined surgical procedures since only the mandibular advancement remained to be performed whereas



FIGURE 5 - Deployment of a force system consisting of two microscrews – one via the buccal region and one through the lingual region – for intrusion of the upper left posterior segment.



FIGURE 6 - Use of a microscrew through the buccal region for intrusion and proclination of the lower arch right segment.



FIGURE 7 - Intermediate and final stages of upper and lower occlusal plane asymmetry correction.

on the maxilla there was no need for any intervention whatsoever (Fig. 7).

## CLINICAL CASE #2

### Dentoalveolar Correction with Asymmetrical Extraction

Female patient, 50 years old. A facial assessment revealed a facial thirds balance, a slight facial asymmetry compatible with normal standards and a discreet deflection of the upper dental median line towards the right in relation to the facial median line.

An analysis of the dental arches disclosed a Class II – Division 2, subdivision malocclusion

on the left hand side;  $\frac{3}{4}$  cuspid and bicuspids relations on the left-hand side; an upper left lateral incisor with an infra-buccal-rotation and a slight deflection of the upper median line towards the right in relation to the lower median line. The molar, bicuspids and cuspid relationship on the right-hand side revealed a Class I (Fig. 8).

The orthodontic treatment plan consisted in the extraction of the first upper left bicuspid and an asymmetric anterior retraction. The extraction aimed to provide sufficient space for aligning the upper left lateral incisor during the initial cuspid retraction stage.

Following upper arch alignment and level-



FIGURE 8 - Patient's initial images showing a Class II-2, left subdivision malocclusion.



FIGURE 9 - Initial phase of asymmetric anterior retraction using a microscrew as anchorage device on the left hand side.



FIGURE 10 - Intraoral images six months after treatment.

ing, the asymmetrical anterior retraction was achieved with the use of a microscrew on the left hand side between the upper second bicuspid and the upper first molar for direct anchorage (Fig. 9). Once the asymmetrical anterior retraction was completed, it was observed that the upper left cuspid relationship had been corrected without producing any molar/bicuspid reciprocal movement on that same side. At the completion of treatment, the left hand side molar relationship remained at Class II and the cuspid relationship in Class I. The occlusion showed that the upper and lower median lines coincided between themselves as well as with the facial median line; a fair cuspid relationship was accomplished on both sides while incisor horizon-

tal and vertical overlaps were normalized (Fig. 10). Facially, no significant changes were noted since it was a dentoalveolar correction which remained circumscribed to the upper arch.

### CLINICAL CASE #3

#### Correction of Unilateral Dentoalveolar Crossbite

Male patient, 28 years old. A facial assessment revealed a good balance between the facial thirds, adequate convexity, a slight mandibular deflection towards the left and an adequate relationship between the lips and the upper incisors. An evaluation of the arches disclosed the absence of the lower first molars, left unilateral posterior crossbite, a Class I malocclusion and a deflection of the

lower median line towards the left. The bicuspid and upper left first molar were palatally rotated, indicating a dentoalveolar crossbite (Fig. 11).

The treatment plan consisted in correcting the posterior crossbite using two microscrews through the buccal region to accomplish the intrusion and proclination of the bicuspid and upper left first molar. By choosing to implant the microscrew via the buccal region, the force action line passed through the buccal region in relation to the teeth's resistance center, whereby these teeth were led to undergo intrusion and proclination in a straightforward manner and without causing any side effect on the remaining teeth (Fig. 12). After these teeth had been intruded, the upper

arch was leveled and the second upper left bicuspid was attached to the microscrew to prevent relapse. The correction of crossbite dentoalveolar occurred efficiently without the need for palatal appliances or use of intermaxillary elastics. At the end of treatment, we observed: medium tooth lines coincide with each other and the face value for the canines, vertical and horizontal overlap of the incisors and the presence of standard space for prosthetic rehabilitation of the second premolars and second molars (Fig. 13). In the lower right segment, the presence of an anomalous third molar prevented an efficient second molar uprighting, which limited the opening of space for a tooth the size of a bicuspid; and on the left hand side,



FIGURE 11 - Initial images showing Class I malocclusion and unilateral posterior crossbite. Units 24, 25 and 26 are inclined toward the palatine.



FIGURE 12 - Intrusion of units 24, 25 and 26 anchored to the buccally positioned microscrews.



FIGURE 13 - Final intraoral images.



FIGURE 14 - Occlusal view of upper arch: **A)** prior to and **B)** following treatment.

the second molar was uprighted and larger space was attained, about the size of a molar tooth. The upper arch showed adequate conformation while posterior teeth inclination was thoroughly corrected (Fig. 14).

#### CLINICAL CASE #4

##### **Correction of Upper Dentoalveolar Asymmetry By Means of Unilateral Distalization and Mesialization**

Male patient, 42 years old. A facial assessment showed a balance between the facial thirds; a slightly augmented facial convexity due to a mild median third protrusion; discreet retrognathic mandible; chin-neck line slightly reduced and a passive labial seal. An analysis of the dental arches disclosed the absence of the lower first molars and upper second molars, in addition to non-coinciding dental median lines (upper deflection towards the right and lower deflection towards the left). Despite the absence of lower first molars, bicuspid relationship on the right hand side proved more favorable, while the left hand side was in Class II similar to a Class II, left subdivision malocclusion. It also showed an anterior deep bite and a Class I cuspid relationship on the right hand side, and a  $\frac{3}{4}$  Class II on the left hand side (Fig. 15). An assessment of the panoramic radiograph showed that on the lower arch there was a divergence between second bicuspid roots and second molar roots; and the upper arch revealed a lowered sinus in the region where the second molars were missing.

The first treatment stage consisted in correcting the vertical problem on the lower arch by intruding the anterior teeth, extruding the posterior teeth and verticalizing the molars, thereby opening space between bicuspid and second molars.

In order to correct the Class II cuspid relationship on the left hand side upper first molar distalization was planned by means of a microscrew which was implanted between the latter and the second bicuspid. A cursor was inserted in a molar triple tube and connected to the microscrew using a NiTi spring (Fig. 16). Distalization was accomplished without any side effects to the other dental units. Two months after moving the first molar, which gave the bone sufficient time to reach a higher level of organization, the microscrew was relocated to a more distant position next to the molar root's mesial region. Next, the upper cuspids and bicuspid were retracted. A microscrew was inserted between the upper right bicuspid with the purpose of stabilizing the first molar and then using it to achieve mesial traction of the third molar (Fig. 17), which was mesialized without affecting the position of adjacent teeth. On the left hand side an asymmetric anterior retraction was carried out to correct the upper median line. With the aid of the microscrews a differentiated anchorage could be implemented in each of the upper arch segments, which allowed the distalization of the left hand side, mesialization of the right third molar and asymmetric anterior retraction. At the completion of treatment it was noted



FIGURE 15 - Initial intraoral images.



FIGURE 16 - Upper left first molar distalization, after completion.



FIGURE 17 - Upper right third molar mesialization, after completion.



FIGURE 18 - Final intraoral images.

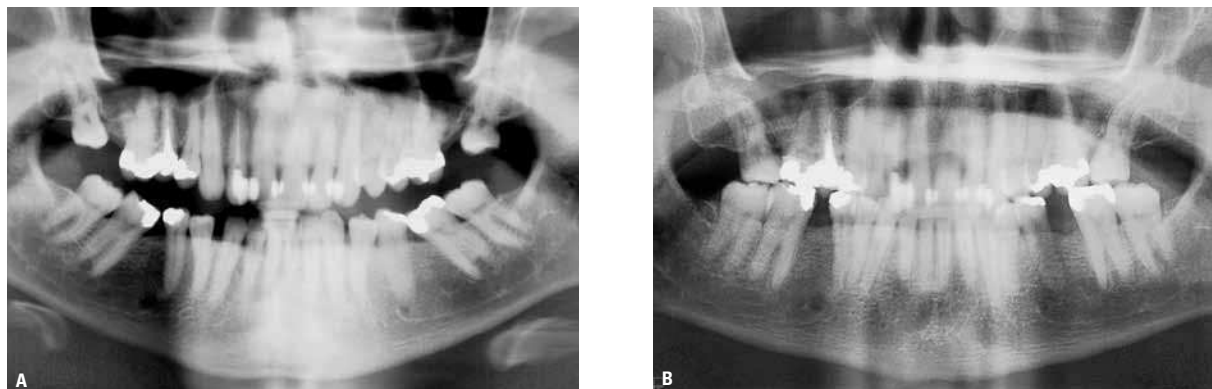


FIGURE 19 - **A)** panoramic radiograph (protrusive); **B)** Final panoramic radiograph in centric occlusion.

that: the upper median line harmonized with the face; there was an adequate cuspid relationship; the horizontal and vertical incisor overlaps were normalized and there was enough space left for prosthetic rehabilitation between the lower second bicusps and lower second molars (Fig. 18).

The analysis of the final panoramic radiograph showed parallelism between the roots and adequate space for future installation of implants in the posterior inferior (Fig. 19)

## CONCLUSION

With the advent of microscrews in orthodontic practice a new absolute anchorage alternative has emerged which, amid a variety of readily available clinical applications, can be used to correct den-toalveolar asymmetries. This resource simplifies orthodontic mechanics, dispenses with patient adherence, is easily accepted and affordable, reduces treatment time and has hitherto shown total reliability as an efficacious anchorage system.

Submitted in: April 2008  
Revised and accepted in: June 2008

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