VERTICAL CONTROL
OF SECOND MOLARS IN FIXED
APPLIANCE TREATMENT

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Abstract

OBJECTIVES. A proper amount of overbite is necessary to obtain a sufficient disclosure of posterior segments during mandibular excursions. Increase of overbite during orthodontic fixed appliance treatment is often achieved by using anterior vertical elastics. Such a procedure does however, involve risks related to the increased incidence of root resorption and to potential condylar distraction. The authors, are moreover of the opinion that the use of anterior vertical elastics simply often fails to address the problem at its origin. A careful analysis of occlusion reveals that in most instances the lack of adequate overbite is caused by presence of posterior precontacts. Obtaining a sufficient overbite and eliminating posterior precontacts can therefore in most cases be achieved by controlling the vertical dimension at level of second molars.

MATERIAL AND METHODS. The present article examines five possible causes of posterior precontacts at level of second molars and subsequent bite opening during orthodontic fixed appliance treatment and suggests several possible biomechanical solutions. A case in which some of these solutions were used is presented as example.

CONCLUSION. Posterior precontacts are the most common cause of insufficient overbite during orthodontic fixed appliance treatment. It is therefore very important to learn to identify such problems and address them with a proper biomechanical system.

Keywords
Precontacts, Open bite, Vertical control
INTRODUCTION

One of the main occlusal goals of an orthodontic treatment is to obtain a proper amount of overbite. This is commonly quantified in 2 mm but according to some authors 3 to 4 mm would be more optimal, in order to facilitate disclosure of molars during mandibular protrusion and disclosure of the non-working side during mandibular lateral excursion. Several authors have shown the relationship between the presence of posterior precontacts during protrusion and/or lateral movement of the mandible and altered muscular function, although there is no consensus about the relationship between occlusion and temporomandibular dysfunction.

The cause of a lack of adequate overbite can be skeletal, articular, or occlusal, or an interaction of two or more of the above. It is beyond the purpose of this article to evaluate the treatment of skeletal or dentoalveolar open bite, the authors have chosen to analyze some of the occlusal aspects of bite opening, focusing on the mechanics and the tools to use for vertical control during treatment with full fixed appliance.

The most common tool in orthodontics to increase the amount of overbite is the use of vertical elastics. However, such tool presents three main shortfalls: first, the use of elastics tends to produce jiggling and therefore potentially increase the risk for root resorption. Secondly, the lack of overbite is most often caused by the presence of posterior precontacts and the use of anterior vertical elastics simply fails to address the problem at its origin. Moreover, the presence of posterior precontacts is often overlooked, given that 85% of the errors found in board cases presented at the ABO were found to be at the level of second molars. Third, the use of vertical elastics can potentially, in presence of a posterior fulcrum, cause a distraction of the condyle, leading to a lack of stability of the achieved results, due to the compounding of condylar relapse and dental relapse.

In this article, the authors will analyze 5 different possible causes of posterior precontacts and consequently lack of adequate overbite, suggesting possible clinical solutions for each case (Fig. 1).

The authors especially wish to emphasize that it is not in the authors' intention to provide a "cookbook" solution, being the primary interest to focus on recognizing the origin of occlusal precontacts, to which many solution can be applied. A clinical case will then be presented in which different tools had to be used to achieve an adequate overbite.
1. OVER-ERUPTED LOWER SECOND MOLARS

A possible source of posterior precontact is over-eruption of lower second molars. The most common cause of such over-eruption is a delayed eruption of the upper second molars which, especially in presence of distal molar occlusion, will leave the lower second molars without an antagonist and therefore free to erupt above the occlusal plane.

Indiscriminate leveling of such over-erupted second molars with a straight wire coming from the first molars leads to the risk of generating unwanted side effects due to unwanted moments and forces depending on the reciprocal angulation of the slot of the first and second brackets.

Although it is not possible for the clinician to calculate the moment of forces generated in a statically indeterminate system, a description and schematization of the force system generated by the insertion of a wire in the slot of 2 brackets has been done by Burstone and Koenig. This situation can be reasonably compared to the one occurring between second and first molar as we level an over-erupted second molar (although of course the archwire is inserted in the full arch, making it impossible to calculate all force and moments generated).

According to this model, the insertion of a straight wire in an over-erupted second molar will generate a force system typical of a I-II geometry of Burstone-Koenig, which will lead to over-eruption of the first molar and steepening of the occlusal plane, due also to the fact that the eruptive force on the first molar tend to be expressed more promptly than an intrusive force on the second molar (Fig. 2).

In patients in whom the treatment plan includes extraction of premolars, a possible way to avoid the described side effects is to benefit from the concept of “free anchorage” and use the premolars which are to be extracted to level the second molars (Fig. 3). It is important to underline how the premolars to be extracted are to be used for leveling the over-erupted second molars but the decision to extract premolars should be independent from this.

In patients in which no extractions are planned, the use is suggested of bite blocks on the first molar, which prevent the expression of the unwanted extrusive force while the second molars are leveled. The bite blocks can be fixed or removable: the fixed form has the advantage of not relying on patient cooperation but may create a fulcrum with possible effect of condylar distraction.

The removable bite block (Fig. 4) should be built in articulator to obtain stable occlusal contacts in centric relation, minimizing the negative effects on the articulation.

Fig. 1 Common causes of posterior precontacts and possible solutions.

Fig. 2 Force system generated by a straight wire inserted between first and second molars when second molars are overerupted.
2. HANGING PALATAL CUSPS OF UPPER MOLARS

A second source of posterior prematurities is the hanging of the palatal cusps of upper first or, more often, second molars. The cause of the excessive vestibular crown torque of upper molars can be due to asynchronous eruption of antagonist in the lower arch, anatomy of the facial cortical plate of the maxilla, presence of wisdom teeth facial to the apex of the roots of the upper second molars.

A possible solution to this problem is the use of attachments on the upper second molars with increased value of lingual crown torque, together with the use of passive transpalatal arches on the first molars to limit the side effects. This technique presents two main shortcomings: first, it implies that the second and first molar have to be leveled before correcting the torque, where it would be best to correct the torque before leveling, since the flaring of the second molars means that the attachments on the second molars will be placed on a different vertical level (more gingival) respect to the one on the first molar and therefore leveling will give steepening of the occlusal plane and flaring of the first molars (due to the vertical intrusive force vestibular to the center of resistance of the molar). Second, the level of force delivered by the distal end of the tube is rather reduced and very often not sufficient to correct the torque of molars.

A second possible way of correcting
the torque of second molars is to use a passive transpalatal arch on the first molars with two soldered cantilevers activated for intrusion and ligated to the lingual face of second molars (Fig. 5). The problem with this approach is the fact that the palatal vault is normally concave with the lateral wall not perfectly vertical but at an angle, therefore the use of the above described cantilever will also give on the second molars an unwanted horizontal force directed lingually and tending to reduce the transversal arch diameter at level of the second molars. The biomechanically most sound solution appears to be the insertion of a transpalatal arch activated for reciprocal torque at the level of the second molars, generating a geometry V to VII. The drawback of this solution is the patient’s comfort, since the presence of a transpalatal arch at the level of the second molars is not always tolerated (especially in case of patient with flat palate).

3. EXCESSIVE DISTAL ROTATION OF UPPER MOLARS
When analyzing the patients occlusion during the finishing stage of treatment, a very frequent finding will be the presence of a pre-contact on the disto-vestibular cusp of the upper second molars. This is due to the additional distal rotation present in most bracket prescriptions. Beside the obvious solution of adopting a prescription with a lesser degree of distal rotation built into the appliance at the level of upper molars, the tool which can be used to solve the situation is once again a transpalatal arch at the level of first and/or second molars.

4. INSUFFICIENT TRANSVERSAL UPPER ARCH WIDTH
The fourth problem is strictly connected to the above mentioned point. The marked amount of distal rotation is present in both first and second molar attachments. The distal rotation of the first molar

Fig. 6 Patient M.R., extraoral picture pre-treatment.
will tend to project lingually the distal end of the archwire and this will add to high distal rotation of the second molar itself, generating a reduction in transversal width. The correction can be done by expanding the archwire or by using a transpalatal arch (better as it will simultaneously work on the rotation).

5. ABNORMAL FORM OF UPPER SECOND MOLARS
The upper second molars are frequently of abnormal form. Sometimes this anomaly will not permit to achieve a proper occlusion, and sometimes not even bonding of the second molars.
A solution to this problem may be negative coronoplastic or, when wisdom teeth are present, eventual extraction of the upper second molars.

CLINICAL CASE
The patient M.R came to our observation at age 13 yrs and 2 months with a primarily cosmetic complaint of generic nature.
The general anamnesis did not evidence relevant problems, nor did the clinical functional examination.
On the extraoral examination, lack of support was found of the upper and lower lip, together with the necessity to avoid retraction of the upper incisors (Fig. 6).
Intraorally, there was a shallow overbite with open bite tendency, over-eruption of 37 47 and transversal incoordination with crossbite, even more accentuated when taken into account the presence of lingual tilting of the lower molars as dentoalveolar compensation (Fig. 7).
There was no significant difference between CO and CR (Fig 8).
Radiographically, the cephalometric analysis revealed a normo to dolicocephalic growth pattern and slightly increased proclination of the upper and lower incisors (Fig 9).
The orthopantomogram showed short, “bottle shaped” roots of the upper

Fig. 7 Patient M.R., intraoral pictures pre-treatment.

Fig. 8 Patient M.R., articulator mounting in CR pictures, pre-treatment.

Fig. 9 Patient M.R., pre-treatment lateral telediograph and cephalometric analysis according to Roth-Fraihatk.
incisors (Fig. 10). “Bottle shaped” roots are recognized as strong risk factor for root resorption during orthodontic treatment. The case presented therefore several challenges, i.e. the need to:
- improve (or at least not worsen) the definition of upper and lower lip
- increase the vertical overbite, considering at the same time the

absolute contraindication to the use of anterior vertical elastics due to the bottle-shaped short roots of upper incisors
- increase the transversal dimension of the upper arch, while controlling at the same time the bite opening
- level the overerupted 37 and 47 without further bite opening.

It was clear how the key to a successful treatment was the need for absolute vertical control.

The case began with leveling of the lower arch (Fig. 11).

At the same time, the upper arch was expanded with a rapid maxillary expander with occlusal acrylic coverage. The choice of this appliance was taken being aware that the age of the patient was at the limit for this type of treatment. The appliance was built in articulator so to provide the maximal occlusion possible with the lower arch, so to counteract the steepening of the occlusal plane caused by the leveling of the over-erupted 37 and 47.

As a detail, a small acrylic extension was built so to prevent over-eruption of 17 and 27 while occluding on the other teeth of the posterior segment (Fig. 12). After the phase of expansion of the upper arch, a transpalatal arch was inserted as retention. During this phase, orthodontic mini-screws were inserted in the lower posterior segments and coupled with the use of a lower lingual arch, in order to
control the side-effects generated by leveling of 27 and 37 in progressing thicker rectangular NiTi wires, once the bite-block effect of the hyrax occlusal acrylic coverage was no longer present (Fig. 13). Leveling was then begun of the upper arch and a first bracket repositioning was planned after intermediate impressions taking (Fig. 14).

Transpalatal arches were used on both first and second upper molars in order to control the torque and avoid posterior pre-contacts (Fig. 15).

A final intermediate impression was taken and mounted in articulator, evidencing the presence of posterior precontact on the disto-vestibular...
cusp of the upper second molars, which was corrected by introducing slight expansion and distal rotation on the transpalatal arch on the second molars (Fig 16).

The final intraoral result showed the achievement of a solid neutral occlusion with a sufficient amount of vertical overbite and a nearly complete coincidence of centric relation and centric occlusion (Fig 17). Extraorally, there were no significant changes (Fig 18). The final orthopantogram evidenced slight blunting of the apex of the upper incisors roots; this took place despite avoiding the use of vertical elastics, but it is likely an unavoidable effect in presence of bottle-shaped roots (Fig 19).

Superimposition on the cranial base stable structures showed linear vertical growth with no significant changes in incisal position and torque (Fig 20). Pictures taken at the end of retention (Fig 21) and 1 year after the end of retention (Fig 22) showed a good stability of the result, thanks also to the mutual support provided by the upper and lower incisors in presence of adequate overbite and optimal intercuspidation.

CONCLUSIONS

One of the major factors for an optimal function and a good stability
of result is the achievement of a proper amount of vertical overbite. This should be achieved through the elimination of posterior occlusal interferences rather than the use of anterior vertical elastics. It may be said that consideration must be given to the occlusion of our patients from the posterior to the anterior and not vice versa. Fundamental in this sense is the control of upper and lower molars. Primary emphasis has to be given to tools for diagnosis of posterior problems. A proper biomechanics will be indispensable but can come only after the identification of a problem, since it has to be objective oriented.
REFERENCE LIST


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