Orthodontic treatment of Dental Class II
with miniscrews: an alternative to
extraction of upper second molars

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1 – INTRODUCTION

The treatment of severe dental class II by
serial extraction of second molars (17-27-38-48) for hypodivergent patients still in the
growth phase produces interesting esthetic
results and at the same time respects
occlusal and orthodontic imperatives. When
the patient is still in the growth phase this is
a very elegant solution that is contingent
upon achieving good vertical control.

However this treatment strategy requires
excellent cooperation from the patient in the
wearing of extra-oral force headgear as well
as the extraction of upper second molars.

When miniscrews first became part of our
therapeutic arsenal, their key advantages for
the treatment of antero-posterior discrepancies totally changed how we worked and expanded the boundaries of our practice.

Therefore the final goals of treatment
remains identical but our clinical choices
are becoming easier and the extraction
of upper second molars are no longer
mandatory.

The first part of this article describes the
different stages of treatment for correction of
dental class II by using miniscrews, with a
description of the choice of the implant site
for the miniscrews and of the technical
details for using and modifying the
mechanics during the different therapeutic
stages.

In the second part of the article, two clinical
cases will demonstrate the effectiveness of
this protocol for treatment. For these exam-
pies, in each initial case, extraction of second
molars with extra-oral headgear was the
therapeutic plan; and in each case, we
switched the protocol so as to conserve
17-27 (and extraction of 18-28) by first
retracting the upper first molars that was
made possible by the use of miniscrews for
anchorage.
2 – PROTOCOL FOR TREATMENT AND DIFFERENT THERAPEUTIC STAGES

The orthodontist achieves an essential overall retraction of the arch entire by using miniscrews (posterior, lateral and anterior retraction).

A three stage strategy is required:

– simultaneous retraction of the posterior teeth (6-7) using direct mechanical force;
– retraction of the buccal teeth using direct mechanical force for 5 and indirect mechanical force for 3-4;
– retraction of the 4 upper incisors using direct mechanical force.

2 – 1 First stage: retraction of molars to class I (Fig. 1)

Position of the miniscrews
We use intraseptal miniscrews for antero-posterior discrepancies. If anatomical conditions allow it, it is preferable to place the miniscrew as anteriorly as possible in order to be able to move as many teeth as possible in the mobilized area: the 7 and the 6, and then the second premolars during the second stage.

The screw should be positioned between the 4 and the 5.

Force modules
The active module is in the open position, and here we see a compressed open spring placed between the 6 and the 3 (5 and 4 are not bracketed so that they can be bypassed).

Anchorage for mobile elements (direct mechanical force)
This is an offset system using anterior compressive force. The miniscrew is attached to a sliding hook (or directly by a wire) that maintains anterior compression on the spring.

Mechanical analysis (Fig. 2)
Despite the presence of extensive open portions (spaces 3-6), we think of the system as a type of rigid sliding connection because it uses a heavy arch wire (.017 × .025") in brackets with .018 × .025" slots.

Figure 2 shows the mechanics of simultaneous retraction of 6-7 using an open spring between 6 and 3, compressed by a tie connected to the screw between 4 and 5. The metallic tie “forces” the point of attachment to

Figures 1a to 1c
Retraction 6-7.
distribute forces on a centered sphere at the screw and of a radius equal to the length of the metallic tie. The tension of the ligature, with a radial force directed toward the screw will balance any centrifugal radial force (unless it breaks). An analysis of the movement of the anchorage point requires the break down of the force vectors of the force system into:

- a radial component $Fr$, incompatible with the connection;
- a tangential component (to the sphere) $Ft$ compatible with the connection.

This $Ft$ component must be broke down into its forces vector to:

- an activation parallel to the arc $Fh$ that allows the point of anchorage to slide;
- a perpendicular activation to the $Fv$ arc that makes it possible to move the entire arch (with a slight intrusion and counter clockwise rotation since the force is applied in front of the center of resistance of the arch), which is a useful movement in order to correct a hypodivergent class II with overbite.

2 – 2 Second stage: retraction of the premolars and the canines to Class I

- **Retraction 5** (Figs. 4 and 5)
  The 5 is for the most part often retracted by transseptal fibers (Fig. 3), the position of the screws and the mechanical system (anchorage and modulation of force) are the same as those mentioned previously (Figs. 4 and 5) with direct mechanical force is direct.

- **Retraction 4-3** (Fig. 6)
  **Position of the miniscrews** (Fig. 7)
  The orthodontist moves the miniscrew into the posterior area which is now stabilized 7-6-5. The practitioner now places the miniscrew between 5 and 6.
Retraction of second premolars, direct force analysis with rigid archwire (miniscrew) between 4-5

Figure 5
Mechanical analysis of the stage of retraction of the second premolars.

Retraction of the 5’s: intraoral views.

Figures 4a to 4c

A miniscrew between the 5 & 6 and retied to the 5 by a steel ligature, a Guerin Lock screwed-on at the mesial of the 6, crimped hook distal of the 2’s, the A-lastic chain from the 3’s to the mini-screws that are visible in the pictures.

Figures 6a and 6b
Retraction 3’s.

After retraction to Class I of the 5’s-6’s-7’s the miniscrew is relocated distally between the 5-6.

Figures 7a to 7c
Force modules

We use active modules for space closure, in this case, elastomeric modules.

Anchorage method on the stable element (indirect mechanical force) (Figs. 8 and 9)

The orthodontist secures the screw to the stable element by using a steel ligature tied to the bracket of the 5. The need, even though the screws are secured, to have a balanced relationship between moveable anchorage and stable anchorage will lead to the use of remote groups of teeth for stable anchorage. During the premolar-molar retraction phase, as soon as the 5 is sufficiently retracted, it is blocked by the screw. The gap of the retracted teeth in the upper anteriors is closed (6 is blocked by a hook and 5 by the screw). The arch is blocked anteriorly (by hooks crimped distally to the 3s) and the stable anchorage group for the retraction of the successive teeth becomes:

- for the 4: 3-2-1 plus 5-6-7 that are already retracted and the support screw for anchorage;
- for the 3: 2-1 plus 4-5-6-7 that are already retracted and the support screw for anchorage.

Mechanical analysis (indirect mechanical force) (Figs. 8 and 9)

The metallic ligature “forces” the point of attachment to move onto the centered sphere using the screw and the radius equal to the length to the steel ligature. The tension on the ligature, radial force directed towards the screw, will balance any centrifugal radial force (unless it breaks). The analysis of the movement of the anchorage point requires the break down of the force vectors of the system of forces into:

- a radial Fr component, incompatible with the connection;
- a tangential Ft component (to the sphere), compatible with the connection.
This Ft component must be broken down into the force vectors of the system of forces:

– into a parallel action to the Fh arc which allows the stabilized group to slide along the arch;

– into an Fv perpendicular action which mobilizes the entire arch (slight intrusion and practically no rotation since Fv is applied to the center of resistance of the arch).

Comment (Fig. 10)

When the orthodontists succeed in overcorrecting the premolar-molar occlusal relationship (7-6-5) in the first stages or in achieving anchorage preparation on the lower jaw (by conventional mechanical force or with miniscrews), they avoid moving the maxillary screws in the posterior area. The retraction of the anterior dentition (4-3 then 2-1) will be achieved either by reciprocal anchorage in the first case with an identical configuration to the preceding one but without the support of miniscrews (Fig. 10) or by exerting Class II mechanical force in the second case (on the prepared lower arch).

2 – 3 Third stage: retraction of the incisors (Fig. 11)

Position of the miniscrews

The screw stays positioned in the gaps 5-6.
Force modules
We use active module for closure (stretched closed coil helical springs).

Modality of anchorage on the mobilized element (direct mechanical force)
The tensioned closed coil springs are retied from the miniscrews to hooks soldered to the arch wire distal the 3’s. This allows for modulation of the vertical force component in regulating the respective attitudes of the miniscrew/anchorage on the arch.

The closed coil helical springs are applied directly onto the mobile group. The F force is broken down into its force vectors of an Fh horizontal component and an Fv vertical component. The Fh horizontal component is compatible with the connection it creates and it causes the intraarch movement (closing of the “drawer”). The Fv component is incompatible; it conflicts with the overall resistance of the arch that is globally subject to a small intrusion along Fv and most of the time subject to a counter clockwise rotation depending on the Fv.Ba moment.

The practitioner should note that there are several possible situations based on the site of the miniscrews and of the height of the hook (Fig. 13).

4 – CLINICAL CASES

4 – 1 Case n° 1: Jonathan (Figs. 14 to 24)
Jonathan comes in for a consultation 03/27/2008 at the age of 11 years and 11 months.
Intra-oral clinical examination
(Fig. 15)

The examination indicates a need for improved hygiene. The molars and canines are in a full Class II relationship. The overbite present from the mixed dentition is significant. The 75 is still present in the arch. We did not notice any crowding in the lower jaw.

Panoramic x-ray examination
(Fig. 16)

The examination does not reveal any missing, supernumerary or transposed teeth. We did notice the presence of the 45 under the 85. The four wisdom teeth are present, the buds of the 38-48 are situated at the base of the ascending ramus.
Cephalometric examination
(Fig. 17)

This examination makes it possible to do a cephalometric analysis (Tab. I) and to calculate the objectives of cephalometric treatment (Tab. IIa and IIb). The Tweed analysis of total space allows us to measure posterior crowding (Tab. III).

- Synthesis of the diagnosis
  Class II hypodivergent skeletal profile.
  Bimaxillary retrusion with overbite.

Severe dental Class II division 2.

Discussion and treatment plan
Choice of extraction and explanation

Based on the Root Analysis Chart, treatment requires the extraction of 17-27-38-48 and wearing an extra-oral device (headgear) for 18 months. Since the patient refused to wear headgear, the orthodontist performed a therapeutic test using miniscrews and anchorage was sufficient to avoid extraction of 17-27.

Table I
Cephalometric analysis at the start of treatment (March 3; 11 y 9 m).

Case No 1: Jonathan
Type of appliance
A Root pre-programmed maxillary and mandibular multibracketted appliance.
Maxillary slot .018 × .024”.
Mandibular slot .022 × .025”.

- Results at the end of treatment
06/07/2010
Treatment lasted 28 months.

Extra-oral photographs (Fig. 18)
- The smile is harmonious.
- The profile is balanced (Fig. 19) and the conspicuous furrow line is no longer present on the labial chin area.

Intra-oral photographs (Fig. 20)
Dental hygiene has still not improved. The occlusion achieved corresponds to the Andrews standards.

Table IIa and IIb
Root Analysis, chevrons and “boxes” (March 3; 11 y 9 m).

Table III
Tweed Analysis (total space) (March 3; 11 y 9 m).

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Panoramic x-ray examination (Fig. 21)

Root parallelism is satisfactory. The eruption of the wisdom teeth will be carefully watched.

Cephalometrics and superimpositions

Cephalometric analysis (Fig. 22, Tab. IV)
ANB diminished 2 degrees concurrently with retraction of the incisors, the inter-incisal angle was notably reduced going from 150 degrees to 128 degrees.

General and local superimpositions (Figs. 23 and 24) reveal a significant counterclockwise maxillary rotation with a lesser clockwise mandibular rotation with retraction of 16-26 with correction of maxillary torque and a leveling of the deep overbite of the maxillary incisors; note a repositioning of the lower incisors conforming to the objectives of proper vestibular alignment.

4 – 2 Case n° 2: Louis  
(Figs. 25 to 35)

Louis comes in for a consultation on 05/23/2007 at the age of 13 years and 1 week.

- Clinical examination 05/23/2007
Extraoral clinical examination
(Fig. 25)
The examination shows a convex profile with a retrognathic mandible.

Intraoral clinical examination
(Fig. 26)
The examination indicates full Class II molar and canine relationships. The overbite arising in the mixed dentition is pronounced.

Panoramic x-ray examination
(Fig. 27)

Figures 25 a to 25 c
Portraits: Profile, full face and smile at the start of treatment (05-07; 13 y 0 m)

Figures 26a to 26c
Intra-oral views a the start of treatment (05-07; 13 y 0 m).

Case N°2: Louis

Figure 27
Panoramic x-ray at the start of treatment (05-07; 13 y 0 m).
This examination does not indicate any missing, supernumerary or transposed teeth. The four wisdom teeth are present, the buds of 38-48 are situated on the base of the ascending ramus.

**Cephalometric examination** (Fig. 28)

This examination allows us to perform a cephalometric analysis (Tab. V) and to calculate the objectives of cephalometric treatment (Tab. VIa and VIb) and to calculate the extent of posterior crowding (Tab. VIII).

- **Synthesis of the diagnosis**
  Class II hypodivergent skeletal profile.
  Bimaxillary retrusion with overbite.
  Severe dental Class II division 2.

- **Discussion and treatment plan**
  **Choice of extraction and justification**

As with the first clinical case, based on the Root Analysis chart, treatment should begin with extraction of 17-27-38-48 and wearing of extra-oral force (headgear) for 1 year. The same...
Table VIa and VIb
Root Analysis, chevrons and "boxes" (October 7; 13 y 0 m).

Table VII
Total space analysis

Figures 29a and 29b
Full face and smile portraits at the end of treatment (02-10; 15 y 9 m).

Figure 30
Facial change during treatment.
Intra-oral views at the end of treatment (02-10; 15 y 9 m).

Panoramic x-ray at the end of treatment (02-10; 15 y 9 m).

Traced lateral cephalometric x-ray at the end of treatment (02-10; 15 y 9 m).
A therapeutic procedure was adopted in order to avoid extraction of 17-27.

**Type of appliance**
A Root pre-programmed maxillary and mandibular multibracketted appliance.

- Maxillary slot .018 × .025”.
- Mandibular slot .022 × .025”.

**Results at the end of treatment**
02/16/2010
Treatment lasted for 33 months because the patient missed many appointments.

**Extraoral photographs**
An examination of the face at the end of treatment shows a good mandibular anterior rotation (Fig. 30).

**Intraoral photographs**
After removing the appliance, the occlusion is in Class I molar and canine (Fig. 31), the arches are symmetrical and the Curve of Spee is leveled.

Panoramic x-ray examination (Fig. 32)
The final panoramic x-ray objectively demonstrated posterior crowding and therefore justifies the extraction of 18-28-38-48 at the end of treatment.

**Cephalometrics and superimpositions** (Figs. 33 to 35)
- **Cephalometric analysis** (Fig. 33, Tab. VIII) shows normalizations of the ANB angle and of the AoBo distance resulting from the increase of the SNB angle, going from 75° to 80°. The Class II improvement is especially noted on the upper incisors that go from 18° to 24°.

- **The general and local superimpositions** (Figs. 34 and 35) show the counter clockwise rotation of the upper jaw and especially of the lower jaw that made it possible to avoid adversely impacting the profile of the patient in spite of significant nasal growth.
5 - CONCLUSION

Using miniscrews for treating Dental Class II appears to be a remarkable new tool since they can delay indications for extraction and surgical decisions and at the same time reduce the need for the cooperation of the patient.

New standard protocols for correction of Class II malocclusions that include miniscrews have been introduced, implying that we must update our skills with a new mechanical force technique that is essential for more complex and notably a typical clinical and therapeutic situations most notably for atypical clinical situations.

The orthodontic discipline is constantly changing and we, the practitioners, can quickly become overwhelmed and concerned by this steady influx of information.

The profusion of new materials, of new technologies and of new instruments represents considerable progress and obviously provides us with intellectual stimulation. However, a critical analysis of the mechanics of miniscrews is a necessary “safeguard” that should temper our clinical observations.