C L I N I C A L C A S E S

Retreatment with mini-screws of severe recurrent crowding in a case of Class III malocclusion with a marked arch length discrepancy problem

Jacques FAURE

1 - INTRODUCTION

In December 2004, Myriam H. was almost 16 years old. The appliances used for her full-banded orthodontic treatment had been removed a few months earlier and she consulted our clinic because of a complete recurrence of anterior crowding.

She had brought along the X-rays that were taken for the extraction of her four un-erupted wisdom teeth the previous month. Unfortunately, these extractions could not and did not do anything to improve the crowding which occurred as soon as the appliances were removed. She was determined to undertake a re-treatment procedure.

We carefully explained to her how hard it would be to correct all the over-lapped incisor teeth and the remaining bi-maxillary protrusion that persisted even though four premolars and four third molars had been extracted in a treatment program that lacked adequate anchorage preparation and precautions. Clearly we were not being asked to correct a minor imperfection but to undertake the difficult complete re-treatment of a malocclusion that was now more severe than it had been originally.

But Myriam was undeterred.

2 - DIAGNOSIS

Facial inspection showed slight right latero-mandibular facial asymmetry, indicating a class III tendency (fig. 1). Intraoral examination confirmed this: right side Class III relationship and mid-line deviation to the right (fig. 3). From

an occlusal inspection of the models we discerned severe anterior crowding, 4 mm in the maxilla and 6.5 mm in the mandible, as well as a curve of Spee more exaggerated than those usually found in patients with Class III

Address for correspondence: J. FAURE, 10, place Lannes, 32000 Auch. faure_ja@club-internet.fr

a

b

c

Figures 1 a to c
Facial views: profile, full face, smile, at rest, at start of treatment (12/2204, 15y 10 m).

Figure 2
Study of the facial asymmetry (12/2004, 15y 10m).

a

b

c

Figure 3 a to c
Intraoral views, right, anterior, and left (12/2004, 15y 10m).

a

b

c

Figure 4 a to c
Study models, right anterior, and left (12/2004, 15y 10 m).

Figures 5 a to d
a and b: models: occlusal views;
c and d: right and left mandibular
curves of Spee (12/2004, 15y
10m);

Crowding: maxillary 4 mm,
mandibular, 6.5 mm.

Figure 6

Panoramic X-ray film taken before the
first appointment (12/2004, 15y 10m).

Figure 7

Cephalometric film taken before the first
appointment (12/2004, 15y 10m).

malocclusions (fig 5). The greater extent of overlapping of lower anterior teeth than of upper anterior teeth indicated a more serious arch length discrepancy (fig. 5) in the mandible than in the maxilla that was confirmed by the measurements (lower excess + 0.8 mm).

The profile cephalometric film showed a slight Class III tendency,

with incisor positions close to standard with compensatory linear maxillary labioversion (fig. 7).

Before deciding what objectives would best accomplish a re-alignment of our prospective patient's anterior teeth, we thought it was logical to draw conclusions from our predecessor's failure:

Figures 8 a to c

Tweed analysis chart (a), tracing (b) and Steiner analysis chart (c).

With a mandibular incisor at 4 mm and 23°, a 6.5 mm crowding, and a curve of Spee of -2.5 mm, it could be assumed that at the end of the previous treatment, the mandibular incisors, which were perfectly aligned according to the patient, were 3.2 mm in front of the

current position if the curve of Spee had not been corrected and 4.5 mm in front if it had been flattened.

Accordingly, they were in a linear position between 7.25 mm and 8.5 mm for I/NB mm and an angular position between 32° and 33.5° for I/NB°.

3 - THERAPEUTIC OBJECTIVES

To make our therapeutic decision, we had to come to two fundamental conclusions:

- Define our objectives for the anterior dentition and determine what mechanics were required to achieve them
- Decide how to compensate for the facial asymmetry.

3 - 1 - Objectives for incisor positions

The Steiner chevron is depicted in (fig. 9): 1/6/5/3.5.

We revised it 1 mm in advance to take into account the ethnic origin of our patient (N. African through one of her parents).

The corresponding “boxes” (fig. 10) could be balanced only if we were able to retract the upper and lowers molars 3 mm and achieve acceptable alignment of the mandibular incisors by gaining 1 mm of space by inter-proximal stripping.

We were certain that only way to retract both arches was to use fixed anchorage mini-screws.

We employed two different mechanical systems:

For the maxilla we chose an indirect system of posterior retraction anchored to the stable anterior sector. A second stage after removing the screws would involve anterior retraction with reciprocal anchorage.

Figure 9
Steiner chevrons.

Solution 1

Mandible	-	+
Discrepancy	-6.5	
Relocation 1		+2
Curve of Spee	-2.5	
Relocation 6		+6
Stripping		+1
Total	-9	+3 → +9

Maxilla	-	+
Discrepancy	-4	
Relocation 1	0	
Curve of Spee	-2	
Relocation 6		+6
Stripping		0
Total	-6	0 → +6

Figure 10

Steiner maxilla and mandible boxes with molar retraction.

Solution 2

Mandible	-	+
Discrepancy	-6.5	
Relocation 1		+8
Curve of Spee	-2.5	
Relocation 6		
Stripping		+1
Total	-9	+1 → +9

Maxilla	-	+
Discrepancy	-4	
Relocation 1		+6
Relocation 6		
Curve of Spee	-2	
Stripping		0
Total	-6	+6

Figure 11

Steiner maxilla and mandible boxes without molar retraction.

In the mandible, we performed an “en masse” retraction, necessarily limited in the anterior sector, but accentuated in the posterior sector with strong molar tip backs. We planned to retract the anterior sector using reciprocal anchorage from the strongly prepared posterior sectors, with class III mechanics if necessary.

The “alternative” solution would be to accept a 3 to 4 mm forward positioning of the anterior teeth (fig. 11) with permanent retention (ITD splint); would this be a satisfactory compromise solution for a young girl of this age? That is more a problem of medical ethics than of aesthetics.

3 - 2 - Asymmetry

The asymmetry was comprised of a dominant vertical component and a

small transverse component. There was no antero-posterior component requiring particular asymmetrical mechanics. This asymmetry was revealed in an assessment of the full face facial photograph (fig. 2) and in a super-imposition of cephalometric tracings of the horizontal branches of the mandible (particularly fig. 14 and 24).

The facial aesthetics were very pleasant. The lack of anterior-posterior component and completion of the patient's growth helped to convince us to use a compensation approach: the transverse and vertical asymmetry should be corrected gradually and harmoniously from top to bottom with no sudden rupture point, so as to keep the terminal deviation as discrete as possible.

4 - TREATMENT

4 - 1 - Stages of treatment

- Initial records

12/2004, 15y 10 m.

- Start of full-banded treatment

0/2005, 15 y 10 m.

- Alignment-leveling completed and screws under loading

07/2005, 16y 5 m.

We installed the screws between the premolars and the molars and connected them to the .019 x .026" arch wire with a metal ligature secured to a welded brass stop. Then we applied distal force from the first molars to the second molars with compressed open coil springs.

- Retraction of 7 completed and start of retraction of 6

12.2005, 16y 10 m.

The sevens were locked by welded brass stops and the arch was still anchored to the screws. A compressed spring between 5 and 6 in the maxilla, modules 6-7 in the mandible, ensured retraction of 6 (fig. 12 and 13).

- Retraction of the first molars in progress (fig. 14 to 16)

07/2006, 17y 5m.

- Start of retraction of the 5 lower teeth (fig. 17)

11/2006, 17y 9m.

Delay in the maxilla because of breakage: retraction of the first

a

b

c

Figures 12 a to c

Intraoral views, right, frontal, and left (07/2006, 17y 5m).

Retraction of first molars in progress

- compressed coil spring on the maxilla / elastomer module anchored to 7 on the mandible.
- second molars locked by a welded brass stop.

Figure 13
Occlusal view of the mandible
(07/2006, 17y 5m).

Figure 14
Cephalometric profile film
(07/2006, 17 y 5 m).

Figure 15

Panoramic X-ray (07/2006, 17y 5m): the min-screws are highlighted with red arrows and the welded stops with blue arrows.

Mesure	Norme à 17 ans 6	29/08/2006
Analyse de Tweed :		
FMA	25.00°	27.85 (+2.85)
FMIA	68.00°	57.02 (-10.98)
IMPA	87.00°	95.13 (+8.13)
SNA	82.00°	81.39 (-0.61)
SNB	80.00°	79.12 (-0.88)
ANB	2.00°	2.27 (+0.27)
AO-BO	0.00mm	-5.42 (-5.42)
Occlusal - SN	14.00°	23.13 (+9.13)
Occlusal - FH	10.00°	14.16 (+4.16)
Inter-incisif	135.00°	125.57 (-9.43)
total chin	11.00mm	16.01 (+5.01)
upper lip	13.00mm	13.16 (+0.16)
Angle Z	78.00°	80.01 (+2.01)
Nasion - ENA	0.00mm	54.63 (+54.63)
Menton - ENA	65.68mm	63.94 (-1.74)
HFP	45.00mm	39.67 (-5.33)
HFA	65.00mm	64.07 (-0.93)
HFP / HFA	0.70	0.62 (-0.08)

a

b

Mesure	Norme à 17 ans 6	29/08/2006
Analyse de Steiner :		
SNA	82.00°	81.39 (-0.61)
SNB	80.00°	79.12 (-0.88)
ANB	2.00°	2.27 (+0.27)
SND	76.00°	77.16 (+1.16)
SL	51.00mm	55.11 (+4.11)
SE	22.00mm	17.10 (-4.90)
GoGn to SN	32.00°	36.03 (+4.03)
I to NA mm	4.00mm	5.69 (+1.69)
i to NB mm	4.00mm	5.87 (+1.87)
Pog to NB	0.00mm	4.10 (+4.10)
Pog to iNB	0.00mm	1.78 (+1.78)
I to NA °	22.00°	21.10 (-0.90)
i to NB °	25.00°	31.06 (+6.06)
I to i °	131.00°	125.57 (-5.43)
Occl to SN	14.00°	23.13 (+9.13)

c

Figures 16 a to c

Tweed analysis chart (a), tracing (b) and Steiner analysis chart (c) (07/2006, 17y 5m).

a

b

c

Figures 17 a to c

Right, front and left intraoral views (11/06, 17y 9m).

Completion of molar retraction on the right maxilla.

Start of premolar retraction on the lower jaw after screws we removed screws from the mandible.

molars had to be started again and completed on the right. In the lower jaw the posterior sectors were locked by welded stops, the screws removed and the anterior retraction started with reciprocal anchorage.

- Retraction of lower canines

01/2007, 17y 11m.

Identical mechanics but retraction of 33-43 started (retraction of 35-45 completed), (fig. 18).

- Retraction of lower incisors

03/2007, 18y 1m.

- Retraction of maxillary premolars

05/2007, 18y 3m.

The anterior maxillary retraction would be carried out using reciprocal

anchorage on the over-retracted molar groups (maxillary screws removed); the necessary loss of upper anchorage was strictly controlled, (fig. 19). In the lower jaw, canine retraction was completed.

- Start of finishing

07/2007, 18y 5m.

After two years three months, we were in class I for molars and canine, spaces closed, retraction objectives achieved; our provisional schedule was respected (fig. 20).

Unfortunately, the patient began thrusting her tongue forward creating an anterior open bite (fig. 20). We had to repeat the finishing process with the patient wearing intensive vertical elastics and undergoing a course

a

b

c

Figures 18 a to c
Intraoral frontal and right and left buccal views.
Continuing retraction of maxillary molars.
Start of retraction of lower canines after we removed screws.

a

b

c

Figures 19 a to c
Right, front and left intraoral vestibular views (7/2007, 18y 5m)
Anterior maxillary (15-25) and mandibular retraction (33-43); maxillary mini-screws removed.

Figures 20 a to c

Right, front and left intraoral vestibular views (10/07, 18y 8m), open-bite highlighted with arrows.
Finishing: this stage was delayed by the occurrence of an interposition.

Figures 21 a and b
Right and left intraoral
views just before band removal
(04/08, 19 y 2 m).

of myo-functional therapy (fig. 21 and 23).

• Debanding

04/2008, 19y 2m.

A last minute functional problem delayed the completion of treat-

ment, which took a full 3 years but the result met our objectives (fig. 22 to 26) and is displaying satisfactory post-treatment stability, which an essential goal for this severe anchorage problem re-treatment case. (fig. 27 and 28).

Figures 22 a to c

Profile and full face smiling and at rest photographs
at the end of treatment (04/08, 19 y 2 m).

a

b

c

Figures 23 a to c

Right, front and left intraoral views (04/08, 19y 2m).

Figure 24

Cephalometric film at the end of treatment (04/08, 19y 2m).

Analyse de Tweed :			
Angle FMA	25.00°	29.67	(+4.67)
Angle FMIA	68.00°	58.47	(-9.53)
Angle IMPA	87.00°	91.86	(+4.86)
Angle SNA	82.00°	80.04	(-1.96)
Angle SNB	80.00°	77.97	(-2.03)
Angle ANB	2.00°	2.06	(+0.06)
AQ-BD	0.00mm	-6.61	(-6.61)
Occlusal - SN	14.00°	25.27	(+11.27)
Occlusal - FH	10.00°	16.84	(+6.84)
Inter-incisif	135.00°	134.53	(-0.47)
total chin	11.00mm	16.70	(+5.70)
upper lip	13.00mm	15.14	(+2.14)
Angle Z	78.00°	75.94	(-2.06)
Nasion - ENA	0.00mm	57.39	(+57.39)
Menton - ENA	65.68mm	63.11	(-2.57)
HFP	45.00mm	39.29	(-5.71)
HFA	65.00mm	63.15	(-1.85)
HFP / HFA	0.70	0.62	(-0.08)

a

b

Analyse de Steiner :			
SNA	82.00°	80.04	(-1.96)
SNB	80.00°	77.97	(-2.03)
ANB	2.00°	2.06	(+0.06)
SND	76.00°	75.87	(-0.13)
SL	51.00mm	51.28	(+0.28)
SE	22.00mm	18.18	(-3.82)
GoGn to SN	32.00°	38.47	(+6.47)
I to NA mm	4.00mm	6.18	(+2.18)
i to NB mm	4.00mm	5.21	(+1.21)
Pog to NB	0.00mm	3.59	(+3.59)
Pog to iNB	0.00mm	1.62	(+1.62)
I to NA °	22.00°	15.47	(-6.53)
i to NB °	25.00°	27.93	(+2.93)
I to i °	131.00°	134.53	(+3.53)
Occl to SN	14.00°	25.27	(+11.27)

c

Figures 25 a to c

Tweed analysis chart (a), tracing (b) and Steiner analysis chart (c) (04/08, 19y 2m).

Figures 26 a to c
Study models: occlusal
views and curve of Spee
(04/08, 19y 2m).

Figures 27 a to c
Profile and full face smiling and at rest photographs one year
after treatment (03/09, 20y 1m).

Figures 28 a to c
Right, frontal, and left intraoral views (03/09, 20 y 1 m).

4 - 2 - Molar retraction protocol

Here we present the functional diagrams of possible molar retraction in

figures 29 to 34, this stage being mechanically more difficult.

Figure 29

Functional diagram of retraction 7: option 1.

Direct ligature on 3. Open spring 6-7 (there was no space between 3-5 and 5-6).

→ Difficulty in installing the coil.

Figure 30

Functional diagram of retraction 7: option 2 which was used in this case.

Open spring 6-7. Ligature directly to 3.

Compressed spring 5-7 (there was no space between 3 and 5).

→ Difficulty in installing the coil.

Figure 31

Functional diagram of retraction 7: option 3.

Debanding 6. Ligature directly to 3.

Compressed spring 5-7 (there was no space between 3 and 5).

→ Benefit: easy to install the coil.

→ Disadvantage: momentary loss of control of 6.

Figure 32

Functional diagram of retraction 6: option 1.

Welded stop or step in mesial contact with 7 and distal stop at 3. Metal ligature on the stop on 3. Compressed spring 5-6 (there was no space between 3 and 5). Metal ligature "flush" on 6 converted.

→ Risk of disto-buccal rotation of 6.

→ Option chosen for this case in the maxilla.

Figure 33

Functional diagram of retraction 6: option 2.

Mesial crimped stop. Metal ligature directly on 3. (no space between 3 and 5), or on the arch via a stop in the 3-5 space. Compressed spring 5-6.

Care must be taken to make the crimping secure.

Figure 34

Functional diagram of retraction 6: option 3.

Stops on contact (mesial on 7 and distal on 3).

Metal ligature on the stop on 3 or directly on 3. Module 7-6. Metal ligature "flush" on 6 converted.

→ Risk of disto-buccal rotation of 6.

→ Risk of loss of anchorage on 7.

→ Option chosen for this case in the mandible.

5 - CONCLUSION

Because in our opinion any orthodontic therapeutic plan that will require permanent fixed post treatment retention is unacceptable for ethical reasons, we had no other treatment option than the one we used. Although the technique may appear difficult and complex, it was the only method that could guarantee stability without permanent retention.

In this case, it was interesting to note that, in spite of her ethnic origins, this patient required anterior

aesthetic harmony that conformed to European standards because the relapse was within the range of European norms.

The unusual mechanics required for this case led us to use it as a model for the seminar on mini-screws (a week allotted to simulation of treatment on a typodont using mini-screws) as part of the teaching program at CECSMO Bordeaux-Toulouse (Toulouse: 9-13/3/2009).