The SmartClip™ Self-Ligating Appliance System

Technique Guide

Dr. Hugo Trevisi

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Acknowledgement

A special thank you is given to Dr. Hugo Trevisi
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Dr. Hugo Trevisi

Dr. Hugo Trevisi received his dental degree in 1974 at Lins College of Dentistry in the state of São Paulo, Brazil. He received his orthodontic training from 1979 to 1983 at that same college. Since that time he has been involved in the full time practice of Orthodontics in Presidente Prudente, Brazil. Dr. Trevisi has lectured extensively in South America, Central America and Europe, and he has developed his own orthodontic teaching facility in Presidente Prudente. Dr. Trevisi has over 25 years of experience with the pre-adjusted appliance and, together with Drs. McLaughlin and Bennett, has developed the MBT technique. He is a professor at the Specialization Course in Orthodontics at the Paulista Association of Dentistry – Presidente Prudente - Brazil, a member of the Brazilian Society of Orthodontics and the Brazilian College of Orthodontics.

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SmartClip™ Self-Ligating Appliance System

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SmartClip™

1. Introduction

One of the greatest Orthodontic advancements in the 1990's was the development of the twin-wing preadjusted appliance system with rhomboidal shape, in which angulation was incorporated into the shape of the bracket.

At the end of the 1990's, drawing on their twenty-years of experience using the straight-wire appliance, McLaughlin, Bennett and Trevisi proposed a modification to these type of appliances. Their aim was to achieve better three-dimensional control of the tooth, providing good sliding biomechanics to treatment (increasing the positive torque for upper incisors, increasing the negative torque for the lower incisors, offering three torque options for upper and lower cuspids, extra negative torque for upper molars, and reducing the negative torque to the lower posterior teeth). These changes have been very well accepted by clinicians worldwide.

Without a doubt, the preadjusted appliance system has demonstrated reliability regarding the tri-dimensional control of teeth. The biggest concern regarding this appliance is the friction created by the tying in of archwires by elastic and metallic ligatures during the three stages of the orthodontic treatment – aligning, leveling and space closure.

The new proposal for preadjusted appliance system is to continue to use the twin wing system, mid-size rhomboidal shape, slot .022"/.028", but diminish friction between the archwire and the bracket slot, thereby decreasing the level of force applied to the ligated appliances. The appliance should retain the characteristics of previous appliances, should be easy to work with and should be comfortable for the patient.

An appliance presenting all of the above characteristics has been created, providing for orthodontic treatment using very low levels of forces during the biomechanics, decreasing friction between the archwire and bracket slot, providing a good three dimensional and operational control, providing reduction in treatment time whilst achieving excellent orthodontic results. This guide will present the SmartClip™ Self-Ligating Appliance System and demonstrate its use in a variety of cases.

2. Design and Development of SmartClip™ Self-Ligating Appliances

Ming-Lai Lai, 3M Unitek

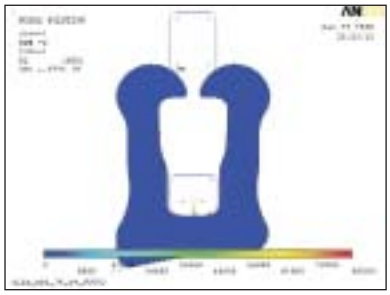
The SmartClip Self-Ligating Appliance System design shares the MBT™ Versatile+ Appliance System philosophy: maximum versatility, mid-sized twin brackets, bracket prescription and the use of light force. The SmartClip™ Bracket's self-ligating mechanism consists of two Nitinol clips that open and close through elastic deformation of the material when the archwire exerts a force on the clip. The bracket contains no moving door or latch. The feature of no moving doors or latches can eliminate problems such as sticking, spontaneous opening, plaque build-up, etc., that are associated with other types of self-ligating brackets.

SmartClip brackets are the only true self-ligating brackets, because the clip automatically closes and secures the archwire in the wire slot. A SmartClip Appliance hand instrument is designed to simplify the process of archwire engagement and disengagement. Because of the true twin design, the clinician has the option of selectively engaging the archwire in only one clip when teeth are severely maloccluded. In addition, the familiar tie-wing design allows for the use of traditional ligation at the option of the clinician. This design also facilitates simple and easy use of chain ligatures when needed for space closure.

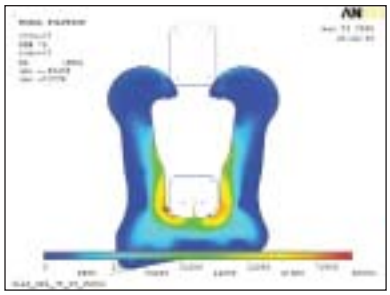
Nitinol Clip Design

Each bracket contains two clips made of Nitinol material. Careful engineering of the geometry of the clip ensures proper archwire engagement and disengagement forces and stress-strain distributions for fatigue resistance. Finite Element Analysis (FEA) computer simulation software was used to predict the forces and stress-strain distribution during archwire engagement and disengagement. In addition, extensive laboratory testing was conducted to verify the analytical results. Figures 1-6 illustrate the computer simulation results.

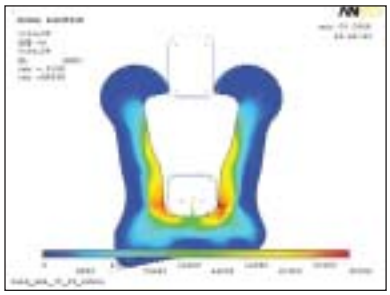
Clip stress distribution during a .019"x.025" wire engagement and disengagement



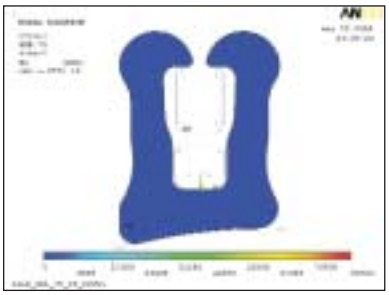
1: .019"x.025" Wire Engagement



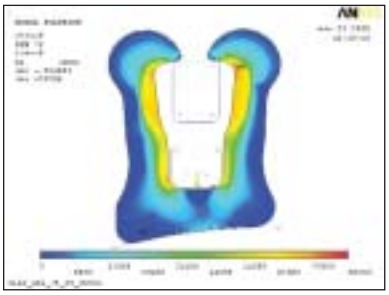
2: .019"x.025" Wire Engagement



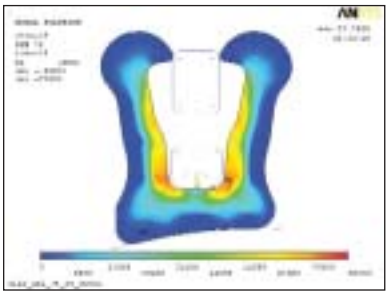
3: .019"x.025" Wire Engagement



4: .019"x.025" Wire Disengagement

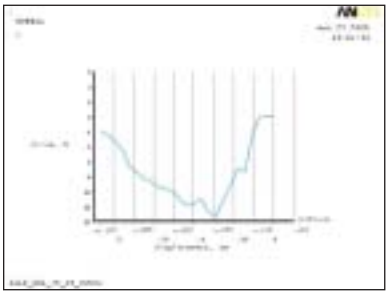


5: .019"x.025" Wire Disengagement

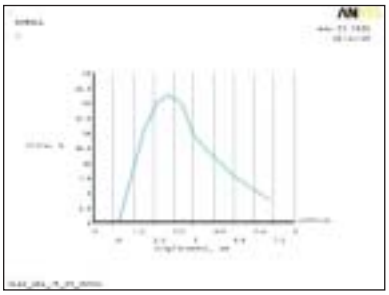


6: .019"x.025" Wire Disengagement

Engagement and disengagement forces for .019"x.025" wire



7: Engagement Force vs. Wire Displacement



8: Disengagement Force vs. Wire Displacement

Figures 7 and 8 show that the stresses in the clip during engagement and disengagement are well within the ultimate strength of Nitinol, thus ensuring adequate fatigue life. The forces to engage and disengage a .019"x.025" wire are about 13 N and 20 N respectively. The forces and stresses will be less for smaller wires. It should be noted that the alignment between the wire and clip is critical to ensure easy archwire engagement.

SmartClip™ Bracket Fabrication

The main bracket body is molded using the metal injection molding process. A high-precision laser process cuts the Nitinol clip and subsequent processes smooth the clip. The bracket holds the clip through mechanical means. The mesh bonding base is laser-welded onto the bracket body.

3. Bracket Prescription Incorporating the MBT™ System Prescription

The SmartClip™ Self-Ligating Appliance System features the MBT™ System Prescription, (Figure 9). The MBT prescription provides several features that significantly improve clinical management of orthodontic cases. These features are as follows:

Anterior Tip

Reduced anterior tip was incorporated into the appliance to conform to Andrew's original research, and to reduce the anchorage needs of each case.

Upper Posterior Tip

Upper bicuspid brackets are provided with 0° of tip to keep these teeth in a more upright (Class I) position. Upper molar brackets are provided with 0° of tip, which when placed parallel to the occlusal plane, introduce 5° of tip into the upper molars.

Lower Posterior Tip

Lower posterior tip in the first and second bicuspid brackets is maintained at 2°, to slightly incline these teeth forward (in a Class I direction). For the lower first and second molars, 0° tipped brackets are provided, which when placed parallel to the occlusal plane, introduces 2° of tip to these teeth.

Incisor Torque

Upper incisor brackets are provided with additional palatal root torque, while lower incisor brackets are provided with additional labial root torque. This adjustment aids in the correction of the most common torque problems occurring in the incisor areas.

Upper Cuspid, Bicuspid and Molar Torque

Upper cuspid and bicuspid brackets are provided with the normal -7° of torque. Upper molar brackets are provided with an additional 5° of buccal root torque (to -14°) to reduce palatal cusp interferences with these teeth.

Lower Cuspid, Bicuspid and Molar Torque

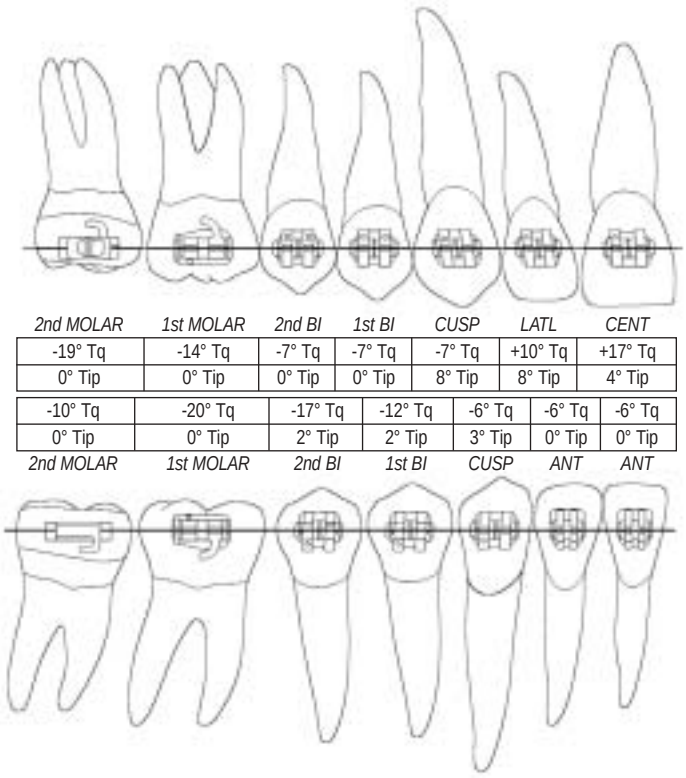
Progressive buccal crown torque is provided in the brackets of the lower cuspids and lower posterior segments. This allows for buccal uprighting of these teeth, which is beneficial in most cases.

In/Out Modifications

Because upper second bicuspids are frequently smaller than upper first bicuspids, brackets with an additional .5 mm of in/out compensation are provided for these. If upper bicuspids are the same size, upper first bicuspid brackets can be used on all upper bicuspids.

SmartClip™ Brackets

SmartClip™ Self-Ligating Brackets can be used with other conventional orthodontic treatment mechanics. With the reduction in frictional forces, the clinician may find the use of optional treatment mechanics an advantage. The material and information provided in this guide are an example of the use of a modified MBT™ System treatment method. Traditional MBT system archwire sequencing and mechanics have been altered to better optimize the lower frictional forces presented with the SmartClip appliance.



2nd MOLAR	1st MOLAR	2nd BI	1st BI	CUSP	LATL	CENT
-19° Tq	-14° Tq	-7° Tq	-7° Tq	-7° Tq	+10° Tq	+17° Tq
0° Tip	0° Tip	0° Tip	0° Tip	8° Tip	8° Tip	4° Tip

-10° Tq	-20° Tq	-17° Tq	-12° Tq	-6° Tq	-6° Tq	-6° Tq
0° Tip	0° Tip	2° Tip	2° Tip	3° Tip	0° Tip	0° Tip
2nd MOLAR	1st MOLAR	2nd BI	1st BI	CUSP	ANT	ANT

Figure 9: SmartClip™ Self-Ligating Appliance System, MBT™ System Prescription.

4. Archwire Sequencing

Aligning stage

Techniques for use of the SmartClip Self-Ligating Appliance in the aligning stage of orthodontic treatment is related to the crowding and to the malocclusion of the patient's teeth. It is advised to initiate the aligning stage using .014" or .016" Nitinol archwire, preserving the original shape of the patient's dental arch. After the beginning of the aligning phase, it is recommended to complete the derotation of teeth using .016"x.025" Nitinol wires. The .016"x.025" Nitinol wire finishes the derotations and enables the initiation of the leveling stage.

Leveling stage

Leveling is related to the degree of the curve of Spee, mainly in the Class II/Div. 1 dental malocclusion. In this stage of treatment, it is recommended to work with .019"x.025" Nitinol archwire, enabling a good correction of the curve of Spee. In cases in which it is difficult to level the curve of Spee, it is advisable to use very stiff arch wires.

Space closure

During the space closure stage of treatment, the SmartClip Self-Ligating appliance is designed to work with .019"x.025" stainless steel wires. This allows a good application of the sliding biomechanics, maintaining good torque control in both the upper and lower anterior segments as well as in the posterior segments.

Finishing and detailing

When detailing of the occlusion is indicated this can be achieved using .019"x.025" braided archwires. These wires allow good settling of the occlusion.

Archwire sequencing:

Aligning

.014" Classical Nitinol or .014" Super Elastic

.016"x.025" Classical Nitinol or .016"x.025" Super Elastic

Leveling

.019"x.025" Nitinol or .019"x.025" Super Elastic

Space closure

.019"x.025" Stainless Steel

Detailing

.019"x.025" Braided

5. Engagement and Disengagement of Wires

The Nitinol clips in the SmartClip Self-Ligating Appliance System present some resistance to archwire engagement and disengagement, with the amount of the resistance varying based on archwire size and shape.

Hand instruments have been manufactured (working key) to make the engagement and disengagement of the archwires easier. Their use also allows easier engagement of rectangular archwires with torque added to the wire.

Engagement: One end of the working key has a rectangular notch, allowing the engagement of the orthodontic archwire. This notch allows the professional to direct the archwire into the bracket slot, applying very gentle pressure to fix the wire into the bracket slot behind the clips.

Figure 10

When applying pressure to the wire (Figure 10), the clinician should support the tooth from the lingual, using the fingers to provide comfort for the patient.

To make the wire engagement easier, it is advised to initiate its installation by the upper and lower central incisors. Flexible archwires may be fed through the slots created by the clips in the premolar and molar brackets if the wire ends have not been bent back before installation of the wire.

Disengagement: The reverse end of the working key is used to disengage orthodontic archwires from the bracket slot. The disengagement tool has two hooks to engage the wire, and its central part holds itself over the buccal surface of the mesial and distal wings. By means of a rotation movement, the wire disengages from the bracket slot (Figures 11, 12).

Figure 11

Figure 12

Case Presentation:
Atypical case (agenesis of upper lateral incisor)
Treatment time: 13 months

Patient: F. F.

Sex: Female

Age: 13 years and 05 months

Facial pattern: Brachifacial

Skeletal pattern: Class I

Dental malocclusion:

4mm Class II malocclusion on the right side, 2mm Class II malocclusion on the left side, upper midline deviation to the right, agenesis of the upper right incisor (tooth 12), accentuated curve of Spee.

Diagnosis and treatment plan:

Finishing treatment with Class II buccal segment relationship on the right side and in Class I on the left side, correcting the midline and the curve of Spee, and controlling the proclination of the lower incisors.

Appliance:

SmartClip™ Self-Ligating Appliance System
Applying the MBT™ appliance versatility on tooth 13, 16 and 17
Hawley retainer in the upper arch
3x3 retainer in the lower arch

Case report:

The patient presented with agenesis of the upper right lateral incisor (tooth 12), 4mm dental Class II malocclusion on the right side, 2mm dental Class II malocclusion on the left side, 2mm upper midline deviation to the right, accentuated curve of Spee, increased inclination of the lower incisors and a low maxillary-mandibular plane angle as shown in the cephalometric measurements.

The treatment plan was to close spaces, bringing the right cuspid into the position of the lateral incisor, correcting the midline, controlling the proclination of the lower incisors. The treatment would thus finish with Class II on the right side and Class I in the left side.

Two of the versatility options of the MBT technique have been applied in the case in order to detail the occlusion: **A-** Lower left second molar tubes were bonded on the upper right molars to leave these teeth without rotation and with 0°. **B-** Brackets of the upper right cuspids were positioned with a rotation of 180˚, aiming to introduce +7º positive torque, and leaving the angulation in 8º.

As for the biomechanics, Class III elastics have been used on the right side and Class II elastics on the left side. Class III elastics with .018” arch wire have been used in the lower arch to control the lower incisors inclination. When using the rectangular arch wire, resistant buccal root torque was introduced in the archwire to control the proclination of lower incisor teeth.

The curve of Spee has been corrected without further proclination of the lower anterior teeth thus illustrating good torque control. As seen on the cephalometric tracings, the initial IMPA was 102 and the final 101.

Initial

SNA	∠	80º
SNB	∠	79º
ANB	∠	01º
ANF-H	⊥	0mm
PN-FH	⊥	0mm
Wits		2mm
GoGn.SN		28º
FH.MD	∠	19º
Mx.Md	∠	25º
1-A-Po		9mm
1-A-Po		5mm
1.Pl.Mx	∠	116º
1.Pl.Md	∠	102º

Facial Analysis

Nasolabial	∠	91º
NA ⊥ Nose		29mm
Lip thickness		10mm

Cephalometric tracing related to Fig. 4-C

Final

SNA	∠	80º
SNB	∠	78º
ANB	∠	02º
ANF-H	⊥	1mm
PN-FH	⊥	0mm
Wits		3mm
GoGn.SN		29º
FH.MD	∠	19º
Mx.Md	∠	24º
1-A-Po		7mm
1-A-Po		4mm
1.Pl.Mx	∠	112º
1.Pl.Md	∠	101º

Facial Analysis

Nasolabial	∠	89º
NA ⊥ Nose		29mm
Lip thickness		11mm

Cephalometric tracing related to Fig. 28-C

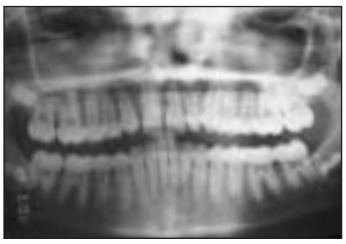
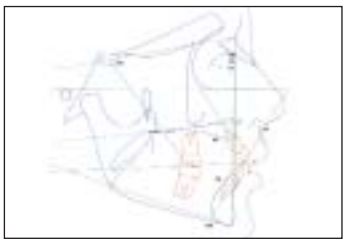
1A – 1B: Frontal and profile

Harmonic Class I profile, with a very good lip seal.

2A – 2B – 2C: Buccal, frontal, lateral

Agenesis of the upper right lateral incisor, upper midline deviation to the right, 4mm Class II on the right, and 2mm Class II on the left.

3A – 3B: Open mouth

4A – 4B – 4C: Cephalometric and panoramic x-rays, cephalometric tracing

The cephalogram and the cephalometric measurements show increased inclination of the lower incisors. The panoramic x-ray shows that the permanent dentition is complete with a very accentuated curve of Spee.

5A – 5B – 5C: Models, frontal, lateral – right and left

6A – 6B: Models – open mouth

7A – 7B: Models – curve of Spee, right and left

Showing a very accentuated curve of Spee in both sides.

8A – 8B – 8C: Buccal, frontal, lateral – right and left

SmartClip™ appliance in both upper and lower arches, .014" Nitinol archwire to initiate the aligning stage, and direct bonding of brackets on the upper right cuspid with rotation of 180º.

9A – 9B: Open mouth

Showing the initial stage of aligning with .014" Nitinol arch wire.

Both upper and lower arches were bonded using the direct bonding technique. In the lower arch, the second molars were included. The archwires were bent back distally in both arches.

10A – 10B – 10C: Buccal, frontal, lateral – right and left

Initiating the leveling stage in the upper arch with .018" Nitinol arch wire. .017" x .025" Nitinol archwire in the lower arch.

11A – 11B – 11C: Buccal, frontal, lateral – right and left

Initiating the biomechanics of Class II and Class III elastics. Space closure stage with .019" x .025" stainless steel rectangular archwire in the upper arch, and .018" stainless steel round archwire with prewelded hooks to the mesial of cuspids in the lower arch.

12A – 12B: Rectangular arch wire bending and Class III biomechanics

Tubes for the molars allow the bending of the rectangular arch wire before engagement, providing more comfort to the patient, as is shown in fig. 12A. Fig. 12B illustrates the beginning of the Class III biomechanics.

13A – 13B – 13C: Second upper molar buccal tubes

Upper second molar buccal tubes and re-leveling.

.018" Nitinol archwire in the upper arch.

14: Distal bend backs

.018" Nitinol archwire with distal bend backs

15A – 15B – 15C: Buccal, frontal, lateral – right and left

.019" x.025" stainless steel rectangular archwire in the upper arch.

.018" stainless steel round archwire in the lower arch with prewelded hooks to the mesial of the cuspids to finalize the biomechanics.

16A – 16B – 16C: First and second molar buccal tubes

The versatility of the MBT™ Appliance System being used to detail the occlusion. Lower left second molar buccal tube bonded on the upper right first molar and second molars. Repositioning of the lower right first molar tube, and .016" Nitinol round archwire in both arches.

17A – 17B – 17C: Buccal, frontal, lateral – right and left

.019" x.025" Nitinol archwire in the upper arch and .018" stainless steel archwire in the lower arch in the finishing stage of detailing the treatment.

18A – 18B – 18C: Buccal, frontal, lateral – right and left

End of treatment with .019" x .025" stainless steel rectangular archwires in both arches to finalize the biomechanics and to detail the occlusion of the patient.

19A – 19B: Open mouth

Final stage of treatment with an occlusal view of both arches.

20A – 20B – 20C: Buccal, frontal, and lateral final shots

End of the orthodontic treatment after appliance removal. Class II on the right side, Class I on the left side and midline correction.

21A – 21B – 21C: Final shots – open mouth, anterior guidance

End of the orthodontic treatment, 3 x 3 fixed retainer in the lower arch, anterior guidance.

22A – 22B – 22C: Buccal, frontal, and lateral final shots

Disclusion by the incisors with a good posterior interocclusal space in the molars and premolars area.

23A – 23B – 23C: Buccal, frontal, and lateral final shots

Lateroprotrusive disclusion (group partial) in the right side, showing a good interocclusal space in the left side.

24A – 24B – 24C: Buccal, frontal, and lateral final shots

Lateroprotrusive disclusion in the left side by cuspid guidance (mutually protected occlusion), and a good interocclusal space in the right side.

25A – 25B – 25C: Frontal and lateral shots in the articulator

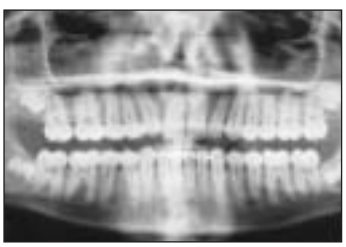
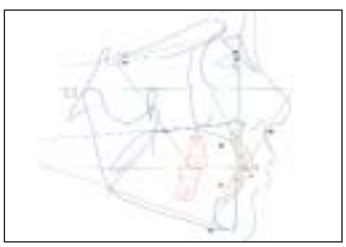
Mounting in a semiadjustable articulator in order to check the detailing of the functional occlusion.

26A – 26B: Open mouth

Observing the alignment of the arches by means of the preformed template in order to start treatment.

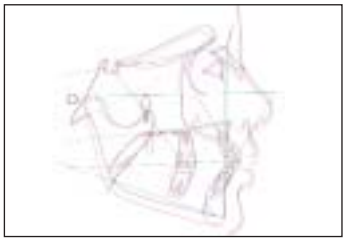
27A – 27B: Upper model – lateral shot

Lateral shots showing the curve of Spee at the end of the orthodontic treatment.

28A – 28B – 28C: Cephalometric and panoramic x-rays, final cephalometric tracing

The cephalogram and the cephalometric measurements show good torque control of the lower incisors at the end of treatment. The panoramic x-ray showing the parallelism of the roots.



29: Cephalometric tracing superimposition

Superimposition of the initial and the final cephalometric tracings, illustrating good growth control and a good lower incisor torque control.

30A – 30B – 30C: Frontal, profile and smile

End of treatment with a good frontal facial harmony and a good smile line.

31A – 31B: Tomography

Computerized tomography showing both right and left sides and a good position of the condyles in the articular fossa.

32A – 32B: Tomography

Lateral view VRT tomography, showing good positioning of the condyles in the articular fossa.

Case Presentation:
Class II without extraction of bicuspid teeth
Treatment time: 15 months

Patient: L. D.

Sex: Female

Age: 13 years and 04 months

Facial pattern: Mesofacial

Skeletal pattern: Class I

Dental malocclusion:

Class I malocclusion with dental bi-protrusion, generalized upper and lower spacing, deep overbite, and accentuated curve of Spee.

Diagnosis and treatment plan:

Correcting the anteroposterior relationship, the deep overbite and the curve of Spee, controlling the torque of the lower incisors.

Appliance:

SmartClip™ Self-Ligating Appliance
Class II elastics
Hawley retainer in the upper arch
3 x 3 fixed retainer in the lower arch

Case report:

The patient presented with a Class I malocclusion with generalized spacing in the upper and lower arches, a very accentuated curve of Spee and proclination of the lower incisors.

The treatment plan was to correct the overjet, the over bite and the curve of Spee with good torque control of the lower incisors.

The SmartClip™ Self-Ligating appliance was used in the patient using indirect bonding technique in both upper and lower arches. At the second appointment, lower second molar buccal tubes were bonded to achieve a better control when correcting the overbite and the curve of Spee. In the stage of the .019"x.025" stainless steel rectangular arch wire, resistant buccal root torque was introduced in the lower anterior teeth to control the inclination of the lower incisors as it shows the initial and final tracings of the patient.

The biomechanics to correct the overjet was applied using Class II elastics and, in the final stage, braided arch wires were used to detail the patient intercuspation.

Initial

SNA	∠	85º
SNB	∠	78º
ANB	∠	07º
ANF-H	⊥	6 mm
PN-FH	⊥	-1 mm
Wits		6 mm
GoGn.SN		33º
FH.MD	∠	24º
Mx.Md	∠	27º
1-A-Po		10 mm
1-A-Po		5 mm
1.Pl.Mx	∠	123º
1.Pl.Md	∠	103º

Facial Analysis

Nasolabial	∠	110º
NA ⊥ Nose		33 mm
Lip thickness		12 mm

Cephalometric tracing related to Fig. 4-C

Intermediate

SNA	∠	81º
SNB	∠	76º
ANB	∠	05º
ANF-H	⊥	4 mm
PN-FH	⊥	-2 mm
Wits		1 mm
GoGn.SN		35º
FH.MD	∠	26º
Mx.Md	∠	28º
1-A-Po		6 mm
1-A-Po		3 mm
1.Pl.Mx	∠	113º
1.Pl.Md	∠	101º

Facial Analysis

Nasolabial	∠	106º
NA ⊥ Nose		34 mm
Lip thickness		13 mm

Cephalometric tracing related to Fig. 14-C

Final

SNA	∠	82º
SNB	∠	77º
ANB	∠	05º
ANF-H	⊥	2 mm
PN-FH	⊥	-3 mm
Wits		2 mm
GoGn.SN		35º
FH.MD	∠	27º
Mx.Md	∠	29º
1-A-Po		5 mm
1-A-Po		2 mm
1.Pl.Mx	∠	113º
1.Pl.Md	∠	101º

Facial Analysis

Nasolabial	∠	101º
NA ⊥ Nose		34 mm
Lip thickness		14 mm

Cephalometric tracing related to Fig. 28-C

1A – 1B: Frontal, profile

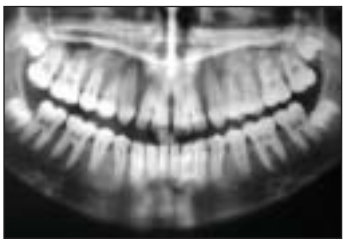
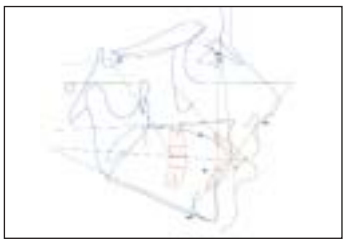
Facial symmetry, bi-protrusive profile, good lip seal.

2A – 2B – 2C: Buccal, frontal, lateral – right and left

Generalized spacing, increased overjet and overbite and a very discrete molar Class II relationship.

3A – 3B: Open mouth

Good contour and shape of the dental arches with generalized spacing.

4A – 4B – 4C: Cephalometric, panoramic x-rays, cephalometric tracing

The cephalogram and the cephalometric measurements show increased proclination of the upper and lower incisors. The panoramic x-ray shows that the permanent dentition is complete with an accentuated curve of Spee.

5A – 5B – 5C: Models, frontal, lateral – right and left

6A – 6B: Open mouth

7A – 7B: Model, curve of Spee

Accentuated curve of Spee on both sides

8A – 8B – 8C: Buccal, frontal, lateral – right and left

SmartClip™ appliance bonded using indirect bonding in both arches.

.016” Nitinol archwire initiating the aligning stage.

9A – 9B: Open mouth

Beginning of the aligning stage with .016” Nitinol archwire (indirect bonding until the first molars with distal bend in both arches).

10A – 10B – 10C: Buccal, frontal, lateral – right and left

Beginning of the leveling stage with .017”x .025” Nitinol archwire in both upper and lower arches.

11A – 11B – 11C: Buccal, frontal, lateral – right and left

Direct bonding of the upper and lower second molars.

.018” round Nitinol archwire for re-leveling.

12A – 12B: Open mouth

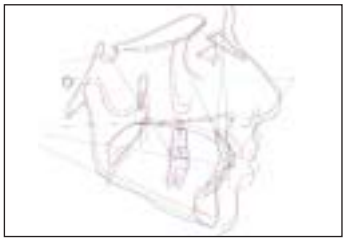
Occlusal view with .018” Nitinol round archwire and buccal tubes up to the second molars in both upper and lower arches.

13A – 13B – 13C: Buccal, frontal and lateral – right and left

.019”x.025” stainless steel rectangular archwire in both dental arches, and prewelded hooks to the mesial of cuspids.

14A – 14B – 14C: Cephalometric, panoramic x-rays, intermediate cephalometric tracing.

Intermediate cephalogram showing a good torque control of the lower incisor teeth. The initial IMPA was 103º and, at the intermediate stage, the IMPA was 101º. Panoramic x-ray to check the parallelism of roots.



15: Superimposition of the cephalometric tracing

Initial and intermediate superimposition of the cephalometric tracings illustrating good growth control and good torque control of the lower incisor teeth.

16A – 16B: Open mouth

Occlusal view at the final stage with a .019"x.025" stainless steel archwire, showing a good dental arch shape and a good rotational control of teeth.

17A – 17B – 17C: Buccal, frontal, lateral – right and left

.019"x.025" braided rectangular archwire in the upper arch at the end of the detailing phase.

18A – 18B – 18C: Open mouth

Final stage of treatment with .019"x.025" braided rectangular archwire up to the first molars in both upper and lower arches. Photo 18C shows the anterior guidance.

19A – 19B – 19C: Buccal, frontal and lateral final shots

Anterior disclusion by incisors with a good posterior interocclusal space in the molars and premolars area.

20A – 20B – 20C: Buccal, frontal and lateral final shots

Lateroprotrusive disclusion in the right side by cuspid guidance (mutually protected occlusion) with a good interocclusal space in the working and non-working sides.

21A – 21B – 21C: Buccal, frontal and lateral final shots

Lateroprotrusive disclusion in the left side by cuspid guidance (mutually protected occlusion). Good interocclusal space in the working and non-working sides.

22A – 22B – 22C: Buccal, frontal and lateral final shots

Upper arch retainer (Hawley retainer) allowing a good occlusion.

23A – 23B – 23C: Buccal, frontal and lateral final shots

Anterior disclusion by cuspids with a good posterior interocclussal space in the molars and premolars area.

24A – 24B – 24C: Buccal, frontal and lateral final shots

Lateroprotrusive disclusion in the right side by cuspid guidance (mutually protected occlusion), with a good interocclusal space in the working and non-working sides.

25A – 25B – 25C: Buccal, frontal and lateral final shots

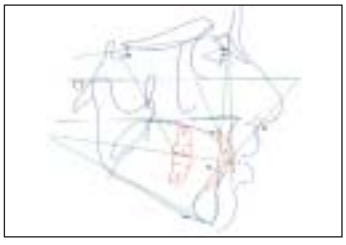
Lateroprotrusive disclusion in the left side by means of the cuspid guidance (mutually protected occlusion). A good interocclusal space in the working and non-working sides.

26A – 26B – 26C: Buccal, frontal and lateral final shots

End of treatment presenting a good intercuspation of teeth, and a good overjet and overbite.

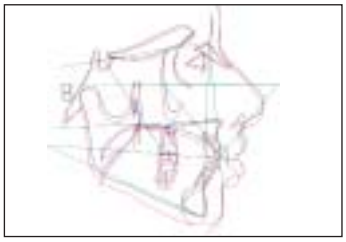
27A – 27B: Open mouth

Control of the patient original arch form achieved by template at the start of treatment.



28A – 28B – 28C: Cephalometric, panoramic x-rays, final cephalometric tracing

The cephalogram and the cephalometric measurements show good torque control of the lower incisors at the end of treatment. The panoramic x-ray shows the parallelism of roots.



29: Superimposition of the cephalometric tracings

Initial and final superimposition of the cephalometric tracings, illustrating good growth control and good torque control of the lower incisor teeth.

30A – 30B – 30C: Frontal, profile and smile final shots

End of treatment with a good frontal facial harmony, good profile and a good smile line.

Case Presentation:
Class II with no extraction
Treatment time: 19 months

Patient: S. M.

Sex: Female

Age: 12 years and 05 months

Facial pattern: Mesofacial

Skeletal pattern: Class II

Dental malocclusion:

Class II/Div. 1 malocclusion with increased inclination of upper incisors, deep overbite and a very accentuated curve of Spee.

Diagnosis and treatment plan:

Treatment was carried out in two phases:
1. Firstly, correcting the Class II relationship;
2. Secondly, finishing treatment detailing the occlusion of the patient.

Appliance:

Headgear
Bionator functional appliance
SmartClip™ Self-Ligating Appliance
Biomechanics with Class II elastics
Hawlley retainer in the upper arch
3x3 fixed retainer in the lower arch

Case report:

The patient presented with a Class II/Div.1 malocclusion in the mixed dentition when the interceptive treatment was started with the use of headgear and Bionator.

The interceptive orthopedic treatment (first stage) aimed to correct the anteroposterior relationship by the time the deciduous teeth had exfoliated.

The corrective orthodontic treatment (second stage) was carried out using the SmartClip™ appliance in both upper and lower arches. Direct bonding technique was used in both arches.

The patient used the headgear to keep the Class I molar relationship until the use of the stainless steel arch wire. During leveling, the patient had minitubes bonded on the lower second molars to control the curve of Spee and the overbite. When using the stainless steel rectangular arch wire, resistant root buccal torque was introduced in the lower incisors to control the inclination of these teeth. In the final stage of treatment, .019"x.025" braided rectangular arch wires were used to detail the occlusion of the patient.

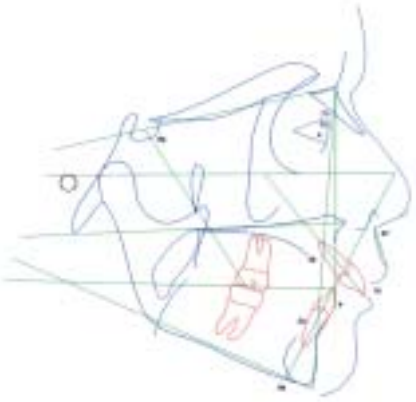
Initial

SNA	∠	77º
SNB	∠	73º
ANB	∠	04º
ANF-H	⊥	0 mm
PN-FH	⊥	-7 mm
Wits		6 mm
GoGn.SN		35º
FH.MD	∠	24º
Mx.Md	∠	26º
1-A-Po		13 mm
1-A-Po		02 mm
1.Pl.Mx	∠	127º
1.Pl.Md	∠	94º

Facial Analysis

Nasolabial	∠	97º
NA ⊥ Nose		27 mm
Lip thickness		09 mm

Cephalometric tracing related to Fig. 4-C



Intermediate

SNA	∠	80º
SNB	∠	78º
ANB	∠	02º
ANF-H	⊥	0 mm
PN-FH	⊥	-5 mm
Wits		4 mm
GoGn.SN		32º
FH.MD	∠	25º
Mx.Md	∠	25º
1-A-Po		08 mm
1-A-Po		02 mm
1.Pl.Mx	∠	119º
1.Pl.Md	∠	91º

Facial Analysis

Nasolabial	∠	97º
NA ⊥ Nose		29 mm
Lip thickness		12 mm

Cephalometric tracing related to Fig. 11-B

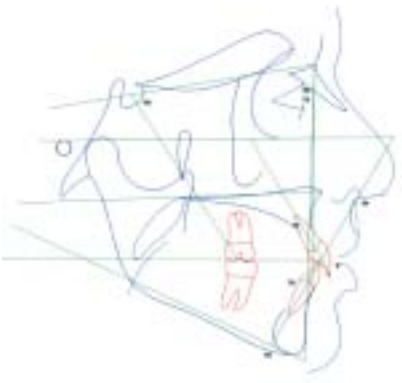
Final

SNA	∠	80º
SNB	∠	79º
ANB	∠	01º
ANF-H	⊥	-1 mm
PN-FH	⊥	-4 mm
Wits		2 mm
GoGn.SN		33º
FH.MD	∠	26º
Mx.Md	∠	27º
1-AP		8 mm
1-AP		3 mm
1.Pl.Mx	∠	118º
1.Pl.Md	∠	94º

Facial Analysis

Nasolabial	∠	94º
NA ⊥ Nose		32 mm
Lip thickness		10 mm

Cephalometric tracing related to Fig. 26-C



1A – 1B: Frontal and profile

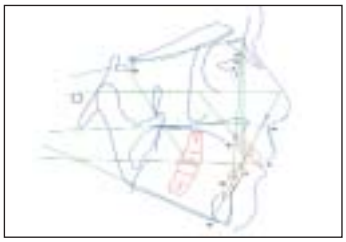
Facial symmetry, bi-protrusive profile with a good lip sealing.

2A – 2B – 2C: Buccal, frontal, lateral – right and left

Generalized spacing, increased overjet and overbite, and Class II molar relationship.

3A – 3B: Open mouth

Good contour and shape of the dental arches, and generalized spacing in the upper arch.



4A – 4B – 4C: Cephalometric and panoramic x-rays, cephalometric tracing

The cephalogram and the cephalometric measurements show an increased inclination of the upper incisors. The panoramic x-ray shows the chronology of a normal eruption with a very accentuated curve of Spee.

5A – 5B – 5C: Models, frontal, lateral – right and left

Class II molar relationship with an increased inclination of the upper incisors.

6A – 6B: Models – open mouth

There is no crowding in the incisors area and sufficient space for the eruption of the premolars and cuspids.

7A – 7B: Models, curve of Spee – right and left sides

Very accentuated curve of Spee in both sides.

8A – 8B: Frontal and profile

Intermediate frontal shots

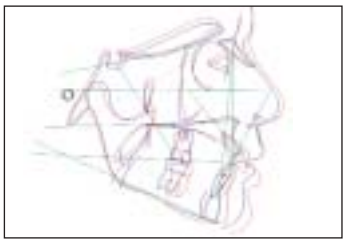
Good facial harmony, Class I pattern profile, good lip seal.

9A – 9B – 9C: Buccal, frontal, lateral – right and left

Final stage of the interceptive treatment (Orthopedics). The case now presents with a good anteroposterior molar relationship, overbite and curve of Spee.

10A – 10B: Open mouth

Final shots after the interceptive treatment (Orthopedics). Generalized spacing in the upper arch and rotations of the lower premolars.



11A – 11B – 11C: Cephalogram, intermediate tracing, and superimposition

Intermediate x-ray with the cephalometric tracing and the superimposition, showing a good result of the first stage of the orthopedic treatment.

12A – 12B – 12C: Buccal, frontal and lateral – right and left

SmartClip™ appliance placed on both upper and lower arches. A lingual clip has been fitted in order to provide an initial de-rotation of the lower second premolars.

13A – 13B – 13C: Buccal, frontal and lateral – right and left

.014" Nitinol arch wire at the beginning of the aligning stage of treatment. Elastics have been used in order to commence the de-rotation of the lower second premolars.

14A – 14B: Open mouth

Occlusal view with a .014" Nitinol arch wires in the initial of the aligning stage, with elastics between the lower second premolars and the first molars to allow the de-rotation of the premolar teeth.

15A – 15B – 15C: Buccal, frontal and lateral – right and left

.018" stainless steel round arch wire engaged on the leveling stage of treatment. Buccal mini tubes have been bonded on the lower second molars to help the correction of the curve of Spee.

16A – 16B: Open mouth

Occlusal view at the end of the leveling stage of treatment with .018" stainless steel round arch wire, mini tubes bonded on the lower second molars and distal bend.

17A – 17B – 17C: Buccal, frontal and lateral – right and left

.019"x.025" stainless steel rectangular arch wire with prewelded hooks to the mesial of cuspids, passive lace-backs/tiebacks bonded tubes on the upper second molars.

18A – 18B – 18C: Open mouth and panoramic x-ray

Occlusal view of the upper and lower arches, .019"x.025" stainless steel rectangular arch wire, observing the arch form and the alignment of teeth. The panoramic x-ray shows the parallelism of roots of all teeth.

19A – 19B – 19C: Buccal, frontal and lateral final shots

Final stage of treatment with a .019"x.025" braided arch wires in both upper and lower arches when detailing the occlusion. Second molar tubes have been removed.

20A – 20B – 20C: Open mouth and anterior guidance

Occlusal view showing the shape of the arch and the alignment of teeth. Photo 20C shows the anterior guidance achieved at the end of the orthodontic treatment.

21A – 21B – 21C: Buccal, frontal and lateral final shots

Anterior disclusion by the incisor teeth, with a good interocclusal posterior space in the molar and premolar area.

22A – 22B – 22C: Buccal, frontal and lateral final shots

Lateroprotrusive disclusion by cuspid guidance (mutually protected occlusion), showing a good interocclusal space in both the working and non-working sides.

23A – 23B – 23C: Buccal, frontal and lateral final shots

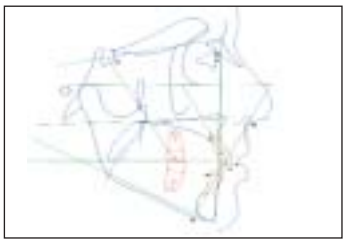
Disclusion in a left lateroprotrusion by cuspid guidance (mutually protected occlusion), a good interocclusion space in both working and non-working sides.

24A – 24B – 24C: Buccal, frontal and lateral final shots

End of treatment, showing a good intercuspation of teeth, a good overjet, overbite and midline.

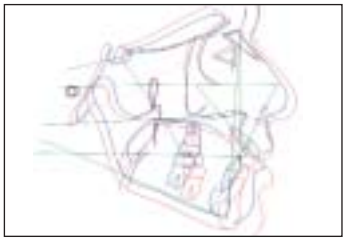
25A – 25B – 25C: Open mouth and anterior guidance

Occlusal view illustrating the shape of the dental arch and the alignment of teeth. Photo 25C shows the anterior guidance achieved at the end of the orthodontic treatment.



26A – 26B – 26C: Cephalometric and panoramic x-rays, final cephalometric tracing.

The cephalogram and the cephalometric measurements show a good torque control of the lower incisors at the end of treatment. The panoramic x-ray shows the parallelism of the roots.



27: Superimposition of the cephalometric tracings

Superimposition of the initial and the final cephalometric tracings, presenting good growth control and a good torque control of the lower incisors.

28A – 28B – 28C: Frontal, profile, and smile

End of treatment with a good frontal facial harmony, good profile and a good smile line.

Case Presentation:
Class I with bicuspid extraction
Treatment time: 19 months

Patient: N. C.

Sex: Female

Age: 11 years and 10 months

Facial pattern: Dolichofacial

Skeletal pattern: Class I

Dental malocclusion:

Class I malocclusion with severe crowding in the upper and lower arches. There was a cross bite of tooth 12 (upper right lateral incisor).

Diagnosis and treatment plan:

Treatment was carried out in two stages:

1. Initially, a removable appliance was used to correct the cross bite on tooth 12 (right lateral incisor). A palatal bar was placed in the upper arch, and a lingual arch was placed in the lower arch in order to carry out serial extraction of the deciduous teeth and the first bicuspids.

2. Subsequently, comprehensive orthodontic treatment was initiated using fixed appliance in the upper and lower arches.

Appliance:

Palatal bar in the upper arch
Lingual arch in the lower arch
SmartClip™ Self-Ligating Appliance
Hawley retainer in the upper arch
3 x 3 Fixed retainer in the lower arch

Case report:

The patient presented a very accentuated dental discrepancy in the mix dentition. Serial extractions of the deciduous teeth and of the upper and lower first premolars were performed in order to enable the eruption of all teeth. To keep the anchorage of molars, a palatal bar and a lingual arch were used in the extraction stage until the end of the leveling stage of the orthodontic corrective treatment.

.014" and .016" Nitinol round wires were used at the beginning of treatment, and .018" and .020" stainless steel round wires were used at the leveling stage. Stainless steel .019"x.025" arch wires with prewelded hooks to the mesial of cuspids were used during the space closure biomechanics, and .019"x.025" rectangular braided archwires were used at the finishing stage of treatment.

Initial

SNA	∠	81º
SNB	∠	73º
ANB	∠	08º
ANF-H	⊥	5 mm
PN-FH	⊥	-5 mm
Wits		8 mm
GoGn.SN		43º
FH.MD	∠	30º
Mx.Md	∠	31º
1-AP		09 mm
1-AP		02 mm
1.Pl.Mx	∠	111º
1.Pl.Md	∠	85º

Facial Analysis

Nasolabial	∠	124º
NA ⊥ Nose		25 mm
Lip thickness		06 mm

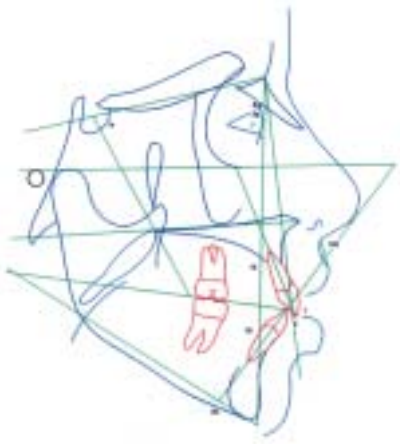
Cephalometric tracing related to Fig. 3-C

Intermediate

SNA	∠	83º
SNB	∠	76º
ANB	∠	07º
ANF-H	⊥	6 mm
PN-FH	⊥	-2 mm
Wits		2 mm
GoGn.SN		44º
FH.MD	∠	33º
Mx.Md	∠	36º
1-AP		08 mm
1-AP		05 mm
1.Pl.Mx	∠	108º
1.Pl.Md	∠	94º

Facial Analysis

Nasolabial	∠	105º
NA ⊥ Nose		29 mm
Lip thickness		09 mm



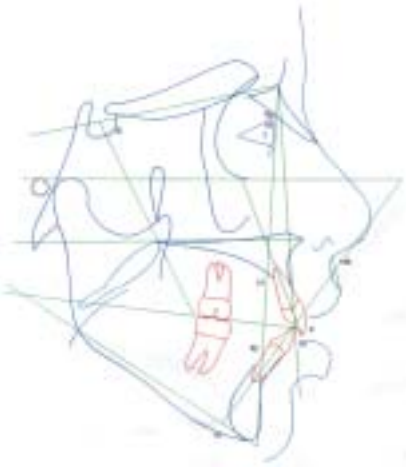
Cephalometric tracing related to Fig. 29-B

Final

SNA	∠	82º
SNB	∠	75º
ANB	∠	07º
ANF-H	⊥	5 mm
PN-FH	⊥	-5 mm
Wits		4 mm
GoGn.SN		43º
FH.MD	∠	33º
Mx.Md	∠	34º
1-AP		09 mm
1-AP		05 mm
1.Pl.Mx	∠	111º
1.Pl.Md	∠	92º

Facial Analysis

Nasolabial	∠	105º
NA ⊥ Nose		29mm
Lip thickness		11mm



Cephalometric tracing related to Fig. 33-C

1A – 1B: Frontal and profile

Facial symmetry, good facial profile and a good lip.

2A – 2B – 2C: Buccal, frontal, lateral – right and left

Mixed dentition showing a cross bite of the upper right lateral incisor (tooth 12), lack of space for the permanent cuspids, with a very discrete Class II in the right side.

3A – 3B – 3C: Cephalometric and panoramic x-rays, cephalometric tracing

The cephalogram and the cephalometric measurements show the patient with a high angle and the incisors in a good position. The panoramic x-ray shows a normal chronology of eruption with severe crowding.

4A – 4B – 4C: Models, frontal, lateral – right and left

Class I molar relationship with cross bite of the upper right lateral incisor.

5A – 5B: Models – open mouth

Severe crowding with a lack of space for the permanent cuspids.

6A – 6B: Model, curve of Spee – right and left sides

Very discrete curve of Spee in both sides.

7A – 7B – 7C: Frontal, profile and panoramic x-ray

Intermediary frontal shot, presenting good facial harmony, Class II with a good lip seal. Panoramic x-ray showing the chronology of normal eruption before the extraction of the first premolars.

8A – 8B – 8C: Buccal, frontal, lateral – right and left

Stage of treatment after the serial extraction in the final stage of the eruption of all teeth. The case presents a good molar relationship.

9A – 9B: Open mouth

Final shots after the serial extraction. Palatal bar in the upper arch and lingual arch in the lower arch, with space after the extraction of the premolars.

10A – 10B – 10C: Buccal, frontal, lateral - right and left

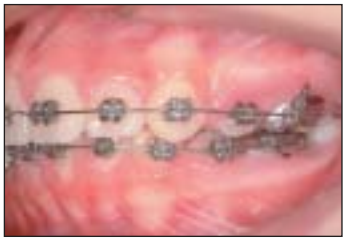
SmartClip™ appliance with a partial set-up in both the upper and lower arches. Beginning of the aligning stage with a .014" Nitinol archwire.

11A – 11B: Open mouth

Occlusal view with a .014" Nitinol archwire at the beginning of the aligning stage. The palatal bar and the lingual arch were used until the end of the aligning stage to preserve anchorage.

12A – 12B – 12C: Buccal, frontal, lateral – right and left

.016" Nitinol round archwire at the end of the aligning stage with brackets set on the cuspid teeth.



13A – 13B: Open mouth

Occlusal view at the leveling stage with .016" round arch wire. The lingual arch has been removed and the palatal bar kept.

14A – 14B – 14C: Buccal, frontal, lateral – right and left

.020" stainless steel round archwire in the upper arch and .018" round Nitinol archwire in the lower arch, with bonded tubes on the second molars at the beginning of the leveling stage.

15A – 15B – 15C: Open mouth

Occlusal view of the upper and lower arches, with .020" stainless steel round archwire in the upper arch and .018" Nitinol archwire in the lower arch up to the second molars.

16A – 16B – 16C: Buccal, frontal, lateral – right and left

.019"x.025" stainless steel rectangular archwire with prewelded hooks to the mesial of cuspids, upper and lower lace-backs/tiebacks.

17A – 17B: Open mouth

Occlusal view of the upper and lower arches, .019"x.025" rectangular archwire, closure of the remaining spaces established by the extraction of the first premolars.

18A – 18B – 18C: Buccal, frontal, lateral – right and left

.019"x.025" stainless steel rectangular arch wire with prewelded hooks to the mesial of the cuspid. Space closure of the remaining spaces established by extractions, and Class II elastics biomechanics in both sides.

19A – 19B – 19C: Buccal, frontal, lateral – right and left

.019"x.025" stainless steel rectangular archwire with prewelded hooks to the mesial of cuspids, passive lace-backs in both arches after space closure. Tubes were bonded on the upper second molars.

20A – 20B – 20C: Open mouth and panoramic x-ray

Occlusal view showing the shape of the archwire, as well as the alignment of teeth with a .019"x.025" stainless steel rectangular archwire. Photo 20C shows the panoramic x-ray, the shape of the dilacerated roots, and the parallelism between them.

21A – 21B – 21C: Buccal, frontal, and lateral final shots

Final stage of treatment with .019"x.025" braided archwire in the upper and lower arches. Final stage of detailing the occlusion.

22A – 22B – 22C: Buccal, frontal, and lateral final shots

Final stage of treatment with .019"x.025" braided arch wire in the upper and lower arches. Intercuspation elastics on the molars.

23A – 23B – 23C: Buccal, frontal and lateral final shots

Frontal view after the use of the elastics to improve the intercuspation and .019"x.025" braided archwire.

24A – 24B – 24C: Open mouth, anterior guidance

Occlusal view showing the shape of the dental arches and the aligning of teeth. Photo 24C shows the anterior guidance achieved at the end of the orthodontic treatment.

25A – 25B – 25C: Buccal, frontal and lateral final shots

Anterior disclusion by the incisor teeth with a good posterior interocclusal space in the molars and premolars area.

26A – 26B – 26C: Buccal, frontal and lateral final shots

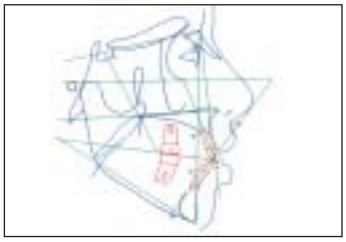
Lateroprotrusive disclusion on the right side by cuspid guidance (mutually protected occlusion). A good interocclusal space on both the working and non-working sides.

27A – 27B – 27C: Buccal, frontal and lateral final shots

Lateroprotrusive disclusion on the left by cuspid guidance (mutually protected occlusion). A good interocclusal space on both the working and non-working sides.

28A – 28B – 28C: Buccal, frontal, and lateral final shots

Maximum intercuspation after upper appliance removal.

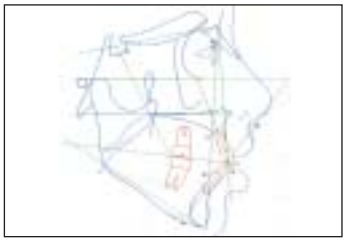


29A – 29B: Intermediate x-ray and cephalometric tracing

30A – 30B – 30C: Buccal, frontal and lateral final shots after appliance removal

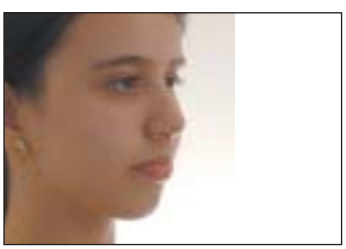
31A – 31B: Open mouth – upper and lower dental arches – final shots

32A – 32B: End of orthodontic treatment – anterior guidance and overbite



33A – 33B – 33C: Cephalogram, panoramic x-ray and cephalometric tracing at the end of treatment

34A – 34B: Frontal and profile shots at the end of treatment



35A – 35B: Lateral and smile final shots

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