Case Report

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Bidimensional system for space closure treatment of missing lateral incisors: 10 years follow-up

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Abstract:

INTRODUCTION: Missing lateral incisors represent a common condition that normally requires specific anchorage conditions to be treated with space closure mechanics to protract upper teeth creating a proper occlusal relationship.

CASE PRESENTATION: Two cases showing Class II malocclusion with missing lateral incisors in developing age are presented, both treated with the same approach of maximum anterior anchorage applied using the Bidimensional Technique system. Long-term follow-up of 10 years is shown.

MANAGEMENT AND OUTCOME: Bidimensional technique is a modified edgewise technique that uses sliding mechanics for protraction of the posterior segments by placing vertically slotted brackets of different sizes on the anterior (.018" x 0.025") and posterior teeth (.022" x 0.028"). When a .018" x .022" wire is inserted in the .018" x .025" brackets slot on the incisors, third-order control is created in the incisor segment while the wire is undersized in the rest of the arch. Lateral brackets have been positioned on the canines, while the canine brackets have been positioned on the first premolars respecting a differential bonding height able to produce canine extrusion and first premolars intrusion and proper torque expression. Full Class II molar relationship and Class I substituted canine relationship has been reached in both cases and kept stable in the long-term follow-up (10 years).

DISCUSSION: The described approach provided anterior anchorage with more simple mechanics expressing the anterior torque with a full engagement concept and adding few auxiliaries (uprighting springs) which do not require compliance.

Keywords:

Anterior anchorage, biomechanics, missing laterals

Introduction

Agenesis of teeth is an anomaly characterized by the absence of one or more dental elements in the arch. This condition can be determined by the alteration of one or more of the 200 genes involved in the mechanisms of odontogenesis[1] and it seems that the mutation of gene 9 (PAX9) is the most frequent in cases of non-syndromic agenesis.[2,3] Dental agenesis affects about 20% of the world's population and in particular, agenesis of the maxillary lateral incisors is the most frequent after third molar agenesis. The incidence can vary from 1.5% to 5% in different populations[4] and it can be unilateral or bilateral. Generally, in cases of unilateral agenesis, very often (38.8% of the cases) the opposite lateral incisors may be microdontic,[5,6] while for sure all teeth in agenesis patients present a narrower dimension.[7]

There are two common options of orthodontic treatment widely discussed in the literature:

- Space Opening for implant insertion with subsequent prosthetic rehabilitation (implant, bridge, mobile fixed prosthetic restorations);

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- Space Closure of all posterior teeth in a more mesial position.

The orthodontic space closure with upper jaw protraction became popular[8] in recent years to avoid prosthodontic solution and treating adolescents in one phase. The indications in literature[9,10] are clearly described to create ideal front teeth camouflage positioning respecting gingival leveling of the six anterior teeth, proper build-ups, differential torque of canines and first premolars, differential tipping, and functional guidance. One fundamental aspect of this approach is represented by the ideal space closure biomechanics to be used in missing laterals treatments, that should be able to achieve safely anterior anchorage while protracting all teeth in the upper jaw. For this reason, the Bidimensional Technique[11] system proposed and used in this clinical report is an ideal conventional biomechanical system for space closure in case of missing laterals to achieve long-term stability. As described in previous articles,[12,13] the Bidimensional Technique is a modified edgewise technique that uses sliding mechanics for protraction of the posterior segments by placing vertically slotted brackets of different sizes on the anterior (.018″ x 0.025″) and posterior teeth (.022″ x. 028″). When a 0.018″ x .022″ wire is inserted in the .018″ x .025″ brackets slot on the incisors, third-order control is created in the incisor segment while the wire is undersized in the rest of the arch. When anterior anchorage is required, an .018″ x .022″ SS wire with 10-15 degrees of buccal crown torque on the incisors is inserted together with an accentuated curve of Spee in the upper arch. In addition, uprighting springs which exert approximately 200 g of force, are placed in the vertical slots of the canine or first premolars brackets, directing the crowns of these teeth mesially and creating anterior anchorage while Class I forces (elastic chain) are used for protraction of all teeth. To apply this approach to missing laterals patients, lateral brackets have been positioned directly on canines, while canine brackets have been positioned on first premolars respecting a differential bonding height able to produce canine extrusion and first premolars intrusion and proper torque expression. When the upper canine is in contact with central incisors, the anterior anchorage system is applied to utilize a full slot engagement with .018 x .022 SS archwire inserted with 15° of lingual root torque and accentuated curve of Spee, uprighting spring in the vertical slots of canines, hooks crimped on the wire mesial to first premolars and elastic chain from the hooks to the molars. To reinforce anchorage, Class III elastics used at nighttime are commonly prescribed.

Case 1

Diagnosis and etiology

A 15-year-old male presented upper and lower incisors protrusion (U1/121° - L1 104°), Class II skeletal with small mandible and pronounced chin, mild Class II dental malocclusion with hyperdivergent skeletal pattern (38° Sn/GoGn), mild crowding in the lower arch and upper spacing because of missing lateral incisors. The smile was unpleasant due to agenesis spacing and irregular gingival contour with a gummy smile, the vertical incisors exposure (smile arc) was correct while irregular canines distal tipping could be noticed because of previous orthodontics treatment for space opening. The lateral profile showed a normal nasolabial angle with reduced chin projection and protruded anterior limit of dentition. The patient was previously treated to open spaces for implant in the area of 1.2 and 2.2. No sign or symptoms of TMJ problems and no limitations in mandibular movements were detected [Figure 1].

Treatment objectives

The treatment plan was focused on anterior space closure through 1/3 of incisors retraction and 2/3 of mesial sliding of posterior teeth. The project aimed to close all the gaps in the upper positioning of the canines in laterals position and first premolars in canines position. To this purpose, specific differential bonding has been used. After alignment and leveling phases (.014 NiTi wire and 0.018 x 0.018 NiTi wire), and partially space closure for anterior retraction [Figure 2], the remaining space closure by the mesial movement of lateral and posterior teeth has been achieved utilizing the Bidimensional System following the stages previously described [Figure 3]:

- .018 x 0.022 SS wire with 15° of lingual root torque and accentuated curve of Spee;
- Uprighting spring in the vertical slot of canine brackets;
- Hooks crimped on the wire mesial to first premolars;
- Elastic chains from hooks to maxillary premolars and molars.
- Class III intermaxillary elastics worn night-time.

Treatment alternatives

Initial space opening treatment for an implant on 1.2 and 2.2 area have been considered but because of the proclination of the upper incisors and because of the collapsed bone in the area of the missing laterals requiring extensive grafting, extraction of first premolars was suggested. The patient refused this option to avoid extractions and future implants. One alternative solution to mesialize the posterior sectors could be represented by the us of TADs for anterior anchorage.

Treatment progress

When full space closure has been achieved a finishing wire (.016 x 0.022 SS) has been used to finalize upper canines and first premolars torque and gingival margins leveling [Figure 4]. Full Class II molar relationship and Class I “canines” relationship with proper OVB and OVJ and in particular with regular smile arc exposure

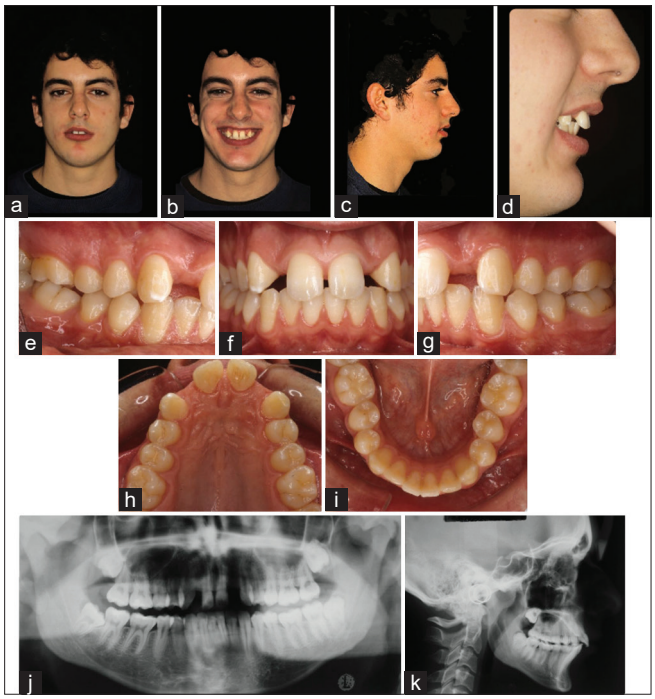

Figure 1: a-k. Pre-treatment records

Figure 3: a-c. Phase 3 finishing phase with 0.016 x 0.022 SS archwire and intermaxillary vertical elastics

has been reached in around 24 months [Figure 4]. The facial analysis showed a slight improvement in chin projection and a more balanced position between upper incisors and maxillary bone. The lateral X-ray general superimposition showed the amount of upper and lower incisors retraction (6° in the upper and 8° in the lower) due to upper space closure and IPR in the lower and a favorable counterclockwise rotation of the mandible (1° reduction of SN-GoGn) [Table 1] due to space closure with posterior maxillary molars mesial movement [Figure 5]. The upper canines have been subjected to reductive and additive plastic and bleaching, as well as direct additive plastic has been planned for first premolars with direct composite restorations. At 2 years out of retention stage, the occlusion was still stable with normal periodontal conditions and reduced need for restorative modifications on 2.4 and some minor relapse in the lower jaw. Natural settling of the posterior occlusion can be noticed while third molars were extracted at this time [Figure 6]. At 10 years control out of retention still stable full Class II molar relationship and Class I "canines" relationship is maintained with some criticism only related to periodontal conditions

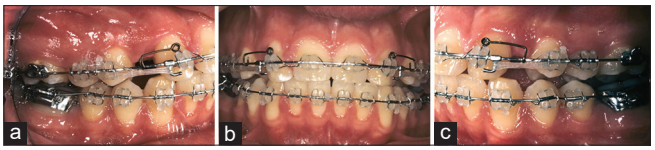

Figure 2: a-c. Phase 2, maximum anchorage bidimensional system in place; with hooks crimped distal to canines, uprighting springs on canines and full engaged 0.018 x 0.022 SS wired with elastic module from premolars and molars to crimped arch hooks

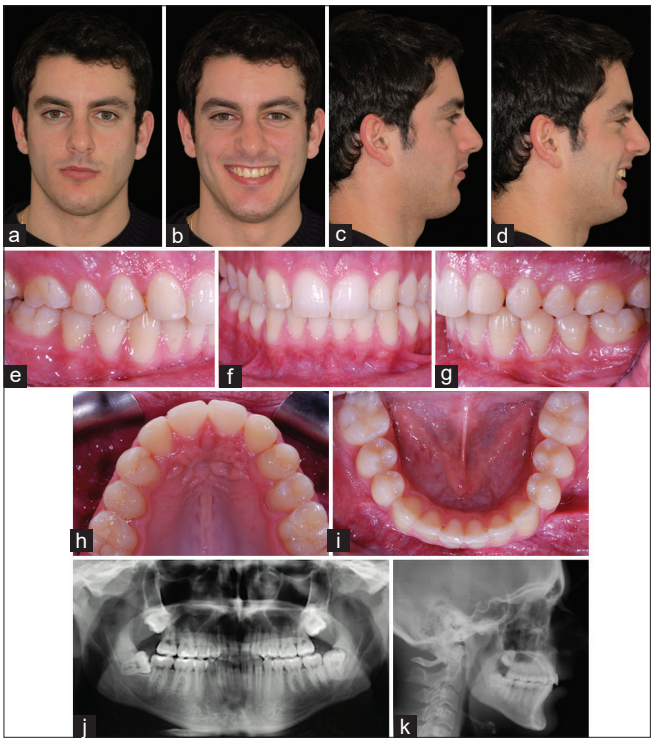

Figure 4: a-k. Post-treatment records

mostly independent to orthodontic treatment and some evident need for additive restorative on premolars. Only some criticism about torque of 1.3 can be noticed. The facial analysis showed normal aging processes with stable torque and lip support and proper smile exposure [Figure 7].

Case 2

Diagnosis and etiology

A 14-year-old female patient presented with retruded upper incisors inclination (U1 103°) and normal lower incisors inclination (L1 92°), Class I skeletal and Class II subdivision dental malocclusion with normal divergent skeletal pattern (33° Sn/GoGn), light crowding in the lower arch and upper diastema due to missing lateral incisors. Upper canines fully erupted in the space of lateral incisors, deviated midline since the patient showed full Class II molar relationship on the right side and edge to edge relationship on the left side. The upper incisors showed excessive vertical

Table 1: Pre-Post-Treatment cephalometric analysis case 1

Cephalometric morphological assessment	Mean±SD	Pre-treatment	Post-treatment
Sagittal skeletal relations			
Maxillary position s-n-a	82°±3.5	76°	76°
Mandibular position s-n-pg	80°±3.5	74°	74°
Sagittal jaw relation a-n-pg	2°±2.5	2°	2°
Vertical skeletal relations			
Maxillary inclination s-n/ans-pns	8°±3.0	10°	8°
Mandibular inclination s-n/go-gn	33°±2.5	38°	37°
Vertical jaw relation ans-pns/go-gn	25°±6.0	28°	29°
Dento-basal relations			
Maxillary incisor inclination 1/ans-pns	110°±6.0	121°	115°
Mandibular incisor inclination 1/go-gn	94±7.0	104°	96°
Mandibular incisor compensation 1/a-pg (mm)	2±2.0	3	2
Dental relations			
Overjet (mm)	3.5±2.5	6	2
Overbite (mm)	2±2.5	3	2
Interincisal angle 1/1	132°±6.0	108°	121°

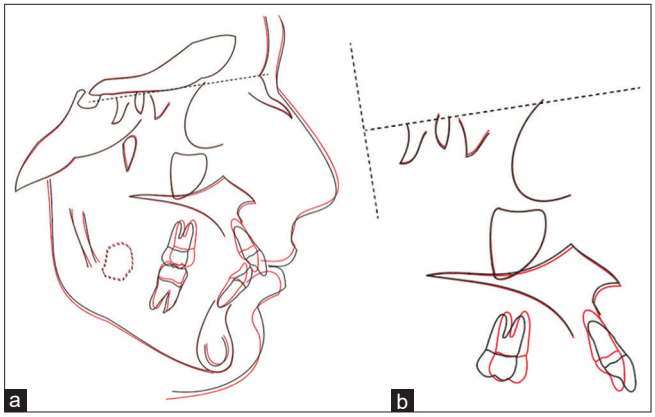

Figure 5: a and b. General and maxillary superimposition showing slight anterior retraction and molar mesialization

inclination (103° 1/Ans-Pns). The facial analysis revealed a straight profile with a reduced nasolabial angle. The smile arc was correct even though the upper canines approximated the upper centrals resulting in an unpleasant smile. No signs or symptoms of TMJ problems and no limitations in mandibular movements were detected [Figure 8].

Treatment objectives

Since no space was available, the treatment plan was focused on shifting mesially the upper left arch to move the midline to the right by means of incisors proclination and then torque expression for anterior anchorage. The project aimed, only after centering the midlines, to close all the remaining gaps in the upper by asymmetric mesial space closure applying the same Bidimensional Biomechanical System and the same bonding procedure [Figure 9]. The stages previously described were still the same:

- .018 x 0.022 SS wire with 15° of lingual root torque and accentuated curve of Spee;

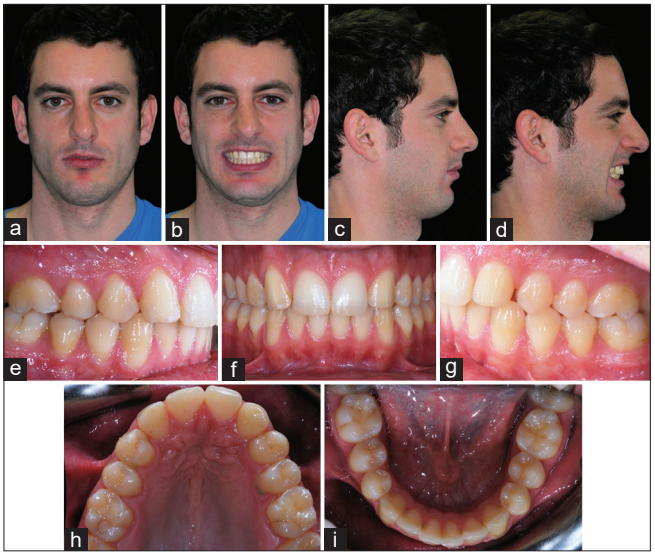

Figure 6: a-i. Two years follow up out of retention

- Asymmetric uprighting spring in the vertical slot of first premolar bracket;
- Hook crimped on the wire distal to the left canine;
- Elastic chains from the hooks to maxillary premolars and molars on the left side.
- Class III intermaxillary unilateral elastic worn night-time only on the left side.

Treatment alternatives

The initial option was to open space for implant insertion in laterals position balancing the upper incisors inclination. But because of the complete space closure and in particular because of the full class II molar relationship on right side, the mesialization option on the left side was preferred.

Treatment progress

After reaching complete space closure a finishing

Figure 7: a-h. Ten years follow up out of retention

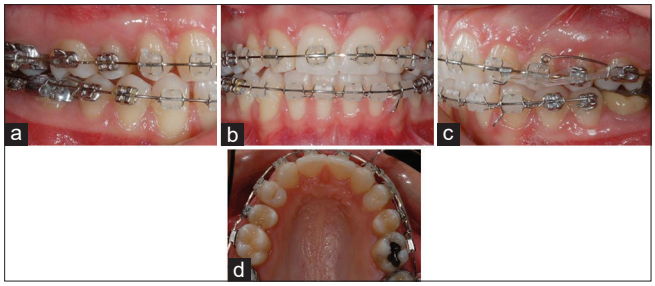

Figure 9: a-d. Asymmetric maximum anchorage bidimensional system in place; with hooks crimped distal to premolars, uprighting springs on premolars and full engaged 0.018 x 0.022 SS wire with elastic module from molars to arch crimped hook

wire (.016 x 0.022 SS) has been used to finalize upper canines and first premolars torque and gingival margins leveling [Figure 10]. Full Class II molar relationship and Class I "canines" relationship with proper OVB and OVJ has been achieved in 26 months. Facial analysis revealed a slight improvement in nasolabial angle due to upper proclination with a more balanced smile [Figure 11]. General superimposition showed a significant change in upper incisors' proclination associated with corresponding incisors proclination (4° in the upper and 4° in the lower) to keep the proper overjet. On the maxillary superimposition interesting asymmetric molar mesial movement can be noticed without affecting negatively incisors torque. A favorable clockwise control of the mandible (1° increase of SN-GoGn) [Table 2] occurred during treatment due to extrusion of the posterior sectors [Figure 12]. The upper canines have been subjected to reductive and additive plastic and bleaching, as well as direct additive plastic has been planned for first premolars with direct composite restorations. At 2 years out of the retention stage, the occlusion was still stable with natural periodontal conditions and stable alignment, third molars have been

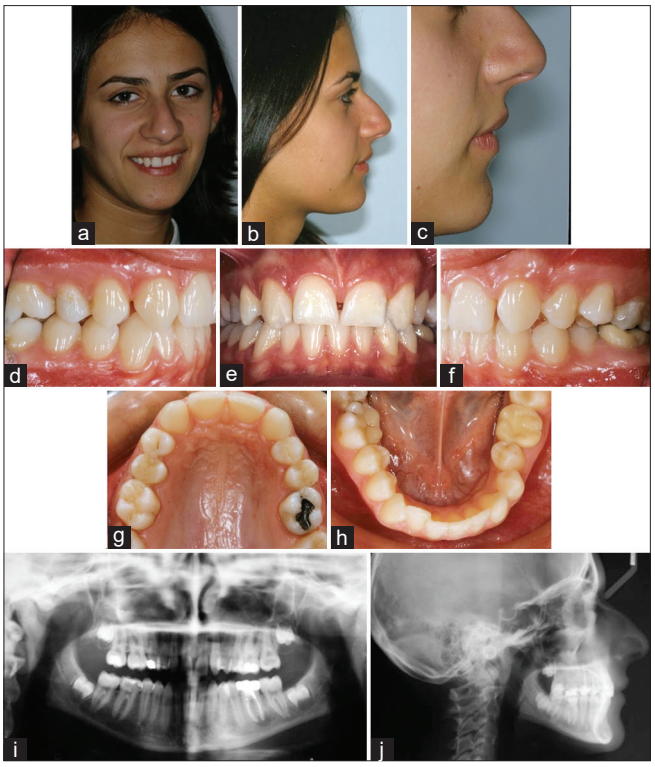

Figure 8: a-j Pre-treatment records

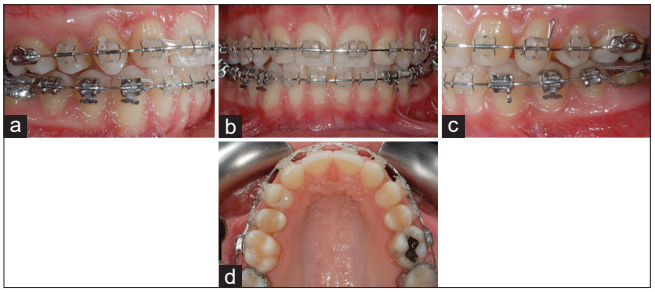

Figure 10: a-d. Finishing phase with 0.016 x 0.022 SS archwire and intermaxillary vertical elastics

extracted at this time [Figure 13]. The 10 years control out of retention showed a still stable full Class II molar relationship and Class I "canines" relationship with some criticism only related to wearing of premolars restoration that needed to be renewed and some relapse of lower incisors position [Figure 14].

Treatment results

Space closure of missing lateral incisors was achieved in a normal range time of more or less 24 months for both patients respecting the posterior occlusion of Class II full molar relationship and Class I canine (first premolar restored) relationship. To achieve this result in the first case partial retraction of upper incisors occurred to reduce overjet while the rest of proper occlusion was obtained by means of mesial drifting of molars with anterior anchorage configuration. In the second case since the malocclusion was a Class II subdivision (Type 1)

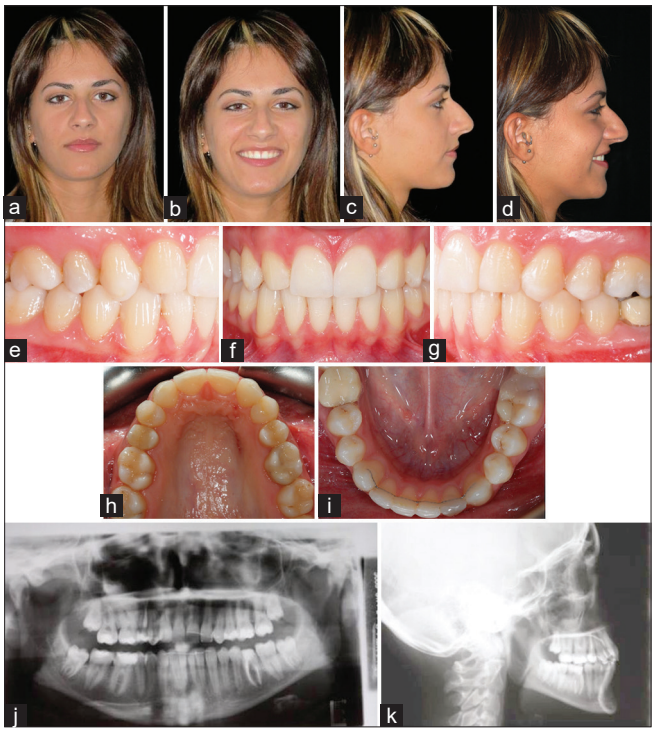

Figure 11: a-k Post-treatment records

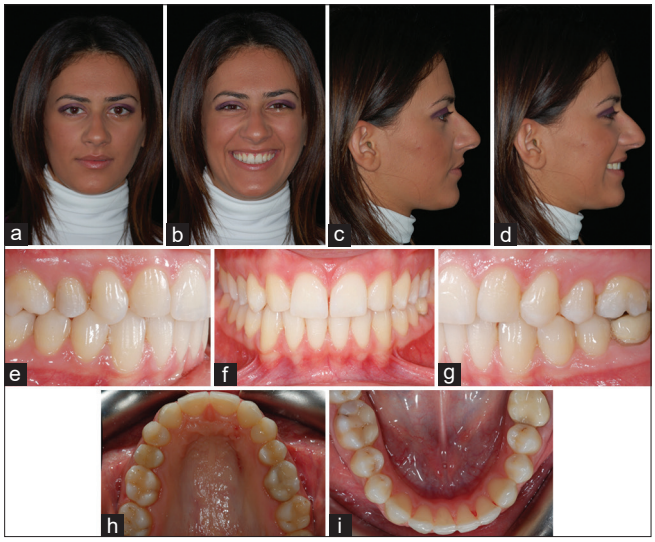

Figure 13: a-i. Two years follow up out of retention

with normal overjet, the initial stage was focused on upper incisors proclination to center the midline and only after with a maximum anterior anchorage configuration (torque on the archwire, full engagement, uprighting spring) left molars were protracted to reach full Class II molar relationship. Canine extrusion with reshaping and premolars intrusion were planned for ideal gingival contour in both situations.

Discussion

Since anterior anchorage represents the key point

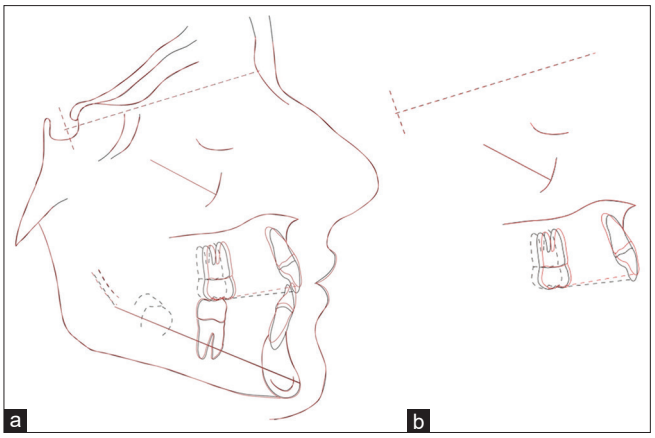

Figure 12: a and b. General superimposition showing asymmetric molar mesial movement and anterior torque maintenance

Figure 14: a-h. Ten years follow out of retention

in the treatment of space closure in case of missing laterals, several authors[14,15] recently proposed a skeletal anchorage solution to manage without risks the anterior teeth inclination while moving lateral and posterior segment mesially. Of course, skeletal anchorage could be considered the elective choice for absolute anchorage, the system described is limited to a conventional approach, even though the use of palatal screws require a precise skill, two surgical phases, wide device extension on the palate, specific lab, and high cost. The described approach allows managing the anterior anchorage with more simple mechanics expressing the anterior torque with a full engagement concept and adding few auxiliaries (uprighting springs) which do not require compliance. Moreover, the concept of the Bidimensional Technique described by Gianelly combines the full engagement of archwires (.018 x 0.022 SS) in the anterior teeth brackets (.018 x 0.025 slot) together with low friction and easy sliding in the posterior teeth

Table 2: Pre-Post-Treatment cephalometric analysis case 2

Cephalometric Morphological assessment	Mean±SD	Pre-treatment	Post treatment
Sagittal skeletal relations			
Maxillary position s-n-a	82°±3.5	83°	83°
Mandibular position s-n-pg	80°±3.5	81°	82°
Sagittal jaw relation a-n-pg	2°±2.5	2°	1°
Vertical skeletal relations			
Maxillary inclination s-n/ans-pns	8°±3.0	9°	9°
Mandibular inclination s-n/go-gn	33°±2.5	32°	33°
Vertical jaw relation ans-pns/go-gn	25°±6.0	23°	24°
Dento-basal relations			
Maxillary incisor inclination 1/ans-pns	110°±6.0	103°	107°
Mandibular incisor inclination 1/go-gn	94±7.0	92°	96°
Mandibular incisor compensation 1/a-pg (mm)	2±2.0	0	2
Dental relations			
Overjet (mm)	3.5±2.5	1	2
Overbite (mm)	2±2.5	4	2
Interincisal angle 1/1	132°±6.0	139°	124°

since the wire is .018 x .022 inside a slot of .022 x .028. This biomechanical approach leads easily to keep the incisors position stable while moving forward all upper teeth as showed in the clinical report, and above all the position is kept stable during years in long term control at 2 years out of retention as well as 10 years out of retention. At follow-up, normal wearing of teeth and some periodontal issues can be noticed on upper canines but both incisors' inclination and posterior intercuspation are stable and with normal function and proper new canine (first premolars) guidance during mandibular movements confirming data in literature.[16] The space closure option described can be considered more reliable in the long term when compared to the space opening option, since the need for bone grafting is really high to allow the proper implant insertion and in some case implants should be placed in more palatal area with consequent change in inclination of the prosthetic solution. Moreover, the soft tissues aging around implants in the frontal area can create unwanted unnatural esthetic effects on smile.[17,18]

Conclusion

In case of missing laterals, the biomechanical system could represent an alternative conventional treatment option providing sufficient reliability in the management of anterior anchorage and torque expression while protracting all upper teeth.

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Nil.

Conflicts of interest
There are no conflicts of interest.

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