clinical TIPS

A Simplified Method for Crimping Double-Back Bends

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Abstract

Many orthodontic appliances such as the Quad Helix, Transpalatal arch, Pendulum and Nance appliance utilize double-back bends that are inserted in lingual sheaths typically bonded to, or welded on, banded posterior teeth. These bends are advantageous because of ease of removal and reinsertion of the appliance for modification or activation without the need for debanding and recementation, and because there is no need to drop to a softer wire after appliance modification.

Some problems encountered when making a double-back bend include poor adaptation of the wire sections preventing passive insertion into the lingual sheaths, a weakened joint due to multiple attempts to approximate the two sections, and hand injury due to slippage of the wire during this tedious procedure. The modified pliers developed by Hashir requires permanent welding or soldering of a 19-gauge stainless steel wire to a utility plier[1].

Thus we propose a new, simplified approach to making a double-back bend with ease and precision.

Keywords
double back bend, lingual sheath, goshgarian sheath, TPA

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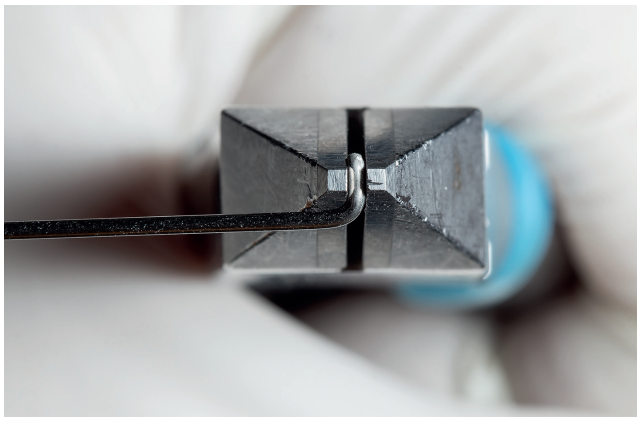
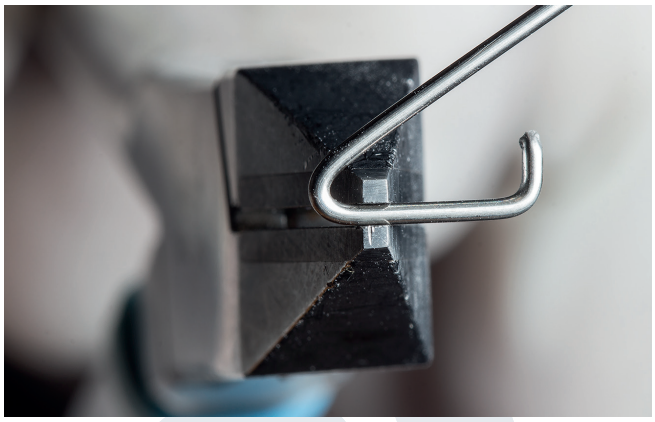
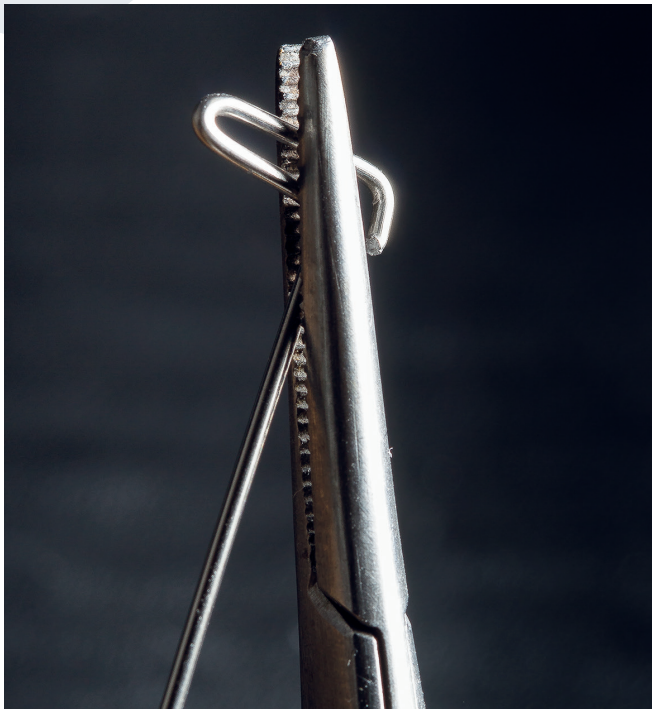
PROCEDURE

1 A 0.036” wire is roughly bent into a double-back bend.





2 All three sections of the wire are all held securely with a mosquito forceps and locked firmly.



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3 An Adams plier is used to grasp as much as possible of the wire sections and pressed down.

4 A well-adapted double-back bend is seen.

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CLINICAL ARTICLE

Modified Palatine Arch: An Option for Traction of Impacted Maxillary Central Incisors in the Presence of Odontomas

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Abstract

A new appliance for applying traction to impacted teeth is described. The appliance is supported on rings fitted to the maxillary first molars (16 and 26) and extends to the anterior region, where lingual tubes are fixed, supporting the molars which will traction the impacted teeth. In the present case, the maxillary central incisors were disimpacted and mixed occlusion, normal for the age of the patient, was re-established.

Keywords
Odontoma, tooth, unerupted, orthodontics, corrective

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INTRODUCTION

Impaction of a permanent tooth is uncommon in mixed dentition. An impacted central incisor is usually diagnosed when the tooth fails to erupt[1]. Although the maxillary canine is the most frequently impacted anterior tooth, impaction of the maxillary central incisor poses a problem at an earlier age[2]. This tooth usually erupts several years before the canine, when the child is between 8 and 10 years of age, and its impaction is more obvious to parents[3–5].

Impaction of the maxillary central incisors may be due to the presence of supernumerary teeth, odontomas or trauma[4]. Odontoma is the most common type of odontogenic tumour[1–3], representing up to 70% of all such lesions[2,4,5]. However, some authors consider odontogenic tumours to be developmental malformations (hamartomas), in which all dental tissues are represented, and which are caused by a series of factors[6–8].

Treatment for tooth impaction due to the presence of odontomas consists of the removal of the odontoma, followed by orthodontic traction of the impacted teeth. There are various ways to disimpact impacted teeth using mobile or fixed appliances. The authors describe a new method consisting of the fabrication and use of an appliance to traction impacted teeth in the presence of odontoma. Use of this appliance resulted in dental traction with easy biomechanics and without aesthetic compromise.

CLINICAL CASE

The patient arrived at the orthodontic dental office, accompanied by his guardian, having been referred by his paediatric dentist with the complaint that his maxillary permanent central incisors had not erupted.

The patient had satisfactory oral and general health. He was at the stage of mixed dentition, with an absence of maxillary central incisors. In the mandibular arch, crowding of the teeth and various primary teeth in the mouth were noted *(Figs. 1 and 2)*.

Initially, complete orthodontic documentation was requested. The panoramic radiograph confirmed the presence of odontomas close to the maxillary central incisors *(Fig. 3a,b)*. Because of the lack of clarity of the radiograph, computed tomography was requested *(Fig. 3c,d)* which showed impaction of the incisors and the presence of odontomas. It was therefore decided to perform orthodontic traction of the incisors and remove the odontomas.

APPLIANCE DESIGN

Initially, orthodontic rings were fitted to the patient's maxillary first molars. Lingual tubes for the transpalatine bar from the palatine and a triple

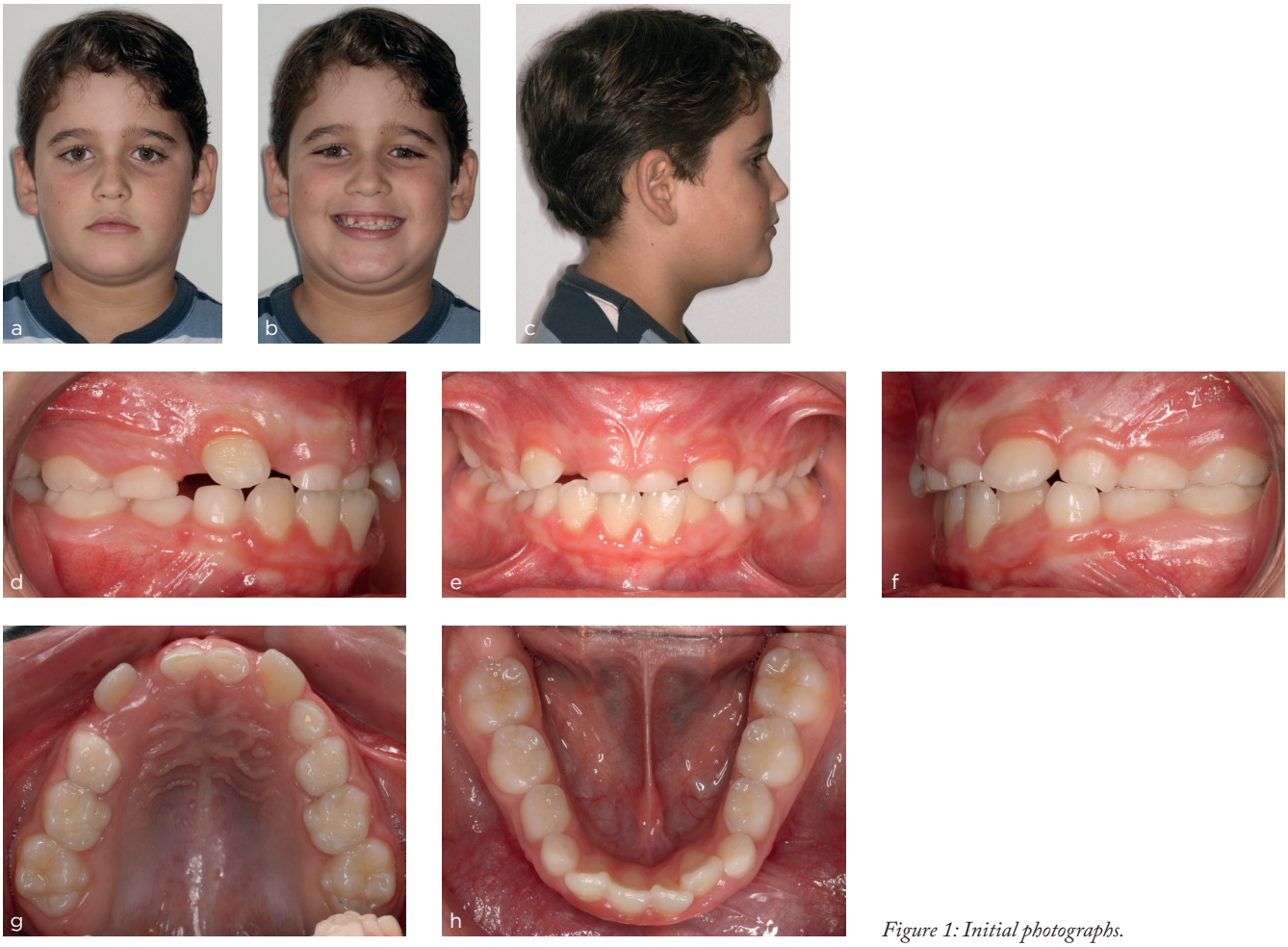

Figure 1: Initial photographs.

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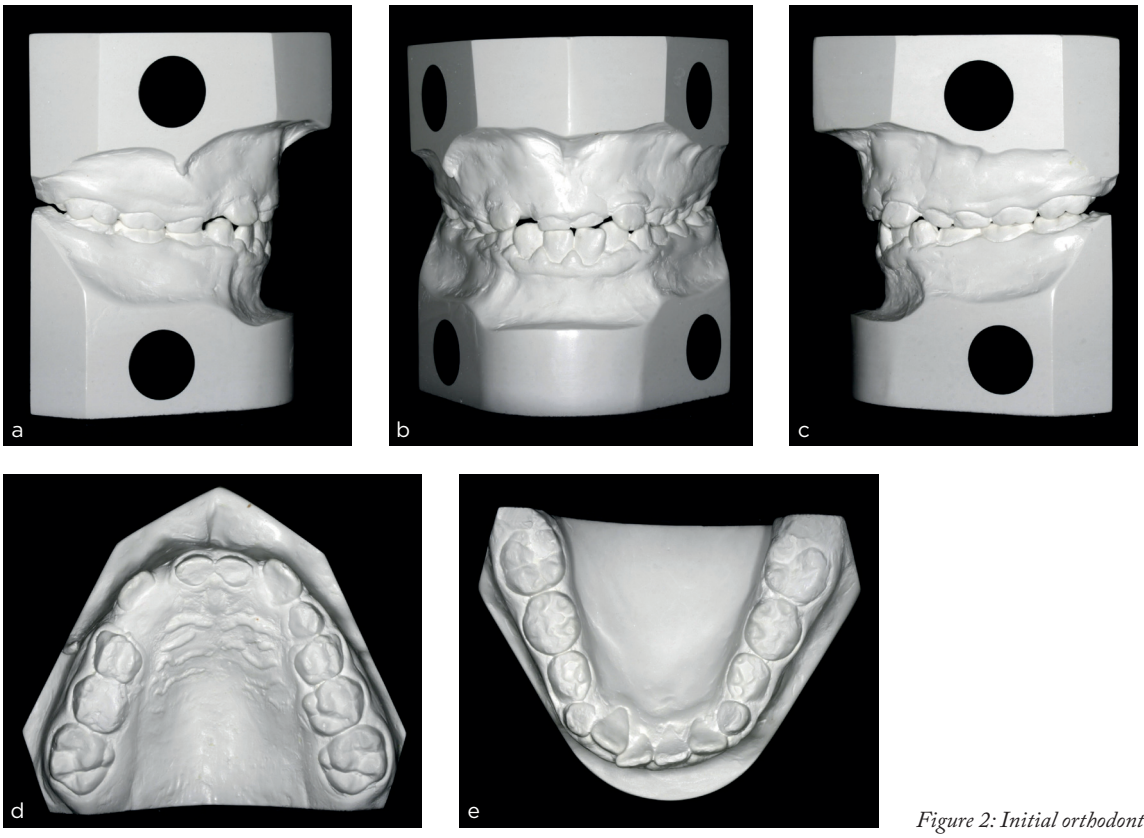

Figure 2: Initial orthodontic models.

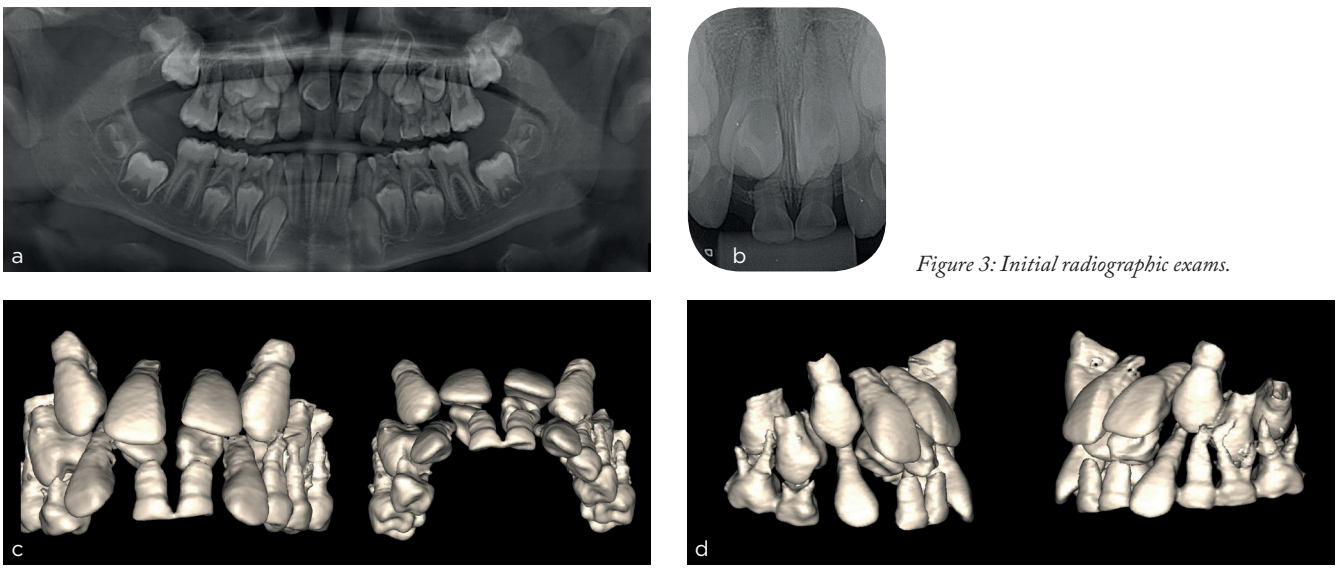

Figure 3: Initial radiographic exams.

tube from the vestibular region were welded to these rings. Impressions were then taken and the rings were visible in the cast. A stainless steel 0.032″ archwire was placed along the contour of the palatine arch. This wire was adapted to the lingual tube and followed the contour in the anterior region close to the distal region of the left maxillary primary canine. After the palatine arch was contoured, anterior rods were welded with silver solder to obtain a surface to which the lingual tubes could be welded. After this, the palatine tubes were welded onto the wire segment, and the palatine arch was removed from the model and placed in the spot-welding machine. The palatine tubes were repaired and the anterior segment of the palatine arch was acrylized. The appliance was polished and finished after the acrylic resin was polymerized *(Fig. 4)*.

The rings were cemented to the maxillary first molars (16 and 26) before surgery for odontoma removal. It was not possible to bond the buttons for traction on the vestibular surface of the teeth during surgery

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because they significantly projected and so the buttons were bonded to the lingual surface.
Seven days after accessories were bonded and the odontomas were removed, the patient returned to the dental office and the palatine arch and springs for traction of the incisors were fitted. The springs were fabricated with a 0.032″ stainless steel wire with a bend to fit in the lingual tubes, and helicoid in shape to facilitate activation by the chain of bonded accessories. The connection between the springs and the chain, which wasjoined to the tubes bonded to the teeth, was made with ligature wire *(Fig. 4)*. The fabricated appliance would cause an extrusion movement and movement inside
Complete traction of the impacted

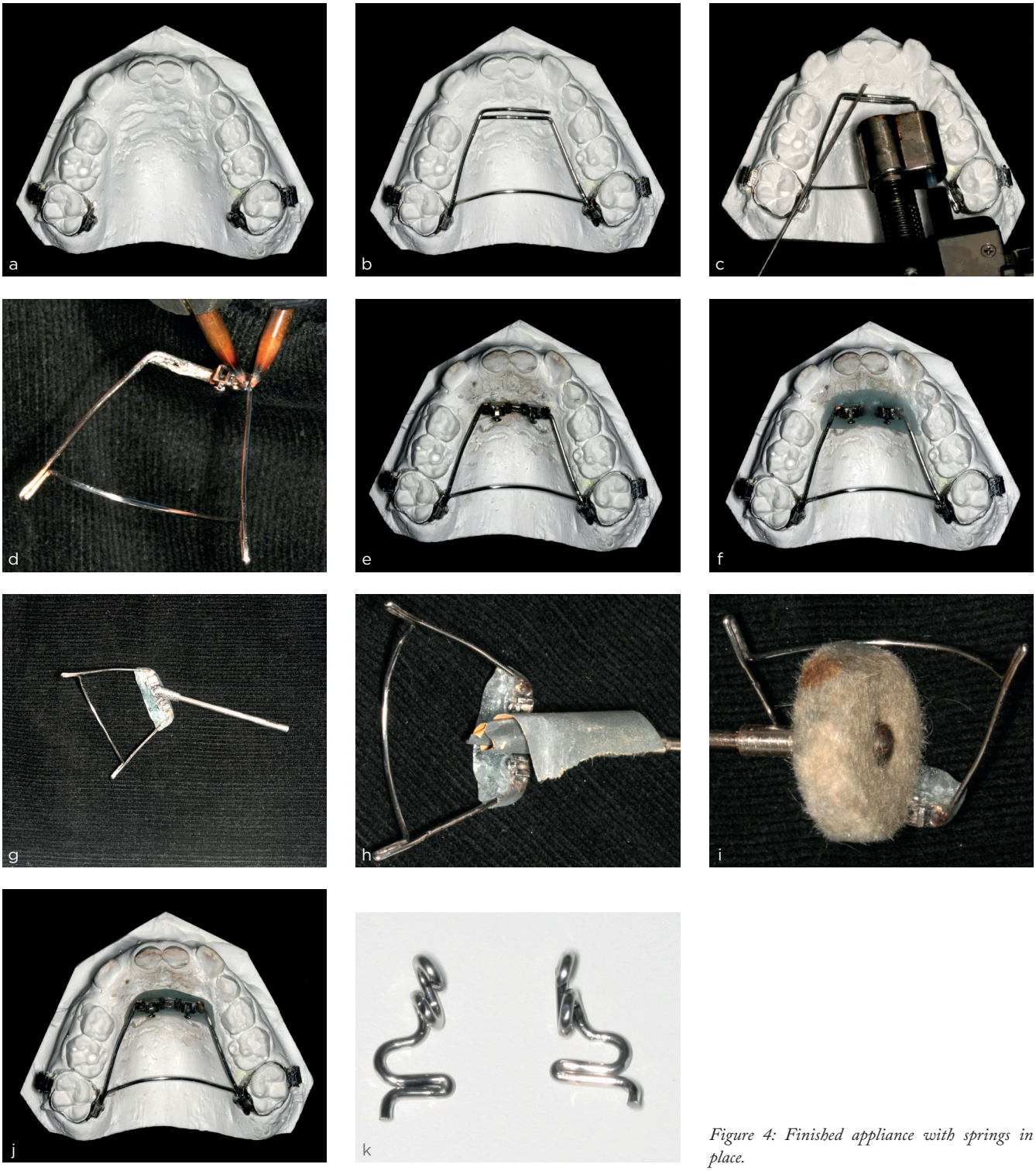

Figure 4: Finished appliance with springs in place.

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incisors was achieved over 4 months *(Figs. 5 and 6)*. The palatine arch was then removed, and the rings were used to support a transpalatine bar in order to prevent mesial migration of the permanent first molars, maintaining the leeway space. The patient's dental development is currently being monitored *(Figs. 7 and 8)*.

DISCUSSION

The authors have described the clinical case of a young patient who presented with impacted maxillary central incisors due to the presence of compound odontomas. Although the maxillary canine is the most frequently impacted tooth in this region, an impacted maxillary central incisor poses a problem at an earlier age and affects the child's aesthetic appearance, giving parents cause for concern[6,7].

When impacted teeth are associated with odontomas, these pathologies must be removed in order to provide space for the teeth to erupt spontaneously or after orthodontic traction.

In cases of impacted teeth, it is important to inform the patient and their parents of the possibility of treatment failure before extensive measures are implemented to save severely impacted teeth[6,8]. Depending on the position of the teeth, alternative treatments must be considered, including extraction of the impacted teeth[8], followed by multidisciplinary treatment. However, extraction of impacted teeth must be a last resort because the development and maintenance of the premaxilla depends on the development and eruption of the incisors[7].

Various appliances for applying traction to impacted teeth are described In the literature[7-9]. Traction may be applied to impacted teeth using mobile or fixed appliances. Fixed appliances are more commonly used for practical reasons and because they can also be used to correct other malpositioned teeth. However, in a patient in mixed dentition, placement of a fixed orthodontic appliance may result in radicular correction, which

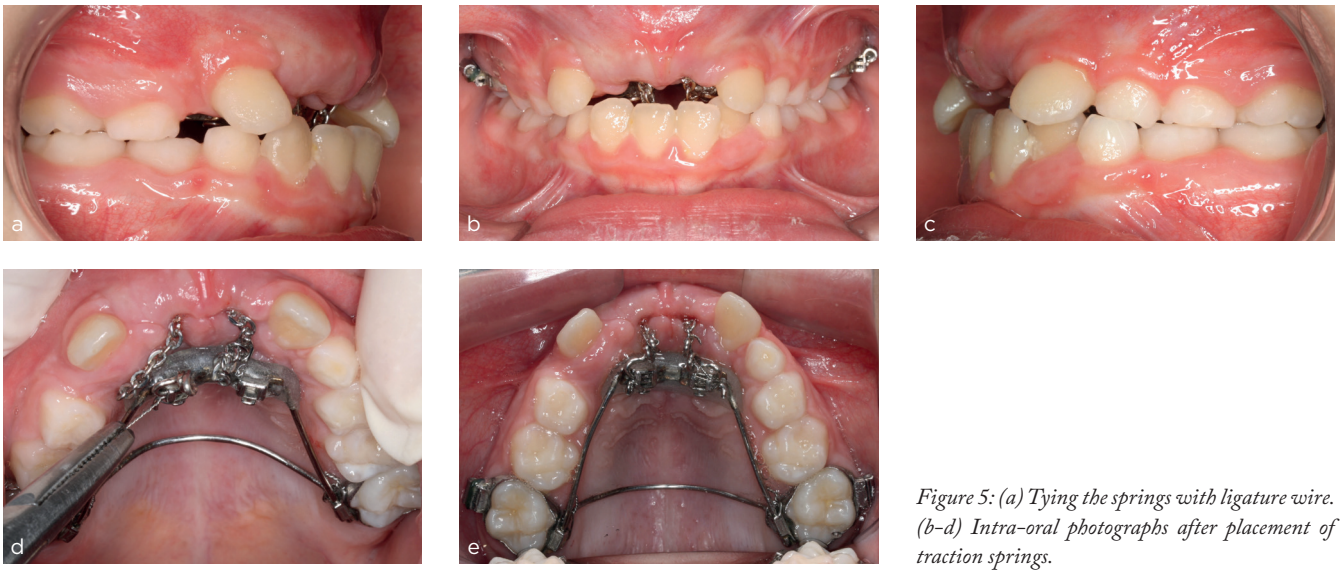

Figure 5: (a) Tying the springs with ligature wire. (b-d) Intra-oral photographs after placement of traction springs.

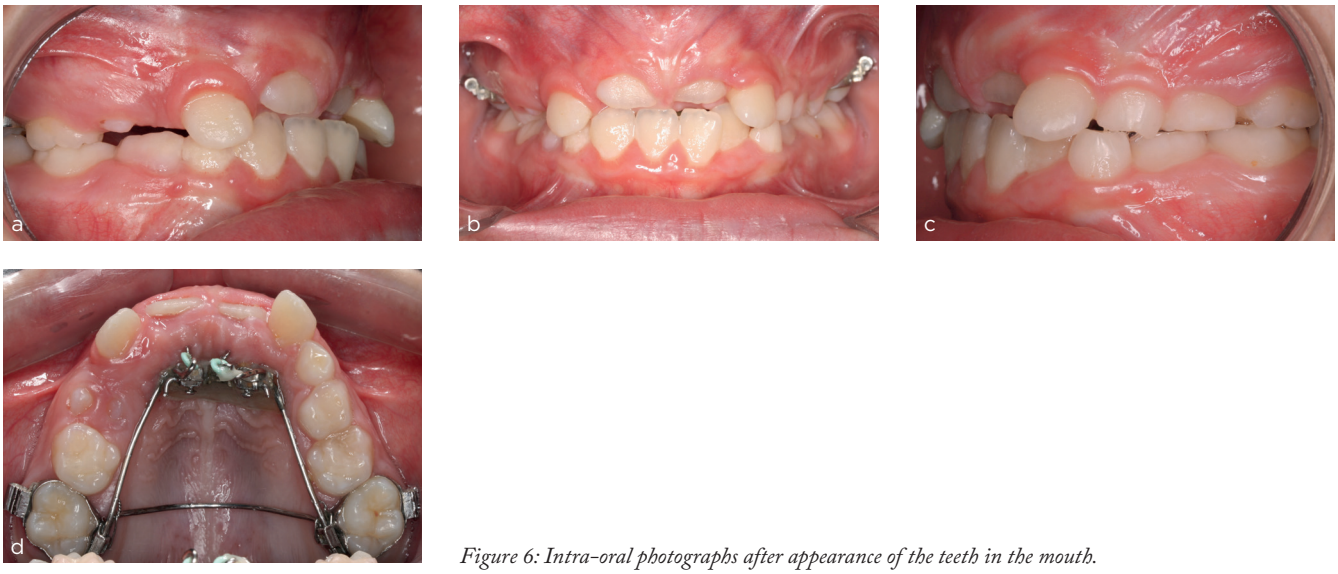

Figure 6: Intra-oral photographs after appearance of the teeth in the mouth.

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Figure 7: Intra- and extra-oral photographs after traction of the central incisors.

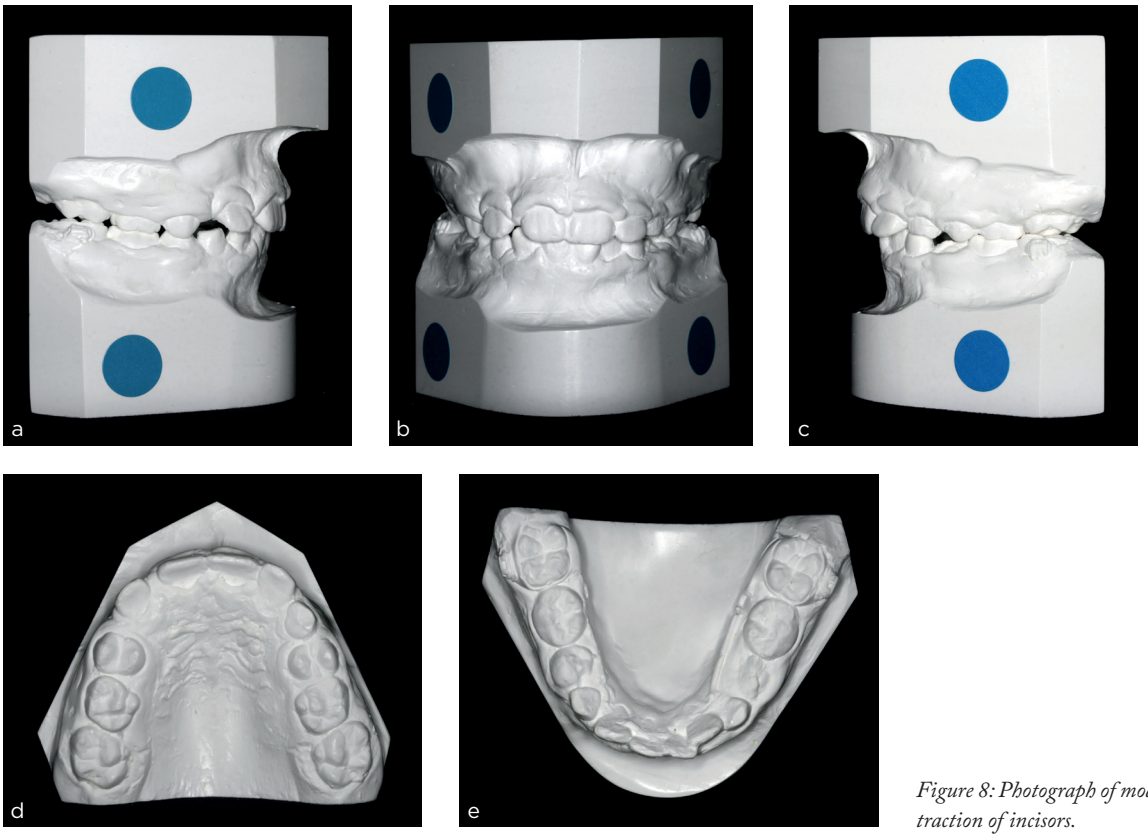

Figure 8: Photograph of models after completion of traction of incisors.

is usually undesirable at this stage of dental development.

Our appliance differs from others because the traction springs are coupled to lingual tubes welded in an anterior region of the dental arch, allowing easier activation and replacement of springs, which is impossible when the springs are welded to the palatine arches[9]. Another treatment possibility in this case would be to weld fixed cantilever tubes to the rings of molars using 0.018×0.025″ TMA cantilever wire, which would reduce the low-deflection rate, decreasing the risk of unwanted side effects.

The main side effect of traction of anterior impacted teeth using a fixed appliance bonded on molars is the intrusion and mesial tipping of the molars, even in the presence of a transpalatal arch. However, extension of the device associated with the

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presence of a button reduced this effect in the apparatus described here.

Recently, Chandhoke et al.[10] described a clinical case where a system composed of a rectangular arch associated with crossed tubes that supported another more flexible arch was inserted into the slot of the tooth to undergo traction. This system appears to be very similar to the method proposed by Ruellas[11]. This method was shown to allow good control but was difficult to use in patients in the initial stages of mixed dentition, as previously discussed. However, the appliance described here was suitable for such cases because it uses posterior anchorage and mucosa in the anterior region of the palate. Avoiding the use of anterior teeth as anchorage reduces the chances of these teeth being moved towards the canines in eruption, which could lead to resorption of their roots.

Considering this problem, Giancotti et al.[12] described a modified lingual arch with coupled hooks to apply traction to an impacted maxillary central incisor. The disadvantage of this appliance is the impossibility of changing the hook to which the elastic used to traction the tooth is attached. However, the appliance used in the present case does not have this problem because the traction springs can easily be removed from the tubes during activation. Another possible problem with the appliance described by Giancotti et al. was that the vertical anchorage of the appliance applied to the occlusal regions/surface of the primary teeth could lead to a change in the process of rhizogenesis. However, the appliance described by us avoids this disadvantage because vertical anchorage was to bone tissue in the region of the palatine rugosities.

Vaid et al.[13] developed a modified lingual arch for the traction of impacted mandibular teeth, which was supported on lingual tubes. This arch was effective but was difficult to insert or remove. The spring in the appliance described here was easily inserted and removed, thereby saving clinical time.

A limitation of the use of this device is the fact that biofilm can accumulate around the acrylic button, potentially infecting the surgically exposed area.

CONCLUSION

The modified palatine arch was effective for applying traction to impacted maxillary incisors in the presence of odontomas. This appliance is therefore a new tool at the disposal of the orthodontist.

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CLINICAL ARTICLE

A Case of Bi-Maxillary Protrusion with Ankylosed Incisors Treated with a Multidisciplinary Approach

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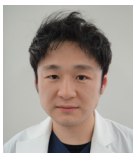

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Abstract

This case report describes a multidisciplinary approach in a patient with maxillary protrusion and ankylosed upper incisors. The patient was a 15-year-old boy with the chief complaint of maxillary protrusion and superiorly positioned upper incisors. The patient had maxillary protrusion with an overjet of 6 mm. Cephalometric analysis showed a skeletal class II relationship. Presurgical orthodontic treatment was performed with lower bicuspid extractions followed by a Wassmund segmental osteotomy and then prosthetic treatment. A good aesthetic and functional result which included an acceptable facial profile and occlusal relationship was achieved. When planning similar cases, a multidisciplinary approach can be considered as one treatment alternative.

Keywords
Bi-maxillary protrusion, ankylosed teeth, wassmund segmental osteotomy

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INTRODUCTION

Maxillary protrusion may be caused by trauma to the maxillary anterior teeth during the growth phase[1]. In cases of complete tooth dislocation, the periodontal ligament is torn over the entire root surface and the pulp is severed. Survival of the periodontal ligament cells before replantation is important for long term success. If repair of the periodontal ligament is problematic, external root resorption occurs and results in ankylosis[2].

In the case presented here, the correction of malocclusion was more complicated due to the presence of ankylosed teeth. Several different treatments were considered including orthodontic traction following subluxation of the ankylosed teeth[3,4], extraction of the ankylosed teeth and autologous transplantation of lower bicuspid teeth into their place[5–7], bone distraction in combination with alveolar osteotomy[8–13], and aesthetic improvement using prosthetic treatment alone[2]. A multidepartmental approach with orthodontic treatment, oral surgery, periodontal and prosthetic dentistry was adopted. Treatment involved pre- and post-surgical orthodontics, a maxillary alveolar osteotomy and prosthetic treatment, and resulted in functional and aesthetic improvement.

We report a case of maxillary protrusion with ankylosed incisors successfully treated using a multidisciplinary approach.

HISTORY

The patient was a 15-year-old boy with the chief complaint that he could not bite as his front teeth protruded and the upper right central and lateral

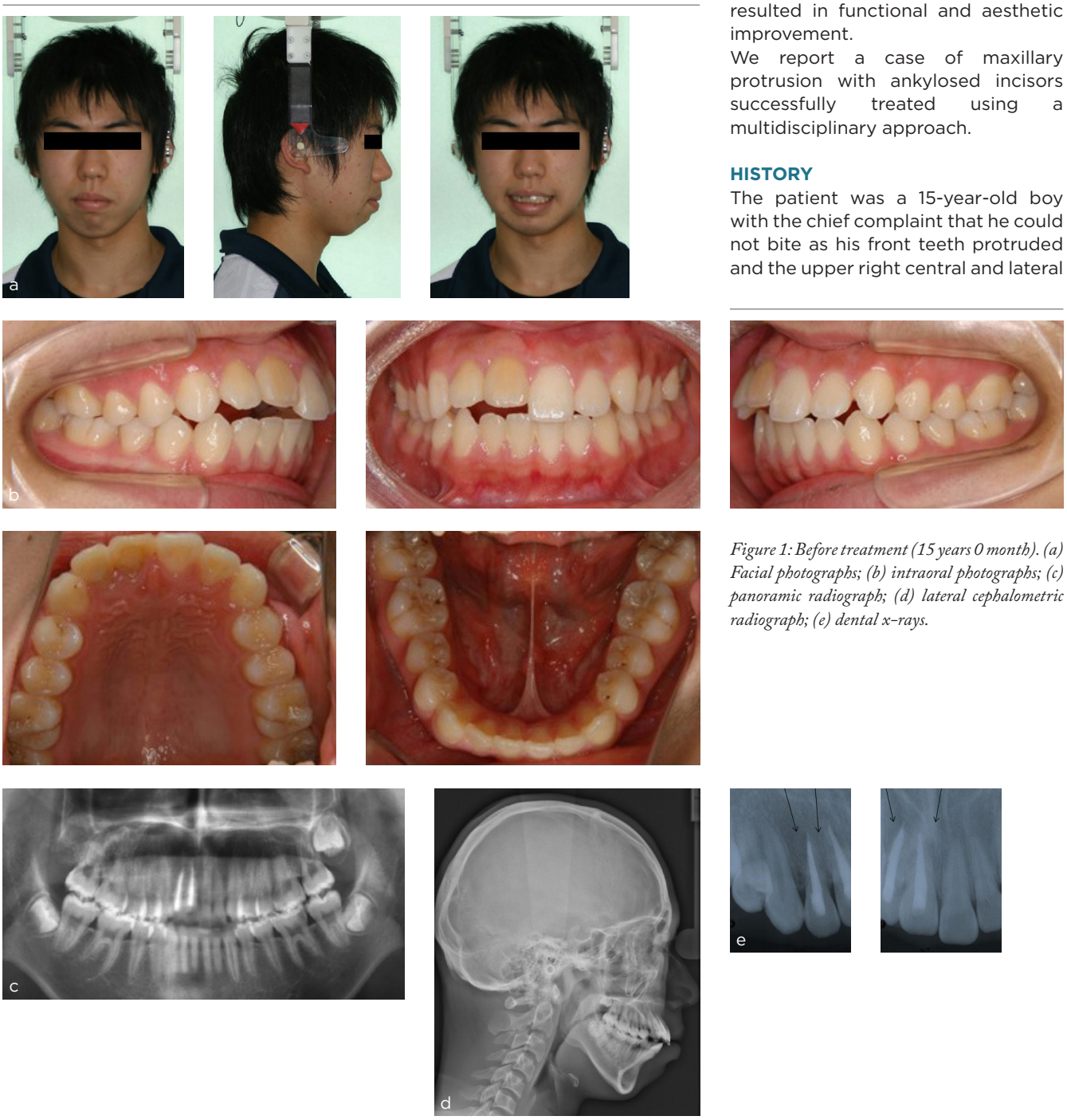

Figure 1: Before treatment (15 years 0 month). (a) Facial photographs; (b) intraoral photographs; (c) panoramic radiograph; (d) lateral cephalometric radiograph; (e) dental x-rays.

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incisors were superiorly positioned. The patient's siblings had received orthodontic treatment for crowding. The patient's medical history was unremarkable.

At 12 years of age, the patient's upper right central and lateral incisors had been completely dislocated by trauma. These teeth were replanted, but ankylosis and external resorption had occurred in both. As a result, the patient was introduced to the Nippon Dental University Niigata Hospital, Japan.

On clinical examination, the patient's face was symmetrical except for the right corner of his mouth which was slightly elevated. He had a convex profile due to retrognathia of the chin and protrusion of the upper lip. There was strong muscular tension in the chin during lip closure. The overbite was +2 mm, while the overjet was +6 mm. Molars were in Angle class I relationships. The crowns of the upper right central incisor and lateral incisor were discoloured. The percussion sounds of the two teeth were high, and the teeth were positioned superiorly compared to neighbouring teeth *(Fig. 1)*.

Model analysis revealed a tooth-arch length discrepancy of 0 mm in the upper jaw and −2 mm in the lower jaw. The panoramic radiograph confirmed that endodontic treatment of the upper right central incisor and upper right lateral incisor had been completed. Periapical radiographs revealed that the upper right central and lateral incisors had lost lamina dura, indicating root ankylosis. A reduction was noted in the alveolar bone height.

Lateral cephalometric analysis showed that SNA (84.5°) was increased but within normal variation (standard deviation), SNB (78.5°) was reduced, and ANB (6°) indicated a class II relationship. The Frankfurt plane to the mandibular plane angle (FMA; 37°) was increased and was greater than +1 SD. The upper incisor angle (U1 to SN; 111.5°) and lower incisor angle (L1 to Md; 96°) were both within the standard deviation, but the inter-incisor angle (U1 to L1; 105.5°) was reduced by more than 3 SD. The upper lip was +5.5 mm and the lower lip was +12 mm in relation to the E line. The nasolabial angle was 104° *(Fig. 1, Table 1)*.

The diagnosis was maxillary protrusion with superiorly positioned and ankylosed upper right central and lateral incisors, and mild skeletal class II malocclusion with a high mandibular plane angle.

TREATMENT PLAN AND PROGRESS

Surgical orthodontic treatment with a Wassmund osteotomy with upper left and right first bicuspid extractions was planned to improve the maxillary protrusion and was to be followed by an advancement genioplasty. Orthodontic treatment was to be employed using an upper and lower multi-bracket system after extraction of the lower first bicuspid teeth. The preoperative orthodontic treatment was designed to align and level the teeth in the anterior and buccal segments. The lower anterior teeth were to be retracted. Cephalometric analysis indicated that the upper anterior teeth would move back by 8.5 mm after the Wassmund procedure and the lower anterior teeth would move back by 6 mm. Postoperative orthodontics was planned to improve the stability of the occlusion.

The bilateral first lower bicuspids were extracted and a multi-bracket appliance was fitted on the

	Pre-treatment	Pre-operation	Post-treatment	Post-retention	Normative mean (adult)	
Measurement	**(15 years 0 months)**	**(18 years 1 months)**	**(18 years 11 months)**	**(21 years 7 months)**	**Mean**	**SD**
Angle, degrees						
SNA	84.5	82	79	79	82.6	3.5
SNB	78.5	76.5	76.5	76.5	80.3	3.3
ANB	6	5.5	2.5	2.5	2.2	2.2
FMA	37	37.5	37.5	37.5	26	5.5
IMPA	96	77	77	77.5	94.7	5
FMIA	47	65.5	65.5	65	59	6.7
U1SN	115	108.5	100	103.5	105.8	6.8
OP	9	9	9	9	9.4	3.9
II	105.5	129	135.5	133	127.6	6.2
Nasolabial angle	104	104	113	118	93.8	11.3
Linear, mm						
Overjet	6	11.5	1.5	3		
Overbite	2	2	2	2		
Upper lip to the E line	5.5	5.5	−1.5	−2.5		
Lower lip to the E line	12	8.5	6	2		
Standard by Sakamoto, Miura, Iizuka, Yamanouchi et al.						

Table 1: Cephalometric analysis at the pre-treatment, pre-operation, post-treatment and post-retention stages

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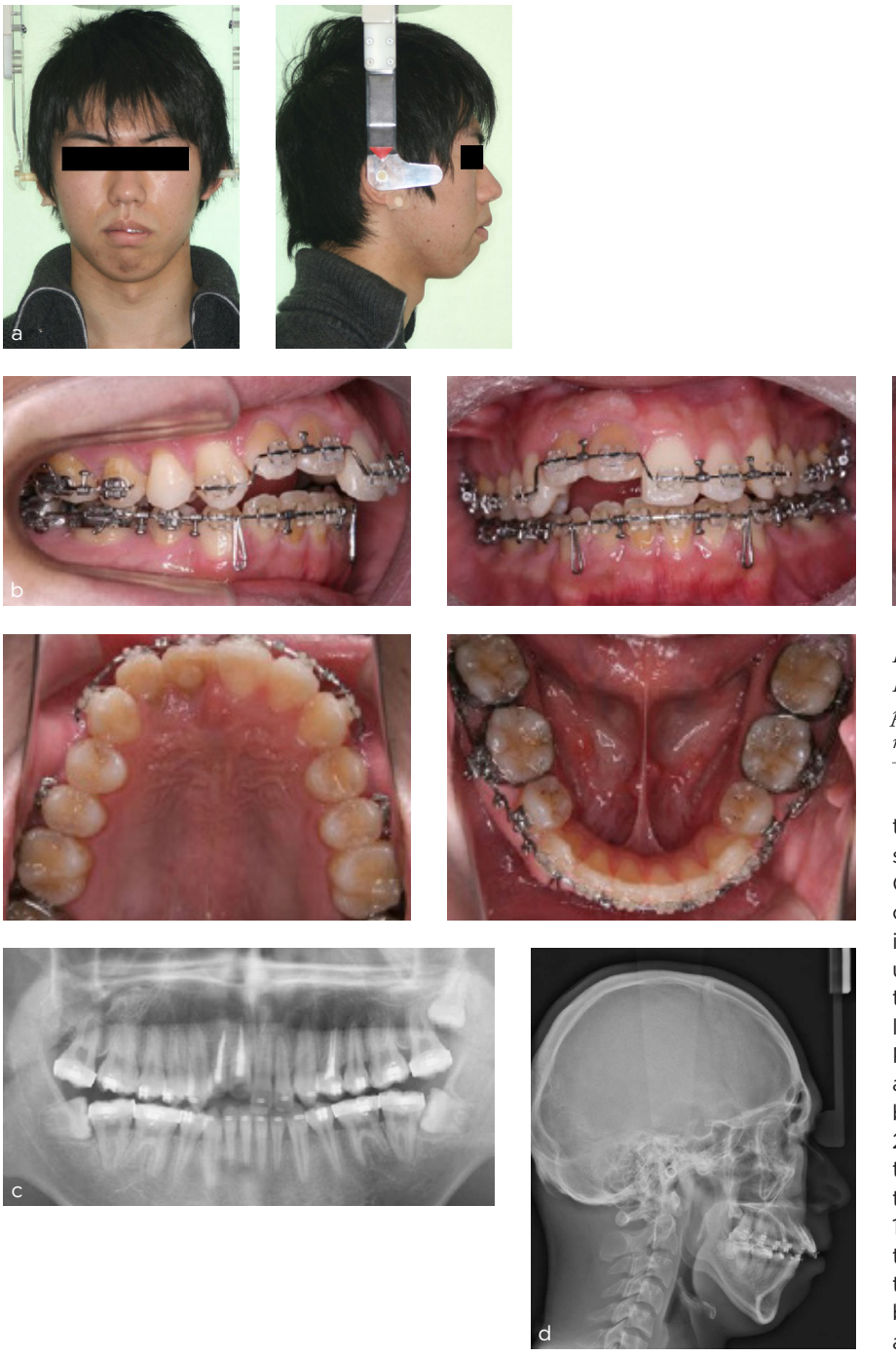

Figure 2: Before surgery (18 years 1 month). (a) Facial photographs; (b) intraoral photographs; (c) panoramic radiograph; (d) lateral cephalometric radiograph.

mandibular teeth (0.018×0.025-in slot). After 16 months of preoperative orthodontic treatment, the extraction sites had almost closed and a multibracket appliance was fitted to the upper teeth.

Cephalometric analysis at the end of the preoperative orthodontic treatment showed maxillary surgery had caused the maxillary anterior incisor to move by 9.5 mm. In the upper jaw, sectional mechanics was employed with the upper arch wire divided into an anterior section which incorporated the incisor and canine teeth. The posterior section incorporated the second bicuspids together with the first and second molar teeth *(Fig. 2b)*. Preoperative orthodontic treatment took 23 months to complete. Surgical treatment was delayed because of the patient's graduation from high school.

Changes during the preoperative orthodontic phase included an increase of 5.5 mm in the overjet. The upper right central and lateral incisor teeth were not covered by the upper lip in the resting position.

Pre-Wassmund lateral cephalometric analysis showed that SNA decreased by 2.5° to 82°, and SNB decreased by 2.0° to 76.5°. FMA increased by 0.5° to 37.5°, U1 to SN decreased by 6.5° to 108.5°, and L1 to Md decreased by 19° to 77°. The upper lip's relationship to the E line was unchanged, while the lower lip position was decreased by 3.5 mm to +8.5 mm. The nasolabial angle was unchanged.

The panoramic radiograph indicated that the upper right third molar was poorly developed, and that both upper third molar teeth were unerupted and mesially inclined *(Fig. 2, Table 1)*.

During the Wassmund procedure, the upper first bicuspids were removed as well as the lower third molars which were partially erupted and mesially impacted. Following surgery, a fixation splint was placed for 2 weeks. Postoperative orthodontic

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treatment was performed for 12 months followed by prosthetic treatment of the upper right central and lateral incisors. The patient did not want to receive an advancement genioplasty.

Changes from before surgery to the end of orthodontic treatment

The overjet was decreased by 10 mm to +1.5 mm, SNA was decreased by 3° to 79°, and SNB was unchanged. ANB was decreased to 3° due to the improved anteroposterior position of the maxilla. U1 to SN was decreased by 8.5° to 100°. The upper lip was –1.5 mm and the lower lip was +6 mm in relation to the E line.

The nasolabial angle had improved from 104° to 113°. There did not seem to be any additional root resorption *(Fig. 3, Table 1)*.

Changes from the end of orthodontic treatment to the end of prosthetic treatment

U1 to SN increased by 3.5° to 103.5°, while L1 to Md increased by 0.5° to 77.5° *(Fig. 4, Table 1)*.

The symmetry of the corners of the mouth was improved. The incisor edges of the upper right central and lateral incisors were adjusted to be in harmony with adjacent teeth.

The upper right central and lateral incisors showed root resorption on the dental x-ray *(Fig. 4e)* but this did not appear to differ greatly from the previous assessment *(Fig. 3c)*, and clinically there were no problems with regard to tooth mobility or inflammation. Following this appointment, the patient left his home town to enter university and did not attend further follow-up appointments for additional prosthetic rehabilitation.

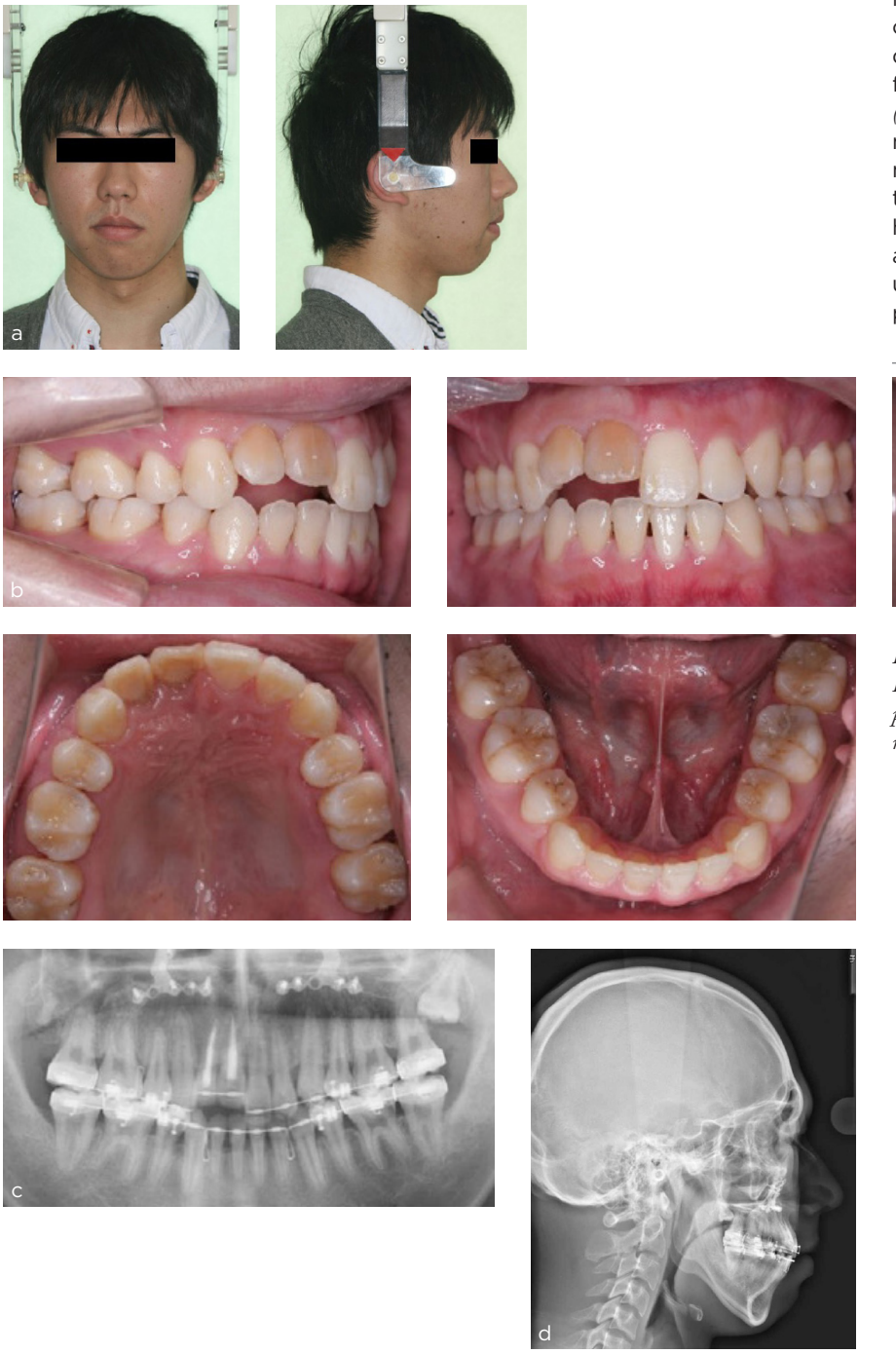

Figure 3: After treatment (18 years 11 month). (a) Facial photographs; (b) intraoral photographs; (c) panoramic radiograph; (d) lateral cephalometric radiograph.

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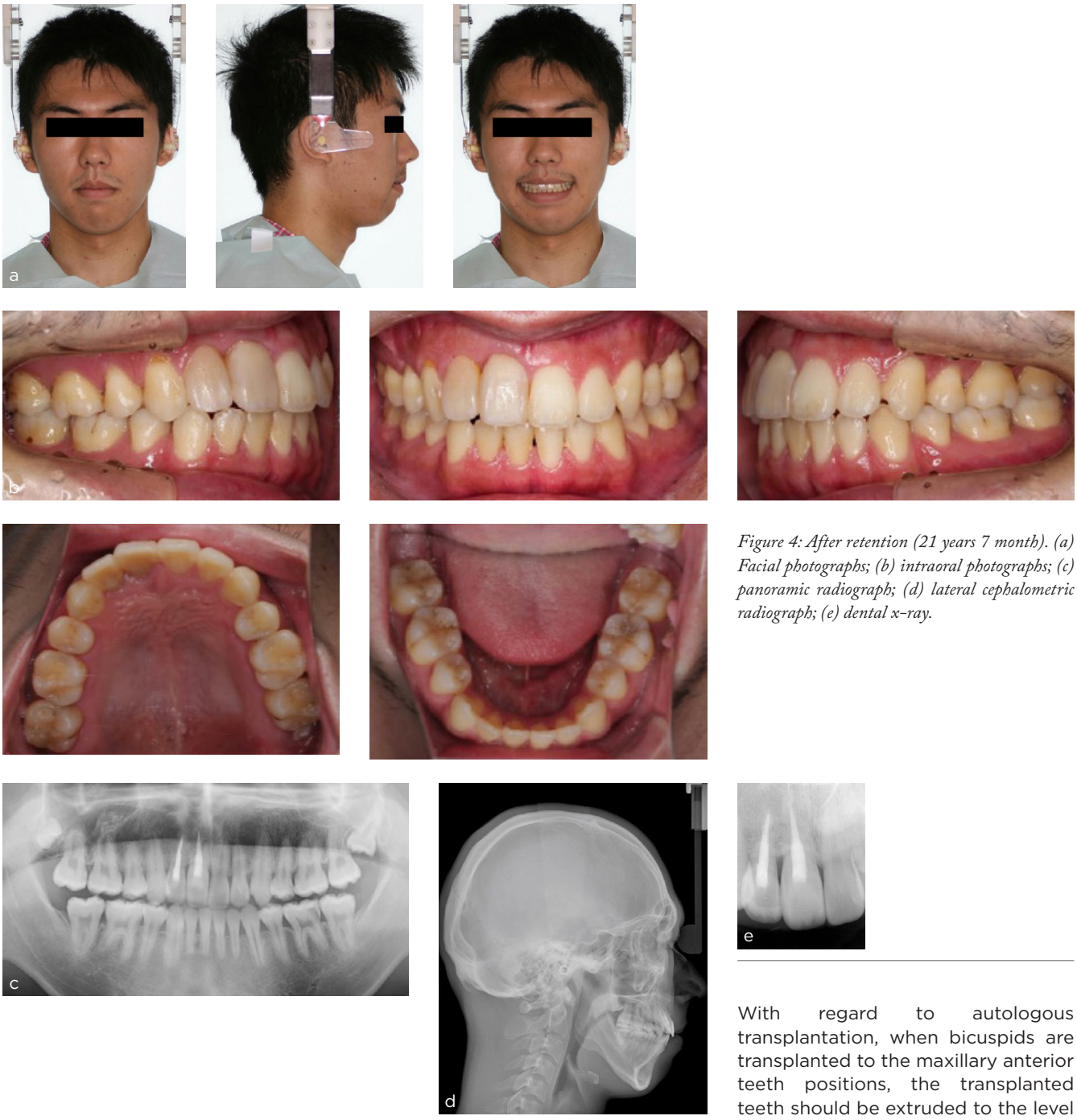

Figure 4: After retention (21 years 7 month). (a) Facial photographs; (b) intraoral photographs; (c) panoramic radiograph; (d) lateral cephalometric radiograph; (e) dental x-ray.

DISCUSSION

Treatment alternatives

In this report, we describe treatment combining orthodontics with prosthetics and a localized osteotomy of the Wassmund type. Had there not been two ankylosed teeth, this case could have been treated as a bicuspid extraction with orthodontic treatment alone. Alternative treatment plans could have involved orthodontic traction following subluxation[3,4] or autologous transplantation[5–7]. However, in this case, traction following subluxation was not chosen as external root resorption of the two ankylosed teeth was widespread across the entire root. Also, the amount of post-dislocation orthodontic tooth movement was predicted to be too large[4].

With regard to autologous transplantation, when bicuspids are transplanted to the maxillary anterior teeth positions, the transplanted teeth should be extruded to the level of the adjacent teeth so that the gingival margins are at the same level. Furthermore, following implantation, lingual root torque would have been needed and this combined with the large orthodontic tooth movement required and the disparate root morphology of the incisor teeth compared to the bicuspid teeth, led to the conclusion that control of the teeth would be difficult[14]. In addition, the height of the alveolar bone was not sufficient to receive the bicuspid

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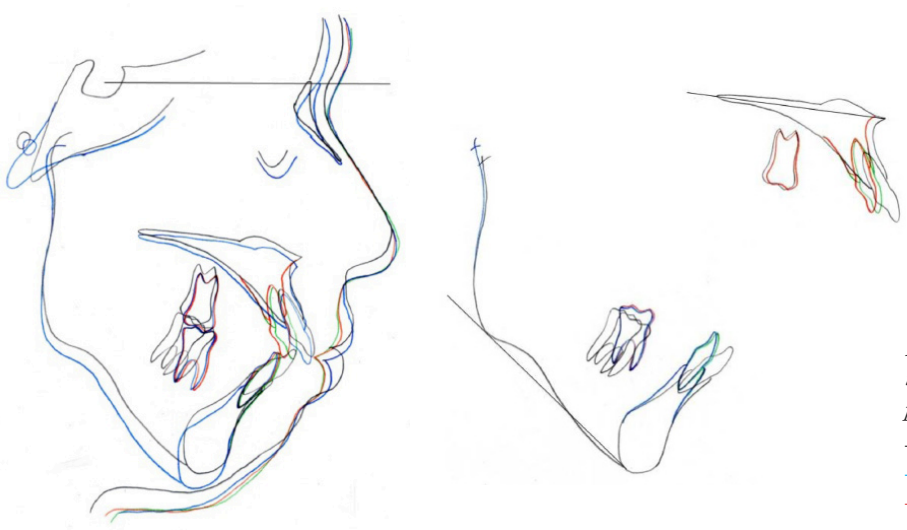

Figure 5: Superimposition of cephalometric tracings on the S-N plane at S, on the palatal plane at ANS, on the mandibular plane at Me.
Pre-treatment;
pre-surgery;
post-treatment;
post-retention.

tooth. Also, due to the advanced stage of the lower first bicuspid root development, the timing for autotransplantation was not considered to be optimal[5,7]. Therefore, as autologous transplantation was thought to carry a high risk, an alternative plan was adopted.

Localized osteotomy with distraction for the movement of ankylosed teeth has been reported[8–13]. In this case, however, movement of the upper labial segment including the ankylosed teeth was thought to be technically risky, and it was considered that distraction osteogenesis would be unreliable.

Wassmund local osteotomy

Wassmund local osteotomy can move teeth en masse with the surrounding bone. Although Wassmund local osteotomy is more extensive compared to non-surgical alternatives, there is a reduced risk of damage to the adjacent teeth compared to distraction osteogenesis, because the osteotomy cuts are made at the site of the upper bicuspid extractions. In addition to local Wassmund osteotomies and genioplasty, more extensive treatment options combining orthodontics with orthognathic surgery were also evaluated. Single jaw and two jaw options were considered to address the issues of the increased overjet, the class II profile, the local open bite and the inclination of the occlusal plane. However, Wassmund osteotomy in combination with an advancement genioplasty was thought to be the best option to improve the profile. Even so, the patient did not want the genioplasty.

Anterior maxillary alveolar osteotomy is a surgical technique that can enhance the aesthetics of protruding maxillary anterior teeth and improve lip competence[15]. In addition, improvement of ANB and the nasolabial angle by backward movement of point A can be expected, and so anterior maxillary alveolar osteotomy was considered to be advantageous.

Achieving these improvements is thought difficult with conventional orthodontic treatment[16]. The upper anterior alveolus including point A was sufficiently retracted, and the E line and nasolabial angle were improved.

Tooth replacement using implants is generally performed after orthodontic treatment. However, the patient refused implant treatment due to its cost and changes in his living circumstances: he wanted minimally invasive treatment rather than further surgery. Consequently implants were not placed and an aesthetic solution was achieved with enamel bonding.

After the prosthetic treatment and recontouring of the anterior teeth, the patient's pronunciation clearly improved. A small functional improvement in chewing function was also noted.

After retention

An increase in the overjet was observed at the end of the retention period. It was noted that the muscle tension around the mouth had reduced. This mild relapse may have been caused by tongue pressure on the incisors.

CONCLUSION

This case report describes maxillary protrusion with anterior teeth ankylosis. Treatment consisted of a combination of various disciplines to achieve an acceptable aesthetic and functional result, which further underscores the effectiveness of a multidisciplinary approach in such cases.

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clinical TIPS

Modifying The Ballista Spring Design For Better Clinical Outcome

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Abstract

The Ballista spring is frequently used for extruding impacted maxillary canines. Despite its the simple design and easy fabrication, design details should be carefully considered in order to avoid unexpected and sometimes undesirable reaction forces that might complicate treatment. The current article suggests some changes to the design of the spring that could improve the final outcome.

Keywords
Ballista spring, canine impaction, forced eruption, biomechanics

INTRODUCTION

Maxillary canines have the longest period and deepest area of development together with the most difficult path of eruption of all the teeth[1]. Ectopic eruption and impaction of the maxillary canine is a frequently encountered problem in orthodontics. The incidence of maxillary canine impaction is reported to be between 0.9% and 1.7%[2,3] and it is more common in females than in males (1.1% and 0.5%, respectively) and on the palatal side than labially (85% and 15%, respectively)[4,5]. During orthodontic treatment, traction is applied to move the impacted canine in proper alignment in a procedure traditionally known as forced eruption. Regardless of the method used, the direction of applied force should initially move the impacted tooth away from the neighbouring teeth roots[6]. Additionally, use of a light force of 60–120 g and a stiff main archwire of 0.018×0.025-inch stainless steel (st.st.) to resist possible deformation caused by the applied traction forces has been recommended[7]. Various methods have been described to move the impacted tooth in an occlusal direction (vertically downwards) in order to avoid any interruption in the path, and then buccally towards its final and desired location[6].

One of the methods employed for canine forced eruption is use of the Ballista spring originally described by Harry Jacoby. The Ballista spring is made of round (0.014 or 0.016-inch st.st.) wire that induces a downwards and labial movement *(Fig. 1)*[8].

Despite the simple design and easy fabrication of the Ballista spring, design details should be carefully considered in order to avoid unexpected and sometimes undesirable reaction forces that might complicate treatment. One problem which might be encountered is expansion of the posterior segment on the same side of the impacted canine despite the use of 0.019×0.025-inch st.st. customized main arch wire. This problem could be related to spring design, the distance of the impacted canine from the alveolar ridge, and the depth of the palatal vault.

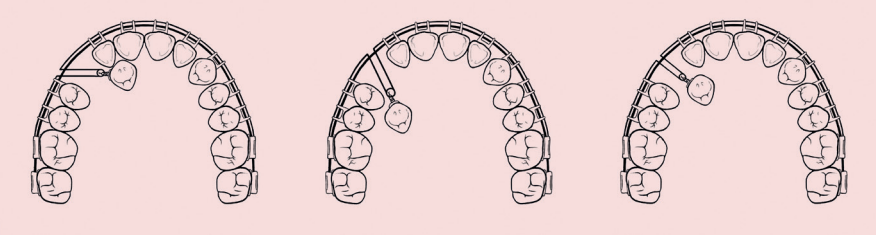


Figure 1: Changing the angle of the Ballista spring relative to the anteroposterior position of the impacted canine.

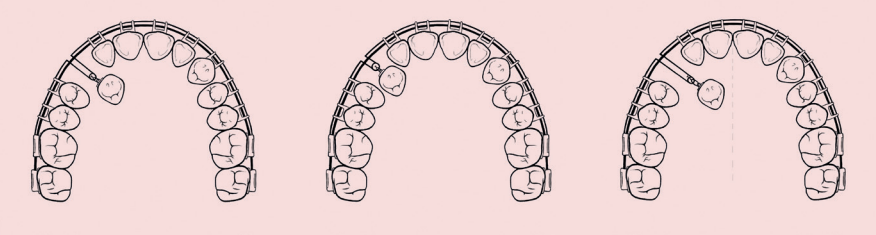


Figure 2: Changing the length of the Ballista spring relative to the transverse position of the impacted canine.

SPRING ANGLE DESIGN (THE ANTEROPOSTERIOR CANINE POSITION)

As the main purpose of using the Ballista spring is to forcefully erupt the impacted canine in order to make it accessible for levelling and alignment, the palatal arm of the spring should be measured and fabricated taking into consideration the location of the impacted

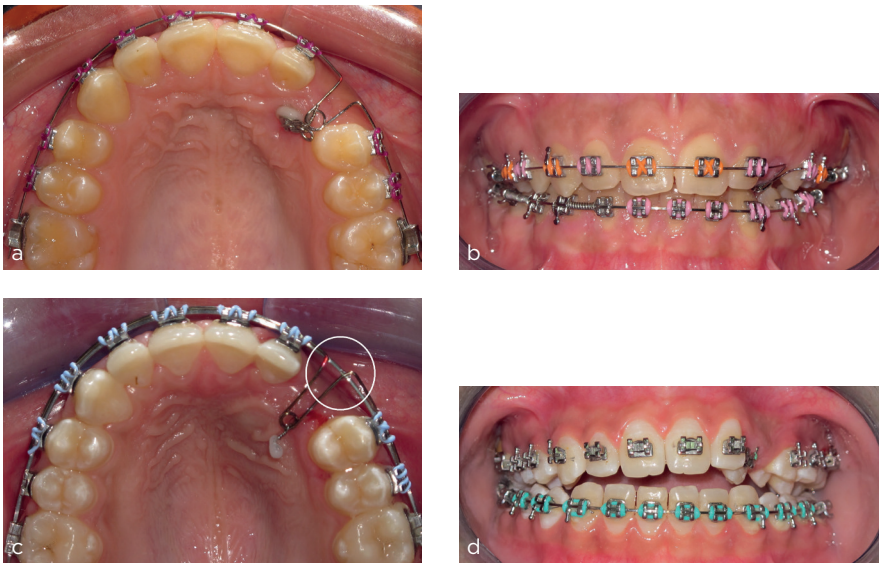
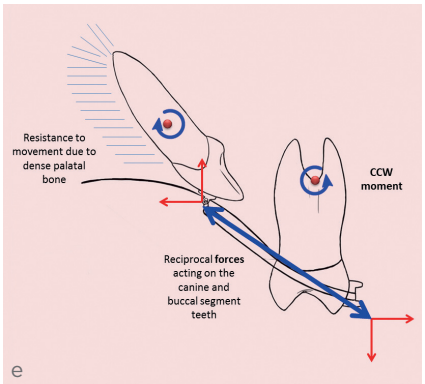


Figure 3: (a,b) Accurate arm length with no impact on the posterior segment despite the absence of a base arch wire. (c,d) Mistakenly long arm length with undesired expansion at the posterior segment despite the use of a rigid base arch wire. (e) Analysis of forces and moments acting on the canine and buccal segment teeth.



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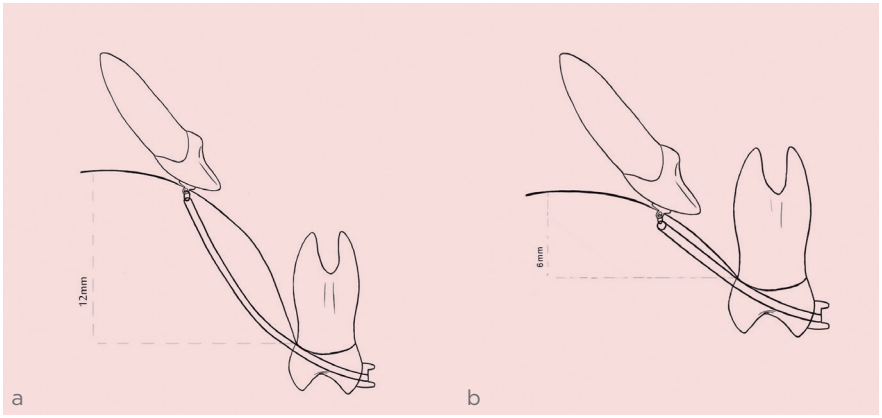

Figure 4: Effect of palatal vault depth on the Ballista spring arm length. (a) Deep palatal vault. (b) Shallow palatal vault.

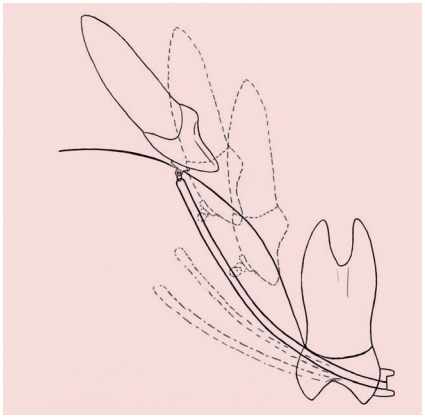

Figure 5: A 'free to slide' attachment between the impacted canine and the Ballista spring arm.

canine antero-posteriorly relative to its intended alignment position. Modification of the angulation of the spring arms might be considered for easier canine engagement and direct occlusal movement *(Fig. 1)*.

Distance from the alveolar ridge (transverse canine position)

As a normal step during spring construction, the distance from the alveolar ridge to the site of the impacted canine is measured, and fabricating the palatal arms of the spring according to this measurement is essential *(Fig. 2)*. Mistakenly long spring arms might result in unwanted arch expansion, extrusion of the buccal segment on the same side of the impacted canine, open bite as well as canting of the occlusal plane. Such iatrogenic problems may complicate the case and unduly extend the treatment time. These side effects may be related to the long spring arm pushing the impacted canine through the palate in the direction of the mid-palatal suture. This movement is considered a difficult one resisted by the dense palatal bone in that area. In turn, the forces will be reciprocally transmitted to the buccal segment teeth in an occlusal and buccal direction resulting in both extrusion as well as buccal tipping of the posterior segment which occurs more easily *(Fig. 3)*.

Depth of the palatal vault (vertical canine position)

In cases with a deep palatal vault, the length of the palatal arms of the Ballista spring is unavoidably increased compared to similar cases with normal or shallow palatal vaults *(Fig. 4)*. The long spring arms in such cases might result in a similar expansion scenario as the canine erupts, especially if the attachment point between the spring and the impacted canine is fixed. To avoid this side effect, the attachment between the spring and the impacted canine could be modified so that it allows sliding of the canine along the spring arm during eruption. A 'free to slide' attachment would allow vertical eruption of the canine together with movement in a labial direction *(Fig. 5)*.

CONCLUSIONS

1. A better design of the Ballista spring angle in view of the anteroposterior canine position in the palate is described.
2. In cases with average palatal vault depth, the conventional Ballista spring design is recommended but great attention must be paid to the arm length to avoid undesirable arch expansion or contraction.
3. In cases with deep palatal vault, a 'free to slide' arm design is recommended to avoid adverse transverse effects on the arch during canine eruption.
4. In cases with pre-existing arch expansion or constriction in the premolar-molar region, the spring is intentionally fabricated shorter or longer, respectively, than the distance between the canine and the main arch wire in order to benefit from the side effects of the change in the arm length.

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The Sea of Learning Has No End

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Editor-in-Chief

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I started working as an orthodontist in the early 70's. At the time there was no internet and, obviously, no real-time communication via e-mail.
I perfectly remember when I first discovered a collection of AJO issues in the library of the Bologna University that I used to attend.
I can't articulate my greed to read all these articles; withdrawing in that place in the spare time from my clinical practice had become my favourite pastime.
I soon decided to subscribe. I filled out a form I found in one AJO issue and immediately sent it with the payment receipt.
Many years have elapsed since then but nothing has changed as to my excitement in reading new articles as well as their clinical and professional usefulness... in the meanwhile I have subscribed to many other journals.

Some considerations are necessary:

- *In the early 70's there were far fewer continuous training courses than nowadays; it cannot be denied that their current proliferation presents, especially in certain cases, marketing aspects that don't benefit our profession very much;*
- *This process has been triggered by a need for education that universities often failed to meet;*
- *Manufacturing companies were the first to understand this phenomenon and get ownership of it, thus somehow affecting our profession;*
- *In modern terms we could say that "hardware" and "software" have almost become synonyms; materials have become more important than ideas or perhaps ideas are no longer considered necessary? This situation can often be misleading and doesn't benefit either newcomers or highly educated professionals.*

At this point a question clearly arises: what is the future of our profession? What does the salvation of our profession depend upon? What is going to save us from this barbarization?
On a prestigious journal, the European Journal of Orthodontics, I found a publisher's ad: "the sea of learning has no end!"
It immediately provided me with food for thought: in our profession there are three things that really count: reading, reading, reading...

I remember a sentence Marguerite Yourcenar wrote in her book "Hadrian's memoirs":
"Dounding libraries was like constructing more public granaries, ammassing reserves against a spiritual winter which by certain signs, in spite of myself, I see ahead..."

CLINICAL ARTICLE

Considering Factors to Maximize Facial Profile in the Treatment of Patients With Hyperdivergent Skeletal Pattern Using Microimplants

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Abstract

In the treatment of patients with severe hyperdivergent skeletal pattern, the counterclockwise autorotation of the mandible after intrusion of the posterior teeth has an essential role in improvement of the facial profile. However, there are many factors affecting facial profile changes. These factors include the intrusion of the upper posterior teeth, the consideration of anteroposterior occlusal plane cant, bodily retraction of the upper incisors, intrusion of the upper incisors, intrusion of the lower posterior teeth, vertical position of the lower incisors, and most importantly coordination of movement at the upper and lower posterior teeth and the upper and lower incisors. A case of profound facial profile change after intrusion of the upper and lower molars and bodily retraction of the upper incisors and retraction and intrusion of the lower incisors is presented.

Keywords
Profile change; hyperdivergent patients; microimplants

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INTRODUCTION

With development and use of extradental skeletal anchorage such as the microimplants, clinicians can move teeth according to the specific planned goal without anchorage loss. The teeth movement can also be precisely controlled with the help of the microimplants three-dimensionally. After observing that microimplants could provide anchorage for the whole maxillary dentition distally in 1999[1], microimplants started to be used in many clinical situations. There are many clinical reports and studies on the treatment of various types of malocclusion, including bialveolar protrusion that required maximum retraction of the anterior teeth[2,3], whole-arch distal retraction[4-7], and intrusion of a tooth or teeth[8,9], and on open bite treatment after intrusion of the posterior teeth[10,11]. In addition, microimplants could be used more efficiently in the correction of mesially tipped molars[12], crossbites[13], and impacted canines[14].

Among all these treatment effects, the intrusion of the tooth or teeth was the only movement not obtained with conventional orthodontic treatment. Therefore, there are many case reports and studies that evaluate treatment effects after intrusion of the posterior teeth. The author has also focused on the treatment of open bite with molar intrusion. Recently, the intrusion of the posterior teeth in both arches became known as an essential factor to improve the facial profile. And the author has realized the importance of coordination of retraction and intrusion movement at the upper and lower incisors and intrusion of the upper and lower posterior teeth.

In this clinical report, the author explains a way to maximize changes in the facial profile in patients with hyperdivergent skeletal patterns and presents a case in which the patient had maximum changes in their facial profile.

The skeletal characteristics of patients with severe hyperdivergent skeletal pattern are high mandibular plane angle, upcanted palatal plane, retropositioned mandible, and long lower anterior facial height relative to posterior facial height. The dental characteristics include mesially tipped molars, divergent upper and lower functional occlusal plane, and long anterior alveolar height *(Fig. 1)*. In order to improve the facial profile with orthodontic treatment, we need to have autorotation of the mandible after intrusion of the molars with microimplants. However, there are many factors that influence the profile changes.

What follows is a list of factors that affect the facial profile in patients with hyperdivergent skeletal pattern[15]:

- The first consideration is the intrusion of the upper posterior teeth. To achieve counterclockwise rotation of the mandible, the first thing to be considered is the intrusion of the upper posterior teeth.
- Second, the anteroposterior occlusal plane cant should be checked. A large amount of intrusion of the upper posterior teeth can make the occlusal plane steep and guide the mandible backward, and this restricts the amount of counterclockwise autorotation of the mandible.
- The third factor is bodily retraction of the upper incisors. If the upper incisors are tipped lingually during retraction, this causes contact between the upper and lower incisors and tends to open the mandibular plane angle, thus reducing autorotation of the mandible. Lingual tipping of the upper incisors moves the incisal tips down and causes incisal contact. Therefore, bodily retraction of the upper incisors plays an essential role in profile changes.
- The fourth factor is the intrusion of the upper incisors. In open bite with hyperdivergent skeletal pattern, the intrusion of the posterior teeth causes autorotation without incisal contact, but autorotation of the mandible causes incisal contact with normal overbite. In this case, the intrusion of the upper incisors should be considered to provide space for autorotation of the mandible.
- For the fifth factor, the lower posterior teeth also need to be intruded in severe cases. The intrusion of only the upper teeth can induce extrusion of the lower posterior teeth, which should be prevented by microimplants, and the active intrusion of the lower posterior teeth is required in severe hyperdivergent cases.
- The sixth factor is the vertical position of the lower incisors. The lower incisors are retracted by tipping in most cases, and tipping may bring the incisal tip upward and cause incisal contact. Therefore, intrusion of the lower incisors is required in patients with severe hyperdivergent skeletal pattern.
- The seventh factor is the coordination of movement at the upper and lower posterior teeth and the upper and lower incisors, which is very important. In patients with hyperdivergent skeletal pattern, interdigitation of the teeth is not obtained easily. If 1 cusp of a tooth has occlusal contact only, the occlusion stays with no contact at the other teeth. Therefore, the coordination of movement is most important.
- For the eighth factor, the extraction of the lower second premolars is better in terms of profile improvement, because the mesial protraction of the lower posterior teeth is helpful in reducing vertical dimension or autorotation of the mandible by moving the fulcrum forward.

Figure 1: Skeletal and dental characteristics of a patient with severe hyperdivergent skeletal pattern.

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Figure 2: Pre-treatment extraoral photographs.

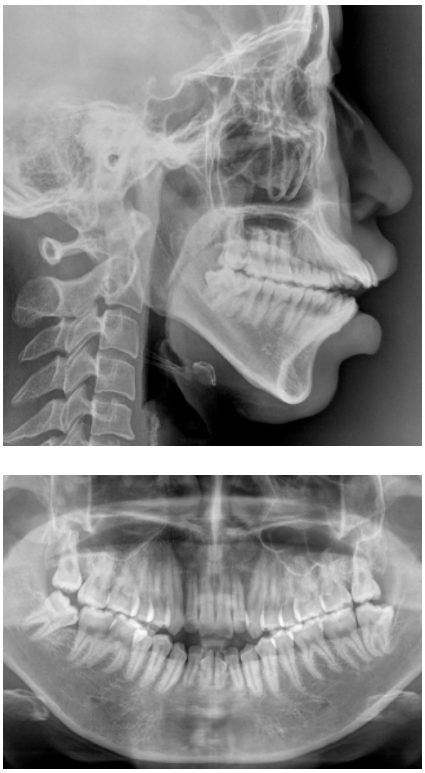

Figure 3: Pre-treatment lateral cephalometric and panoramic radiographs.

THE CASE

Patients with a hyperdivergent skeletal pattern with a large mandibular plane angle and with posteriorly positioned menton and overeruption of the maxillary and mandibular anterior teeth could only be properly treated by orthognathic surgery with a very complicated design. However, microimplants can be used in these patients. A 24-year-old female patient presented with anterior open bite and lip protrusion. The patient was treated with microimplants, and improvement of the facial profile was obtained after intrusion of the maxillary and mandibular molars and simultaneous intrusion of the anterior teeth. The mechanics using microimplants to intrude posterior teeth and retraction of the anterior teeth were applied to maximize anterosuperior rotation of the mandible.

Extraoral Findings

Lateral extraoral photos showed a convex profile with severe bilabial protrusion. A retruded mandible compared with the maxilla was observed, with a long distance from the stomodeum to the menton. Moreover, a small nasolabial angle and hyperactivity of the mentalis muscle during lip closure were found *(Fig. 2)*. The upper and lower lips were protruded from the esthetic line by 5 mm and 9 mm, respectively.

Cephalometric Analysis and Radiographic Findings

In cephalometric analysis, the A point–nasion–B point angle (ANB) was 5.6°, and the Frankfort-mandibular plane angle (FMA) was 38.6°, showing a dolichofacial pattern with long lower facial height *(Table 1)*. The maxillary and mandibular anterior teeth showed a severe labioversion. The patient was diagnosed with a skeletal Class II malocclusion caused

Measurements	Pretreatment	14 months of treatment	Posttreatment
Skeletal			
SNA	83.2	81.9	81.4
SNB	77.6	77.6	77.6
ANB	5.6	4.3	3.8
FMA	38.6	37.8	37.8
Dental			
U1 to FH	125.3	115.7	106.8
IMPA	104.4	87.5	82.7
Soft tissue			
Z-ANGLE	64.9	52.2	59.7
Upper lip to esthetic line, mm	5	1	−1
Lower lip to esthetic line, mm	9	6	2.5

Data are presented as degrees unless otherwise indicated. Abbreviations: ANB, A point–nasion–B point angle; FH, Frankfort horizontal; FMA, Frankfort-mandibular plane angle; IMPA, incisor mandibular plane angle; SNA, sella–nasion–A point angle; SNB, sella–nasion–B point angle; U1, upper incisor.

Table 1: Cephalometric measurements.

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Figure 4: Pre-treatment intraoral photographs.

Figure 5: Immediate light distal force applied from microimplants.

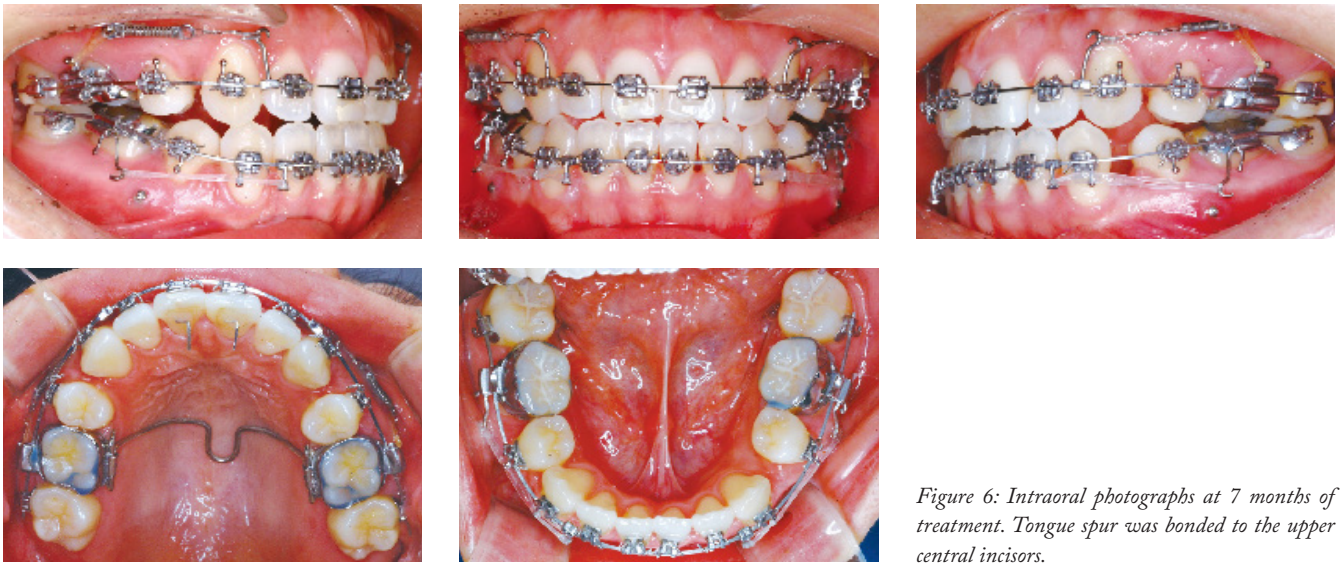

Figure 6: Intraoral photographs at 7 months of treatment. Tongue spur was bonded to the upper central incisors.

by mandibular retrognathism and open bite. In a panoramic radiograph, 4 third molars existed and there was no sign of root resorption *(Fig. 3)*.

Intraoral Findings

Anterior open bite was observed with an overbite of −5 mm. The arch length discrepancies were moderate: 3.5 mm in the maxillary arch and 3 mm in the mandibular arch. The curve of Spee was 0 mm. The anterior Bolton ratio was 79.5%, meaning that the mandibular anterior teeth were 1.1 mm larger than the maxillary anterior teeth. Therefore, interproximal reduction on the mandibular anterior teeth was planned. Class II canine and molar relationships were seen on both sides *(Fig. 4)*.

DIAGNOSIS AND TREATMENT PLAN

Third molars that might interrupt vertical control were extracted. In

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Figure 7: Extraoral photographs at 10 months of treatment. Facial profile change was minimal.

Figure 8: Intraoral photographs at 11 months of treatment. Intrusion force was applied to the upper and lower posterior teeth.

Figure 9: Intraoral photographs at 14 months of treatment. To obtain more intrusion of the maxillary posterior teeth, the palatal microimplant was placed, and palatal intrusion force was added.

addition, to solve the lip protrusion and crowing, the first premolars in all 4 quadrants were also extracted. For maximum retraction of the anterior teeth and vertical control of the posterior teeth, microimplants on both the maxilla and mandible were planned.

Treatment Progress

022 Roth straight wire brackets were bonded, and initial alignment was started. A transpalatal arch was inserted in the maxillary arch, and microimplants (Absoanchor, upper arch, SH1312-08; lower arch, SH1413-06; Dentos, Daegu, South Korea) were placed between the second premolar and first molar in both the maxilla and mandible *(Fig. 5)*. The square thread (045; Dentos, Daegu, South Korea) was connected to the canine immediately following the placement of the microimplant to exert 50 gm of distalizing force. A 016 × 022 stainless steel (SS) archwire with long anterior hooks was inserted in the maxillary arch, and 150 gm of retraction force was applied with nickel-titanium coil springs. To obtain the space for resolving anterior crowding in the mandibular arch, distal force was applied to the canine continuously. At 11 weeks of treatment, Super thread (T-45; RMO, Denver, CO, USA) was connected from the maxillary microimplant to the first molar hook to apply about 50 gm of light intrusion force to the maxillary molars.

At 7 months of treatment, positive overbite was achieved. The crowding at the mandibular anterior teeth was resolved. Thus, a 016 × 022 TMA archwire with hooks crimped in the gingival direction was inserted. The distal force to the anterior hooks was applied from the gingivally extended hook on the mandibular first molars. Because the patient had a tongue thrusting habit, tongue spurs were

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bonded on the lingual surfaces of the mandibular anterior teeth *(Fig. 6)*.

At 10 months of treatment, lip protrusion was decreased, and hyperactivity of the mentalis muscle disappeared. However, the facial profile change was minimal, and the lower facial height was still long because of inherent retropositioned mandible *(Fig. 7)*.

At 11 months, after space closure, a 017 × 025 SS archwire was inserted in the mandibular arch, and intrusion of the mandibular molars was started to induce counterclockwise rotation of the mandible *(Fig. 8)*. Unlike the maxillary arch, the mandibular arch does not require a lingual arch if light intrusion force is applied because there is a tendency toward lingual tipping in cases where premolars are extracted.

The necessity of improving the facial profile by anterosuperior rotation of the mandible justified additional intrusion of the maxillary molar with microimplants. At 14 months of treatment, the microimplant (Absoanchor, SH1312-10; Dentos, Daegu, South Korea) was placed into the palatal alveolar bone between the maxillary first and second molars, and intrusion force was applied to the molars from the microimplants. The intrusion of the posterior teeth rotates the mandible forward and upward, and this may cause traumatic occlusion at the anterior teeth. Thus, intrusion and retraction of the mandibular incisors was required. To enhance intrusion of the mandibular incisors during retraction, the hooks were crimped in the incisal direction *(Fig. 9)*.

At 20 months of treatment, the nasolabial angle was improved. Thus, retraction of the maxillary anterior teeth was stopped, and intrusion of the molars and intrusion and retraction of the mandibular anterior teeth were continued for more autorotation of the mandible. Occlusal settling was done in the final detailing procedure. At 28 months of treatment, Class I canine and molar relationships were achieved with a satisfactory facial profile *(Fig. 10)*.

Treatment Results

The total treatment time was 28 months, and open bite was treated by retraction of the anterior teeth and counterclockwise rotation of the mandible resulting from the intrusion of the maxillary posterior teeth and intrusion and uprighting of the mandibular posterior teeth. By these changes, anterior lower facial height was decreased, and hyperactivity of the mentalis muscle disappeared. Finally, improvement of the facial profile was achieved *(Fig. 10)*. The anterior open bite was corrected, and Class I canine and molar relationships were achieved. The coincident maxillary and mandibular midline and favorable arch shape were obtained *(Fig. 11)*.

On the cephalometric radiograph, uprighting of the molars on both arches could be found, and minor root resorption was found at the maxillary anterior teeth *(Fig. 12)*. The cephalometric superimpositions showed that the maxillary and mandibular anterior teeth were retracted by 12 mm and 11 mm, respectively, and this brought about a decrease in lip protrusion *(Fig. 13)*. The maxillary and mandibular molars were intruded by 3 mm and 1 mm, respectively, and counterclockwise rotation of the mandible was evident.

Figure 10: Post-treatment (28 months) extraoral photographs.

Figure 11: Post-treatment intraoral photographs.

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Figure 12: Post-treatment lateral cephalometric radiographs.

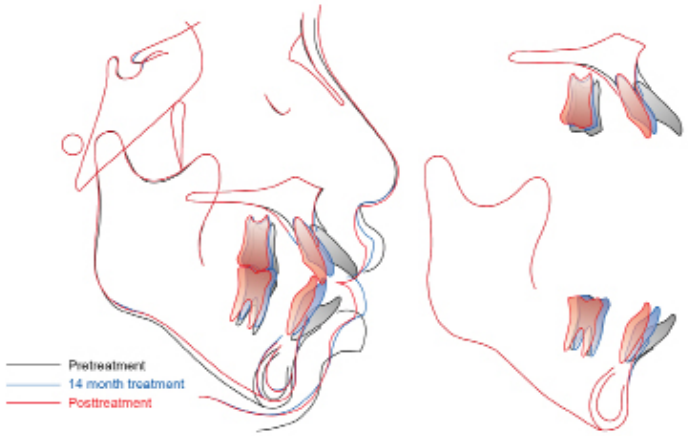

Figure 13: Superimposition of lateral cephalometric radiographs.

The ANB and FMA decreased by 1.8° and 0.8°, respectively. This is difficult to achieve in a patient with a dolichofacial pattern, and it is believed to be achieved by intrusion of the molars. At 4 years of retention, the profile and occlusion were stably maintained *(Fig. 14, 15)*.

DISCUSSION

To intrude the posterior teeth effectively, the microimplants were placed in the maxillary and mandibular posterior teeth. The 50 gm of light force was applied to minimize side effects. When intruding the posterior teeth in one jaw only, the teeth in the opposite jaw are extruded, and no decrease in vertical dimension results. Simultaneous intrusion of the posterior teeth was performed in the patient, and this brought about improvement of the facial profile. In patients who have a long distance from the incisal edges of the mandibular incisor to the menton, anterosuperior rotation of the mandible cannot be induced by intrusion of the posterior teeth only, but can be induced by combined intrusion of the anterior and posterior teeth. Elastic thread force was applied from the microimplant between the second premolars and first molars to the hook attached incisal to the archwire. This down and backward force brought about intrusion of the

Figure 14: Extraoral photographs at 4 years of retention.

Figure 15: Intraoral photographs at 4 years of retention.

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mandibular anterior teeth during retraction, enhancing autorotation of the mandible.

If space deficiency is not severe and the molar uprighting is needed more than the anterior teeth intrusion, extraction of the mandibular second premolars might be better. The general position of the mandibular microimplant is between the first and second molars in microimplant anchorage sliding mechanics, and the main purpose of this microimplant is vertical control of the posterior teeth rather than the retraction of the anterior teeth. However, the patient had a long height from the mandibular anterior incisor tip to the menton, and intrusion of the anterior teeth along with the molar intrusion was necessary for anterosuperior rotation of the mandible. Therefore, to apply down and backward force to the mandibular anterior teeth, the microimplant was placed between the second premolar and first molar.

Root resorption occurring at the maxillary anterior teeth is believed to have been caused by the anterior traumatic occlusion due to the posterior open bite after molar intrusion. Therefore, to minimize such traumatic occlusion, retraction of the anterior teeth and the intrusion of the molars should be coordinated. The anterior teeth were believed to receive jiggling force due to the tongue thrusting habit, and this was believed to be one reason for root resorption. Another reason might be the use of the 016 × 022 SS archwire until the end of treatment. Distalizing force after closing of the extraction space may act as jiggling force to anterior teeth, especially when there is no distal movement of the posterior teeth. Therefore, when applying intrusion or retraction force to the dentition after extraction space is closed, 019 × 025 SS archwire should be inserted.

Basically, the maxillary posterior teeth receive intrusion force when posterosuperior retraction force is applied from the microimplant to an anterior hook on the archwire. If more intrusion is required at the maxillary posterior teeth, intrusion force can be added to the archwire from the buccal microimplant during retraction of the anterior teeth. After extraction space is closed, intrusive force to the archwire at the premolar area from the buccal microimplant may produce labial tipping of the anterior teeth and may be insufficient to gain the maxillary molar intrusion. Therefore, the microimplant should be placed between the first and second molars for suitable molar intrusion such as in nonextraction open bite treatment. This is highly recommended if the roots of the maxillary posterior teeth are close to the maxillary sinus.

Regarding retention, retention was satisfactory, and the reasons might be because of the changes in tongue posture after treatment and the patient's excellent cooperation in performing clenching and swallowing exercises.

CONCLUSION

In the treatment of patients with severe hyperdivergent skeletal pattern, the intrusion of the posterior teeth is not enough to maximize the facial profile, and many factors need to be considered to not restrict the amount of autorotation of the mandible. The factors include the intrusion of the upper posterior teeth, the consideration for anteroposterior occlusal plane cant, bodily retraction of the upper incisors, intrusion of the upper incisors, intrusion of the lower posterior teeth, vertical position of the lower incisors, and most importantly coordination of movement at the upper and lower posterior teeth and the upper and lower incisors.

The Author presents a case in which a patient experienced a profound facial profile change after intrusion of the upper and lower molars and bodily retraction of the upper incisors and retraction and intrusion of the lower incisors. The patient showed excellent retention after 4 years.

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WHO'S WHO

In this section we introduce an influential orthodontist who has given a significant contribution to the specialty. An article by the author featuring his landmarks follows.

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Hyo-Sang Park

Hyo-Sang Park was born in a small country town in Kyungpook Province, South Korea. He received his dental education from Kyungpook National University and completed his specialty as orthodontic resident in the Department of Orthodontics, Kyungpook National University Hospital under the supervision of his mentor professor, Jae-Hyun Sung. He joined the army as captain in a military public hospital for 3 years. He worked at the Dental Department, Medical College, Keimyung University for 10 years, where he completed his PhD in 1997. His PhD research topic was neurotransmitter expression in response to orthodontic tooth movement. He moved to the Department of Orthodontics, School of Dentistry, Kyungpook National University, where he is currently Professor and Chair.

He learned many orthodontic techniques during and after his specialty education, such as the Ricketts technique, Broussard technique, and Tweed technique. The technique that influenced him most was the Tweed technique, which was introduced in South Korea by Il-Bong Kim and Jae-Hyun Sung. Because South Korean patients mostly have high-angle Class II malocclusion that requires vertical control to improve facial features, the high-pull J-hook headgear used in the Tweed-Merrifield technique can prevent lingual tipping of the upper incisors during retraction and can produce mandibular forward movement response. This is the most important effect to obtain in treating high-angle Class II cases. However, in patients who don't adhere to treatment, the results are less than desirable, and high-pull J-hook headgear use is a very difficult task for patients.

Since 1998, his interests moved to clinical studies and the use of surgical screws for orthodontic anchorage to overcome the need for high-pull J-hook headgear, publishing the first article on microimplants in the Korean Journal of Orthodontics. In the article, he alleged that microscrews can provide anchorage for distalization of the whole maxillary dentition. Since then, he has lectured extensively at orthodontic meetings and at universities in South Korea, Japan, and Taiwan to communicate the technique. He developed simple and efficient microimplant anchorage mechanics, using sliding mechanics with microimplant anchorage, retracting the 6 anterior teeth together or distalizing the dentition altogether.

He has been using microimplants for 18 years, owns 10 patents, and has written more than 70 international articles, 6 textbooks, and 5 chapters on orthodontic microimplants. He has spoken more than 70 times at prestigious meetings, including the American Academy of Orthodontics Annual Session, European Orthodontic Society Congress, and International Orthodontics Congress, as a keynote speaker. He has provided more than 130 two- or three-day microimplant training courses internationally.

He is thankful to his family for their patient support during his long travels to lectures. His son, Mick, is now studying for a PhD degree in biology at Yale University in the United States of America. Outside of orthodontics, he loves playing golf with friends and traveling with his wife, Jae-Eun.

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X-RAY ODDITIES

Many times, when we see in our practice a radiograph, we have the opportunity to note images that may or may not influence directly our diagnosis and our treatment plan.
This column of EJCO gives us the opportunity to show these images and to make some brief observations about them. The style is concise: the images largely speak for themselves.
Your suggestions for future topics as well as your comments will be very welcome.

The Goldenhar Syndrome

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Goldenhar syndrome (GS) is a rare condition with an estimated incidence of 1 per 5,800 births and a male:female ratio of 3:2. It is presumed to be an inherited condition and results in morphological abnormalities in the regions of the face that develop from the first and second branchial arches. A multifactorial aetiopathology is reported and nutritional and environmental factors seem to be important[1]. The facial features of a rare case of an 8-year-old male patient with GS are described.

GS, also known as hemifacial microsomia and oculo-auriculo-vertebral dysplasia (OAVS), can have very different manifestations in affected subjects, with severe malformations varying between patients.
According to scientific evidence, GS has the following features: mandibular hypoplasia, hemifacial microsomia, tissue underdevelopment on one side of the face, and underdevelopment of the lower and upper jaws[2,3] *(Fig. 1)*.
Macrostomia, tracheal-oesophageal fistula, oesophageal atresia, and structural and functional malformations of the pharynx and larynx increase the risk of airway obstruction and impair communication and mobility. This syndrome may cause severe obstructive sleep apnoea, which, if left untreated, could lead to growth and, in some cases, mental retardation.

A cleft lip and ogival palate are very common[4,5]. The mandibular ramus can be short or absent and the chin tends to be asymmetric. If the mandibular ramus and the mandibular condyle are absent, so too are the glenoid fossae *(Figs. 2–5)*. This phenomenon is probably due to the absence of the functional stimulus of mandibular movements and dental growth which determines the development of the temporal bone as a functional process. In this rare case, the absence of the zygomatic arch makes the facial asymmetry more obvious[6,7].
Moreover, oral abnormalities are present and visible on panoramic x-ray, with supernumerary teeth in the lower arch and a supernumerary premolar in the upper arch *(Fig. 6)*. Three-dimensional radiological diagnosis is always required so the best treatment can be planned.

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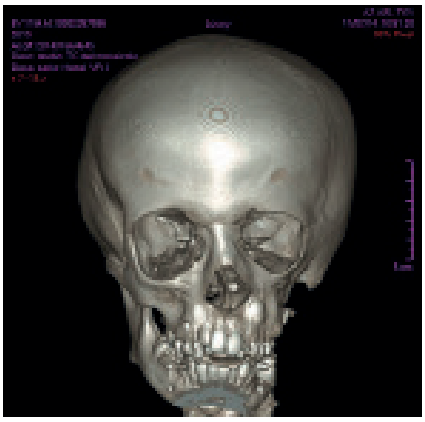

Figure 1: CT – frontal view. Asymmetric development of the maxillae and the mandible, deviation of the nasal septum and absence of the zygomatic arch.

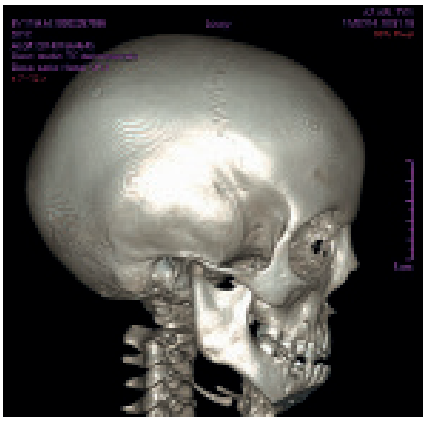

Figure 2: CT – lateral right view. Normal anatomy of the skeletal structures.

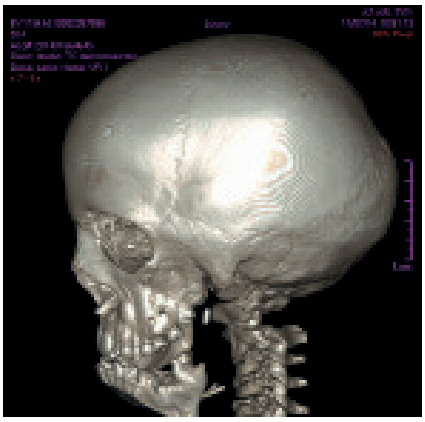

Figure 3: CT – lateral left side. Absence of the mandibular ramus, hypoplasia of the maxillae and the third middle of the face with alteration of the lower edge of the eye orbit and absence of the glenoid fossae and associated ligaments (temporomandibular, sphenomandibular, stylomandibular).

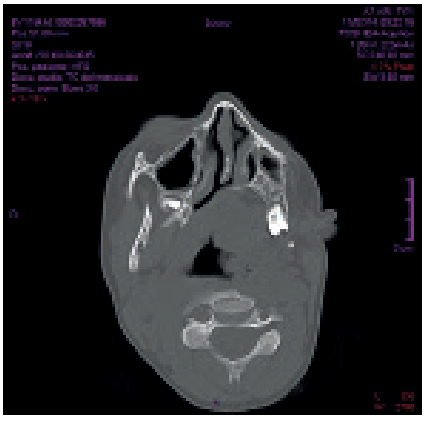

Figure 4: MRI – horizontal view of the nasal region. Asymmetric development of the maxillary sinus. In particular, there is underdevelopment of left maxillary sinus with pneumatisation at the retrobulbar level; the ethmoid and sphenoid sinuses show no significant anomalies. Note the asymmetric vertical position of the maxillary tuberosity.

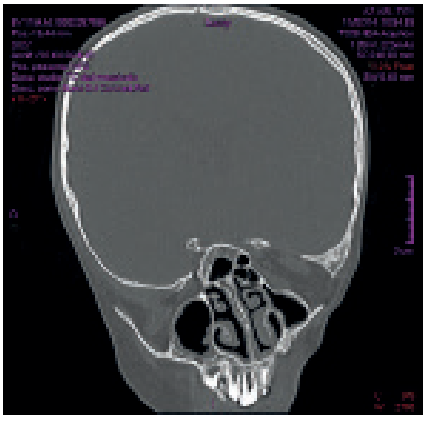

Figure 5: MRI – frontal view of the nasal region. Deviation of the nasal septum with reduced patency of the ipsilateral nasal fossa (interruption of the nasal cavity floor bilaterally in the cranial portion).

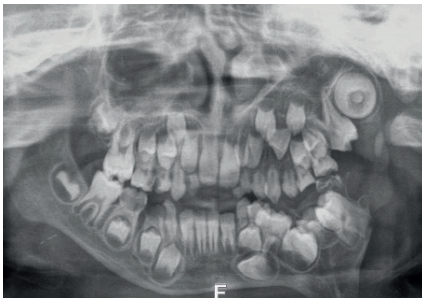

Figure 6: Orthopantomograph. Normal development of the mixed dentition on the right side but dental anomalies on the left side with supernumerary teeth in the upper jaw. There is multiple dental impaction in the lower arch and absence of the mandibular canal, a wide cleft palate and otodysplasia major. A bony formation with downward development is visible on the left side of the mandible.

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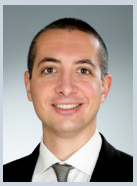

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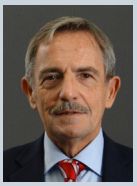

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Workshop on Early Treatment, SIDO International Spring Meeting, Turin, Italy, March 6-8, 2014

A questionnaire was given to all of the speakers who attended the SIDO International Spring Meeting in Turin, Italy on March 6-8, 2014. Each speaker was asked to answer the following 7 questions:

1. What are the most commonly known orthodontic problems usually addressed with one phase of early treatment?
2. Based on the answer to Question 1, do we have sufficient evidence regarding one phase of early treatment?
3. Do we have evidence on the cost-benefits of early treatment?
4. Does an early phase of treatment eliminate/reduce the need for a second phase of treatment in permanent dentition?
5. Are treatment alternatives to early treatment possible?
6. If so, in your opinion, are treatment alternatives clearly and routinely provided to the patient?
7. Is information to the public about early treatment protocols and their evidence clear and exhaustive?

Answers to Questions 1 and 3 were divided into vertical, transverse, sagittal, dental, and functional/temporo-mandibular joint problems. Speakers were then asked to agree or disagree with the remaining questions according to the following scale: strongly agree; agree; neither agree nor disagree; disagree; and strongly disagree. The answers are shown in *Tables 1 and 2*. All speakers were invited to quote references supporting their answers.
Out of the 33 speakers who attended the meeting, 19 (58%) answered the questionnaire and only 13 (39%) gave references. A scientific committee summarized the consensus of the workshop, based on the answers given to the 7 questions.

CONSENSUS SUMMARY OF THE WORKSHOP

1. What are the most commonly known orthodontic problems usually addressed with one phase of early treatment?

Early, or phase I, orthodontic treatment is defined as treatment started in either the primary or mixed dentitions[1]. The perceived benefits include improvement in the patient's self-esteem[2], greater ability to modify the growth process[3], earlier resolution or interception of the developing malocclusion[4], more stable results[1], less extensive therapy, and shorter treatment time in the permanent dentition[1,3].
The most commonly known orthodontic problem addressed with one phase of early treatment was posterior crossbite (according to 92.31% of the speakers). When grinding alone is not effective, maxillary expansion will decrease the risk of a posterior crossbite from being perpetuated to the permanent dentition[5,6]. Banded or bonded rapid maxillary expanders (RME), Quad Helix (QH), and expansion plates (EP) provide a correction of posterior crossbite at a high success rate[5-12], an anterior crossbite self-correction[13], an increase in maxillary arch perimeter (approximately 4 mm, when RME is followed by fixed appliances), and a maintenance of mandibular arch perimeter (2.5 mm)[9,10]. Moreover, early treatment of functional unilateral posterior crossbite could optimize conditions for function and development[14-19]. It was unclear if RME could help Class II correction[20].

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Early orthodontic treatment was also proposed by 46.15% of speakers for the correction of a mild to moderate dento-skeletal Class III or Class II malocclusions. Rapid maxillary expansion and facemask therapy[21-27], Frankel's function regulator-3 (FR-3)[28], and reverse pull headgear[29] are effective in the short- and long-term correction of Class III malocclusion. Better results could be obtained when the interventions are undertaken during mixed dentition (under 10 years of age). With regard to Class II malocclusion, the evidence suggests that providing "two-phase treatment" is more effective in reducing the incidence of incisor trauma than providing "one-phase treatment". There are no other advantages to providing early treatment when compared to treatment in adolescence. When functional appliance treatment is provided in early adolescence, it appears that there are minor beneficial changes in skeletal pattern; however, these changes are probably not clinically significant[30-37].

The third orthodontic problem (38.46%) addressed with one phase of early treatment was impacted or displaced permanent teeth. RME treatment following surgical removal of the obstacles to the eruption (supernumerary teeth, odontomas) seems to be an efficient interceptive approach leading to the eruption of impacted permanent incisors[38]. Meanwhile, interceptive protocols proposed for palatally displaced permanent canines include extraction of the corresponding primary teeth (EC), orthodontic procedures to maintain or increase maxillary arch length or perimeter such as RME, transpalatal arch (TPA), and cervical-pull headgear (HG), or a combination of these modalities (TPA+EC, RME+TPA+EC, RME+HG, EC+HG). There is currently no evidence on the effects of EC with palatally displaced permanent canines[39]; meanwhile, the prevalence of canine eruption is 65.7% for RME[40], 79.0% for TPA+EC[41], 80.0% for RME+TPA+EC[41], 82.3% for HG[42] and 85.7% for RME+HG[42] versus 28% for no treatment[41].

Approximately one third (30.77%) of the speakers said they treated early anterior open bite[43,44] and functional/tempo-mandibular disorders[45-47].

2. Based on the answer to Question 1, do we have sufficient evidence regarding one phase of early treatment?

Most of the speakers strongly agreed (38.46%) or agreed (38.46%) that there is evidence on one phase of early treatment[48-50]. Only two (15.39%) were undecided and one (7.69%) was in strong disagreement[51]. The highest level of evidence concerns early treatment of posterior crossbite, Class III malocclusion, and Class II malocclusion, when attempted to reduce the incidence of incisor trauma[52].

3. Do we have evidence on the cost-benefits of early treatment?

The answers on the cost-benefit of early orthodontic treatment were consistent with those for question 1, with the exception of functional/tempo-mandibular disorders. According to the speakers, there was evidence for transverse (84.62%), sagittal (53.85%), and functional problems, while the early treatment of vertical (38.46%) and dental problems (38.46%) reached the lowest level of evidence.

According to the cited references, there is some evidence of the effectiveness of early treatment only for the posterior crossbite[53-55]. Regarding the sagittal problem, although providing early treatment for children with prominent upper front teeth (Class II malocclusion) is more effective in reducing the incidence of incisor trauma than providing treatment in adolescence[30,56], it appears that "two-phase treatment" does not produce major differences in jaw relationships or dental occlusion compared with "one-phase treatment"[30,57,58]. None of the studies cited evaluated the cost-benefit of early treatment of Class III malocclusion and other vertical, dental, and functional problems.

Generally, the most suitable ages for screening the child population for interceptive orthodontics is 9 years and 11 years[59]. The outcome of interceptive treatment is very favourable, both in terms of improvement in the presenting condition and in reducing the need for subsequent treatment[60,61]. The disadvantages of early treatment are prolonged treatment time and a higher incidence of premature termination of treatment, which is attributed to patient/parent "burn-out." To avoid compliance problems due to excessive treatment times, it is recommended that early treatment with fixed appliances be limited to 12 months of active phase I treatment and be reserved for patients where it is clearly indicated[62].

4. Does an early phase of treatment eliminate/reduce the need for a second phase of treatment in permanent dentition?

Most of the orthodontists (61.54%) did not perceive one-phase treatment as prevention for the need for a second

Questions	Vertical	Transverse	Sagittal	Dental	Functional / TMJ
1. What are the most commonly known orthodontic problems usually addressed with one phase of early treatment?	4	12	6	5	4
	30.77%	92.31%	46.15%	38.46%	30.77%
3. Do we have evidence on the cost-benefits of early treatment?	5	11	7	5	7
	38.46%	84.62%	53.85%	38.46%	53.85%

Table 1: Answers to questions 1 and 3.

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Questions	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
2. Based on the answer to Question 1, do we have evidence to one phase of early treatment?	5	5	2	-	1
	38.46%	38.46%	15.39%	-	7.69%
4. Does an early phase of treatment eliminate/reduce the need for a second phase of treatment in permanent dentition?	1	7	3	1	-
	7.69%	53.85%	23.08%	7.69%	-
5. Are treatment alternatives to early treatment possible?	-	3	4	3	3
	-	23.08%	30.77%	23.08%	23.08%
6. If so, in your opinion are they clearly routinely provided to the patient?	1	-	6	2	2
	7.69%	-	46.15%	15.39%	15.39%
7. Is information to the public about early treatment protocols and their evidence clear and exhaustive?	-	-	3	3	5
	-	-	23.08%	23.08%	38.46%

Table 2: Answers to the questions 2, 4, 5, 6 and 7.

phase of treatment, or that it offered any particular advantage with respect to preventing the need for extractions or other skeletal treatments in the second phase. They viewed early treatment as effective in reducing the severity of and priority for a second phase of treatment[61,63-68]. Only 3 speakers answered that they were undecided, while one was in disagreement. Although they have a wide theoretical basis and an appealing rationale, preventive and interceptive orthodontic procedures appear unable to successfully manage more than 15-20% of developing malocclusions in children. Corrective orthodontic procedures, rather than preventive-interceptive ones, should be emphasized both in public planning for the delivery of care and in dental education[69].

5. Are treatment alternatives to early treatment possible?

The most common alternative to "two-phase treatment" is "one-phase treatment" with fixed appliances, with or without the extraction of permanent teeth. The possibilities of not treating, camouflaging, or opting for orthognathic surgery at the end of growth should be considered for correcting malocclusion, as well[70-71]. The distribution of the answers was quite similar (from 23.08 to 30.77%) for all of the speakers. No one was in strong agreement.

6. If so, in your opinion, are treatment alternatives clearly and routinely provided to the patient?

About half of the speakers (46.15%) were undecided on this point, while the remaining strongly agreed (7.69%); disagreed (15.39%); and strongly disagreed (15.39%).
Whether treatment alternatives are clearly and routinely proposed to patients depends on the individual practitioner. It is clear that each practitioner should provide exhaustive verbal and written options of the different types of treatment, illustrating both their advantages and disadvantages, so patients are facilitated in their choice of treatment[72].

7. Is information to the public about early treatment protocols and their evidence clear and exhaustive?

No, the public do not receive clear and exhaustive information about early treatment protocols and their evidence. Orthodontists should be encouraged to inform patients regarding the possible risks, benefits, costs, and alternatives of their chosen treatment[73]. All of the speakers agreed with this statement (23.08-38.46%).

DISCUSSION

The aim of this workshop was to summarize the knowledge and experiences of the referenced speakers who attended the SIDO International Spring Meeting on early orthodontic treatment. The speakers agreed in most of the answers, but a consensus was not always found. Additionally, all of the systematic reviews on early treatment were considered,

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in order to reach the highest level of scientific evidence. According to the systematic reviews analysed, there is moderate to low quality of evidence on one phase of early treatment. The highest level of evidence concerns early treatment of posterior crossbite[5,74,75], Class III malocclusion[76,77] and Class II malocclusion, when attempted to reduce the incidence of incisor trauma[30]; meanwhile, the quality of the rest of the evidence is very low[39,78-80]. Most of the available studies have serious problems that range from small sample size, bias and confounding variables to a lack of method error analysis, blinding in measurements, and deficient or lack of statistical methods. Better-controlled randomized clinical trials, which follow the guidelines produced by the Consolidated Standards of Reporting Trials (CONSORT), are needed to obtain reliable scientific evidence[75].

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clinical TIPS

The Midline Guide: A New Method for Evaluating Midline Deviation

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Abstract

Evaluation of the dental midline in relation to facial midline is key in diagnosing, treatment planning and tracking progress. We propose a unique method to clinically locate and quantify maxillary dental midline deviations using a 'midline guide,' which can also be used to check for mandibular asymmetry and possible canting.

Keywords
Dental midline, facial midline, midline guide, canting, asymmetry

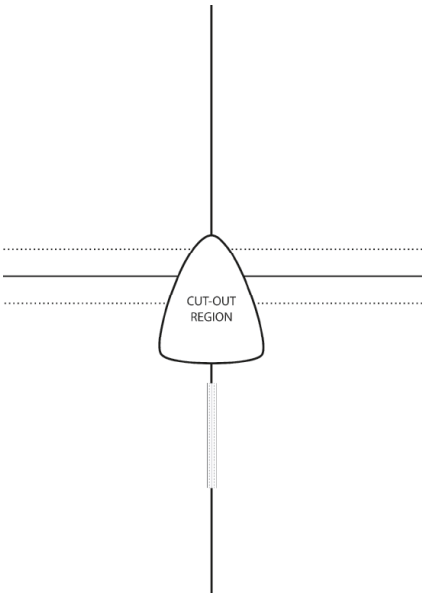


Figure 1: The midline guide is printed on a transparent sheet using a laser printer. The figure shows vertical and horizontal orientation lines and the nose cut-out region.

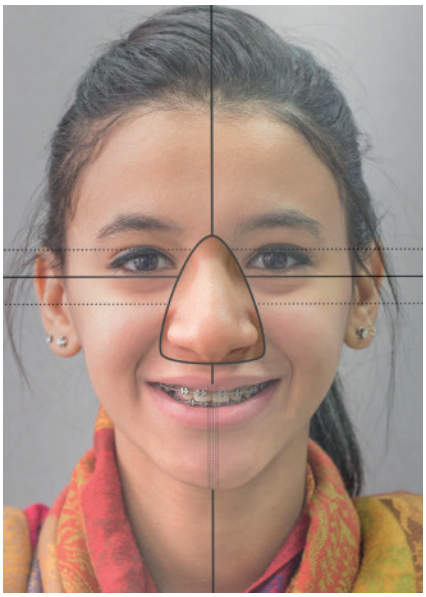


Figure 2: The guide is placed over the patient's face, and the orienting lines are aligned as follows: (1) the horizontal lines are parallel to the interpupillary line; (2) the vertical center line passes through two points, the center of the Glabella and Subnasale; and (3) the dental midline is compared with the vertical center line to determine deviation.

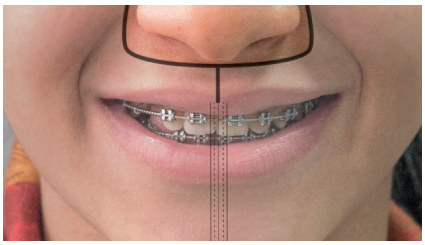
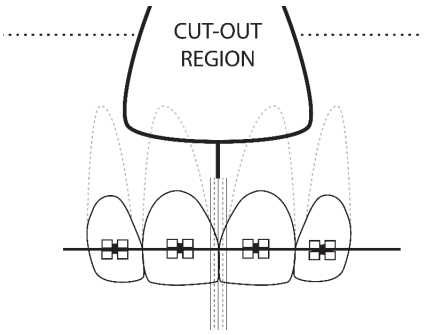


Figure 3: A close-up view of a patient showing a 0.5 mm shift to the right side.



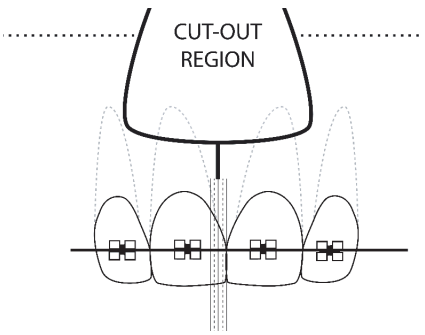


Figure 5: Illustration showing dental midline shifted 2 mm to the left.

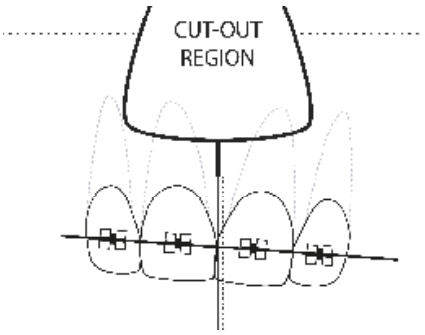


Figure 6: Illustration showing canting of incisors. The dental midline crosses several vertical orienting lines.

INTRODUCTION

Clinical evaluation of dental midlines in relation to the facial midline is troublesome. It has been shown that 39% of patients receiving orthodontic care have maxillary midline deviation from the facial midline[1]. Many methods have been proposed to localize and quantify midline deviation. Some of these methods include drawing two vertical marks on the patient's face with a soft pencil; one at the center of the philtrum and the other at the mid-chin region[2]. Another method uses a piece of dental floss stretched and centralized from above the forehead to below the chin with the patient supine or standing up[3]. A third method includes visual assessment by an imaginary line passing through a single structure such as the philtrum[4] or, alternatively, two structures – the center of the Glabella and soft tissue Pogonion[5]. Finally, one method utilizes the mid-philtrum and the distance between the canine and corners of the mouth, as suggested by Burstone[6].

Some of the points used to establish the facial midline are located arbitrarily, require parallax to properly visualize them, and are affected by asymmetry[6]. However, the face is never symmetrical, and many of the midline structures are not well aligned on the face. The nose plays an important role in the perception of facial symmetry[7]. In Korea, the prevalence of nasal septal deviation was found to be 48%[8]. Nasal septal deviation may be apparent on the face; thus, it is essential to exclude a deviated nose in midline assessment[4]. A deviated chin can also distort the reference plane and lead to improper midline assessment[9].

None of the methods described above are universally accepted, and no guidelines on properly clinically locating and quantifying midline deviations without error exist. Thus, there is a need for a quick, simple, and reproducible way to check midline shifts at any stage of treatment. We herein propose a new method to find and measure midline deviations.

TECHNIQUE

To use the attached midline guide *(Fig. 1)*, print it out on a transparent laser printer sheet and use a sharp knife or scalpel to remove the nose cut-out region. The guide consists of vertical and horizontal orienting lines. The vertical center line should

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coincide with the midline of the face – the center of the Glabella and Subnasale are used as references and can be marked with a light pencil if necessary *(Fig. 2)*. The horizontal lines must be oriented parallel to the interpupillary line. The two vertical broken lines to the right and left of the vertical center line denote a 1 mm deviation from the vertical center line, and the two solid lines denote a 2 mm deviation. If the dental midline appears between any two lines, the value is 0.5 mm *(Fig. 3)*.

The nose, which if taken into account would result in erroneous measurement, is cut out from the midline guide. Excluding the effect of the nasal tip or septal deviation on the facial midline allows the guide to be placed closely to the face of the patient to reduce parallax errors. Additionally, no points are chosen on the chin region because it would be subject to change due to asymmetry or functional shifting.

After determining the upper midline position *(Fig. 4, Fig. 5)*, it can be used as a reference to quantify the lower midline shift. However, it is important to ensure that there is no functional shifting and that the patient bites in the correct position. The midline guide can also be used to check for canting. Dental or skeletal canting may be present if the maxillary dental midline is not parallel to the vertical center line of the midline guide *(Fig. 6)*.

CONCLUSION

A new method to clinically assess shift in the dental midline using a transparent sheet marked with orientation lines was presented. The advantages of this method include:

- It is simple, reproducible, and inexpensive;
- It determines upper midline deviation from the facial midline and lower midline shift in relation to upper midline position;
- It indicates mandibular asymmetry and possible dental/skeletal canting.

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