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**Management of a Patient with Euryprosopic Face and Upper Central Diastema**

Chung-Teng Chang  
*Dr. Su’s Teamwork Orthodontic Center, Taipei, Taiwan*

Yi-Min Liu  
*Dr. Su’s Teamwork Orthodontic Center, Taipei, Taiwan*

Yuen-Yung Tsang  
*Dr. Su’s Teamwork Orthodontic Center, Taipei, Taiwan*

Huei-Mei Tsai  
*Dr. Su’s Teamwork Orthodontic Center, Taipei, Taiwan; Dental Department, Taipei Medical University, drsuortho@yahoo.com.tw*

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INTRODUCTION

A 53-year-old Chinese female with upper central diastema requested to close the gap permanently. The space at the center of the upper dentition is commonly seen in local people, and it was thought as an unlucky sign of hard to secure one’s fortune. The patient demonstrated broad face, under-developed nose and protrusive lips (Figure 1, 2, 3). The patient asked for no change of her facial profile. A low facial index of 82 degree was revealed (Figure 1); the face was thus classified as ‘euryprosopic’, which differs from “brachyfacial” or “brachycephalic”, as suggested by Franco. Broad facial transverse dimension and ovoid-shaped dental arch equipped with normal sized teeth were the main etiologies, the deep bite acquired afterward.

Upper median space closure was accomplished by having the roots of upper central incisors over-corrected to become divergent while the crown of the teeth converged toward the midline, as suggested by Mulligan. This is absolutely necessary to avoid space reopening. On the other hand, spacing became more obvious at the lower dentition after initial leveling with the pre-adjusted edgewise system. Class II intermaxillary elastics were used to protract the lower posterior teeth forward to reduce the lower interdental spaces. This traction force can result in correction of deep bite and overjet, close the spaces and also induce lower incisor flaring. Patient’s facial profile improved slightly, and space reopening was not found in the follow up records.

Euryprosopic facial pattern usually has influences on the mandibular growth direction and dental arch development and thereby affects the selection of orthodontic mechanics. This case report aims to clarify the characteristics of euryprosopic facial type and its dental adaptation. The diagnosis, planning of the treatment, and the retention for the stability of upper central diastema will be presented.
Euryprosopic Face and Upper Central Diastema

**Fig. 1A** Facial index is usually measured in the dry skull and/or PA cephalometry. Bizeygomatic width (blue arrow) and facial height (orange arrow) were illustrated on patient’s facial photograph to demonstrate patient’s facial type classification. The ratio of facial height/bizeygomatic width was 82% and classified as euryprosopic facial pattern.

<table>
<thead>
<tr>
<th></th>
<th>Patient</th>
<th>Chinese female norms</th>
</tr>
</thead>
<tbody>
<tr>
<td>bifrontozygomatic width</td>
<td>124.0</td>
<td>102.9±3.0</td>
</tr>
<tr>
<td>maxillary width</td>
<td>101</td>
<td>92.7±4.9</td>
</tr>
<tr>
<td>bignonal width</td>
<td>110.0</td>
<td>92.0±4.7</td>
</tr>
<tr>
<td>bizeygomatic width</td>
<td>153.0</td>
<td>125.8±3.8</td>
</tr>
</tbody>
</table>

**Fig. 1B** Bifrontozygomatic width, bizeygomatic width, maxillary width, and bignonal width were all beyond the mean value. (Wei, 1970)

**Fig. 2** The mean value of facial convexity angle described by Legan and Burstone is 12±4°. The facial convexity angle (yellow and blue line) was 3°. It was classified as a straight profile. The nasal depth (red line) of this patient was 14mm, smaller than the normal value from Li and Arshad’s study. (Li, 2014; Arshad, 2013) This indicated that the patient had a small nose.

**Fig. 3** Since the patient had underdeveloped nose, the ideal positions of the lips should not be judged only by Ricketts’ esthetic line. Esthetic lines described by different authors were used to measure the patient’s lip protrusion.
CASE REPORT

Clinical findings

The patient had low facial index value and an euryprosopic face which was confirmed with cephalometric measurements (Figure 1). On the PA cephalogram, the facial index is figured out from the facial height (nasion to gnathion), divided by the bizygomatic width and then multiplied by 100. The facial index was 82%, and ranked as “euryprosopic”, in a group of 80 to 84.9%. Sagittally, the patient showed a straight profile with a normal value of facial convexity angle (Figure 2). The patient had small, upward inclined nose which made the lips looked more protrusive.

The patient’s upper dental midline was coordinated to the facial midline. The lower midline was 1 mm deviated to her right side (Figure 4). An upper central diastema of 2.5 mm was distinctive. The dental papilla loss was found between the upper central incisors. There was 5.5 mm overjet, 4.5 mm overbite, and the curve of Spee was 3 mm in depth. Molars and canines were both in Class II relationships (Figure 5). These findings suggested that the patient had jaw discrepancy and dental compensation. The periodontal conditions were generally fair.
Euryprosopic Face and Upper Central Diastema

Fig. 6 Patient’s upper and lower inter-canine and inter-molar width were larger than the norms of Chinese population (Ling, 2009). This indicated that this patient had a relatively wider basal arch, which is agreed with patient euryprosopic facial form.

<table>
<thead>
<tr>
<th>Arch width (mm)</th>
<th>Chinese norm</th>
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<tbody>
<tr>
<td>13 to 23</td>
<td>35.09±3.5</td>
<td>35.9</td>
</tr>
<tr>
<td>33 to 43</td>
<td>27.32±2.4</td>
<td>29.3</td>
</tr>
<tr>
<td>14 to 24</td>
<td>42.83±4.2</td>
<td>44.9</td>
</tr>
<tr>
<td>16 to 26</td>
<td>54.15±2.6</td>
<td>55.3</td>
</tr>
<tr>
<td>36 to 46</td>
<td>47.82±2.1</td>
<td>48.4</td>
</tr>
<tr>
<td>17 to 27</td>
<td>51.71±2.4</td>
<td>53.3</td>
</tr>
<tr>
<td>37 to 47</td>
<td>52.03±3.0</td>
<td>54.8</td>
</tr>
</tbody>
</table>

Fig. 7 Arch length at both arches were all shorter than mean values (Huang, 1991), this further exposed the procumbency of patient’s anterior teeth. Patient’s lower dentition was also in a retruded position than the upper dentition.

<table>
<thead>
<tr>
<th>Arch length (mm)</th>
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<th>this patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>dentition</td>
<td>maxilla</td>
<td>34.2±2.38</td>
</tr>
<tr>
<td></td>
<td>mandible</td>
<td>31.07±2.54</td>
</tr>
<tr>
<td>basal bone</td>
<td>maxilla</td>
<td>29.96±2.16</td>
</tr>
<tr>
<td></td>
<td>mandible</td>
<td>27.56±2.19</td>
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</table>

Tooth size

<table>
<thead>
<tr>
<th>Tooth size</th>
<th>Chinese Female Mean±SD</th>
<th>patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maxilla</td>
<td></td>
<td></td>
</tr>
<tr>
<td>central incisor</td>
<td>8.39±0.47</td>
<td>8.2</td>
</tr>
<tr>
<td>lateral incisor</td>
<td>6.85±0.45</td>
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</tr>
<tr>
<td>canine</td>
<td>7.78±0.41</td>
<td>8.1</td>
</tr>
<tr>
<td>1st premolar</td>
<td>7.27±0.38</td>
<td>7.5</td>
</tr>
<tr>
<td>2nd premolar</td>
<td>6.79±0.37</td>
<td>6.8</td>
</tr>
<tr>
<td>1st molar</td>
<td>10.00±0.62</td>
<td>10.0</td>
</tr>
<tr>
<td>Mandible</td>
<td></td>
<td></td>
</tr>
<tr>
<td>central incisor</td>
<td>5.32±0.35</td>
<td>5.4</td>
</tr>
<tr>
<td>lateral incisor</td>
<td>5.90±0.41</td>
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</tr>
<tr>
<td>canine</td>
<td>6.90±0.44</td>
<td>7.0</td>
</tr>
<tr>
<td>1st premolar</td>
<td>7.10±0.49</td>
<td>7.3</td>
</tr>
<tr>
<td>2nd premolar</td>
<td>7.03±0.46</td>
<td>7.4</td>
</tr>
<tr>
<td>1st molar</td>
<td>10.75±0.67</td>
<td>10.5</td>
</tr>
</tbody>
</table>

Fig. 8 Patient’s tooth size was within normal ranges at both arches. (Huang, 1991) With enlarged arch width, tooth size/arc length discrepancy exists.
The Bolton’s ratio was measured 77.9% anteriorly, the overall ratio was 91.1%. The tooth size was ascertained and found within normal ranges of Chinese female. Both upper and lower arch widths were distinctly wider, while arch lengths were shorter than the normal values, concomitant with patient’s facial type and head form (Figure 6, 7, 8).

The Steiner analysis of indicated that the patient’s jaw relations was orthognathic as revealed from ANB angle (Figure 9). The Wits appraisal was -3.5, which is closed to normal range of Chinese Female. With these two measurements, the patient has no major sagittal jaw bone discrepancy.

Secondly, the Wylie’s analysis becomes essential in this case, the mandibular corpal length was found much larger than the norm, whereas the anteroposterior dysplasia in net score was measured as -8. These features indicated that the mandibular body was relatively over-sized. The lower jaw did not protrude anteriorly, instead, it stayed posteriorly to the maxilla. The negation of mandibular prognathism in sagittal direction might result from patient’s large transverse dimensional growth which usually completed prior to other two dimensions, vertical and sagittal. Large dental arch equipped with normal sized teeth would further induce deep bite, deep curve of Spee and spacing dental arches.

The mandibular plane angle was within normal range. The patient had proclined upper and lower incisors initially. The U1-SN and L1-MP values were larger than the norm value, and the inter-incisal angle was acute (Figure 9). From the PA cephalometric radiograph, mild skeletal asymmetry was noted. Transverse dimensions showed no significant maxillomandibular difference in width. Linear data including bifrontozygomatic width, bizygomatic width, maxillary width, and bigonial width were all larger than the norm values (Figure 1B).

The panoramic film revealed missing of all 3rd molars (Figure 11).

**Diagnosis**

Patient’s malocclusions were mainly taken place primarily on transverse dimension. The diagnosis was listed as (1) Euryprosopic facial pattern and relatively posterior-located large mandible, (2) broad ovoid-shaped upper dental arch and spacing due to broad facial pattern and normal sized teeth, (3) upper central diastema, supra-erupted upper incisors and bimaxillary dentoalveolar protrusion.

**Treatment planning based on the etiology and diagnosis**

The treatment goal is to correct patient’s central diastema, deep bite, and improve upper lip protrusion slightly. The treatment strategies were: no expansion of dental arches, no extraction of teeth and to close upper diastema by root divergency. In the lower arch, the space closure mainly by protraction and bodily movement of the posterior teeth to reach the goal. Elastomeric power chains should not be used in diastema closure. The major concern hence included the management of avoiding reopening of those already closed spaces.

To gain stable treatment results, endeavors should be done to pursue root divergency of upper central incisors in early treatment stages, and long term or permanent fixed retention.

Two TADs were inserted at upper anterior region to intrude the upper anterior teeth. The aim was to prepare a better foundation for the upper incisors to maintain a normal display during retraction, closing the central diastema and application of Class II elastic traction at later stage.

**Treatment progress**

The .022x.028 preadjusted brackets were bonded and the .014 NiTi arch wire was used to start initial leveling and aligning. Anterior bite turbo was added at upper central incisors to disocclude the teeth and facilitate the leveling of curve of Spee. Two 4.5oz vertical elastics
Fig. 9 From the initial lateral cephalogram, it was diagnosed that the patient had orthognathic maxilla and mandible sagitally. The mandibular plane angle was normal. The upper and lower incisors were labially inclined.

<table>
<thead>
<tr>
<th>Pre-treatment</th>
<th>Post-treatment</th>
<th>Follow-up</th>
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<tbody>
<tr>
<td>SNA</td>
<td>65°</td>
<td>65°</td>
</tr>
<tr>
<td>SNB</td>
<td>82°</td>
<td>82°</td>
</tr>
<tr>
<td>ANB</td>
<td>3°</td>
<td>3°</td>
</tr>
<tr>
<td>Wits</td>
<td>-3.5</td>
<td>-3.5</td>
</tr>
<tr>
<td>SN-MP</td>
<td>30°</td>
<td>30°</td>
</tr>
<tr>
<td>U1-SN</td>
<td>119°</td>
<td>111°</td>
</tr>
<tr>
<td>L1-MP</td>
<td>103°</td>
<td>112°</td>
</tr>
</tbody>
</table>

Fig. 10 In Wylie’s analysis of AP dysplasia, if the net score is zero, it represents lack of anteroposterior dysplasia; a Class III tendency is manifested in positive value, while a Class II tendency is reflected by negative values (Wylie, 1947). In this case, the mandibular length was 108mm, larger than the standard value by 7mm, yet the net score of the analysis was -8. The patient has larger than normal mandibular corpus but the mandible is located posterior to the maxilla.

Fig. 11 (Left) Tooth 18 28 38 48 missing, teeth 17 and 45 were previously endodontic treated and had crowns fabricated. The periodontal conditions were fair and acceptable. (Right) After treatment, roots parallelism was mostly achieved. Root resorptions were not noticeable.
at the premolar region in both sides were also included (Figure 12A). The Mulligan method was adapted. The roots of the central incisors were moved apart, the elastomeric chain was avoided to prevent tipping and approximating only the crown portion of both central incisors (Figure 12). The root divergence of incisors would ensure their crown portions to develop a stable contact relationship. The contouring of the incisal edges of the central incisors was performed at later stage.

After initial leveling, anterior bite turbos were removed and main arch wires were changed to .016x.022 NiTi. Two TADs were placed at the upper anterior region to assist relative intrusion of upper anteriors (Figure 12C). The arch wires were changed to .016x.022 stainless steel wires. Class II elastics (3.5oz) was adopted for holding the upper anteriors while protracting the lower posteriors to close the space at the lower dentition. The remaining space closure was reached by protracting the lower posterior teeth as much as possible (Figure 13).

After detailing and consolidation, both arch wires were removed but left the brackets on teeth for at least 4 more months. The stage of prolonged treatment is ensuring the stability of space closure. Lingual fixed retainers were then placed two months ahead of total brackets removal (Figure 14). Hawley retainers were delivered in addition to the fixed lingual retainers afterward. The orthodontic treatment duration was 44 months.

Treatment results

The patient had less protrusive lips after orthodontic treatment (Figure 14A). The nasolabial angle was changed from 80° to 90°. The space in the front teeth were all closed. The canines and molars were both in Class I relations with good interdigitation. The incisor relations became optimal, with 2 mm overjet and 1.5 mm overbite (Figure 14). The follow up records demonstrated stable occlusion and no signs of relapse for at least two years (Figure 14C).

The post-treatment panoramic radiograph showed good root parallelism and no appreciable root resorption (Figure 11). In regional superimpositions of cephalometric tracings, patient’s upper incisor had retracted 1 mm without elongation; the upper first molar was extruded 1.5 mm and retracted 1 mm (Figure 15). Patient’s lower incisor was labially inclined by 9 degrees and the lower first molar was protracted by 1 mm. The mandible had a minor clockwise rotation with the mandibular plane angle increased 0.5°.

DISCUSSION

1. The euryprosopic facial form

The mongoloid has different characteristics to the Caucasoid or negroid, they are more common to have broad and flat facial profile with prominent zygomatic arches. Small nasal bones and a concave nasal profile are also common features for the mongoloid. To describe a face which is broad and not long, Franco et al pointed out that “euryprosopic” should be more specific and relevant than” brachyfacial”. The authors indicated that the facial width is not considered in most classification system, and the terms related to cephalometric index such as dolicocephalic and brachycephalic are not able to describe the face. It was reported that the shape of face may not necessary relate to skull morphology, a dolichocephalic head may have euryprosopic facial pattern. Enlow proposed a concept in his counterpart analysis that the brachycephalic headform is more likely to have an upright orientation of the middle cranial fossa, which may cause the mandibular ramus and body to have a “protrusive effect”, and the vertical dimension of the face is relatively reduced. Enlow reported normal variations in facial form as well as the anatomic basis of malocclusions and indicated that the backward rotation of the nasomaxillary complex concurrent with a well-developed nose contribute a tendency of Class II malocclusion with protrusive maxilla and retrusive mandible in facial development of dolichocephalic
(top) **Fig. 12A** Initial leveling with .014 NiTi wires. Anterior bite turbo (yellow arrow and circled) was added to instantly raise the bite and to disocclude the teeth. The up-and-down (red dotted lines) elastics at the premolar region can elongate the premolars and facilitate the leveling of the curve of Spee.

(bottom) **Fig. 12C** Two TADs were placed anteriorly to help the intrusion of upper anterior teeth. Use .016x.022 stainless steel wire with L loops to simultaneously maintain the vertical position and torque values of the upper incisors and for the Class II elastics to hook on later.

**Fig. 12B** To use pre-adjustment appliances and bonding the brackets with exaggerated inclined angles as shown in this figure, the incisors can slide along the arch wire with crown portions approaching the midline while their roots became separated. Or, clinicians can put a central V bend on the midline of the upper arch wire with zero-degree brackets to create a divergent force couple to the roots of the incisors. Red dotted line indicates incisal edge grinding later on.

**Fig. 13** Light, long Class II elastics were used to extrude lower posterior molars and protract them to close the space, anterior teeth flaring and bite opening can then be obtained. Before debonding, teeth were well aligned in proper positions. After bite opening, no space left between the teeth was found. The incisal edges (red dotted line) of the upper central incisors were re-shaped by diamond bur. Dental midlines were on.
head.\textsuperscript{17-19} On the contrary, the oriental including Chinese and Japanese, have more common brachycephalic head form and strong mandible, retrusive maxilla and Class III tendency. The upward-turned nostrils in this patient was a sign of failing to have a backward rotation of the nasomaxillary complex.

Enlow also pointed out that the face is a composite of various imbalances and each malocclusion is the result of compensations on top of individual structures. Less backward but more downward growth of nasomaxillary complex could cause a compensatory growth of the mandible in transverse or/and sagittal dimensions.

In this case, small facial index, positive ANB value, small gonial angle and deep bite were detected. Because transverse growth completed before sagittal and vertical growth, after a broad transverse dimensional facial pattern was constructed, the growth potential of the other two dimensions became limited, which further hindered the forward movement of the teeth and the mandible. Therefore, the negation of mandibular prognathism in sagittal aspect was actually resulted from a euryprosopic facial composition. The Wylie’s analysis confirmed that although the patient has a relative long mandibular corpus length, the net score of AP dysplasia is still a negative value and the mandible stayed in a posterior position to the maxilla (Figure 10).\textsuperscript{13}

In patient’s lower dentition, orthodontic mechanotherapy was designed to increase dentoalveolar compensation. In adult patients with increased corpus length of mandible and wide face, anterior flare of the lower incisors is required for their limited forward growth of the mandible.\textsuperscript{20}

2. Midline diastema

The maxillary central diastema is prevalent in the oriental and midwestern people with high incident rate varied from 1.6 to 25.4\%\textsuperscript{21}. After ruling out the developmental or pathological causal factors such as supernumerary teeth, high insertion of the labial frenum, odontomas, or cysts, conditions associated with the teeth size/ arch length discrepancies are known as the most common cause of the diastema in adults.\textsuperscript{22} This includes microdontia, hypodontia, or increased arch/ jaw dimensions as seen in this case. Another major factor for diastema is excessive anterior overbite. Any attempt to close the midline spacing without correcting the deep bite will lead to a speedy relapse of the condition.\textsuperscript{21-24} This patient had both of the above contributing factors, and avoiding relapse is a major concern. Long-term use of retainers or permanent bonded lingual retainers are necessary, especially in cases with large pretreatment diastema and the presence of at least one family member with a similar condition usually increases the risk of relapse.\textsuperscript{22}

It is not recommended to close the upper central diastema only by reciprocal traction using elastomeric chains on an arch wire. Moving the roots of the central incisors apart can improve the stability of the treatment result.\textsuperscript{7} When both upper central incisors’ roots are tipped distally, the vertical forces will produce functional moments to further tip the crown, which makes the crowns of the incisors only to stay in contact and not departing. If the space is already nearly closed, the crown portion cannot be tipped any more, clinicians can still diverge the roots to produce higher functional moments (Figure 12).

To have a stability test, remove all arch wires and elastic forces from the teeth for 6 months as suggested by Mulligan.\textsuperscript{7} If the space reopens, same arch wires are placed back into the bracket slots, and the roots are permitted to undergo additional divergence. The crown portions were tipped mesially, reshape the incisal edges is required (Figure 12B,13).

There was no evidence that long-term presence of bonded palatal surface retainer adversely affected the periodontal health of the maxillary central incisors.\textsuperscript{24} Fixed type wire retention at lingual surface of the anterior teeth was used in both arches on this case (Figure 14).
Fig. 15 The overall superimposition shows the mandibular plane angle of the patient increased by 1°, the upper and lower lips retracted and became less protrusive. The regional superimpositions show upper incisor was retracted by 1mm, upper first molar was distalized and extruded.

Fig. 14A The orthodontic treatment didn’t worsen the profile but improved the smile and made the lips slightly less protrusive.

Fig. 14B All teeth were well aligned, the spacing of lower dentition and maxillary central diastema disappeared completely. Molars and canine were finished at Class I relationships. Overjet and overbite were within normal limits. Fixed retainers (yellow arrows) were bonded to both upper and lower anterior teeth.

Fig. 14C The follow-up photos displayed no relapse of the space and the teeth, and showed good stability of the orthodontic treatment. Beautiful smile is discovered.
3. **Class II elastic traction**

The Class II elastics exerts a horizontal force on the lower dentition that will protract and extrude the lower posterior teeth. It could not only promote space closure and bite opening, but also increase the degree of the lower incisor flaring. The effects of Class II elastics include: (1) retract the upper anterior teeth, (2) protract the lower teeth forward, (3) extrude lower posterior teeth, (4) reduce overbite, (5) close the space, (6) reduce the excessive overjet. Upper anterior teeth extrusion and lower anterior teeth flaring are side effects. The characteristics of to achieve the treatment objectives of this patient could be achieved by the Class II elastics for bite opening, proper upper incisal show, no central diastema and not worsening the soft tissue profile.

The lower incisor changes did not compromise the esthetic expectation of the patient. This case finished with bilateral Class I canine and molar relationships with relatively improved facial profile. Initially, the patient had retrognathia and a horizontally long and wide mandible, the minor retraction of upper incisors and forward proclination of lower incisors corrected the deep bite and closed the diastema concomitantly.

4. **Periodontal considerations**

The periodontal care was provided with oral hygiene instruction and prophylactic scaling to eliminate periodontal inflammation before treatment. The dental papilla loss and gingival recession are more likely to occur in adult. The opening of gingival embrasures led to appearance of black triangles. In this case, tipping of 2 central incisors and increase the root divergence might change the level of the contact point coronally. Tarnow et al. pointed out that when the measurement from the contact point to the crest of bone was 5 mm or less, the papilla was present almost 100% of the time. If the distance increased, the higher chance of missing dental papilla. To avoid potential black triangle, inter-proximal enamel reduction could be applied and also favorable for anterior tooth retraction.

The gingival recession and apical displacement of the marginal bone level are often age-related, generalized reduction in marginal bone level is seen in patients with periodontal disease. Large overjet and overbite or lack of proper occlusal stops usually combined with tooth elongation. With a low bone level, the center of resistance of the tooth is displaced apically, functional forces acting on the crowns could generate moments to induce tooth migration, spacing, bite deepening and palatal gum impingement.

In the present case, upper median diastema and deep overbite originated from jaw growth discrepancy and broad dental arches should be considered as predisposing factors for periodontal involvement. Orthodontic therapy on patients in the presence of periodontal problem will potentially intensify the tissue damages. Advanced periodontitis may disrupt the delicate balance of surrounding forces thereby resulting in pathologic tooth migration. The importance of a stable and healthy periodontium before, during and after orthodontic intervention should also be stressed.

**CONCLUSION**

1. Euryprosopic facial type deserves more attention because it is not rare. There is intrinsic mandibular protrusive potential within the facial complex, however, this capacity has been compensated largely in transverse dimension. This resulted in a less downward and forward mandibular growth, wide dental arch form can further cause central diastema and deep bite that require full mouth orthodontic care instead of minor tooth movement.

2. Root movement is the name of the game. Upper central diastema was treated with changing the root axis of the upper central incisors, lower spacing was closed with roots of the teeth moving forward.

3. Since the incisors in a spaced dental arch were usually
upright, the protraction of the lower teeth was the major tooth movement. The labial inclination of lower incisors in finishing was pertinent in order to obtain an optional overjet and overbite.

4. Adult periodontitis can be a potential threat to the stability of orthodontic outcome.

REFERENCE


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