

Bimaxillary Protrusion Treated with Miniscrews

SUMMARY

This report describes a conservative orthodontic treatment of a bimaxillary protrusion adult case. After four first premolars extraction, two bone screws were laced in the infrazygomatic crests to ensure maximal retraction and two additional bone screws were placed in between the central and lateral incisors for the vertical control of the maxillary anterior segment. Pleasing esthetic and functional results were achieved. (IJOI 2014;34:78-89)

Key word: Bimaxillary protrusion, miniscrew

History and Etiology

A 31-year-4-month-old woman presented with the major concerns of protrusive lips, mildly crowded teeth, and excessive gingival exposure (“gummy smile”) (Figs. 1-2). The patient's medical and dental histories were non-contributory. Moreover, there was no evidence of contributing oral habits or temporomandibular dysfunction. The patient was treated to an acceptable result as (Figs. 4-9), as will be subsequently discussed.

Diagnosis

Pretreatment facial photographs showed a convex profile with protrusive lips and a gummy smile (Fig. 1). The pretreatment intraoral photographs and study models (*casts*) revealed a Class I molar relationship on both sides (Figs. 2-3). The maxillary midline was deviated 1 mm to the right of the facial midline. The cast evaluation (Fig. 3) documented the following dental problems: 1. anterior cross-bite (#24-26), 2. mild crowding of the upper and lower anterior segments.

The ABO Discrepancy Index (DI) was 18 as shown in the subsequent worksheet.¹



■ Fig. 1: Pretreatment facial photographs



■ Fig. 2: Pretreatment intraoral photographs



■ Fig. 3: Pretreatment study models (casts)

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■ Fig. 4: Post-treatment facial photographs showing considerable facial profile improvement.



■ Fig. 5: Posttreatment intraoral photographs



■ Fig. 6: Posttreatment study models (casts)

Skeletal:

- Skeletal Class II ($SNA\ 81^\circ$, $SNB\ 76^\circ$, $ANB\ 5^\circ$), high mandibular plane angle ($SN-MP\ 40^\circ$)

Dental:

- Class I canine and molar relationship
- Anterior cross-bite #24-26
- Crowding: moderate in the maxillary and mild in the mandibular anterior segments

Facial:

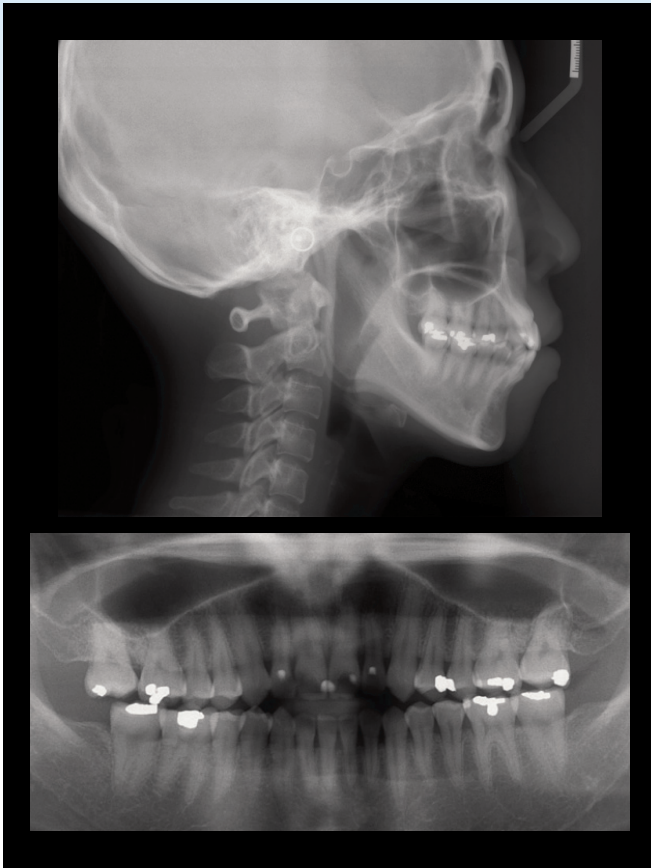
- Convex profile
- Bimaxillary protrusion with lip strain and excessive gingival exposure ("gummy smile")
- Maxillary dental midline shifted 1 mm to the right of the facial midline

Treatment Objectives

The principal objectives were to: 1. intrude the maxillary dentition, 2. retract the maxillary and mandibular anterior segments, 3. retract the lips, and 4. achieve an ideal overjet and overbite relationship.

Maxilla (all three planes):

- A - P: Maintain
- Vertical: Maintain
- Transverse: Maintain



■ Fig. 7: Pre-treatment panoramic and cephalometric radiographs



■ Fig. 8: Post-treatment panoramic and cephalometric radiographs



■ Fig. 9:

Superimposed cephalometric tracings reveal retraction of the incisors, slightly increased vertical dimension of occlusion, and reduction of lip protrusion.

| CEPHALOMETRIC | | | |
|-------------------|--------|---------|--------|
| SKELETAL ANALYSIS | | | |
| | PRE-Tx | POST-Tx | DIFF. |
| SNA° | 81° | 80° | 1° |
| SNB° | 76° | 75° | 1° |
| ANB° | 5° | 5° | 0° |
| SN-MP° | 40° | 41° | 1° |
| FMA° | 33° | 34° | 1° |
| DENTAL ANALYSIS | | | |
| U1 TO NA mm | 6 mm | 0 mm | 6 mm |
| U1 TO SN° | 103° | 95° | 8° |
| L1 TO NB mm | 14 mm | 8 mm | 6 mm |
| L1 TO MP° | 103° | 95° | 8° |
| FACIAL ANALYSIS | | | |
| E-LINE UL | 2 mm | 0 mm | 2 mm |
| E-LINE LL | 5 mm | 0.5 mm | 4.5 mm |

■ Table 1: Cephalometric summary

Mandible (all three planes):

- A - P: Maintain
- Vertical: Maintain
- Transverse: Maintain

Maxillary Dentition

- A - P: Retract incisors
- Vertical: Maintain
- Inter-molar / Inter-canine Width: Maintain

Mandibular Dentition

- A - P: Retract incisors
- Vertical: Maintain
- Inter-molar / Inter-canine Width: Maintain

Facial Esthetics:

- Retract upper and lower lips

Treatment Alternatives

Because of the convex profile and protrusive lips, an orthognathic surgical option was discussed, but the patient deemed it to be too aggressive. Therefore, a more conservative plan was devised to meet the patient's needs: 1. extract all four first premolars, 2. place bone screws in the infrazygomatic crests bilaterally to ensure maximal retraction of the maxillary anterior segment, 3. use bone screws between the roots of the maxillary central and lateral incisors to control the vertical dimension of the upper incisors.

Appliances and Treatment Progress

Extraction of the four first premolars was accomplished before orthodontic treatment commenced. Brackets (.022" Damon Q[®], Ormco) were used (Maxillary: high torque; Mandibular: standard torque). Both arches were bonded and aligned with the following arch wire sequence: .014" CuNiTi, .014"x.025"NiTi, .017"x.025" TMA, .019"x.025" SS. During the course of treatment, Class II elastics were upgraded from 3.5 to 4.5 oz. Two months after the .014"x.025" CuNiTi wires were placed, a panoramic radiograph revealed axial inclination problems, and brackets were repositioned accordingly. Extraction spaces were closed with power chains on a .019" x0.25" SS archwire.

In the 20th month, two bone screws (Ortho-BoneScrews[®], Newton's A) were placed bilaterally in the infrazygomatic crests, and two additional Orthobonescrews (OBS) were placed bilaterally between the central and lateral incisors roots. These four bone screws acted as anchorage to reduce



■ Figs. 10-12:

Four bone screws were used to retract and intrude the maxillary dentition: infrazygomatic crests and in between the central and lateral incisors roots, bilaterally. This was the principal anchorage for correcting the lip protrusion and gummy smile.

the gummy smile, by retracting and controlling the extrusion of the maxillary arch (Figs. 10-12). After twenty-seven months of active treatment, the appliances were removed and retainers were delivered.

Results Achieved

Maxilla (all three planes):

- A - P: Maintained
- Vertical: Maintained
- Transverse: Maintained

Mandible (all three planes):

- A - P: Retracted
- Vertical: Increased ~1-2mm
(posterior rotation of the mandible)
- Transverse: Maintained

Maxillary Dentition

- A - P: Anterior segment retracted
- Vertical: Maintained
- Inter-molar / Inter-canine Width: Maintained

Mandibular Dentition

- A - P: Incisors were retracted
- Vertical: Molars were extruded ~1mm
- Inter-molar / Inter-canine Width: Maintained

Facial Esthetics:

- Upper and lower lip protrusion was reduced, and lip competence was achieved

Retention

The fixed retainer was bonded on all maxillary incisors, and from canine to canine in the mandibular arch. An upper clear overlay was delivered. The patient was instructed to wear it full time for the first 6 months and nights only thereafter. Instructions were provided for home hygiene and for maintenance of the retainers.

Final Evaluation of treatment

Cephalometric analysis (table) and superimpositions (Fig. 9) show that the lower molars were extruded ~1mm and the mandible was rotated posteriorly,

resulting in a slight increase in the mandibular plane angle and reduction of SNB. The upper incisor to SN angle decreased from 103° to 95°. The angle of the lower incisor to the Md plane decreased from 103° to 95°. Both lips were retracted and lip competence was achieved. The gummy smile was improved due to the retraction of the maxillary incisors and upper lip.

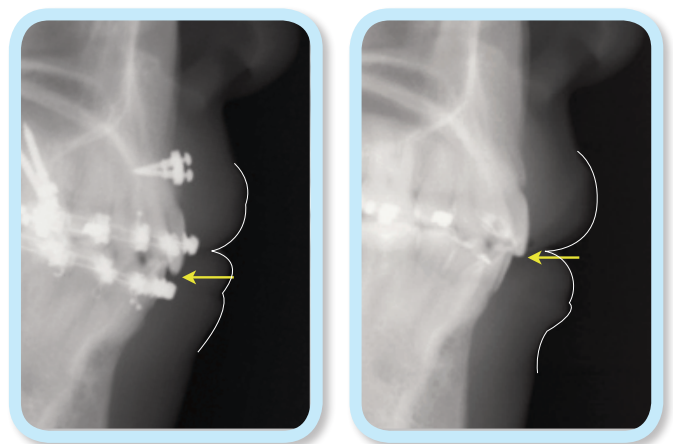
The ABO Cast-Radiograph Evaluation score was 16 points.¹ There are some discrepancies in occlusal contacts, but the overall alignment was good. The protrusive lips were corrected and facial harmony was improved. The patient was particularly pleased with the improvement in her facial profile.

Discussion

Bimaxillary protrusion is a condition associated with proclined incisors (*increased axial inclination*) and protrusive lips.² Because of the negative perception, relative to a protrusive dentition and lips in most cultures, many patients with bimaxillary protrusion seek orthodontic care to resolve the problem.

Bimaxillary protrusion can be treated effectively in growing patients and in adults with conventional orthodontic therapy. For many adult patients, orthognathic surgery is necessary to achieve an optimal esthetic result.³ However, some patients are resistant to orthognathic surgery due to expense, postoperative morbidity and the potential for complications. Despite the potential esthetic benefits associated with surgery, many patients opt for conventional orthodontics therapy.

Orthodontics treatment to correct bimaxillary protrusion usually involves extraction of four first premolars and the utilization of maximal anchorage to retract the anterior segments of both arches. Retracting the maxillary anterior segment may result in extrusion of the incisors and exacerbation of the gummy smile. To provide vertical control of the anterior segment, bone screws are used between the roots of the maxillary central and lateral incisors (*Fig. 13*). Currently, bone screws as temporary anchorage devices (TADs) provide increased anchorage and thereby expand the potential for orthodontic tooth movement.⁴ Premolar extractions are necessary to achieve maximal retraction with interradiolar TADs. However, when bone screws placed in an extra-alveolar site such as the infrazygomatic crest (*Fig. 14*), the anterior segments can be retracted effectively without resorting to extractions in some cases. For the present patient premolar extractions were necessary because there was inadequate retromolar space to sufficiently retract both arches (*Fig. 15*).



■ Fig. 13:

The bone screws placed between the roots of central and lateral incisors effectively correct the gummy smile by controlling the vertical position of the maxillary incisors.

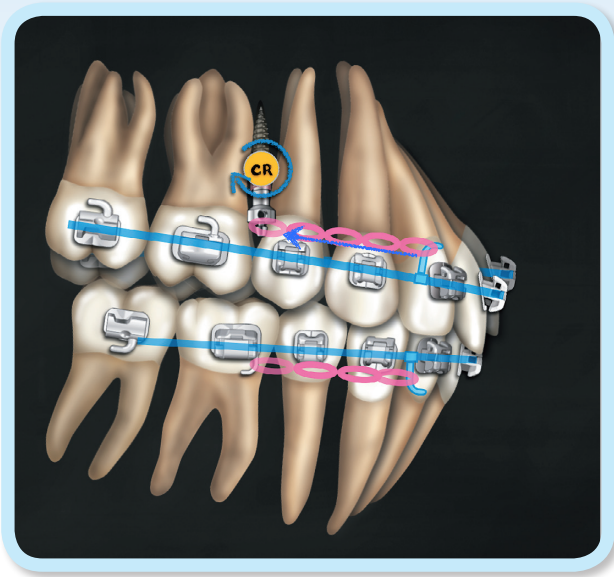


Fig. 14:
Using infrazygomatic bone screws for anchorage to retract maxillary incisors to reduce protrusion may have undesirable side effects: lingual tipping of the anterior teeth, increasing upper incisor exposure, as well as dehiscence and fenestration of the labial plate. These problems are due to the clock-wise rotation of the maxillary arch because the line of force (pink elastic chain) is occlusal to the center of resistance (CR) of the maxilla.

When using extra-alveolar TADs, the retraction of the arches is only limited by anatomic restraint. The space between the terminal molar and the external oblique ridge of the ascending ramus of the mandible, or the tuberosity in the maxilla, limits the distance that the entire arch can be retracted (Fig. 15).

There are some side effects associated with retracting the entire upper arch with posterior extra-alveolar TADs because the line of force is typically occlusal to the center of resistance (CR) of the maxilla, which causes the entire arch to rotate clockwise around the CR (Fig.14). This effect results in downward movement (*extrusion*) of the anterior teeth and additional gingival exposure when smiling, which is unacceptable for patients being treated to correct

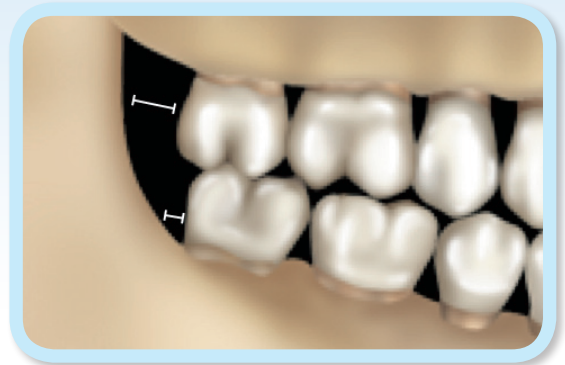


Fig. 15:
The limiting factor for retracting the entire arch is the retromolar space between the distal of the terminal molar and the external oblique ridge of ascending ramus in the mandible, or the tuberosity in the maxilla.

a gummy smile. Additional undesirable side effects are lingual tipping of the anterior teeth, as well as dehiscence and fenestration of the labial plate of bone. An effective solution for the side effects due to retraction of the arch, via direct anchorage from posterior extra-alveolar TADs, is to place bone screws bilaterally between the central and lateral incisors roots (Figs. 13 and 16). Vertical traction, from

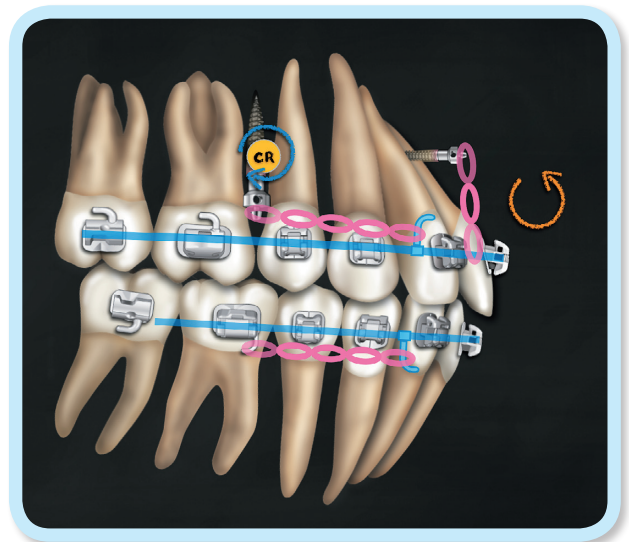


Fig. 16:
One of the solutions is to create a counter-clockwise rotation by placing two OBS bilaterally in between the central and lateral incisors root.

these interradicular TADs to the archwire, creates a moment in the opposite direction, producing counter-clockwise rotation of the maxillary arch. The correction of the gummy smile is achieved by intrusion of the anterior maxillary segment, in addition to preventing the clockwise rotation of the arch due to traction from the posterior TADs. Thus, four TADs, two in the infrazygomatic crests and two in the anterior maxilla, effectively intrude all maxillary teeth, thereby correcting the gummy smile due to the inferiorly positioned maxillary dentition.

High-torque brackets were used on the maxillary incisors to compensate for the loss of torque during retraction of the maxillary arch. Employing high-torque brackets (Fig. 17) introduces torque correction gradually as the size of the rectangular archwire increases, thereby avoiding roundtrip tooth movement to correct excessively tipped incisors.⁵

There are other alternatives for correcting the torque of the anterior teeth, such as pre-torqued archwires, and root torquing auxiliaries (*The ART® Auxiliary*,

Atlanta Orthodontics). When the ART® auxiliary wire is hooked on the main archwire, the roots of the anterior teeth are effectively torqued in a lingual (*palatal*) direction (Fig. 18).

Light force should be used during intrusion to minimize the root resorption. According to Burstone,⁶ 20 g of force is recommended for the intrusion of anterior teeth. As observed in Fig.13, the maxillary incisors were successfully intruded using OBS anchorage, and no significant root resorption was apparent (Figs. 7-8).

The soft tissue profile of the face does not always reflect changes in the under-lying skeletal structure during orthodontic treatment.⁷ The lip profile change is also influenced by lip thickness, posture and strain.⁸

For the present patient, cephalometric analysis (*Cephalometric Summary Table*) documents the substantial reduction in lip protrusion. The U1 to NA distance reduced from 6 to 0 mm while the E-line



■ Fig. 17:
High-torque brackets were used in the maxillary anterior segment to compensate for the tendency to tip the incisors lingually as the segment is retracted.



■ Fig. 18:
The ART® torquing auxiliary is a wire segment that is effective for increasing the axial inclination of the maxillary incisors.



■ Fig. 19:

Abnormal enamel abrasion was noted on the left central incisor once the crossbite was corrected.

to UL was decreased from 2 to 0 mm. The L1 to NB distance was reduced from 14 to 8 mm while the E-line to LL was decreased from 5.0-4.5 mm. These morphologic changes resulted in a lip profile that was much improved after treatment.

It is important to note that the present patient presented with an anterior cross bite that was associated with abnormal enamel abrasion of the incisors⁹ which compromises esthetics and occlusion¹⁰ (Fig. 15). After orthodontic treatment, the anterior cross bite was corrected, thereby preventing further anterior teeth mobility, potential for fracture, periodontal problems, and temporomandibular joint dysfunction.¹¹ A mutually protected occlusion was achieved by establishing ideal overjet, overbite and canine guidance.

Conclusion

Bimaxillary protrusion is common in the Asian population. Conventional orthodontics treatment

involves extraction of all four first premolars, followed by retraction of the anterior segments to reduce dental and soft tissue protrusion. Torque control of the incisors is an important issue. With the aid of four OBSs, the whole maxillary arch can be retracted and intruded to achieve an optimal result.

References

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Discrepancy Index Worksheet

TOTAL D.I. SCORE 18

OVERJET

- 0 mm. (edge-to-edge) = 1 pt.
- 1 – 3 mm. = 0 pts.
- 3.1 – 5 mm. = 2 pts.
- 5.1 – 7 mm. = 3 pts.
- 7.1 – 9 mm. = 4 pts.
- > 9 mm. = 5 pts.

Negative OJ (x-bite) 1 pt. per mm. per tooth =

Total = 4

OVERBITE

- 0 – 3 mm. = 0 pts.
- 3.1 – 5 mm. = 2 pts.
- 5.1 – 7 mm. = 3 pts.
- Impinging (100%) = 5 pts.

Total = 0

ANTERIOR OPEN BITE

0 mm. (edge-to-edge), 1 pt. per tooth
then 1 pt. per additional full mm. per tooth

Total = 0

LATERAL OPEN BITE

2 pts. per mm. per tooth

Total = 0

CROWDING (only one arch)

- 1 – 3 mm. = 1 pt.
- 3.1 – 5 mm. = 2 pts.
- 5.1 – 7 mm. = 4 pts.
- > 7 mm. = 7 pts.

Total = 1

OCCLUSION

- Class I to end on = 0 pts.
- End on Class II or III = 2 pts. per side pts.
- Full Class II or III = 4 pts. per side pts.
- Beyond Class II or III = 1 pt. per mm. pts.
additional

Total = 0

LINGUAL POSTERIOR X-BITE

1 pt. per tooth Total = 0

BUCCAL POSTERIOR X-BITE

2 pts. per tooth Total = 0

CEPHALOMETRICS (See Instructions)

ANB $\geq 6^\circ$ or $\leq -2^\circ$ = 4 pts.

Each degree $< -2^\circ$ x 1 pt. =

Each degree $> 6^\circ$ x 1 pt. =

SN-MP

$\geq 38^\circ$ = 2 pts.

Each degree $> 38^\circ$ 3 x 2 pts. = 6

$\leq 26^\circ$ = 1 pt.

Each degree $< 26^\circ$ 4 x 1 pt. = 4

1 to MP $\geq 99^\circ$ = 1 pt.

Each degree $> 99^\circ$ x 1 pt. =

Total = 13

OTHER (See Instructions)

- Supernumerary teeth x 1 pt. =
- Ankylosis of perm. teeth x 2 pts. =
- Anomalous morphology x 2 pts. =
- Impaction (except 3rd molars) x 2 pts. =
- Midline discrepancy (≥ 3 mm) @ 2 pts. =
- Missing teeth (except 3rd molars) x 1 pts. =
- Missing teeth, congenital x 2 pts. =
- Spacing (4 or more, per arch) x 2 pts. =
- Spacing (Mx cent. diastema ≥ 2 mm) @ 2 pts. =
- Tooth transposition x 2 pts. =
- Skeletal asymmetry (nonsurgical tx) @ 3 pts. =
- Addl. treatment complexities x 2 pts. =

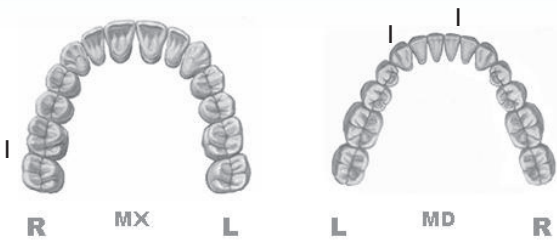
Identify: 0

Cast-Radiograph Evaluation

Total CRE Score 17

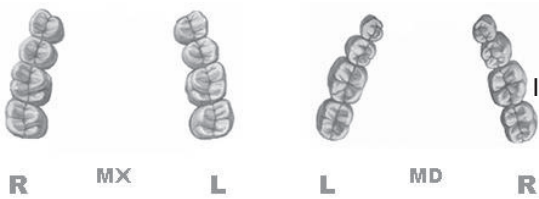
Alignment/Rotations

3



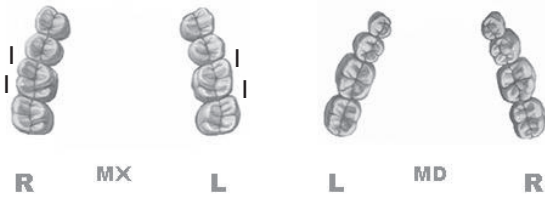
Marginal Ridges

1



Buccolingual Inclination

4



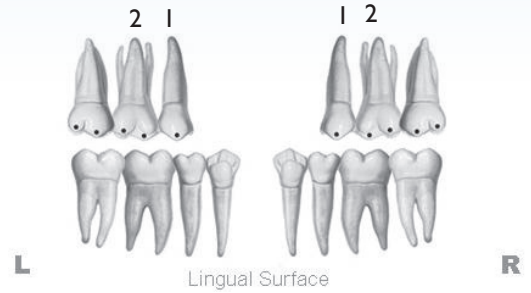
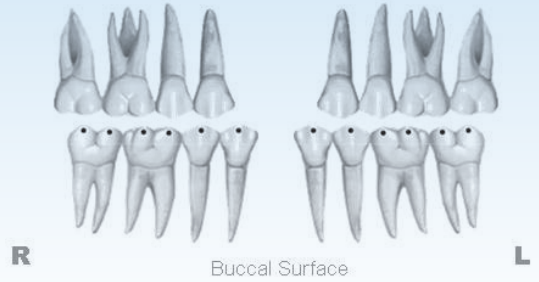
Overjet

0



Occlusal Contacts

6



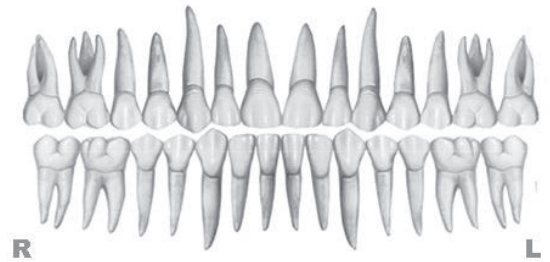
Occlusal Relationships

1



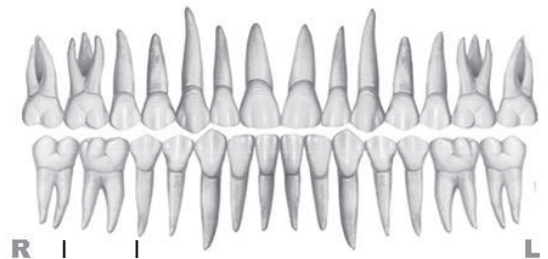
Interproximal Contacts

0



Root Angulation

2

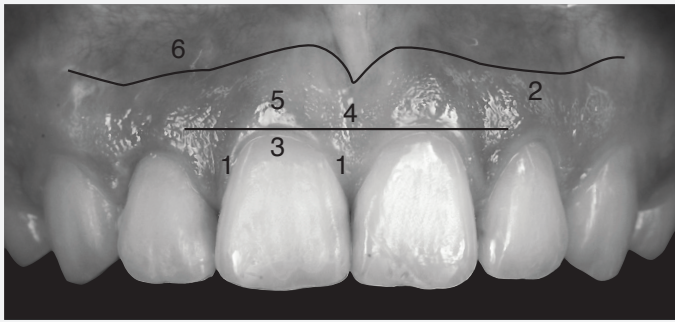


INSTRUCTIONS: Place score beside each deficient tooth and enter total score for each parameter in the white box. Mark extracted teeth with "X". Second molars should be in occlusion.

IBOI Pink & White Esthetic Score

Total Score: = 6

1. Pink Esthetic Score

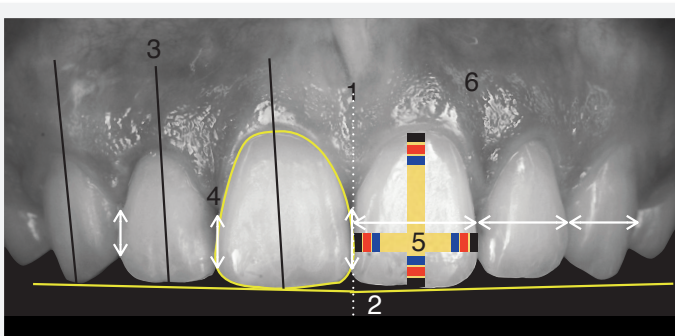


Total = 3

| | | | |
|---------------------------------|---|---|---|
| 1. M & D Papillae | 0 | 1 | 2 |
| 2. Keratinized Gingiva | 0 | 1 | 2 |
| 3. Curvature of Gingival Margin | 0 | 1 | 2 |
| 4. Level of Gingival Margin | 0 | 1 | 2 |
| 5. Root Convexity (Torque) | 0 | 1 | 2 |
| 6. Scar Formation | 0 | 1 | 2 |

| | | | |
|---------------------------------|---|---|---|
| 1. M & D Papillae | 0 | 1 | 2 |
| 2. Keratinized Gingiva | 0 | 1 | 2 |
| 3. Curvature of Gingival Margin | 0 | 1 | 2 |
| 4. Level of Gingival Margin | 0 | 1 | 2 |
| 5. Root Convexity (Torque) | 0 | 1 | 2 |
| 6. Scar Formation | 0 | 1 | 2 |

2. White Esthetic Score (for Micro-esthetics)



Total = 3

| | | | |
|--|---|---|---|
| 1. Midline | 0 | 1 | 2 |
| 2. Incisor Curve | 0 | 1 | 2 |
| 3. Axial Inclination (5° , 8° , 10°) | 0 | 1 | 2 |
| 4. Contact Area (50%, 40%, 30%) | 0 | 1 | 2 |
| 5. Tooth Proportion (1:0.8) | 0 | 1 | 2 |
| 6. Tooth to Tooth Proportion | 0 | 1 | 2 |

| | | | |
|--|---|---|---|
| 1. Midline | 0 | 1 | 2 |
| 2. Incisor Curve | 0 | 1 | 2 |
| 3. Axial Inclination (5° , 8° , 10°) | 0 | 1 | 2 |
| 4. Contact Area (50%, 40%, 30%) | 0 | 1 | 2 |
| 5. Tooth Proportion (1:0.8) | 0 | 1 | 2 |
| 6. Tooth to Tooth Proportion | 0 | 1 | 2 |