Farhad B Naini

Daljit S Gill

Facial Aesthetics: 2. Clinical Assessment

Abstract: The clinical ability to alter dentofacial form requires an understanding of facial aesthetics. This is vital for any clinician involved in treatment that will alter a patient's dentofacial appearance, whether through orthodontics, facial growth modification, corrective jaw surgery or aesthetic dentistry. Part 1 of this article covered the historical and theoretical aspects of facial aesthetics and their importance in contemporary dentofacial treatment. Part 2 covers important aspects of the interview and clinical assessment of patients requiring alterations in their dentofacial appearance, including guidelines used in the assessment of facial proportions and symmetry.

Clinical Relevance: These articles cover the theoretical and clinical aspects of facial aesthetics required by clinicians involved in the treatment of dentofacial deformity.

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Patient interview

The patient's presenting complaint, as always, is very important. However, clinicians must be aware that patients presenting for an initial consultation may have numerous mixed emotions and will often find it difficult to convey their reasons for seeking advice or treatment. Therefore, jumping in with the type of treatment that is required may well frighten the patient. The clinician will often require more than one consultation appointment in order to assess the patient's:

- Perception of his/her dentofacial appearance;
- Motivation for seeking treatment;
- Realism of his/her expectations from treatment; and
- Likely level of co-operation, as well as the support of the family.

Farhad B Naini, BDS, FDS RCS, MSc, MOrth RCS, FDS Orth RCS, Consultant Orthodontist, St George's Hospital and Kingston Hospital and **Daljit S Gill**, BSc, BDS, FDS RCS, MSc, MOrth RCS, FDS Orth RCS, Consultant Orthodontist, Eastman Dental Hospital, London UK.

The clinician's first goal is to determine whether a dentofacial deformity exists and, if so, whether the patient's perception of the deformity ties in with the clinician's assessment. If a patient has excessive concerns regarding a minor or imperceptible dentofacial deformity, has seen a number of other clinicians and treatment has been refused, or if he/she is particularly vague about his/her concerns, then referral to a clinical psychologist or liaison psychiatrist may be required, as these may suggest evidence of a psychiatric disorder, such as Body Dysmorphic Disorder.[1] A study by Phillips *et al.*[2] of patients with dentofacial deformity requiring orthognathic surgery found that almost a quarter of the patients qualified as a positive diagnosis for psychiatric disorder.

The patient's motivation for undergoing treatment is important. Patients who have 'external' motivation involving, for example, the need to please others or have a more successful career, are less likely to be happy with treatment than patients who have 'internal' motivation, which is that they want to look better for themselves.[3]

Finally, it is important for patients to have realistic expectations. A desire to look like their favourite film star is often neither realistic nor achievable! It is also vital for the clinician not to over-promise. The patient must fully understand the likely result that can be realistically achieved, the approximate length of treatment and also the likely complications. Only in this way will he/she be able to make an informed decision as to whether or not to proceed with treatment.

Macgregor[4] stated that, 'Time spent in communication (with patients) is never wasted'.

Clinical assessment

'Everything has beauty, but not everyone sees it!'

Confucius

The most important aspect of the clinical assessment is for the clinician to know what to look for. Leonardo da Vinci called this 'saper vedere', or 'Knowing how to see'.[5] Every face has disproportions and asymmetries, as does every smile and its associated dentition. Therefore, it requires a clinician's educated eye if the correct diagnosis is to be reached.

Natural head position

In order to assess facial

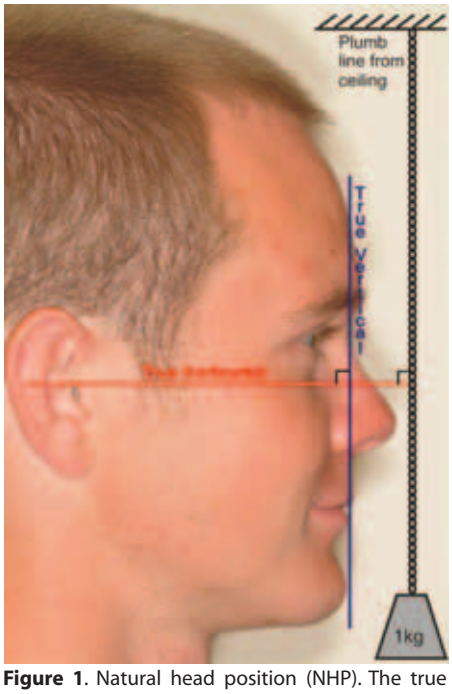


Figure 1. Natural head position (NHP). The true facial vertical and true horizontal lines used to assess facial aesthetics are shown. The true vertical may be taken as a line parallel to a plumb line hanging from the ceiling. The true horizontal will be at right angles to this. In some patients, the Frankfort plane may be parallel to the true horizontal, however, the inclination of the Frankfort plane is subject to biologic variability.

Figure 2. Facial soft tissue landmarks *in the midsagittal plane* (profile view). 1. Trichion (hairline); 2. Glabella (most prominent point of the soft tissue drape of the forehead); 3. Soft tissue nasion (deepest point of the concavity between the forehead and the nose); 4. Subnasale (point where the base of the nasal columella meets the upper lip); 5. Labrale superioris (point denoting vermilion border of the upper lip); 6. Stomion (midpoint of interlabial fissure); 7. Labrale inferioris (point denoting vermilion border of the lower lip); 8. Labiomental fold (point of greatest concavity on the contour of the lower lip between labrale inferioris and soft tissue menton); 9. Soft tissue pogonion (most prominent point on the soft tissue chin), and 10. Soft tissue menton (most inferior point on the soft tissue chin).

Figure 3. Facial height to width ratio (Facial index). Facial height (white); Bizygomatic width (white); Bitemporal width (red); Bigonial width (blue).

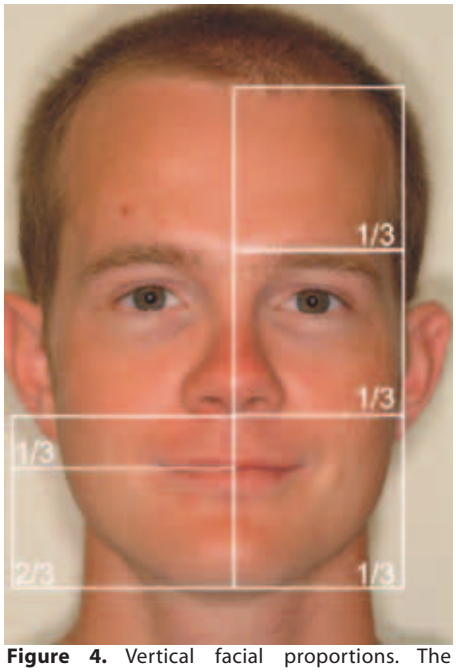


Figure 4. Vertical facial proportions. The facial trisection and anterior lower facial third proportions are shown. The anterior lower facial height is often slightly greater than the middle third, especially in males.

proportions patients must be examined in natural head position (NHP).[6] NHP is a standardized and reproducible position of the head in space when the subject is focusing on a distant point at eye level. In NHP, the visual axis is horizontal. This allows an extra-cranial vertical, and a horizontal perpendicular to that vertical, to be used as reference lines for facial aesthetic analysis (Figure 1). This is important as the cant or inclination of all other reference lines, such as the Frankfort plane, is subject to biologic variation.[7] The procedure to obtain a clinical facial photograph in NHP is with the subject standing upright and looking straight ahead into the image of his/her own eyes in a small mirror located at a distance, at the level of the eyes.

A number of important soft tissue landmarks are used in the assessment of facial aesthetics (Figure 2). The patient must be examined for facial proportions and symmetry in full face and in profile view.

Frontal facial analysis (Table 1)

Facial type

The facial height to width ratio (Facial index) gives the overall facial type, such as 'long' or 'short' or 'square' face (Figure 3). The proportionate facial height to width ratio is 1.35:1 for males and 1.3:1 for females. Bizygomatic facial width, measured from the most lateral point of the soft tissue overlying each zygomatic arch (zygion), is approximately 70% of vertical facial height. In addition, bitemporal width, measured from the most lateral point on each side of the forehead, is 80–85% of bizygomatic width. Bigonial width, measured from the soft tissue overlying the most lateral point of each mandibular angle (soft tissue gonion), is usually 70–75% of bizygomatic width.

Vertical facial proportions (Figure 4)

Knowledge of vertical

Vertical proportions	■ Facial trisection: hairline (trichion) to glabella, glabella to subnasale, subnasale to soft tissue menton. ■ Anterior lower facial third is often slightly greater than middle third, especially in males. ■ Anterior lower facial third is further subdivided into: - Upper lip (subnasale to stomion): one-third. - Lower lip and chin (stomion to soft tissue menton): two-thirds. ■ Vertical face height is one-tenth of standing height.
Transverse proportions	■ 'Rule of fifths'. Each fifth is approximately the width of an eye. ■ Mouth width equal to the distance between the medial iris margins. ■ Alar base width equal to the intercanthal distance.
Anteroposterior assessment	■ Increased sclera show above the lower eyelid and below the iris is a sign of midface deficiency. ■ Paranasal hollowing/flatness is a sign of maxillary hypoplasia. This may be observed in frontal and profile examination of the face.
Bilateral facial symmetry	■ Middle of philtrum of upper lip (Cupid's bow) and glabella used to construct facial midline. ■ Minor asymmetry is essentially normal. ■ Transverse occlusal plane parallel to interpupillary line in absence of transverse maxillary cant or vertical orbital dystopia.
Maxillary dental midline	■ Assessed in relation to middle of philtrum of upper lip (Cupid's bow) and to facial midline.
Mandibular dental midline	■ Assessed in relation to midpoint of chin and to the facial midline.
Dark 'buccal corridors' on smiling	May be due to: ■ Transverse maxillary deficiency; ■ Palatally inclined maxillary posterior teeth; ■ Anteroposterior maxillary deficiency.

Table 1. Frontal facial analysis.

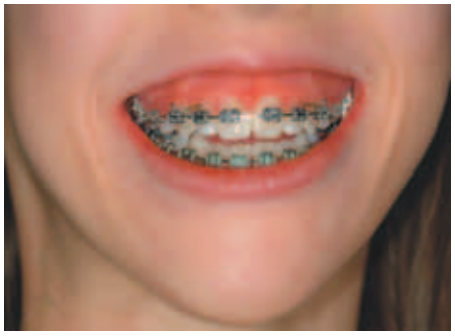


Figure 5. Vertical maxillary excess (VME) may lead to increased gingival exposure on smiling, also termed a 'gummy smile'.

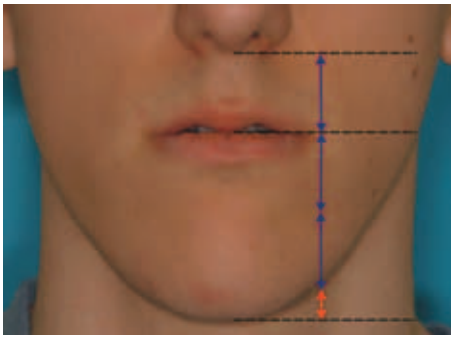


Figure 6. Increased vertical chin height (stomion to soft tissue menton), leading to an increase in the anterior lower facial height.

proportions is important in any prosthodontic treatment plan aimed at altering the occlusal vertical dimension, as well as in planning dentofacial surgery. The vertical facial thirds should be approximately equal, although the lower facial third may be slightly greater than the middle third in males. The lower facial third may be further subdivided, with the upper lip forming the upper third and the lower lip and chin forming the lower two-thirds. An increased anterior lower facial height may be due to:

■ Vertical maxillary excess (VME), resulting from excessive inferior development of the maxilla (Figure 5). This is often accompanied by excessive gingival display at rest and on smiling, referred to as a 'gummy smile'. Treatment, therefore, centres on superior repositioning of the maxilla. In certain cases, anterior VME may be due to excessively over-erupted maxillary incisors (for example, Class II division 2 malocclusion), in which case the treatment of choice will either be an anterior segmental impaction of the maxilla, or orthodontic intrusion of the maxillary incisors and associated gingivae.

A 'gummy smile' may also be due to excessive gingival tissue, in which case a gingivectomy to remove excess gingival tissue, and thereby move the gingival margin apically, would be the treatment of choice.

■ Increased vertical chin length. The proportion of the lower two-thirds of the lower facial third (stomion to soft tissue menton) to the lower facial third (subnasale to soft tissue menton) will be increased (Figure 6). Treatment will therefore centre on vertical reduction genioplasty.

The length of the face must be assessed, bearing in mind the patient's standing height and stature as described in Part 1 of this article. The distance from the hairline (trichion) to the inferior aspect of the chin (soft tissue menton) is one-tenth of standing height. The distance from the top of the head to soft tissue menton is one-eighth standing height.

Transverse facial proportions (Figure 7)

The 'rule of fifths' describes the ideal transverse proportions of the face to comprise equal fifths, each roughly equal to one eye width. The alar base width should be equal to the intercanthal width.

Figure 7. Transverse facial proportions. The 'rule of fifths' states that transverse facial dimensions can be divided into equal fifths, each the width of an eye. The nasal alar base width should be equal to the intercanthal distance. Also of note, the mouth width is equal to the distance between the medial iris margins.

a

b

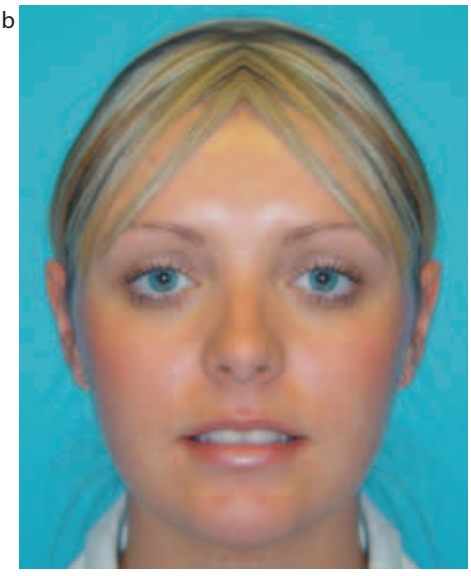


Figure 8. (a) Bilateral facial symmetry. **(b)** The original true image is shown in **(a)**. This is a constructed composite image, in which the subject's right facial hemisphere has been mirrored on the left to create a symmetric image. This illustrates that mild asymmetry is essentially normal.

This is important clinically as anterior repositioning of the maxilla tends to increase the alar base width. This may be partially counteracted by the placement of a 'cinch suture' at the time of surgery to maintain the alar base width.

Facial symmetry

The face must also be examined for bilateral symmetry, bearing in mind that a small degree of asymmetry is present in most individuals and essentially normal (Figure 8). The facial midline can be constructed using two main landmarks. The mid-philtrum of the upper lip (Cupid's bow) will be in the midline of the face, except in exceptional circumstances, eg cleft lip. A line joining this point to the mid-glabellar region (glabella), midway between the eyebrows, forms the facial midline. In the symmetrical face, this line will extend to the mid-point of the chin.

The presence of a cant in the transverse occlusal plane may be assessed in relation to the interpupillary line with the patient biting on a wooden spatula, either in the incisor/canine region or the premolar/molar region (Figure 9). In the absence of a maxillary cant and/or vertical orbital dystopia, the transverse occlusal plane should be parallel to the interpupillary line.

Lip lines	■ Maxillary incisor exposure at rest: 2–4 mm. ■ Depends on upper lip length and vertical maxillary incisor position (Table 3). ■ Lower lip should cover incisal third of maxillary incisors.
Lip activity	■ A strap-like lower lip often retroclines incisors (commonly occurs in Class II division 2 malocclusions). ■ Flaccid lips are less likely to significantly alter position with anteroposterior dental movement.
Lip morphology	■ Everted lips may be due to interposed proclined maxillary incisor teeth. ■ Flat or backward sloping lips give an 'aged' appearance to facial profile. ■ Full lips are less likely to significantly alter position with anteroposterior dental movement. ■ Thin lips are more likely to 'flatten' with incisor retraction. ■ Vermilion show of lower lip slightly more than upper lip (by 2–3 mm).
Lip posture	■ Lips held together at rest (competent). ■ Lips habitually held apart at rest by more than 3–4 mm (also termed lip incompetence). ■ Potentially competent (lips are unable to be held together due to interposed incisor teeth).

Table 2. Aesthetic lip assessment.

Dental midlines

The relationship of the dental midlines to their respective jaws and to the facial midline must also be assessed. The maxillary dental midline can be assessed in relation to the midpoint of the upper lip

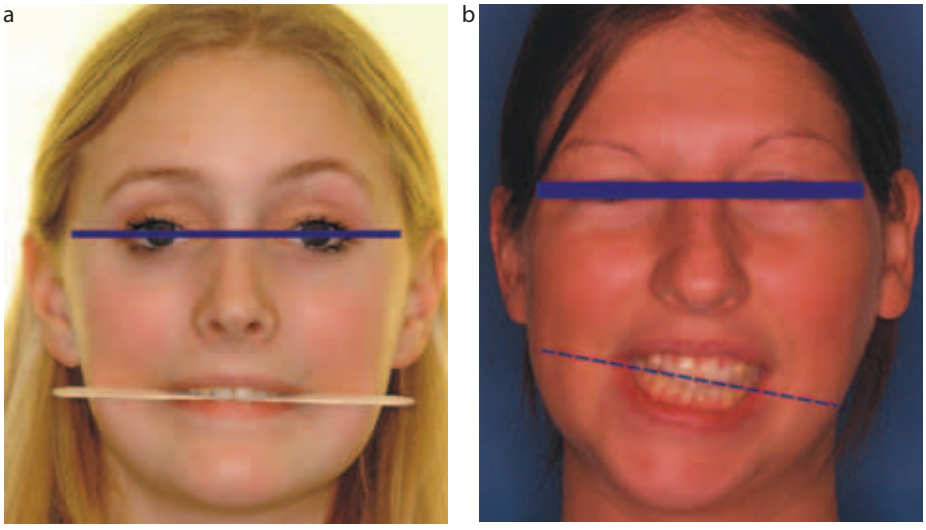


Figure 9. (a) In the transverse plane the occlusal plane should be parallel to the interpupillary plane, in the absence of a transverse maxillary cant or vertical orbital dystopia. **(b)** An increase in the patient's left ramal height has caused compensatory over-eruption of the maxillary dentition on the left side. The resultant transverse maxillary cant is therefore secondary to the mandibular asymmetry.

Upper lip length	■ Normal upper lip length: 18–22 mm. ■ Upper lip length comprises one-third of anterior lower face height. ■ Philtrum length and commissure length should be approximately equal (in adults).
Smile 'curtain'	■ An increased muscular capacity to raise the upper lip higher than average on smiling may lead to a 'gummy smile'. ■ If lip-incisor relationship at rest is correct this may have to be accepted. ■ The Le Fort I incision tends to reduce the smile curtain slightly, at least temporarily.
Anterior vertical maxillary development	■ Anterior Vertical Maxillary Excess (VME) may lead to a 'gummy smile'. ■ Anterior Vertical Maxillary Deficiency (VMD) may lead to reduced incisor exposure. ■ Anterior dentoalveolar VMD may be due to a digit sucking habit preventing normal incisor eruption.
Anteroposterior maxillary position	■ Maxillary deficiency in this plane reduces incisor exposure.
Maxillary incisor inclination	■ Increased proclination reduces incisor exposure. ■ Retroclination of proclined incisors towards normal inclination increases incisor exposure (Figure 13).
Maxillary incisor crown height	■ Maxillary central incisors are approximately 9–12 mm in length. ■ Incisal wear reduces incisor exposure.
Labial gingival margins of maxillary incisors	■ A vertically more incisal gingival attachment, or any gingival hypertrophy will reduce incisor exposure. ■ Incisor gingival margins may migrate gingivally until late adolescence when normal crown length is achieved.

Table 3. Upper lip to maxillary incisor relationship (Figure 12).

(Cupid's bow). In addition to the relationship of the maxillary incisors to the facial midline, their transverse angulation must also be assessed, as increased transverse angulation in frontal view reduces dentofacial aesthetics (Figure 10).[8] The mandibular dental midline is assessed in relation to the midpoint of the chin.

Lip aesthetics

Aesthetic assessment of the lips must also be undertaken. The acronym 'LAMP' may be used to assess the length, activity, morphology and posture of the lips (Table 2).

Upper lip to maxillary incisor relationship (Table 3)

Leonardo da Vinci described the importance of the 'strongly movable section of the face around the mouth and chin in determining facial expression', emphasizing the importance of observing the face in animation as well as static.[5] The vertical exposure of the maxillary incisors in relation to the upper lip at rest should be 2–4 mm, and on smiling the entire crown of the maxillary incisors should be exposed, with up to 1–2 mm of associated gingiva. A spontaneous smile, which is involuntary and expresses joyous emotion, tends to raise the upper lip slightly more than a posed smile, which is voluntary (Figure 11). The lip-incisor relationship depends on a number of factors (Figure 12), including:

1. Upper lip length. A long upper lip will tend to decrease maxillary incisor show and vice versa.
2. The 'smile curtain', defined as the muscular capacity to raise the upper lip. If the position of the maxilla and maxillary incisors in relation to the face is correct, yet the patient presents with a 'gummy smile' owing to vertical hypermobilility of the upper lip, the option of 'Botox' injections to the levator muscles of the upper lip is available. Alternatively, the situation may be accepted.
3. The vertical position of the anterior maxilla and incisor teeth. The more inferior the position of the anterior maxilla, the greater the exposure of the maxillary incisors, and vice versa.
4. The anteroposterior position of the anterior maxilla and incisor teeth. The more anterior the position of the maxillary

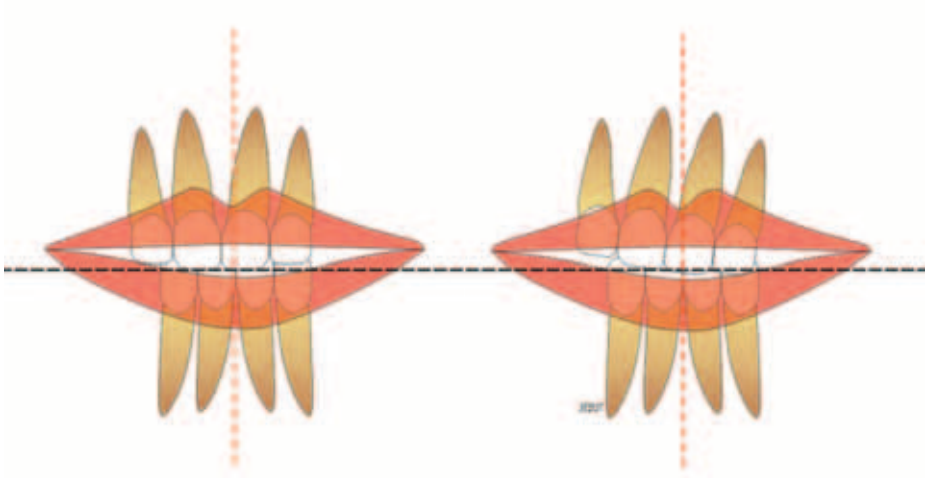


Figure 10. The dental midlines must be assessed in relation to the facial midline. The angulation of the maxillary incisors is an important factor in dental aesthetics, with incorrect angulations (right image) making midline deviations more evident to the lay observer. The vertical red dotted line represents the facial midline.

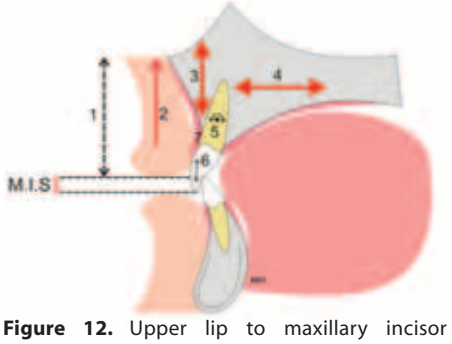


Figure 12. Upper lip to maxillary incisor relationship. The exposure of the maxillary incisors in relation to the upper lip (M.I.S = maxillary incisor show) depends on a number of factors. Refer to numbered list in the text.

Figure 13. Retroclination of proclined maxillary incisors increases the incisor exposure by rotating the teeth around their centre of resistance (root centroid).

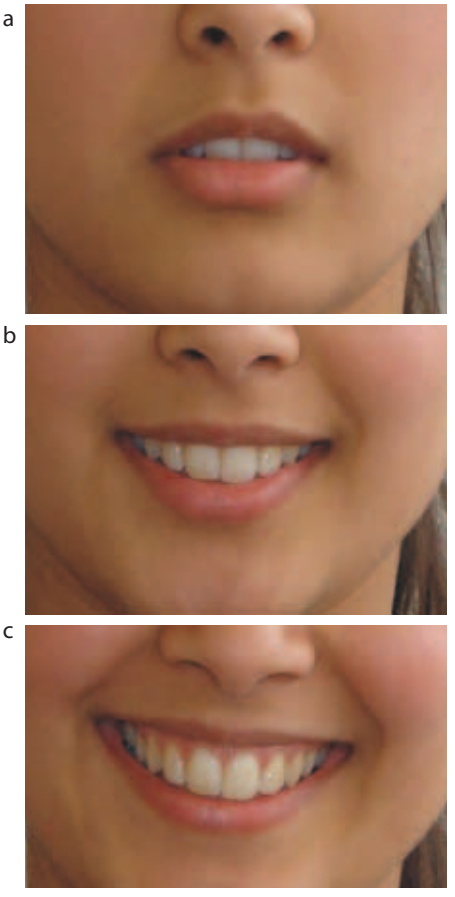


Figure 11. Maxillary incisor exposure in relation to upper lip. **(a)** At rest, 2–4 mm of maxillary incisor show. **(b)** A 'posed' smile reveals the entire maxillary incisor crown and up to 1–2 mm of the gingivae. **(c)** A 'spontaneous' smile raises the upper lip more than a posed smile.

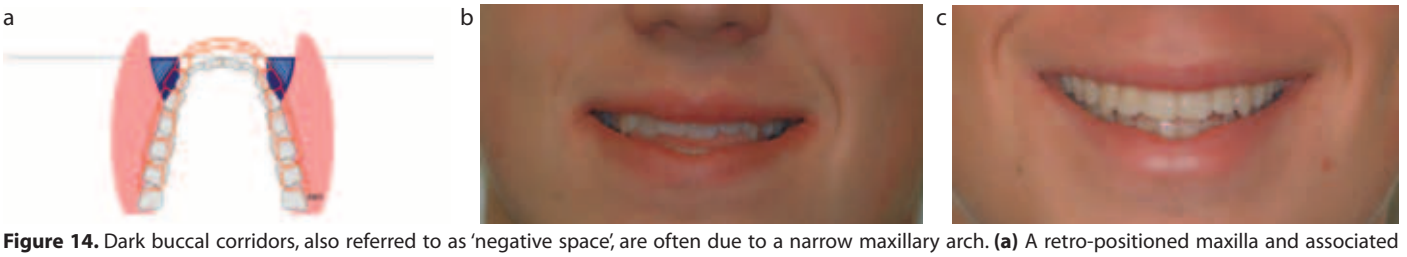


Figure 14. Dark buccal corridors, also referred to as 'negative space', are often due to a narrow maxillary arch. **(a)** A retro-positioned maxilla and associated dentition may result in the appearance of dark buccal corridors on smiling (dark blue). Anterior repositioning of the maxilla and associated dentition (red outline) will 'fill out' the smile and reduce the buccal corridors (striped dark blue). **(b)** Dark buccal corridors evident in a patient with maxillary hypoplasia. **(c)** Full smile after maxillary advancement.

incisors, the greater the exposure of the maxillary incisors, and vice versa.

5. The inclination of the maxillary incisor teeth. Retroclination of proclined maxillary incisors towards the correct inclination increases the incisor exposure, as the teeth rotate around their centre of resistance (Figure 13).

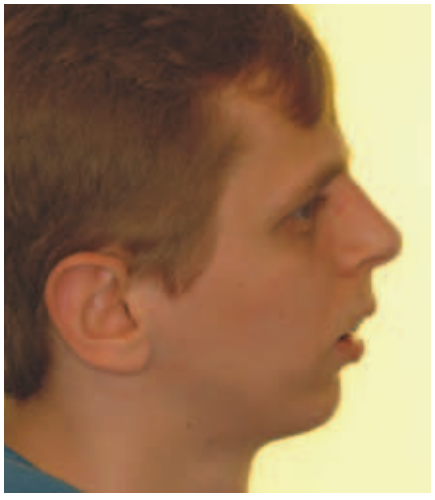
6. Maxillary incisor crown length, including the presence of incisal wear. Short maxillary incisor crowns and vertical wear of the incisor crowns reduces incisor exposure.

7. The vertical level of the gingival margins on the labial surface of the maxillary incisor crowns. It is important to note that the gingival margins of the maxillary incisors may migrate gingivally until late adolescence, reducing gingival exposure and exposing the normal crown length.

Dark buccal corridors

The 'buccal corridor' or 'negative space' is the space created between the buccal surface of the posterior teeth

a



b

c

Figure 15. The facial profile may be: **(a)** convex (Class II skeletal pattern, due to a retrognathic mandible, prognathic maxilla, or both), **(b)** concave (Class III skeletal pattern, due to a prognathic mandible, retrognathic maxilla, or both), or **(c)** orthognathic/straight (Class I skeletal pattern).

and the commissures of the lips when a patient smiles. The presence of dark buccal corridors may be due to:

- Transverse narrowing of the maxilla, especially in the premolar region. Expansion of the maxillary arch is required in order to fill the corners of the smile.
- Palatal angulation of the maxillary posterior dentition. Increased palatal root torque and/or expansion of the posterior maxillary dentition, primarily the premolar region, are required. In cosmetic dentistry, an increase in the thickness of the buccal aspect of ceramic restorations on the premolar teeth may help to fill out the smile.
- Retro-positioned maxilla. Maxillary advancement is the treatment of choice (Figure 14).

Figure 16. Paranasal hollowing is a sign of anteroposterior maxillary deficiency.

Figure 17. Increased sclera show above the lower eyelid is a sign of midfacial hypoplasia.

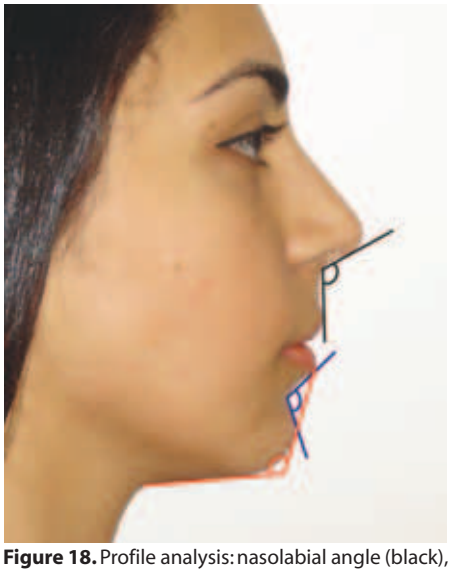


Figure 18. Profile analysis: nasolabial angle (black), labiomental angle (blue) and lip-chin-submental plane angle (red). Mandibular setback procedures may be contra-indicated if the length of the submental plane (soft tissue menton to junction of submental plane and vertical plane of the anterior aspect of the neck) is reduced, as this may lead to a 'double chin' appearance.

Facial profile analysis (Table 4)

Facial profile convexity is an indication of an underlying Class II skeletal pattern either due to maxillary prognathism, or more likely due to mandibular retrognathism. Facial profile concavity is an indication of an underlying Class III skeletal pattern either due to maxillary retrognathism or mandibular prognathism, or both (Figure 15). Paranasal hollowing (Figure 16) is a sign of midface deficiency, as are a flattened upper lip and an obtuse nasolabial angle. Increased sclera show above the lower eyelid, normally assessed in the frontal facial examination, is also a sign

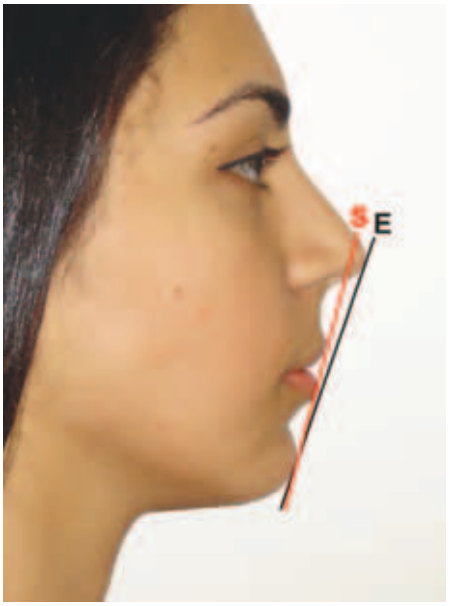


Figure 19. Profile analysis of anteroposterior lip relationships. The E (Esthetic) line and S (Steiner) line are shown. It is also important to assess the soft tissue thickness of the lips.

Anteroposterior position of maxilla	■ Facial vertical from soft tissue nasion, perpendicular to Frankfort plane (or ideally true horizontal line) with patient in natural head position. Subnasale is on this line. ■ Paranasal hollowing/flatness is a sign of maxillary hypoplasia.
Anteroposterior chin position	■ Facial vertical[9] is a line from soft tissue nasion, perpendicular to Frankfort plane (or ideally true horizontal line). Soft tissue pogonion should be 0 ± 2 mm to this line. ■ Bass aesthetic analysis[15] uses subnasale (rather than soft tissue nasion) from which to drop a perpendicular to the true horizontal line with the patient in NHP. This analysis is useful for planning treatment in mandibular retrognathia, where the maxillary position is correct. ■ It is vital to assess the soft tissue thickness anterior to the bony chin, as an over-projection of the chin may be entirely due to the soft tissue thickness.
Anteroposterior lip position	■ Esthetic line (E-line).[9] Joins the nasal tip to soft tissue pogonion. The upper lip should be 4 mm and the lower lip 2 mm behind this line in adults. This is very dependent on nasal and chin projection. ■ Steiner line (S-line).[10] Joins soft tissue pogonion to the midpoint between subnasale and nasal tip. The lips should touch this line. ■ Harmony line (H-line).[11] A line from soft tissue pogonion touching the upper lip should bisect the nose. ■ Profile line (of Merrifield).[12] A tangent to the chin and vermilion border of both lips should ideally bisect the nose.
Relationship of upper lip to nasal columella	■ Nasolabial angle is formed between the nasal columella and the upper lip slope. Average value: 85–120°. Depends on anteroposterior position of maxillary incisors and anterior maxilla, the morphology of the upper lip, as well as the vertical position of the nasal tip.
Relationship of lower lip to chin	■ Labiomental angle is formed between the lower lip and chin, and depends on the lower incisor inclination and anterior lower face height. Average value: 110–130°. ■ Excessively proclined lower incisor teeth, a prominent chin and a reduced lower anterior facial height may lead to an acute labiomental angle.
Relationship of chin to submental plane	■ Lip-chin-submental plane angle: average 90–110°. This is obtuse if mandibular retrognathia, retrogenia, excessive lower lip projection or increased submental fat are present. ■ Submental plane length (soft tissue menton to junction of submental plane and vertical plane of the anterior aspect of the neck). If excessively short, this is a contra-indication to mandibular setback, which could result in the formation of a 'double chin'.

Table 4. Facial profile analysis.

of midface deficiency (Figure 17).

A number of useful soft tissue profile analyses exist (Figures 18 and 19).[9–13]

The clinical examination may be supported by lateral and postero-anterior cephalometric radiographs with in-depth analyses to assess the soft tissues[14,15] and underlying hard tissue relationships further.[16] Three-dimensional imaging may also be used to assess more complicated cases, including severe asymmetries and craniofacial deformity.[17]

Conclusion

'Art washes away from the soul the dust of everyday life'
Pablo Picasso

In the assessment of dentofacial aesthetics, art and science must act in unison. Edward Angle, known as the father of modern orthodontics, said, 'There is nothing in which the student of Orthodontia should be more keenly interested than art generally and especially in its relation to the human face'.[18] This is true of all aspects of aesthetic dentistry and is indeed the beauty of orthodontics.

It is, however, important to note that the canons described are guidelines. Only thoughtful patient interview/consultation and careful clinical examination will lead to a considered overall clinical judgement regarding both the suitability for treatment and the type of treatment required. The clinician must be able to discuss every treatment option with the patient, both in terms of its effects on dental aesthetics and its potential effect on facial aesthetics, be it positive or negative.

As our clinical practice should always be based upon a sound knowledge of theory, Part 1 of this article has described the historical and theoretical background to our contemporary understanding of facial aesthetics. In Part 2 a number of useful basic guidelines for the clinical evaluation of dentofacial aesthetics have been described to aid the clinician involved in the treatment of patients

requiring alterations in their dentofacial appearance.

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