

CLINICAL
SECTION

Measurement of the profile angle and the aesthetic analysis of the facial profile

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Abstract

Index words: cephalometric, radiograph, aesthetic, horizontal, facial profile, natural head position, aesthetic analysis

Cephalometric measurement of the face in terms of aesthetics can be difficult and misleading due to the variability of the intra-cranial reference lines. Extra-cranial references are more accurate, but can be time-consuming to apply. The Aesthetic Horizontal is an intuitive datum line related to the 'photographic position' of the head, which is expedient in use and clinically relevant. A new and straightforward technique is presented for transferring the Aesthetic Horizontal directly from the patient to any recent radiograph, which can then be used as the reference line for an aesthetic analysis of the facial profile. The instrument used for measuring the profile angle and the transfer is readily constructed from a protractor and small weight. The technique can also be used to transfer any other orientation (e.g. Natural Head Position or Natural Head Posture) from the patient to a recent radiograph.

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The success of an orthodontic treatment is frequently related to the improvement gained in the patient's facial appearance, which includes the soft tissue profile. Unfortunately, traditional cephalometric measurements do not provide all the answers to the aesthetic considerations of the face and dentition, particularly in relation to the soft tissues. Experienced clinicians are generally aware of the poor aesthetic results often obtained by 'treating to the numbers' and the limitations of cephalometric analysis.¹ 'Metric deviations from mid-normal dento-facial relationships should not be looked upon as indicative of treatment goals' and applying statistical population means to parts of the structure of an individual face does not always produce ideal relationships.² Furthermore, the inclinations of intra-cranial reference lines, such as Frankfort and S–N, are very variable, making them unsuitable for cephalometric analysis and particularly for analysis of the facial profile.^{3–6} Extra-cranial reference lines have been proposed avoiding the inherent problems associated with possible variations in the intra-cranial lines,^{7,8} but creating new difficulties in technique and variability in reproduction. The accurate use of Natural Head Posture⁹ and Natural Head Position¹⁰ is time consuming and not particularly easy in the clinical environment. Natural

Head Orientation¹¹ is also difficult to reproduce and demands a keen eye. To overcome these problems the Aesthetic Horizontal reference line was proposed, which is related to the Aesthetic or photographic position of the facial profile, familiar to all orthodontists.¹² The variability of this reference line has been shown to be considerably less than other methods of orientating the facial profile, with a Method Error of only 1.36 degrees. An Aesthetic Analysis of the facial profile can be carried out using this reference line on the radiograph with simplicity and with confidence in its clinical relevance.^{12,13}

In the previously published technique, a radio-opaque wire was adjusted to the true horizontal by means of a spirit level and attached to the patient's face held in the Aesthetic Position.¹² However, although the procedure is relatively simple, it requires the co-operation of trained staff or the clinician's own time. Most significantly, the reference line could not be placed after the radiograph has been taken and, therefore, all cephalometric radiographs needed to be taken with the wire in position, to avoid duplication of exposure. To avoid this drawback, a new method has been developed which allows the Aesthetic Horizontal line (or any other chosen horizontal datum) to be placed at any time after a radiograph has been processed, and has the merits of

simplicity and accuracy. The method has proved to be quick and easy in the clinical environment, and has superseded the previous spirit level technique.

Construction of the instrument and measuring the profile angle

Materials

An inexpensive student's protractor forms the basis of the simple measuring device. A small hole is drilled at the centre and a 0.9-mm wire approximately 10 cm in length is suspended from this position, by means of a hook formed at one end. A small weight is attached to the other end, to form a plumb bob (Figure 1). Alternatively, a nylon thread can be used to suspend the weight. A tracing template (Dome protractor—Precision Orthodontics, Dove House, 2 Esher Road, Walton-on-Thames, Surrey, KT12 4JY; Figure 2) is also very effective for measuring the angle and can subsequently be used to make the tracing.

Clinical technique

The patient's head is placed in the Aesthetic Position, as if a profile photograph were about to be taken, so that the face does not appear to be tilted up or down (Figure 3). This orientation can be reproduced with an error of less than 1.5 degrees, more than sufficient accuracy for all clinical purposes.¹² The straight edge of

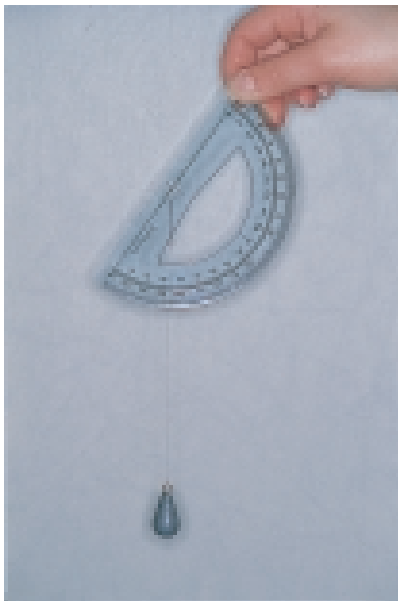


Fig. 1 Protractor with hole drilled in centre and weight attached.



Fig. 2 'Dome' tracing template with weight.

the protractor is placed in light contact with the tip of the nose and the chin and the plumb bob allowed to settle (Figure 4a, b). A note is made of the angle between the vertical and the line joining the nose tip to chin (the E-plane). This is the measured Profile Angle (Figure 5a).

Transferring the measured angle to the radiograph (Figure 5b)

1. Draw in the E-plane on the radiograph, from tip of nose to soft tissue pogonion.¹⁴ The radiograph must be taken with effective soft tissue filtration to show the soft tissues accurately, without 'burn-out'.
2. Apply the measured profile angle to the E-plane and draw in the vertical (the line of the plumb bob).
3. Draw the Aesthetic Horizontal at 90 degrees to this vertical line. (As only angular measurements are used in the transfer, any difference in enlargement between the radiograph and the face will not be relevant.)

This method of profile angle measurement can also be used as a convenient means of transferring Natural Head Position or Natural Head Posture, or any other extra-cranial datum line, from the patient to the cephalogram.

The aesthetic position, natural head position, and natural head posture

Although the Aesthetic Position frequently will equate to Natural Head Position or Natural Head Posture



Fig. 3 Placing the patient in the 'photographic position'. (a) Head is tipped down. (b) Head is tipped up. (c) Head is level in the Aesthetic Horizontal.

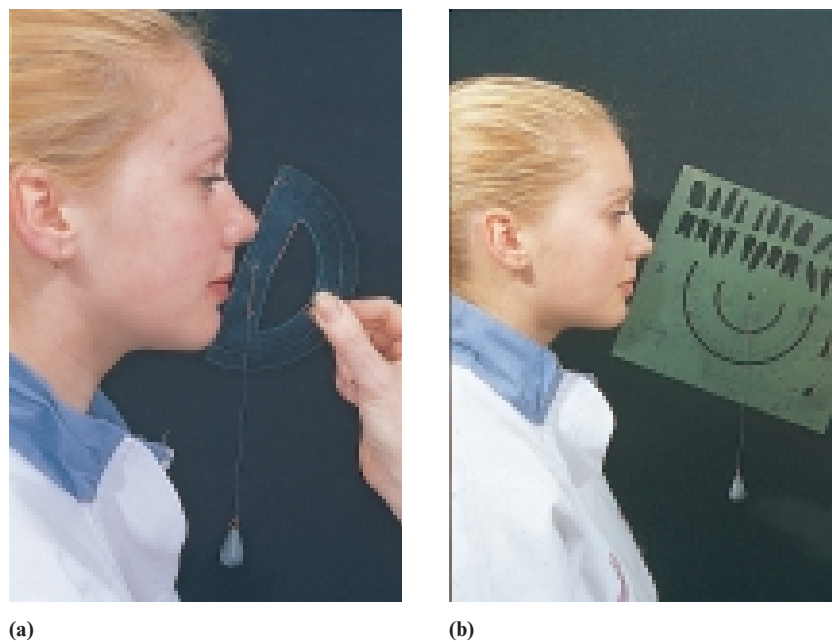


Fig. 4 (a) Reading off the profile angle. (b) Side of tracing template is convenient to measure the angle. The template can then be used for the cephalometric tracing and Aesthetic Analysis.

(these terms are not interchangeable), many individuals characteristically hold their heads in a habitually displaced position, to a greater or lesser extent. Furthermore, Natural Head Position and Posture are both affected by ambient temperature and nasal obstruction, which also would create errors if subsequently used to assess the aesthetics of the soft tissue facial profile.

Natural Head Position is defined as 'a standardised and reproducible orientation of the head in space when focusing on a distal point at eye level'.¹⁵ However, Moorees himself states that 'X-ray technicians and dental assistants ... can learn to recognize and correct slight tipping of the head upward and downward'.¹⁶ Thus, Natural Head Position is not fully determined by

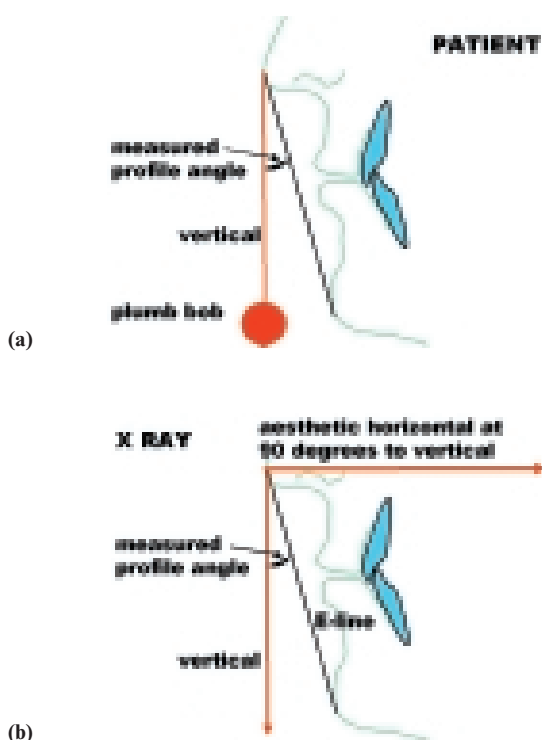


Fig. 5 (a) The measured profile angle. (b) Placing the profile angle on the radiograph allows the vertical to be transferred. The Aesthetic Horizontal line is placed at 90 degrees to this.

the patient, but requires adjustment by the radiographer, prior to exposure.

Natural Head Posture¹⁷⁻²¹ is a functional position of the head that, apart from the variations noted above, differs in the sitting and standing subject and appears to oscillate around the individual's mean Natural Head Position.²² It is a dynamic, physiologic concept,²³ and is difficult and time consuming to establish; as such it is not appropriate as a clinical technique.

The Aesthetic Position (or photographic position of the head) is effectively a corrected Natural Head Position with the adjustment made by the clinician, rather than the radiographer, subsequent to the radiograph being taken. As important treatment decisions affecting the patient's profile and smile will be based on this datum, it is apparent that the responsibility for the correct positioning of the patient cannot be entrusted to the radiographer or dental assistant.

Furthermore, with today's concerns regarding exposure to ionizing radiation, an incorrectly registered radiograph cannot simply be repeated, even if the error in positioning was recognized. Using the Aesthetic Position and the transfer method described permits the clinician to directly assess the correct head position for

the individual patient and register the datum line on a previously taken radiograph. The possibility of error is eliminated and the technique takes but a moment of clinical time.

The aesthetic analysis

The analysis evaluates the soft tissue profile in a clinically meaningful way and provides the possibility of evaluating the correct position of the upper incisors within the face, for the optimum smile. (As this is one of the primary features which a lay person would perceive in assessing facial aesthetics, it would seem to make sound clinical sense to address this in planning orthodontic treatment.) The position of the upper incisors and the relationship to the lips is the key to the smile and, as such, requires to be made a central focus of the orthodontic treatment plan. Ultimately, this will be a feature of major significance to the patient. The thickness of the soft tissues of the facial skeleton varies considerably between individuals and the Analysis allows the patient to be compared to themselves, rather than to a statistical group norm. [‘Each person should be judged by a measure within himself’ (Aristotle, c. 500 BC).]

Orthodontic treatment can only influence the lower facial third, and it will be apparent that the position of soft tissue nasion or glabella will not be significant in assessing the harmony and balance of the lower facial third. It is therefore more logical to assess this from a closer point of reference and subnasale (Sn) is used for this, the deepest point on the curve where the profile of the nose joins the lip.

(Note that in cases of significant maxillary retrusion or hypoplasia, where adjunctive surgical procedures are being considered, it will be necessary to make an allowance for the abnormal position of the maxilla)

Tracing procedure

- Step 1 Draw in the Aesthetic Horizontal line, from which vertical perpendiculars can be constructed.
- Step 2 Find subnasale (Sn) and A-point (Figure 6).
- Step 3 Chin position:
 - Draw a vertical perpendicular from the Aesthetic Horizontal through a point (‘V’-point) half-way between Sn and A-point (‘Chin Line’; Figure 6b,c). This gives the posterior limit for a harmonious soft tissue chin position. Behind this, the chin has the appearance of being retrusive.

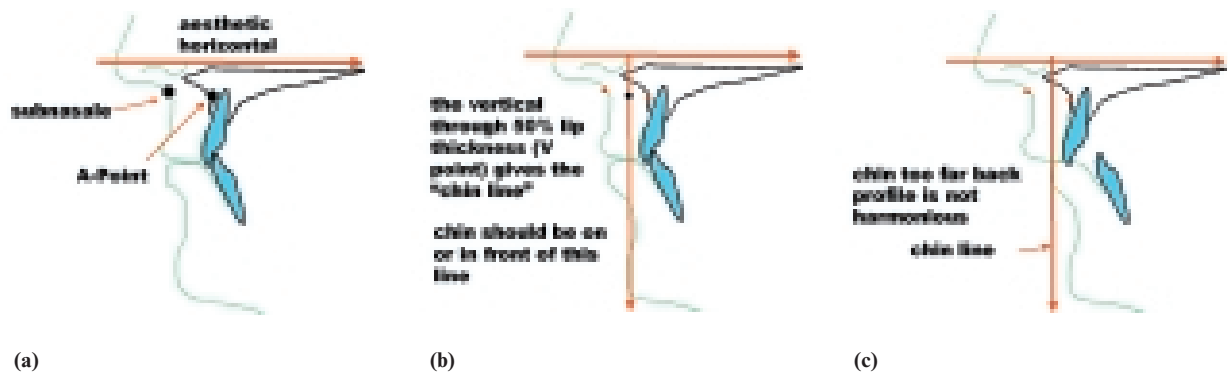


Fig. 6 (a) Subnasale and A-point. (b) The posterior limit for the chin. (c) The chin appears retrusive.

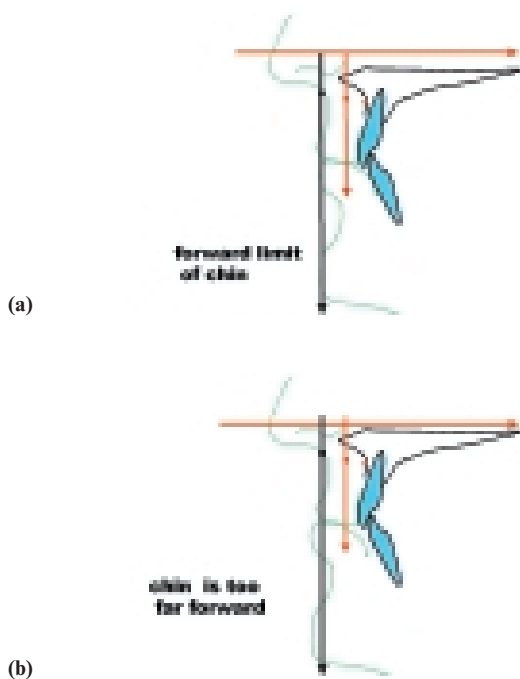


Fig. 7 (a) The anterior limit for the chin. (b) The chin appears protrusive.

- Draw a vertical line through subnasale ('Lip Line'; Figure 7a). This is the anterior limit of the chin for a balanced profile. Anterior to this, the chin looks protrusive.^{24,25} (Figure 7b). This appears to hold true for all ethnic groups.

Step 4 Lip position (Caucasian; Figure 8a,b). The slope of the upper lip should lie on or slightly in front of the vertical from subnasale ('lip line') with the most anterior part of the upper lip 1–2 mm in front and the most anterior part of the lower lip 0–1 mm behind the line. Asian, Oriental and Black individuals will have a

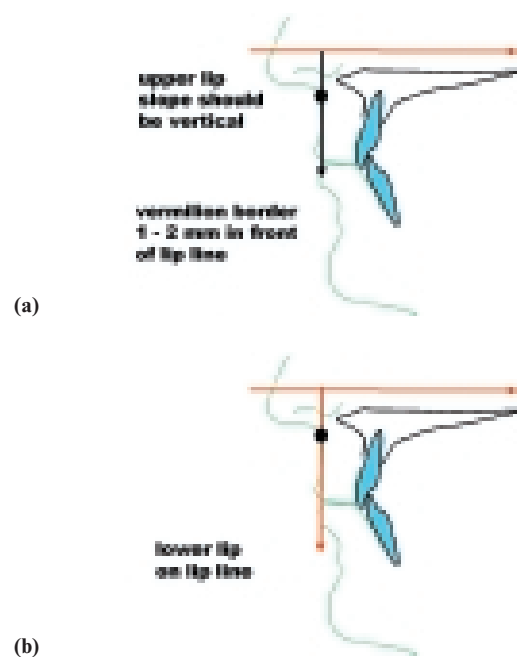


Fig. 8 (a,b) Lip position.

harmonious lip position more advanced than this, to varying extents.

Step 5 Maxillary Incisor Position (Caucasian; Figure 9a–d):

- *Horizontal Position:* Bisect the distance between point A and V-point (to give one-quarter the thickness of the upper lip) and drop a vertical line. The middle third of the labial surface of the maxillary central incisor should lie tangent to this line. This ensures that the teeth are well displayed during expression, without appearing to be too proclined or retroclined. This also places the roots at the correct angulation, assuming an average crown-root angle. However, there is considerable variation, up to 42

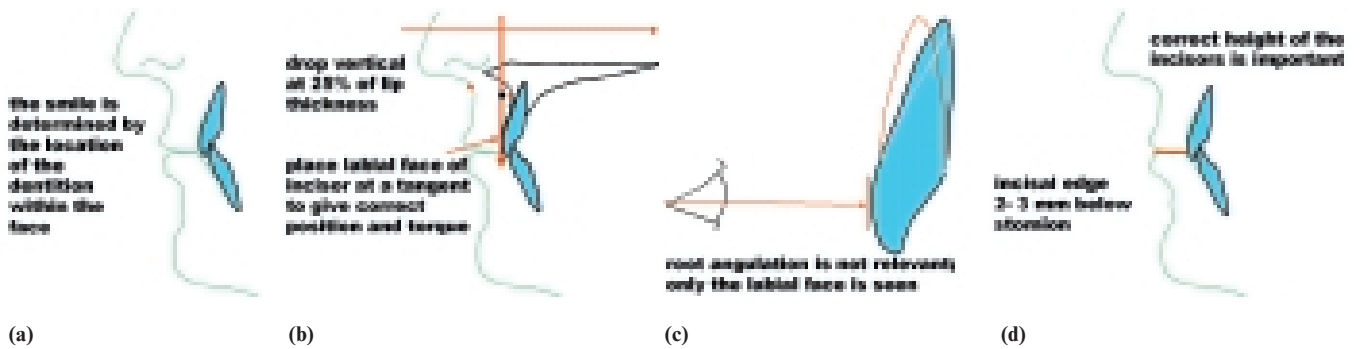


Fig. 9 (a-d) Maxillary incisor position.

degrees in some cases, between the labial surface and the root long axis, and it is unwise to rely on root position to determine the aesthetic appearance of the crowns of the incisors.²⁶ When the incisors are in good position, the soft tissue profile will tend to be harmonious.^{27,28} (The position of the maxillary incisors is more forward in Black, Oriental and some Asian groups, when they will tend to fall on the vertical line through V-point.)

- *Vertical:* The incisal edge should lie 2–3 mm below stomion for maximum exposure of the teeth during expressive behaviour without an excess of gingival tissue showing.

Step 6 Lower incisor position (Caucasian). The anterior contour of the incisal edge will generally lie on the vertical perpendicular through A point, with a normal overjet and with the upper incisors in the correct position (Figure 10).

Step 7 Determination of need for mandibular advancement. If soft tissue pogonion is too far back, as assessed in Step 3 and if repositioning the maxillary incisors in Step 5 still leaves an overjet, then orthopaedic or surgical correction of mandibular position is indicated.

Comparison of serial cephalometric records may be carried out by transferring the Aesthetic Horizontal to previous or subsequent radiographs with reference to stable anatomical structures within the anterior cranial base, which do not change with growth.²⁹ A template is made on acetate tracing paper on which the anatomical structures and the Aesthetic Horizontal line are drawn. This template is then orientated over the additional radiographs and the line transferred.

Conclusion

A clinically effective method is described for accurately placing the Aesthetic Horizontal, or any other chosen extra-cranial datum line, on the cephalometric radiograph after it has been taken. A measurement of the orientation of the patient's face in relation to the vertical is made, which can then rapidly transferred to the radiograph.

A series of four vertical lines (Figure 11) provide the determinants for the horizontal positions of the soft tissue chin, upper lip, lower lip, upper incisors, and lower incisors in relation to the profile. This allows the Aesthetic Analysis to be rapidly carried out, as an addition to the clinician's usual cephalometric analysis.

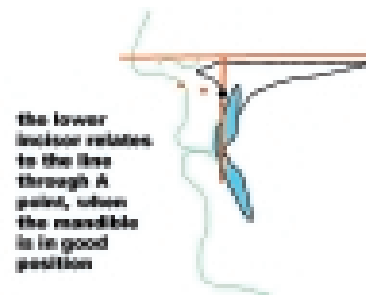


Fig. 10 Lower incisor position in Skeletal I case.

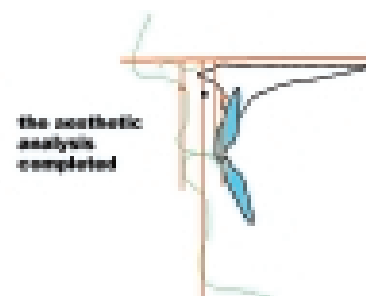


Fig. 11 The four vertical lines required for the Aesthetic Analysis.

The analysis permits straightforward assessment of the orthodontically important lower facial third and the location of the dentition in the face to be determined in an individualistic way, taking the soft tissues into consideration. The position of the upper incisor is taken as a key landmark in treatment planning, in order to provide the patient with the most attractive and well-balanced smile. Spurious and misleading bony landmarks are avoided by the use of the Aesthetic Horizontal line—an easily reproducible datum line with a low method error. Aesthetic changes in the profile can subsequently be accurately assessed for treatment monitoring, using progress radiographs.

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