Reliability and accuracy of the lower incisor mandibular plane angle: Proposed correction factor

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يكون الوضع اللساني الشفوي للقواطع السفلية في منطقة توازن ، و ان أي تغيير فعلي لهذا الوضع يؤدي إلى نكس الحالة بالرغم من وجود استثناءات لبعض الحالات . في التحـــاليل السفالومترية يقاس التوضع الأمامي الخلفي للقواطع السفلية بواسطة زاوية القواطع السفلية ومستوى الفك السفلي (IMPA). ولكن يمكن للشكل الخارجي للفك السفلي أن يؤثر في هذه الزاوية. صممت هذه الدراسة لتحليل العوامل المؤثرة على زاوية (IMPA) ولتقديم طريقة لتعديل القراءة في حالة الميل غير الطبيعي .

The labiolingual position of the lower incisors is in a zone of balance. Any significant changes in the position lead to relapse, although, in some cases, there are exceptions. In cephalometric analysis, the relative anteroposterior position of the lower incisor is measured by the lower incisor mandibular plane angle (IMPA). However, the morphology of the mandible could vary affecting the value of IMPA. This study is designed to analyze the factors influencing the IMPA, and to introduce a method for adjusting abnormal inclination.

Introduction

It is accepted that the lower incisors lie in a zone of balance between the tongue and the lips.[1] During orthodontic treatment in a majority of patients, the significant changes in the position of the lower incisors are followed by relapse.[2] However in some cases, there are exceptions to the above rule.[3] The determination of the incisor labiolingual position is part of the cephalometric analysis.[4-8] The lower incisor mandibular plane angle (IMPA) is a valuable parameter for clinicians to assess the position of the lower incisors procumbancy relative to the face. In addition some clinicians would find it useful for the determination of teeth extractions and the orientation of the teeth to their upper counterparts during treatment planning. This parameter has gained popularity after its adoption by Tweed in 1946.[9] The mean value for the angle of the lower incisor to the mandibular plane was around $90^0 \pm 5^0$.[10] The range of normality was almost 10^0. However, the accuracy of this parameter will depend on the position of the incisor on the mandibular basal bone and the inclination of the lower border of the mandible. The latter is affected by the height of the ramus.

The purpose of this paper was to introduce a correction factor for the abnormal inclination of the lower border of the mandible.

Materials and Methods

In the study, a model template of the mandible was derived through a computer from the lateral skull radiographs of a random sample of 150 school children (75 boys and 75 girls).[10]

The computer model template was used as a guide to transfer to and correct individual mandibular points for patients and propose an adjustment factor for the lower incisor mandibular plane angle.

The method for calculating the correction factor for the lower incisor mandibular plane angle is as follows. In the model template of the mandible, the anatomical points B (supramentale) and Gn (Gnathion) were located. The distance between points B and Gn was found equal to 20 mm in the template. A perpendicular line drop to B-Gn from X (hypothetical point) was made to form X-Gn. The perpendicular X-Gn made an angle of 15^0 with the mandibular plane on the mean template (Fig. 1). From the above parameters, the value of B-

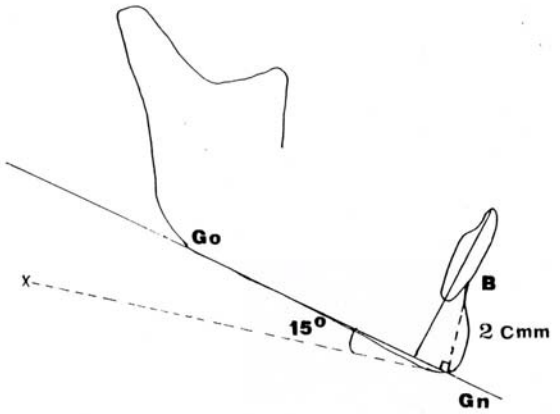

Fig. 1. The perpendicular X-Gn made an angle of 15^0 with the mandibular plane on the template.

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Gn and the angle of X-Gn to mandibular plane in addition to the gonial angle were used to calculate the correction factor for the lower incisor mandibular plane angle.

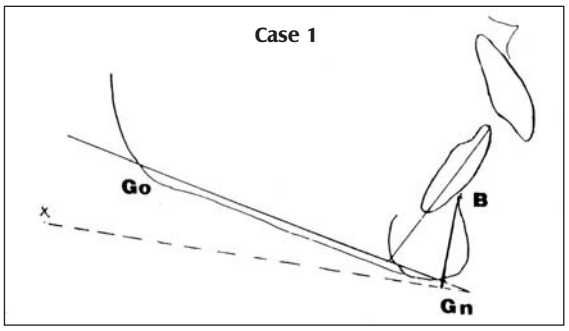
Results

The results of applying the correction factor are presented in the following cases.

Case 1:

Measured: Lower incisor mandibular plane angle (IMPA) = 105^0
Gonial angle = 120^0
Join B-Gn (20 mm)
Drop perpendicular X to B-Gn
Go Gn X = 13^0

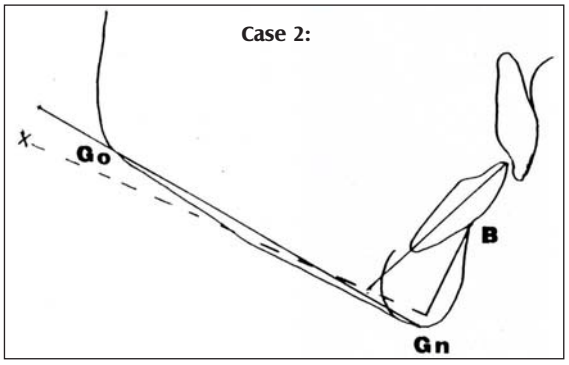
Difference between measured GoGnX and the model GoGnX = $13^0 - 15^0 = -2^0$
Corrected IMPA = $105^0 - 2^0 = 103^0$



Case 2:

Measured: Lower incisor mandibular plane angle (IMPA) = 101^0
Gonial angle = 121^0
Join B-Gn (20 mm)
Drop perpendicular X to B-Gn
Go Gn X = 7^0

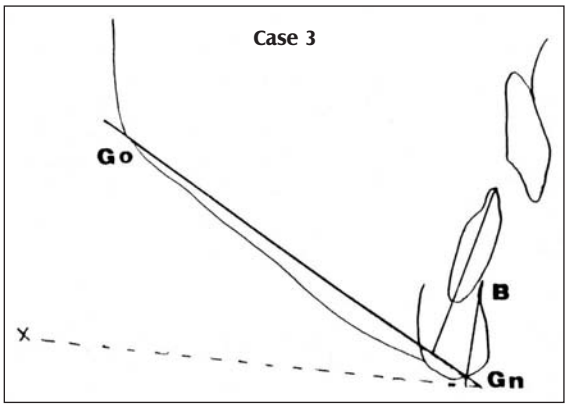
Difference between measured GoGnX and the model GoGnX = $7^0 - 15^0 = -8^0$
Corrected IMPA = $101^0 - 8^0 = 93^0$



Case 3:

Measured: Incisor mandibular plane angle (IMPA) = 70^0
Gonial angle = 138^0
Join B-Gn (20 mm)
Drop perpendicular X to B-Gn
Go Gn X = 30^0

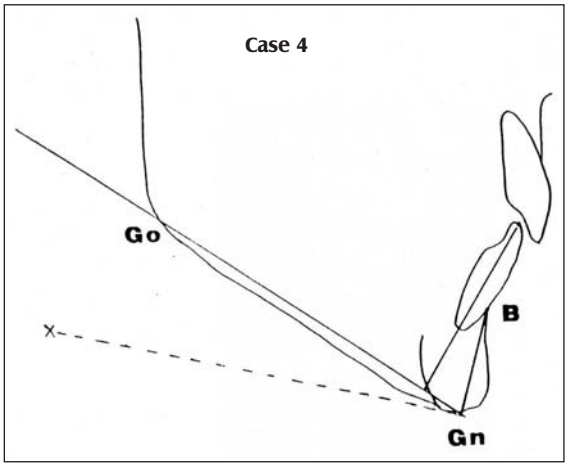
Difference between measured GoGnX and the model GoGnX = $30^0 - 15^0 = +15^0$
Corrected IMPA = $70^0 + 15^0 = 85^0$



Case 4:

Measured: Incisor mandibular plane angle (IMPA) = 81^0
Gonial angle = 131.5^0
Join B-Gn (20 mm)
Drop perpendicular X to B-Gn
Go Gn X = 22^0
Mean Go Gn X = 15^0

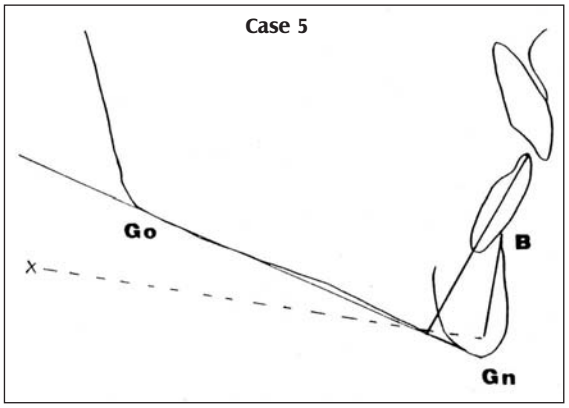
Difference between measured GoGnX and the model GoGnX = $22^0 - 15^0 = +7^0$
Corrected IMPA = $81^0 + 7^0 = 88^0$



Case 5:

Measured: Incisor mandibular plane angle (IMPA) = 90.5^0
Gonial angle = 131^0
Join B-Gn (20 mm)
Drop perpendicular X to B-Gn
Go Gn X = 16^0

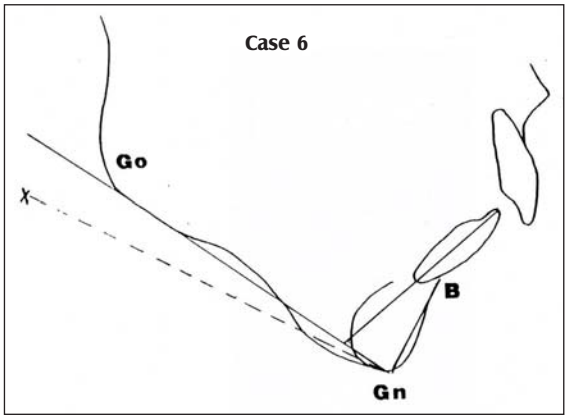
Difference between measured GoGnX and the model GoGnX = $16^0 - 15^0 = +1^0$
Corrected IMPA = $90.5^0 + 1^0 = 91.5^0$



CASE 6:

Measured: Incisor mandibular plane angle (IMPA) = 100^0
Gonial angle = 130^0
Join B-Gn (20 mm)
Drop perpendicular X to B-Gn
Go Gn X = 8^0

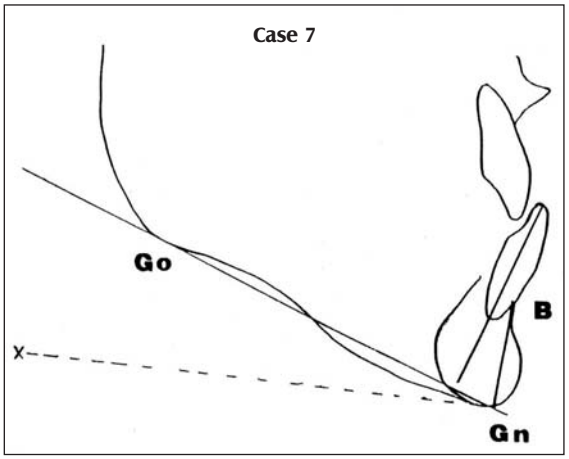
Difference between measured GoGnX and the model GoGnX = $8^0 - 15^0 = -7^0$
Corrected IMPA = $100^0 - 7^0 = 93^0$



Case 7:

Measured: Incisor mandibular plane angle (IMPA) = 80^0
Gonial angle = 130^0
Join B-Gn (20 mm)
Drop perpendicular X to B-Gn
Go Gn X = 22^0

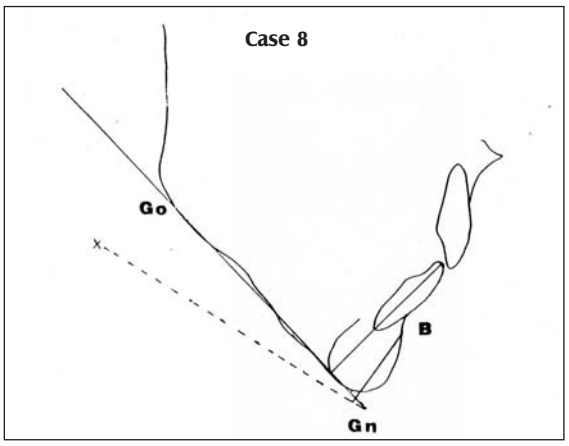
Difference between measured GoGnX and the model GoGnX = $22^0 - 15^0 = +7^0$
Corrected IMPA = $80^0 + 7^0 = 87^0$



Case 8:

Measured: Incisor mandibular plane angle (IMPA) = 82^0
Gonial angle = 135^0
Join B-Gn (20 mm)
Drop perpendicular X to B-Gn
Go Gn X = 15^0

Difference between measured GoGnX and the model GoGnX = $15^0 - 15^0 = 0^0$
Corrected IMPA = $82^0 + 0^0 = 82^0$



In general, the corrected factor for the abnormal inclination of the lower border the mandible can be summarized into the following formula:

Corrected IMPA = IMPA + (G - 15^0)

where IMPA = Incisor mandibular plane angle
G = measured GoGnX

Discussion

The incisor mandibular plane angle is a useful parameter in indicating the relative anteroposterior position of the lower incisor. However, in previous studies[4,6] the range of normality of this parameter was around 10^0. This wide range did not permit the clinician to utilize this parameter accurately; therefore, if this range was narrowed a somewhat more precise diagnosis could be achieved.

The IMPA simply is the intersection between the long axis of the lower central incisor and the inclination of the lower border of the mandible. In the majority of cases, the mandible has normal dimensions which will not alter related parameters, i.e. FMA, SNMP, IMPA&e tc. In some cases, the mandible could acquire short or long ramii, short or long anterior border (B-Gn) or a combination of both. However, the incisor mandibular plane angle (IMPA) will be affected by the relative labiolingual position of the lower central incisor and the inclination of the lower border of the mandible.

This is explained in Fig. 2 by the tracing of two cases with the same lower incisor position relative to the face. The shorter the ramus relative to the anterior border of the mandible (B-Gn), the larger the gonial angle, the longer the ramus relative to the anterior border of the mandible, the smaller the gonial angle. However, the above factors, which alter the mandibular parameters, did not change the position of the lower central incisor relative to the facial plane or Frankfort horizontal and if the anterior border of the mandible used as a reference the mandibular structures could be adjusted in order to obtain an accurate IMPA.

The labiolingual inclination of the lower incisor is the target angle for measurement and therefore should be accepted. The inclination of the lower border of the mandible alters the angle. In addition, the inclination of the lower border of the mandible varies according to the gonial angle. For example a steep mandibular lower border will be associated with a large gonial angle, if the lower central incisor is reasonably upright relative to the face, the incisor mandibular plane angle will be less than its true value. While a decreased gonial angle will give an increased value for incisor mandibular plane angle if the lower incisor is an upright position relative to the face. Therefore, the inclination of the mandibular plane will vary according to the height of the ramus relative to the height of the anterior border of the mandible (Fig. 2). From the above, the incisor mandibular plane angle's value will vary according to the inclination of the mandibular plane, which in turn affected by the ramal height independent of the true inclination of the lower central incisor.

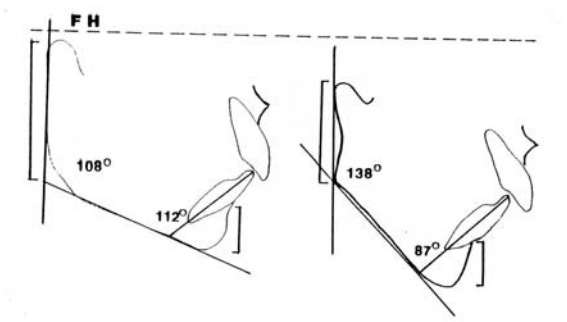


Fig. 2. Tracing a, b with the same lower incisor position relative to the face.

Therefore, since the position of the lower central incisor anteroposteriorly is significant in orthodontic diagnosis and treatment planning independent of other related parameters as the mandibular plane, the inclination of the lower border of the mandible should be corrected so that the true position of the lower central incisor anteroposteriorly can be assessed.

In the present study, a model mandible derived from a mean template was used as a guide to transfer to and correct individual mandibular points for patients and propose an adjustment factor for the lower incisor mandibular plane angle. The mean template used was a combination of a random sample for boys and girls aged 9-12 years. The choice of this model enabled this study to assess mandibular inclination for both sex's fairly accurate.

Further standardization of the height of the anterior border of the mandible B-Gn at 20 mm in this study confirms that an accurate inclination of the mandibular plane will be recorded independent of the border of the mandible. Furthermore, using point Gnathion and not Menton in this study was to avoid morphological abnormality at the mandibular symphysis. However, a clinical study may be needed to assess

the reliability of this correction.

Conclusion

In conclusion, the true inclination of the lower central incisor in relation to the face could be measured using the above method. This may help in the treatment planning to change the angulation of the lower incisor in relation to the mandibular plane.

The following correction factor for the abnormal IMPA was introduced:

Corrected IMPA = IMPA + (G - 15^0)
where IMPA = Incisor mandibular plane angle
G = measured GoGnX

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