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A CEPHALOMETRIC APPRAISAL OF OVERBITE CORRECTION*

MAURICE J. COSTELLO, M.D.Sc. (Syd.), B.D.Sc. (Qld.), F.A.C.D.S.**

Introduction.

At the 1967 Clinical Day of this Branch, Milton Sims presented a paper on the Begg technique entitled "Reciprocal Force Application." During the resulting discussion, a controversy arose concerning the manner of overbite correction. Begg and Sims maintained that, properly used, the technique reduced overbite by depressing upper and lower incisors. Many of us, however, from clinical experience considered molar elevation to contribute at least partly to the effect — whether by marginal ridge elevation, or by actual bodily extrusion.

The initial intention of this study was to establish a cephalometric method of appraising the spatial changes of anchor molars and incisors during orthodontic treatment, and to apply this method by means of a pilot study of the Begg Technique. As I was unsuccessful in obtaining an adequate sample of pre-treatment, treatment, and post-retention cephalometric X-rays from orthodontists practising the Begg technique, records were obtained from patients being treated, under specialist supervision, by graduate students. Consequently, these results might not truly represent the Begg technique as practised by experienced clinicians. However, the pilot study could serve as a basis for future more detailed investigations into this or any other orthodontic technique.

Literature Review.

As a background to this study, I propose to review the literature on the etiology and treatment of deep anterior overbite.

Etiology.

Thurow[22] expressed the importance of understanding the etiology of deep anterior overbite when he said: "The basic cause of the overbite is the most important factor in all stages of treatment."

Early studies were based mainly on unorientated plaster models, and upon subjective clinical observations. Perhaps this explains the controversy that existed over such an apparently basic issue as to whether the problem lay with lack of vertical development of the posterior teeth, or with over-development vertically of the anterior teeth— (the so-called 'over-erupted' anteriors . . . . a very much abused word, and one which is best eliminated from our literature . . . . as we surely do not mean literally over-erupted from the alveolus), or with combinations of both factors.

Early cephalometric studies on overbite etiology concentrated on the physiologic rest position of the mandible, and on the freeway space. Some authorities, notably Thompson and Brodie[20] considered that most cases of deep overbite had normal rest positions, but excessive freeway spaces. These authors considered the problem lay with lack of vertical development of the posterior alveolar process and hence infraclusion of the posterior teeth. This supported some of the early pre-cephalometric studies. Others however, notably Wylie[24, 25] considered that the majority of deep overbite cases had normal freeway spaces, and hence the problem was one of supraclusion of the anterior teeth. Wylie considered treatment should be directed at intruding such anterior teeth. Wylie conceded that cases did exist that required active extrusion of posterior segments, but considered these in the minority.

More recent cephalometric studies[9, 10, 14, 15, 16] have merely shown the individual variation which exists from patient to patient. There has been no general agreement as to which malocclusions have the problem with the anterior teeth and which with the posterior teeth.

Perhaps we are striving to over-simplify our diagnoses, for surely each individual patient needs to be considered as an entity, and the individual skeletal and dento-facial structures examined and studied, rather than attempt to fit each patient into a definite etiological grouping.

Treatment.

If one believes that it is important to know the basic etiology of a patient's anterior

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overbite, then it is equally important to understand the manner in which the various appliances reduce overbite. In this way the correct appliance can be used for a given malocclusion.

Basically, there are **five** methods for correcting deep anterior overbites. These are:—

i. Active intrusion of the anterior teeth (either upper or lower, or both), e.g.: various fixed appliances;

ii. Retardation of eruption of the anterior teeth, while the remaining posterior structures continue to develop vertically, e.g.: various fixed appliances, and perhaps removable biteplate type appliances;

iii. Active extrusion of the posterior teeth and alveolar process, e.g.: various fixed appliances;

iv. Passive eruption of posterior teeth and alveolus, e.g.: the suggested mode of operation of biteplates and biteplanes;

v. Combinations of the above.

Since the appliances used in this country are, in the main, fixed appliances, I have reviewed the literature on the manner of overbite correction with the major appliances, in use here, e.g.: Edgewise and Begg.

Edgewise Appliance.

As there is now no standard "Edgewise Technique," but a series of highly personalised appliances all using Edgewise-type brackets, it is pointless to attempt to review all varieties. However, it can be said that clinicians using this broad system have in their hands a very powerful tool with many uses. Overbites can be reduced by combination of molar elevation and incisor depression (as Stonier[19] found on evaluating cephalometrically 57 cases treated by Tweed). Dewel[7] uses arch levelling by depressing molars, canines and incisors, and elevating premolars. Thurow[21] almost routinely used incisor depression combined with premolar elevation.

Detailed cephalometric studies on cases treated with the so-called "Edgewise Technique" revealed that there was no set manner of reducing overbite: lower incisor depression, retardation of lower incisor eruption, molar and premolar extrusion, and various combinations were found, depending presumably upon the various clinicians' treatment objectives.

Begg Technique.

The Light Wire Technique as preached and practised by Begg[2, 3, 4] follows the philosophy that "As deep anterior overbites are due to over-eruption of upper and lower anterior teeth, depression of anterior teeth is the logical way for their correction."[3]

Over the past 6 years there have been numerous cephalometric investigations into the Begg technique.[5, 6, 8, 11, 13, 23] Several have demonstrated apparent lower molar elevation of up to 4mm., most[6, 8, 13] have shown varying degrees of lower incisor depression, while one study[5] showed no lower incisor depression — merely lack of vertical development during treatment. However, with several exceptions, many were investigations of patients treated by graduate students under supervision. In this light, it is significant that both Begg[2, 4] and Sims[17] consider any such molar elevation or lack of incisor depression to be an indication of improper treatment mechanics. This stresses the importance of critically reviewing the published literature, as much of what is written may not in reality be truly representative of a specific "pure" technique. Brackets and archwires do not make a Technique — it is the disciplined action in using such brackets and archwires which warrant a specific approach to treatment being called a "Technique." In this light we need more published investigations by experienced clinicians before we can fully understand the detailed operation of a specific technique. It is hoped that the specific cephalometric method introduced in this paper may be a useful one for such future studies.

Reviewing this topic revealed that there were many yet unanswered questions in the literature. I mention some, in the hope that it might provoke some future study.

The first concerned the measurement of rates of increased vertical development of the teeth and alveolus. To be specific, we just do not know the amount of increased molar height and incisor height which occurs with growth during the early permanent dentition period. How then, can we say how much so-called "molar elevation" has been produced by treatment, and how much by growth. Likewise, in cases that present successfully corrected overbites and yet which show no lower incisor depression, could not the treatment mechanics have been successfully effective in retarding their vertical development? To date, it appears we have no guide lines.

Secondly, we still hotly debate the question of the significance of molar elevation. Authors are equally emphatic that if the freeway space is encroached upon, the stretched muscles of

mastication will depress the extruded teeth following treatment, in order to regain the original freeway space; and that molar teeth, once extruded, remain that way. Perhaps the answer lies somewhere between.

Finally, on the question of molar elevation, I wish to quote Schudy[16] on the subject. Schudy, as you are aware, is one who believes that the correct way to eliminate deep overbite is to extrude the posterior teeth . . . .

> "I have not made documented studies of the freeway space, but it is my opinion that its importance is grossly over-rated. You wondered how consistently molars resist intrusion from muscle pressure in the post-treatment period. I can tell you that it is about 99.9% of the time. Men who think that molars do intrude have not bothered to look and find out. When you find a case in which the distance from anterior nasal spine to menton decreases, please send me the films. When you find a case in which the distance from palatal plane to mandibular plane decreases, please let me know."

Perhaps someone would like to take up this challenge!

ORIGINAL INVESTIGATION.

Aim.

The aim of this investigation was to establish a cephalometric method for evaluating the spatial changes of the anchor molars and incisors during orthodontic treatment. The method was tested by means of a pilot study of the manner of overbite correction in a series of patients treated with the "Begg Technique" by graduate students under specialist supervision. No intention existed of evaluating the "Begg Technique" as such, since these cases could not be expected to be truly representative of the Technique. It is hoped however, that the pilot study shows that the method has an application in further investigations of this or any other treatment technique.

Materials and Method.

The sample consisted of 49 lateral cephalometric headfilms from 19 patients treated in the Orthodontic Clinic, Department of Preventive Dentistry, University of Sydney. All patients had either Class I or Class II division I malocclusions, and all had the four first premolars extracted. Patients were selected on the basis of a clearly discernible alteration, cep-

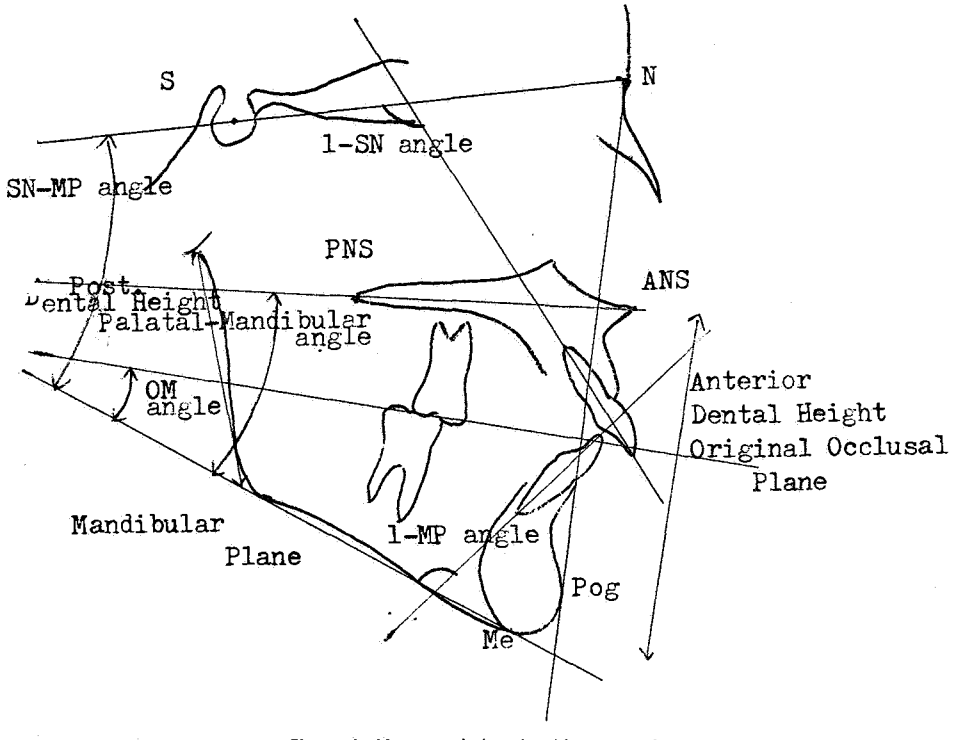

Figure I—Linear and Angular Measurements.

halometrically, in the overbite. In all, 30 sets of comparative X-rays were compiled as follows:

All patients had a pre-treatment headfilm, 14 patients had one treatment film, 3 had two films, 2 had four progress films, while 2 patients had post-treatment films. Observation periods ranged from 7 weeks after commencing treatment to 114 weeks, with a mean of 57 weeks. Although the patients were not studied Stage by Stage, since most patients had a marked reduction in overbite within several months of starting treatment, it was felt that, for a pilot study, adequate information had been obtained.

Tracings were drawn of each headfilm showing the standard cephalometric landmarks: Sella, Nasion, Anterior Nasal Spine, Posterior Nasal Spine, Pogonion, Menton, Articulare, upper and lower incisor, and upper and lower first molar.

On each tracing linear and angular components were constructed and measured, (Figure 1).

The anterior overbite and overjet were measured relative to the Facial Plane (Figure 2).

Overbite—the distance, measured along the Facial Plane, between perpendiculars drawn from the incisal edges of the upper and lower centrals;

Overjet —the perpendicular distance between lines drawn parallel to the Facial Plane and passing through the incisal edges of the upper and lower centrals.

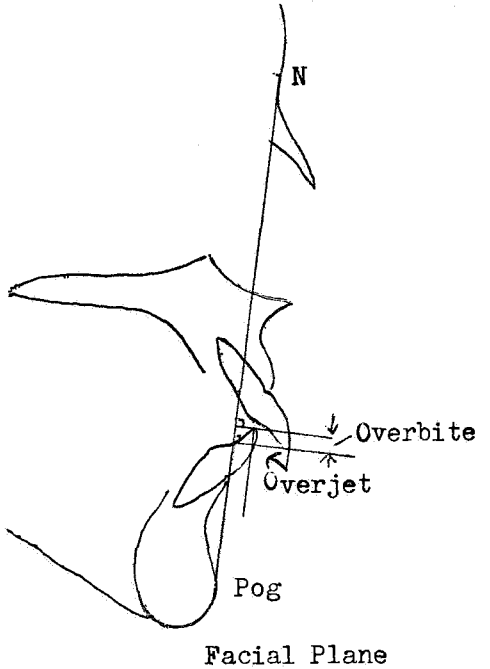

Figure 2—Overbite and Overjet measured relative to the Facial Plane.

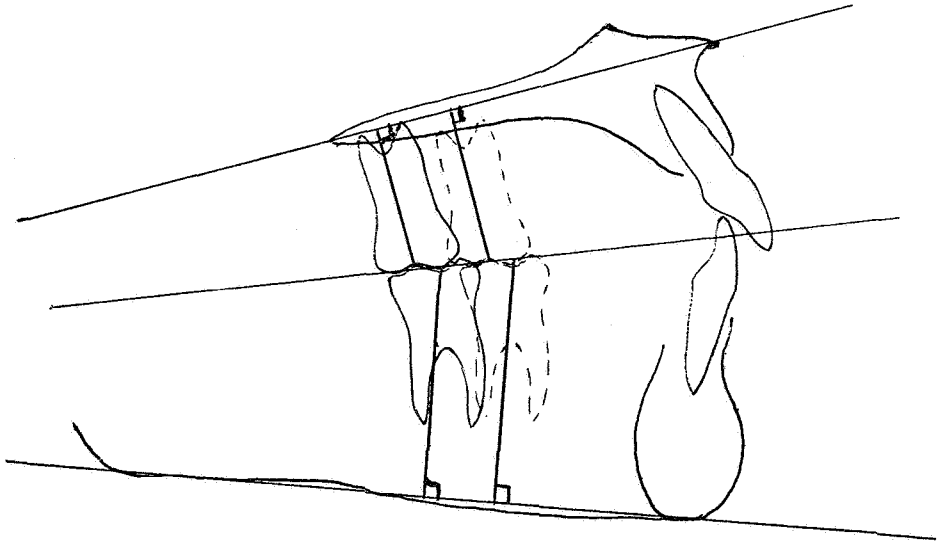

Figure 3—As Anchor Molars move mesially in treatment, their heights, measured as perpendiculars to the Mandibular and Palatal Planes, increases. The degree of such 'molar elevation' must be allowed for before condemning 'molar elevation' per se as being due to faulty treatment mechanics. The degree of elevation due to mesial movement increases as the divergence between Palatal, Occlusal, and Mandibular Planes increases.

Before explaining the method of measuring the spatial changes of the teeth during treatment, I wish to discuss what I consider a serious error in most of the published cephalometric studies on individual tooth movement. I refer to the technique of measuring heights from the palatal and mandibular planes.

Previous studies have claimed that in the Begg Technique, (and in other techniques), molar elevation from Class 2 elastics contributed to bite opening. They have all measured molar height as the length of perpendiculars to the respective palatal or mandibular planes. However, as Figure 3 shows, since the Palatal, Occlusal, and Mandibular Planes are divergent, if any mesial movement of the molars occurs in treatment, the molar height, measured from the respective Palatal or Mandibular Plane must increase in order for the teeth to remain in occlusion. This additional molar height becomes more apparent as the divergency increases. As I see it, the correct method of measuring the actual molar elevation is relative to the plane of Occlusion . . . . preferably the Original Pre-treatment Occlusal Plane (Figure 4).

If the original occlusal plane is transferred from one tracing to the next during superimposition procedures, then the "Effective Molar Heights" and the "Effective Incisor Heights" can be measured as they change throughout treatment. (Figure 4). This is the original contribution of this investigation, and I consider it is a measurement that truly shows the vertical height changes that occur irrespective of any mesial movement of molars, or lingual movement of incisors.

In order to compare this investigation with previous ones, the various heights were also measured from the Palatal and Occlusal planes.

The actual method of measuring the changes in the individual tooth positions was as follows. Separate tracings were made of the mandible and maxilla showing skeletal outline, and positions of the incisor teeth. Templates were used to draw the teeth. To draw the incisor teeth, the long axis of the tooth was first drawn, and the template oriented with the incisal edge and the long axis. The molar templates were oriented with an axis tangent to the mesial surface of the molar, and with the occlusal surface of the molar.

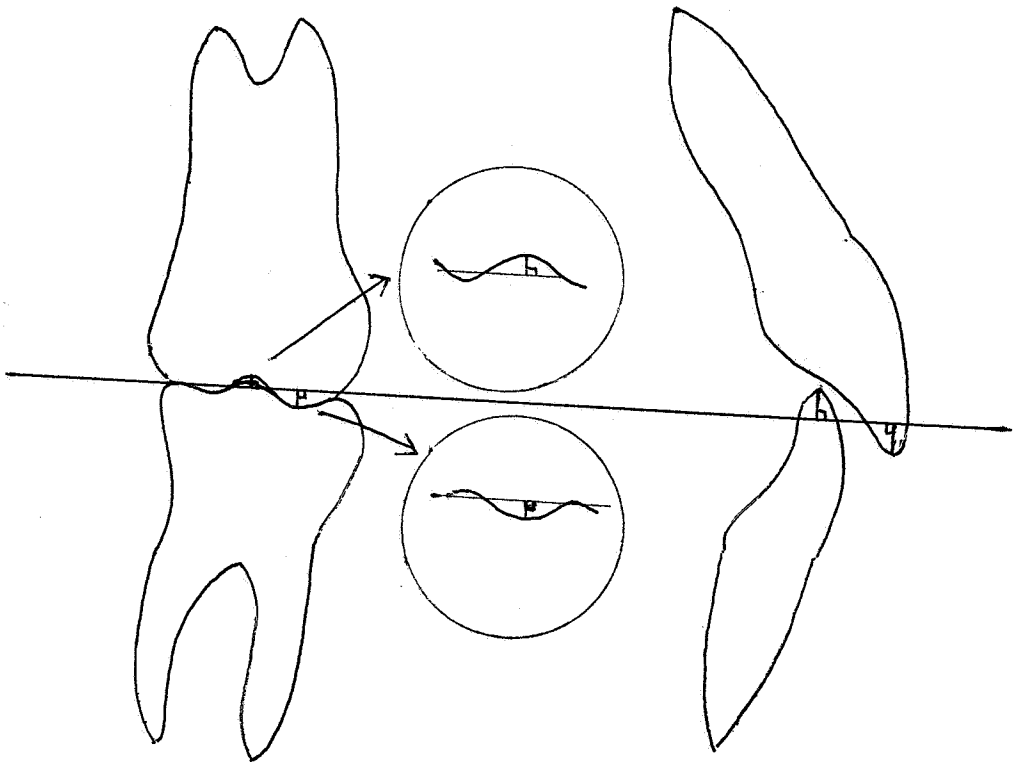

Figure 4—Perpendicular Measurements to Original Occlusal Plane records true 'Molar Elevation' and Incisor vertical changes during treatment.

On the mandibular tracing from the original pre-treatment headfilm, landmarks and measurements were made, as in Figure 5.

Outlines of symphysis and lower border, and tracings of lower incisor and lower molar were made.

Three reference planes were used:

Mandibular Plane;

Original Occlusal Plane;

Tangent to the lingual surface of the symphysis, perpendicular to the mandibular plane.

With reference to these three planes, the following were measured:

1. Height of the lower molar from the mandibular plane;
2. Antero-posterior position of the molar;
3. The "Effective Height" of the lower molar . . . . to the original occlusal plane;
4. The Axial inclination of the lower molar, relative to the Mandibular Plane.
5. The lower incisor crown height, as measured to the Mandibular Plane;
6. The antero-posterior position of the lower incisor, relative to the Tangent to the Perpendicular to the Symphysis;
7. The lower incisor apex height;
8. The antero-posterior position of the lower incisor apex;
9. The "Effective Height" of the lower incisor . . . relative to the Original Occlusal Plane;
10. The axial inclination of the lower incisor to the Mandibular Plane.

Successive tracings of the mandibular teeth were compared by superimposition along the Mandibular Plane, registering at the outline of the lingual symphysis. The Original Occlusal Plane, and the Tangent Perpendicular to the Mandibular Plane were transferred to successive tracings.

The positional changes of the maxillary teeth were measured in a similar manner, as in Figure 6.

The following landmarks were drawn from the pre-treatment headfilm: Maxillary outline, upper molar, upper incisor, Palatal Plane, Orinal Occlusal Plane, and a perpendicular to the Palatal Plane at the original Anterior Nasal Spine.

Using these latter reference planes, the following measurements were made:

1. Upper molar height . . . relative to the Palatal Plane;
2. Anterior-posterior position of the upper molar relative to the Perpendicular through original Anterior Nasal Spine;

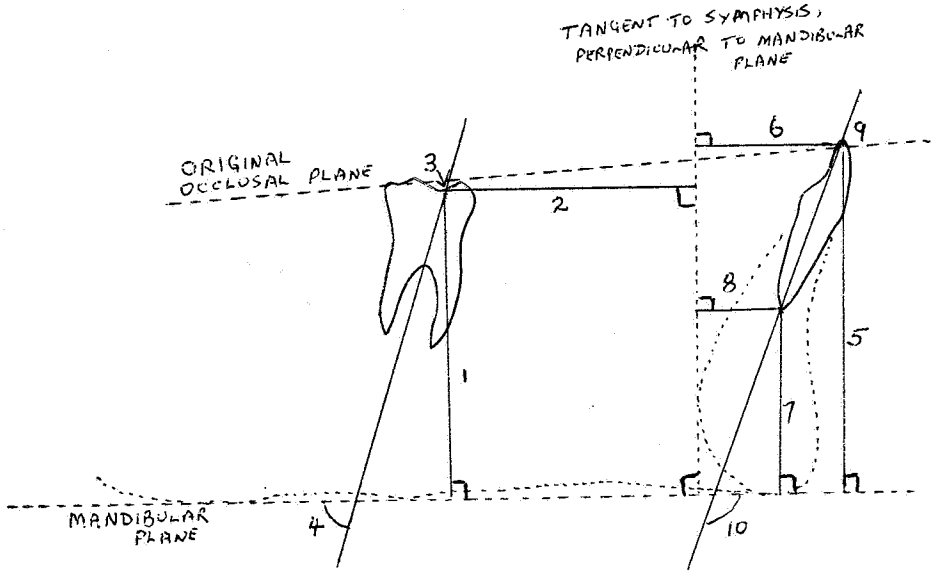

Figure 5—Mandibular Measurements.

1. Lower Molar Height
2. Lower Molar Antero-posterior Position
3. Lower Molar to Original Occlusal Plane
4. Lower Molar Axial Inclination
5. Lower Incisor Crown Height
6. Lower Incisor Crown Antero-posterior Position
7. Lower Incisor Apex Height
8. Lower Incisor Apex Antero-posterior Position
9. Lower Incisor to Original Occlusal Plane
10. Lower Incisor Axial Inclination

TABLE 1 **Treatment Changes.**

	Mean	S D	S E
Period of Observation (weeks)	57.3	26.3	4.8
Overbite	—3.9mm	1.8	0.3
Overjet	—5.9mm	5.9	1.1
Anterior Dental Height	+2.8mm	1.7	0.3
Posterior Dental Height	+1.6mm	1.9	0.4
Occlusal — Palatal Angle	+3.2°	3.1	0.6
Occlusal — Mandibular Angle	—2.3°	2.7	0.5
Palatal — Mandibular Angle	+0.9°	1.4	0.3
SN — Mandibular Angle	+1.1°	1.5	0.3
Upper Incisor to SN Angle	—14.0°	12.1	2.2
Lower Incisor to M.P. Angle	+6.1°	6.7	1.2
Interincisal Angle	+6.9°	11.6	2.1
Upper Molar Height	+1.2mm	1.7	0.3
Upper Molar Antero-Posterior	—1.0mm	1.9	0.3
Upper Molar Axial Inclination	+2.9°	5.1	0.9
Upper Incisor Crown Height	+0.5mm	1.3	0.2
Upper Incisor Crown Antero-Posterior	—5.4mm	4.1	0.7
Upper Incisor Apex Height	—1.5mm	1.5	0.3
Upper Incisor Apex Antero-Posterior	—1.0mm	2.3	0.4
Upper Incisor Axial Inclination	—12.9°	12.1	2.2
Lower Molar Height	+1.9mm	1.3	0.2
Lower Molar Antero-Posterior	—1.9mm	1.5	0.3
Lower Molar Axial Inclination	+1.3°	5.9	1.1
Lower Incisor Crown Height	—1.9mm	1.4	0.3
Lower Incisor Crown Antero-Posterior	+1.4mm	2.3	0.4
Lower Incisor Apex Height	—1.1mm	1.4	0.3
Lower Incisor Apex Antero-Posterior	—1.1mm	1.1	0.2
Lower Incisor Axial Inclination	+6.1°	6.7	1.2
Upper Molar Height to Original Occlusal Plane	+0.8mm	1.2	0.2
Upper Incisor Height to Original Occlusal Plane	+1.2mm	1.6	0.3
Lower Molar Height to Original Occlusal Plane	+1.2mm	1.1	0.2
Lower Incisor Height to Original Occlusal Plane	—1.9mm	1.6	0.3

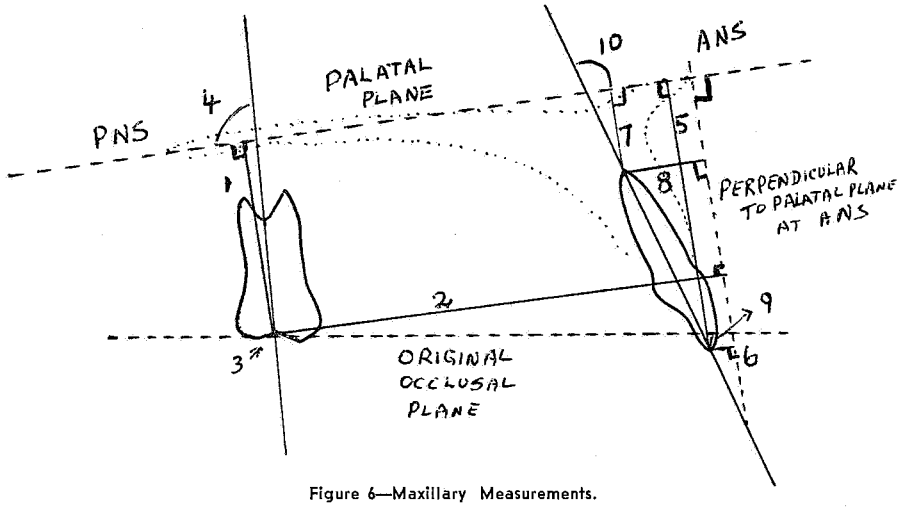

Figure 6—Maxillary Measurements.

1. Upper Molar Height
2. Upper Molar Antero-posterior Position
3. Upper Molar to Original Occlusal Plane
4. Upper Molar Axial Inclination
5. Upper Incisor Crown Height
6. Upper Incisor Crown Antero-posterior Position
7. Upper Incisor Apex Height
8. Upper Incisor Apex Antero-posterior Position
9. Upper Incisor to Original Occlusal Plane
10. Upper Incisor Axial Inclination

3. "Effective Height" of the upper molar relative to the Original Occlusal Plane;
4. Axial inclination of the upper molar relative to the Palatal Plane;
5. Upper incisor crown height, relative to the Palatal Plane;
6. Antero-posterior position of the upper incisor relative to the Perpendicular through the Original Anterior Nasal Spine;
7. Upper incisor apex height, relative to the Palatal Plane;
8. Upper incisor apex antero-posterior position, relative to the Perpendicular to the Palatal Plane, at the original Anterior Nasal Spine.
9. The "Effective Height" of the upper incisor . . . relative to the Original Occlusion Plane;
10. The axial inclination of the upper incisor to the Palatal Plane.

Results:

In a pilot study such as this where a new method is being tested, and where there are a large number of measurements recorded from a relatively small sample, it is not possible to draw definite conclusions. Although sections of the results were analysed statistically, for our present purposes it is best merely to discuss overall trends.

Clinically, alterations in the vertical positions of the molars and incisors would be expected to contribute to overbite reduction. As mentioned previously, I consider changes in the "Effective Heights" of the molars and incisors, as measured from the original Occlusal Plane, to be a more correct measure of vertical tooth changes, than measurements from the Mandibular and Palatal Planes.

Table 1 is a summary of the results of this study. Of interest is the apparent minimal changes in incisor and molar heights in view of the measured overbite changes. A minimal amount of anchor molar mesial drift (anchorage loss) was demonstrated, in both upper and lower arch, associated with a considerable reduction in overjet. There was a considerable degree of lingual movement of lower incisors.

SUMMARY:

A cephalometric format was presented as a method of accurately measuring the positional changes, during treatment, of the anchor molar and incisor teeth. The patients were treated with the Begg Technique by graduate students, so these results may not truly represent the Begg Technique. It is hoped, however, that the method presented will be of use in further studies.

Suite 45, First Floor,
Civic Arcade,
48-50 George Street,
PARRAMATTA 2150.

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