Research In The Department Of Orthodontics Graduate College, University Of Illinois From 1951 To 1956

ALLAN G. BRODIE, D.D.S., Ph.D.
Chicago, Illinois

Since our last reunion, March, 1951, forty-one men have completed the course of study in orthodontics at the University of Illinois. All of these have been granted certificates of proficiency and twenty-seven have earned, in addition, the Master of Science degree based on original investigation.

As the abstracts of these theses are read, it will be noted that they cover a wide range of subjects — a result of the increase in personnel and facilities in other departments in both the dental and medical colleges. This has opened up new avenues for exploration by our orthodontic graduate students and we have been glad to take advantage of them. Thus, the Cleft Palate Training Center, the Department of Histology and that of Oral Pathology in the College of Dentistry, Physical Medicine, Anthropology and Embryology in the College of Medicine have offered opportunities for research.

As all of you have studied here know, there is no effort made either to induce a student to pursue an advanced degree or to follow any particular line of investigation if he does so. To do either would be contrary to the purpose of graduate work, which has for its object the fostering of independent and original thinking. Such thinking can be equally developed by either pure or applied science and in both it fosters the same valuable qualities of the mind.

When I was faced with the organization of these contributions, I considered placing them according to subjects and treating together all of those in a single category. On second thought, it seemed wiser to arrange them chronologically because this would give a better idea of the scope and range of projects proceeding simultaneously within the department. I hope this decision was a wise one but you will have to be the judges. The plan of organization was as follows:

All of the men who have done thesis work were asked to prepare abstracts not to exceed ten minutes in length. Some could not be here but they have prepared their abstracts and sent them to me. The men who are here will make their own presentations. Those works that have been published will be noted.

NOTE: Prior to and since the Reunion Meeting, many of the papers that were given in abstract form have been published in this and other magazines. These are listed below together with references as to where they may be read in full. The abstracts of those that have not appeared thus far will be found following this list.

1. Craig, Charles E.
SKELETAL PATTERNS CHARACTERISTIC OF CLASS I AND CLASS II, DIV. I MALOCCLUSIONS IN NORMA LATERALIS
The Angle Orthodontist, Vol 21, No. 1, pp. 44-56, 1951
2. Speck, Norman
LONGITUDINAL STUDY OF DEVELOPMENTAL CHANGES IN LOWER HUMAN DENTAL ARCHES
The Angle Orthodontist, Vol. 20, No. 4, pp. 215-228, 1950
3. Posen, Aaron
VERTICAL HEIGHT OF THE BODY OF THE MANDIBLE AND THE OCCLUSAL LEVEL OF THE TEETH IN INDIVIDUALS WITH CLEFT AND NON-CLEFT PALATES
The Angle Orthodontist, Vol. 27, No. 2, pp. 109-113, 1957
4. Blair, S. Eugene
CEPHALOMETRIC ROENTGENOGRAPHIC APPRAISAL OF THE SKELETAL MORPHOLOGY OF CLASS II, DIV. I AND CLASS II, DIV. II MALOCCLUSIONS

The Angle Orthodontist, Vol. 24, No. 2, pp. 106-119, 1954

5. Coben, S. Eugene
THE INTEGRATION OF CERTAIN VARIANTS OF THE FACIAL SKELETON: A SERIAL CEPHALOMETRIC ROENTGENOGRAPHIC ANALYSIS OF CRANIOFACIAL FORM AND GROWTH
The American Journal of Orthodontics, Vol. 41, No. 6, pp. 407-434, 1955
6. Macapanpan, Luz
EARLY TISSUE CHANGES FOLLOWING TOOTH MOVEMENT IN RATS
The Angle Orthodontist, Vol. 24, No. 2, pp. 79-95, 1954
7. Sanborn, Richard T.
DIFFERENCES BETWEEN THE FACIAL SKELETAL PATTERNS OF CLASS III MALOCCLUSIONS AND NORMAL OCCLUSION
The Angle Orthodontist, Vol. 25, No. 4, pp. 208-222, 1955
8. Pruzansky, Samuel
THE FOUNDATIONS OF THE CLEFT PALATE AND TRAINING PROGRAM AT THE UNIVERSITY OF ILLINOIS
The Angle Orthodontist, Vol. 27, No. 2, pp. 69-82, 1957
9. Subtelny, J. Daniel
WIDTH OF THE NASOPHARYNX AND RELATED STRUCTURES IN NORMAL AND UNOPERATED CLEFT PALATE CHILDREN
American Journal of Orthodontics, Vol. 41, No. 12, pp. 889-909, 1955
10. Brodie, Allan G. Jr.
THE BEHAVIOR OF THE CRANIAL BASE AND ITS COMPONENTS AS REVEALED BY SERIAL CEPHALOMETRIC ROENTGENOGRAMS
The Angle Orthodontist, Vol. 25, No. 3, pp. 148-160, 1955
11. Silverstein, Abraham
CHANGES IN THE BONY PROFILE COINCIDENTAL WITH THE TREATMENT OF CLASS II, DIV. I (ANGLE) MALOCCLUSION
The Angle Orthodontist, Vol. 24, No. 4, pp. 217-237, 1954
12. Sleichter, Charles D.
EFFECTS OF MAXILLARY BITE PLANE THERAPY IN ORTHODONTICS
American Journal of Orthodontics, Vol. 40, No. 2, pp. 850-870, 1954
13. Tovestein, Byron
BEHAVIOR OF THE OCCLUSAL PLANE AND RELATED STRUCTURES IN THE TREATMENT OF CLASS II MALOCCLUSION
The Angle Orthodontist, Vol. 25, No. 4, pp. 189-198, 1955
14. Cunat, J. J.
DEVELOPMENT OF THE SQUAMOSO-MANDIBULAR ARTICULATION IN THE RAT
Journal of Dental Research, Vol. 35, No. 4, pp. 533-546, 1956
15. Craven, Arthur H.
A CEPHALOMETRIC INVESTIGATION OF CENTRAL AUSTRALIAN ABORIGINES USING A ROENTGENOGRAPHIC TECHNIQUE
The Angle Orthodontist, To be published

ABSTRACTS OF UNPUBLISHED STUDIES

MANDIBULAR GROWTH IN THE CLEFT PALATE INFANT

Gerald H. Borden
Los Angeles, California

Development and growth of the middle face in individuals with facial and/or maxillary clefts are obviously abnormal, but there long has been controversy over the question of whether adjacent structures or areas were simultaneously affected.

Specifically the objective of this thesis was to investigate mandibular growth in cleft palate infants and to determine if this growth differed from that in normal infants.

The cleft palate sample consisted of 27 male infants ranging in age from 15 days to 3 years. All types of clefts were included except those involving only the most posterior part of the palate. All infants of this sample had undergone varying amounts of surgery.

The control group consisted of the records of 21 male infants ranging in age from 5 months to 3 years. This control material was that previously reported by Brodie (1941).

The serial cephalometric method of Broadbent was applied to the cleft palate sample. Films were taken at 15 days, 3, 6, 9, 12, 18, 24, 30, and 36 months. All exposures were made with the sedated infant in a supine position. Readings were made from tracings of the lateral head films.

The same readings were made from the tracings of the control group, but these infants had not been sedated and, after one year of age, the films had been taken with the patient sitting upright.

The data were tabulated from the control and cleft palate samples and means for each measurement were computed at each age. A scatter diagram for each measurement was constructed and the standard deviations of the means were computed; "t" values were calculated to determine if any significant difference actually existed between the cleft palate and normal samples.

The above data were derived from the following measurements:

1. Length of the anterior cranial base (N-S)
2. Length of the lower border of the mandible (Go-Gn)
3. Anteroposterior width of ramus
4. Total length of mandible (Con-Gn)
5. Height of mandible posterior to the last molar in eruption
6. Lower incisor to Gn
7. Angle N-S-Gn

The mean S-N growth curves for cleft and normal infants were practically identical.

Mandibular growth in the cleft palate infants exhibited the same rate of growth and type of pattern as that displayed by normal infants. However, the cleft palate mandibles showed a general tendency to be smaller. The differences in linear measurements were statistically significant except for measurement "incisor to Gn."

The cleft palate group demonstrated a strong tendency for each infant to exhibit stability of the angle N-S-Gn although the range among infants was wide. Also they demonstrated the same stability of gonial angle as described by Brodie (1941).

The rates of growth and type of growth patterns exhibited by the mandibles of the cleft palate and normal infants of this study were almost identical. This substantiates the contention that the growth of the mandibles of cleft palate individuals appears normal. In this study however, the actual difference in size, although small, could not be ignored. All linear measurements, except incisor to Gn, exhibited a difference which proved to be statistically significant. This indicates that some factor or factors have affected mandibular growth in the cleft palate sample.

Many factors could influence mandibular growth in these infants. First of all, any intra-uterine factor powerful enough to cause the cleft itself certainly might arrest the growth of elements forming concurrently, at least for the interval of time the etiological factor was operating. Second, the cleft palate infant usually experiences postnatal feeding difficulties and such a systemic handicap might affect the growth of all structures. Finally, all the cleft palate infants in this series had undergone some type of surgical procedure. The traumatic effects of such procedures might possibly handicap mandibular growth.

A difference in size between the cleft palate infants and normals was not found in the anterior cranial base. The S-N growth curves of the two samples were almost identical. Originally, S-N was intended only as a line of orientation for mandibular measurements but, due to the fact that S-N did not exhibit the discrepancy in size that characterized the mandibular readings, it was included in the findings. The close similarity of the S-N growth curves poses the question whether or not this should be interpreted as an indication that the growth of other adjacent structures is not affected as is mandibular growth. Probably, it should not be so interpreted. Embryologically, the brain and its retaining structures antedate the facial components in their differentiation and development. Being further ahead in its development, the cranial base may not be affected to the same degree as the mandible. However, the close similarity of the S-N curves indicates that the difference in mandibular readings is not due to an experimental error common to all measurements.

The results of this study indicate that it would be desirable to differentiate between pre and postnatal influences of cleft palate pathology upon mandibular growth. Such a differentiation would have been possible in this study had cephalometric material been available to serve as a control. Records of cleft palate newborns were available to the author, but the only material of normal newborns available was of non-sedated infants and in many cases the mandibles were blurred beyond acceptable accuracy.

Embryological Evidence for the Non-Existence of the Premaxilla in Man*

Alex Jacobson
Johannesburg, South Africa

Serial sections of twelve human embryos varying in length from 17 to 22 mm. were studied microscopically. It had been found by others that the stages of differentiation could be used to arrange foetal material in its relative chronological order; thus the present study was directed toward such details as the appearance of anlagen, ossification centers, and so forth.

It was most difficult to gain an understanding of the general and detailed shape of the various parts from the study of the sections alone and therefore graphic reconstructions were made. These gave contour configurations but were still too difficult to permit three-plane concepts. Recourse to wax reconstructions was therefore necessary.

Every second section in the case of 10 micron series and every section in the 20 micron series were projected and the outline of all bone spicules and related structures were traced at the same magnification. For purposes of orientation the following structures were included: the cartilaginous nasal capsule, Meckel's cartilage, Jacobson's vomeronasal organ, the superior dental lamina with associated tooth buds and the inferior segment of the eye.

Colored wax plates 1 mm. thick were cut according to the tracings of each structure, each structure being represented by a different colored wax. These were assembled over the total tracing of the section according to the accepted technique for laminated reconstructions (Figs. 1 and 2). Two models were made from the 10 micron sections and one from the 20 micron sections. The septal cartilage of the nasal capsule was used as the mid-sagittal orientation plane and the connected cut-outs were piled serially in the same order as the sections were cut.

Findings

1. The upper jaw develops from a condensation of embryonic mesenchyme within the maxillary process of the mandibular arch. This center secondarily encroaches upon the medial nasal process of the original facial primordia. Ossification begins as a *single center,* opposite the canine tooth bud, in embryos of 18-22 mm. (6-7 weeks). This center remains single throughout development and extends forward into the incisor region and backward toward the molars. The future body of the maxilla constitutes the main mass and its frontal, zygomatic, palatal and alveolar processes are extensions from this primary center.
2. Tiny bony spicules or a minute accessory center, situated anterior to the early bony mass in the upper jaw, evidently had been observed by several investigators. Such trabeculae which, even ac-

*Published in the *Journal of the Dental Association of South Africa,* 10(6), pp. 189-211, 1955
Since this publication is not readily available in this country, this abstract is published here.

Fig. 1 Wax reconstruction of the maxilla and associated structures made from a 32 mm. human embryo.

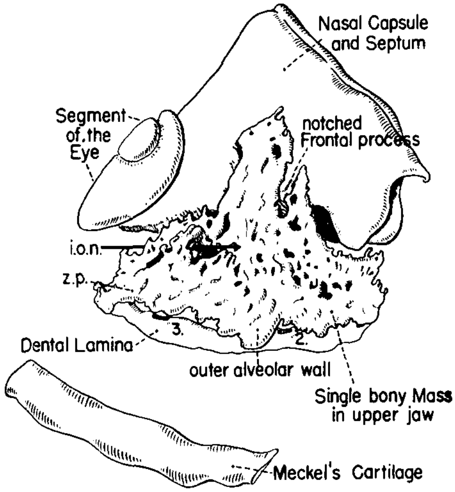

Fig. 2 Diagram of wax model shown in Fig. 1.

cording to the same authors, fuse very early with the main bony mass, had been identified as an independent "premaxillary" ossification center. Such evanescent centers, when present, are not truly separate ossification centers but represent merely small aberrant trabeculae which rapidly fuse with the main mass. They thus fall within range of insignificant variations in development.

3. On the rather adequate and well preserved material available in this study, no other independent ossification centers, specifically no premaxillary, no prevomerine nor stenonian centers could be identified.
4. The so-called incisive "suture" is not a true suture. It represents a fissure which is the result of incomplete fusion of the anterior and posterior palatal shelves arising from one and the same osseous center of the maxilla proper.
5. Since there is no embryological evidence to substantiate the existence of the so-called "premaxillary" bone in man, there is no justification for the association of the anterior portion of the notched frontal process of the embryonic maxilla with a nasal process of a "premaxilla." This notch, if retained, is eventually reduced to a small fissure.
6. The concept of an existing premaxilla as a definite entity in the human skull appears to be based largely on considerations and speculations by comparative anatomists. It has been assumed too long and asserted too often that, in as much as there is a premaxilla in mammals and in most primates, the facial skull of man also be provided with such a unit in the maxillary arch in spite of the grave doubts expressed by such eminent authors as Lawrence (1840) and Frazer in 1948.
7. A lip-jaw palate cleft does not necessarily coincide with the incisive fissure. The early ossification

center, as well as tooth formation in the upper jaw, occur secondary to and independent of the embryonic fusion of the embryonic facial process.

Relative Growth Rate (Height) of the Alveolar Processes in Man

Roger O'Meyer
Paris, France

The material for this thesis was entirely derived from the files of the Bolton Study at Western Reserve University through the generosity of its director, Dr. B. Holly Broadbent. Twelve white females and eighteen white males were selected, six of whom had received orthodontic treatment. A total of 316 films were traced and measured with an average of 10 in each series. The age span for the sample was 4-20 years.

After tracing, two planes were constructed: ANS - PNS for the maxilla and Go-Gn for the mandible. From these base planes perpendiculars were measured to the crest of the alveolar process at the central incisors and distal to the first molars from their respective base planes. The study was restricted to the period beginning with the eruption of the first permanent molar.

No significant change in height could be detected in that part of the alveolar process lying posteriorly to the deciduous teeth which is gradually prepared for the accommodation of the first molars. In contrast to this were the marked changes which accompanied the shedding of the primary incisors and the eruption of their successors. In this region there was a loss in height of the crest prior to the loss of the tooth. Measurements were tabulated before this loss began.

As would be expected during this period of life, all dimensions showed increase. Certain sex differences were noted, as well as differences in amount, sites and time. There were also differences found between treated and non-treated cases.

Growth in height of all parts of the alveolar process is definitely greater in the male. The mean increase for the female in the incisor region was 6.95 mm. and for the male 12.71 mm. or almost twice as much. Similar but smaller differences were found in the posterior heights. Both sexes gained more in posterior than in anterior height.

It was found that the male exceeded the female values everywhere except in the upper incisor region where the mean female increase was 6.5 mm. while the male mean was 5.5. Both sexes exhibited a wide range in this measurement. The greatest sex difference was noted in the lower posterior region where the males yielded a mean of 7.5 mm. against 4.5 mm. for the female. Here again the range was wide.

In both males and females the vertical increase in the lower anterior region was greater than that of the lower molar area, while just the reverse was true in the maxilla-molar height, increases in both sexes being higher than anterior increases. This supports recent findings on the growth behavior of the total pattern (Brodie '48, Bjork '51) that the posterior end of the occlusal plane tends to drop with age.

There seemed to be a tendency for teeth that erupted early to be associated with average or better growth while those erupting late showed slow or limited growth.

Of greatest interest were the findings on the loss of alveolar height incident to the eruption of the successional teeth. In this process the crest seems to be attacked long before the roots of the teeth are absorbed to the extent where they are lost. This attack may be at the top of the crest or may occur along the root. In the latter case the crest may be cut off and become a sequestrum (Fig. 3). The loss in height thus sustained may be as much as 7 mm. Four to five

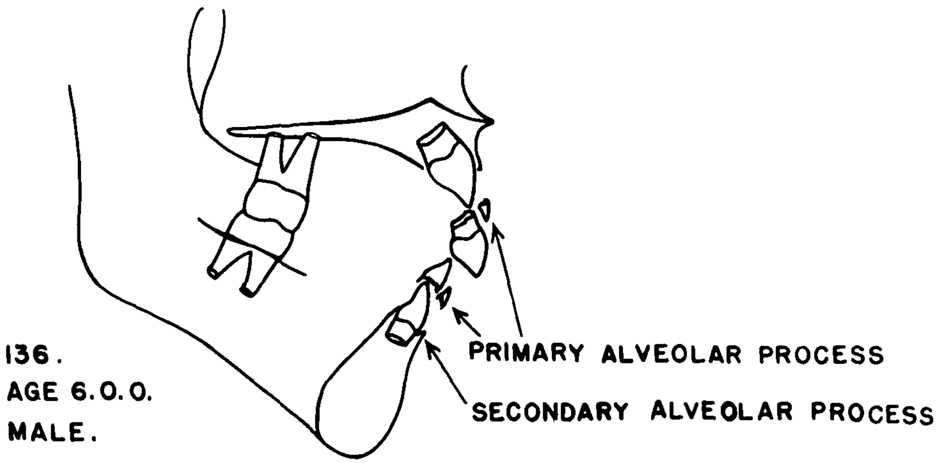

Fig. 3 Diagram illustrating points and planes used in study. Note presence of alveolar sequestra.

years on the average is required to rebuild the process even to its previous height.

The lack of correlation found between the increase in height of the alveolar process and that of the total face casts doubt on the premise that the alveolar process is responsible for a significant amount of vertical facial growth.

LENGTH OF THE CLINICAL CROWNS OF TEETH IN MALOCCLUSIONS TREATED WITH AND WITHOUT EXTRACTION

Robert Gibbs
Elmhurst, Illinois

Oppenheim ('44) concluded, after more than 30 years of histologic examination of both animal and human material: "That anything like physiologic tooth movement is impossible with the means at our disposal."

He also stated that: "It is a well known fact that most of the destructive changes, even those brought about by strong forces, are for the most part repaired to normal. But one part which is never restored to its original height is the buccal or labial alveolar crest. This is the very part of the surrounding and protecting bone with which we should be most concerned. This loss of bony support, which cannot be ascertained by x-ray, is responsible for gum recession and exposure of the root. The lasting firmness of the teeth is dependent on the height of the alveolar bone. If this height becomes reduced prematurely, even the normal forces of mastication ultimately prove detrimental."

From Oppenheim's preceding statement, it becomes apparent that the damage wrought by orthodontic tooth movement is reflected principally in the destruction of the alveolar crest resulting in the recession of the gingiva. This gingival recession would then increase the height of the clinical crown and give us a yardstick by which to measure tissue damage.

The majority of cases which involve extraction as a therapeutic measure of treatment require the removal of more tooth material than is necessary for the alignment of teeth in a given arch. This type of treatment involves the closing of the additional space gained by moving the buccal teeth anteriorly and the anterior teeth posteriorly. Cases in which no extraction is utilized as a therapeutic measure of treatment require only that amount of increase in arch length that is necessary to align every tooth in the arch. It was decided, therefore, to include both extraction and non-extraction cases in this study to determine if these two different methods of orthodontic treatment would produce significant differences in the gain of their clinical crowns measured before and after treatment.

The material for study was based on measurements obtained from plaster models of 31 orthodontic cases in which extraction was performed as a therapeutic measure, and 31 orthodontic cases in which no extraction was performed. Models of each case were obtained at the start of orthodontic treatment and from 6 months to 7 years after the end of active treatment. The age of the patients ranged from 10 years to 26 years at the start of orthodontic treatment. All cases were treated with the Angle edgewise arch mechanism. Fifty-three cases were from the Department of Orthodontics of the University of Illinois, and 9 cases were from the private orthodontic practice of Dr. Abraham Goldstein, Chicago, Illinois.

The selection of cases was based on the availability of complete records and accurate models. Models taken at the end of active treatment were not used since these models would introduce errors in measurement due to gingival hypertrophy usually present at this time.

Only permanent teeth were used in this study. All teeth measured were considered to be fully erupted. In some cases the plaster models were damaged so that one or more teeth were chipped or badly worn. In such cases, those individual teeth were eliminated from the study.

For means of accuracy, accessibility, and ease of measurement, the labial and buccal aspects of all clinical crowns were measured. Measurements were made by means of a Dixon Boley gauge equipped with a vernier scale graduated to tenths of millimeters, the tips being filed to fine points for greater accuracy.

For comparison of gain and loss of the clinical crowns in extraction and non-extraction cases, frequency distribution graphs were constructed. The mean gain of each tooth from central incisors to the second permanent molars in each case, both in the maxillary and mandibular arches, was calculated. Since, for the purpose of strict comparison, it was necessary to keep the total frequency of these mean values equal in each set of graphs, the bicuspid teeth and second molars were eliminated. Bicuspids were eliminated in the extraction cases because these teeth were removed. Second molars were eliminated because these teeth were not fully erupted in all cases. This made it possible to keep the total frequency in each set of graphs equal.

Findings

In the non-extraction cases, a total of 324 maxillary teeth showed a mean gain of .85 mm., while 59 showed a mean loss of .43 mm. A total of 296 mandibular teeth showed a mean gain of .83 mm., while 66 showed a mean loss of .48 mm.

In the extraction cases a total of 300 maxillary teeth showed a mean gain of .96 mm., while 27 showed a mean loss of .42 mm. A total of 285 mandibular teeth showed a mean gain of .94 mm., while 40 showed a mean loss of .41 mm.

Frequency distribution graphs comparing the mean gain and loss of the clinical crowns in the maxillary and mandibular arch showed that the non-extraction cases were skewed in the direction of loss while the extraction cases were skewed in the direction of gain. Frequency distribution graphs comparing the mean gain and loss of the clinical crowns in the maxillary arch show that both the extraction and non-extraction cases are equally skewed in the direction of loss, while the extraction cases are slightly more skewed in the direction of gain. Frequency distribution graphs comparing the mean gain and loss of the clinical crowns in the mandibular arch show that the non-extraction cases were more skewed in the direction of loss, while the extraction cases were more skewed in the direction of gain.

The mean gain in crown height per tooth of all teeth measured in the maxillary arch of non-extraction cases was .85 mm. as compared to a mean gain per tooth of .96 mm. for the same teeth in extraction cases, a difference of only .11 mm. more gain per tooth in extraction cases. The mean gain per tooth of all teeth measured in the mandibular arch of non-extraction cases was .83 mm. as compared to a mean gain per tooth of .94 mm. for the same teeth in extraction cases. That also is a difference of .11 mm. more gain per tooth in extraction cases. These differences are small and cannot be considered clinically significant. They may be the result of chance sampling of material.

Loss in clinical crown height occurred in 45 of the 62 cases studied. The mean loss per tooth of all teeth measured in the maxillary arch of non-extraction cases was .43 mm. compared with .42 mm. of the same teeth in extraction cases. The mean loss per tooth of all teeth measured in the mandibular arch in non-extraction cases was .48 mm. compared with .41 mm. for the same teeth in extraction cases. These losses in clinical crown height cannot be explained and have not been reported in the literature. A possibility exists that they may be due to attrition, wear of the plaster models, or to the depression of teeth by the use of orthodontic appliances.

Comparisons of the frequency distribution graphs do not show significant differences in either the gain or loss of the clinical crowns in extraction or non-extraction cases. In all the graphs the frequency remained highest between 0 mm. and -1. mm.

Conclusions

1. The height of the clinical crowns of orthodontically treated cases show both gain and loss
2. There is no significant difference in the gain or loss of the clinical crowns between extraction and non-extraction cases.

Acceleration of Cranial Growth of Young Rats Following Injection of Somatotrophic Hormone

Gordon Meeker
Sandusky, Ohio

The expressions of growth in different parts of the young skull are altered when growth is experimentally hastened by the somatotrophic hormone of the anterior pituitary gland. Several investigations on growth hormones have been reported previously by Beck's group in California. They investigated the growth of mature rats and that of young hypophysectomized rats. The specimens used in this study were intact young rats.

It was thought that the work might contribute information on the following points:

1. The effects of the hormone on normal young animals
2. Whether such effects, if present, changed with time
3. The degree of acceleration of growth in parts which normally grow at different rates.

To study these questions, the experiment was approached from both the roentgenographic and histologic aspects. Eighteen 10-day old, albino rats were carefully selected and divided into 6 groups. In each group, there was an experimental rat, a saline control rat and an uninjected control rat. The experimental animals received high doses of Armour's Beef Growth hormone daily. The dosage was increased with weight increase.

There were sacrifice periods ranging from 11 days to 34 days of injection. Upon sacrifice, a dorsal x-ray was obtained and later, a midsagittal x-ray. From the left half of the decalcified skull, two rectangular pieces containing the coronal and frontonasal sutures were removed and imbedded in paraffin, sectioned and stained with hemotoxylin and eosin.

The skull was studied for the following information: (1) the growth of the brain case, (2) the growth of the upper face, (3) the growth of the mandible, (4) relation of mandible to maxilla, (5) the histologic changes in a brain case suture and an upper face suture.

FINDINGS

1. Growth hormone increased the rate of gain in body weight, but did not change the time pattern of body growth.
2. Height and width of the brain case did not increase in the control animals during the experimental period. The same hormone did not induce growth in these directions during the period.
3. In the control animals growth in width and length of the upper face, length of the mandible, height of the mandibular ramus and body, and length of the lower incisor showed:
   a. An initial high rate of growth
   b. An arrest of growth occurring during the time of weaning
   c. A resumption of growth followed weaning.
4. In the experimental animals the results were:
   a. The effect of growth hormone on the initial phase of growth was an acceleration of all rates. The degree of acceleration was variable
   b. The effect on the second phase was a uniform shortening of the period of arrest due to weaning
   c. Growth hormone did not noticeably affect rates of growth after weaning.
5. The molar relation shifted from a posterior position of the lower molars to the upper in the controls to an anterior position in the hormone treated animals.
6. There was cellular proliferation of sutural connective tissue. Growth hormone did not influence the rate of proliferation in the slow-growing coronal suture, but increased the proliferation in the faster growing frontonasal suture.

CONCLUSIONS

1. Growth hormone imparts different degrees of acceleration to different rates of growth.
2. The degree of acceleration varies in inverse proportion to the rates, thereby causing diverse parts to assume the same rapid rate of growth. Exceptions to this are parts of known dependent growth or those known to require specific stimuli.
3. Growth under the influence of a high dose of growth hormone may be determined by the maximal inherent growth potential of parts; the degree of acceleration imparted to the rates of growth may be determined by the difference between the maximal inherent rate and the actual rates at the time of administration.
4. A systemic disturbance may arrest growth of some parts of the skeleton without interfering with that of other parts.

5. Growth hormone can overcome the arrest of skeletal growth caused by a systemic disturbance without affecting the arrest of gain in weight.
6. The accelerating action of growth hormone in young animals declines more sharply than its growth inducing action in mature animals.

Eruptive Movements of Lower First Molar in the Rat From 13 Days Insemination Age to 30 Days after Birth

Cyril O'Brien
Salem, Oregon

This histologic study was based on frontal sections through the lower first molar region of twenty I.A. and thirty-four normal animals. The I.A. animal is characterized by absence of incisor teeth and of bone resorption. A number of fixed points are retained in this mutant's mandible permitting accurate comparisons of succeeding developmental stages. Normal and I.A. rats were compared to study the role of bone resorption during tooth eruption.

Findings

A. The molar germ is initiated at 13 days insemination age, followed by the differentiation of ameloblasts and odontoblasts at 20 to 21 days. At 3 days after birth, enamel formation begins; 10 days after birth Hertwig's epithelial sheath appears with subsequent root formation; the erupting tooth "breaks through" the oral epithelium

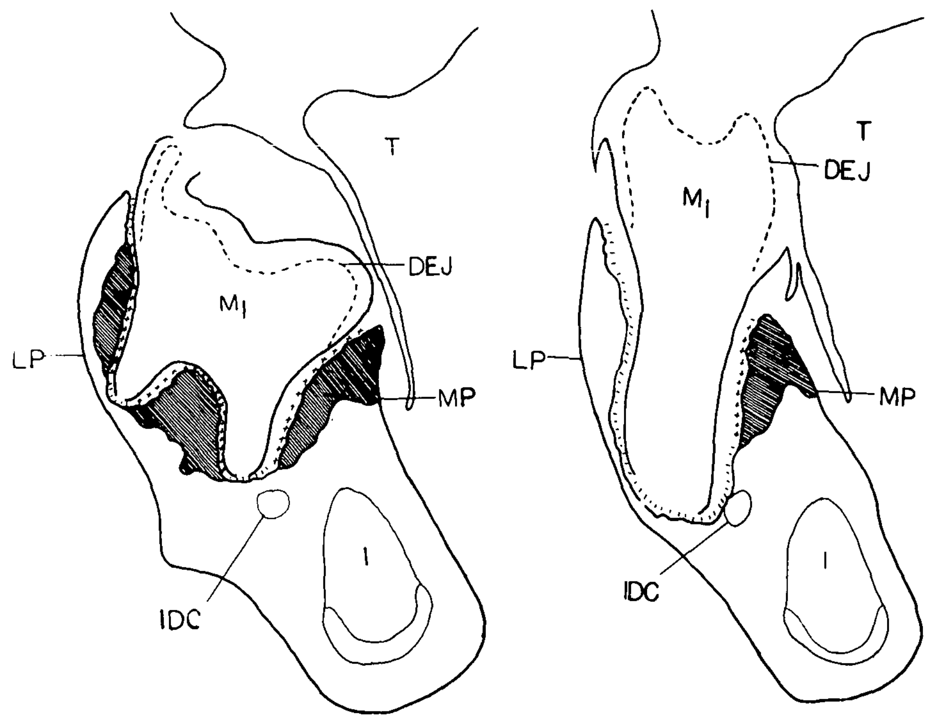

Fig. 4 (Left) Camera lucida drawing of frontal section through mesiolingual and mesiobuccal roots of first molar tooth in normal rat mandible 17 days after birth. Note bone formation on lateral plate and relation at alveolar crests to crown. (Right) Frontal section through mesial root of first molar tooth in normal rat mandible at 21 days after birth. Note areas of resorption. Legends: L.P. lateral plate. M.P. medial plate. T. tongue. DEJ. dentoenamel junction. IDC. interior dental canal. I. lower incisor.

around 17 days after birth and establishes functional occlusion at 23 days after birth. At 30 days, root formation is complete. (Fig. 4).

B. Tooth germ movement begins soon after initiation in a superolateral direction, maintaining a constant relationship to alveolar crests. This relationship changes at 5 days after birth in favor of the alveolar process. Beginning root formation results in rapid eruption and a lateral crown tipping, associated with selective rapid bone formation on the crypt wall which ceases after functional occlusion is established.

C. Cervical loops grow deeper into the jaws for a short distance.

D. The early follicle consists of loosely arranged mesenchymal cells with abundant intercellular fluid which later changes to a highly cellular structure with fusiform cells arranged parallel to the tooth surface. Soon after root formation starts, precollagenous fibers appear among the fusiform cells. The follicle is always widest inferomedially, the site from which the developing tooth migrates. When the tooth erupts into the oral cavity, organization of periodontal fibers occurs, resulting in the fibers' running from bone to slightly apical areas on the root. Establishment of functional occlusion results in a densely collagenized and considerably widened periodontal membrane.

Relative Reliability of Certain Cranial Landmarks Used in Cephalometric Roentgenology

Stephen Seward
Melbourne, Australia

The erratic behavior of porion as determined in serial cephalometric headplate studies has often been noted. The object of this study was to determine whether this behavior was real or due to error in technique or interpretation.

The movements of porion (Po) were compared with those of basion (Ba) and a new point AE, defined as the highest point on the arcuate eminence. The arcuate eminence is an elevation of bone on the anterior surface of the petrous part of the temporal bone overlying the superior semicircular canal. It is not an ideal point for the usual type of cephalometric work because it is necessary to have an oriented frontal headplate to be sure that the two eminentia have been located correctly. Furthermore, the eminentia are frequently rounded, making the selection of a point difficult. However, offsetting this latter defect is the fact that there is a negligible change of shape of the eminence after the third year, enabling the observer always to locate the same point.

The plane of reference used was sella-nasion (S-N), with the center of sella as the registration point. (Fig. 5.)

The material employed in this study consisted of lateral and frontal cephalometric roentgenograms of growing children and was composed of two dif-

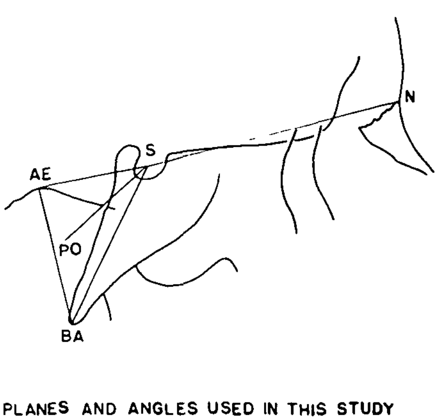

Fig. 5 Points, planes and angles used in study.

ferent groups. The first group was made up of long series of x-rays of three children, two boys and one girl, of whom rather frequent exposures had been made. Thus, one boy was represented by 15 sets of headplates, the first taken at 8 years 10 months and the last at 25 years; the second boy was represented by 17 sets of films which started at 5 years 11 months and ended at 15 years 11 months and the girl by 26 sets which began at 3 years 1 month and ended at 19 years 6 months.

The second group was composed of similar head x-rays of 40 growing children, 23 boys and 17 girls, of whom only two sets of exposures had been made and these 8 years apart. The age span represented by the two groups was quite similar and extended from the 3rd to the 18th year. Because of obvious misplacing of the ear-rods in one case, porion could be studied in only 39 of these cases. All material was derived from the files of the Department of Orthodontics, University of Illinois.

AE was studied in the three long series. It was observed that this point on the temporal bone behaved in the regular manner seen in all cephalometric points other than porion. Its growth course was straight and the direction varied in the different cases between slightly upward and backward to downward and backward. In the same series, porion as determined by machine readings traced its usual irregular path in a generalized downward and backward direction. This in itself was enough to throw doubt on the reliability of determining porion from the shadow of the ear-rods, since either the squamous part of the temporal bone must behave in a radically different fashion from the petrous part, or the "porion" obtained from the cephalometer was not representative of the anthropometric "porion".

The behavior of AE and Po were studied further in the second group of tracings. The triangle AE-S-Ba was constructed and its change of shape over at least an eight-year period was recorded. This change was found to be slight. The greatest change of any of the angles of the triangle was only 12 degrees. The stability of the base plane, Ba-AE of the triangle to the S-N plane was unexpected. The greatest increase of the angle between these planes was 7 degrees, and the greatest decrease was also 7 degrees. If one unusual case which showed no growth at all between sella and basion was omitted, these figures would be 7 and 2 respectively. In other words, this plane, with one end in the petrous part of the temporal bone and the other in the basilar part of the occipital, showed a constancy to S-N equal to that shown by Brodie to exist between S-N and the floor of the nose.

Porion seemed to have no relationship with the triangle. Its movements were compared with those of Ba and AE by comparing the changes with growth which occur in the three angles Po-S-N, AE-S-N, and Ba-S-N. Ba-S-N exhibited the greatest stability in that 18 cases showed no change. Thirteen increased up to 5 degrees, and 9 decreased up to 4 degrees. Although 11 cases showed no change, AE-S-N exhibited a tendency to decrease, 9 increasing up to 6 degrees while 20 decreased up to 9 degrees. Po-S-N showed the greatest deviations. Although 8 remained unchanged, 15 increased up to 15 degrees, and 16 decreased up to 11 degrees.

On the examination of these few cases one might be tempted to conclude that the anthropometric point porion was a most unstable reference point, but there still remained the possible factor of a mechanical error in the positioning of ear-rods. If the true anthropometric point porion was in reality an unstable point, one would expect to see at least as wide a range as herein described with the chance selection of one, or perhaps two, showing no change. Eight, however, seemed a large number to have remain unchanged on a chance basis alone.

On the other hand, if the anthropometric point porion was in fact a stable point, the angle Po-S-N would be constant. Therefore, if one considers the possibility of an improper locating of porion which could operate in all three planes of space, one would expect as many increased as decreased angles. This implies that there would be equal errors on both sides in a large sample. This was actually found in this study, where 15 angles increased and 16 decreased.

This study introduced the point AE into cephalometry. Also it showed by inferential evidence that the anthropometric point porion behaves during growth in a manner similar to other anatomical points, in that it travels on a straight line in a regular fashion. If this is accepted, one cannot take the position of the ear-rods as being representative of the true anthropometric point porion.

Correlation of Orthodontic Treatment Methods and Their Results

Robert R. Foresman
San Marino, California

The soft tissue facial profile and the influence of orthodontic treatment upon it has been the subject of considerable discussion. It was with the intention of gaining some insight into this problem that this investigation was undertaken. Further than this, it was felt that valuable information might be gained concerning the relative effect of treatment which involved the extraction of teeth as contrasted with that in which no teeth were sacrificed.

A review of the literature yields the contributions of many. Contributions on esthetics in growth and treatment include the work of Angle with his normal occlusion concept, Brodie on the growth pattern of the human head, and the work of Goldstein on the dominance of the morphogenetic pattern over treatment procedures. At variance to this is the concept of Tweed, Herzberg, Bull and Swain who feel that the facial profile may be permanently modified through orthodontic procedures. Contributions on the dentition in growth and treatment have been made by Brodie, Noyes, Schaeffer, Litowitz and Cole. Work on the facial profile in growth has been done by Keith and Campion, Hellman, Goldstein, Bjork, Brodie, and Lande.

In this investigation serial cephalometric roentgenograms of fifty orthodontically treated individuals were employed to study changes in the face and denture occurring during treatment and subsequent to release from retention. Attention was given only to the direction and magnitude of the net change in the various readings employed regardless of their size prior to treatment. The sample was divided into two groups, those treated with extraction as a part of the therapy and those treated without extraction. The characteristics studied were the changes in axial inclination and prominence of the upper and lower incisors and the changes in the bony and soft tissue facial profile. Correlations between changes in incisor position and changes in the profile were tested statistically. The means, ranges and correlations and the behavior of the individuals within the sample yielded findings which may be summarized as follows:

1. The bony angle of facial convexity decreases with growth in most individuals and is the only factor among those studied which showed any significant correlation with the changes in the soft tissue

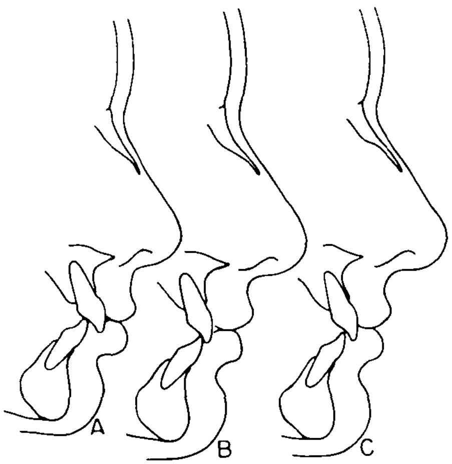

Fig. 6

profile.

2. The soft tissue facial profile did not decrease to any significantly greater extent in cases of malocclusion treated with extraction as compared with those treated without extraction.
3. The decrease in the prominence of the upper central incisor induced by treatment was greater in those cases treated with extraction, while the return toward pretreatment position was almost identical in both.
4. No significant difference in the changes in prominence or angle of inclination of the lower central incisor was found to exist between cases treated with and without extraction.
5. No correlation was found to exist between changes in the lower incisors and changes in the soft tissue facial profile.
6. The marked retraction of the upper incisors in the extraction cases was accompanied by a thickening of the upper lip apparently as a result of the shortening of its fibers (Fig. 6).

In conclusion it seems evident that changes in the facial profile are brought about primarily by changes in the skeletal profile due to growth and by changes in lip form or configuration with the teeth having significantly less influence than heretofore believed. The proper alignment of the teeth plays a major role, however, in establishing the proper approximation of the lips and in this respect bears considerable influence upon the balance of the facial profile.

The extraction of bicuspid teeth in orthodontic therapy does not appear to accomplish the appreciably great reduction in the convexity of the facial profile with which it has been credited.

In view of the lack of any significant differences in the changes of the lower incisor between the two groups and the lack of any correlation between these changes and those of the facial profile, it seems evident that the position of the mandibular incisors as a guide in diagnosis and treatment is very questionable. Furthermore, the uprighting of these teeth has been shown to have no correlation with the establishment of the best balance or best harmony of facial lines.

Human Cranial Base Development During the Late Embryonic and Fetal Periods

Herbert J. Gordon
Chicago, Illinois

The development of the cranial base was studied during the embryonic and fetal periods.

Two methods and sources of material were used, the first being three dimensional wax models of the chondrocrania of a 24 mm. and a 32 mm. embryo. They were compared with reconstructions of other stages made by several embryologists. It was observed that the posterior region of the skull, i.e., the basal plane, and the otic capsules, early attained a high degree of development and resembled the adult configuration sooner than did the anterior region, i.e., the ethmoidal area. Segments of the cranial base related to the older parts of the brain appeared to mature earlier. Subsequently, skull growth was more rapid anteriorly, probably in response to the active development of the cerebral hemispheres.

Additional reconstructions will not necessarily aid in discovering new anatomical entities. They can clarify details in the progressive development of the skull during this period; therefore they are valuable. The lack of a sufficient number of embryonic reconstructions limited their value for a quantitative analysis of the cranial base. The study was thus extended into the fetal period (3 months to term) for the second source and method.

Seven heads of fetuses, obtained from formalin preserved material of the Department of Anatomy, College of Medicine, University of Illinois, were sectioned in the mid-sagittal plane. They were selected to provide a progressive series throughout the fetal period. The various components of the cranial base were measured and compared with each other by expressing their ratios as percentages. Angular relationships within the cranial base and face were also determined. These data were further compared with corresponding data from other studies dealing with postnatal development. The most significant observations are summarized below.

1. Changes in certain ratios involving segments of the cranial base indicate an antero - posterior gradient in skull growth. After the embryonic period the growth rate is more rapid anteriorly, and diminishes posteriorly.

During the early embryonic period, the posterior cranial base is longer than the anterior cranial base. After the third prenatal month, this relationship becomes reversed. Thereafter the ratio of posterior cranial base / anterior cranial base tends to remain stable at about 70%.

Comparisons of the ratios of the length of the individual bones with each other and with various segments of the cranial base further support the idea of an antero-posterior growth gradient. The ethmoid/occipital ratio and the ethmoid/sphenoid ratio both increased throughout the fetal period. The increase in the former was greater. Also, during this period, the ratios of the ethmoid/total cranial base, ethmoid/posterior cranial base, and ethmoid/basion-sphenoethmoidal junction increased steadily. At the other extreme was the remarkable constancy of the ratios of the occipital to the aforementioned cranial segments and to the total cranial base, i.e., the ratios of the occipital-total cranial base varied from 28 to 31 with a mean of 29; the ratio of occipital/posterior cranial base varied from 43 to 46. With the posterior cranial base, the ratio varied between 64-68%. The sphenoid, occupying an intermediate spatial position in the cranial base, also occupied an intermediate position in regard to its growth pattern, i.e., the ethmoid/sphenoid ratio increased, the occipital/sphenoid ratios varied widely. The sphenoid became slightly larger in relation to the posterior cranial base, and slightly smaller in relation to the total cranial base. Yet it showed neither the constancy of the occipital, nor the specific tendency to increase displayed by the ethmoid.

The relative contribution of the basioccipital to the cranial base is established during the fetal period and thereafter remains constant. The relative contributions of the ethmoid and sphenoid do not become stabilized during the embryonic or fetal periods. The ethmoid seems to be increasing, and the sphenoid decreasing in relation to the total cranial base.

One might reason that the areas of

the cranial base related to the older parts of the brain, i.e., the basi-occipital or posterior regions of the skull, mature and attain stable proportions early. Growth is then more rapid anteriorly in the response to the developing cerebral hemispheres, which are phylogenetically later acquisitions.

2. Growth at the spheno-ethmoidal and spheno-occipital synchondroses was studied. The data indicate that the ethmoidal and occipital surfaces of the respective synchondroses showed more active growth than the corresponding surfaces of the sphenoid, i.e., the ethmoid increased 12 mm. in length, whereas the distance from sella to the spheno-ethmoidal junction increased only 7.5 mm. during the same period. The basi-occipital (basion to the spheno-occipital synchondrosis) increased 6.5 mm. while sella to the spheno-occipital synchondrosis increased only 2 mm.

3. Analysis of the angular measurements revealed:

a. The "saddle angle" (crista galli-sella-basion) displayed a wide range of variation, 117% to 154%. It tended to become less acute during the fetal period.

b. The "ventral angle" of the cranial base (formed by the interior edge of the nasal septum and the ventral surface of posterior cranial base) exhibited considerable change. In the early embryonic period, it was found to be more acute than the saddle angle. During the fetal period the ventral angle approached the saddle angle and then became less acute. It had "opened" to a much greater extent.

c. The positional relationships of the points crista galli, spheno-ethmoidal junction, and sella were also of interest. Post-natally, these points lie on a straight line. During the fetal period this was not the case; these three points formed an angle. This angle was measured and expressed as the deviation from a straight line. The deviation decreased steadily from 41° in a 40 mm. embryo to only 1.5° in the term fetus. In other words, in the earlier stages an angle exists between these three points which tend to approach a straight line towards the end of the fetal period. An upward shift of the ethmoid at the spheno-ethmoidal junction would cause this change to occur. Based on the behavior of other angles observed within the cranial base, it appeared that any shifting or change in the angular relations of the cranial base occur primarily at the spheno-ethmoidal junction and not at the sella itself.

The value of the conclusions presented would be greater if a more extensive series of fetal skulls had been available for study. However, even with this limited material certain trends were discernible which warrant further investigation. Increased information regarding the early development of the cranial base would make it possible to better recognize and evaluate the subtle changes occurring in the adult skull.

Skeletal Disharmonies Associated with Anterior Open-Bite

Edward J. White, Jr.
Union, New Jersey

This investigation was undertaken to determine the areas of disharmony that contribute to the anterior or incisal open-bite.

The questions to which answers were sought were:

1. Is anterior open-bite a localized condition?

2. Are the anterior teeth infraerupted?
3. What part does habit play in the etiology of the condition?
4. Why does orthodontics so often fail in its treatment?

The study was based upon lateral cephalometric roentgenograms of two groups of individuals. The control group of 47 individuals had been studied by Coben at the University of Illinois in 1952. All data pertaining to this group was obtained from Coben's thesis *"The Integration of Certain Variants of the Facial Skeleton: A Serial Cephalometric Roentgenographic Analysis of Craniofacial Form and Growth."*

A second group composed of 15 individuals consisted of 10 females and 5 males. All represented Class I malocclusion, were 8 years old ± 1 year, and exhibited anterior open-bite.

Each tracing was divided by a coordinate system of lines, with the Frankfort horizontal plane taken as the abscissa and lines perpendicular to the Frankfort plane as the ordinates. All measurements of craniofacial height were taken parallel to the ordinates and were expressed as percentages of the total anterior facial height (nasion-menton).

The total material available for study consisted of 57 individuals with anterior open-bite and embraced an age range from 6 years to 28 years. To obtain a control group with which to compare them would have been impractical and probably would have given unreliable results. The coordinate method of analysis as employed by Coben in 1952 permitted an excellent method of appraisal of the actual size and relative proportions of the various craniofacial structures of each face. He had studied 47 individuals in the age range 8 years ± 1 year, and because 42 of the 47 were excellent occlusions or Class I malocclusions it was decided to compare the open-bite individuals who were 8 years ± 1 year and represented Class I malocclusion with the data supplied by his work.

To determine whether the two groups were comparable, the means, standard deviations and total range of variability of all characteristics were first determined. The "t" test of significance was then employed to appraise the significance of differences between the groups.

When all measurements had been made and expressed as percentages of total facial height (N-M), it was noted that the mean percentage values obtained for all segments of anterior and posterior facial height were less than the mean values obtained from the control group except the value ANS-M which was greater.

Since individuals with anterior open-bite were being compared with non open-bite individuals, it seemed to follow that if the measurement of total face height were the same in both groups, it might be concluded that the segments making up total face height were smaller in the sample than they were in the control.

On the other hand if the total face height measurements of the open-bite individuals were greater than those of the control group, they should yield segment values that were smaller than those of the control group because the individual segments were expressed as percentages of the total face measurement. In reality they might be of the same size or even greater than the control, but the fact that the total face measurement was greater than the control would make them proportionately smaller.

In order to determine if the proportions of the individual segments making up anterior facial height differed from those of the control group, it was decided to reduce the open-bite by subtracting the inter-incisal distance from the total face height, and, in addition, to give the individual a normal amount of *overbite.* This was done by subtracting 3% from the total facial height, which was the mean percentage of overbite in the control group. In this manner the influence of the open-bite was eliminated. All segments of facial height were then expressed as percentages of the corrected total face height and were tabulated.

Upon examination of this table it was noted that all mean values of the segments of both anterior and posterior facial height, except nasion-sella, were not only very close to the mean of the control group but did not differ from it in any case by more than .2%. Thus, it was realized that infraeruption, as represented by lesser contributions of the upper and lower dental areas to total facial height, did not seem to be present.

If consideration of the segments of both anterior and posterior facial height as contributors to the discrepancy is eliminated, we are left with (a) the form of the mandible itself, and, (b) its position in relation to the horizontal plane.

The gonial angle was found to exceed the mean of the control by 4°, and only three individuals demonstrated values that were less than the mean of the control. It was also noted that in two of these three cases the ramus inclination angle was less than the mean of the control. It would seem then that, where the presence of open-bite could not be related to an excessive gonial angle, the posterior border of the mandible was in too vertical a relationship to craniofacial structures. This could produce the same defect in the anterior part of the face as could an increased gonial angle when the posterior border of the mandible was in a correct relationship.

The mandibular plane angle was found to exceed the mean value of the control by 4°, and, as in the case of the gonial angle, only three individuals demonstrated values that were less than the mean of the control. This seemed to substantiate the evidence that the excessive gonial angle could be the agent responsible, at least in part, for the presence of anterior open-bite, and that this increased gonial angle manifested itself primarily in the relationship of the lower border of the mandible to other structures.

Measurements of the absolute length of the ramus of the mandible and of the absolute length of the mandibular body revealed means that were smaller than those of the control group. The length of the mandibular body was likewise significantly smaller than the mean of the control.

The angle of ramus inclination yielded a mean value for the sample that exceeded the mean of the control, but the difference was not statistically significant.

If open-bite were due, as some claim, to a supraeruption of the molar teeth which resulted in a jacking-open of the mandible in back, one would expect that the inclination of the posterior border of the ramus (ramus inclination angle) would be less than in normal occlusion. This did not prove to be the case. This angle was found to be slightly greater than that of the control group.

This comparison of the mean craniofacial proportions of the open-bite individuals and the control group revealed how the open bite individuals *as a group* differed from the control. To demonstrate how much cancelling out or compounding of disharmonies was present in each case, every individual in the experimental sample was compared to the mean values of the control.

A standard deviation diagram was employed representing the average craniofacial proportions and their limits of variability as measured by the standard deviation. The values derived from each individual in the sample were then plotted in the diagram to illustrate the contribution of each variable to the formation of the disharmony.

Although two of the individuals were found to demonstrate evidence of infraeruption of the anterior teeth and otherwise good craniofacial patterns, eleven of the cases demonstrated discrepancies in mandibular form and/or positioning with no evidence of infraeruption of anterior teeth. The remaining two individuals presented evidence of disharmonies in form and positioning of the mandible which were accompanied by less than average contributions of the upper dental area to total facial height.

It seemed reasonable to assume that in those cases where open-bite was not associated with a skeletal disharmony but was the result of infraeruption of the anterior teeth, control of habits and orthodontic therapy would produce a stable result. Indeed, it has been shown that many of these cases recover spontaneously without the aid of orthodontic treatment. It is not reasonable, however, to assume that all open-bite cases present infraeruption of teeth as a result of habits. Because a patient with openbite places the tongue between the teeth in swallowing, for example, does not necessarily indicate that the tongue is preventing eruption of the anterior teeth. The action of the tongue may be employed to facilitate the act of swallowing in the presence of failure of anterior occlusion. Therefore, it must first be determined whether the openbite has a skeletal basis or is the result of infraeruption. If it is skeletal in origin and the contributions of the upper and lower dental areas to total facial height are average, as was found in 11 of the 15 individuals studied, it would be logical to expect that orthodontic therapy directed at bringing these teeth to a plane of occlusion determined by the posterior teeth could not result in a state of stability. When the appliance is removed the open-bite will probably recur.

Integration of Certain Variants as a Determinant of Facial Morphology

Alvaro Marcondes
Sao Paulo, Brazil

You may recall that Coben's thesis carried a title strikingly similar to this one. His work was carried on with a random sample of males and females in order to gain insight on the behavior of a 'norm' pattern. This study employed his sample as a control to determine whether there were any characteristics in an all Class II sample that markedly distinguished that condition. The present sample consisted of 105 individuals of the same age as Coben's 52 males and 53 females, all classified as Class II, Div. I. For each a pair of plaster models was available for accurate classification. The same height and depth measurements were made as by Coben and these were reduced to percentages of depth or height. The means and standard deviations were calculated for each.

To appraise the significance of differences between Coben's Class I sample and the Class II, Div. I group, the "t" test for unpaired experiments was used and only significances equal to or better than the 5% level were considered.

In order to disclose any trend or tendency that might exist in the distribution of the individual values around the respective means, percentages of the occurrence of larger, similar or smaller values than the means were calculated for each variant in the Class II sample.

Observations

The "t" test of significance revealed a group of variables that were significantly different between the normal or Class

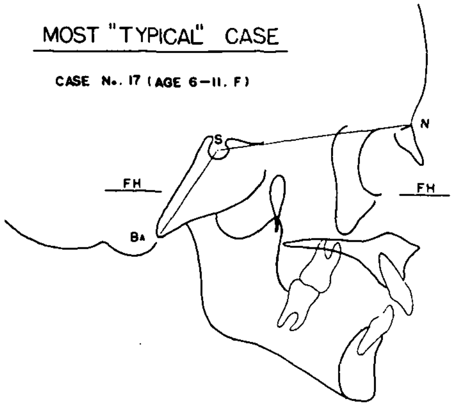

Fig. 7

I and the Class II, Div. I samples (Fig. 7).

The effective length of the cranial base Ba-N was found to be larger in the Class II sample. This means the distance from Ba to N read parallel to the Frankfort horizontal. The S-N distance was significantly smaller. Ba-S was slightly but not significantly larger but the angle Ba-S-N was significantly larger in Class II. Of the upper face segments Ba-S, S-Ptm and Ptm-A, only Ba-S was significantly larger. The other two were smaller but not significantly so.

In the mandibular area, where the distance from basion to chin point (Ba-Po) could be influenced by the segments Ba-Ar and Ar-Po, the latter was found to be significantly smaller. Ar-Po, or the effective length of the mandible could be influenced by three factors; viz., (1) the anteroposterior distance from Ar to Go which would be determined by the length and inclination of the ramus, (2) the absolute length of the mandibular body, Go-Po the effective length of which would be influenced by (3) the size of the gonial angle. Of all these factors only the absolute length of the ramus and the absolute length of the body of the mandible were different. Both were significantly smaller.

In the height dimensions the following was noted: total face height was the same in the two groups. Nasal height was significantly smaller and both upper and lower dental segments and the dental overbite were greater in the Class II sample. Total posterior face height as well as the individual segments contributing to it showed no differences between the samples.

Of the four angular measurements taken, viz., the gonial angle, mandibular plane, ramus inclination and cranial base, only the last showed any difference. It was larger in Class II.

Trends or tendencies that might exist were disclosed by the distribution of the individual values of each variant around the range of the Confidence Limits of their respective means.

Certain variants stood out as occurring more frequently in the Class II, Div. I group. Thus, in the lower face all variants related to the mandible and its contribution to depth were found to be smaller except the distance from basion to articular. The mandible itself was undersized in the majority of cases but its configuration did not differ from Class I.

All variants in the cranial bases with the exception of S-N were quite consistently larger in the Class II sample.

The study of numbers of the individual cases revealed *no one* that had all its variants equal to the values in the average Class II, Div. I table of means. Individual variation was the main feature observed.

808 South Wood St.