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# FACIAL GROWTH IN MAN, STUDIED WITH THE AID OF METALLIC IMPLANTS[1]

*by*

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## INTRODUCTION

The growth of the cranium is highly differentiated. The brain and the visual organs for instance attain practically fully developed size before the age of puberty. By comparison, the growth of the facial structure is functionally more intimately related to the growth of the body structure as a whole and therefore continues to a considerable extent during adolescence. The midfacial structure and nasal cavity grow at a rate which is commensurate with the need for increased oxygen requirement, whereas the jaws develop at a comparatively high rate to keep up with the increase in metabolism which continues up to adult age. From a functional viewpoint the cranial base forms the partition between the brain and the facial structure. Accordingly, the internal and external cranial base must develop at widely different rates in order to accommodate the different development of the brain and the facial structure. Expansion of the brain case during childhood is thus followed by a period of formative development during adolescence in which the cranial base continues to undergo a considerable change.

During the formative development of the cranial base and the brain case, a lowering of the two medial and the posterior cranial fossae occurs in relation to the anterior one. As an effect of this differential growth of the cranial base the glenoid fossa suffers a rearward and at the same time downward displacement in the

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cranium. It is evident therefore, that the growth of the cranial base will exercise a marked influence on the jaw position and on the occlusion of the teeth (*Björk* 1947, 1955). The displacement of the temporal bone within the cranial structure with growth, and hence of the temporo-mandibular joint, varies in extent from case to case.

Vertical and horizontal growth of the lower jaw varies with the direction of the growth at the condyle. The vertical component of the growth of the mandibular condyle and the lowering of the medial cranial fossa, and hence of the temporal bone, determine the extent to which the mandible will be lowered in the facial pattern.

The dorsal displacement of the temporal bone and the sagittal growth component of the mandibular condyle are the growth factors which together determine the longitudinal development of the lower face. In most cases these factors counteract each other.

The lowering and extension of the maxilla in the facial pattern are effected by sutural growth, accompanied by a simultaneous periosteal growth of the alveolar arches in height, length, and width. The growth of the bones forming the mid-facial structure and the maxilla is associated with the growth and development of both the cranial base and the mandible (*Björk* 1947, 1955; *Lindegård* 1953; *Ricketts* 1955).

The formative growth of the brain case may be regarded as taking place with the anterior part as relatively fixed in the cranial structure. Analysis of the general growth pattern of the cranium as a whole may therefore be carried out with reasonable accuracy in the sagittal and vertical directions from a line joining nasion with sella and employing the centre of the sella as a fixed landmark, in accordance with well-known x-ray cephalometric procedure.

Modern x-ray technique is nevertheless unable to reveal the mechanism governing the growth of the individual bone elements in the facial skeleton. The growth of each separate bone, such as the mandible or the maxilla, is bound up with a change in form which to a greater or lesser degree embraces all bone surfaces. This re-generation is effected by a process of periosteal bone growth and through resorption. Hence it is not possible to use x-ray methods for analysing the growth mechanism of in-

dividual bones in humans on the basis of comparisons from the external bone contours (*Brash* 1924; *Weinmann* and *Sicher* 1947; *Moore* 1949; *Gans* and *Sarnat* 1951; *Baer* 1954).

The purpose of this article is to give a preliminary account of a new method which has been developed with the aim of facilitating x-ray studies of the growth mechanism of the maxilla and mandible in Man. A description of the method is given in the following by referring to five cases with different growth patterns. In all cases the period of observation was exactly two years.

## METHOD

The method is based on the use of metallic implants, three or four in each jaw. These x-ray indicators remain in position, serving as reference points with the aid of which the x-ray plates may be orientated so that the growth pattern of each jaw may be analysed.

Vitallium pins were used as x-ray indicators. These pins, which were pointed at one end, had a diameter of 0.62 mm and a length of 2.0 mm. Application of the pins in the jaw bone was effected with an instrument, the design and method of use of which is illustrated in Figs. 1 and 2.

The instrument consists of a cylinder and piston, the point of which has the same diameter as the indicator pins. A bayonet fitting limits the movement of the piston to the length of the pins. The indicator pins are kept in holes in a block, point downwards. They are withdrawn from their storage place directly with the instrument.

The operator steadies the patient's head with his left arm and with his right hand presses the point of the instrument firmly against the bone. The instrument is grasped like pencil and its sharp muzzle penetrates the periosteum and enters a short distance into the bone, getting a firm purchase which prevents it from shifting while the pin is being driven into the bone and thus obviates any risk of the pin not entering straight.

A local anesthetic is applied to the places where indicator pins are to be located. A small quantity is applied to each spot. The assistant drives home the pin with a smart tap of a lead mallet. No pain or aftereffects can be felt when the anesthetic wears off.

In the cases referred to below, the indicators were located in the right hand side of each jaw, the side close to the film. They were placed in the alveolar arch, level with the apical third of the roots (see Fig. 2). X-ray exposures were made with the

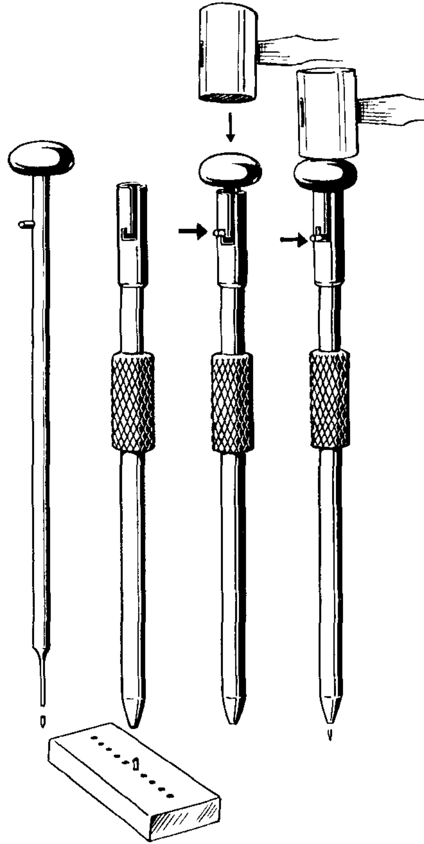

Fig. 1.

patient's head oriented in a cephalometer, the method following the well-known procedure, under controlled conditions. Once the growth at the symphysis is completed, during the first year of life, an increase in the width of the corpus and alveolar arch of the mandible takes place by periosteal bone formation accompanied by a corresponding resorption at the inner surfaces. This periosteal growth varies considerably in extent with different

individuals. The position of the indicators, which are embedded in the jaw bone, is not affected in the transverse plane by this growth. In other words, conditions of projection remain unchanged. In the upper jaw, the growth in width is partly of a similar nature, but the possibility does exist of a transverse widening between the two halves of the maxilla due to a growth at the sagittal suture. This would result in the indicators being

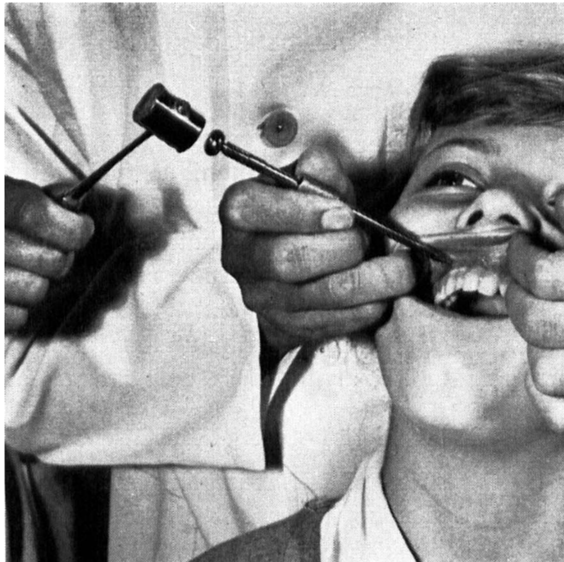

Fig. 2.

brought closer to the plane of the film. However, the error arising from this is of minor importance. A far more important consideration is that the indicators do not shift.

It has been found that under certain conditions the indicators may alter their position in the jaws. The chief reasons for this happening seem to be that the pins do not enter the bone correctly or that they happen to be placed in the eruption path of the teeth and get carried along by them. It has also been found that due to the action of resorption at the nasal floor, as described in the following, the indicators may finish up in the nasal cavity.

Provided that the indicators did not alter their position in the jaw, it would suffice with two indicators per jaw for the purpose of x-ray growth analysis. However, to be on the safe side, three or four have been used in each jaw. If the indicators are found to have maintained their relative positions, this is taken as proof that they have not shifted.

The drawings, illustrating the growth of the jaws, are made with the films enlarged by three.

## INDIVIDUAL DEVELOPMENT

### *Case No. 1 (4245 g)*

*Facial growth:* The first of five cases of growth pattern to be described concerns a boy of harmonious facial structure and having normal dental occlusion (Fig. 3). It will be seen from the general growth pattern in Fig. 4 that there is a pronounced vertical growth of the facial structure, resulting in a marked lowering of the mandible in the facial pattern. The protrusion of the jaws in the facial build remains unaltered. The prognathy angles suffer a reduction owing to sutural growth in length of the anterior cranial fossa.

Three indicators were inserted in the upper jaw (Fig. 4, nos. 1—3). The displacement of the indicators in the facial growth diagram (Fig. 4) indicates the extent of the sutural growth. A fine line, drawn through the indicator locations for the two age stages denotes the direction of the sutural growth. As it is the same for all three indicators in the upper jaw, it may be concluded that the lowering of the maxilla is a parallel displacement, despite that the lowering of the nasal floor is greater at the front than at the rear. It may be inferred from this that the change in position of the maxilla due to growth cannot be determined from changes in the inclination of the nasal floor.

In Table I is given a metrical analysis of the displacement of the implants in the facial growth diagram for all cases discussed.

Three indicators were also inserted in the lower jaw (Fig. 4, nos. 4—6). In this case, however, they were found to follow different paths. The lowering of the indicators is greatest at the posterior end of the jaws. The foremost indicator (No. 6) has undergone a purely vertical displacement, whereas the other two

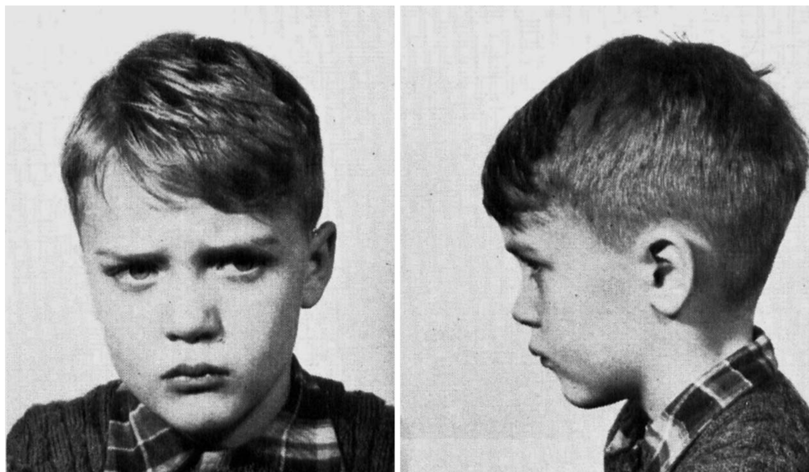

Fig. 3.

have described a downward and rearward path, cf. Table I. This growth pattern indicates that the lower jaw has undergone a marked rotation despite of the fact that the inferior contour of the mandible is lowered nearly parallel in the face (Fig. 4). An explanation of this is given in the following analysis of the growth pattern of the jaws.

The growth pattern of each jaw emerges if one compares x-ray exposures made at different stages of development, taking the indicators fixed in the jaw bones as reference points. X-ray films from the two stages, which are to be compared, are placed one on top of the other and so located that the indicator points in one of the jaws coincide at a time. See Fig. 5 for the analysis. As far as the inclination concerns, the jaws are oriented with the correct relation to the cranial base, in accordance with the facial growth diagram in Fig. 4.

The increase in size of the maxilla and the mandible, as analysed metrically, is to be found in Table II.

*Mandible:* The longitudinal growth of the mandible is confined entirely to the condylar head, which is fully in accordance with present-day concept (Fig. 5). Hence, there has been no increment in length at the chin region in this case. In other aspects the growth pattern deviates in several ways from the

current conception of mandibular growth. In this case, the condylar growth is directed upward and to some extent forward. According to the manner in which the diagram has been orientated, i.e. according to the anterior part of the cranial base, the

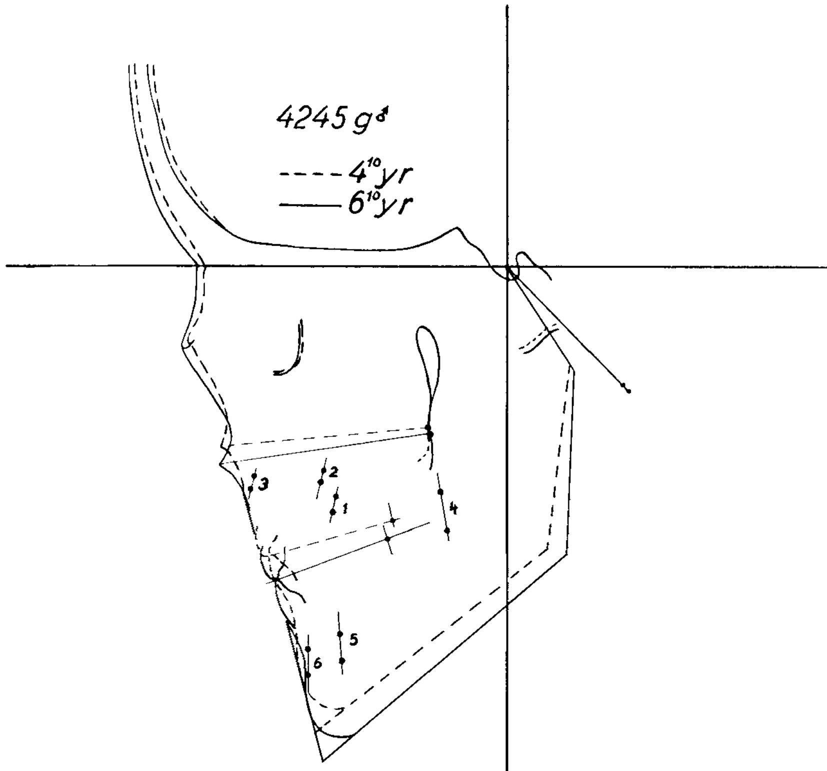


Fig. 4.

growth of the temporo-mandibular joint will have the effect of lowering the mandible and, at the same time, retracting it somewhat. The lowering of the mandible in the face is therefore considerably greater dorsally than frontally. However, the rotation of the mandible is accompanied by a marked resorption at the lower margin in the angulus region. As a result of this resorption, the inclination of the mandibular base line remains virtually unchanged in the face during the growth period, despite of the mandibular rotation.

Table I

*Facial Growth*

Movement of the metallic implants with growth, measured sagittally in relation to the nasion-sella perpendicular (NSP), and vertically in relation to the nasion-sella line (NSL), in mm

| Metallic implants | Case 1 (4245 g) | | Case 2 (5574 g) | | Case 3 (2627 g) | | Case 4 (3111 e) | | Case 5 (5240 g) | |
|---|---|---|---|---|---|---|---|---|---|---|
| no. | Sag. | Vert. | Sag. | Vert. | Sag. | Vert. | Sag. | Vert. | Sag. | Vert. |
| 1 | 1 | 3 | 2.5 | 0.5 | 2 | 3 | 2.5 | 3 | 2.5 | 2.5 |
| 2 | 1 | 3 | 2.5 | 0.5 | 2 | 3 | 2.5 | 2.5 | 2.5 | 2 |
| 3 | 1 | 3 | 2.5 | 0.5 | 2.5 | 5 | 2.5 | 2 | 2.5 | 2 |
| 4 | 1.5 | 8.5 | 2.5 | 0.5 | 3.5 | 4.5 | 3.5 | 7 | 2.5 | 1.5 |
| 5 | 0.5 | 5.5 | 5.5 | 2.5 | 4 | 4 | 4.5 | 6 | 2.5 | 5 |
| 6 | 0 | 5.5 | 6 | 2 | | | 6 | 4.5 | 2.5 | 5 |
| 7 | | | 7 | 1 | | | | | 3.5 | 4 |
| 8 | | | 7 | 1 | | | | | 3.5 | 3 |

Table II

*Growth of the Jaws*

Measurements in mm with the metallic implants as reference points

| | Case 1 (4245 g) | Case 2 (5574 g) | Case 3 (2627 g) | Case 4 (3111 e) | Case 5 (5240 g) |
|---|---|---|---|---|---|
| | *Maxilla* | | | | |
| Appositional growth at maxillary tuberosity | 1 | 1.5 | 2.5 | 2.5 | 2.5 |
| Sutural growth at frontomaxillary junction | 3 | 0.5 | 3 | 2 | 2 |
| Appositional growth at lower border of orbit | 2 | 0.5 | 3 | 0 | 2 |
| Appositional growth of alveolar process at first molar | 2.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| Resorption of nasal floor: | | | | | |
| frontally | 2 | 3 | 1 | 1.5 | 1 |
| dorsally | 0.5 | 3 | 0 | 1.5 | 0 |
| | *Mandible* | | | | |
| Appositional growth of alveolar process at first molar | 1 | 0.5 | 2 | 1 | 1.5 |
| Apposition (+) or resorption (−) of lower border: | | | | | |
| at the symphysis | 0 | 0 | 0.5 | 1 | 0 |
| at the gonial angle | − 3 | 2 | − 1 | 0 | − 2 |

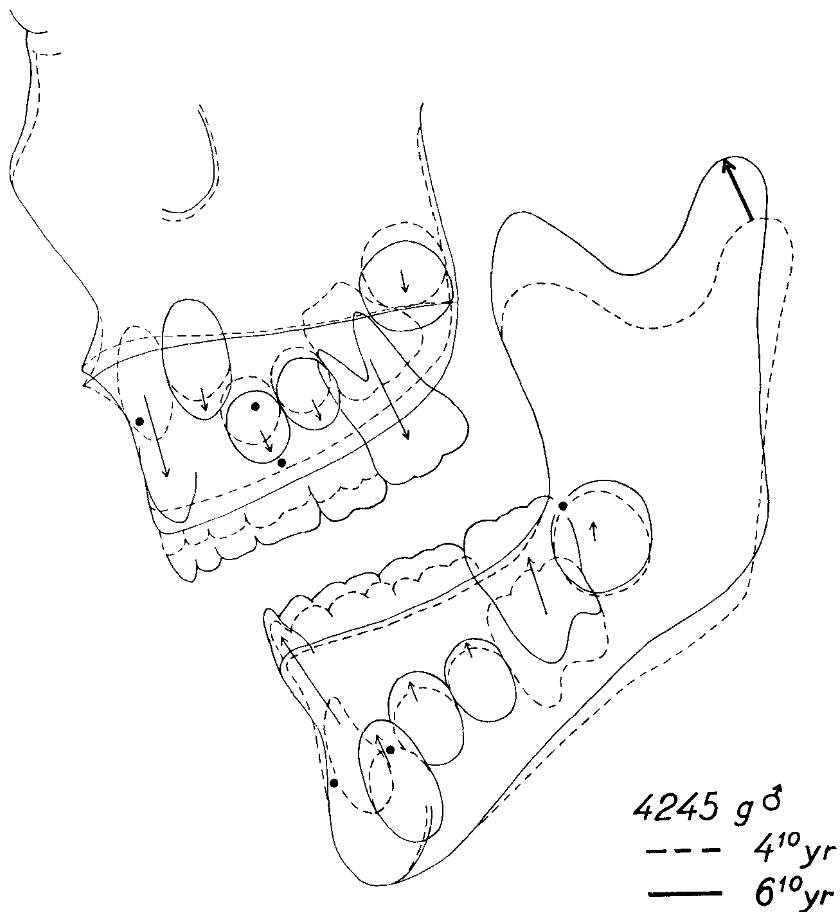


Fig. 5.

The periosteal growth at the posterior border of the ramus is very slight, and there is no appreciable resorption at the anterior border. This growth pattern must be viewed in relation to the condylar growth direction.

*Maxilla:* It will be seen from the drawing, Fig. 5, that the growth occurs dorsally and that there is no frontal growth increment. The upper jaw is moved forward in the face due to growth of the suture towards the palatine bone, while a simultaneous dorsal elongation of the alveolar arch is brought about by a periosteal deposition of bone on the maxillary tuberosity.

The sutural lowering of the maxilla, the extent of which is shown by the movement of the indicators in Fig. 4, increases the height of the frontal process. The fronto-maxillary suture cannot be discerned on the x-ray film, but the increase in height may be estimated from the naso-frontal suture (Fig. 5).

The sutural lowering of the maxilla is accompanied by a periosteal deposition of bone on the floor of the orbit so that the lowering of the latter in the face is less.

On the other hand, the lowering of the nasal floor in the face exceeds the sutural lowering of the maxilla. In other words, the nasal floor is lowered appreciably by the action of resorption and by periosteal bone deposit on the hard palate. In this particular case the process of resorption is more pronounced in the frontal than in the dorsal region, which results in the altered inclination of the nasal line referred to above.

*Tooth Eruption:* The path of eruption of the teeth is in this case essentially at right angle to the plane of occlusion.

*Case No. 2 (5574 g)*

*Facial growth:* The next case of growth analysis to be described concerns a girl with a malocclusion characterized by mandibular overjet (Fig. 6). The mandible protrudes, as seen from Fig. 7, considerably in relation to the maxilla. The growth development of the facial structure is predominantly sagittal. The vertical increment is negligible (Fig. 7). Owing to the longitudinal growth of the mandible being very large in proportion, the sagittal jaw relation is altered with development. As shown in Fig. 7, clivus has grown in length in proportion to the lowering and backward movement of the articular tuberculum. The condylar head, however, has moved forward against the articular eminence. This indicates a ventral displacement of the mandible, probably related to a marked increment of the overbite with the development.

Four indicators were inserted in each jaw. The change in position of these indicators in the facial diagram during the growth period, Fig. 7 and Table I, reveals that the maxilla has been lowered and transported forward by sutural growth without suffering any rotation. In this case the direction of sutural

growth in contrast to that of the first case is chiefly in the sagittal plane.

The positional change of the mandible with growth, Fig. 7 and Table I, is also found to have occurred chiefly in a sagittal direction and is considerably greater in the mandible than in the maxilla. The displacement of the indicators also shows that the vertical lowering has been greatest for those which were located furthest back in the jaw and that a certain rotation of the lower jaw has taken place, although the latter movement is not so marked as in the first case.

*Mandible:* Examination of the growth increment of the individual jaws (Fig. 8 and Table II) shows that the condylar growth has occurred rearwards, in the longitudinal direction of the jaw. Consequently, the jaw has increased in length, whereas there has been no appreciable increase in height. With the orientation used in Fig. 8 the direction of growth in the facial diagram is 45° rearwards. Here we find the growth changes in the mandibular outlines associated with condylar growth different in nature from that observed in the first case. Appreciable periosteal growth has taken place at the posterior border of the ramus, accompanied by a marked resorption of it's frontal border. It is also found that a deposition of bone, associated with the condylar direction of growth, has taken place on the lower border of the mandible at the gonial angle. This is in contrast with the resorption in that area observed in the previous case. On examining the general growth pattern (Fig. 7) one finds that the inclination of the mandibular base line has diminished with growth. The explanation lies in the rotation of the mandible, in conjunction with the bone deposition at the angulus region.

*Maxilla:* In general, the growth changes which have taken place in the maxilla are in accordance with the case no. 1. However, there is a very marked resorption in length in the anterior nasal spine region. The lowering of the nasal floor by resorption is much more pronounced than in the previous case.

The growth analysis reveals certain significant factors in the interpretation of the vertical growth of the upper facial structure. In some individuals the lowering of the maxilla is effected mainly by sutural growth while in others it is brought about chiefly by periosteal growth increment in height of the alveolar arch.

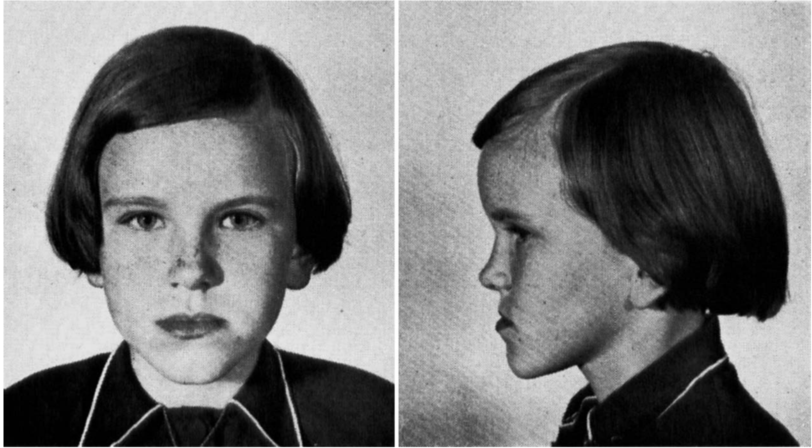

Fig. 6.

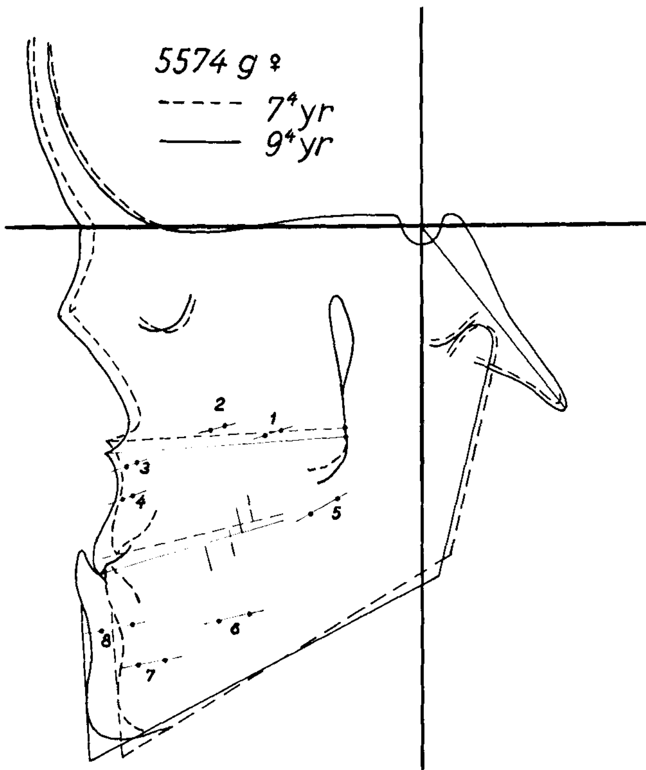


Fig. 7.

In the first mentioned case (Fig. 5) the nasal cavity increases in height mainly due to the sutural lowering of the maxilla, whereas in the latter case (Fig. 8) it is due mainly to the lowering of the nasal floor through resorption.

*Bite development:* The development of the bite is greatly influenced by functional forces, both dysplastic and compensatory. Case no. 2 clearly illustrates the influence of compensatory forces. The general growth pattern in Fig. 7 shows that the mandibular prognathism has increased in relation to the upper jaw. This tendency in the development of the face is compensated by a reduction in alveolar prognathy in the lower jaw and by increased facial inclination of the maxillary incisors. As a result, the alveolar arches change in shape. The anthropological reference points, the subspinal and the supramental points, corresponding to the apical zones, are thus moved with development.

*Tooth eruption:* The method described above allows the conditions governing tooth eruption to be analysed with considerable accuracy, which cannot be achieved with ordinary x-ray cephalometric methods. It should be noted that the direction of eruption depends to some degree on functional influences. The eruption of the teeth thus follows a forward path in the maxilla and a rearward path in the mandible, as compared with the vertical eruption in the previous case.

The eruption of the third molars should also be noted. In case no. 1, where the resorption at the frontal margin of the ramus is slight, the danger of impaction of the lower third molars appears to be greater than in case no. 2, in which the ramal resorption is considerable. The marked resorption at the frontal margin of the ramus and the inadequate vertical growth of the mandible appear to necessitate a lowering of the tooth germs of the third molars, as observed in case no. 2 (Fig. 8). It may be concluded, therefore, that the mode of eruption of the teeth is associated with the growth pattern of the entire face.

Besides the movement of the tooth germ prior to calcification two modes of eruption are considered: 1) due to the root formation by which process the tooth is raised from the socket, 2) due to a heightning of the entire tooth together with the socket. The erupting force is in the first case explained by the

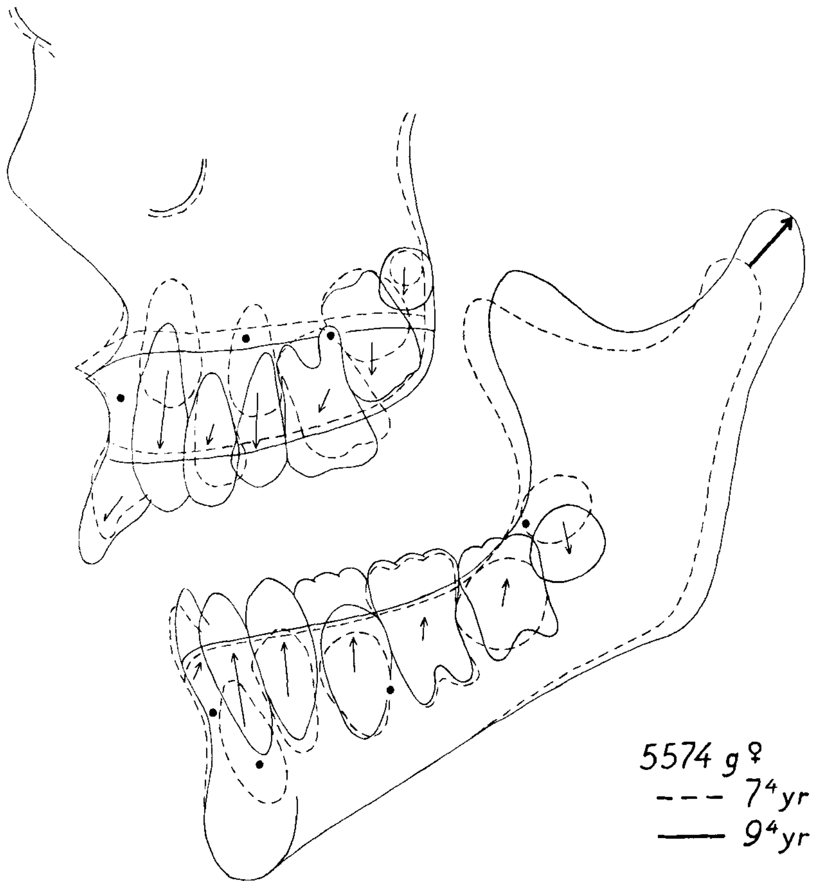


Fig. 8.

mitotic division of the pulp tissue (*Orban* 1953). In the second case the force may be explained by the mitotic division of the periodontal tissue. This suggests in contradiction to current belief that the bone deposition in the socket is a secondary process.

Differentiated proliferation in the various regions of the periodontal membrane explains the variation in eruptive direction and mesial migration of individual teeth in the same manner as the differential growth of the connective tissue in the

cranial sutures causes the formative development of the brain case.

The prefunctional phase of the eruption presupposes a resorption of bone tissue in the direction of movement. It may be justified to consider this resorption as much a primary function in tooth eruption as the proliferation of periodontal tissue. Both processes may be governed by biochemical factors similar to those which control the processes of simultaneous resorption and periosteal deposition of bone at the frontal and dorsal ramal margins. From this it would follow that the eruption of the teeth, at least at the second stage, would be independent of the system of fibres in the periodontal membrane. The influence of external forces on the eruption may be assumed in principle to act in a similar manner as in orthodontic tooth movement (*Reitan* 1951).

*Case No. 3 (2627 g)*

*Facial growth:* The following case (Fig. 9) is that of a boy having normal occlusion of his teeth. The growth of the facial structure is pronounced in both sagittal and vertical directions. The direction of growth of the maxilla is 45° forward and downward, accompanied by a slight rotation, as revealed by the displacement of the indicators in the facial growth diagram (Fig. 10). Considerable rotation is associated with the growth of the mandible, which has been lowered more dorsally than ventrally.

*Mandible:* The condylar growth direction is chiefly vertical, accompanied by appreciable resorption in the angulus region (Fig. 11).

*Maxilla:* The lowering of the maxilla is mainly due to sutural growth (Fig. 11). Increase in the height of the nasal cavity is due almost entirely to sutural growth. Resorption at the nasal floor is insignificant. The orbit has retained its position vertically in the facial diagram due to periosteal growth despite of marked sutural lowering of the maxilla.

*The bite development* is normal and the eruption path of the teeth is vertical to the occlusal plane.

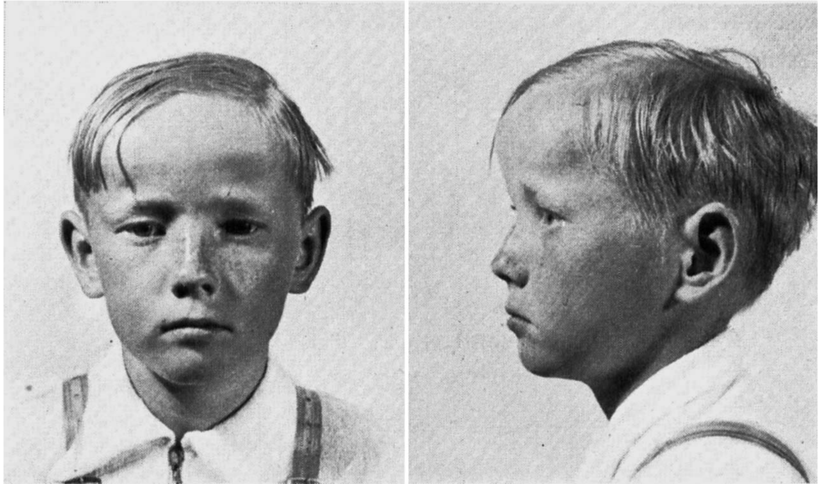

Fig. 9.

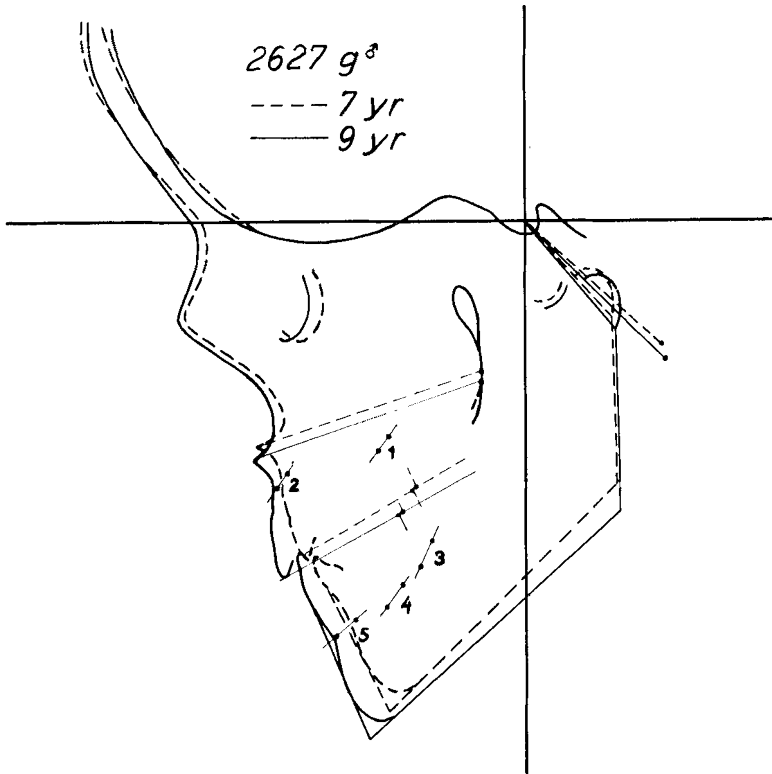


Fig. 10.

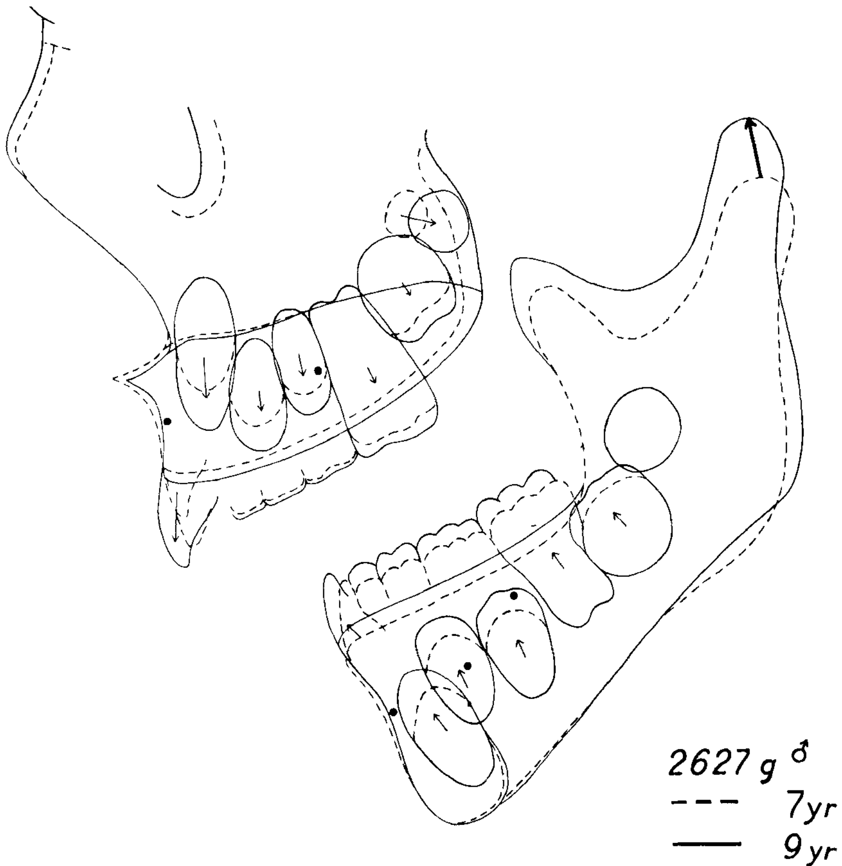


Fig. 11.

*Case No. 4 (3111 e)*

*Facial growth:* In this case (Fig. 12) the dentition is characterized by aplasia of several teeth (8, 5, 4, +4, 5, 7, 8 and 8, 5, 1—1, 4, 5, 7, 8). The growth of the facial structure is pronounced in both sagittal and vertical directions. It is of particular interest to note that the lowering of the maxilla due to sutural growth has been accompanied by a pronounced rotation (Fig. 13). The mandible is also rotated.

The influence which the growth of the cranial base exerts on the vertical development of the facial structure is evident, as

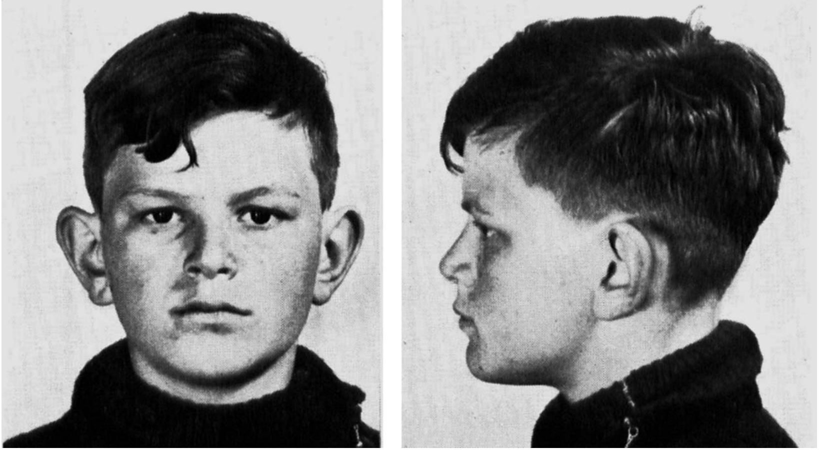

Fig. 12.

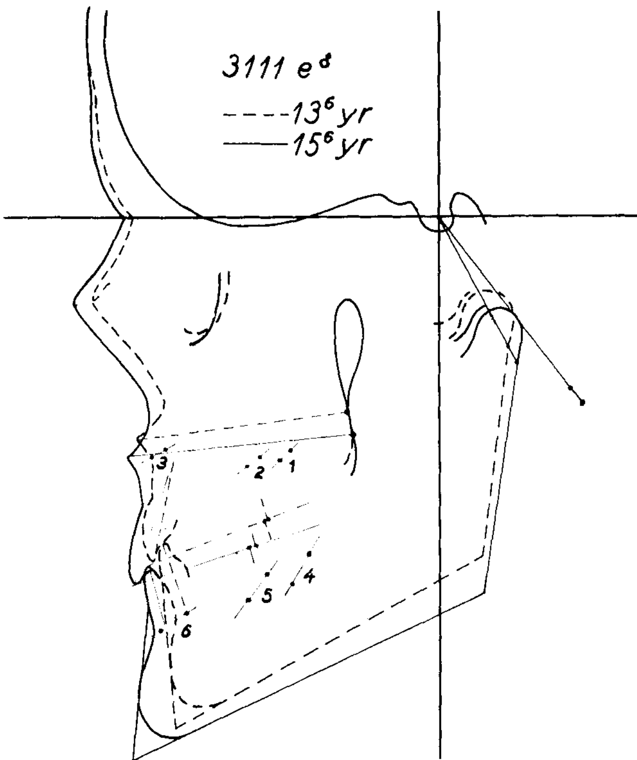


Fig. 13.

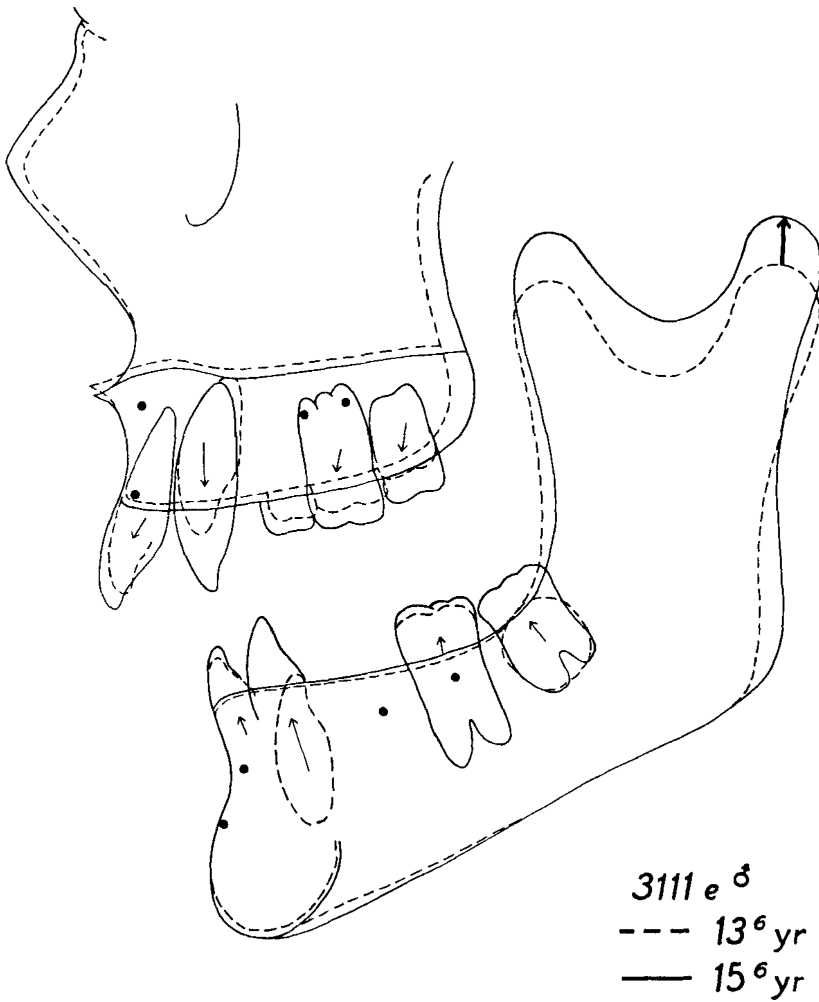


Fig. 14.

the temporal bone together with the articular fossa is markedly lowered during growth in relation to the line drawn from nasion to sella.

*Mandible:* The growth of the mandible (Fig. 14) differs from that of the previous cases, especially as regards the periosteal bone formation on the lower border of the symphysis, whereas

the lower margin of the mandible shows no evidence of change in shape in the angulus region.

*Maxilla:* It will be seen from the diagram (Fig. 14) that a lowering of the maxilla has occurred, due to the joint action of sutural growth and periosteal bone deposition at the alveolar crest accompanied by a corresponding lowering of the nasal floor by resorption. It should be specially noted that in this case no deposition of bone has occurred at the floor of the orbit. The infraorbital ridge has therefore been lowered in the face, as will be seen from fig. 12.

*The bite development* is characterized by a relatively marked increase in prognathy of the lower jaw. The change in sagittal jaw relation due to growth has been compensated in the upper jaw by a facial tilting of the incisors. Eruption of the maxillary molars has followed a mesial direction, which in this case may also be regarded as a compensatory effect. The actual cause of this, however, may be the aplasia of the maxillary premolars. The longitudinal growth of the maxillary alveolar arch at the alveolar tuberosity is normal, despite the lack of three molars. In the lower jaw, tooth eruption is vertical despite of aplasia of premolars.

*Case No. 5 (5240 g)*

*Facial growth:* The final case (Fig. 15) is one of Angle Class II malocclusion. Here the quantitative growth of the face is average both as regards height and length (Fig. 16). No longitudinal growth increment of the clivus is discernible, nor any lowering of the medial cranial fossae. The lowering of the mandible in the facial diagram depends, therefore, entirely on its own growth. The condylar growth in height is very marked, and the mandible is rotated in the same way as is described in the previous case. The direction of growth of the maxilla is forward and downward, with a tendency to rotation.

In case 3 and especially in case 4 it is possible to discern a certain rotation of the maxilla. In all the cases reported there is a definite rotation of the mandible, which is least, however, in case no. 2, in which the growth has been directed rearwards.

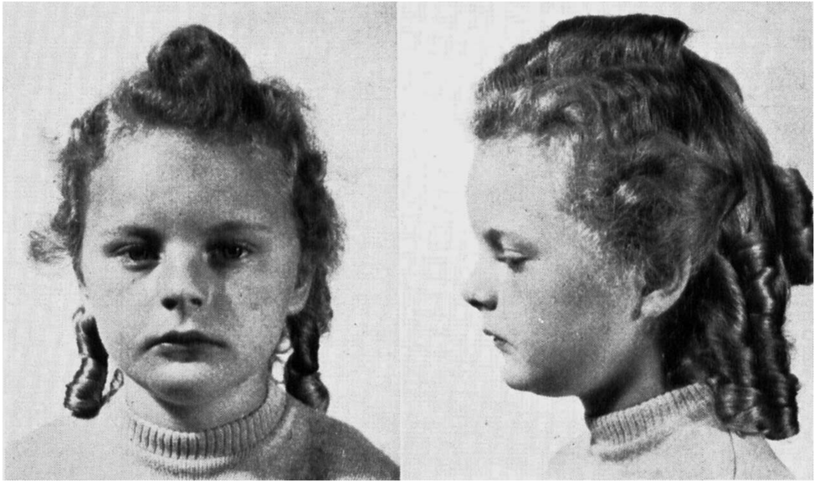

Fig. 15.

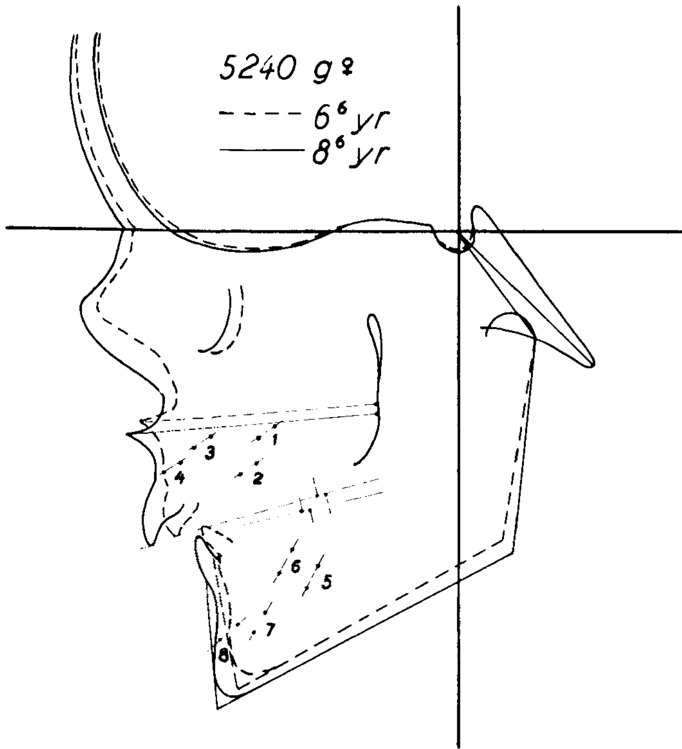


Fig. 16.

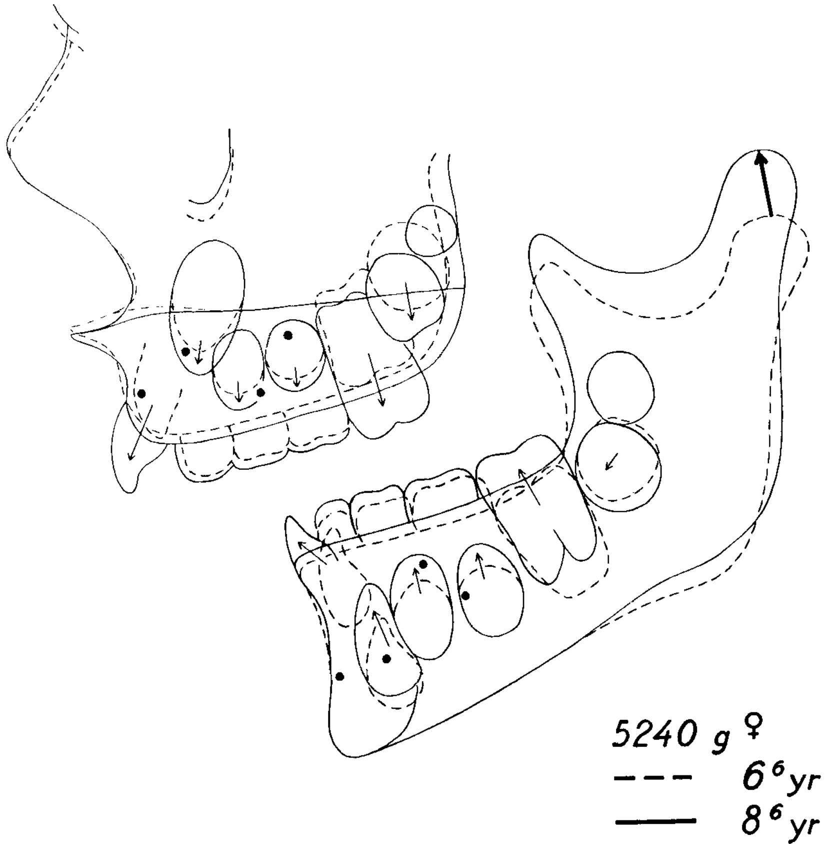


Fig. 17.

*Mandible:* The growth of the mandible (Fig. 17) is essentially vertical, and this growth pattern has been accompanied by resorption in the angulus region.

Examination of the x-ray film will in many cases convey some idea of the progress of the mandibular resorption process, which may provide valuable clinical information. If this information is lacking, great care should be exercised in clinical interpretation of the inclination of the mandibular base.

*Maxilla:* Sutural lowering of the maxilla (Fig. 17) has occurred without any appreciable resorption of the nasal floor. The floor

of the orbit has been raised by periosteal growth and has not been subjected to any lowering in the face (Fig. 15).

*The bite* is characterized by a retruded position in the facial profile of the mandible in relation to the maxilla. The dento-alveolar structure is normal, without major dysplastic deviations. The bite development appears to continue without any appreciable change in the occlusion.

*The eruption* of the teeth in the side segments of both jaws follows a mesial direction, probably due to pressure exerted by the erupting molars.

Eruption appears to depend on the rotational tendency of the mandible. It is also influenced by a mechanical factor, such as the pressure from adjacent teeth, and functional forces such as the pressure of the tongue and lips. Variations of this kind in the conditions governing tooth eruption merit a detailed investigation.

## SUMMARY

The mechanism governing the growth of the jaws in Man is subjected to an investigation with the aid of a new method of x-ray cephalometry in which metallic implants provide a means of orientating the x-ray diagram.

A brief account is given of the method and the application of the latter to analysis of jaw growth and tooth eruption. The procedure is exemplified by five clinical cases. The method has revealed information of interest, especially with regard to the vertical development of the face and the mode of eruption of the teeth.

## RÉSUMÉ

### L'ACCROISSEMENT FACIAL D'HOMME ÉTUDIÉ AVEC L'AIDE DES REPÈRES METALLIQUES IMPLANTÉS

Le mécanisme de l'accroissement des maxillaires ont été étudié radiographiquement avec l'aide d'une méthode nouvelle, basée sur l'application d'un système des repères metalliques implantés dans l'os pour l'orientation des téléradios.

L'article présente un compte rendu de la méthode employée. L'application de la méthode en analysant l'accroissement des maxillaires et l'éruption des dents est démontrée par cinq cas.

## ZUSAMMENFASSUNG

### KNOCHENWACHSTUM IM KIEFERBEREICH BEIM MENSCHEN STUDIERT MIT HILFE VON IM KIEFER IMPLANTIERTE METALLINDIKATOREN

Der Wachstumsmechanismus im Kieferbereich beim Menschen ist durch Fernröntgencephalometrie studiert worden. Dabei ist eine neue Methode in Verwendung gebracht worden, wodurch die Röntgenogramme mittel den Schatten kleinster im Kiefer implantierten Vitalliumindikatoren orientiert werden.

Die Methode und ihre Anwendung bei Wachstumsuntersuchungen wird beschrieben und durch fünf klinische Fälle erläutert.

Die Methode hat interessante Resultate, besonders hinsichtlich der vertikalen Entwicklung des Gesichtes gegeben.

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