De aangezichtsschedel bij kinderen van 7 tot 11 jaar

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SUMMARY

The purpose of this thesis is to contribute to the knowledge of the bony face of the child at certain ages and to provide an insight in the alterations thereof that take place from the age of 7 to 11 years.
In a review of the literature the introduction of roentgenographic cephalometry in orthodontics and its applications are discussed. Special attention is paid to the fixation of the head, the adjustment of the central ray and the focal-film distance, because the value of research conducted on the growth and development of the various parts of the skull increases in proportion to the accuracy of the roentgenocephalometric method employed.
Next a survey is given of the research done on the growth and development of the skull. Museum specimens of skulls generally do not lend themselves to a reliable study of growth. For usually neither the life-history nor the cause of death of the individuals in question are known. Especially where it concerns the skulls of children these factors are of great importance. Measurements made directly on the faces of individuals have failed to provide an unanimous opinion with regard to facial changes. Conclusions drawn in this connection from statistical data are open to serious critism, for the methods employed in analysing this data are often inadequate and unreliable.
With the aid of the roentgenographic cephalometry, facial measurements were also made by various autors. Their methods and findings are discussed, and mention is made of the most important conclusions arrived at.
In chapter II the apparatus and photographic technique of the cephalometric roentgenology employed by us are discussed. Photographs of the apparatus developed by *Bijlstra,* are shown in figures 1, 2, 3 and 4. The focal-film distance used by us was 375 cm. This focal-film distance proved to be distinctly superior, for investigations conducted on facial growth, to the commonly employed

focal-film distance of 150 cm. Our photographs were usually taken with 76 kV, 200 mA and an exposure time of 1.2 seconds.
In chapter III an account is given of how we arrived at a technique to obtain the most accurate measurements from profile-roentgenograms of the skull. The craniometric landmarks used in our investigation are discussed and shown in fig. 7. For the evaluation of the facial structure, 10 linear and 15 angular measurements are always taken.
With the aid of twenty children, on whom two exposures of the same object were taken separately, we tried to determine experimentally whether the American "tracing-method" or the „prick-determination-method" was to be preferred. As no difference in accuracy was found between the two methods (table 1) we gave preference to the tracing-method, because of its being easier, moreover the photographs are not damaged in this way.
The material used in our investigation is described in chapter IV. It comprises 72 schoolchildren (33 boys and 39 girls) from the town of Groningen. When they attended the first form of the primary school a lateral roentgenogram was taken. At the same time impressions of the upper and lower jaw were made for the preparation of plaster models. This was repeated every year. In our investigation only the roentgenograms and plaster models of the first visit, together with those obtained after a period of 4 years, were used. The average age of the children at their first visit was approximately 7 years.
In order to determine the dental age a new scheme is proposed, which is mainly an enlargement of the graduation employed by *Hellman.*
In figs. 8 and 9 the dental age and the chronological age are plotted. It can be noted that the age of shedding differs greatly, which is in accordance with the general view.
The "orthodontic" situation at the age of 11 is decribed; any anomaly, the position of the mandible in relation to the upper jaw, and the vertical relation of the incisors are defined. Moreover the development from an orthodontic point of view is given. On a theoretical basis seven possibilities which may arise during the development of the dento-maxillary system are differentiated.

A summary of all these data relating to our material is given in tables 2 and 3.

The distribution of our data is not of such a nature, that any paramount objections can be raised against the fact that a comparison was drawn between the group of boys and the group of girls. The groups investigated by us consisted out of cases with minor orthodontic anomalies and normals. None of the children received orthodontical treatment.

In chapter V various methods are discussed by means of which the changes of the facial structures can be diagnosed. The value of the "ligne de base" of *De Coster* was determined for the material used in our growth investigation. It proved to be very slight for our purpose.

The application of the method of superimposition to evaluate facial changes is rejected on a theoretical basis. This method was therefore omitted from our investigation.

In determining the degree of prognathism the line connecting the centre of the sella turcica with the nasion has been preferred to the Frankfort Horizontal. We must point out that all measurements given are projections upon the film-plane, so that restrictions in this connection have to be considered.

Chapter VI is dedicated to the profile at the age of 7; in table 4 the data relating to boys are given, in table 5 those to girls. The averages of all linear measurements proved to be larger in boys than in girls. The difference is significant* for the length of the horizontal part of the cranial base (S-N), the distance between nasion and Downs' B point (N-B), the height of the lower part of the face (SNA-GN), the total face height (N-GN) and the length of the maxilla (SNA-SNP). In the angular measurements no difference could be found between the two groups.

A significant diference was found for angle S-N-B, however, this angle is dependent on the relationship of the lower to the upper jaw. The classes (*Angle*), pertaining to this relationship, were not present in the group of girls in the same ratio as in that of the boys. A test, to determine wether any significant differences exist between boys

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* In our statistical evaluation a level of significance of 5 % was concidered troughout.

and girls within the same classes, as far as angle S-N-B is concerned, gave a negative result.

In chapter VII facts relating to the profile of children at the age of 11 are reviewed. The findings are given in tables 7 and 8. Here too the averages of the linear measurements are larger in boys than in girls. A significant difference is found in respect of the horizontal cranial base (S-N), the distance nasion - Downs' A point (N-A) and nasion - B point (N-B), the height of the face (N-GN) and the length of the maxilla (SNA-SNP). No difference could be found between the two groups as far as angular measurements are concerned.

With the aid of the "Standard Deviation Diagram" the variability of the linear and angular measurements at the age of 7 and 11 are graphically given in fig. 13 and fig. 14. To arrive at a norm in the facial pattern is not possible. In considering the overall picture one finds that the individual variability of the various components of the face makes it impossible to draw up general rules for the "normal".

In chapter VIII the average changes, which occured in the linear and angular measurements between 7 and 11 years of age are described.

Table 9 provides the data of changes observed in boys, table 10 that observed in girls, while table 11 gives an account of the changes encountered in both sexes.

The increase in the linear measurements is given as a percentage of the measurement at the age of 7, whereas in the angular measurements the real differences are given. In cases where the increase must be expressed in terms of a percentage of a small linear measurement, the uncertainty (standard error) about this percentage must undoubtedly be very big. For this reason it is often unjustified to compare the percentages of the individual cases separately.

There is a very strong similarity between the corresponding data in the boys' group and in the girls' group as for the avarages and standard deviations of the changes in the linear measurements. The percentage increase in lenght of S-N proves to be the slightest in both groups (boys 5.35 % ± 0.22 %, girls 5.16 % ± 0,21 %), whereas the N-A distance shows the largest percentage increase (13.41 % ± 0.69 % and 12.18 % ± 0.66 %).

The projection of the distance between the articulare and the centre of the sella turcica (ART-S) increases more than twice as much (12.58 % ± 0.75 % and 11.53 % ± 0.56 %) as the horizontal part of the cranial base (S-N).

A notable difference is observed in the percentage increase of measurements made of certain parts of the facial height. As for the distance between the nasion and Downs' points we may state that on the average the distance nasion — A point increases more in lenght (13.41 % ± 0.69 % and 12.18 ± 0.66 %) than the distance nasion — B point (9.09 % ± 0.53 % and 8.66 % ± 0.45 %).

We found that the larger part of the increase of the total height of the face — measured between nasion and gnathion (9.13% ± 0.31 % and 8.70 % ± 0.33 %) — is utilized for the increase of the "middle face" (N-SNA, 10.72 % ± 0.38 % and 10.57 % ± 0.38 %), whereas the smaller portion serves to increase that part of the face where the dental arches are situated (SNA-GN, 7.75 % ± 0.46 % and 7.13 % ± 0.60 %).

Likewise the percentage increase of ART-S (12.58 % ± 0.75 % and 11.53 % ± 0.56 %) is definitely larger that the increase in length of the projection of the distance between gonion and articulare (8.28% ± 0.83 % and 8.60 % ± 0.57 %).

There is no marked difference between the increase in lenght of the projection of the mandibular body (GN-GO, 11.25 % ± 0.47 % and 10.02% ± 0.33%) and the ramus mandibulae (GO-ART, 8.28% ± 0.83 % and 8.60 % ± 0.57 %) whereas for the maxilla a smaller increase in length was found (SNA-SNP, 6.76 % ± 0.60 % and 7.06 % ± 0.45 %).

It becomes evident that no proportional increase takes place of the various linear measurements; marked differences occur. In a comparison of the corresponding measurements in boys and in girls one finds that only one shows a significant difference of increase: the projection of the lenght of the mandiblar body (GN-GO) shows a greater increase in boys between the age of 7 and 11 years, than in girls of the same age group.

The average of the angular measurements reveals no, or only a slight change. Thus the average of the angle: articulare, centre sella turcica and nasion, remains unchanged, while the angle: gonion, centre sella turcica and nasion increases only sligthy (+0.75 ± 0.37° and +0.75

$\pm 0.28°$). The angle SNP-S-N, on an average, clearly in creases in size ($+1.58 \pm 0.30°$ and $2.08 \pm 0.31°$). The angle of the maxillary prognathism (S-N-SNA) and the angle S-N-A do not change on the average neither does the angle Y-S-N. On the other hand there is a marked increase of the mandibular prognathism (S-N-PG, $+1.18 \pm 0.30°$ and $1.06 \pm 0.20°$). Analogous changes are observed in the angle S-N-GN ($+1.19 \pm 0.31°$ and $+1.20 \pm 0.19°$).

In boys no average change is found in the angle S-N-B, while in girls there is a slight increase ($0.60 \pm 0.19°$). This points to an increase of the prominency of the chin, because the chinpoint moves ventrally, whereas on the average no, or only a very slight movement of the mandibular alveolar process takes place in this direction. The angle N-SNA-PG showed the following increase: $+1.05 \pm 0.56°$ and $+1.45 \pm 0.55°$. The angles formed by the lower border of the mandible, the spinal plane and the horizontal cranial base (M P-S N, M P-SNA SNP, SNA SNP-S N) do not change on the average.

On the average the GO-ART-S-angle increases in boys ($+1.24 \pm 0.50°$), whereas in girls a corresponding increase could not be proved. The angle of the mandible (GN-GO-ART) on the average becomes smaller between the age of seven and eleven years. ($-1.29 \pm 0.39°$ and $-1.23 \pm 0.34°$).

While on the average, the majority of the angular measurements did not change (and where it did, the change was very slight) one finds on the other hand that the changes in the individual cases were often marked. The standard deviation, which is an indicator of the variability around the mean, is large (cf. fig. 15).

In chapter IX we discussed the possible relationship between the various changes in angular measurements as observed from the age of seven until eleven. The correlation coefficients are given in table 12. A poisitive correlation was found to exist between the increase or decrease in prognathism of the mandible and the corresponding changes in the maxilla ($r = +0.43$).

It is notable that the alterations in position of point B in a sagittal direction, determined with respect to the horizontal cranial base (S-N-B), stand in a much closer relationship to the changes in angle S-N-PG ($r = +0.92$), than the corresponding alterations in

position of point A (SNA) and the changes in maxillary prognathism (S-N-SNA, r = +0.54). This is shown in figs. 16 and 17.
An increase in mandibular prognathism is accompanied by a more horizontal positioning of the lower border of the mandible with respect to the horizontal part of the cranial base (r = —0.75).
No correlation whatever could be found between changes at the angle of the jaw and the increase or decrease of mandibular prognathism (r = +0.07). In the same way no relationship could be demonstrated between an altered position of the anterior and posterior nasal spines in a sagittal derection, and an altered change in position of the spinalplane with respect to the horizontal cranial base.
The changes in the various angular measurements are often closely correlated to each other. Growth and development of the facial skeleton and the cranial base also show a relationship.
Further investigations were caried out by us to see if any relationship exists between angular measurements at the age of seven years, and the subsequent changes accompanying these measurements up to the age of eleven. The results furnished in table 13 show that practically no relationship exists.
With the facts pertaining to a certain age at our disposal, it was not possible to predict any future changes that may arise.
With due consideration to the criteria, developed from the study of the two groups, we finally in chapter X, give a graphical record of the appearance of some anomalies. On this occasion (figs. 18, 19 and 20) we also utilized the polygone form, but while we have plotted the standard deviation once on both sides in figs. 13, 14 and 15, we now, however, plotted it twice on both sides of the diagram.