New Parameters for Roentgencephalometric Analysis "Zagreb 82 MOD"

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Summary

New methods of orthodontic treatment and a wider use of fixed orthodontic appliances in Croatia, together with the use of computers for orthodontic diagnosis, has lead to a need for new parameters in the roentgencephalometric analysis „Zagreb 82 MOD".

Craniograms from the Department of Orthodontics School of Dental Medicine in Zagreb served for defining10 new parameters. These parameters were statistically analyzed, and the mean values and standard deviations added to the roentgencephalometric analysis for the Croatian population.

The aim of the investigation was also to obtain parameters that change during growth. The results are shown as „norms" for the new analysis „Zagreb 82 MOD2".

The most significant changes during growth were found in the variable representing the inclination of the upper and lower occlusal plane in relation to the anterior cranial base, which could be explained by the significant increase in posterior facial height in relation to anterior facial height, as well as the overall pattern of growth of the viscerocranium.

Key words: *roentgencephalometria, parameters*

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Introduction

Knowledge of the growth and development of the craniofacial region is of great importance in orthodontic diagnosis and treatment, and recognition of deviations from the normal trend of craniofacial growth is important for comprehension of the aetiology of orthodontic anomalies and for correct planning of treatment. The most reliable evaluations of craniofacial morphology are the result of the application of roentgencephalometric analyses, which enable accurate diagnosis on which orthodontic treatment can be based. For this purpose ten roentgencephalometric analyses have been created since the second half of the last century, which were either authorised or named after university and clinical centres throughout the world (1-7).

During the above period many analyses were created which describe the diverse morphology of the craniofacial system of different ethnic groups or races (8,9,10). One such analysis, created by investigating the craniofacial specifics of subjects from the Croatian population, was published in 1982 under the name "Zagreb 82" (11). The analysis is maximally simplified and contains 14 parameters, intended for basic diagnostics of dentofacial irregularities by a conventional method. The development of basic principles and application of new techniques of orthodontic treatment by fixed technique, and the

wider use of the computer in diagnostics, indicated the need to introduce new parameters, and consequently the initial analysis was augmented by new parameters and adapted for computer use in 1993 (12). The wider use of fixed orthodontic technique of treatment in this country has lead to the need to introduce new targeted parameters in the existing analysis for evaluation of the effect of treatment, which is particularly noticeable during control of the inclination of the occlusal plane, on which mobile devices are almost ineffective, while with fixed methods it intensively changes.

For the above reasons there is an objective need to propose 10 new parameters in the analysis of the existing sample of a Croatian population of eugnathic subjects, adapted to modern orthodontic diagnostics and treatment.

Object of the investigation

The aim of the investigation can be defined by the following tasks:

Determine mean values (X) and standard deviations (SD) of ten examined variables of eugnathic subjects, in order to complete «norms» for roentgencephalometric analysis "Zagreb 82 MOD".

- Describe the intensity of the changes in the examined variables during growth.
- Determine which of the examined variables show the greatest change during growth.
- Establish whether there are statistical significant differences in the mean values between the marginal age groups.

Sample and methods

The sample consisted of 199 latero-lateral radiographs of eugnathic subjects from the Croatian population, aged from 10 to 18 years and over. The group comprised 107 female and 92 male subjects, (roughly) uniformly arranged according to gender and age groups. The X-rays were taken from the records of the Department of Orthodontics, School of Dental Medicine, University of Zagreb.

The sample was divided into five age groups: 10-11 years, 12-13 years, 14-l5 years, 16-17 years, and 18 years and over. All the X-rays were recorded by tele-X-ray technique for roentgencephalometry and the structures copied onto tracing paper for further investigation. Angular measurements were performed with a protractor with accuracy of ± 0.5°, and a linear ruler with accuracy of ± 0.5 mm.

The investigation included a total of 10 variables, of which 5 were angular, 4 linear and 1 deduced? (izvedena) (Fig. 1):

V1 = n-s (MM) - length of the anterior cranial base

V2 = m-go (mm) - length of the mandibular base

V3 = s-go (mm) - posterior facial height

V4 = n-m (mm) - anterior total facial height

V5 = s-go / n-m % - relation between posterior and anterior facial height

V6 = 1 : s-n - inclination of the upper incisors in relation to anterior cranial base

V7 = is-mo:sp-pm - inclination of the upper occlusal line inrelation to the base of the maxilla

V8 = is-mo:m-go - inclination of the upper occlusal line in relation to the cranial base

V9 = ii-mo:s-n - inclination of the lower occlusal line in relation to the anterior cranial base

V10 = ii-mi:m-go - inclination of the lower occlusal line in relation to the mandibular base

Statistical analysis of the variables included basic statistical parameters: mean value, range, and standard deviation. The significance of the difference in arithmetic means between the youngest and oldest age groups was assessed by Student t-test.

Results and discussion

Table 1 shows the values of the basic statistical parameters: mean values (X) and standard deviations (Sd) for all variables. Table 2 shows

the changes in the mean values of the examined variables between the youngest and oldest age groups, expressed by absolute and relative indicators, and the results of testing the differences in arithmetic means of the variables of the marginal groups. The average values of all variables of the total sample, which are proposed as new parameters of the analysis Zagreb 82 MOD, are presented in Table 3.

Table 4 shows all parameters with norms for the new roentgencephalometric analysis "Zagreb 82 MOD2".

Increase in the length of the anterior cranial base between the youngest and oldest age groups amounted to 3.82 mm. Pavlec-Weber et al. reports similar results, with higher values in female subjects. (13).

Hahn von Dorsche et al. (14) report a small increase in the cranial base between birth and 25 years of life. According to their investigation the length of the anterior part of the base of the skull increases up to 16 years in females and up to 20 years in males. After coalescence of the synchondrosis splenoethmoidalis at around 7 years of age, a further increase of this distance occurs exclusively by apposition of the bones in the region of the nasion point. The authors report that during growth the viscerocranium increased mainly in height, which can be seen in the increase in the length of the nasion-gnathion and sella-gonion. Absolute values of the length of the cranial base, and also all other linear values, reported by different authors are not entirely comparable because of differences in the age of subjects and recording conditions (10,15,16). The differences found for the values originating from analysis of the various samples may also be due to racial or ethnic origin (9,17,18) and also the level of facial prognathism (19,10).

The length of the mandibular base shows greater growth (7.47 mm) than the length of the anterior cranial base, which was also found in other investigations (13). In a longitudinal investigation on the craniograms of subjects aged from 3 to 26 years Nanda (16) determined that increase in the length of the base of the skull was of less intensity compared with the growth of the length of the maxilla and mandible, and he found that after 10 years the growth of the mandible was intensive. He determined significantly greater increase in the ratio of the length of the mandible and the cranial base, compared with the increase in the ratio of the maxilla and cranial base. Foley et al (21) measured vertical and saggital facial growth on the craniograms of subjects between the ages of 14 and 20 years and noticed a significant increase in all linear parameters, which showed growth of the maxilla and mandible. However, they determined more significant growth of the mandible compared with that of the maxilla, while changes in total posterior and anterior facial height did not differ significantly.

In the present investigation an increase in the posterior and anterior facial height was found amounting to 12.9% and 8.53% respectively, which was more or less the same before and after 14-15 years of life. The slightly greater increase in posterior facial height in relation to anterior, leads to an increase in facial height index (variable 5) by which the proportions of anterior and posterior facial height are evaluated. The mean value of facial height index for the whole of our sample amounted to 65.5%, which is slightly above the upper limit reported by Jarabak and Fizzel (22). As the aforementioned authors define values of less than 62 and more than 65 as posterior and anterior mandibular rotation, we can hypothesise a tendency in our population of anterior mandibular rotation. Van der Beek et al. (23) demonstrated an increase in anterior and posterior facial height in subjects aged 7 to 14 years and found culmination in the intensity of puberty growth at the age of 12.2 years for anterior facial height (n-gn) and 13.1 years for posterior facial height (s-go). They determined more intensive growth of the posterior facial height compared to the anterior, which agrees with our finding. Bishara et al. (24) also determined more intensive growth of the posterior facial height compared to growth of the anterior facial height. This was also seen in the increased ratio of anterior and posterior facial height, which was demonstrated in their investigation. Peng (25) monitored a sample of 19 young girls with mixed dentition by

longitudinal cephalometric method in order to analyse vertical growth of the craniofacial system. The greatest increase in total anterior facial height was the result of more intensive growth of the middle facial third (4.7 mm between the ages of 7 and 10 years, and 3.9 mm between the ages of 10 and 12 years), while the lower facial third remained almost unchanged.

Inclination of the upper incisors in relation to the anterior cranial base showed the least increase of all the examined variables (0.89°), and consequently the mean value found of 102.5° can be considered reliable, regardless of age.

The value of the angle between the upper occlusal line and the base of the maxilla decreased from 11.28° in the youngest to 7.65° in the oldest examined group, which is a decrease of as much as 32.18°. Chang (26) found a significant decrease of this angle in a Chinese population. Kuno et al. (27) found the value of this angle of 8.6° in adult Japanese, which is similar to our finding.

Value of the angle between the upper occlusal line and the anterior cranial base found in our investigation amounted to 19.46° in the youngest and 15.94° in the oldest age group, which is a significant decrease in mean values with increasing age. Similar results were found by Chang (26) in a Chinese population. In a longitudinal investigation, which included subjects aged from 9 to 25 years, Iseri and Solow (29) found decreased values of this angle of 6°, which is only slightly more than our finding. In a short period (between 10 and 11 years) Öztürk (28) found a decrease in this parameter of 1.8°. Vukušić et al. (30) found a very significant decrease in the angle between the occlusal line and the anterior cranial base and the basal line of the upper jaw.

Inclination of the lower occlusal line (V9) in relation to the cranial base showed a significant decrease with increasing age, which reflects / follows the behaviour of the upper occlusal line. Inclination of the lower occlusal line in relation to the base of the mandible is shown by the slight increase in mean values between the marginal age groups of 1.54°.

The consistent changes in inclination of the occlusal lines in the described sense are the result of anterior rotation of the total viscerocranium with increasing age, which is also confirmed by the significant increase in posterior facial height compared to anterior (31,32).

Conclusions

By analysing the selected roentgencephalometric parameters the following conclusions can be made:

- Mean values of the new 10 variables should be included in the existing roentgencephalometric analysis, which will contain a total of 29 parameters under the name “Zagreb 82 MOD2” (Table 4).
- Changes in the mean values of all variables between the defined marginal age groups are statistically significant, apart from Variable 6, by which the inclination of the upper incisors in relation to the anterior cranial base is evaluated/assessed.
- Intensive changes of variables 7, 8 and 9, by which the inclination of the occlusal lines in relation to the cranial base and basic line of the upper jaw are evaluated, are the result of a significant increase in posterior facial height and a general tendency towards anterior rotation of the total viscerocranium during growth.
- Because of the significant increase in the mean values of linear variables, and also of angular variables which show significant differences with increasing age, during practical application of the above mean standard values of the analysis “Zagreb 82 MOD2” the age of the subject whose craniofacial parameters are evaluated should be taken into account.