

Tbilisi State Medical University

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**Characteristic Features of Cephalometric
Parameters in Patients with
class III Malocclusion**

14.00.21.–Stomatology

Abstract of dissertation

(autorefferate)

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Introduction

Problem Actuality. Medial occlusion is a quite complicated anomaly of anterior occlusion of the jaw-teeth system. Among occlusion anomalies the share of medial occlusion is 4-6% (O. Darjania, 2005; Jacobson A, 1980; Kalamkarov Kh. A. et al., 1981; Manetti V., 1984; Miller J. P., 1990; Latyi A. A., 1998; Hunter W. S., Snigler P., Mamandras A. H. 1997; Bacetti T. 1999; Persin L. S., 1999). Though, A. M. Kovalevskaya et al., 2001 report that according to data for 2001, in recent times, frequency of this anomaly, among both, boys and girls, grew almost as twice.

Medial occlusion is one of the most complicated anomalies of the jaw and teeth system. It is characterized with disorders of growth and development of alveo-dental arcs, facial part of the

skull and basal structures of the skull. This occlusion anomaly is characterized with morphological, functional and esthetic disorders of the jaw and teeth system, what has negative impact on the psychological condition of the patients. With respect of the above, in modern orthodontia there is a trend of improvement of diagnostic and treatment methods, directed towards optimization of treatment results (T. Kublashvili, 2006; Person L. S., Kuznetsova G. V., Popova I. V., 1999; Khoroshilkina F. Ya., 1999; West K. S.,m McNamara J. A., 1999; Andrey Centner, 2001).

Occlusion curve is a curve of interfacing of the upper and lower teeth and therefore, regular position of the teeth and direction of occlusion curve is one of the conditions of development of physiological occlusion. All this is of great importance for face esthetics. T. Mikadze, 1999; Lulla P, Gianelli A, 1976; Rakosi T, Schilli W 1981; Segner D. 1989; Gieva Yu. A. et al., 18998; popova I. V., 1998; Bednyakov A. A., 2001; Persin L. S. et al., 2002 describe relations of formation of the occlusion curve with various anomalies of jaw and teeth system. In the literature there is very poor information about influence of various growth type of the skull on teeth location in patients with medial occlusion. Impact of the type of jaw growth on occlusion curve in patients with medial occlusion is not studied adequately up to date. The issue of diagnostics in contemporary orthodontia is quite acute.

Teleroentgenography is of special significance for diagnostics of anomalies of the jaw and teeth system. Through studying of the linear and angular parameters of teleroentgenography it is possible to predetermine the sizes and locations of separate tooth, teeth arcs and apical bases, also harmony of the structure of facial part of the skull. Most cephalometric methods allow for studying of arcs of the upper and lower jaws. The problem of elaboration of the one single criterion, which would be common for the teeth arcs of both, upper and lower jaws, is a significant problem. In the process of development of the jaw and teeth system there is formed the occlusion curve, direction of which is greatly influenced by type of growth of the bones of upper and lower jaws. Types of growth of jaw bones were first described by Bjork A., Skiller V (1977).

It is also necessary to study characteristic features of location of the incisors, canines and molars, with regard of type of growth of the jaws and age in patients with medial occlusion; Changes of the occlusion curve direction, in patients with medial occlusion, taking into consideration age of the patients and jaws growth type; Parameters of location of the occlusion curve, correlation of ordinate point K and gonial angles, for various growth types of the jaws.

Purpose of the research. improvement of diagnostics of medial occlusion anomalies, taking into consideration the type of skull growth and treatment orthodontic tactics.

Objectives:

- Cephalometric analysis of cephalograms of the patients with physiological occlusion (in the periods of changing and permanent occlusion);
- Studying of linear and angular parameters of cranofacial and cranocerebral parts in patients with medial occlusion (in the period of changing and permanent occlusion) and comparizon of the obtained parameters with the physiological occlusion;
- Cephalometric analysis of impact of the jaws growth type on formation of the occlusion plane;
- Studying of the impact of jaws growth type and direction of the occlusion plane on standing of teeth;
- Determination of correlation dependence between cephalometric parameters in patients with medial occlusion, for all three types of growth of the jaw bones.

Scientific novelty of the work:

For the first time:

- There were determined characteristic features of locations of the incisors, canines and molars in the patients with class III malocclusion, regarding various types of growth of the skull and age of the patients;
- There was assessed characteristics of location of the occlusion plane in the patients with class III malocclusion, taking into consideration various types of growth of the skull and age;
- There was studied correlative dependence between the parameters determining location of the occlusion plane – Ordinate K and gonial angles in patients with class III malocclusion, for various types of skull growth.

Practical value of the work.

- Results obtained in the process of research facilitate effective diagnostics of class III malocclusion and improvement of treatment ways;
- These was justified application of vertical elastic supports for vertical type of jaw growth;
- There was justified treatment of back dissociation of the incisors for vertical-type growth of jaw bones through inclination of the incisors and canines in patients with class III malocclusion;

- In planning of orthodontic treatment of the patients with class III malocclusion it is recommended to study the values of K-Po parameters.

Basic theses to be reported at the defense

- For the patients with class III malocclusion there is characteristic medial inclination of the coronas of upper incisors, canines and molars of the upper jaw and distal inclination of the coronas of upper incisors, canines and molars of the lower jaw. Degree of inclination depends on the growth type of the jaw bones. Inclination of the upper teeth is more prominent for horizontal and neutral type of growth of the jaw bones and inclination of the lower teeth – in case of vertical type of growth.
- In case of horizontal and neutral types of jaws growth change of inclination of the upper incisors may be followed with by change of alveodental vertical heights in the frontal part, and in case of vertical growth similar signs were not noticed.
- Among all parameters of direction of jaws growth, gonial angle and its components have the greatest impact on location of the teeth, their inclination and alveodental heights and therefore on location of occlusion plane.
- Inclination of the occlusion plane depends on the type of growth of the jaw bones: in case of vertical type growth, clockwise rotation of occlusion plane takes place and in case of horizontal type of growth – rotation is anticlockwise.

Practical Use of Study Results

Results of our research work are in curriculum for lecture courses and practical training of students at Tbilisi State Medical University- Department of Pediatric and Preventive of Dental Diseases, also in practical use at Georgian-German-Spanish Dental and Medical Aesthetic Clinic “UniDent-RÖS’S”.

Approbation: Materials of the dissertation are reported and discussed at the Enlarged Session of Tbilisi State Medical University Departments of Stomatological Profile and Association of Stomatologists of Georgia (Tbilisi, 26th March, 2006).

Publications: We have published 4 scientific works on the issues of dissertation.

Structure and volume of the dissertation: Dissertation is represented on 138 pages and includes following chapters: Introduction; Literature Review; Research Object; Materials and Methods; Obtained Results; Consideration of Obtained Results; Conclusions; Practical Recommendations. The work is illustrated with 15 tables, and 73 Pictures. List of references includes 166 sources.

Object of the Research, Materials and Methods

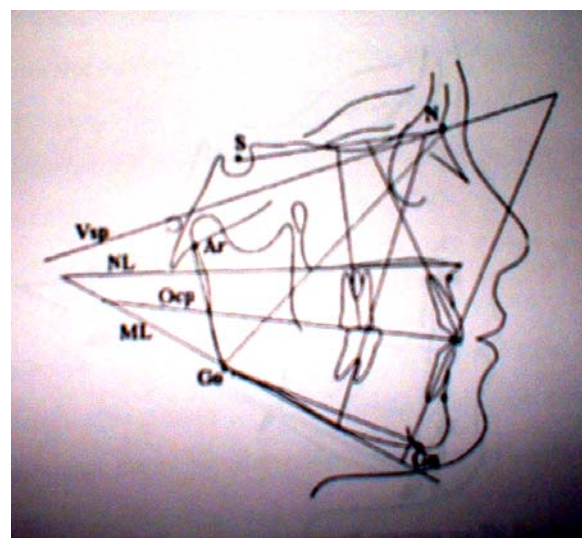
Materials were obtained in 1999-2005, at the Department of Child Stomatology and Prevention of Stomatological Diseases on Tbilisi State Medical University; at the Department of Children Prosthodontics and Orthodontia of Moscow State Medical Stomatological University and Georgian-German-Spanish Clinic of Dentistry and Medical Esthetics, “Unident-Ross”.

The work is based on study of 60 patients of age from 7 to 25 and 30 persons with physiological occlusion. The patients were divided into three groups: first group included 16 patients, with vertical growth of the jaw bones; in second group there were 18 patients with horizontal-type growth of jaw bones and in 26 patients from the third group there was indicated neutral type growth of jaw bones. The patients were divided into two age groups: from 7 to 12 and from 12 to 25; among these patients 23 had the period of changing of the teeth and 37 – period of permanent occlusion.

To provide uniform group of the patients we did not include patients with cross and open bites and those, who experienced extraction of the teeth and surgery on the lower jaw bone. We studied the patients clinically and with X-rays.

On each cephalogram we studied 18 linear (Fig. 1) and 27 angular (Fig. 2) parameters. We applied Schwartz; Bjork; Di Paolo (Fig. 3) cephalometry methods and K-analysis.

Fig. 1. Linear parameters
of the cephalogram



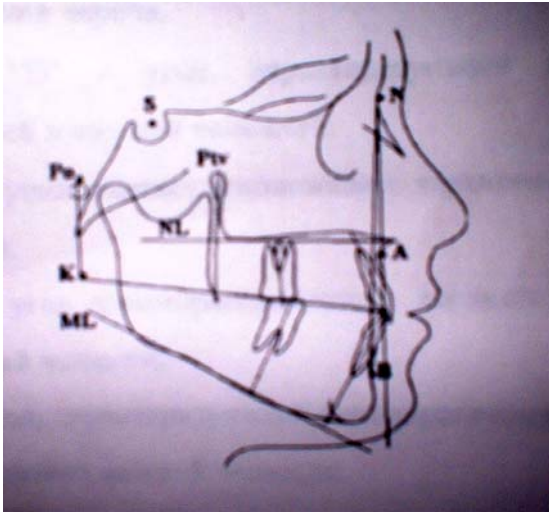


Fig. 2. Angular parameters of the cephalogram

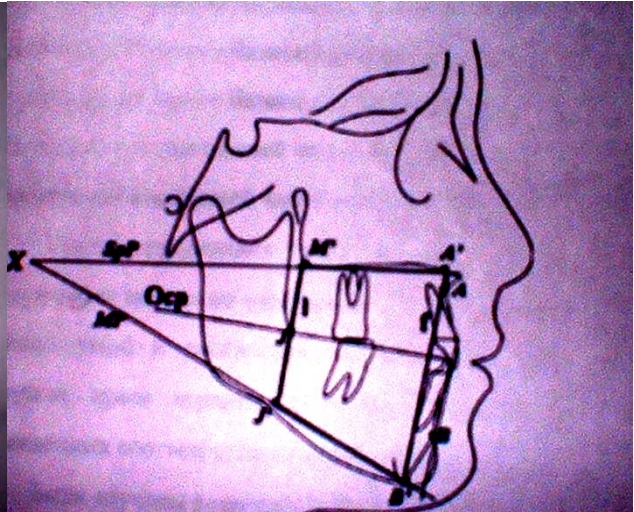


Fig. 3. Di Paolo quadrilateral analysis

For each studied parameter there were determined simple average, quadratic mean deviation; there was determined error of simple average, relation between the studied parameters was determined through correlation ratio; in case of reliable correlation we calculated the coefficient of determination, where R – is correlation coefficient. Weak – $R = 0.1 - 0.3$; Medium – $R = 0.4 - 0.6$; Strong – $R = 0.7 - 1.0$

Obtained results and their discussion:

On the basis of studying of the upper and lower incisors of the patients with medial occlusion, comparing with the generally recognized anatomic indicators (reference lines) (Fig. 4) and via analysis of the obtained results, we concluded that in patients with medial occlusion there is statistically reliable ($p < 0.001$) distal inclination of the lower incisor coronas towards the plane of the lower jaw, what points to retrusive inclination of lower incisors. Statistical processing of the angles of upper incisors showed their protrusive location, statistically reliable growth of $<U1/N$ ($p < 0.001$).

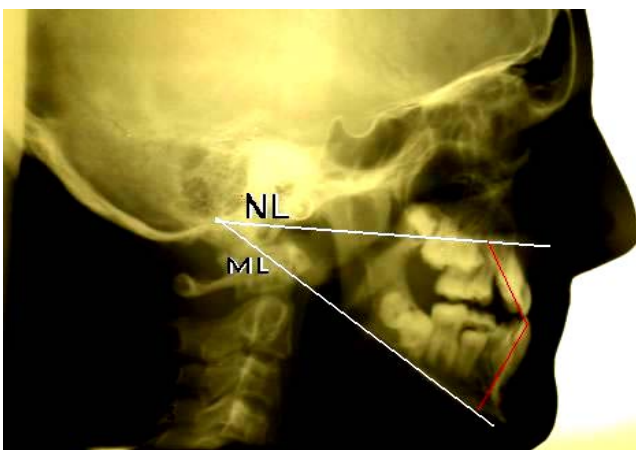


Fig. 4. Location of incisors towards the upper and lower jaw bases

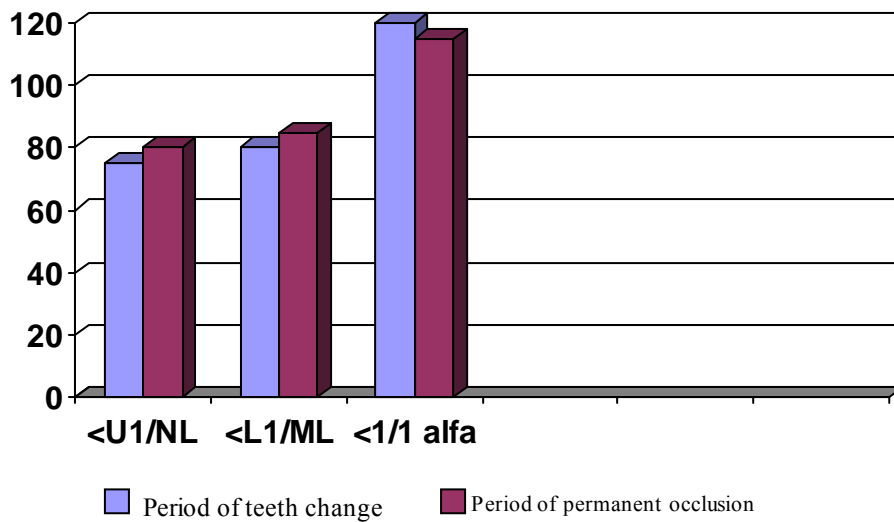
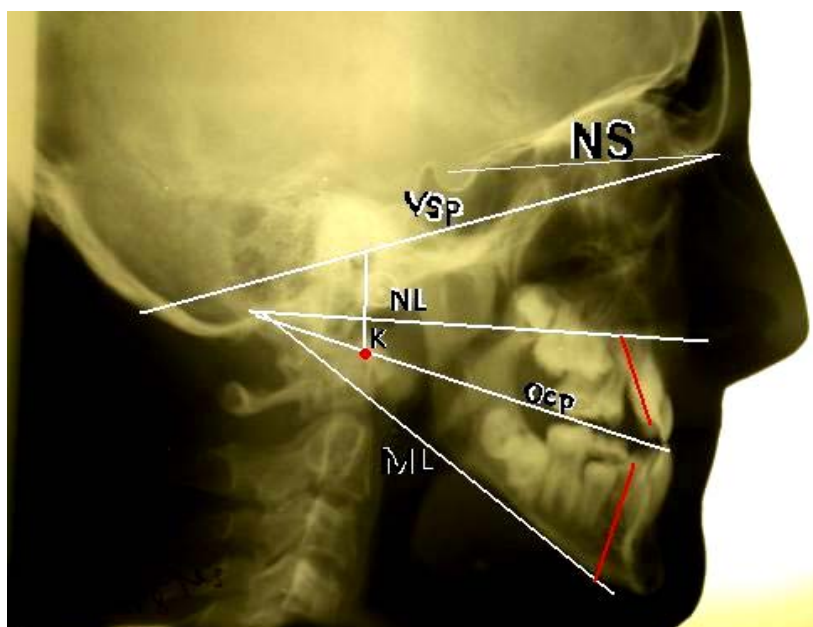
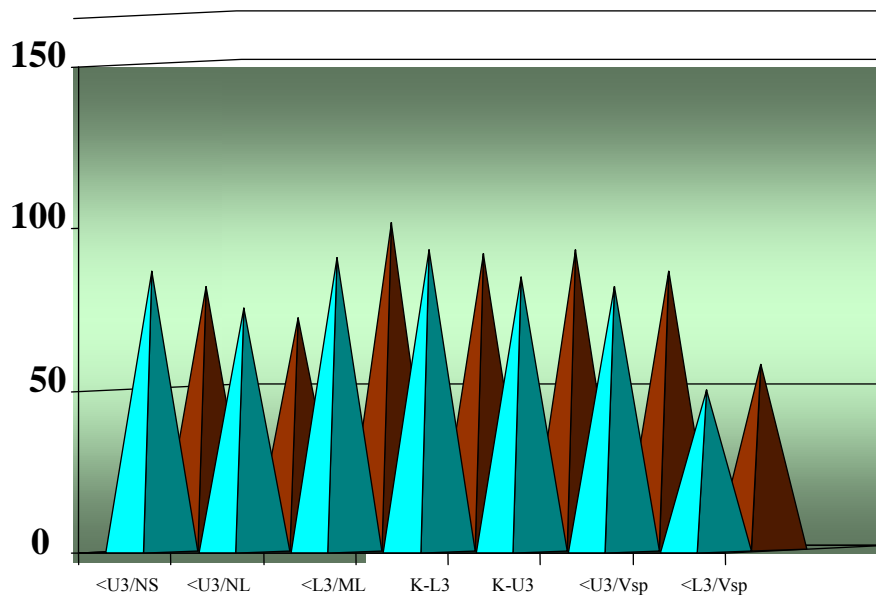


Fig. 5 Location of upper and lower incisors in the periods of deciduous and permanent occlusion

We have analyzed locations of upper and lower incisors in the period of teeth changing and period of permanent occlusion (Fig. 5) in the patients with medial occlusion. On this basis we made a conclusion that protrusion of upper incisors and retrusion of lower incisors grow with age.

We have compared and analyzed the parameters of location of the canines in patients with physiological and medial occlusions (Fig. 6).





■ Class III malocclusion ■ Physiological occlusion

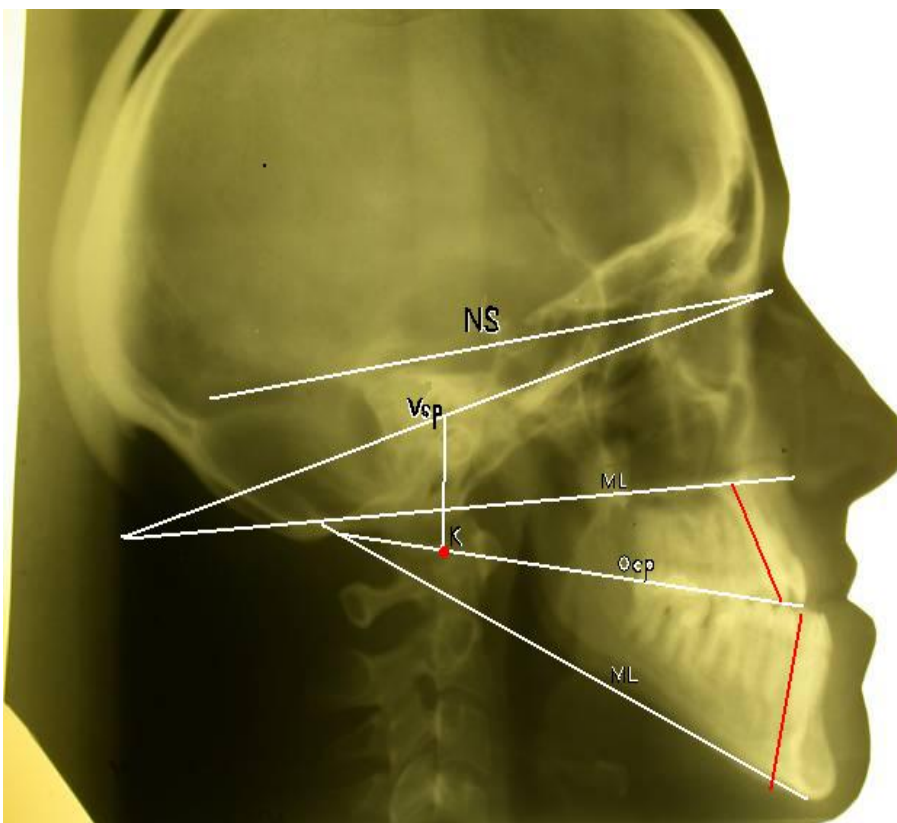
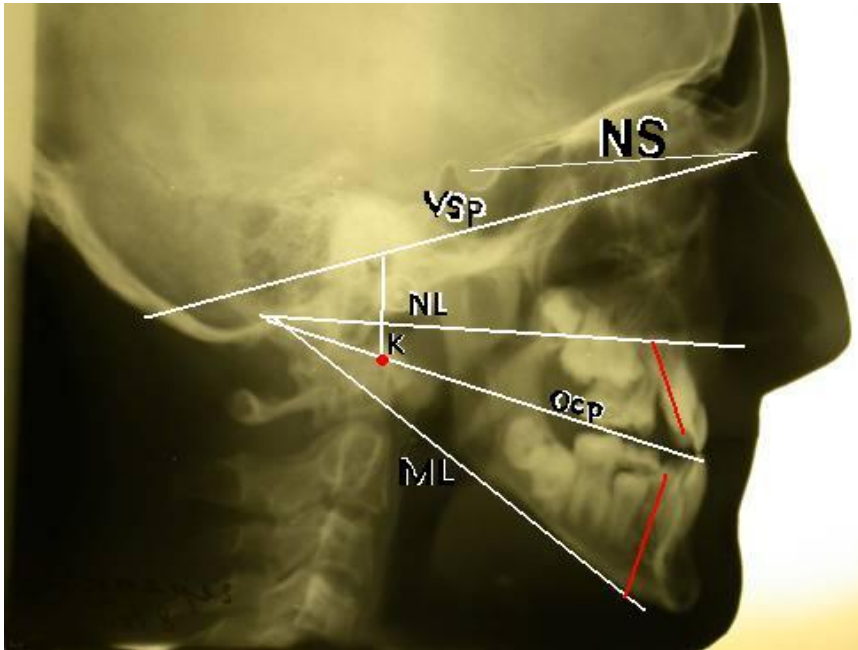
Fig. 6. Inclination of upper and lower canines against reference lines

Coronas of the upper canines have medial inclination, what is confirmed by statistically reliable ($p < 0.001$) decrease of inclination of the upper canine to the skull basis and the basis of upper jaw bone $< 3NS$; Statistical ($p < 0.001$) increase of Vsp to $< 3NL$ ($p < 0.05$) and vestibular plane < 3 . This, on its side caused increase of distance from the K point to the convexity of upper canine ($p < 0.001$), lower canines are distally inclined, what is confirmed by increase of inclination of lower canine to the basis of lower jaw and vestibular plane ($p < 0.001$).

As 38% of the patients with medial occlusion had no canines in the dentition, we had chance to study direction of cutting out of the canines, to determine, whether medial inclination of the upper canines and distal inclination of the lower canines could be regarded as pre-determined, genetically (Fig. 7).

Inclination of the upper canines to the plane of jaw basis is greater by $4.0 \pm 1.94^\circ$ in those people, whose canines were at the stage of cutting out. These changes are statistically reliable ($p < 0.05$) and shows that inclination of canines is changed at a time of cutting out. It turned out that inclination of the corona, at a cutting out stage is within normal range.

On the basis of analysis of the obtained results we can conclude that for the patients with medial occlusion, medial inclination of upper canine coronas and before cutting out (in the period of being within the body of upper jaw) the germs of the canines have normal inclination and the coronas of the lower canines are characterized with distal inclination towards the plane of lower jaw basis.



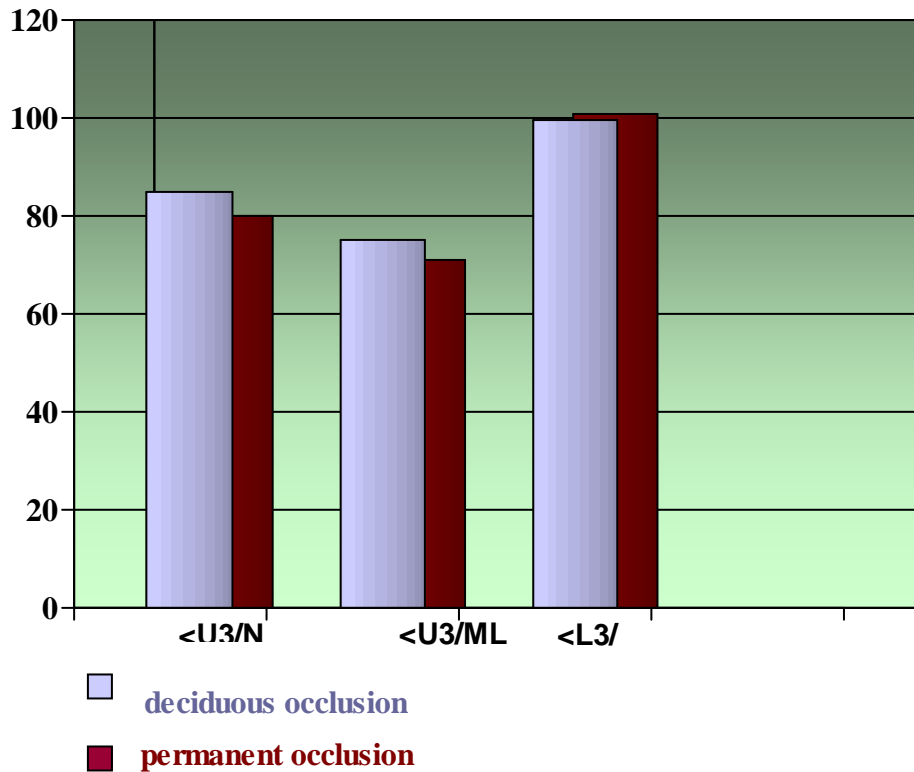
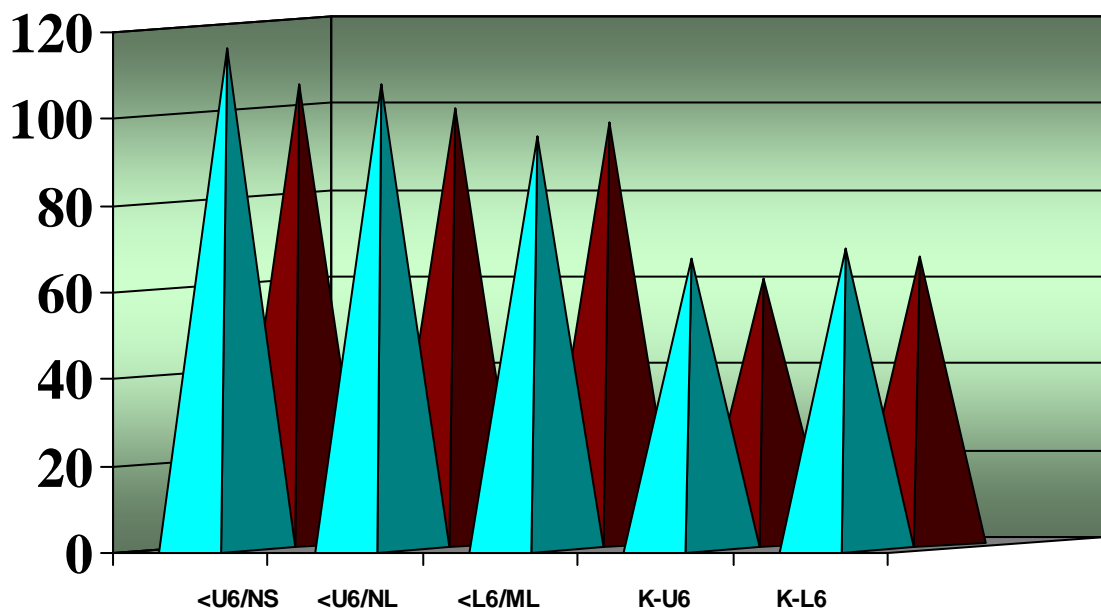
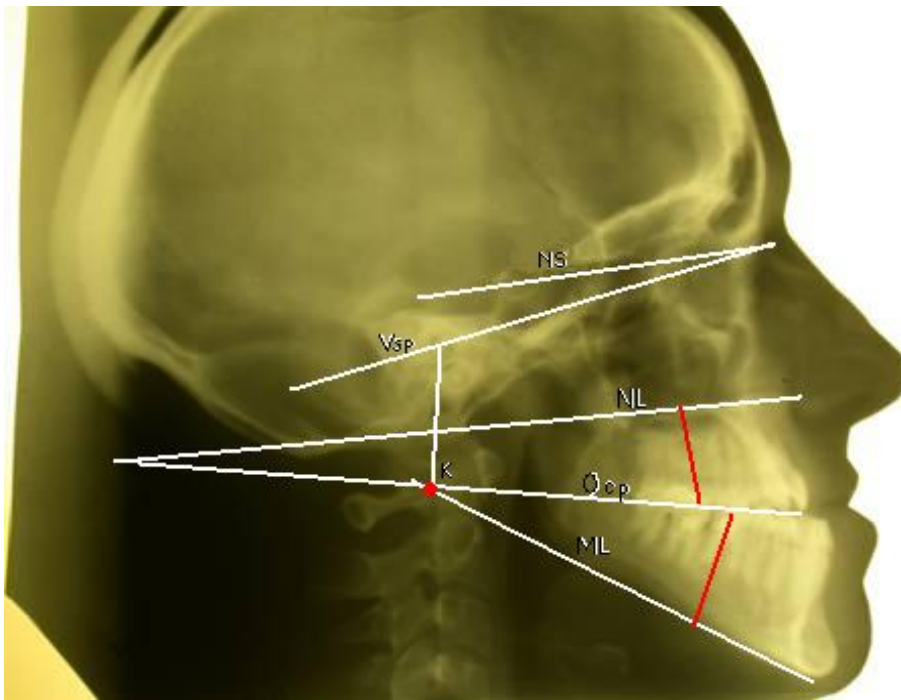


Fig. 7 Location of the upper canines in the periods deciduous and permanent occlusion

First permanent molars play leading role at the initial phase of formation of permanent occlusion. They ensure vertical growth of alveolar process, growth of jaw bones in the distal sections, dynamics of formation of dentition formation, complete chewing function, correct articulation, symmetric development of the face.

In patients with medial occlusion the angle of inclination of longitudinal axis of the first permanent molar to the plane of the frontal part of the cranial basis is reduced ($p < 0.01$) and to the plane of the basis of the same jaw ($p < 0.05$), what conforms medial inclination of the coronas of the first permanent molars of the maxilla. Yet, distance from K point to the first molar of the maxilla is less than normal value ($p < 0.01$), what points to distal location of entire upper dentition and perhaps retro location of the upper jaw, in patients with medial occlusion.

As for the first lower molars, their location, location K point and their inclination to the plane of the jaw basis and vestibular plane, all these are within norm (Fig. 8)



■ Medial occlusion
 ■ Physiological occlusion

Fig. 8. Comparison of location of the first molars in patients with class III malocclusion and normal location.

We have also studied location of the third molars against the plane of cranial basis and planes of bases of upper and lower jaws (Fig. 9). Characteristic parameter of location against cranial basis

plane of maxilla third molar is actually one and the same for physiological and medial occlusions. The change is not reliable statistically ($p > 0.05$). Angles of inclination of the longitudinal axes of the third molars of upper and lower jaws to the planes of the bases of respective jaws are practically identical in people with medial and physiological occlusion and existing differences are not statistically reliable ($P > 0.05$).

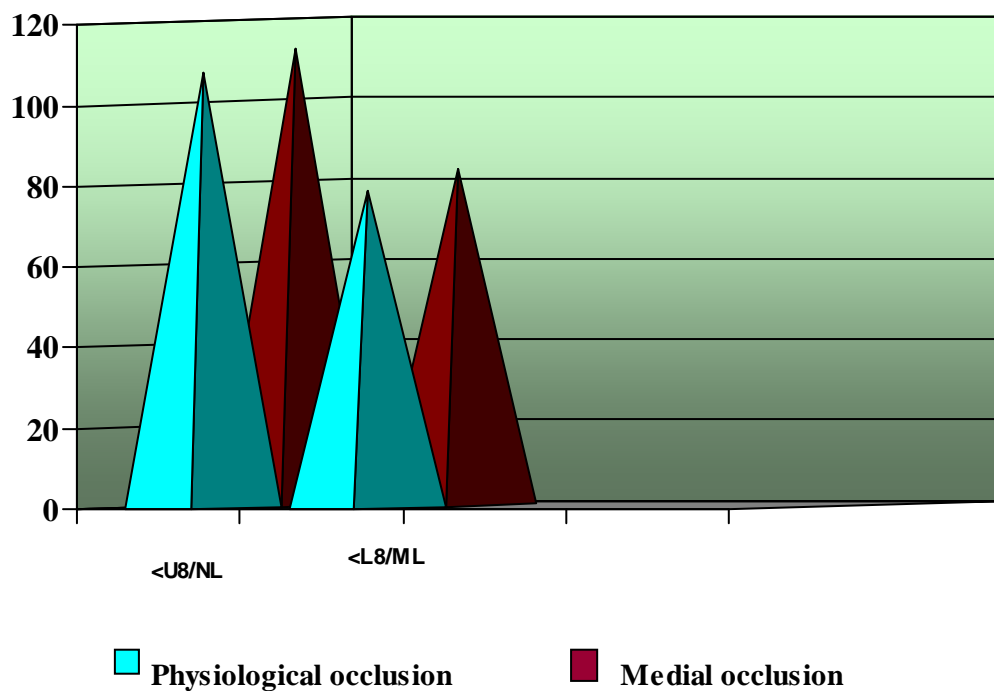
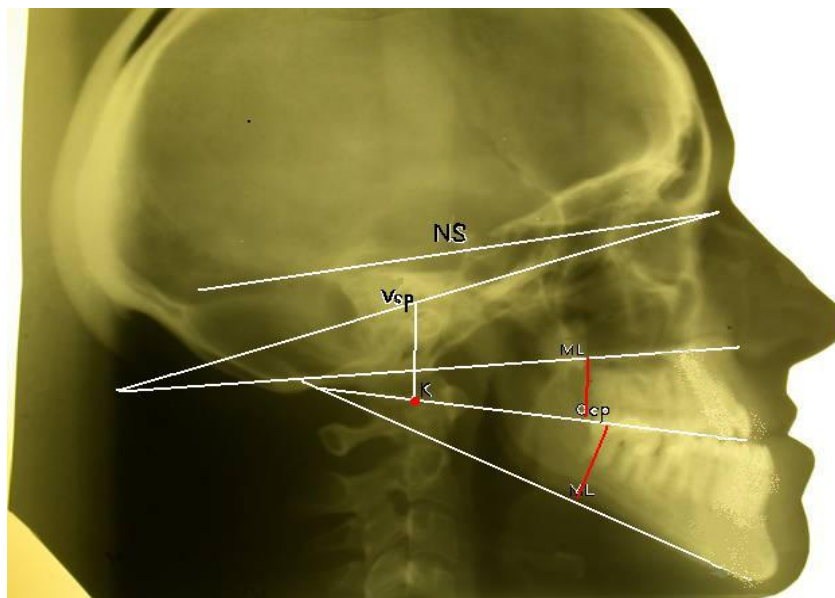


Fig. 9 Comparison of the location third molars of the patients with medial occlusion with normal locations.

Occlusion plane is the plane of curve of coming together of two dentitions. Direction of the occlusion plane determines the function of jaws and teeth at a great extent and is of great

significance for the face esthetics. We studied inclination of occlusion plane to the planes of jaw bases and vestibular plane and conducted quadrilateral analysis by Di paolo technique

In the patients with medial occlusion, in the teeth change period, angle of inclination of occlusion plane with the maxilla plane is reduced by 3.03 ± 1.2 ($p < 0.01$). Angles between the occlusion plane and mandibula basis plane and vestibular plane are within normal values. In the studied patients, angle of inclination of the occlusion plane, increase in average by 2.98 ± 0.07 , with age (Fig (10)).

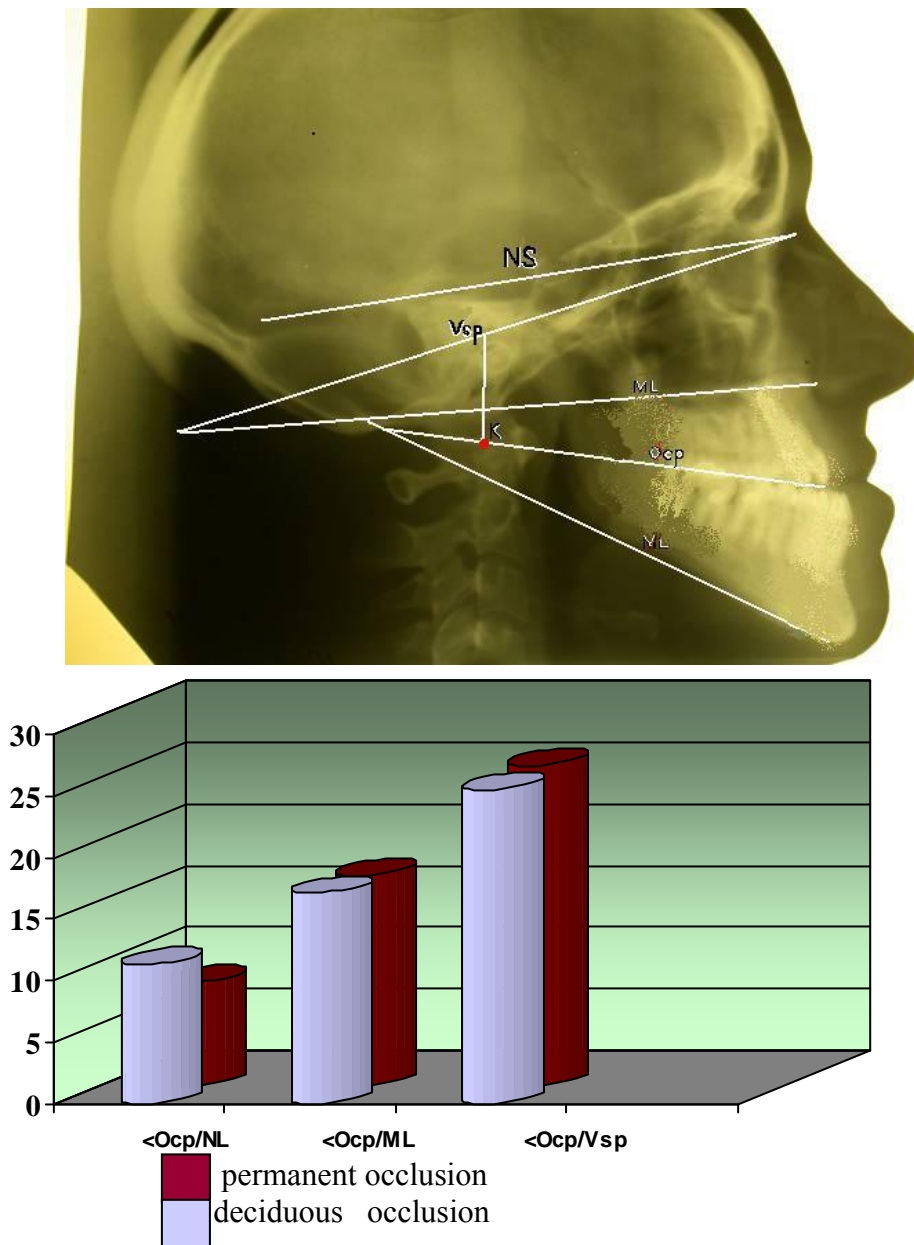


Fig. 10. Formation of the occlusion curve in patients with class III malocclusion.

We can make conclusion that in patients with medial occlusion front alveodental height is decreased and back alveodental height is increased (occlusion plane turns anticlockwise). On the

basis of analysis of the obtained data, that in the process of growth and development of craniofacial osseous system, in patients with medial occlusion, occlusion plane rotates anticlockwise, on account of decrease of the teeth alveolar heights in the area of lower molars.

We grouped data on the studied patients with medial occlusion by the types of growth of jaw bones and compared the results with normal values. We divided patients into three groups: in the first group there were 30 patients, with vertical type growth of the jaw bones (Bjork summarizing angle $> 396^\circ$). The second group included 36 patients with horizontal type growth of the jaw bones (Bjork= 381°). The third group involved those 84 patients, who were characterized with natural type growth of jaw bones (Bjork summarized angle $=396^\circ \pm 3.0$).

Patients with horizontal and neutral types of growth the location of upper incisors. their inclination angle to the plane of maxilla base is lower, what points to their protrusion. In case of vertical type growth on the jaw bones location of the upper incisors of patients with medial occlusion is close to normal location. As for lower incisors, in case of vertical growth type, their retrusion takes place ($p < 0.01$). In case of horizontal and neutral growth type retrusion of lower incisors takes place, but these data were not reliable ($p > 0.05$) (Fig. 11)

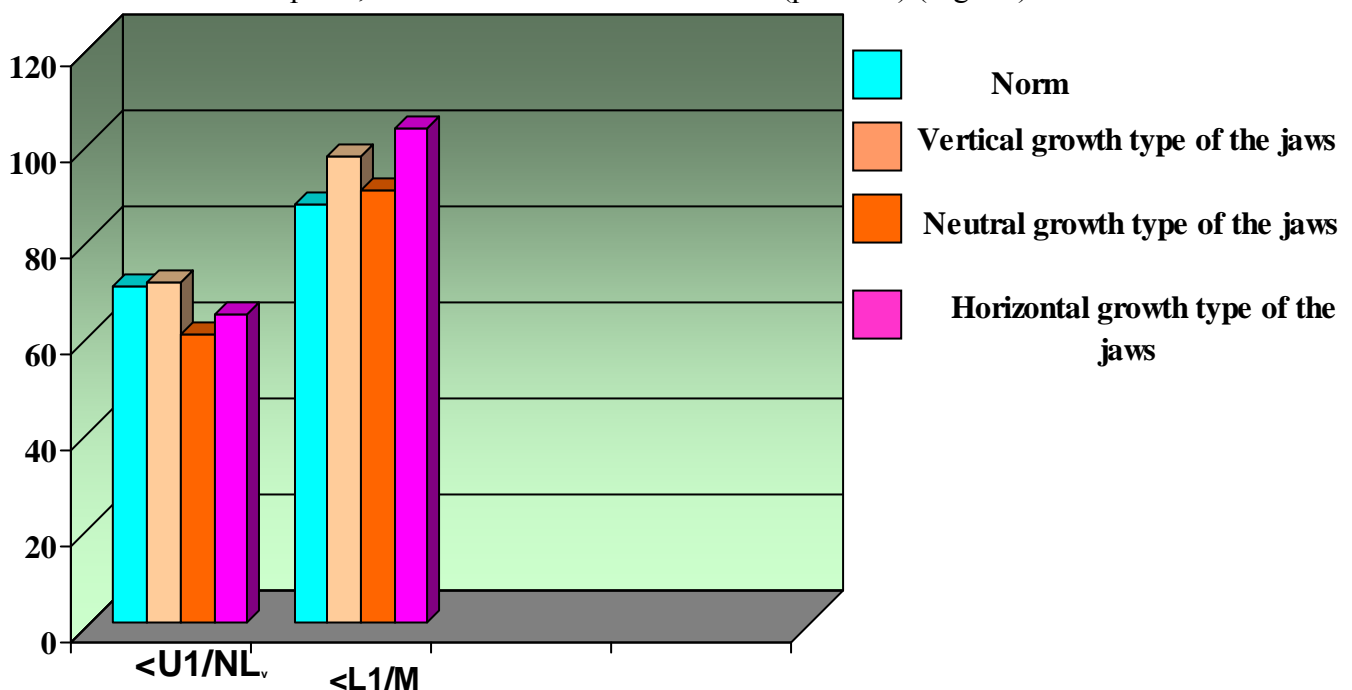


Fig. 11. Comparative characteristic of incisors for various types of growth of the jaw bones in patients with class III malocclusion.

In case of vertical type growth in the patients with medial occlusion there was noticed trend of distal inclination of the upper canine coronas ($p > 0.05$). Distal inclination of the lower canines was statistically unreliable ($p > 0.05$) (Fig. 12).

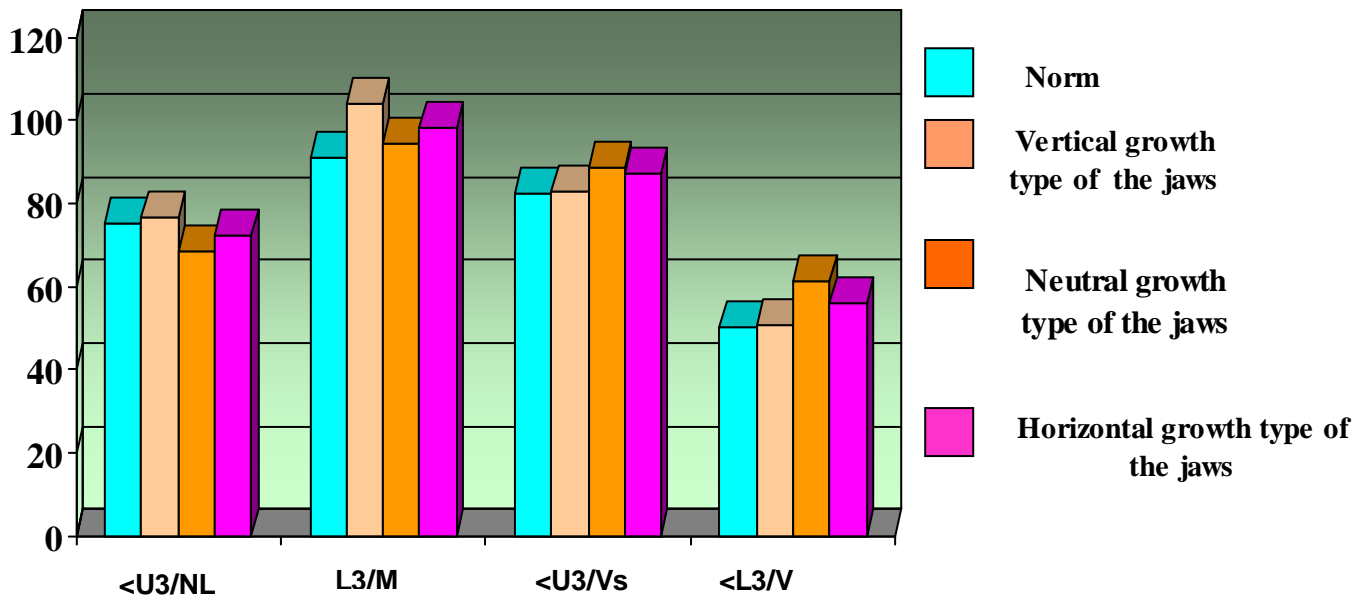


Fig. 12. Comparative characteristic of canines' location in patients with class III malocclusion. for various growth types of jaws and norm.

Minor decrease of the angle between the lower molar axes and vestibular plane was indicated in those patients, which were characterized with vertical type of growth of the jaw bones ($p < 0.001$). In the above patients first permanent upper molars were inclined medially ($p < 0.05$), unlike those patients, who are characterized with vertical and neutral type growth of jaw bones

(Fig. 13)

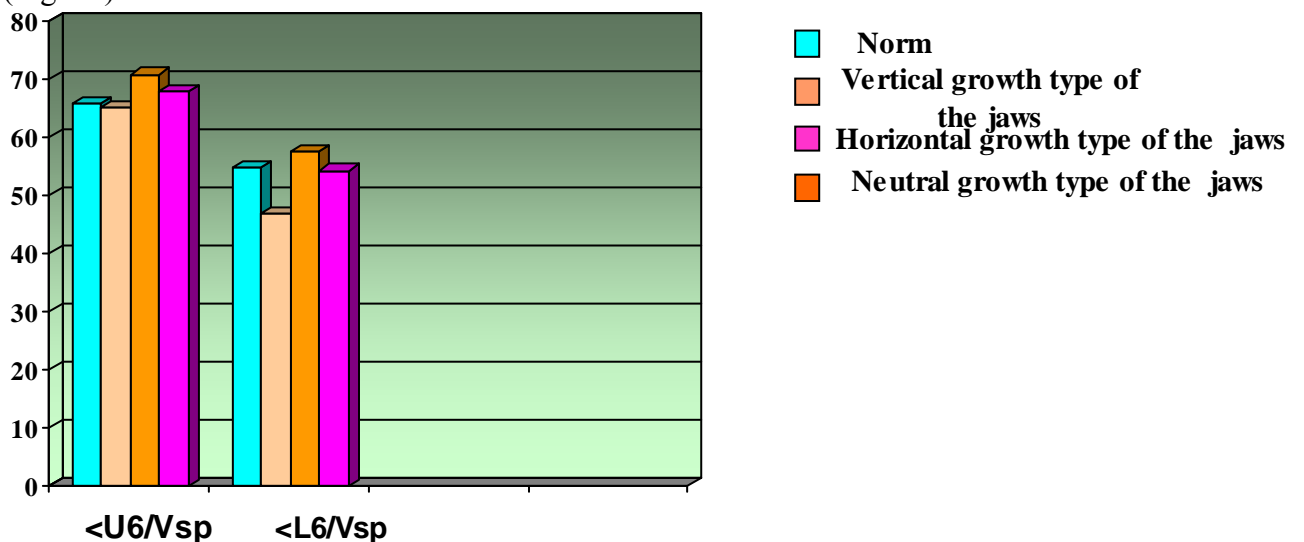


Fig. 13. Comparative characteristic of location of the first molars in patients with class III malocclusion. for various growth types and norm.

In the process of researches there was determined that angle of inclination of the occlusion plane to the plane of the lower jaw basis grew in those patients, which were characterized with neutral and vertical type of growth of the jaw bones ($p < 0.01$), and alveolar height of the teeth, in patients of this group, in the area of the first molar of lower jaw did not change (there was

indicated clockwise rotation of the occlusion plane), what was confirmed by increase of the angle of inclination of the plane of lower jaw towards vestibular plane (Fig. 14).

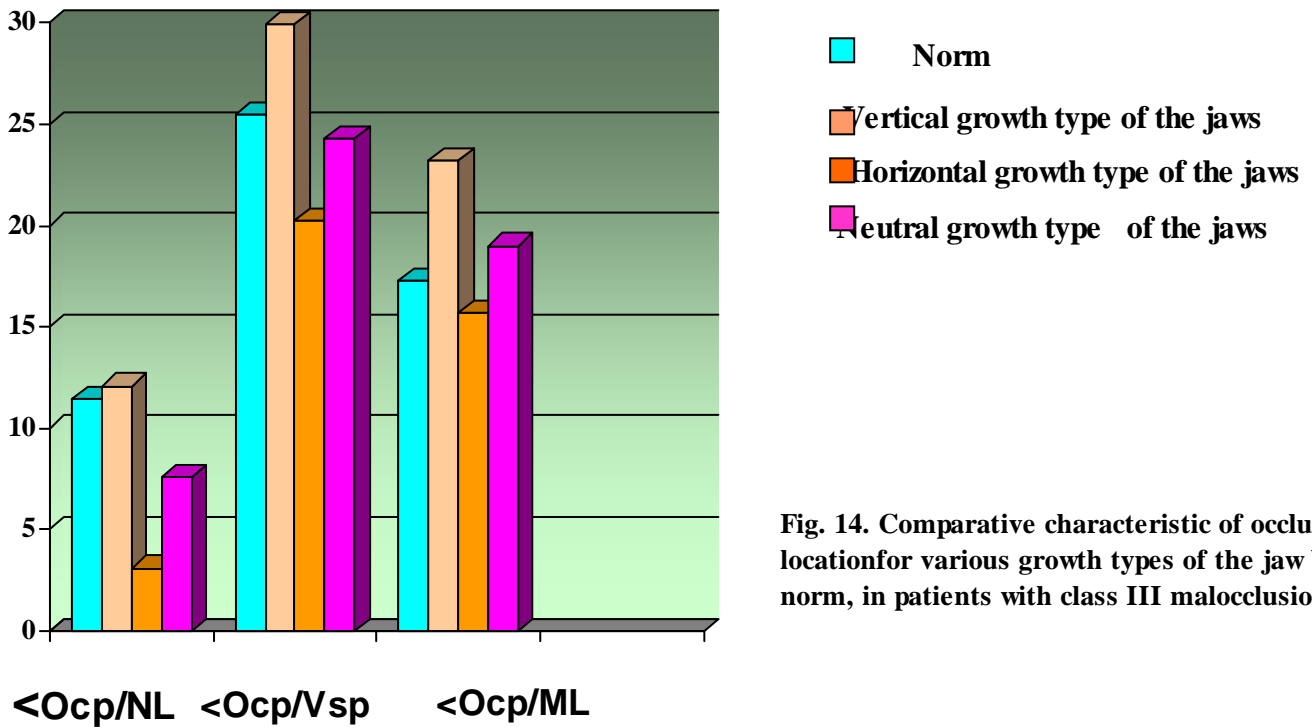


Fig. 14. Comparative characteristic of occlusion location for various growth types of the jaw bones and norm, in patients with class III malocclusion.

Inclination of occlusion plane depends on the type of growth of the jaw bones at a more or less extent: In case of vertical type growth rotation of the occlusion plane is clockwise and in case of horizontal and neutral type of growth rotation is anticlockwise (Fig. 15)

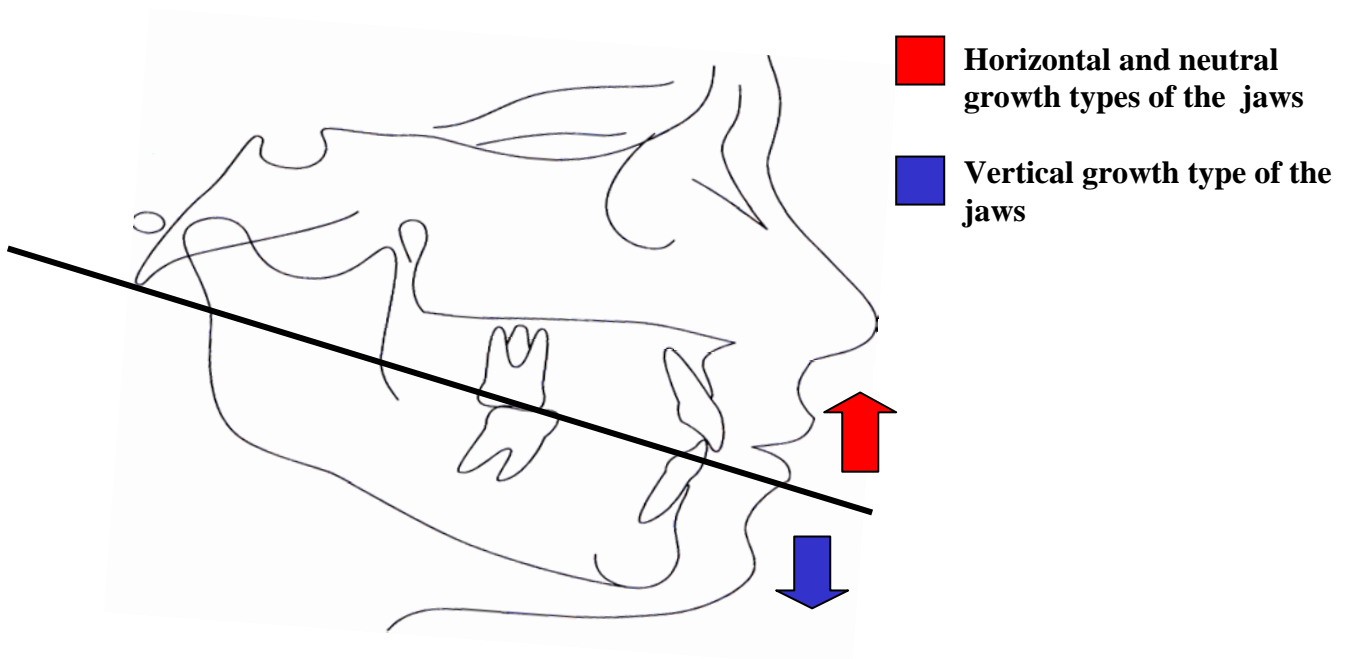
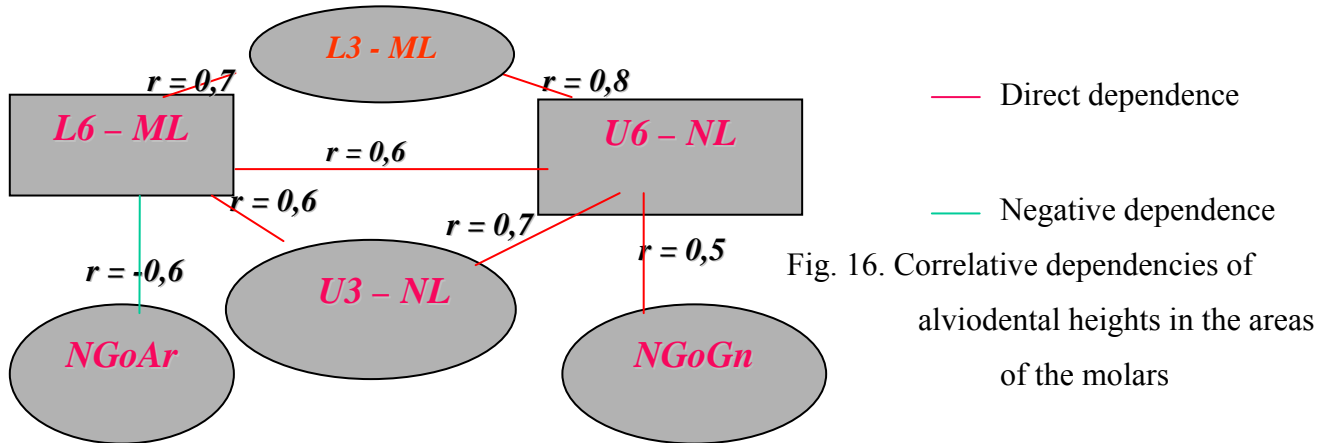


Fig. 15. Rotation of the occlusion plane

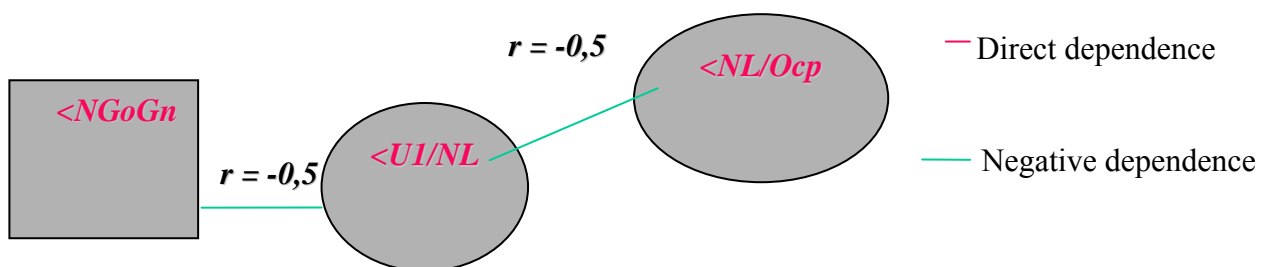
We have assessed and analysed parameters from cephalograms of the patients with class III malocclusion, with jaw bones growing in different directions.

Studied showed that alveodental heights of the upper and lower jaws have numerous correlation dependencies in the area of the first molars. Similar dependencies were indicated in the areas of upper and lower incisors and upper and lower canines. In the latter case there was indicated very string direct dependence (Fig. 16)



Among all the parameters characterizing teeth locations, their inclinations, alveodental heights and therefore, occlusion plane, gonial angle and its components have the greatest impact. Above is confirmed by direct correlative dependence of the average force with lower gonial angle, for vertical and horizontal type of growth of the jaws and absence of such dependence in case of neutral type of growth.

In case of vertical type of growth of the jaw bones increase of lower gonial angle is followed by protrusion of upper incisors $r=0.6$, and in case of neutral or horizontal types of growth there is observed minor negative dependence (Fig. 17).



Location of level of K point on the occlusion plane (K-Po) is related to the size of lower gonial angle and impacts location of the first upper molar as in sagittal, also in vertical direction (U₆-NL). ($r=0,7$). (Fig. 19).

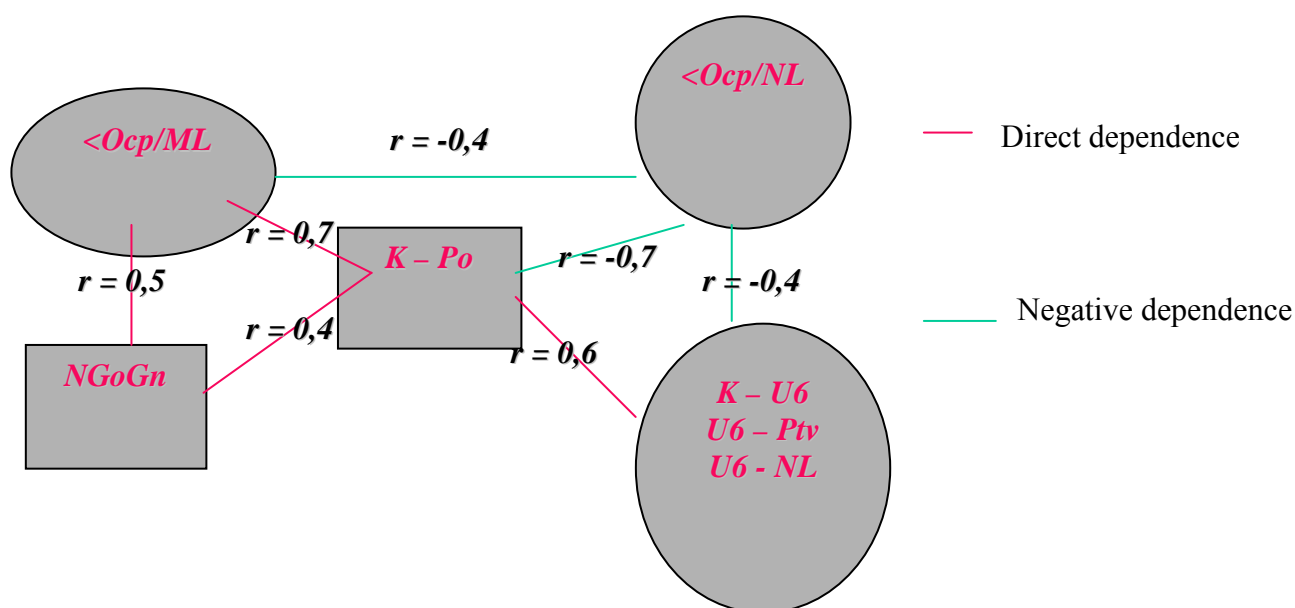


Fig. 18 Correlative dependencies of lower gonial angle and K-Po

Conclusions

1. Characteristic features of class III malocclusion include medial inclination of the coronas of upper incisors, canines and molars and distal inclination of coronas lower incisors, canines and molars. Degree of inclination depends on the type of growth of the jaw bones. Inclination of the upper teeth is more prominent in case of horizontal and neutral types of growth of the jaw bones, whereas inclination of the lower teeth – in case of vertical type of growth ($p < 0.01$).
2. In patients with class III malocclusion upper canines have normal inclination towards jaw basis, before cutting out, but at a time of cutting out and taking their place in the dentition they obtain medial inclination ($p < 0.05$).
3. Occlusion plane, in patients with class III malocclusion changes its dislocation with age, on account of reduction of lower alveodental heights and increase of back alveodental heights, or there occurs its rotation anticlockwise ($p < 0,01$).
4. Inclination of the occlusion plane strongly depends on the type of growth of the jaw bones: in case of vertical type of growth there occurs rotation of the occlusion plane clockwise ($p < 0.01$), whereas in case of horizontal type of growth rotation is anticlockwise.
5. In case of horizontal and neutral growth types of the jaw bones the change of inclination of the upper incisors might be followed by change of alveodental heights in the front part ($r = 0.7$) and in case of vertical type of growth this is not observe ($r = -0.6$).

6. The gonial angle and its components have the greatest impact on location of the teeth, their inclination and alveodental heights and therefore on the location of the occlusion plane, among all parameters, characterizing direction of growth of the jaw bones. ($r=0.6$).
7. Level of location of “K” point on the occlusion plane (K-Po) is interrelated with the size of lower gonial angle and impacts location of the first upper molar as in sagittal (K-U₆), also in vertical directions (U₆-NL). ($r=0,7$).
8. There were observed strong correlative dependencies between the alveodental heights in the areas of incisors and first molars on upper and lower jaws, in patients with medial occlusion ($r=0,8$).
9. In patients with class III malocclusion of the dentitions there exists correlative dependence between K-Po parameter, characterizing level of location of the K point and angle of inclination of the occlusion plane to the planes of jaw bases and there are observed positive relations – to the upper jaw $r=0.6$, negative – with the lower jaw $r= -0.5$.
10. Parameter K-Po characterizing location of the occlusion plane against otopharyngeal opening is comparable with the parameter, characterizing the distance from distal surface of the first molars to the phtherigo-maxillar fissure. Power of correlative dependence depends of the type of growth of jaw bones. This dependence is stronger ($r=0.7$), in case of neutral type of growth of the jaw bones and weaker – in case of vertical ($r=0.5$) and horizontal ($r=0.4$) types of growth.

Practical Recommendations

1. For orthodontic treatment of the patients with class III malocclusion, in case of vertical type of growth of the jaw bones, it is not likely that change of inclination of the upper incisors would cause change of alveodental height in the frontal segment, therefore, to ensure the contact, it is recommended to apply additional vertical supports.
2. In case of vertical type growth of the jaw bones, inclinations of upper and lower incisors and canines are close to normal value; compared with the respective inclinations in case of horizontal and neutral types of growth. Consequently, against the background of vertical type growth, in patients with class III malocclusion we can close (or reduce) back sagittal gap via change of inclination of incisors and canines, within allowed deviation ($\pm 5^\circ$).
3. In planning of orthodontic treatment of patients with class III malocclusion of the dentitions it is recommended to study the value of K-Po parameter, as it characterizes level of location of the occlusion plane against numerous reference points and in the process of orthodontic

treatment, through change of this parameter (K-Po) we could propose clockwise rotation of the occlusion plane (at a time of extrusion of molars), or anticlockwise (in case of intrusion of the molars).

4. In case of horizontal type of growth of the jaw bones, when there is indicated tight standing of the teeth of medium severity (3-6 mm), it is possible to incline frontal teeth without extraction, in a vestibular way, whereas in case of vertical growth of the jaws, extraction is necessary.

List of Works Published on the Issue of Dissertation

1. Intrusion Arc R. Nanda // Fourth International Dental Congress (Proceedings) 4-6 September, Yerevan 2003 ., p. 96-98.
2. Characteristic Features of the Canines in Patients with class III malocclusion .
Collection of Scientific Works, vol. XL, Tbilisi State Medical University 2004,
pp. 196- 198 (Co-author Z. Vadachkoria)
3. Characteristics of Formation of the Occlusion Plane in Patients with class III malocclusion, Depending on Age.
//Georgian Medical News, № 12(129), 2005, стр. 37-40.
4. Specific features of location of the anterior teeth in patients with class III malocclusion.
//Annals of Biomedical, Research and Education, 2006, vol. 5 , Issue 4 ,
p. 216-218, (Coauthor Z. Vadachkoria).