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IDENTIFICATION OF NORMATIVE CEPHALOMETRIC PARAMETERS BASED ON G. SCHMUTH METHOD FOR YOUNG MALE AND FEMALE UKRAINIANS

Summary. *The article contains cephalometric parameters used in G. Schmuth's analysis for the young boys and girls of the Podilskyi region of Ukraine having orthognathic occlusion, the evaluation of gender differences of these parameters (the majority of which is identified for the indicators that define the profile of soft tissues), as well as the comparison of the findings with the data obtained and provided as normative by G. Schmuth.*

Key words: *head lateral teleroentgenograms, cephalometry, young boys, young girls, G. Schmuth's analysis.*

Introduction

Prof. Gottfried P. F. Schmuth is one of the most prominent and influential orthodontists of Germany. He finished his medical studies in 1949 at the University of Vienna. From 1950 to 1955 Dr. Schmuth worked under the guidance of A. Martin Schwartz at the Department of Orthodontics. From 1955 to 1960 he served as an assistant to Prof. Dr. Karl Haupl in Dusseldorf who is known throughout the world for his pioneer work in functional appliances. In 1960 Dr. Schmuth worked as the head of the Department of Orthodontics at the University of Cologne. During these years, he was a prolific author and lecturer, and a very active member of the German Orthodontic Society. Assuming the full professorship at the University of Bonn, in 1967 Dr. Schmuth was appointed the director of the Dental School and the Department of Orthodontics, succeeding the famous Prof. G. Korkhaus.

From 1969 to 1971 Gottfried Schmuth served as dean of the Dental School at the University of Bonn. In 1981 and 1982 he occupied the position of the president of the European Orthodontic Society.

His key areas of research in orthodontics have been clinical experimental work with removable appliances, the analysis of post-treatment results in orthodontics, the problems of relapse and cephalometric studies. In whole, he has about 190 publications to his credit, including eight textbooks [4].

The one of the most famous researches deals with the study of 393 cephalograms of patients with orthodontic pathology and the comparison of their main indicators with the normative data provided in the literature. The study revealed a slight difference in the indicators of both groups [8].

The proposed research is a continuation of the range of the publications dedicated to the study of normologia and biometrics of the craniofacial complex taking into account age, ethnic, gender and anthropometric features of Ukrainians using the methods of computed tomography, teleroentgenography, photometry and odontometry. The paper also examines teleroentgenographic indicators based on the research scheme proposed by Gottfried Schmuth. This method allows evaluating the sagittal and vertical features, the position of incisors and the structure of soft tissues [5-7].

The *aim* of the research is to identify cephalometric parameters used in G. Schmuth's analysis for the young

boys and girls of the Podilskyi region of Ukraine having orthognathic occlusion and to compare the results with the data provided as normative.

Materials and methods

Using Veraviewepocs 3D, Morita (Japan), lateral teleroentgenograms of 38 young boys (aged from 17 to 21 years) and 55 young girls (aged from 16 to 20 years) with normal occlusion maximum close to the orthognathic one have been obtained. To make the cephalometric analysis, OnyxCeph?™ software (3DPro version) developed by Image Instruments GmbH (Germany) must be used.

The cephalometric points and measurements have been conducted according to the guidelines of Basavaraj Subhashchandra Phulari [1], S.I. Doroshenko, E.A. Kulginskiy [3] and G. Schmuth [7].

To identify metric characteristics according to the author method using cephalograms, the following points have been defined: (pic. 1-4):

A (subspinale, A point according to Downs) - the most posterior positioned point of the front contour of the upper jaw;

ANS (spina nazalis anterior) - the apex of the anterior nasal spine that forms the point of the palatine plane of SpP;

Ar (articulare) - the intersection of the front surface of the main part of the occipital bone with the posterior surface of the neck of the lower jaw;

Ap1L (apex first inferior incisor) - the point of the root apex of the lower medial incisor;

Ap1u (apex first upper incisor) - the point of the root apex of the upper medial incisor;

B (submentale, B point according to Downs) - the deepest point positioned on the anterior contour of the lower jaw;

Ba (basion) - the lowest point of the front edge of foramen magnum in the sagittal plane;

Cotg - the transition point of the straight part of the lower edge of the nasal septum to the nose apex determined by the tangent line drawn with Sn point;

Gl' (glabella) - the most projected point of the soft tissues of the forehead;

Gn' - the anterior skin point on the lower contour of the body of mandible;

Ls1u - the most projected point of vestibular contour of

the crown of the upper medial incisor;

Li1l - the most projected point of vestibular contour of the crown of the lower medial incisor;

Is1L (incision inferior) - the point positioned on the cutting edge of the lower medial incisor;

Is1u (incision superior) - the point positioned on the cutting edge of the upper medial incisor;

Ls (labium superius) - the most projected point of the outer contour of the red border of the upper lip;

Li (labium inferius) - the most projected point of contour of the red border of the lower lip;

Me (menton) - the lowest point on the ossified symphysis of the lower jaw;

N (nasion) - the most anterior point of the frontonasal suture, union of the frontal and nasal bones in the sagittal plane;

Ns (also known as pr-pronasale) - the most projected point of the nose tip;

Pog' - the most projected skin chin point that is also identified by the tangent line omitted from N' point;

Pog (pogonion) - the most anterior point of the bone mental protuberance;

PNS (spina nazalis posterior, nasal spine of palatine bone) - posterior border of the upper jaw basis;

S (sella) - the constructive point in the center of the Turkish saddle;

Sn (subnasale) - the skin point located in the place of the transition of the lower nose contour to the upper lip;

Sp' - the constructive point of G. Schmuth, ANS-PNS intersection (palatine SpP plane) with N-Gn line;

tGo - the projected point on the mandibular angle formed at the intersection of lines, one of which is a tangent line to the posterior edge of the branch of the lower jaw with Ar point, while the second one is a tangent line to the lower edge of the mandibular body from Me point. It is usually located a few millimeters below and more distal to Go point.

The following indicators have been identified according to G. Schmuth in the sagittal plane (pic. 1): SNA angle - formed by S-N and N-A lines (the angle indicates anterior and posterior position of the upper jaw to the skull base); SNB angle - formed by S-N and N-B lines (the angle indicates anterior and posterior position of the lower jaw to the skull base); ANB angle - formed by A-N and N-B lines (the angle indicates intermandibular correlation in the anterior and posterior direction); NSBA angle - formed by S-N and S-Ba lines.

The indicators defined in the vertical plane according to G. Schmuth are represented in pic. 2: NL NSL angle (also known as SN_SpP angle) is formed by ANS-PNS and S-N lines (the angulation of the palatine plane to the skull base); ML NSL angle (also known as SN_GoMe angle) is formed by tGo-Me and S-N lines (the angulation of the the mandibular plane to the skull base); ML_NL angle (also known as SpP_GoMe angle, or base angle) is formed by ANS-PNS and tGo-Me lines (the agnel between the palatine SpP and mandibular MP planes); N_Sp'_Sp'_Me coefficient is correlation of N-Sp' and Sp'-Me distances (correlation of upper and lower face heights), identified in percents; Ar-Go-

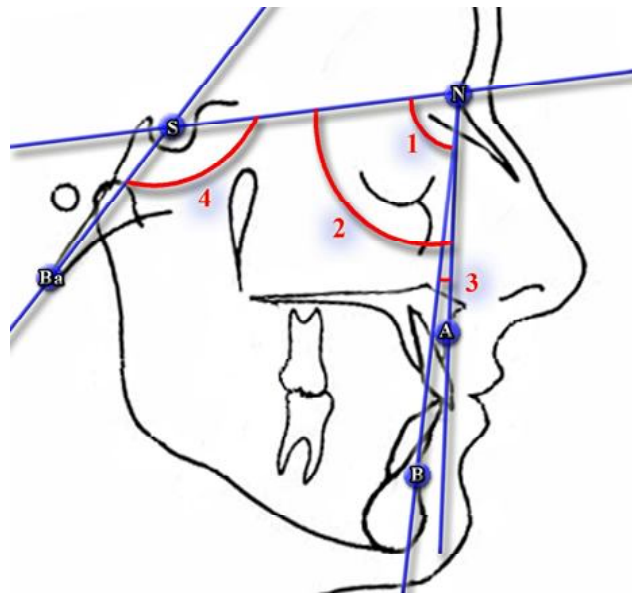


Fig. 1. The indicators according to G. Schmuth defined in the sagittal plane. 1 - SNA angle, 2 - SNB angle, 3 - ANB angle, 4 - NSBA angle.

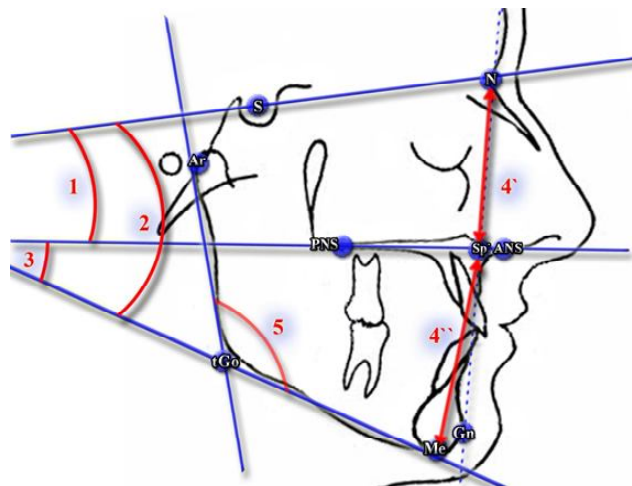


Fig. 2. The indicators according to G. Schmuth defined in the sagittal plane. 1 - NL NSL angle; 2 - ML NSL angle; 3 - ML_NL angle; 4'/4'' - N_Sp'_Sp'_Me coefficient; 5 - Ar-Go-Me angle.

Me angle (angle of mandible) is formed by Ar-tGo and tGo-Me lines.

The position indicators of the upper and lower medial incisors according to G. Schmuth are represented in pic. 3: II angle, or interincisal angle is formed by Ap1u-Is1u (the central axis of the upper medial incisor) and Ap1L-Is1L lines (the central axis of the lower medial incisor); Max1_SpP angle is formed by Ap1u-Is1u (the tilt of the central axis of the upper medial incisor) and ANS-PNS lines (palatine plane, SpP); Max1_NA angle is formed by Ap1u-Is1u (the tilt of the central axis of the upper medial incisor) and N-A lines; Mand1_ML angle is formed by Ap1L-Is1L (the central axis of the lower medial incisor) and tGo-Me lines (mandibular plane, Mp) and characterizes the tilt of the lower medial incisor to

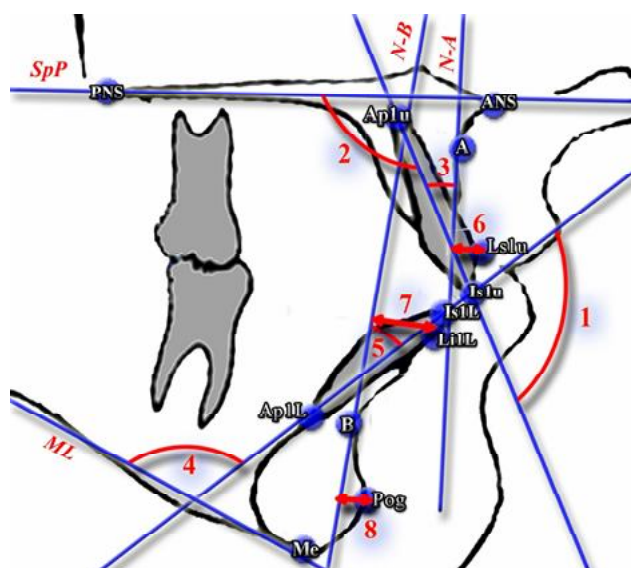


Fig. 3. The indicators according to G. Schmuth defining the position of upper and lower medial incisors. 1 - $\angle$ angle; 2 - Max1_SpP angle; 3 - Max1_NA angle; 4 - Mand1_ML angle; 5 - Mand1_NB angle; 6 - 1u_NA distance; 7 - 1L_NB distance; 8 - Pog_NB distance.

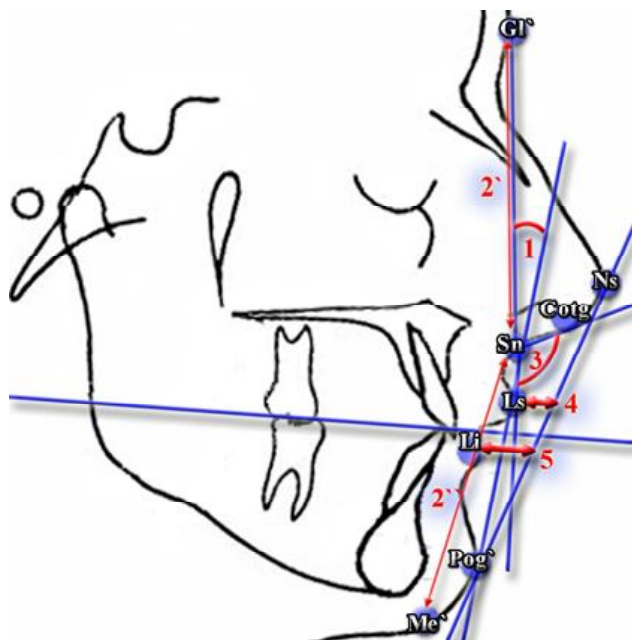


Fig. 4. The indicators according to G. Schmuth defining the profile of soft tissues. 1 - $\angle$ angle; 2' - $\angle$ - $\angle$ index; 3 - CotgSnLs angle; 4 - Li_NsPog distance; 5 - Ls_NsPog distance. the mandibular plane; Mand1_NB angle is formed by Ap1L-Is1L (the tilt of the central axis of the lower medial incisor) and N-B lines; 1u_NA distance is the distance from Ls1u point to N-A line (identifies the anterior and posterior position of the tooth crown part of the upper medial incisor to N-A line); 1L_NB distance is the distance from point Li1L to N-B line (identifies the anterior and posterior position of the tooth crown part of the lower medial incisor to N-B line); Pog_NB distance is the distance from point Pog to N-B line

(characterizes the position of the bony chin to N-B line); Holdaway ratio is the difference in distances from point Li1L to N-B line and point Pog to N-B line, characterizes the anterior and posterior position of the crown of the lower medial incisor to the bony chin, this ratio allows directing the treatment plan toward teeth extraction, or genioplasty.

The indicators defining the profile of soft tissues are represented in pic. 4: $\angle$ is an indicator of the convexity of the soft-tissue profile formed by $\angle$ -Sn and Sn-Pog lines; $\angle$ -Sn-Sn_Me index, or facial vertical index is the ratio of $\angle$ -Sn and Sn-Me distances (identifies the vertical ratio in the facial profile); CotgSnLs angle (nasolabial angle) is formed by Sn-Cotg (nasal tangent line) and Sn-Ls (labial tangent line) lines; Li_NsPog distance is the distance from Li point to Ns-Pog line (the aesthetic line indicating the balance of the soft tissues, namely the ratio of the lower lip and profile); Ls_NsPog distance is the distance from Ls point to Ns-Pog line (the aesthetic line indicating the balance of the soft tissues, namely the ratio of the lower lip and profile).

The statistical processing of the findings has been conducted in the license package "Statistica 6,0" using nonparametric methods of evaluation of the obtained results. The reliability of the differences between independent quantitative values has been identified with the help of the Mann-Whitney U-test.

Results. Discussion

The cephalometric parameters according to G. Schmuth for the young boys and girls of the Podilskyi region of Ukraine having orthognathic occlusion, as well as their normative values are represented in table 1.

When comparing the cephalometric parameters of young boys and girls of the Podilskyi region of Ukraine used in the analysis according to G. Schmuth, more valid ($p < 0,05$) values of **1L_NB distance** (identifies the anterior and posterior position of the tooth crown part of the lower medial incisor to N-B line) and **$\angle$ angle** have been obtained (the indicator of the convexity of the soft-tissue profile); the young girls' results demonstrate more valid ($p < 0,05-0,01$) values of **ML NL angle** (or **base angle**) identified in the vertical plane; **$\angle$ -Sn-Sn_Me index** (or **facial vertical index**) and **Ls_NsPog distance** identifying the profile of soft tissues (see table 1).

It should be noted that when comparing the cephalometric parameters used in the analysis of Steiner, the young boys and girls of the Podilskyi region having orthognathic occlusion, we have observed isolated cases of gender differences. Moreover, higher values have been observed mainly among the young boys [2].

When comparing the cephalometric parameters provided by G. Schmuth with those obtained when examining the young boys and girls of the Podilskyi region having orthognathic occlusion, significant differences for the **Max1_SpP angle** only formed by the lines of the tilt of the central axis of the upper medial incisor and palatine plane and **Li_NsPog** and **Ls_NsPog distances** formed from the

Table 1. The cephalometric parameters according to G. Schmuth for the young boys and girls of the Podilskyi region of Ukraine having orthognathic occlusion.

Indicator	Norms according to G. Schmuth	Young boys		Young girls		p
		M±δ	25 - 75 p-l	M±δ	25 - 75 p-l	
The indicators defined in the sagittal plane						
SNA	82±3°	82,32±3,98	79,45 - 84,22	81,48±3,36	79,17 - 83,35	>0,05
SNB	80±3°	80,16±3,89	76,89 - 83,12	79,66±3,05	77,10 - 81,89	>0,05
ANB	2±2°	2,167±1,965	0,658 - 3,913	1,816±1,991	0,684 - 3,185	>0,05
NSBa	130±6°	129,6±6,0	125,9 - 133,6	129,2±5,4	126,1 - 132,7	>0,05
The indicators defined in the vertical plane						
NL NSL	8,5±3°	7,705±3,217	6,602 - 9,229	7,120±2,914	5,206 - 8,980	>0,05
ML NSL	32±6°	27,55±6,74	23,00 - 32,84	29,47±5,32	25,23 - 32,73	>0,05
ML NL	23,5±3°	19,84±5,63	15,26 - 22,92	22,35±4,98	18,46 - 25,45	<0,05
N-Sp':Sp'-Me	79±5%	82,01±6,23	77,89 - 85,43	81,36±5,89	76,46 - 85,99	>0,05
arGoMe	126±10°	119,5±6,4	115,1 - 125,0	120,5±7,5	114,6 - 126,3	>0,05
The position indicators of the upper and lower medial incisors						
II	131±6°	130,6±7,1	126,0 - 134,9	130,5±8,0	125,4 - 135,5	>0,05
Max1-SpP	104±3°	67,46±6,38	63,03 - 71,78	67,89±5,94	63,09 - 72,43	>0,05
Max1-NA	22±3°	22,51±5,84	19,56 - 26,92	23,51±5,72	20,34 - 26,62	>0,05
Mand1-ML	90±3°	97,06±8,08	90,49 - 103,2	95,07±6,49	88,91 - 99,59	>0,05
Mand1-NB	25±3°	24,77±5,51	20,70 - 28,90	24,20±6,26	20,43 - 27,92	>0,05
1u-NA	4±2 mm	5,403±1,647	4,297 - 6,422	5,197±1,757	4,131 - 6,595	>0,05
1l-NB	4±2 mm	4,891±1,453	3,685 - 6,013	4,223±1,693	3,090 - 5,443	<0,05
Pog-NB	4±2 mm	2,901±1,680	1,718 - 3,722	2,367±1,418	1,320 - 3,366	>0,05
Holdaway ratio	0±2 mm	1,989±2,402	0,663 - 3,282	1,855±2,667	0,465 - 3,637	>0,05
The indicators defining the profile of soft tissues						
Gl'SnPog'	12±4°	13,24±6,33	8,158 - 18,42	9,816±5,110	5,192 - 13,85	<0,05
Gl'-Sn:Sn-Gn'	100%	94,16±7,94	89,17 - 99,26	100,2±10,7	93,37 - 108,2	<0,01
CotgSnLs	102±8°	107,1±11,1	99,13 - 115,6	104,9±10,0	98,38 - 111,9	>0,05
Ls-NsPog'	-2±2 mm	-4,725±2,288	-6,245 - -3,072	-5,602±2,325	-6,866 - -4,296	<0,05
Li-NsPog'	-1±1 mm	-2,904±2,192	-4,943 - -1,151	-3,106±2,739	-5,209 - -1,004	>0,05

Notes: M±δ - middle ± standard aberration; 25p-l, 75p-l - percentile range.

corresponding points (Li or Ls) to Ns-Pog' line (the aesthetic line indicating the balance of the soft tissues) (see table 1).

Thus, the majority of the cephalometric parameters obtained while examining young boys and girls of the Podilskyi region of Ukraine having orthognathic occlusion do not have significant differences in comparison with the value of these parameters provided by G. Schmuth.

Conclusion

1. The majority of gender differences in the cephalometric parameters used in the analysis according to G. Schmuth between the young boys and girls of the Podilskyi region having orthognathic occlusion has been identified for the indicators of defining the profile of soft tissues - higher values are characteristic of the young girls with facial vertical index

and Ls_NsPog' distance, while of the young boys - Gl'SnPog' angle. Moreover, it has been marked that the young girls have got higher values of the base angle identified in the vertical plane, while the young boys - 1l_NB distance defining the anterior and posterior position of the tooth crown part of the lower medial incisor to N-B line.

2. The differences in the cephalometric parameters provided by G. Schmuth and those obtained while examining the young boys and girls of the Podilskyi region having orthognathic occlusion have been identified regardless of gender only for Max1_SpP angle and Li_NsPog' and Ls_NsPog' distances.

Further researches will focus on the identification of the normative measurement base using the methods proposed by Schwarz, McNamara, Downs, Holdaway and Tweed.

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Дмитрієв М.О.

ВИЗНАЧЕННЯ НОРМАТИВНИХ ЦЕФАЛОМЕТРИЧНИХ ПАРАМЕТРІВ ЗА МЕТОДИКОЮ Г.ШМУТА ДЛЯ УКРАЇНСЬКИХ ЮНАКІВ ТА ДІВЧАТ

Резюме. В статті наведені цефалометричні параметри які використовуються в аналізі Г. Шмута для юнаків і дівчат Подільського регіону України з ортогнатичним прикусом, оцінка статевих розбіжностей даних параметрів (переважна більшість яких встановлена для показників, що визначають профіль м'яких тканин) і проведено порівняння отриманих результатів з даними, що були отримані та запропоновані як нормативні Г. Шмутом.

Ключові слова: бокові телерентгенограми голови, цефалометрія, юнакі, дівчата, аналіз Г. Шмута.

Дмитриев Н.А.

ОПРЕДЕЛЕНИЕ НОРМАТИВНЫХ ЦЕФАЛОМЕТРИЧНЫХ ПАРАМЕТРОВ ПО МЕТОДИКЕ Г.ШМУТА ДЛЯ УКРАИНСКИХ ЮНОШЕЙ И ДЕВУШЕК

Резюме. В статье приведены цефалометрические параметры используемые в анализе Г. Шмута для юношей и девушек Подольского региона Украины с ортогнатическим прикусом, оценка половых различий данных параметров (подавляющее большинство которых установлено для показателей, определяющих профиль мягких тканей) и проведено сравнение полученных результатов с данными, которые были получены и предложены как нормативные Г. Шмутом.

Ключевые слова: боковые телерентгенограммы головы, цефалометрия, юноши, девушки, анализ Г. Шмута.

Рецензент - д.мед.н. Маєвський О.Є.

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