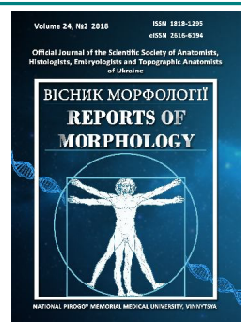




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# Cephalometric studies of Ukrainian adolescents with orthognathic bite by the method of E.P. Harvold

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According to many numerical literary sources, the modern direction of provision of dental care involves an individual approach to the patient, in particular, based on his gender, age and nationality. This calls for the creation of its own regulatory bases for the population of different countries and ethnic groups, taking into account all possible criteria. The purpose of the study is to establish and analyze the cephalometric parameters by the method of E.P. Harvold in young men and women of Podillia region of Ukraine with orthognathic bite. Primary lateral teleroentgenograms of 38 young men and 55 women with normal occlusion close to orthognathic bite, obtained using the Veraviewepocs 3D device, Morita (Japan), were taken from the data bank of the research center of the National Pirogov Memorial Medical University, Vinnytsya. Cephalometric measurements were performed according to the recommendations of E.P. Harvold. Statistical processing of the obtained results was carried out in the license package "Statistica 6.0" using nonparametric methods of estimating the results. When comparing teleroentgenographic indices between boys and girls of the Podillia region of Ukraine with orthognathic occlusion, significantly higher values of the length of the upper and lower jaw, lower facial height and interjaw differences in young men were established, and Ap1uAp1l-DOP angle was significantly higher in young women. When comparing these data with the results obtained by E.P. Harvold, the boys and girls of the Podillia region of Ukraine with orthognathic bite have significantly lower values of the length of the upper and lower jaw and lower facial height. In addition, Ukrainian young women have significantly higher values of the Ap1uAp1l-DOP angle and a tendency to lower interjaw differences, while in young men, the tendency towards higher values of the cross-sectional angle than the value of these parameters obtained by E. Harvold is established. The results of the study confirm the need to create a normative basis for teleroentgenographic indices by the method of E.P. Harvold for the population of different regions of Ukraine, taking into account both sexual and age affiliation.

**Keywords:** lateral teleroentgenograms of the head, cephalometry, young men and women of Podillia with orthognathic bite, E.P. Harvold analysis.

### Introduction

The face as the most open part of the human body plays many key roles in the modern human life, and in particular performs aesthetic function. If we talk about the lower part of the face, then the aesthetic function is ensured not only due to a smile (correct arrangement, size of teeth, etc.) and, in general, the correct arrangement of all structures of the lower face of each other (upper and lower jaw, chin, etc.).

In order to correctly assess the interrelationship of these entities, a cephalometric analysis based on the study of specific points, lines, planes and angles is used [14].

There are numerous methods of cephalometric analysis

of lateral teleroentgenograms, each of which has its own characteristics. So, at the moment, well known methods of analysis are by Steiner, Wits, Downs, Tweed, Ricketts, Burstone, McNamara [1, 4-6, 17, 18, 20, 21].

Among them, special attention should be paid to the analysis of the Norwegian scientist Egil Peter Harvold, proposed in 1974 [7]. Its peculiarity is that the position of the patient's teeth is not taken into account [15]. However, like other methods, Harvold's analysis has a significant drawback - norms laid down in this technique are specific because the study was conducted on Canadians who had European

ancestors. The modern direction of provision of dental care involves an individual approach to the patient, in particular, taking into account his gender, age and nationality.

All this pushes scientists in different parts of the planet to create their own normative bases for their own population, taking into account all possible criteria.

The purpose of the work - to establish and analyze cephalometric parameters by the method of E.P. Harvold in young men and women of the Podillia region of Ukraine with orthognathic bite.

### Materials and methods

Primary lateral teleroentgenograms of 38 young men (aged 17-21 years) and 55 young women (aged 16 to 20 years) with normal occlusion close to orthognathic bite, obtained using the Veraviewepocs 3D device, Morita (Japan), taken from the data bank of the scientific-research center of National Pirogov Memorial Medical University, Vinnytsya.

According to the cephalometric method of E.P. Harvold [16] determined the following indices (Fig. 1).

Used points:

**ADP** (anterior Downs point, anterior point of the closing plane (**OcIPI**) by Downs) - the middle of the line connecting the cutting edges of the middle cutters upper (**Is1u**) and lower (**Is1L**) jaws;

**ANS** (spina nazalis anterior) - usually in the majority of cephalometric techniques is indicated as the apex of the anterior nasal ostium, forming the anterior point of the palatal plane, but in the Harvold method, this is a point on the lower contour of the anterior nasal passage where the thickness reaches three millimeters and is used for horizontal measurements. For vertical measurements a point is used on the upper contour of the anterior nasal passage where the thickness reaches three millimeters;

**Ap1L** (apex first inferior incisor) - the point of the top of the root of the median lower cutter;

**Ap1u** (apex first upper incisor) - the point of the top of the root of the median upper cutter;

**Gn** (gnation) - anterior point on the lower contour of the body of the mandible, in Harvold method marked as **GN**;

**Is1L** (incision inferior) - point located on the cutting edge of the lower middle incisor;

**Is1u** (incision superior) - point located on the cutting edge of the upper middle incisor;

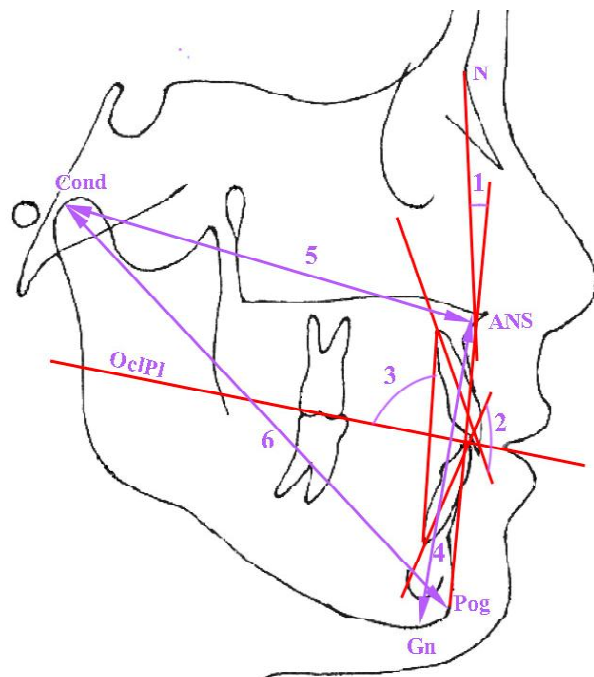
**N** (nasion) - the most forward point of the fronto-nasal suture connections frontal and nasal bones in the mid-jib plane;

**PDP** (posterior Downs point) - rear point of closing plane (**OcIPI**) by Downs - the middle of the line, connecting the near-buccal tip of the first molars of the upper and lower jaws;

**PGN** (prognathion) - a point on the anterior chin contour which determines the maximum length of the lower jaw from the point (**TM**);

**Pog** (pogonion) - the most forward point of the bony chin performances, in the Harvold method is indicated as **PG**;

**TM** (temporomandibular joint) - a point on the contour of



**Fig. 1.** Cephalometric indices determined by the cephalometric method of E.P. Harvold [16]. 1. **N-ANS-Pog** (Convexity) - angle of convexity, determines the convexity of the profile formed by the reference lines **N-ANS** and **ANS-Pog** (note - in the author's technique, the point Pog is marked as PG) ( $^{\circ}$ ); 2. **II** (Interincisal Angle) - Angulation of axes of upper to lower incisor, formed by the reference lines **Ap1u-Is1u** and **Ap1L-Is1L** ( $^{\circ}$ ); 3. **Ap1uAp1L-DOP** - Angle between Occlusal Plane and the connecting line between the root tips of the central upper and lower incisor ( $^{\circ}$ ); 4. **TM-ANS** (is also found as **ANS-Cond**) (maxillary length, forward position of the maxilla) - distance from (**TM**) to spina nazalis anterior (**ANS**) determining the maxillary length (mm); 5. **TM-PGN** (is also found as **Pog-Cond**) (mandibular length) - distance from (**TM**) to (**PGN**) determining the mandibular length (mm); 6. **ANS-Gn** (Lower Face Height) - distance from Anterior nasal spine to Gnathion determining the lower face height (mm); 7. **Max-Mand** (Difference in Jaw Lengths) - difference of the lengths of the lines **ANS-Cond** and **Pog-Cond** (mm).

the mandibular fossa through which the line of the greatest length of the mandible passes, usually in most of the cephalometric techniques is indicated as a point on the vertex of the contour of the head of the mandible **Cond** (condylion).

Statistical processing of the obtained results was carried out in the "Statistica 6.0" licensing package using nonparametric estimation methods. The reliability of the difference in values between the independent quantitative values was determined using the Mann-Whitney U test.

### Results

Indicators determined by cephalometric method of E.P. Harvold [16] and A.E. Athanasiou [3] (mean with standard deviation and percentage scale) in Ukrainian young men and women with orthognathic bite are presented in Table 1.

It should be noted that part of the parameters determined

**Table 1.** Percentage scale of teleroentgenographic indices by E.P. Harvold method in Ukrainian young men and women with orthognathic bite.

Indexes	Young men		Young women		p
	M±σ	25p-l, 75p-l	M±σ	25p-l, 75p-l	
N-ANS-Pog (°)	11.24±5.85	7.0-16.0	10.45±5.18	7.0-14.0	>0.05
II (°)	130.6±7.1	126.0-134.9	130.5±8.0	125.4-135.5	>0.05
Ap1uAp1I-DOP (°)	90.29±4.05	87.0-94.0	92.45±4.21	89.0-95.0	<0.05
ANS-Cond (mm)	91.19±13.01	86.3-92.7	83.40±7.21	79.8-85.3	<0.001
Pog-Cond (mm)	117.4±18.3	110.4-117.8	107.4±10.0	102.8-108.9	<0.001
ANS-Gn (mm)	64.64±11.10	61.2-66.0	59.63± 6.40	56.0-61.4	<0.001
Max-Mand (mm)	26.16±6.84	23.1-29.5	24.05± 4.51	21.5-26.7	<0.05

**Notes:** M±σ - average ± standard deviation; 25p-l, 75p-l - percentage scale; p - statistical significance of differences between the sizes of young men and women.

**Table 2.** Comparison of teleroentgenographic indices obtained by E.P. Harvold with young men and women with orthognathic bite (M±σ).

Indexes	Value by E.P. Harvold [16]		Young men	Young women
N-ANS-Pog (°)	no data		11.24±5.85	10.45±5.18
II (°)	128±4		130.6±7.1 t	130.5±8.0
Ap1uAp1I-DOP (°)	89±5		90.29±4.05	92.45±4.21 **
	Boys	Girls		
ANS-Cond (mm)	100±4.17	93±3.45	91.19±13.01 ***	83.40±7.21 ***
Pog-Cond (mm)	127±5.25	119±4.44	117.4±18.3 **	107.4±10.0 ***
ANS-Gn (mm)	71±5.73	65±4.67	64.64±11.10 **	59.63±6.40 ***
Max-Mand (mm)	27	26	26.16±6.84	24.05±4.51 t

**Notes:** \*, \*\*, \*\*\* - significant differences (p<0.05, p<0.01 and p<0.001) of corresponding indicators obtained by E.P. Harvold method with young men and women with orthognathic bite; t - trends of differences in the corresponding indicators obtained by E.P. Harvold method with Ukrainian young men and women with orthognathic bite.

by the cephalometric method of E.P. Harvold (angle II, or inter-incisive angle) are used in the analyzes proposed by C. Steiner, G. Schmutz and A.M. Schwarz and are reflected in the studies of M.O. Dmitriev [10, 11, 13].

When comparing teleroentgenographic indices obtained by the method of E.P. Harvold between young men and women of the Podillia region of Ukraine with orthognathic occlusion, established significantly higher (p<0.05-0.001) values of the length of the upper jaw (ANS-Cond), the length of the mandible (Pog-Cond), the lower face length (ANS-Gn) and maxillary difference (Max-Mand) in young men, as well as significantly higher (p<0.05) value of the Ap1uAp1I-DOP angle for young women (see Table 1).

When comparing teleroentgenographic indices of E.P. Harvold with the results obtained in young men and women of the Podillia region of Ukraine with orthognathic occlusion, established significantly lower (p<0.01-0.001) values of the length of the upper jaw (ANS-Cond), the length of the mandible (Pog-Cond) and lower face height (ANS-Gn) in Ukrainian young men and women with orthognathic bite (Table 2). In addition, young women of the Podillia region of Ukraine have significantly higher (p<0.01) values of the Ap1uAp1I-DOP angle and the trend (p=0.063) to smaller values of the maxillary difference (Max-Mand), while in young men of the Podillia region of Ukraine there is a slight trend

(p=0.078) to higher values of the inter-incisive angle (angle II) than teleroentgenographic parameters obtained by E.P. Harvold (see Table 2).

## Discussion

Scientists from Bangladesh conducted a cephalometric examination of lateral teleroentgenograms using E.P. Harvold's technique of 50 young men and 50 women aged 18 to 24 years with a physiological bite. After the statistical processing of the obtained data revealed signs of sexual dimorphism - most of the studied values were greater in young men. Compared with the author's methodology, for Bangladesh girls found lower values of such indicators as: inter-incision angle (p<0.001), occlusal and radicular planes (p<0.001) and inter-jaw differences (p<0.001). Also, a significant difference was found between the position of the upper and lower jaw and the anterior lower facial height (p<0.01) [2].

A.A. Daer and A.H. Abuaffan conducted a similar study to determine the cephalometric norms by the method of E.P. Harvold for the population of Yemen. To achieve this goal, 105 young women and 89 men aged from 18 to 25 years old who had no history of trauma or illness of the tooth-jaw system and physiological bite were examined. All of them had an X-ray examination with subsequent

cephalometric analysis and statistical treatment of the results. Statistically significant differences were noted between young men and women among skeletal sagittal relationships [9].

E. Lara-Carrillo and colleagues surveyed 116 boys and 125 girls aged from 9 to 18, in the third generation of Mexican residents. The purpose of the study was to identify cephalometric norms for residents of the capital of Mexico, according to their age and sexual characteristics. After statistical data processing, manifestations of sexual dimorphism were revealed among the indicators of the position of the upper and lower jaw, the anterior lower height of the face in all age groups [19].

When comparing teleroentgenographic indices used in the E.P. Harvold analysis between young men and women of the Podillia region of Ukraine with orthognathic bite, pronounced sexual differences are established, namely, significantly higher values of the length of the upper and lower jaw, lower facial height and interjaw difference in young men, and higher angle values Ap1uAp1I-DOP for young women. In previous studies, in the analysis of cephalometric parameters by methods of C.J. Burstone and R.M. Ricketts, we also revealed pronounced sexual differences [8, 12].

Comparing teleroentgenographic indices obtained by E.P. Harvold with the magnitude of the data obtained in the young men and women of Podillia with orthognathic bite, we also established the distinct differences, namely: significantly lower values of the length of the upper jaw (allows us to estimate the position of the anterior point of the upper jaw in the arterial plane and clinically allows interpret the results as a normal position, front position or prognathism, underdevelopment or retrognathia of the upper jaw), length of the mandible (allows you to evaluate the position of the chin in the jet and the vertical planes; essentially the hypotenuse of the lower jaw takes into account not only the length of the branch and the body of the mandible but also the angle between them) and the lower height of the face (vertical absolute index characterizing the lower face height; an increase in the index testifies to the affiliation of the case to the open bite and decrease to deep bite) in Ukrainian young men and women. Also, Ukrainian young women have significantly higher values of the Ap1uAp1I-DOP angle (it allows to determine the position of the tops of the anterior group of teeth in relation to the functional plane. Individuals with second-degree pathology according to Engle have an

increased angle value, and patients with a pathology of 3rd grade by Engle have a reduced value. Consequently, clinically, this indicator helps to orient itself in the person's belonging to one or another group of sagittal anomalies) and the tendency towards lower values of the interjaw difference (which, unlike the generally accepted indicators of the angle ANB and Wits, which characterize interjaw correlation, do not depend on the vertical bite characteristics and allow the maxillofacial determination of the existence of interjaw disharmony. When taking into account the parameters of the length of the upper and lower jaws, the interjaw difference allows one to determine which of the jaws most changed as a result of anomalies of development). It should be noted that according to our research, most of the cephalometric parameters obtained by R.M. Ricketts [8] and more than half of the cephalometric parameters obtained by C.J. Burstone [12] also have significant differences with the magnitudes of these parameters obtained in young men and women of Podillia region of Ukraine with orthognathic bite.

The obtained results indicate the need to create a normative basis for teleroentgenographic indices by E.P. Harvold for the population of various ethno-territorial regions of Ukraine, taking into account both sexual and age-related affiliation.

## Conclusion

1. Significant sexual differences between cephalometric parameters by E.P. Harvold between young men and women of Podillia with orthognathic bite were found: significantly greater lengths of the upper (ANS-Cond) and lower jaw (Pog-Cond), lower facial height (ANS-Gn), and maxillary difference (Max-Mand) in young men, and higher value of the angle Ap1uAp1I-DOP in young women.

2. When comparing the cephalometric parameters obtained by E.P. Harvold with the indices obtained in young men and women of Podillia with orthognathic bite, the values of the length of the upper (ANS-Cond) and the lower jaw (Pog-Cond) and lower face height (ANS-Gn) in young men and women established significantly lower values. Also, young women from Podillia have significantly higher values of the Ap1uAp1I-DOP angle and a tendency to lower values of the interjaw difference (Max-Mand), and in young men, the tendency towards higher values of the intersection angle (angle II) is established.

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#### ЦЕФАЛОМЕТРИЧНІ ДОСЛІДЖЕННЯ УКРАЇНСЬКИХ ЮНАКІВ ТА ДІВЧАТ З ОРТОГНАТИЧНИМ ПРИКУСОМ ЗА МЕТОДОМ Е.Р. HARVOLD

Черниш А.В.

Згідно багато чисельних літературних джерел сучасний напрямок надання стоматологічної допомоги передбачає індивідуальний підхід до пацієнта, зокрема, з урахуванням його статі, віку та національної приналежності. Це викликає необхідність створення власних нормативних баз для населення різних країн та етносів з урахуванням всіх можливих критеріїв. Мета дослідження - встановити та проаналізувати цефалометричні параметри за методом Е.Р. Harvold у юнаків і дівчат Подільського регіону України з ортогнатичним прикусом. Первинні бокові телерентгенограми 38 юнаків та 55 дівчат з нормальною оклюзією наближеною до ортогнатичного прикусу, отримані за допомогою пристрою Veraviewerpross 3D, Моріта (Японія), взяті з банку даних науково-дослідного центру Вінницького національного медичного університету ім. М.І. Пирогова. Цефалометричні вимірювання проводили згідно рекомендацій Е.Р. Harvold. Статистична обробка отриманих результатів проведена в ліцензійному пакеті "Statistica 6,0" з використанням непараметричних методів оцінки результатів. При порівнянні телерентгенографічних показників між юнаками та дівчатами Подільського регіону України з ортогнатичним прикусом встановлено достовірно більші значення довжини верхньої і нижньої щелепи, нижньої висоти обличчя та міжщелепної різниці в юнаків, а також достовірно більше значення кута  $Ar1uAr1l-DOP$  у дівчат. При порівнянні даних показників з результатами отриманими Е.Р. Harvold, в юнаків і дівчат Подільського регіону України з ортогнатичним прикусом встановлені достовірно менші значення довжини верхньої і нижньої щелепи та нижньої висоти обличчя. Крім того, в українських дівчат встановлені достовірно більші значення кута  $Ar1uAr1l-DOP$  та тенденція до менших значень міжщелепної різниці, а в юнаків - тенденція до більших значень міжрізцевого кута, ніж величина даних параметрів отриманих Е.Р. Harvold. Результати дослідження підтверджують необхідність створення нормативної бази телерентгенографічних показників за методикою Е.Р. Harvold для населення різних регіонів України з урахуванням як статевої, так і вікової належності.

**Ключові слова:** бокові телерентгенограми голови, цефалометрія, юнакі і дівчата Поділля з ортогнатичним прикусом, аналіз Е.Р. Harvold.

#### ЦЕФАЛОМЕТРИЧЕСКОЕ ИССЛЕДОВАНИЕ УКРАИНСКИХ ЮНОШЕЙ И ДЕВУШЕК С ОРТОГНАТИЧЕСКИМ ПРИКУСОМ ПО МЕТОДУ Е.Р. HARVOLD

Черныш А.В.

Согласно многочисленных литературных источников современное направление оказания стоматологической помощи предусматривает индивидуальный подход к пациенту, в частности, с учетом его пола, возраста и национальной принадлежности. Это вызывает необходимость создания собственных нормативных баз для населения различных стран и этносов с учетом всех возможных критериев. Цель исследования - установить и проанализировать цефалометрические параметры по методу Е.Р. Harvold у юношей и девушек Подольского региона Украины с ортогнатическим прикусом. Первичные

боковые телерентгенограммы 38 юношей и 55 девушек с нормальной окклюзией приближенной к ортогнатическому прикусу, полученные с помощью устройства Veraviewerocs 3D, Морита (Япония), взяты из банка данных научно-исследовательского центра Винницкого национального медицинского университета имени Н.И. Пирогова. Цефалометрические измерения проводили согласно рекомендациям Е.Р. Harvold. Статистическая обработка полученных результатов проведена в лицензионном пакете "Statistica 6,0" с использованием непараметрических методов оценки результатов. При сравнении телерентгенографических показателей между юношами и девушками Подольского региона Украины с ортогнатическим прикусом установлено достоверно большие значения длины верхней и нижней челюсти, нижней высоты лица и межчелюстной разницы у юношей, а также достоверно большее значение угла  $Ar1uAr1l-DOP$  у девушек. При сравнении данных показателей с результатами, полученными Е.Р. Harvold, у юношей и девушек Подольского региона Украины с ортогнатическим прикусом установлены достоверно меньшие значения длины верхней и нижней челюсти и нижней высоты лица. Кроме того, в украинских девушек установлены достоверно большие значения угла  $Ar1uAr1l-DOP$  и тенденция к меньшим значениям межчелюстной разницы, а у юношей - тенденция к большим значениям между-резцового угла, чем величина данных параметров, полученных Е.Р. Harvold. Результаты исследования подтверждают необходимость создания нормативной базы телерентгенографических показателей по методике Е.Р. Harvold для населения различных регионов Украины с учетом как половой, так и возрастной принадлежности.

**Ключевые слова:** боковые телерентгенограммы головы, цефалометрия, юноши и девушки Подолья с ортогнатическим прикусом, анализ Е.Р. Harvold.

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