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Craniometric Method for Age Estimation by the Degree of Lambdoid Suture Obliteration

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Abstract

Background: In anthropology age of skeletal remains can be estimated without specific equipment by the degree of serrate suture obliteration; however, standard methods of obliteration measurement cannot be used to calculate age of a skull with a fragmented or damaged calvaria, which significantly complicates age estimation.

Objective: To assess validity of a new method for age estimation relying on data of lambdoid suture obliteration on skulls of both sexes from the craniological collection at the Department of Normal Anatomy of Kuban State Medical University (Krasnodar, Russian Federation) and compare with that of a conventional method.

Materials and methods: We determined sex and age of 41 skulls using craniometry. Based on the sex and calvaria condition, the skulls were divided into 2 groups and further subdivided by sex: male and female skulls with preserved calvariae (age was estimated by Zvyagin's standard regression equations [N=20]) and male and female skulls without calvariae (age was estimated by a new equation taking into account lambdoid suture obliteration [N=21]). The skulls with calvariae were subjected to double independent craniometry to find absolute and relative errors. Quantitative indicators of suture obliteration and the estimated age were assessed for normal distribution using the Kolmogorov-Smirnov test. Data collection, correction, and systematization were conducted using Microsoft Access 2016 and Microsoft Excel 2016 (Microsoft Corp, USA). Statistical analysis was performed using Statistica 10.0 (StatSoft Inc, USA).

Results and discussion: We determined age and sex of 36 skulls (87.80%) using craniometry. When comparing age values calculated using the standard regression equations and the new equation for the lambdoid suture, the absolute and relative errors for male skulls were 3.05% and 6.09%, respectively. For female skulls, the absolute and relative errors were 9.39% and 19.42%, respectively.

Conclusions: Equations that take into account lambdoid suture obliteration enable to estimate age of male and female skulls, including fragmented skulls, and can be used in anatomical and paleoanthropological studies, as well as in medical and forensic identification.

Keywords: craniometric age estimation, suture obliteration, lambdoid suture, age estimation, regression equations

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Краниометрический способ определения возрастной принадлежности (по степени облитерации лямбдовидного шва)

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Резюме

Актуальность: Используемое в антропологической практике определение возраста по степени облитерации зубчатых швов свода позволяет без специфического оборудования диагностировать возраст по скелетным останкам, однако стандартные методы измерения облитерации не позволяют вычислить возраст черепа с фрагментированным или разрушенным сводом, что значительно усложняет определение возрастной принадлежности.

Цель: Оценка валидности нового способа определения возрастной принадлежности по данным облитерации ламбдовидного шва по сравнению с традиционным методом, применяемым при метрической диагностике, у черепов обоих полов из краниологической коллекции кафедры нормальной анатомии ФГБОУ ВО КубГМУ.
Материалы и методы: Было проведено краниометрическое определение половой и возрастной принадлежностей 41 черепа. На основании установленного пола и состояния костей свода объекты были разделены на 2 группы, разделенные на подгруппы по половым характеристикам: черепа обоих полов с сохранившимся сводом и возрастом, определяемым по стандартным регрессионным уравнениям В.Н. Звягина (n=20); черепа обоих полов без костей свода и возрастом, определяемым новым уравнением с учетом облитерации ламбдовидного шва (n=21).
Черепа со сводом подвергались двойной независимой краниометрии с целью выведения абсолютной и относительной погрешностей. Количественные показатели облитерации и диагностированной возрастной принадлежности оценивались на предмет соответствия нормальному распределению с помощью критерия Колмогорова-Смирнова. Накопление, корректировка, систематизация исходной информации осуществлялись в базах данных Microsoft Access 2016 и электронных таблицах Microsoft Excel 2016 (Microsoft Corp., США). Статистический анализ проводился с использованием программы Statistica 10.0 (StatSoft Inc., США).
Результаты и обсуждение: По результатам краниометрии был определен возраст и пол 36 черепов (87,80%). При сравнении значений возрастов, рассчитанных по стандартным регрессионным уравнениям и новому уравнению для ламбдовидного шва, величина абсолютной и относительной погрешностей для мужских черепов составляли 3,05 и 6,09% соответственно. Для женских черепов значения абсолютной и относительной погрешностей составляли 9,39 и 19,42% соответственно.
Заключение: Использование уравнений с учетом облитерации ламбдовидного шва позволяет установить возрастную принадлежность черепов обоих полов. Применение уравнений как альтернативного способа определения возраста фрагментированных черепов может использоваться в анатомических, палеоантропологических исследованиях, а также при медико-криминалистической идентификации личности.
Ключевые слова: краниометрическая диагностика возраста, облитерация швов, ламбдовидный шов, возрастная принадлежность, регрессионные уравнения
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Introduction

Osteometry is one of the fundamental methods for determining age, sex, and race. It also enables to assess individual characteristics of the human body based on involutional changes of bones. Resultant osteobiography plays an important role not only in theoretical anthropology and archaeological studies of burial grounds and settlements, but also in forensic examinations of skeletal remains.[1-4]

Age estimation is the most challenging aspect of osteobiography due to a large number of available methods and proprietary techniques, as well as inherent variability in estimated age ranges, depending on the accuracy of calculations.[5] Lack of universal guidelines and variety of diagnostic methods significantly complicate practical age estimation. Certain methods require mathematical refinement and additional standardization to ensure reliable age ranges.[6-8]

One of the key elements in osteometric age estimation is the skull, particularly varying degrees of cranial suture obliteration as part of age-related involution, allowing for reliable osteobiography formulation.[9] This craniometric method is relatively simple and does not require expensive specialized equipment, making it preferable to histochemical and radiological methods.[3,10]

Zvyagin's scoring system for suture obliteration most accurately reflects the correlation between age and the degree of cranial suture closure. However, this regression-based approach relies on data from 3 cranial sutures, which can pose difficulties when estimating age of skulls with fragmented or damaged calvariae—whether due to postmortem changes or antemortem trauma.[6,11,12]

Anthropological studies indicate that among all the cranial sutures, the lambdoid suture is the last to undergo synostosis. According to Pashkova's monograph,[13] the mean age of lambdoid suture closure in both sexes is approximately 60-70 years. Furthermore, Zaichenko et al's review highlights a sexual dimorphism in aging: men exhibit pronounced thinning of the cranial bones near the lambda, whereas women show bone thickening in this area.[14] Delayed lambdoid suture closure on both inner and outer surfaces of the skull is particularly valuable for age estimation, as it allows for identification of advanced age of the skull. Moreover, it can help adjust an estimated age range based on the principle of suture closure from within outward.[6,13,14]

Our study aims to investigate a craniometric method for age estimation relying on mathematical data of lambdoid suture obliteration in male and female skulls from the craniological collection at the Department of Normal Anatomy of Kuban State Medical University (Krasnodar, Russian Federation).

Methods

We estimated sex and age of 41 skulls from the craniological collection using craniometry. Sex was determined anthroposcopically by standard diagnostic features.[6] Age was calculated using regression equations based on the cranial suture obliteration data (Zvyagin, 1998).[15] For each skull with a preserved calvaria, we measured longitudinal and transverse diameters using a spreading caliper and calculated the cranial index.[6,13] Based on the sex and calvaria condition, the skulls were divided into 2 groups and further subdivided by sex:

- Male and female skulls with preserved calvariae and age determined by Zvyagin's standard regression equations (N=20);

• Male and female skulls without calvariae (horizontal cross sections), with age determined by a new equation taking into account lambdoid suture obliteration (N=21).

Obliteration measurements were taken from the *norma verticalis* in the skulls with calvariae and from the *norma occipitalis* in the skulls without calvariae. Quantitative indicators of obliteration and the estimated age were assessed for normal distribution using the Kolmogorov-Smirnov test. Data collection, correction, and systematization were conducted in Microsoft Access 2016 and Microsoft Excel 2016 (Microsoft Corp, USA). Statistical analysis was performed using Statistica 10.0 (StatSoft Inc, USA).

The new lambdoid suture equation was derived from the sum of standardized functions representing "regression series," where the x-axis corresponded to obliteration values on the outer and inner surfaces of the calvaria, and the y-axis, to the skull's age. The coefficients were determined through regression analysis of the mathematical models and standardized for the sample to improve accuracy. The skulls with preserved calvariae were subjected to double independent craniometry using the standard and new methods to find absolute and relative errors in the calculated age.

Results

Age and sex were estimated for 36 skulls (87.80%) using craniometry. Among the skulls with preserved calvariae (N=20), 10 were classified as male and 10 as female. In the group of the skulls with fragmented or absent calvariae (N=21), 11 were classified as male and 5 as female. Five skulls from the craniological collection were categorized as indeterminate in terms of sex and age due to poorly expressed diagnostic features. For 20 skulls with preserved calvariae, age was calculated for both sexes as the mean derived from 4 regression equations incorporating the cranial index (Figure 1 and Figure 2).

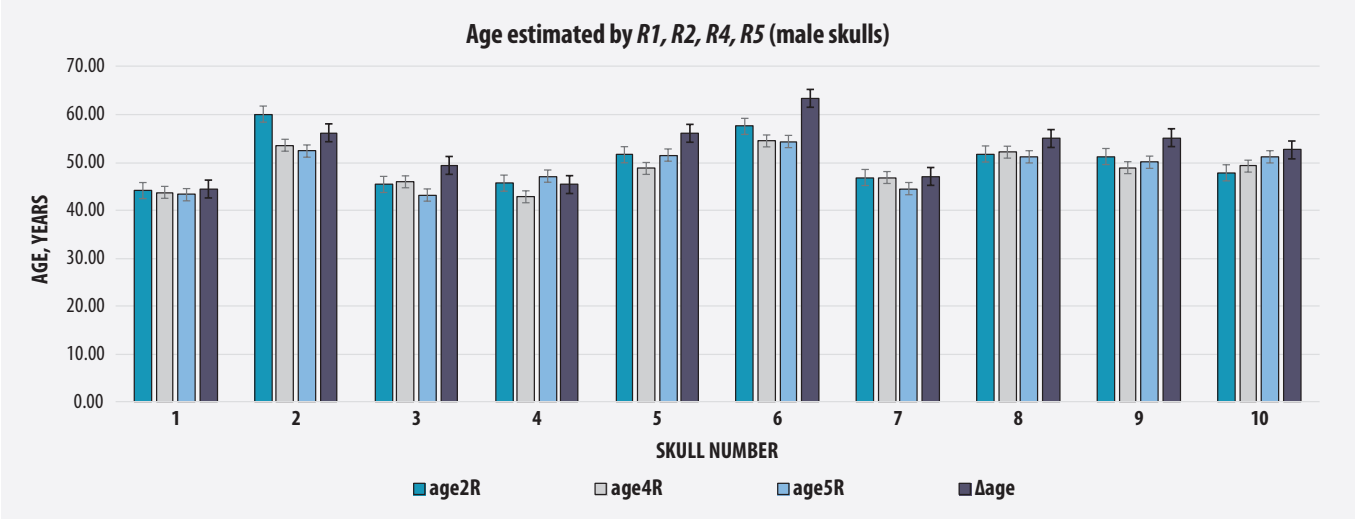


Figure 1. Age estimated by 4 Zvyagin's standard regression equations (male skulls)
Рисунок 1. Определенный возраст по 4-м стандартным регрессионным уравнениям В.Н. Звягина для мужских черепов

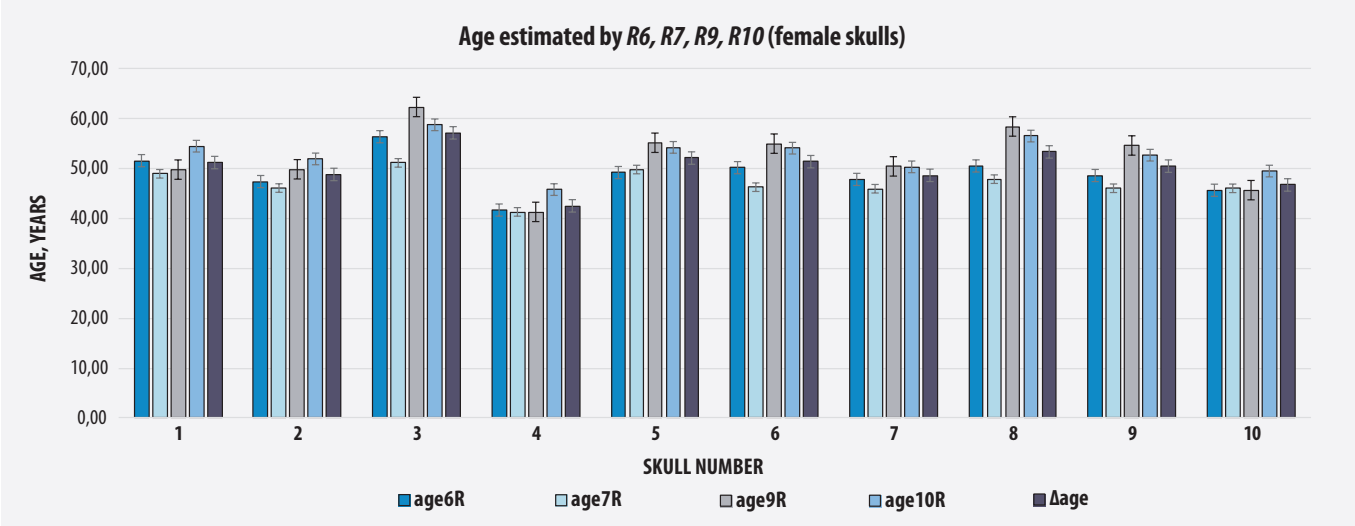


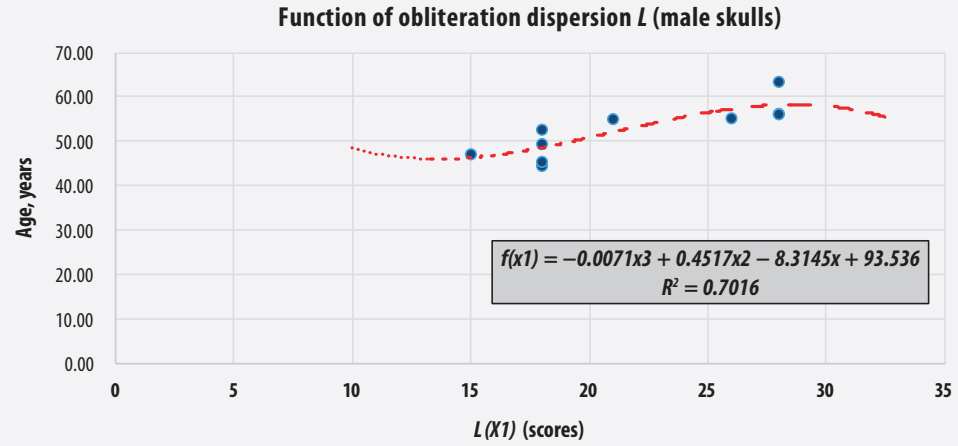
Figure 2. Age estimated by 4 Zvyagin's standard regression equations (female skulls)
Рисунок 2. Определенный возраст по 4-м стандартным регрессионным уравнениям В.Н. Звягина для женских черепов

For both sexes, the functions were derived based on the data of the lambdoid suture obliteration from the outer *f(x1)* and inner *f(x2)* surfaces of the calvaria, as well as the averaged age. When constructing graphs, we selected the functions with the highest coefficient of determination ($R^2=0.7016$ and $R^2=0.8444$ for *f(x1)* and *f(x2)*, respectively, for the male skulls; $R^2=0.7948$ and $R^2=0.6585$ for *f(x1)* and *f(x2)*, respectively, for the female skulls) (Figure 3 and Figure 4).

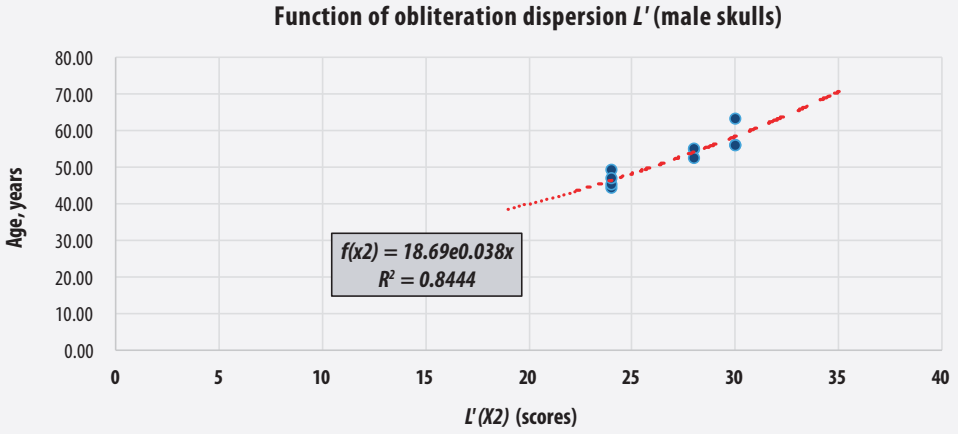
Given that the same age value was obtained by 2 different functions, *f(x1)* and *f(x2),* corresponding to the outer and inner surfaces of the calvaria, we can equate these functions, forming a complete lambdoid suture at the junction of the squamous part of the occipital bone. Based on this principle, we proposed a general equation expressed as the sum of the lambdoid suture obliteration values from the outer *f(x1)* and inner *f(x2)* surfaces for both male and female skulls. During the regression analysis of the mathematical model, the following equations were formulated, with coefficients later standardized according to the age values of the sample (Figure 5 and Figure 6).

To determine the absolute and relative errors in the group of skulls with preserved calvariae, an additional independent measurement of the cranial suture obliteration was conducted on both surfaces. Age was calculated using 4 standard regression equations and the newly derived lambdoid suture equation as an alternative. The absolute and relative errors of the second measurement are given in the Table below.

Based on the values of absolute and relative errors, we can conclude that the findings of the control and experimental craniometric studies by 2 different methods are quite similar. Using the newly formulated equation for the skulls with fragmented calvariae and intact lambdoid sutures, we calculated the age for the second study sample for each sex (Figure 7).



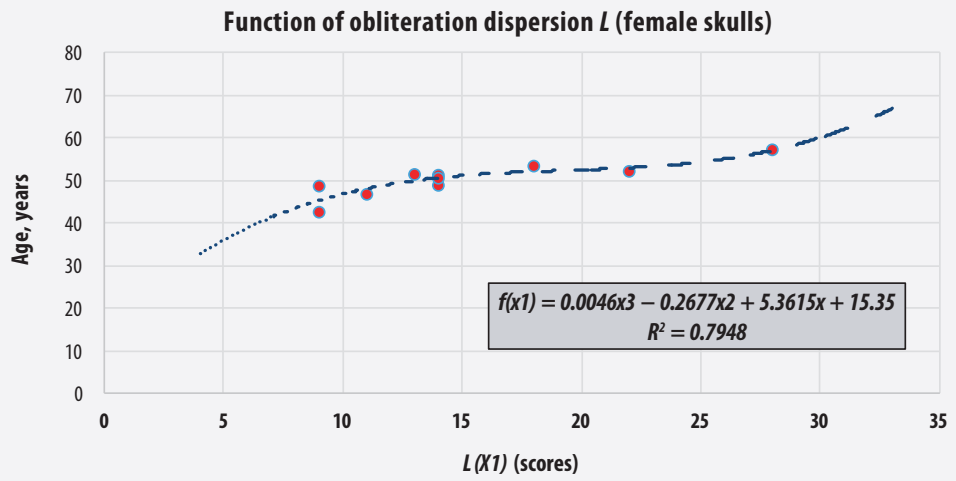
X2	Y
18	44.47
28	56.20
18	49.39
18	45.39
28	56.09
28	63.38
15	47.09
21	55.00
26	55.18
18	52.62



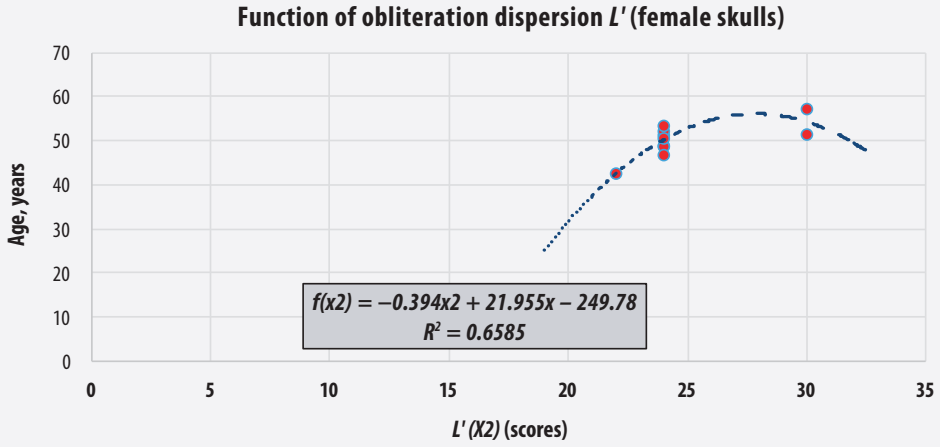
X2	Y
24	44.47
30	56.20
24	49.39
24	45.39
30	56.09
30	63.38
24	47.09
28	55.00
28	55.18
28	52.62

Figure 3. Function f(x1), demonstrating the dependence of age (years) on the obliteration of the lambdoid suture from the outer surface of the calvaria (L), and function f(x2), demonstrating the dependence of age (years) on the obliteration of the lambdoid suture from the inner surface (L'), male skulls

Рисунок 3. Функция f(x1), отражающая зависимость возраста (лет) от облитерации ламбдовидного шва с наружной поверхности свода (L), и f(x2), отражающая зависимость возраста (лет) от облитерации ламбдовидного шва со внутренней поверхности свода (L') для черепов мужского пола



X2	Y
14	51.224
14	48.840
28	57.182
9	42.544
22	52.128
13	51.403
9	48.662
18	53.359
14	50.513
11	46.737



X2	Y
24	51.22
24	48.84
30	57.18
22	42.54
24	52.13
30	51.4
24	48.66
24	53.36
24	50.51
24	46.74

Figure 4. Function f(x1), demonstrating the dependence of age (years) on the obliteration of the lambdoid suture from the outer surface of the calvaria (L), and function f(x2), demonstrating the dependence of age (years) on the obliteration of the lambdoid suture from the inner surface (L'), female skulls

Рисунок 4. Функция f(x1), отражающая зависимость возраста (лет) от облитерации ламбдовидного шва с наружной поверхности свода (L), и f(x2), отражающая зависимость возраста (лет) от облитерации ламбдовидного шва со внутренней поверхности свода (L') для черепов женского пола

$$Y = a \times f(X_1) + b \times (X_2) =$$

$$= 0.99 \times (-0.0071X_1^3 + 0.4517X_1^2 - 8.3145X_1 + 93.536 + 0.01 \times (0.1869 \times e^{(0.038 \times X_2)})$$

$$Y = -0.00703X_1^3 + 0.4472X_1^2 - 8.231X_1 + 92.6 + 0.01 \times (0.1869 \times e^{(0.038 \times X_2)})$$

Figure 5. Equation for age estimation, which is based on the lambdoid suture obliteration data for male skulls, with coefficients standardized for the craniological collection, where Y is age of the skull (years); X_1 is lambdoid suture obliteration on the outer surface; X_2 is lambdoid suture obliteration on the inner surface

Рисунок 5. Составленное возрастное уравнение, основанное на данных облитерации ламбдовидного шва для мужского пола с коэффициентами, стандартизированными для краниологической коллекции, где Y – возраст черепа (лет), X_1 – облитерация участков ламбдовидного шва с наружной поверхности свода, X_2 – облитерация участков ламбдовидного шва с внутренней поверхности свода

$$Y = c \times f(X_1) + d \times (X_2) =$$

$$= 0.01 \times (0.0046X_1^3 - 0.2677X_1^2 + 5.3615X_1 + 15.35) + 0.99 \times (-0.394X_2^2 + 21.955X_2 - 249.78)$$

$$Y = 0.000046X_1^3 - 0.002677X_1^2 + 0.053615X_1 - 0.39X_2^2 + 21.735X_2 - 247.1285)$$

Figure 6. Equation for age estimation, which is based on the lambdoid suture obliteration data for female skulls, with coefficients standardized for the craniological collection, where Y is age of the skull (years); X_1 is lambdoid suture obliteration on the outer surface; X_2 is lambdoid suture obliteration on the inner surface
Рисунок 6. Составленное возрастное уравнение, основанное на данных облитерации ламбдовидного шва для женского пола с коэффициентами, стандартизированными на краниологической коллекции, где Y – возраст черепа (лет), X_1 – облитерация участков ламбдовидного шва с наружной поверхности свода, X_2 – облитерация участков ламбдовидного шва на внутренней поверхности свода

Table
Absolute and relative errors of the second measurement using standard and new methods (skulls with calvariae). Comparison of the second and first craniometric studies
Таблица
Абсолютная и относительная погрешность по результатам второго измерения, выполненного стандартным и новым способами у черепов со сводом. Сравнение второго краниометрического исследования с первым

No.	Measurement 1, years	Measurement 2, years	Median age (mean values of measurements 1 and 2), years	Age (*L*), years	[A] error	∂ error, %
1♀	51.40	51.40	51.40	25.35	26.05	50.68
2♀	48.66	48.66	48.66	54.66	6.00	12.33
3♀	57.18	57.18	57.18	55.75	1.43	2.50
4♀	48.84	48.84	48.84	54.69	5.85	11.98
5♀	53.36	53.36	53.36	56.06	2.70	5.06
6♀	46.74	46.74	46.74	31.87	14.87	31.81
7♀	48.66	48.66	48.66	42.61	6.05	12.43
8♀	42.54	42.54	42.54	54.68	12.14	28.54
1♂	56.2	48.31	52.25	55.67	3.42	6.55
2♂	55.18	51.73	53.46	54.53	1.08	2.01
3♂	49.39	46.32	47.86	49.64	1.79	3.73
4♂	63.80	46.19	55.00	45.93	9.07	16.48
5♂	44.47	45.63	45.05	45.93	0.88	1.95
6♂	52.62	45.11	48.87	47.21	1.65	3.39
7♂	47.09	40.71	43.90	49.81	5.91	13.46
8♂	55.00	53.41	54.21	54.82	0.62	1.13

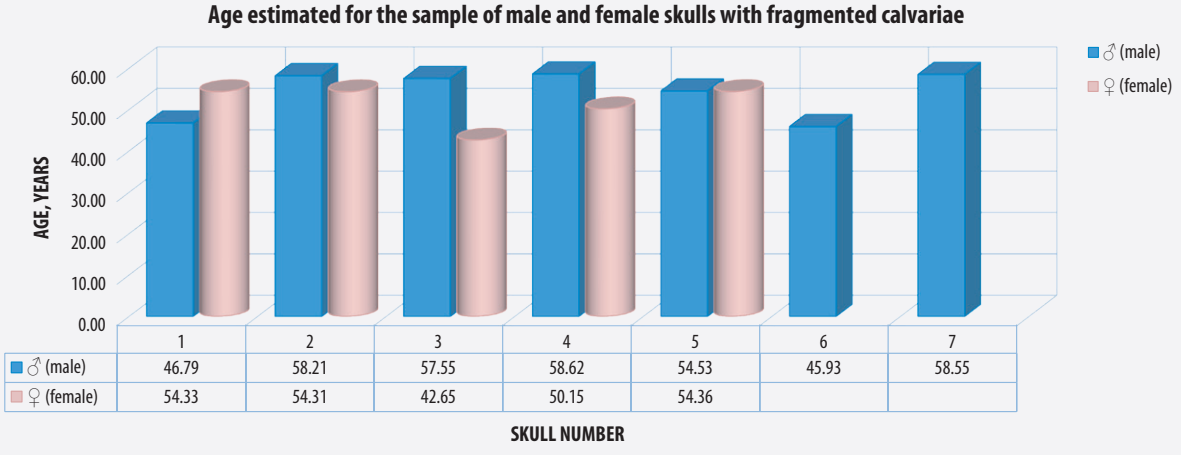


Figure 7. Age determined by the new equation for the lambdoid suture in male and female skulls with fragmented calvariae
Рисунок 7. Определенный по новому уравнению возраст для ламбдовидного шва у мужских и женских черепов с фрагментами свода

Discussion

It is well known that men and women have different obliterations of sagittal and coronal sutures. Our study also confirmed this. However, sexual dimorphism of the lambdoid suture (different obliteration values and different thickening of areas adjacent to calvarial bones) can be found only in the lambda region. The obliteration values of the suture parts located dorsolaterally in the asterion region were similar in both sexes. Figure 3 and Figure 4 show that male and female skulls have reciprocal coefficients of 0.99 and 0.01 before the functions *f(x1)* and *f(x2)* in the new equations. An explanation has been proposed that men exhibit more suture obliteration between ages 25 and 60 years than women. However, by age 60, the rate of obliteration becomes equivalent in both sexes, and after age 60, obliteration is more intense in women. In men, bone thickening and more intensive sagittal and lambdoid suture obliteration start at age of 40-49 years. With age, there is a gradual thinning of the calvarial bones in the lambda region (lambdoid suture), whereas in the region of the vertex (sagittal suture) bones thicken (starting at age 70). Obliteration in women occurs in 2 stages (30-49 years; 70-86 years) with gradual thickening of the calvarial bones in the lambda and bregma (coronal suture).[14]

In men the thinning of the calvarial bones in the lambda region along the lambdoid suture with age can be attributed to slowing down of lambdoid suture obliteration from the inner surface. In women, on the contrary, the thickness of the bones in the lambda region increases due to more intensive obliteration from the inner surface after age of 60 years. A more pronounced correlation between age values and scores of obliteration from the inner surface of the calvaria than that from the outer surface was also reported.[6,13]

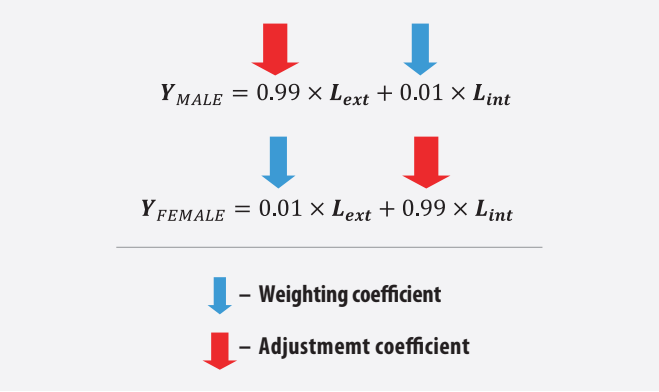


Figure 8. Reciprocal coefficients for male and female variants of new equations, where L is obliteration of the lambdoid suture on the outer surface of the calvaria (function f(x1)); L'is obliteration of the lambdoid suture on the inner surface (function f(x2))
Рисунок 8. Отражение взаимно обратных коэффициентов для мужского и женского нового составленного уравнения, где L – облитерация ламбдовидного шва с наружной поверхности свода (функция f(x1)); L'– облитерация ламбдовидного шва с внутренней поверхности (функция f(x2))

Thus, the coefficient near the function *f(x2)* of the conditionally internal obliteration of the lambdoid suture is determinant (weighting) and shows that with age the score of internal calvarial obliteration decreases in male skulls and increases in female skulls, which is expressed in thinning/thickening of the calvarial bones in the lambda region.

The coefficients near the function expressing the external obliteration of the lambdoid suture (*L*), selected by regression analysis and standardized for the craniological collection, are adjusting and should fit the condition in which the coefficients are reciprocal (Figure 8).

The research has shown that osteometric aspects of anthropology require further mathematical refinement and systematization of the acquired knowledge of new methods under development for successful practical formulation of human osteobiography.

Conclusions

The proposed method of age estimation has all the characteristics of classical methods and additionally allows for studying fragmented skulls. The evaluation of the results demonstrated the advantage of using the new method in the age estimation, ie, less sexual dimorphism of the lambdoid suture and the minimum number of variables required for the construction of sex-age equations. This method can be used for age estimation in craniometric studies in developmental anatomy and can also be an additional clarifying method in paleoanthropological and archaeological excavations or in medical and forensic identification of skulls with damaged calvariae or facial skeleton. The study has shown the importance of creating mathematical models to modernize existing craniometric methods in order to reconstruct the most complete human osteobiography.

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Литература/References

1. Ибрагимов А.Ш., Евсеев Р.В., Алиев А.А. Восстановление внешнего облика мужчины из шемахинского могильника периода раннего Средневековья. *Вестник Московского университета. Серия 23: Антропология*. 2023;(1):129–137.

Ibrahimov AS, Yevseyev RV, Aliev AA. Forensic facial reconstruction of a man from the Shamakhigrave field of the early medieval period. *Lomonosov Journal of Anthropology*. 2023;(1):129–137. (In Russ.).

2. Бахарева Н.С. Особенности асимметрии линейных размеров лицевых черепов жителей Юга России. *Фундаментальные исследования*. 2012;(8–2):279–284.

Bakhareva NS. Asymmetnry of facial cranium liner sizes in Southen regions of Russia. *Fundamental Research*. 2012;(8–2):279–284. (In Russ.).

3. Işcan MY. Global forensic anthropology in the 21st century. *Forensic Sci Int*. 2001;117(1–2):1–6. PMID: 11230940. https://doi.org/10.1016/s0379-0738(00)00433-3

4. Gupta A, Kumar K, Shetty DC, Wadhwan V, Jain A, Khanna KS. Stature and gender determination and their correlation using odontometry and skull anthropometry. *J Forensic Dent Sci*. 2014;6(2):101–106. PMID: 25125917. PMCID: PMC4130011. https://doi.org/10.4103/0975-1475.132536

5. Лифенко К.О., Хромов Д.А. Диагностика возраста по черепу метрическими методами. В: Под ред. С.Н. Алексеенко, А.Н. Редько, С.Е. Байбакова. *Сборник тезисов 85-й Международной научно-практической конференции Студенческого научного общества им профессора Н.П. Пятницкого*. Кубанский государственный медицинский университет; 2024:629–631.

Lifenko KO, Khromov DA. Age estimation by skull metric methods. In: Alekseenko SN, Redko AN, Baybakov SE, eds. *Proceedings of the 85th International Scientific and Practical Conference of N.P. Pyatnitskii Student Scientific Society*. Kuban State Medical University; 2024:629–631. (In Russ.).

6. Абрамов С.С., Гедыгушев И.А., Звягин В.Н., Назаров Г.Н., Томилин В.В. *Медико-криминалистическая идентификация. Настольная книга судебно-медицинского эксперта*. НОРМА-ИНФРА; 2000.

Abramov SS, Gedygushev IA, Zvyagin VN, Nazarov GN, Tomilin VV. *Forensic Medical Identification. Handbook of the Forensic Medical Expert*. NORMA-INFRA; 2000. (In Russ.).

7. Смирнов А.В. Современные подходы к судебно-медицинскому исследованию остеологического материала с целью идентификации личности. В: Под ред. Д.В. Сундукова, М.Л. Благонравова. *Декабрьские чтения по судебной медицине в РУДН: актуальные вопросы судебной медицины и общей патологии: сборник материалов Всероссийской научно-практической конференции с международным участием, посвященной 55-летию кафедры судебной медицины Медицинского института Российского университета дружбы народов, Москва, 20 декабря 2019 года*. РУДН; 2020:192–198.

Smirnov AV. Modern approaches to forensic osteology for identification. In: Sundukov DV, Blagonravov ML, eds. *RUDN December Readings on Forensic Medicine : Current Issues of Forensic Medicine and General Pathology : Proceedings of the All-Russian Scientific and Practical Conference With International Participation Dedicated to the 55th Anniversary of the Forensic Medicine Department of the Institute of Medicine of Peoples' Friendship University of Russia, Moscow, December 20, 2019*. RUDN; 2020:192–198. (In Russ.).

8. Звягин В.Н. Текущие проблемы медико-криминалистической идентификации личности. *Проблемы экспертизы в медицине*. 2012;12(3–4):39–43.

Zvjagin VN. Current problems of medicine and criminalistical identification of the person. *Problemy ekspertizy v meditsine*. 2012;12(3–4):39–43. (In Russ.).

9. Franklin D. Forensic age estimation in human skeletal remains: current concepts and future directions. *Leg Med (Tokyo)*. 2010;12(1):1–7. PMID: 19853490. https://doi.org/10.1016/j.legalmed.2009.09.001

10. Wen H, Wu W, Fan F, et al. Human identification performed with skull's sphenoid sinus based on deep learning. *Int J Legal Med*. 2022;136(4):1067–1074. PMID: 35022840. https://doi.org/10.1007/s00414-021-02761-2

11. Корхмазов В.Т., Перхов В.И. Доступность специализированной медицинской помощи при тяжелых травмах головы в период пандемии COVID-19. *Инновационная медицина Кубани*. 2022;(1):44–52. https://doi.org/10.35401/2500-0268-2022-25-1-44-52

Korkhmazov VT, Perkhov VI. Availability of specialized medical care in cases of severe head injuries during the COVID-19 pandemic. *Innovative Medicine of Kuban*. 2022;(1):44–52. (In Russ.). https://doi.org/10.35401/2500-0268-2022-25-1-44-52

12. Зайцева Е.С., Ахадов Т.А., Маматкулов А.Д. и др. Компьютерная томография ушибов головного мозга у детей до 3 лет. *Инновационная медицина Кубани*. 2024;(1):86–93. https://doi.org/10.35401/2541-9897-2024-9-1-86-93

Zaytseva ES, Akhadov TA, Mamatkulov AD, et al. Computed tomography of cerebral contusions in children younger than 3 years. *Innovative Medicine of Kuban*. 2024;(1):86–93. (In Russ.). https://doi.org/10.35401/2541-9897-2024-9-1-86-93

13. Пашкова В.И., Резников Б.Д. *Судебно-медицинское отождествление личности по костным остаткам*. Изд-во Сарат. университета; 1978.

Pashkova VI, Reznikov BD. *Forensic Identification Through Bone Remains*. Izd-vo Sarat. universiteta; 1978. (In Russ.).

14. Зайченко А.А., Коченкова О.В., Анисимова Е.А., Анисимов Д.И., Лукин О.Ю. Закономерности облитерации зубчатых швов черепа человека (обзор). *Саратовский научно-медицинский журнал*. 2011;7(3):567–572.

Zaichenko AA, Kochenkova OV, Anisimova EA, Anisimov DI, Lukin OYu. Obliteration of serrated sutures of a human skull (review). *Saratov Journal of Medical Scientific Research*. 2011;7(3):567–572. (In Russ.).

15. Мордасов В.Ф., Звягин В.Н., Горшков А.Н., Корсаков А.Л., Васильева Н.В., Соколов С.В., авторы; Бюро судебно-медицинской экспертизы Министерства здравоохранения Ленинградской области, патентообладатель. Способ идентификации личности по скелетированным костным остаткам. Патент РФ № RU2107461C1. 27.03.1998.

Mordasov VF, Zvjagin VN, Gorshkov AN, Korsakov AL, Vasil'eva NV, Sokolov SV, inventors; Bjuro sudebno-meditsinskoj ehkspertizy Ministerstva zdravookhrenenija Leningradskoj oblasti, assignee. Method for identifying person by examining skeleton bone remnants. Russian Patent RU2107461C1. March 27, 1998.

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