GEORGIAN MEDICAL NEWS

ISSN 1512-0112

NO 3 (360) Март 2025

ТБИЛИСИ - NEW YORK

ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

Monthly Georgia-US joint scientific journal published both in electronic and paper formats of the Agency of Medical Information of the Georgian Association of Business Press. Published since 1994. Distributed in NIS, EU and USA.

GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.
GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.
ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf

In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman** (**Кириллица**), ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ,რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

GEORGIAN MEDICAL NEWS
No 3 (360) 2025

Содержание:

GEORGIAN MEDICAL NEWS
No 3 (360) 2025

CRANIAL MORPHOMETRY: COMPARING TRADITIONAL METHODS AND 3D SCANNERS

Kaltrina Veseli[1], Fehim Haliti[2]*, Enis Veseli[3], Art Berisha[4], Argjira Veseli[5,6], Edona Breznica[7], Arta Veseli[8].

[1]Department of Orthodontics, Alma Mater Europaea, Campus College Rezonanca, Prishtina, Kosovo

[2]Department of Pediatric and Preventive Dentistry, Dental School, Faculty of Medicine, University of Prishtina, Prishtina, Kosovo

[3]Department of Prosthodontics, Dental School, Faculty of Medicine, University of Prishtina, Pristina, Kosovo

[4]Private Practice, Prishtina, Kosovo

[5]Department of Periodontology and Oral Medicine, Alma Mater Europaea, Campus College Rezonanca, Prishtina, Kosovo

[6]School of Dental Medicine, Dental Science, University of Zagreb, Zagreb, Croatia

[7]Aura, Prishtina, Kosovo

[8]Ss. Cyril and Methodius University, Skopje, North Macedonia.

Abstract.

Introduction: This narrative review analyzes differences between present 3D scanning technologies and traditional anthropometric methods in cranial morphometry. Reviewing the literature, we highlight the advantages, disadvantages, and uses of both techniques in anthropology, medical plastic surgery, orthodontics, and forensic science. We compared the efficacy of anthropometric measurement techniques, including 3D scanning and traditional methods. Craniofacial anthropometry involves measuring the head and face in living individuals, cadaveric specimens, and radiological images. Traditional caliper-based methods provide accuracy when performed by trained professionals but are prone to human error, time-consuming, and require extensive training. 3D laser scanning emerges as a more modern, accurate, and non-invasive alternative. It avoids physical contact and provides repeatable data with accuracy comparable to calipers. This study examines the differences between traditional approaches and 3D technology in skull measurements, highlighting the advantages of digital methods.

Aim of study: To evaluate and compare conventional manual methods and 3D scanning techniques used in cranial anthropometry, to highlight their respective advantages, limitations, and applicability in research and clinical fields such as anthropology, forensic science, orthodontics, and maxillofacial surgery.

Material and methods: This study summarizes relevant studies comparing traditional and digital craniometric methods. A systematic search using keywords like “conventional methods craniometry” and “laser scanning craniometry” was conducted in PubMed, Scopus, and Google Scholar. Inclusion criteria focused on English-language research articles, reviews, and studies involving direct or 3D laser-based measurements. Irrelevant articles were excluded.

Conclusion: Traditional craniofacial measurements using tools like calipers and osteometric boards rely on physical contact and are prone to human error, require time, and demand professional training. Although 3D scanning offers greater accuracy and efficiency, studies with large sample sizes and proper comparisons remain limited. This paper explores the application of both methods in preserving osteological material and advancing research in anthropology, forensic medicine, orthodontics, and orthognathic surgery.

Key words. Craniofacial anthropometry, 3D scanning, traditional methods, laser scanning, forensic science, orthodontics, orthognathic surgery, skull measurements, digital morphometrics.

Introduction.

The field of anthropometry known as craniofacial anthropometry measures the head and face of living, cadaveric, and radiological specimens [1]. Craniometric data are essential for orthodontists during the planning of orthodontic treatments (as a correlation has been found between skull shape, facial form, and the dimensional values of the dental arches of the jaws, especially in the transverse direction), for plastic surgeons to understand craniofacial dimensions to apply this knowledge to facial reconstructive procedures, and for anthropologists, as it aids in analyzing biological variation and comparing human populations. In forensic medicine, craniometric data are used for identifying individuals by determining sex, age, and ethnic characteristics from the skull. Orthodontists and plastic surgeons must understand craniofacial dimensions to apply these understandings when recommending orthodontic treatments and performing facial reconstructive procedures [2]. The osteometric board, Mollison's craniophore, and spreading and sliding calipers are the traditional tools used to measure the skeleton. Limitations include the time needed for data collection, storage, and reconstruction for 3D applications, even though different kinds of calipers and linear measuring instruments can offer precise and repeatable 3D surface measurements [3]. Still, researchers continue to use traditional approaches. Biodiversity morphometrics has a long history of using external caliper measurements, mostly because of its affordability and ease of use. The application of two-dimensional photographs as a source of morphological information is equally common. Numerous morphometrics research uses a digital camera to take pictures of every person. Then, using the proper software, all measurements are obtained from those digital photos. This strategy caused a lot of criticism, though. Scholars contend that there will always be some mistakes when interpreting data from three-dimensional objects in two dimensions. Laser surface scanners, which replicate the scanned items in all three dimensions, can help prevent this measurement error [4,5]. Laser-based scanners are non-invasive, reasonably priced, and do not emit any radiation. In addition to being quick and precise, these scanners do not make direct contact with the subject [6,7]. Furthermore, the validity of calipers as diagnostic tools for cranial measures has been questioned in earlier research [8]. Bony landmarks must be carefully located to avoid inconsistent readings caused by soft tissue movement [9]. Using sophisticated tools and anatomical reference points, direct measurements of the skull are obtained in traditional craniometry. As an alternative, 3D models made using various methods, such as laser scanning, can be used to extract craniometric data. According to Park's 2006 study, handheld 3D laser scanning is a very dependable method for craniometry when paired with accurate landmark identification on a scanned skull. Strong intra- and inter-rater consistency was shown by the approach, guaranteeing repeatable measurements across many observers and research projects. The study also showed that the quality and precision of craniometric data acquired by 3D scanning are on par with those attained by conventional caliper-based measures. These results show that handheld 3D laser scanning is a viable solution for traditional craniometric techniques [10]. By analyzing the relevant scholarship, this study aims to illustrate what is different between traditional techniques and 3D measurement technology on dry skulls. Spreading calipers, sliding calipers, and the osteometric board have all been used in the past to acquire craniofacial measurements. To estimate the size of the skull, face, and other cranial components, these techniques rely on physical interaction with anatomical landmarks. Research indicates that while traditional approaches can be accurate when used by skilled professionals, they have disadvantages. Inconsistent outcomes may arise from human mistakes in measurements, incorrect landmark placement, and soft tissue movement, for instance. Traditional approaches can often be difficult and require much training.

Materials and Methods.

Using a narrative review methodology, this study synthesizes appropriate research from novels, scientific reports, and peer-reviewed journals. Using the keywords "conventional methods craniometry" and "laser scanning craniometry," systematic searches in databases including PubMed, Scopus, and Google Scholar were used to find sources, with an emphasis on publications that contrasted traditional and digital morphometric techniques. Article kinds, research papers, reviews, direct anthropometry measurements of study participants, laser scanning morphometric measurements, and English-language articles were among the requirements for the literature inclusion. Articles unrelated to the subject were excluded.

Classical Methods.

For years, the shape and structure of the skull have been analyzed and measured using traditional methods of skull examination. These techniques usually require using calipers for manual measurements as well as other osteometric tools such as craniophor tools and osteometric boards. Finding anatomical reference sites on the head and calculating the distances between them are essential components of the examination. The following instruments are frequently used for traditional skull measurements: Skull length, width, and depth are measured with sliding calipers. A level surface used to measure different aspects of the skull is called an osteometric board. A device called a craniophor is used to hold the skull still while taking measurements. Other techniques may be used in addition to these instruments to measure angles and other skull dimensions, which aid in identifying the kind of skull and its many attributes [11].

There are some significant disparities between measurements made with calipers and those acquired using 3D scanning. Although calipers are an affordable option for taking direct measurements, they require the patient to be present and take a lot of time. Additionally, they could deform tissue, which could result in measuring mistakes [12]. There are several significant variations between measurements made with calipers and those acquired using 3D scanning. For direct measurements, calipers are an affordable alternative, but they take time and need the patient to be present. They might also deform tissue, which would result in inaccurate measurements. On the other hand, 3D scanning, which necessitates post-processing, provides a quicker procedure through virtual modeling but is more costly. This eliminates the requirement for the patient to be present and avoids tissue distortion problems by enabling repeated measurements on a 3D model. Accurate regions with intricate morphologies and data storage are two more advantages of 3D scanning. The disadvantages and benefits of both strategies are highlighted in Table 1.

Table 1. *Comparative Assessment: 3D Scanning vs. Classical.*

	3D Scanning	**Classical Methods**
The accuracy	High	Moderate
Method of Measuring	Indirect-on a virtual model	Direct
Reproducibility	Repeated measurements on a 3D model are possible	Presence of the patient required
Time Efficiency	Faster data acquisition	Time-consuming
Non-Destructive	Yes	Sometimes invasive
Cost	High (initial investment)	Low
Data Storage & Sharing	Digital, easy-to-share	Limited (manual records)
Other benefits	Data storage Accurate areas with complex morphology	

3D scanning methods.

In general, there are two kinds of 3D surface scanners: contact and non-contact [13]. Non-contact scanners use light or cameras without coming into contact with the object, whereas contact scanners touch the object to measure its shape [14]. Two types of non-contact scanning techniques are active scanning and passive scanning [15]. The passive methods rely on taking several pictures from different locations on the object's surface and using photogrammetric software to detect relations between them [16]. In contrast, the active scanning method uses scanners that generate light and measure its reflection from the object. This allows the surface object to be replicated by predicting the type of light that is applied to the object's surface [17]. A well-known invention, 3D active scanning has found use in several fields, including medicine, dentistry, the automotive industry for recording auto accidents, forensic sciences for facial recognition and mapping, heritage documentation, and archeological applications [18-20]. 3D scanning in craniometry is used to measure the skull with high accuracy without physical contact. It replaces traditional caliper-based methods by offering faster, more precise, and repeatable measurements. This technology is applied in anthropology, forensics, medicine, and archaeology to analyze skull shape, identify individuals, or study human evolution. The use of 3D scanners also allows for the digital preservation and sharing of skull models for research purposes [21]. With post-processing needed, 3D scanning provides a quicker procedure through indirect virtual modeling, despite being more costly. It eliminates tissue distortion problems and reduces the requirement for a patient to be present by allowing repeated measurements on a 3D model. Additional benefits of 3D scanning include precise mapping of objects with complex morphology, data exportation and storage, and the possibility to measure specific areas later [22].

Results and Discussion.

This narrative review includes a total of 33 scientific references that address cranial anthropometric measurements using various methods. Of these, 10 studies employed only the classical (manual) method, while 20 studies applied 3D scanning technology in craniometric analyses. Only a limited number of studies have directly compared classical anthropometric methods with 3D scanning techniques in cranial morphometry. Among them, three studies stand out for employing both methodologies within the same research framework. Schaaf et al. (2010) evaluated the accuracy of photographic assessment compared to standard anthropometric measurements in patients with nonsynostotic cranial deformities. Their results indicated that while photographic methods offer acceptable accuracy, they are less reliable than direct anthropometric techniques due to variability in landmark positioning and soft tissue interference [9]. Major et al. (2024) conducted a comparative study using a structured light 3D scanner to assess facial dimensions, juxtaposing the results with those obtained through direct anthropometry. They reported a strong correlation between the two approaches, highlighting that structured light scanning provides reliable and reproducible measurements with high clinical applicability in craniofacial assessments [22]. Fahrni et al. (2017) compared CT scanning with 3D surface scanning in skull evaluations. Although CT was slightly more consistent, the findings demonstrated that 3D surface scanning is a valid alternative, especially in scenarios where radiation exposure must be minimized. The authors emphasized the importance of choosing the appropriate modality depending on the specific clinical or forensic context These findings collectively support the potential of 3D scanning technologies as complementary or alternative tools to classical methods, especially for their non-invasive nature, digital storage, and measurement reproducibility [23].

Only 3 studies used both methods comparatively, allowing for a more detailed evaluation of accuracy and efficiency between traditional and digital approaches. The studies utilizing 3D technology involved a wide range of scanners, including laser scanners, structured light scanners, handheld devices, photogrammetry, intraoral scanners, and cone-beam computed tomography (CBCT). This variety highlights the rapid technological development and broad adoption of modern methods in scientific research. In terms of geographical distribution, the studies were conducted internationally, with a notable concentration in Asia, Europe, and Africa, demonstrating the global relevance of anthropometric measurements in both clinical and research contexts (Figure 1). Furthermore, the publication years of the references span a wide time range, from 1984 to 2024. The number of studies published per decade is as follows: before 2000: 1 study (1984), 2000–2009: 5 studies, 2010–2019: 15 studies, 2020–2024: 12 studies (Figure 2). This distribution reflects a significant increase in scientific interest in recent decades, particularly due to the advancement of 3D

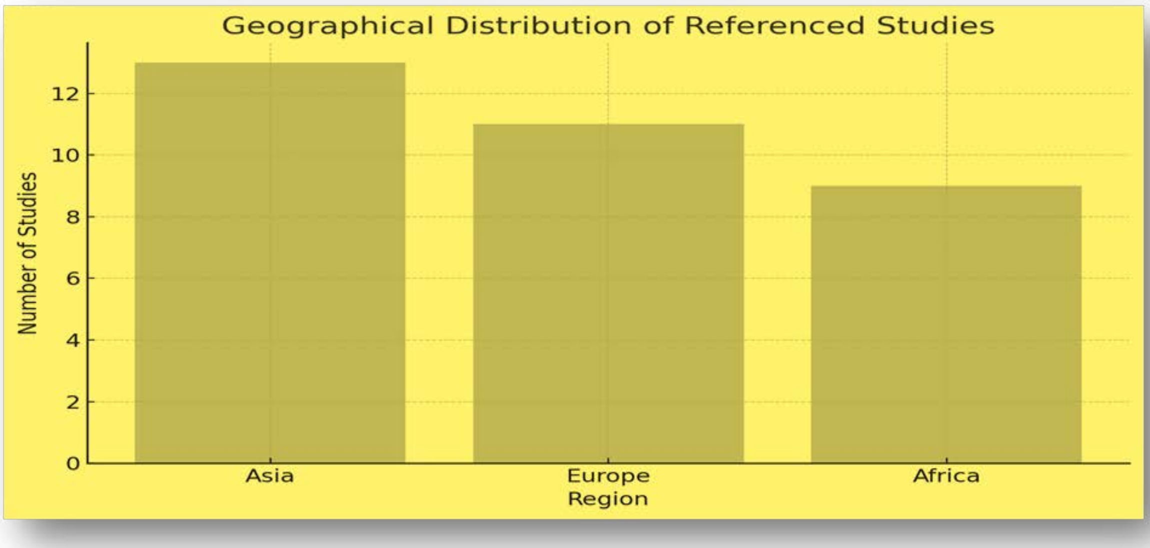

Figure 1. Geographical distribution of the referenced studies. The studies were conducted across multiple regions, with a notable concentration in Asia, Europe, and Africa, highlighting the global relevance of anthropometric measurements in both clinical and research contexts.

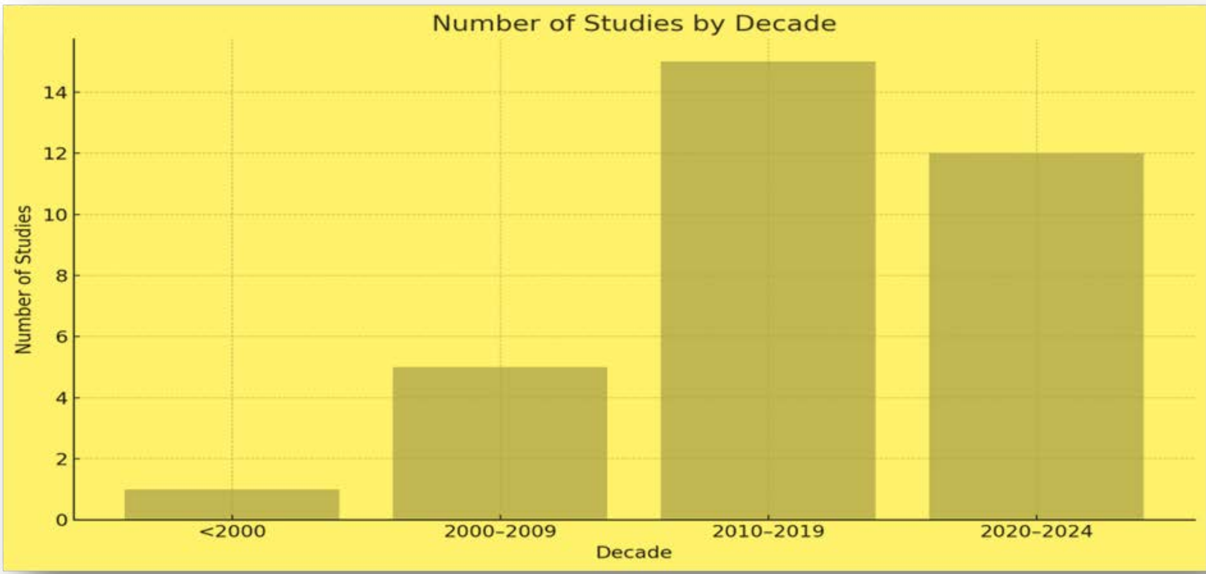

Figure 2. *Temporal distribution of the referenced studies, showing a steady increase in publications from 2000 onward, with a peak between 2010 and 2019 (15 studies), followed by 12 studies between 2020 and 2024.*

technology and its application in the fields of anthropometry and orthodontics.

Skull morphometry researchers are using three-dimensional laser surface scanners more and more because of their accuracy and advanced capabilities. Two distinct clinicians measured the same subjects using a spreading caliper, and the anthropometric parameters obtained were recorded to independently examine the method's validity and reliability. The results show that competent examiners are necessary when using a spreading caliper to evaluate head shape because the degree of deformity is greatly impacted by the precision and competence of the location and execution of the measurement. The spreading caliper may not always be precisely placed in the same region since babies and young children frequently can't stay static enough. The 3D scanning method allows for the preservation of the original 3D image through computer software and can statically depict the head shape [23]. The development of a 3D scanner that uses distance sensor technology has opened up exciting possibilities for scanning objects in the real world and incorporating them into augmented reality (AR). Furthermore, the effective implementation of this 3D scanner demonstrates the rapid advancement of sensor technology and underscores the increasing importance of augmented reality in our daily lives [24]. A comparison study examined measurements taken using a laser surface scanner, calipers, and two-dimensional digital photographs. The findings demonstrated a high degree of consistency between the measurements obtained from 2D pictures and those made using calipers. Comparing the 3D laser scanner's measurements to the conventional approach, however, revealed differences. The authors worry that how the device is used determines how accurate the scanning is, and they advise making the most of all of its technical features, such as high-resolution scans, scanning from various angles, controlled lighting, and surface reflectivity reduction, to enhance the quality of 3D models. Nevertheless, this method needs more time, computing resources, and storage space [25]. According to one study, structured light 3D scanning is a promising technique for determining an infant's head shape. It provides precise and trustworthy findings for measurements that are normally taken with a tape measure. Even so, the study only measures one component of the cranium [26]. The authors' suggestions for baby head measurements are based on the findings of this study. Infant head measurements can be taken using both conventional methods and 3D scanning. However, 3D scanning is superior to spreading calipers because it offers more and more accurate characteristics, which help identify irregularities in head shape and provide personalized helmet orthopedics [27]. Laser scanning is an effective technique for evaluating dry skulls, and it is advised for data accuracy. In complex and challenging-to-reach areas of the cranial skeleton, this method works especially well for taking precise measurements [28]. The fact that just one operator carried out the scanning process was one of the study's limitations. It was determined not to acquire a second operator because of the sensitivity of the scanned objects, which needed to be handled carefully, and time constraints associated with the volume of data created. Consequently, it was not possible to evaluate the operator-dependent error. Nonetheless, the majority of the 3D model production software is automated, and the operator carries out the scans following the manufacturer's instructions and pertinent training. So, if another operator was involved, we wouldn't expect significant variances under these conditions. Prior research evaluating a variety of anatomical surface models has confirmed that the Viewbox 4 software's processing error is minimal [29-31]. This technique can be applied to the preservation and documentation of osteological material, the development of research concepts in the fields of anatomy, dental prosthetics, orthodontics, maxillofacial surgery, and forensic science, as well as to enhance opportunities for scientific collaboration [32]. The current work draws important conclusions, including the possibility of using these scans to create precise digital 3D models of bone specimens for anthropological data, forensic applications, radiologic research, and medical applications (such as inter-operation scans). Most commonly used imaging techniques, like computed tomography (CT) and cone beam CT (CBCT), are more prone to errors, especially when low-radiation protocols are used for radiation protection concerns. These models enable the acquisition of gold-standard measurements in ex vivo studies that can be used to assess the accuracy of these techniques [33]. Furthermore, the recent development of advanced technology could enhance interaction and progress in this field [34-36].

Conclusion.

Traditionally, instruments including calipers, slide calipers, and osteometric tables have been used to take craniofacial measurements. These techniques estimate the size of the skull, face, and other craniofacial components by making physical contact with anatomical sites. According to studies, traditional approaches have several limitations but can be accurate when carried out by qualified experts. For instance, conflicting results may arise from human error in measurements, incorrect landmark placement, and soft tissue movement. Traditional methods can take a lot of time and require a lot of training.

Although 3D scanning has proven to be a more accurate and efficient method, studies with large sample sizes and proper comparisons with traditional methods are still lacking. This paper addressed the ways in which these techniques can be applied to the preservation and documentation of osteological material and the development of research concepts in the fields of anthropology, forensic medicine, orthodontics, and orthognathic surgery.

However, before this can be fully achieved, several methodological challenges still need to be addressed. For instance, the precision and accuracy of angular measurements, surface arcs, surface areas, and volumetric data must still be thoroughly evaluated. This will require direct comparisons between datasets obtained from different 3D technologies. Laser scanning is a reliable and recommended technique for ensuring data accuracy. It is particularly effective in capturing detailed measurements of complex and hard-to-access areas of the cranial skeleton. The 3D laser scanning method demonstrates excellent reliability and serves as a valuable alternative to conventional direct measurement in craniometry. Further studies are needed to evaluate the reliability of 3D laser scanning methods in applications such as photographic superimposition and facial reconstruction.

REFERENCES

1. Ulcay T, Kamaşak B. Sex-based comparative examination of craniofacial anthropometric measurements in medical school students. Antropoloji. 2020;39:66-73.

2. Chandouliya S, Arora R, Chandel CS, et al. Anthropometric measurements of craniofacial region in medical students of RUHS College of Medical Sciences. Int J Toxicol Pharmacol Res. 2022;12:10-16.

3. Navic P, Inthasan C, Chaimongkhol T, et al. Facial reconstruction using 3-D computerized method: A scoping review of methods, current status, and future developments. Leg Med (Tokyo). 2023;62:102239.

4. Zelditch ML, Swiderski DL, Sheets HD, et al. Geometric morphometrics for biologists: a primer. 2nd ed. London: Academic Press; 2012.

5. Katz D, Friess M. Technical note: 3D from standard digital photography of human crania—A preliminary assessment. Am J Phys Anthropol. 2014;154:152-158.

6. Petrides G, Clark JR, Low H, et al. Three-dimensional scanners for soft-tissue facial assessment in clinical practice. J Plast Reconstr Aesthet Surg. 2021;74:605-614.

7. Isa M, Lazoglu I. Design and analysis of a 3D laser scanner. Measurement. 2017:111.

8. McGarry A, Dixon MT, Greig RJ, et al. Head shape measurement standards and cranial orthoses in the treatment of infants with deformational plagiocephaly. Developmental Medicine & Child Neurology. 2008;50:568-576.

9. Schaaf H, Wilbrand J-F, Boedeker R-H, et al. Accuracy of photographic assessment compared with standard anthropometric measurements in nonsynostotic cranial deformities. Cleft Palate Craniofacial J. 2010;47:447-453.

10. Park HK, Chung JW, Kho HS. Use of hand-held laser scanning in the assessment of craniometry. Forensic Science International. 2006;160:200-206.

11. Ubelaker D.H. Human Skeletal Remains: Excavation, Analysis, Interpretation. Taraxacum Press. 1984.

12. Thali MJ, Braun M, Brueschweiler W, et al. Morphology imprint' determination of the injury-causing weapon from the wound morphology using forensic 3D/ CAD- suspected photogrammetry. Forensic Sci Int J. 2003;132:177-181.

13. Krouskop TA, Baker R, Wilson MS. A noncontact wound measurement system. J Rehabil Res Dev. 2002;39:337-346.

14. Sansoni G, Trebeschi M, Docchio F. State-of-the-art and applications of 3D imaging sensors in industry, cultural heritage, medicine, and criminal investigation. Sensors (Basel). 2009;9:568-601.

15. Pintus R, Gobbetti E, Scopigno R. Overview of passive and active vision techniques for hand-held 3D data acquisition. In: 3D Imaging, Analysis and Applications. Springer. 2012:89-113.

16. Gautier Q, Garrison T, Rushton F, et al. Low-cost 3D scanning systems for cultural heritage documentation. J Cult Herit Manag Sustain Dev. 2020.

17. Blais F. Review of 20 years of range sensor development. J Electron Imaging. 2004;13:231-240.

18. Sansoni G, Trebeschi M, Docchio F. State-of-the-art and applications of 3D imaging sensors in industry, cultural heritage, medicine, and criminal investigation. Sensors (Basel). 2009;9:568-601.

19. Mangano FG, Hauschild U, Veronesi G, et al. Trueness and precision of four intraoral scanners in oral implantology: A comparative in vitro study. PLoS One. 2016;11:e0163107.

20. Pagounis V, Tsakiri M, Palaskas S, et al. 3D laser scanning for road safety and accident reconstruction. 2006. In: Proceedings of the ISPRS Commission V Symposium; 2006 Jun 25–27; Dresden, Germany. 2006:296-301.

21. Waltenberger L, Rebay-Salisbury K, Mitteroecker P. Three-dimensional surface scanning methods in osteology: A topographical and geometric morphometric comparison. Am J Phys Anthropol. 2021;174:10.1002/ajpa.24204.
22. Major M, Mészáros B, Würsching T, et al. Evaluation of a Structured Light Scanner for 3D Facial Imaging: A Comparative Study with Direct Anthropometry. Sensors (Basel). 2024;24:5286.
23. Mortenson PA, Steinbok P. Quantifying positional plagiocephaly: Reliability and validity of anthropometric measurements. J Craniofac Surg. 2006;17:413-419.
24. Rahman Md, Islam Md, Jaoyad SM, et al. Design & Development of A 3D Scanner based on a Distance Sensor to Scan Real-life Objects & Implementing in Digital Reality. International Journal of Science and Business. 2023;30:75-87.
25. Thoma C, Makridou K, Bakaloudis D, et al. Evaluating the potential of three-dimensional laser surface scanning as an alternative method of obtaining morphometric data. Ann Zool Fenn. 2018;55:61-70.
26. Andrews ET, Ashton JJ, Pearson F, et al. Handheld 3D scanning as a minimally invasive measuring technique for neonatal anthropometry. Clinical nutrition ESPEN. 2019;33:279-82.
29. Winkler J, Gkantidis N. Trueness and precision of intraoral scanners in the maxillary dental arch: an in vivo analysis. Sci Rep. 2020;10:1172.
30. Henninger E, Vasilakos G, Halazonetis D, et al. The effect of regular dental cast artifacts on the 3D superimposition of serial digital maxillary dental models. Sci Rep. 2019;9:10501.
31. Häner ST, Kanavakis G, Matthey F, et al. Voxel-based superimposition of serial craniofacial CBCTs: reliability, reproducibility and segmentation effect on hard-tissue outcomes. Orthod Craniofac Res. 2020;23:92-101.
32 Femi-Akinlosotu O, Igado O, Adeniji K. Morphometrics of human skulls and mandibles obtained from Southwestern Nigeria: implications in clinical manoeuvres. The Journal of Basic and Applied Zoology. 2024;85.
33. Fahrni S, Campana L, Dominguez A, et al. CT-scan vs. 3D surface scanning of a skull: first considerations regarding reproducibility issues. Forensic Sci Res. 2017;2:93-99.
34. Veseli E. Metaverse: a promise avenue for enhancing dental care. Khyber Medical University Journal. 2024;16:1-2.
35. Veseli E. Revolutionizing dentistry: the integration of artificial intelligence and robotics. Khyber Medical University Journal. 2024;16.
36. Veseli E. The future of dentistry through robotics. British Dental Journal. 2025;238:76-77.