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OPINION

of Prof. Svetlozara Petkova, Institute of Experimental Morphology, Pathology And Anthropology With A Museum (IEMPAM) - BAS, appointed as a member of the Scientific Jury by Order No. RD-09-37/27.07.2023 of the Director of IEMPAM.

Regarding: dissertation work for the award of a scientific degree "Doctor of Sciences" field 4. Natural sciences, mathematics and informatics, Professional direction 3. Biological sciences, Scientific specialty "Anthropology" (01.06.01)
Author: Associate Professor Silvia Yanakieva Nikolova, PhD - from the "Anthropology" section at IEMPAM-BAS.
Dissertation topic: Medico-biological aspects of cranial sutures: microstructure, physiological closure, metopism.

Presentation of the author and the contest materials:
Associate Professor Silvia Nikolova, PhD, graduated from the Faculty of Biology of the University of St. Kliment Ohridski" and in 2003 acquired a bachelor's degree in "Biology and Chemistry" and in 2005 graduated with a master's degree in General Anthropology. She joined IEMPAM-BAS in 2009 as a specialist biologist. In 2011, as a full-time doctoral student, he defended a thesis for the acquisition of the ONS "doctor" on the topic "Anatomical variations of the skull - anthropological characterization and assessment of inter-sex and bilateral differences". In 2011, she held the academic position of "assistant", in 2012 she was elected chief assistant, and in 2023 she was elected associate professor in the specialty "Anthropology". She is a member of the Bulgarian Anatomical Society and the European Anthropological Association.
The materials presented by Associate Prof. Nikolova for the competition include: a set of documents required according to the Regulations of IEMPAM for the acquisition of scientific degrees and for the occupation of academic positions, a dissertation and a project for an abstract.
The dissertation is described in 251 pages with well-structured and balanced separate parts. The text part is supported by 71 figures and 28 tables, and 378 literary sources are cited. The paper contains an introduction, literature review, aim and objectives, material and methods, results and discussion, summary, conclusions and scientific contributions. The individual parts follow the logic of scientific research and present a complete work in terms of information and scientific knowledge.
The relevance of the dissertation is determined by the topic and the specifically set goal of the study, namely: to study the microstructure and physiological closure of the cranial sutures and to evaluate the specifics in the cranial morphology in metopism. From the literature review, the author summarizes that the main mechanisms that regulate the formation, functioning and closure of cranial sutures are still not fully understood and continue to be the subject of active research, which supports the need for the present study.
The set goal requires the use of non-destructive methods to study the bone microarchitecture through visualization, by generating three-dimensional images.
Interdisciplinary approaches for data analysis and interpretation were applied and the following specific tasks were formulated:

1. To describe the microstructure of the cranial sutures and to trace their reorganization in the process of closure.
2. To investigate the correlation between the physiological closure of the sutures and the age of the individual.
3. To determine the rates of closure of cranial sutures in metopism.
4. To examine the cranial morphology in metopism.
5. To examine the degree of pneumatization of the frontal sinus in metopism.
6. To study the manifestation of anatomical variations and pathological conditions in metopism.

Reliable and sufficient methods are used to achieve the set goal. Morphometric analyzes were performed entirely in virtual space after generating two-dimensional and three-dimensional images of the studied skulls, which allows obtaining an accurate answer to the set tasks. Classical statistical analysis, geometric morphometrics and artificial intelligence were applied and various software were used. The studied cranial series included a total of 318 skulls of adult individuals, of which 159 were identified as male and 159 as female, which allowed reliable statistical processing of the results.

The results are structured in six parts, described in detail and illustrated precisely. An original descriptive scale was developed to report the contact between bone edges in a cross-section at the level of each of the bone layers. This allows to precisely assess the degree of closure of the sagittal suture, i.e. suture closure is not solely a function of age, but the factors that initiate and govern this process are complex and heterogeneous. Machine learning algorithms were applied to develop regression models for determining age at death by degree of sagittal suture closure.

The obtained results provide concrete evidence that metopism is associated with a specific configuration of the cranial vault and delayed suture closure, presence of supernumerary bones, and also with underdevelopment of the frontal sinus. The combination of all these features can be considered as an expression of a generalized disturbance in intramembranous ossification, which is overexpressed in some types of skeletal dysplasia. Metopic skulls have been shown to differ significantly from controls in a number of traits, and the reasons that lead to the manifestation of any observed differences in cranial morphology have been explored. The studies provide original evidence that sagittal suture closure is significantly delayed in the metopic series compared with that in controls, i.e. in metopic skulls there is almost a complete lack of correlation between suture closure and age. The application of approaches from the field of artificial intelligence and mathematical modeling expand the possibilities for analyzing data and allow the construction of models, which are important steps in understanding the studied processes and phenomena and can contribute significantly to the study of cranial sutures. The overall work on the dissertation is synthesized in six conclusions and two groups of contributions of a scientific applied nature and contributions of a theoretical nature, respectively.

Associate Prof. Nikolova has presented a total of 32 publications on the topic of the dissertation. In 26 of the publications, she is the lead author, which expresses the personal contribution in the scientific works. 57 citations of 11 publications are presented. Associate Professor Nikolova covers and exceeds the required minimum of points when covering the indicators required for registration in the National Center for Information and Documentation.

CONCLUSION

Associate Professor Silvia Nikolova thoroughly and analytically examines a current and significant problem of scientific and practical interest in the field of anthropology. Innovative methods of research and analysis of the results are applied, which summarize and specify the processes of development of cranial sutures. The candidate shows theoretical preparation and qualities to plan, analyze and interpret the obtained results, applying innovative and modern research methods. I confidently give a positive assessment to the dissertation work of associate professor Silvia Nikolova, entitled "Medico-biological aspects of cranial sutures: microstructure, physiological closure, metopism" and convey to the members of the Scientific Jury to vote positively for awarding the scientific degree "Doctor of Sciences" to Associate Professor Silvia Nikolova, soecialty in "Anthropology" 01.06.01, Professional direction 4.3. "Biological Sciences"

15.09.2023

Prof. Svetlozara Petkova