Microevolutionary changes in the human skull since Medieval to Modern Times

A. Aim of the project

Evolutionary changes are identified mainly with the ancestral development of our species, and this is a context that has already been widely described. Within the skull, evolutionary changes were mainly directed towards gracilisation and reduction of facial size, called facial dwarfing. According to the currently most accepted hypothesis, this was due to softening of the diet. However, after the appearance of Anatomically Modern Humans, 200-300 thousand years ago, evolutionary processes did not stop and till today they have been shaping our morphology. Those changes have a microevolutionary character and relatively little is known about them. The main aim of the project is to **explore and explain the character and direction of changes in the human skull from medieval to modern times in adult individuals from Poland.** I would also like to find out whether the softening of the food contributed to increased facial shape variation in modern individuals.

B. Research carried out in the project

The analysis will be carried out in 3D on the three following populations: medieval from Cedynia (10^{th}-14^{th} century), early modern from Radom (18^{th}-19^{th} century) and living humans. In total, 600 individuals will be included in the analysis (200 per population). Chosen populations represent different diets, which have been changing with time towards softer and less abrasive foods. Skulls from both osteological collections will be scanned to assemble 3D models. Hard tissue images will be exported from computed tomography of the head from a medical database obtained for modern living people. Subsequently, key features will be measured and an advanced shape analysis will be performed - geometric morphometrics. By applying anthropometric points to 3D models and distributing a set of regularly located points between them, it will be possible to precisely define the shape of the facial skeleton. The basicranial flexion angle will also be measured, because its value correlates with the occurrence of malocclusion and changes in the dimensions of the craniofacial complex. The masticatory apparatus will also be thoroughly analysed. I will measure the size of the teeth, and the surface of the temporomandibular joint, and assess the frequency of dental tool use, dental crowding and malocclusion. All collected data will be compared among populations to obtain a comprehensive picture of microevolutionary changes.

C. Reasons for undertaking a given research topic

Microevolutionary changes in the human skull are poorly recognized in scientific literature, which is due to the small number of analyses, their fragmentation and selectivity. A comprehensive analysis of changes in both cranial size and shape together with the dentition will help to fill the existing gap in knowledge. A better understanding of this process is extremely important from a medical point of view, as it leads to an increase in the prevalence of orthodontic problems. Due to differential genetic control, bone elements of the masticatory apparatus decrease in size faster than the teeth, which leads to dental crowding, malocclusion and delay or lack of the eruption of the so-called "wisdom teeth". In addition, it becomes problematic for children to position the tongue correctly, because the palate becomes too narrow, which leads to more frequent breathing through the mouth, and this can result in night apnea and sleep disorders. Both can have far-reaching health consequences. The scale of those problems has got to the level, where researchers refer to it as an epidemic. The project will use modern, precise and repeatable methods, which will allow for a more accurate analysis of microevolutionary processes, than the commonly used linear or angular measurements.

D. Expected effects

The project will expand our understanding of temporal changes in the human skull including the facial dwarfism process by focusing on a microevolutionary context, which has been overlooked so far. Comparison of a modern population (representing the diet before the industrial revolution) and people living today will allow to capture the impact of technological advancement (including industrialization) on changes in the craniofacial area. In this project, I use the phrase “technological advancement” in the meaning of the time period starting from the Industrial Revolution to modern times, which brought significant changes in diet structure and food processing. Thanks to including both past populations and modern living individuals in the study, it will be possible to extend the character of the project from cognitive to potentially applicative, in the sense of predicting further changes in dental issues, and health promotion to raise awareness about the causes of modern orthodontic problems.