EDITORIAL

Variation in the Human Skull a Comprehensive Review

Ophelia Stroud*

Stroud O. Variation in the Human Skull a Comprehensive Review. Int J Anat Var. 2024;17(10): 677-678.

ABSTRACT

The human skull exhibits a remarkable range of anatomical variations that can be influenced by genetic, environmental, and developmental factors. Understanding these variations is crucial in fields such as anthropology, forensic science, and medicine. This article reviews the primary types of cranial variations, their causes, implications for clinical practice, and their relevance in anthropological studies.

Keywords: Human skull; Anatomical variation; Cranial morphology; Forensic anthropology; Medical implications

INTRODUCTION

The human skull is a complex structure comprising 22 bones that protect the brain and support the facial skeleton. Variation in cranial anatomy has long fascinated researchers, leading to significant advancements in understanding human evolution, developmental biology, and clinical practice. This article aims to provide a comprehensive overview of the types of cranial variations, their causes, and their implications for various scientific fields [1].

ANATOMY OF THE SKULL

The anatomy of the skull is a complex structure that serves to protect the brain, support the facial structures, and facilitate functions such as breathing, eating, and speaking. It is composed of 22 bones, which are divided into two main parts: the cranium and the facial bones. The cranium, consisting of eight bones, encases and safeguards the brain. These include the frontal, parietal, temporal, occipital, sphenoid, and ethmoid bones. The facial skeleton, made up of 14 bones, forms the structure of the face and includes the nasal bones, maxillae, zygomatic bones, mandible, and others. The skull also contains sutures immovable joints where the bones meet, allowing for growth during childhood. Notably, the mandible is the only movable bone in the skull [2]. Additionally, the skull has several openings, such as the orbits (eye sockets), nasal cavity, and foramen magnum, which allows the spinal cord to connect with the brain. This intricate design supports essential functions while providing stability and protection for the brain.

COMMON VARIATIONS IN THE SKULL

Common variations in the skull can occur due to genetic differences, environmental factors, or developmental anomalies. These variations can affect the shape, size, and structure of the skull [3]. One well-known variation is cranial sutural patterns, where the timing of sutural closure can vary, leading to conditions like craniosynostosis, where one or more sutures fuse prematurely, altering the shape of the head. For example, scaphocephaly results from early fusion of the sagittal suture, leading to a long, narrow skull, while brachycephaly occurs from premature closure of the coronal sutures, causing a wide, short skull. Another common variation is in facial morphology, where individuals may have slightly different shapes of the nasal bone, jaw (mandible), or cheekbones (zygomatic bones). Cleft lip and palate are common congenital conditions that cause openings in the upper lip and/or palate due to incomplete development [4]. Additionally, sexual dimorphism leads to slight differences in skull shape between males and females, with male skulls typically being more robust and having more pronounced brow ridges, larger mastoid processes, and squarer chins.

There can also be racial differences in skull morphology, with variations in the overall shape, nasal aperture, and orbital structure. For instance, individuals of African descent may have wider nasal apertures and more pronounced prognathism (forward projection of the jaw), while individuals of European descent may have narrower nasal cavities and more vertically oriented faces. Finally, aging can bring about changes in the skull, such as a reduction in the size of the orbits, loss of bone density, and changes in the prominence of certain features, particularly in the face. These variations are all part of the natural diversity of human skulls [5].

EMBRYOLOGICAL ORIGINS OF SKULL VARIATIONS

The embryological origins of skull variations are rooted in the complex development of cranial bones, which primarily arise from neural crest cells and mesodermal tissues. Neural crest cells, derived from the ectoderm, migrate during early embryonic development to form most of the facial skeleton, including the maxilla, mandible, and zygomatic bones, as well as parts of the neurocranium. The mesoderm contributes to the formation of occipital bones and parts of the posterior skull. As the skull develops, the bones are initially separated by sutural joints that allow for growth during childhood. Variations in skull shape, such as those seen in craniosynostosis, can occur when these sutures close prematurely, disrupting normal skull expansion. This can lead to abnormal skull shapes, such as scaphocephaly (long, narrow skull) or brachycephaly (wide, short skull) [6]. Additionally, the timing and pattern of neural crest migration and mesodermal interaction can influence individual craniofacial features, resulting in normal variation between individuals, including differences in the size and shape of the orbits, nasal cavity, and jaw. Disruptions in this developmental process, whether genetic or environmental, can lead to congenital anomalies, such as cleft lip and palate, or contribute to sexual dimorphism and racial differences in skull morphology.

CLINICAL IMPLICATIONS OF SKULL VARIATIONS

The clinical implications of skull variations are significant, as they can affect not only the aesthetic appearance of an individual but also function and health. Variations in skull shape or structure can result from congenital anomalies, developmental issues, or acquired conditions, and they may require medical intervention. One of the most prominent clinical concerns is craniosynostosis, a condition where one or more cranial sutures fuse prematurely, restricting skull growth and potentially leading to increased intracranial pressure, developmental delays, and cognitive impairments. The treatment often involves surgical intervention to correct the shape of the skull and allow for normal brain growth. Another common condition is cleft lip and palate, which arises from abnormal fusion of the facial bones during embryonic development. This condition can lead to difficulties with feeding, speech, and hearing and often requires multidisciplinary care, including surgery, orthodontics, and speech therapy [7].

Skull variations can also have functional consequences. For instance, mandibular prognathism (a protruding lower jaw) or maxillary hypoplasia

Department of Anatomy, Monash University Clayton Campus, Australia

Correspondence: Ophelia Stroud, Department of Anatomy, Monash University Clayton Campus, Australia; E-mail: stro_elia22@yahoo.com

Received: 01-Oct-2024, Manuscript No: ijav-24-7327; Editor assigned: 03-Oct-2024, PreQC No. ijav-24-7327 (PQ); Reviewed: 14-Oct-2024, Qc No: ijav-24-7327; Revised: 21-Oct-2024 (R), Manuscript No. ijav-24-7327; Published: 31-Oct-2024, DOI:10.37532/1308-4038.17(10).446

(underdeveloped upper jaw) can cause malocclusion, leading to difficulties in chewing, speaking, and maintaining oral hygiene. These conditions may necessitate orthodontic or surgical intervention to correct the alignment of the jaw and teeth. Sexual dimorphism in skull morphology can have implications for forensic science, as differences in male and female skulls—such as a more pronounced brow ridge and larger mastoid processes in males—are often used in sex determination in skeletal remains [8]. Similarly, racial variations in skull shape can influence anthropological studies, although it's important to approach these differences with caution to avoid reinforcing stereotypes or biases [9].

Aging can also cause changes in skull morphology, such as a reduction in bone density or the loss of teeth, which can impact the shape of the face and jaw, leading to changes in appearance or function over time. In clinical practice, understanding these variations is crucial for accurate diagnosis, treatment planning, and patient management across a range of medical disciplines, from surgery to orthodontics and craniofacial therapy [10].

CONCLUSION

In conclusion, human skull variation is a fascinating aspect of human biology, shaped by genetic, environmental, and developmental factors. These variations can manifest in the form of differences in cranial shape, facial features, and the timing of sutural closure, influencing both appearance and function. While many variations are benign and part of natural human diversity, others may have clinical implications, such as craniosynostosis, cleft lip and palate, or malocclusion, which can require medical intervention. The study of skull variation also holds importance in fields such as anthropology, forensics, and paleontology, where understanding skeletal differences can aid in identifying sex, ancestry, and age. Overall, the complexity of human skull variation highlights the intricate interplay between genetics and development, as well as the need for a nuanced approach in clinical practice to ensure effective diagnosis and treatment.

REFERENCES

1. Albulescu D, Constantin C, Constantin C. Uterine artery emerging variants - angiographic aspects. Current Health Sciences Journal 2014; 40:214-216.
2. Osher M, Semaan D, Osher D. The uterine arteries, anatomic variation and the implications pertaining to uterine artery embolization. J Vasc Interv Radiol 2014; 25:S143.
3. Park K-M, Yang S-S, Kim Y-W, Park KB, Park HS, et al. Clinical outcomes after internal iliac artery embolization prior to endovascular aortic aneurysm repair. Surg Today 2014; 44:472-477. Bleich AT, Rahn DD, Wieslander CK,
4. Wai CY, Roshanravan SM, et al. Posterior division of the internal iliac artery: Anatomic variations and clinical applications. Am J Obstet Gynecol. 2007; 197:658.e651-658.e655.
5. Chase J. Variation in the Branching Pattern of the Internal Iliac Artery. In: University of North Texas Health Science Center. Fort Worth. 2016: 1-33.
6. Nayak SB, Shetty P, Surendran S, Shetty SD. Duplication of Inferior Gluteal Artery and Course of Superior Gluteal Artery Through the Lumbosacral Trunk. OJHAS. 2017; 16.
7. Patel SD, Perera A, Law N, Mandumula S. A novel approach to the management of a ruptured Type II endoleak following endovascular repair of an internal iliac artery aneurysm. Br J Radiol. 2011; 84(1008):e240-2.
8. Rayt HS, Bown MJ, Lambert KV. Buttock claudication and erectile dysfunction after internal iliac artery embolization in patients prior to endovascular aortic aneurysm repair. Cardiovasc Intervent Radiol. 2008; 31(4):728-34.
9. Fontana F, Coppola A, Ferrario L. Internal Iliac Artery Embolization within EVAR Procedure: Safety, Feasibility, and Outcome. J Clin Med. 2022; 11(24):73-99.
10. Szymczak M, Krupa P, Oszkinis G, Majchrzycki M. Gait pattern in patients with peripheral artery disease. BMC Geriatrics. 2018; 18:52.