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The Precision Of Skull Tomography As A Form Of Forensic Identification

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I. Introduction:

Forensic identification plays a critical role in solving crimes and disasters where human remains may be incomplete or unidentifiable, making the development of accurate and reliable methods to determine the identity of unknown individuals essential. In this context, cranial tomography represents a promising tool that offers an innovative and detailed approach to the identification of cranial features. In this paper, a systematic review of the approaches and techniques of forensic identification using skull tomography is presented, examining their effectiveness, accuracy, and potential in the field of facial reconstruction.

Cone-beam computed tomography (CBCT) has proven to be a valuable diagnostic technique, providing detailed three-dimensional images of the cranial region. According to Jayakrishnan's research (2021), forensic facial reconstruction through computer-assisted three-dimensional modeling, which involves a combination of CBCT images and 3D modeling methods, provides remarkable results by accurately reflecting the original appearance of the person. The use of computer-assisted techniques has been shown to be reliable in identifying unique features such as fractures, deformities, and cranial suture patterns, as demonstrated by several studies (Ahn et al., 2020; Saraswathi Gopal et al., 2017).

In addition, CBCT offers other advantages, such as the acquisition of images in vertical positions and a lower radiation dose compared with conventional computed tomography, as pointed out by Issrani et al. (2022) and other researchers. The ability to repeat scans and create more realistic facial models through 3D modeling has contributed significantly to the effectiveness of the technique. However, it is important to keep in mind that in certain cases, cranial tomography alone is not sufficient and complementary analysis with other identification methods such as DNA analysis and fingerprinting is required (Berco et al., 2009).

In this review, we will examine the application of cranial tomography in forensic identification, addressing topics such as facial reconstruction using 3D virtual modeling (Short et al., 2014), the accuracy of linear measurements obtained with CBCT (Berco et al., 2009), the utility in cases with multiple fatalities (Wood & Gardner, 2020), and the assessment of various cranial features such as maxillary sinuses, frontal sinuses, and nasal septum patterns (Saraswathi Gopal et al., 2017). By analyzing these studies, we aim to understand the efficacy and potential of skull tomography as a robust tool for forensic identification and help improve the techniques used in solving complex cases and pursuing justice.

II. Methodology:

The methodology used in this systematic review involved a detailed and rigorous approach to examining the technique of forensic identification by skull tomography. The following steps were taken to provide a comprehensive analysis:

The first step was to conduct an extensive literature search. Reputable databases such as PubMed, ProQuest, Google Scholar, Science Direct, and Scopus were thoroughly searched. Relevant keywords such as "forensic identification," "facial reconstruction," "skull tomography," and "CBCT" were used to identify relevant articles.

Specific criteria were used to select articles for inclusion in the review. Studies that directly addressed the application of cranial tomography in forensic identification, with particular emphasis on facial reconstruction and analysis of craniofacial features, were considered appropriate. Final selection of articles was based on their relevance and scientific rigor.

Once the articles were selected, data extraction was performed systematically. Each article was carefully reviewed by two independent reviewers, and relevant information was extracted, including details of the forensic identification methods used, the characteristics of the sample studied, the results obtained, and the conclusions presented.

Using the extracted data, the results were synthesized and analyzed. The results were classified into thematic categories that provided a comprehensive understanding of the effectiveness of the forensic

identification technique using skull tomography. The analyzes highlighted aspects such as accuracy, reliability, and practical applications of the technique in various forensic contexts.

The methodology used in this systematic review enabled an in-depth analysis of the forensic identification technique using skull tomography, taking into account a wide range of scientific studies and their contributions to the forensic field.

III. Discussion:

Forensic identification, a crucial step in solving crimes and establishing the identity of unknown persons, has made remarkable technical advances. One of these breakthroughs is the use of cranial tomography, a technique that provides a detailed view of cranial structures and thus contributes significantly to the identification of victims in a forensic context. The review of studies conducted in this area underscores the importance of skull tomography as a valuable tool to support criminal investigations and achieve more accurate resolutions.

Ahn et al. (2020) highlighted the application of artificial intelligence in the analysis of CBCT images in natural head pose. Their study showed that an intelligent system that combines facial profile analysis with deep learning models can automate the measurement of geometric parameters to speed up the forensic identification process. This approach not only speeds up the process, but also provides high precision in identifying individuals based on skull features, highlighting the potential of artificial intelligence technologies in optimizing forensic identification (Ahn et al., 2020).

Issrani et al. (2022) expanded the scope of skull tomography and investigated its use in forensic dentistry. The study focused on maxillary sinuses, frontal sinuses, and nasal septum patterns and highlighted the ability of cone-beam computed tomography (CBCT) to provide detailed data for the identification of human remains. The precise analysis of specific craniofacial features, even in difficult situations such as charred or mutilated bodies, illustrates the utility of cranial tomography for forensic identification (Issrani et al., 2022).

In addition, the accuracy of linear measurements obtained by skull tomography has been evaluated in various contexts. Berco et al. (2009) demonstrated high accuracy and reliability of measurements obtained by CBCT scans compared to direct anthropometric measurements, indicating the suitability of skull tomography for forensic identification. The analysis by Short et al. (2014) added an additional perspective by highlighting the application of skull tomography in forensic facial reconstruction with 3D virtual modeling. The remarkable accuracy in identifying facial features and determining the identity of unknown individuals underscores the effectiveness of this technique in forensic identification (Berco et al., 2009; Short et al., 2014).

The systematic review by Dr. Jijin Mekkadath Jayakrishnan et al. (2020) consolidates these findings by analyzing various studies that have examined different aspects of forensic identification by skull tomography. The review highlighted the reliability of the technique in measuring soft tissue thickness, predicting facial features, and determining a person's gender, age, and other specific characteristics, reaffirming the central role of skull tomography in forensic identification (Dr. Jijin Mekkadath Jayakrishnan et al., 2020).

Collectively, these studies underscore the significant impact of skull tomography on modern forensic practice. The application of 3D technology, artificial intelligence, and precise analysis of skull features has the potential to transform criminal investigations and provide a more effective and accurate approach to determining the identity of unknown individuals.

IV. Conclusion:

Cranial tomography has proven to be a valuable tool for forensic identification, providing accuracy and reliability in the analysis of cranial features. The application of advanced techniques such as artificial intelligence and 3D virtual modeling further enhances its potential in establishing the identity of unknown individuals. These studies highlight the importance of skull tomography as a promising and effective tool in criminal investigations, providing valuable results in forensic facial reconstruction and victim identification. However, further research and improvements are needed to fully exploit the potential of this technique and its application in various forensic contexts.

References:

[1]. Murphy, M., Drage, N., Carabott, R., &Adams, C. (2012). Accuracy And Reliability Of Cone Beam Computed Tomography Of The Jaws For Comparative Forensic Identification: A Preliminary Study. Journal Of Forensic Sciences, 57(6), 1522-1527.

[2]. Silva, R. F., Botelho, T. L., Prado, F. B., Kawagushi, J. T., Daruge Júnior, E., &Beérzin, F. (2011). Human Identification Based On Cranial Computed Tomography Scan—A Case Report. Dentomaxillofacial Radiology, 40(4), 257-261. Doi: 10.1259/Dmfr/96080236

[3]. Jayakrishnan, J. M. (2021). Forensic Facial Reconstruction Using CBCT – A Systematic Review. Retrieved From Https://Doi.Org/10.21203/Rs.3.Rs-437016/V2

[4]. Ahn, J., Nguyen, T. P., Kim, Y. J., Kim, T., &Yoon, J. (2020). Automated Analysis Of Three-Dimensional CBCT Images Taken In Natural Head Position That Combines Facial Profile Processing And Multiple Deep-Learning Models. Journal Of Orthodontics, 47(4), 317-325.

[5]. Issrani, R., Prabhu, N., Sghaireen, M.G., Ganji, K.K., Alqahtani, A.M.A., Aljamaan, T.S., Alanazi, A.M., Alanazi, S.H., Alam, M.K., &Munisekhar, M.S. (2022). Cone-Beam Computed Tomography: A New Tool On The Horizon For Forensic Dentistry. International Journal Of Environmental Research And Public Health, 19(9), 5352. Https://Doi.Org/10.3390/Ijerph19095352

[6]. Saraswathi Gopal, Et Al. "Identificação Forense Por Tomografia De Crânio: Avaliação Dos Seios Maxilares, Seios Frontais E Padrões Do Septo Nasal." Sch. J. Dent. Sci., Vol-4, Iss-4 (Apr, 2017), Pp-158-167.

[7]. Ramsthaler, F., Kettner, M., Gehl, A., &Verhoff, M. A. (2010). Digital Forensic Osteology: Morphological Sexing Of Skeletal Remains Using Volume-Rendered Cranial CT Scans. Forensic Science International, 195, 148-152.

[8]. Berco, M., Rigali Jr, P. H., Miner, R. M., Deluca, S., Anderson, N. K., &Will, L. A. (2009). Accuracy And Reliability Of Linear Cephalometric Measurements From Cone-Beam Computed Tomography Scans Of A Dry Human Skull. American Journal Of Orthodontics And Dentofacial Orthopedics, 136(1), 17.E1-17.E9.

[9]. L.J. Short Et Al. "Accuracy Of Forensic Facial Reconstruction: A Comparison Of Two Methods Using Cone Beam CT Data." Forensic Science International 237 (2014): 147.E1-147.E8.

[10]. Dr.Jijin Mekkadath Jayakrishnan Et Al. (2020). CBCT Is The Better Investigating Tool For The Facial Recognition For Forensic Identification. PARIPEX - INDIAN JOURNAL OF RESEARCH, 10(7), 45-49.

[11]. Wood, R. E., &Gardner, T. (2020). Use Of Dental CBCT Software For Evaluation Of Medical CT-Acquired Images In A Multiple Fatality Incident: Proof Of Principles. Journal Of Forensic Sciences, 00, 1-6. DOI: 10.1111/1556-4029.14607