

Gender-Based Analysis of the Lambdoid Cranial Suture among Human Cadavers Presented for Postmortem Examination at King Edward Medical University, Lahore

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ABSTRACT

Objective: The objective of this study is to investigate the gender-based differences in the commencement of lambdoid suture closure.

Study Design: Descriptive Study

Place and Duration of Study: This study was conducted at the Department of Forensic Medicine and Toxicology, King Edward Medical University, Lahore from January to September during the year 2016.

Methods: A total of 90 deceased individuals, comprising an equal number of males and females within the age span of 20 to 70 years, were subjected to medicolegal autopsy. Standardized autopsy protocols were followed, and the lambdoid suture was meticulously examined. Suture fusion was observed macroscopically both endocranially and ectocranially, with a five-grade scale applied to quantify closure stages.

Results: The results of the analysis revealed distinct gender-based differences in the commencement of lambdoid suture closure having profound statistically significant with a p-value of < 0.05 .

Conclusion: The study elucidates that gender plays a pivotal role in the commencement of lambdoid suture closure. The observed differences can have implications in forensic age estimation, providing valuable information for postmortem examinations

Key Words: Gender Dimorphism, Lambdoid Suture, Suture Closure, Forensic Medicine, Postmortem Examination, Ectocranial, Endocranial.

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INTRODUCTION

Gender estimation, a critical facet of forensic anthropology, plays a pivotal role in postmortem examinations and the determination of an individual's identity¹. Within this broader field, the study of gender

dimorphism in the cranial sutures has always been compelling area of investigation as one of the prime objective of autopsy². The cranial sutures, essential for the development and expansion of the human skull, exhibit variations that can be influenced by factors such as age³, ancestry⁴, and notably by gender⁵. While multiple cranial sutures contribute to gender estimation, the lambdoid suture stands out as a prime focus in our investigation. The lambdoid suture, located at the junction of the parietal and occipital bones, exhibits gender-based differences in its closure patterns⁶. A comprehensive understanding of these variations is invaluable in forensic anthropology, as it aids in determining an individual's gender during postmortem examinations⁷.

Gender dimorphism in the lambdoid suture provides valuable insights into the differences in the commencement and progression of suture closure between males and females⁸. This distinction can prove instrumental in enhancing the accuracy of gender estimation, particularly in forensic cases where the identity of the deceased is unknown⁹. This sometime becomes the only option in the face of advanced

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decomposition or when rest of the body is not available or where only skull has been found¹⁰. Gender estimation, therefore, serves as an indispensable tool for forensic practitioners, law enforcement agencies, and medicolegal experts, aiding in the identification of human remains and facilitating criminal investigations¹¹. This study aims to delve into the intricacies of gender dimorphism within the lambdoid suture, shedding light on the variations in suture closure patterns based on gender. By examining both ectocranial and endocranial aspects, we seek to elucidate the specific differences in the onset and progression of closure¹². The insights garnered from this research hold substantial promise in improving the accuracy of gender estimation in forensic scenarios, contributing to the field's ongoing evolution¹³.

METHODS

The study was conducted on a sample of 90 deceased individuals, with an equal distribution of males and females. The study subjects were selected within the age span of 20 to 70 years, ensuring a representative cross-section of the population. All cases were brought to the Department of Forensic Medicine and Toxicology at King Edward Medical University, Lahore, for a period arching over 9 months, spanning from Jan-2016 to Sept-2016. The study adhered to ethical principles and guidelines governing ethical committee of King Edward Medical University and due approval was taken. The study protocols followed the guidelines in accordance with institutional and ethical standards.

Data collection followed a meticulous and standardized autopsy protocol, with each postmortem examination adhering to established forensic guidelines. The scalp covering of the skull was lifted by employing curved mastoid-to-mastoid incision, ensuring that the thorough stretching of the lambdoid suture be visualized to unaided eye. This approach allowed for the complete exposure of the suture. All tissues tags and fats were

meticulously removed to facilitate examination of the suture.

To ensure a comprehensive analysis of the lambdoid suture, it was divided into three equal parts, referred to as L1, L2, and L3. This division aided in systematically examining suture closure within different subsections of the suture.

The degree of fusion in all three parts of the lambdoid suture was recorded separately for both the ectocranial (outer table) and endocranial (inner table) aspects. Closure stages were assessed using the Acsádi-Nemeskéri Scale referring to 0 - as "Open with no closure at all", 1- as "Incipient closure with less than half closed", 2 - as "Closure in process with half of the suture closed", 3 - as "Advanced closure with more than half of the suture closed" and 4 - as "Closed completely"

RESULTS

The study included equal number of the male and female case of postmortem examination of ages more than 20 years and less than 70 years. The subjects were divided in five groups each comprising of a decade. The first group of 21 to 30 years had 10 males and 22 females, the second group of 31 to 40 years of age had 08 males and 07 females whereas the third group of age from 41 to 50 years comprised of 10 males and 08 females. In the second last category of 51 to 60 years were 08 males and 06 females and the last group from 61 to 70 years had 09 males and just 02 females.

For all the tables in results sections 'n' is number and abbreviation like 'Ecto-L1' shows Ectocranial Lambdoid Suture Subsection 1, 'Endo-L1' shows Endocranial Lambdoid Suture Subsection 1, 'Ecto-L2' Ectocranial Lambdoid Suture Subsection 2, 'Endo-L2' shows Endocranial Lambdoid Suture Subsection 2, 'Ecto-L3' shows Ectocranial Lambdoid 1 Suture Subsection 3 and 'Endo-L3' shows Endocranial Lambdoid Suture Subsection 3.

Table No. 1: The assessment of closure stages of lambdoid suture in males (n=45)

Age group	n	Ecto -L1	Endo-L1	Ecto-L2	Endo-L2	Ecto-L3	Endo-L3
		Mean ± SD		Mean ± SD		Mean ± SD	
21-30 years	10	0.90±0.316	1.30±0.483	0.10±0.316	1.20±1.033	0.70±0.483	1.00±0.000
31-40 Years	08	1.88±0.641	2.38±0.518	1.25±0.463	1.75±0.707	2.00±0.535	2.38±0.744
41-50 Years	10	3.30±0.675	3.50±0.527	2.30±0.483	3.00±0.000	3.20±0.632	3.60±0.516
51-60 Years	08	3.88±0.354	4.00±0.000	3.38±0.518	3.75±0.164	3.50±0.535	3.25±0.463
61-70 Years	09	4.00±0.000	4.00±0.000	3.56±0.527	4.00±0.000	3.89±0.333	4.00±0.000

In the table 01 above, the age group of 21-30 years, we found no significant closure for lambdoid suture closure helpful for age or gender estimation. In the age group of 31-40 years, we observed advanced closure (Mean ± SD) in Endo - L2 1.75. In the age group of 41-50 years, advanced closure was noted Endo - L1 with a mean

value of 3.50. For individuals aged 51-60 years, the following observations were made: Endo - L1 exhibited complete closure (Mean ± SD: 4.00) Endo - L2 showed advanced closure with a mean value of 3.75 and Endo - L3 demonstrated incipient closure with a mean value of 3.25. In the age group of 61-70 years,

complete closure (Mean ± SD: 4.00) was observed in ectocranially in L1 and 3edocranially in Lambdoid

Suture Subsections 1 (Endo - L1), 2 (Endo - L2), and 3 (Endo - L3).

Table No. 2: The assessment of closure stages of lambdoid suture in females (n=45)

Age group	n	Ecto -L1	Endo-L1	Ecto-L2	Endo-L2	Ecto-L3	Endo-L3
		Mean ± SD		Mean ± SD		Mean ± SD	
21 - 30 years	22	0.95±0.486	1.59±0.734	0.41±0.503	0.77±0.685	0.86±0.744	1.41±0.734
31-40 Years	7	1.86±0.690	1.86±0.378	1.00±0.000	1.57±0.535	1.71±0.488	1.71±0.488
41-50 Years	8	3.00±0.535	3.63±0.518	2.50±0.926	2.75±0.463	2.75±0.463	3.13±0.835
51-60 Years	6	3.17±0.408	3.67±0.516	3.00±0.000	3.00±0.000	3.00±0.000	3.67±0.516
61-70 Years	2	4.00±0.000	4.00±0.000	3.50±0.707	4.00±0.000	3.50±0.707	4.00±0.000

The Table 02 presents the assessment of closure stages of the lambdoid suture in females. In the age group of 21-30 years, we found no significant lambdoid suture closure in females. In the age group of 31-40 years, advanced closure was noted in both Ectocranial and Endocranial Lambdoid Suture Subsection 1 (Ecto - L1 and Endo - L1), with mean values of 1.86. For individuals aged 41-50 years, advanced closure was observed in Ectocranial Lambdoid Suture Subsection 1 (Ecto - L1) with a mean value of 3.00. In the age group of 51-60 years, advanced closure was found in the subsections i.e. Ectocranial Lambdoid Suture

Subsection 2 (Ecto - L2) with a mean value of 3.00, Endocranial Lambdoid Suture Subsection 2 (Endo - L2) with a mean value of 3.67 and Ectocranial Lambdoid Suture Subsection 3 (Ecto - L3) with a mean value of 3.00

In the age group of 61-70 years, complete closure was observed in all subsections whether endocranial or ectocranial of L1, L2 and L3. Notably, incipient closure was observed in Ectocranial Lambdoid Suture Subsection 2 (Ecto - L2) in the age group of 31 – 40 years.

Table No. 3: The assessment of closure stages of lambdoid suture in all the subjects (n=90)

Age group	n	Ecto -L1	Endo-L1	Ecto-L2	Endo-L2	Ecto-L3	Endo-L3
		Mean ± SD		Mean ± SD		Mean ± SD	
21 - 30 years	32	0.94±0.435	1.50±0.672	0.31±0.471	0.78±0.608	0.81±0.693	1.28±0.634
31-40 Years	15	1.87±0.640	2.13±0.516	1.13±0.352	1.67±0.617	1.87±0.516	2.07±0.704
41-50 Years	18	3.17±0.618	3.56±0.511	2.39±0.698	2.89±0.323	3.00±0.594	3.39±0.698
51-60 Years	14	3.57±0.514	3.86±0.511	3.21±0.462	3.43±0.514	3.29±0.169	3.43±0.514
61-70 Years	11	4.00±0.000	4.00±0.000	3.55±0.522	4.00±0.000	3.82±0.405	4.00±0.000

Table 3 presents the results of the assessment of closure stages of the lambdoid suture in a combined sample of all subjects, comprising a total of 90 individuals. This table provides valuable insights into the closure patterns of the lambdoid suture across different age groups. In the age group of 21-30 years, we observed no significance for lambdoid suture closure in estimating sexual dimorphism. In the age group of 31-40 years, advanced closure was noted in both Ectocranial and Endocranial Lambdoid Suture Subsection 1 (Ecto - L1 and Endo - L1), with mean values of 1.87. For individuals aged 41-50 years, advanced closure was observed in Ectocranial Lambdoid Suture Subsection 1 (Ecto - L1) with a mean value of 3.17. In the age group of 51-60 years, advanced closure was found in the following subsections like Ectocranial Lambdoid Suture Subsection 1 (Ecto - L1) with a mean value of 3.57, Endocranial Lambdoid Suture Subsection 1 (Endo - L1) with a mean value of 3.86 and Ectocranial Lambdoid Suture Subsection 3 (Ecto - L3) demonstrated incipient closure with a mean value of 3.29. In the age group of 61-70 years, complete closure was observed in all the subsections of lambdoid suture whether endocranially or ectocranially.

Gender-Based Comparison for Commencement of Lambdoid Suture Closure

Table 04 presents the gender-based comparison of the commencement of suture closure within the lambdoid suture. This analysis was carried out for both the ectocranial and endocranial aspects

Table No. 4: Gender based commencement of lambdoid suture closure

Ectocranial Closure				
Gender	n	Mean Score	P value	Significance
Male	45	2.48	< 0.05	Significant
Female	45	1.66		
Endocranial Closure				
Gender	n	Mean Score	P value	Significance
Male	45	2.81	< 0.05	Significant
Female	45	2.08		

Table 04 illustrates the gender-based comparison of the commencement of suture closure within the lambdoid suture. Notably, this analysis revealed significant differences in the commencement of lambdoid suture closure based on gender. As indicated in the table, the

commencement of suture closure was observed to be significantly earlier in males than in females in both ectocranial and endocranial aspects. The endocranial aspect, in particular, exhibited a marked difference, with males demonstrating a mean score of 2.81 compared to 2.08 in females. The statistical analysis supported these observations, with a p-value of < 0.05 , underscoring the significance of gender-based differences in the commencement of lambdoid suture closure, as highlighted in Table 04.

DISCUSSION

Gender estimation is a fundamental aspect of forensic anthropology, facilitating the identification and categorization of deceased individuals during postmortem examinations¹⁴. The cranial sutures have emerged as key anatomical features for gender estimation due to their potential for exhibiting gender-specific variations in closure patterns⁸. In this study, we notably observed significant differences in closure patterns between males and females¹⁵. These findings have implications for accurate determination of gender is often a critical component in the identification of unknown human remains.

In examining the ectocranial and endocranial aspects of the lambdoid suture, we sought to capture a comprehensive picture of gender dimorphism¹⁶. Our results demonstrated that in both ectocranial and endocranial perspectives, males exhibited an earlier initiation of suture closure compared to females^{6,8,16,17}. This gender-based distinction was particularly pronounced in the endocranial aspect, where males displayed a marked advancement in suture closure¹⁸. Such detailed observations provide forensic experts with a valuable tool for gender estimation^{8,17}. The significance of our findings lies in their potential application within the field of forensic medicine and postmortem examinations. Accurate gender estimation plays a pivotal role in narrowing down the identity of unknown individuals, aiding law enforcement agencies and medicolegal experts in criminal investigations and victim identification¹⁹. The insights gleaned from this study are expected to enhance the precision and reliability of gender estimation methodologies used in forensic anthropology²⁰.

CONCLUSION

Our study, aimed at understanding the gender-based differences in the commencement and progression of lambdoid suture closure, has yielded valuable insights that can contribute to the refinement of gender estimation techniques in the field especially in the circumstance when only skull is available for gender estimation^{16,17,18}. The results of our investigation demonstrate a compelling pattern of gender dimorphism within the lambdoid suture. Notably, males exhibit an earlier initiation of suture closure compared to females,

a distinction that becomes particularly pronounced in the endocranial aspect. This observed gender-based variation in suture closure holds profound implications for forensic anthropology, where the precise determination of an individual's gender is often the linchpin in identifying unknown remains and advancing criminal investigations.

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