

Lambdoid Suture Closure Assessment Using Modified Reverse Panoramic Radiograph (RPR) - An Age Estimation Tool



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Submission: November 11, 2019, **Published:** November 19, 2019

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Abstract

Aim and Objective: To establish, if any correlation exists between individual's age and lambdoid suture closure on modified reverse panoramic radiograph (RPRg).

Method and Material: Study was conducted on 150 randomly selected subjects within an age range 25 to 65 years. Subjects were positioned in reverse manner in Kodak 8000C Digital Panoramic and Cephalometric system. Suture closure pattern was assessed on the basis of Frederic Rating Scale. Frequency (n) & percentage (%) of outcome of various grades overall & with respect to independent variables was compared using chi square test. $p < 0.05$ was considered statistically significant.

Result: There was a statistically highly significant difference seen for the frequencies of categories of scores with age category ($p < 0.01$) with higher frequency of subjects with score 0 in 25-35 year group followed by score 3 in 36-45 year age group, and higher number of subjects with score 4 in age group between 46-55 years and 55-65 years. The highest percentage was noted for score 4 (95%) in group D (55-65 years) followed by (69.5%) in group C (35-45), score 3 (52.6%) in group B (35-45 years) and score 0 (34.5%) in group A (25-35 years).

Conclusion: Lambdoid suture analysis using modified Reverse panoramic radiograph [RPRg] is effective and can be used as practical age estimation tool, especially in mortals.

Keywords: Cranial suture; Reverse panoramic radiograph; Lambdoid suture

Introduction

The lambdoid suture or lambdoidal suture is a dense, fibrous connective tissue joint on the posterior aspect of the skull that connects the parietal bones with the occipital bone. It is continuous with the occipitomastoid suture. Assessment of suture closure for age estimation dates back to 1962. When Krogman concluded that suture closure seems promising for age estimation despite a deficiency in the amount of study devoted to suture obliteration [1]. The assessment of age is done by anthropologist, archeologist, anatomist and person engaged in medico-legal or forensic case works. Among these, the work of forensic experts requires special attention because his findings are directly related to the administration of law, and his conclusions are debated in court of law [2]. The needs of age determination vary from intra-uterine life to old age for different purpose. Sometimes even when the age of person is known by hospital records and birth certificate, but still its

scientific confirmation is required by court of law and certain administrative department. Usually the age estimation up to 25yrs is done by physical examination, appearance of secondary sexual characters, data from dental eruption, and maturity of bones, appearance and fusion of various ossification centers. The oldest and most controversial age indicator is cranial suture closure. Cranial sutures generally fuse with increasing age, although there is considerable variability in closure rates and patterns [3]. Dwight identified that the posterior portion of saggital suture and inferior portion of coronal suture shows first sign of obliteration, lambdoid closes slower than coronal but the frontal suture is the last to close [4].

After 25 years of age, other scientific methods like tooth microscopy, study of pubic symphysis, study of union of parts of sternum, lipping of joints and closure of cranial suture are considered for age estimation of the individual. Lambdoid

suture of all the cranial suture has been suggested to be the vault suture to attain closure at around 45 to 50 years (Indians) [5]. Anatomically lambdoid suture, divided into three different positional parts from medial to lateral these are; pars lambdica, pars intermedia and pars asterica (Figure 1) Various cadaveric studies have been done on cranial suture for age estimation but, studies specifically on lambdoid sutures in mortals using radiographs for age estimation are very sparse. There was no indicated skull radiographic technique to obtain the radiographic image of lambdoid suture [6]. Panoramic radiography has been

evolving continuously since its introduction in 1950's [7]. Markus [8] described a radiographic technique known as "reverse panoramic radiograph" (RPRg) which can provide a view of various anatomic structures like mastoid air cells, lambdoid suture and occipital bone, but not practiced regularly due to its limitations. Hence, in this study we have tried to determine the pattern of lambdoid suture closure in relation to age, and the relationship between progression of union of lambdoid suture and age on modified reverse panoramic radiograph.

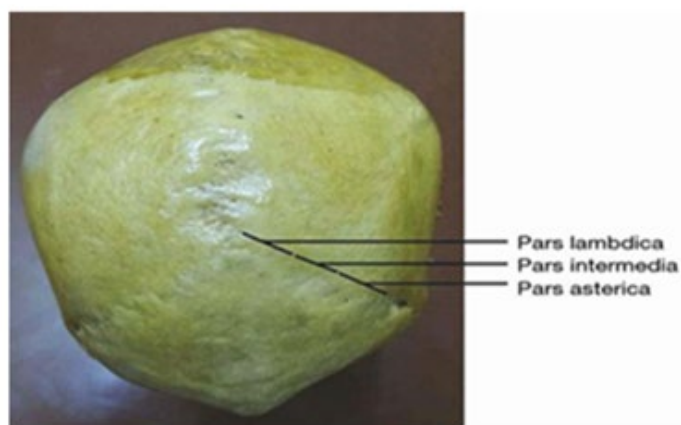


Figure 1: Shows Three Different Anatomical Parts of Lambdoid Suture.

Material and Methods



Figure 2: Shows Patient Positioning in Digital Panoramic Machine [A- Anteroposterior Positioning, B- Lateral Aspect of Patient.

A prospective study was conducted where 150 randomly selected patients, within an age range of 25 to 65 years, were positioned in a reverse manner in Kodak 9000C Digital Panoramic and Cephalometric system at standard exposure parameters (75 kVp, 10 mA, and 15.1 s), in such a way that x-ray beam was directed through the patient’s face and the exit beam then passed through the patient’s head on the opposite side where it was captured on the image receptor (Figure 2). All radiation protection measures were followed. In order to obtain a clear radiographic image and to avoid any distortion, subject’s occiput was placed within the focal trough, with chin lowered at 20-30 degree below the horizontal plane. Patients were divided into four groups, with an age interval of 10 years: Group A (25-35 years) ; Group B (36-45 years) ; Group C (46-55 years) ; Group D (> 55 years) Suture closure pattern was assessed on the basis of Frederic Rating Scale as (Figure 3). All healthy Persons, willing to take part in the study after explaining the method and purpose of the study and willing to give written informed consent were included in the study. Patients who had history of skull surgery, trauma, developmental anomaly related to skull, history or clinical characteristics of endocrine disturbances, nutritional diseases, hereditary facial asymmetries were excluded. Institutional ethical approval was obtained prior. The finding were recorded in the data collection form and subjected to statistical evaluation. Frequency (n) & percentage (%) of outcome of various grades overall and with respect to independent variables was compared using chi square test. $p < 0.05$ was considered to be statistically significant.

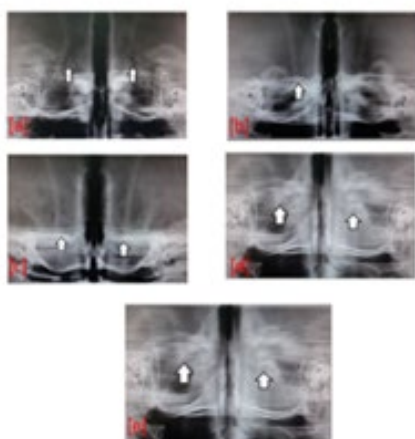


Figure 3: Frederic Rating Scale [A] Score 0-Open Suture; [B] Score 1-Shows Less Than 50 Percentage Of Lambdoid Suture Closed; [C] Score 2-Shows More Than 50 Percentage Of Lambdoid Suture Closed; [D] Score 3-Shows Most Of The Part Of Lambdoid Suture Closure; [E] Score 4-Shows Total Closure With No Visible Suture Line (RPRg Radiograph Taken From The Present Study).

Result

A total of 150 reverse panoramic scans of patients [99 male & 51 female] within the age range of 25 to 65 years were studied. Comparison of frequencies of categories of scores for age and gender was done using chi square test. Group A (25-35year) included 69 subjects, Group B (36-45year) included 38 subject, Group C (46-55years) included 23 subjects and Group D (>55

years) included 20 subjects. (Table 1 & Graph 1). There was a statistically non-significant difference seen for the frequencies of categories of scores with gender ($p > 0.05$). (Table 2). The significant difference was observed between age groups and suture closure .The highest frequency was noted for score 4 (90%) in age group 55-65 years followed by (70%) in group 35-45 years, score 3(52%) in age group (35-45 years) and score 0 (31%) in group (25-35 years) (Table 1).

Graph 1: Lambdoid Suture Closure According to Age Groups.

Suture Closure Score	Amount of Suture Closure
0	Open
1	Less than 50 % closed
2	More than 50% suture closed
3	Most of the part of suture closed
4	Totally closed with no visible suture line

Table 1: Lambdoid Suture Closure According to Age Groups.

Group A 25-35 yrs		Age Groups				Chi Square Value	P Value of Chi Square Test
		Group B 36-45 yrs	Group C 46-55 yrs	Group D 55-65 yrs	Total		
Lambdoid Suture Closure	Score 0	24	0	0	0	176.301	0
	Score 1	22	3	0	0		
	Score 2	20	14	0	0		
	Score 3	2	20	7	1		
	Score 4	1	1	16	19		
	Total	69	38	23	20		

Table 2: Lambdoid Suture Closure According to Gender.

M		Gender			Chi Square Value	P Value of Chi Square Test
		F	Total			
Lambdoid Suture Closure	Score 0	17	7	24	1.663	0.797
	Score 1	15	10	25		
	Score 2	21	13	34		
	Score 3	22	8	30		
	Score 4	24	13	37		
	Total	99	51	150		

Discussion

A correct estimation of age in elderly people is essential for legal, medical, social and administrative matters i.e. fixing of age for regularization of employment, superannuation, pension settlements, senior citizen benefits and retirements [8]. Cranial sutures are line of junction of skull bones separated by a zone of connective tissue (sutural ligament) and are known to attain closure during the lifetime of an individual. The skull vault comprises mainly of three major sutures i.e., coronal, sagittal, and lambdoidal sutures [9]. Sutures appear to be simple and straight in younger age groups but as the age advances these acquire a more complex anatomy due to developing interdigitations by the process of growth [10]. Reverse panoramic radiograph (RPRG) was initially tried back in 1986 by Markus [11] who demonstrated significant improvement in visualization of temporomandibular joint (TMJ) and associated structures. Very few studies have been undertaken on mortals to establish the role of lambdoid suture in age estimation, Thus the present study was undertaken to establish, if any correlation exists between individual’s age and lambdoid suture closure status on RPRg. In this study there was a statistically non-significant difference seen for the frequencies of categories of scores with gender. We observed the fusion of lambdoidal suture was observed as early as 25-35 years, which was five year earlier than that reported by Todd & Lyon [12].

In this study, significant difference was observed between age groups and suture closure. The highest frequency was noted for score 4 (95%) in group D (55-65 years) followed by (69.5%) in group C(35-45),score 3(52.6%) in group B(35-45 years) and score 0 (34.5%) in group A(25-35 years).The higher number of

subjects with score 4 in age group >55 years which corroborates with Modi & Parikh [13,14] according to whom complete cloure occurs in between 50-70 years. As per Moondra [15] endocranial closure occurs above 60 years both for male and females whereas Vyas PC & Sicher [16] conclude that lambdoid suture closes at the age group of 60years. According to J B Mukherjee [8] lambdoid suture closes at the age group of 45-55 years. Parmar P Rathod [17] analyzed sagittal, lambdoid and coronal suture closure with respect to age in mortals, and concluded that the best results for age estimation can be achieved from sagittal suture (50-60 years) followed by lambdoid (45-55years) and coronal suture(50-70 years),which was similar to our study results. During present study, certain limitations were observed: pars lambdica and to some extent pars intermedia can be assessed, but pars asterica got superimposed by the cervical vertebrae shadow; lambdoid suture closure begins from 25 years and fully calcified at around 65 years, so it is difficult to access the age of the individual by this technique, before the age of 25 years and after the age of 65 years; large sample size is required.

Conclusion

From the present study we conclude that the analysis of lambdoid suture through modified reverse panoramic radiographic technique is very effective and practical age estimation tool, especially in mortals. It can be used alone or in conjunction with other age estimation techniques, but more extensive studies are required.

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DOI: [10.19080/JFSCI.2019.12.555855](https://doi.org/10.19080/JFSCI.2019.12.555855)

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