



Original Article

Age-Related Variations in Facial Asymmetry – A Statistical Analysis of Soft Tissue Dimensions in Males and Females.

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ABSTRACT

Background: Facial soft tissue thickness plays a critical role in forensic facial reconstruction and personal identification. Population-specific data are essential for improving the accuracy of facial approximation. Bilateral asymmetry and age-related variations in facial soft tissue thickness remain insufficiently explored in the South Indian population.

Aim: To analyze age-related variations and bilateral asymmetry in facial soft tissue thickness among males and females aged 21–60 years.

Materials and Methods: A cross-sectional analytical study was conducted in the Department of Forensic Medicine, Government Medical College, Thiruvananthapuram. A total of 144 medicolegal autopsy cases (72 males and 72 females) aged 21–60 years were included in the study. Facial soft tissue thickness was measured at eleven bilateral landmarks. Statistical analysis was performed using SPSS version 17. Analysis of Variance (ANOVA), and coefficient of variation (CV) was calculated to assess measurement consistency.

Results: Significant age-related variations were observed at selected landmarks. In males, statistically significant differences were noted in the right supraorbital region and bilateral gonion. In females, significant variations were observed in the left suborbital region, left mid zygomatic region, and bilateral occlusal line. Most other bilateral landmarks did not show statistically significant differences.

Conclusion: Facial soft tissue thickness demonstrates age-related and sex-specific variations with identifiable bilateral asymmetry at certain anatomical landmarks. These findings emphasize that perfect facial symmetry is uncommon and that age- and sex-specific soft tissue data should be incorporated into forensic facial reconstruction protocols to improve identification accuracy.

Keywords: Facial soft tissue thickness; facial asymmetry; forensic facial reconstruction.

INTRODUCTION

Identification of skeletal remains is important in establishing crime. But if the skeletal remains alone are obtained where there were no photographs, dental records, and inability to obtain fingerprints and DNA samples, the identity of the deceased may remain a mystery [1,2,3]. Identity of the person can be established from skull alone in majority of the cases. Forensic facial reconstruction or forensic facial approximation is the process of recreating the face of an individual, though a combined use of artistry, forensic science, anthropology, and anatomy [4,5]. Facial soft tissue thickness plays an important role in facial reconstruction and personal identification. To know the depth of soft tissues at various points of face is essential to reconstruct the face from unidentified skull. Understanding the thickness of soft tissues of face at certain specific points and accounting for bilateral facial asymmetry is essential for accurate forensic facial reconstruction, which

is used for establishing identity from skeletal remains. Perfect facial symmetry is rare in nature. Recognizing and incorporating this natural asymmetry is crucial for creating a realistic and accurate facial approximation that can aid in identification. However, bilateral asymmetry in soft tissue dimensions of face is, insufficiently explored in southern part of India. The purpose of this study is to analyse age-related variations and bilateral asymmetry in facial soft tissue thickness among males and females

MATERIALS AND METHODS

We conducted a cross-sectional analytical study in the Department of Forensic Medicine at the Medical College, Thiruvananthapuram, over a period of one year, after getting institutional ethical committee clearance. Medicolegal autopsy cases of individuals aged 21 to 60 years of both sexes at the Department of Forensic medicine, Government medical college, Thiruvananthapuram, excluding the those with facial disfigurement caused by trauma, burns, or oedema and decomposed cadavers were included in the study. Informed written consent obtained from the near relative available and police officer in charge of the dead body. Sample size was calculated based on the study conducted by Moritsugui DS [6], et al. using the formula $n = \left(\frac{z \cdot \sigma}{E}\right)^2$, where $z = 1.96$ (confidence level 95%), $\Sigma = 3.88$ (largest SD), $E = 0.634$ (maximum error) and got the sample size as 144.

The present study included 144 cases aged 21 to 60 years that were brought for medicolegal autopsy. Consecutive sampling was done. The cases were divided equally between males and females. Each group was further divided into four equal groups. group I 21 – 30 years (Males and Females), group II 31 – 40 years (Males and Females), group III 41 – 50 years (Males and Females) and group IV 51-60 years (Males and Females).

General body measurements, such as height and weight, were also recorded. For recording facial tissue thickness STEWART METHOD was used (His 1895). A sharp lumbar puncture needle with a piece of rubber cork fitted on to the needle was used for measuring the soft tissue thickness. The distance between needle tip and the cork fitted on to the needle was taken to obtain the facial thickness. The distance between the rubber cork and the tip of needle was recorded in milli metre using digital vernier callipers, which represents the tissue thickness at that point. Tissue depth was recorded at eleven bilateral points, which are described below.

1. **Frontal eminence** -The highest point of the forehead, above the top point of the eye socket.
2. **Supraorbital**- The center of the top ridge of the eye socket.
3. **Suborbital**- The center of the bottom ridge of the eye socket.
4. **Inferior malar**- The indentation below the cheek bone and above the tooth line, in line with the bottom point of the eye socket.
5. **Lateral orbit**- The bulge of the cheekbone just below the outer ridge of the eye socket.
6. **Mid zygomatic arch**- The farthest extent of the cheek bone to the side.
7. **Supraglenoid**- The back of the cheek bone, just above the ear.
8. **Occlusal line**- A point on the upper curve of the jaw in line with where the teeth meet.
9. **Gonion**- The point at the back lower corner of the jaw line.
10. **Sub M2**- A point on the tooth line above the second upper molar.
11. **Supra M2**- A point on the tooth line below the second lower molar [7]

All the relevant data were entered in the proforma and subjected to statistical analysis by SPSS (Statistical Package for the Social Sciences) version 17 in which the following statistical methods were used.

- A. Analysis of variants (ANOVA) test was used to find out the significance in the different age groups.
- B. F value - is the calculated statistic from the mathematics behind ANOVA
- C. For comparing the variability of the measurements, the coefficient of variation was used. $CV = (SD/Mean) \times 100$, where, SD is the Standard deviation. Coefficient of variation was calculated at all points in both sexes. The lesser the coefficient of variation (CV) the greater the predictability which showed that at that land marks the mean values of the measurements were more precise and consistent.
- D. p value – probability.

RESULTS

Height & Weight

The mean values of height range from 164.56cm to 166.83cm in males, and from 153.89cm to 157.56cm in females. In males, the mean values of weight range from 59.00 kg to 63.83 kg and in females, the mean values of weight range from 48.17 kg to 60.11kg.

Bilateral points on face

1) Right and left frontal eminence in males.

The difference in the mean values of soft tissue thickness of face in the region of right and left frontal eminence in males in different age groups was not statistically significant.

2) Right and left frontal eminence in females.

The difference in the values of mean soft tissue thickness of face in the region of right and left frontal eminence in females in different age groups were not statistically significant.

3) Right and left supra orbital region in males.

The difference in the mean values of soft tissue thickness in the right supra orbital region showed a statistical significance in the different age groups. The difference in the mean values of soft tissue thickness of face in the region of left frontal eminence showed no significance.

Table 1. The mean values of soft tissue thickness of face in the region of right and left supra orbital region in males in different age groups.

Supra orbital region in male						
Age group	Right			Left		
	Mean (mm)	SD	CV	Mean (mm)	SD	CV
I	4.37	.809	18.5	4.33	.867	20.0
II	4.30	.870	20.2	4.32	.812	18.8
III	5.11	1.136	22.2	4.51	1.219	27.0
IV	4.06	.893	22.0	4.11	.818	19.9

The F value and p value in right supra orbital region were 4.218 and 0.009, and for left supra orbital region, 0.523 and 0.668 respectively.

4) Right and left supra orbital region in females.

For right and left supra orbital region, the values were more consistent in the group I females.

Table 2. The mean values of soft tissue thickness of face in the region of right and left supra orbital region in females in different age groups.

Supra orbital region in female						
Age group	Right			Left		
	Mean(mm)	SD	CV	Mean(mm)	SD	CV
I	4.09	0.610	14.9	4.17	0.590	14.1
II	4.32	0.833	19.3	4.31	0.812	18.9
III	3.85	1.232	32.0	3.97	1.105	27.8
IV	3.82	0.644	16.9	3.75	0.637	17.0

The F value and p value in right supra orbital region were 1.298 and 0.282, and for left supra orbital, 1.608 and 0.196 respectively.

5) Right and left sub orbital region in males.

The difference in the mean values of soft tissue thickness of face in the right and left sub orbital region in males showed no statistical significance in the different age groups. For the right and left sub orbital region the values were more consistent in the group I.

6) Right and left sub orbital region in females.

The difference in the mean values of soft tissue thickness in the left sub orbital region in females showed a statistical significance in the different age groups. The difference in the mean values of soft tissue thickness of face in the region of right sub orbital region showed no significance. For right and left sub orbital regions the values were more consistent in the group II in females.

Table 3. The mean values of soft tissue thickness of face in the region of right and left sub orbital region in females in different age groups.

Sub orbital region in females

Age group	Right			Left		
	Mean (mm)	SD	CV	Mean (mm)	SD	CV
I	4.12	1.126	27.3	4.46	1.653	37.1
II	3.43	.923	26.9	3.57	1.237	34.7
III	3.21	1.270	39.5	3.23	1.245	38.6
IV	3.42	1.185	34.6	3.60	1.131	31.5

The F value and p value in right sub orbital region were 2.204 and 0.096, and for left sub orbital region, 2.78 and 0.048 respectively.

7) Right and left inferior malar region in males.

The difference in the mean values of soft tissue thickness of face in the right and left inferior malar regions of face in males showed no statistical significance in different age groups. The value was more consistent in group III in right and left inferior malar.

8) Right and left inferior malar in females.

The difference in the mean values of soft tissue thickness of face in the right and left inferior malar regions of face in females showed no statistical significance in different age groups. For right and left inferior malar the values were more consistent in the group IV.

9) Right and left lateral orbit in males.

The difference in the mean values of soft tissue thickness of face in the right and left lateral orbital regions of face in males showed no statistical significance in different age groups. The values of right and left lateral orbit in males were more consistent in the age group I.

10) The right and left lateral orbit regions in females.

The difference in the mean values of soft tissue thickness of face in the right and left lateral orbital regions of face in females showed no statistical significance in different age groups. The mean value of right lateral orbit region was more consistent in group II and for left lateral orbit in group IV.

11) Right and left mid zygomatic region in males.

The difference in the mean values of soft tissue thickness of face in the right and left mid zygomatic regions in males showed no statistical significance in different age groups. For right and left mid zygomatic regions the values were more consistent in the group I in males.

12) Right and left midzygomatic regions in females.

The difference in the mean values of soft tissue thickness of face in the region of left mid zygomatic region in females showed a statistical significance in different age groups. But for the right mid zygomatic arch no statistical significance was noted in the different age groups. For right midzygomatic arch the value was more consistent in group II and for the left in group I.

Table 4. The mean values of soft tissue thickness of face in the region of right and left mid zygomatic in females in the different age groups.

Midzygomatic region in females						
Age group	Right			Left		
	Mean (mm)	SD	CV	Mean (mm)	SD	CV
I	5.50	1.703	30.9	5.26	1.226	23.3
II	5.97	1.433	24.0	6.06	1.453	24.0
III	6.57	1.980	30.2	6.44	1.847	28.7
IV	6.74	1.732	25.7	6.87	1.922	28.0

The F value and p value in right mid zygomatic region were 1.954 and 0.129, and for left mid Zygomatic region, 3.155 and 0.030 respectively.

13) Right and left supra glenoid region in males.

The difference in the mean values of soft tissue thickness of face in the right and left supra glenoid regions in males showed no statistical significance in the different age groups. For right supraglenoid the value was more consistent in the group IV and for left in group II.

14) Right and left supraglenoid region in females.

The difference in the mean values of soft tissue thickness of face in the right and left supra glenoid regions in females showed no statistical significance in different age groups. For right and left supra glenoid regions the values were more consistent in the group IV in females.

15) Right and left occlusal line in males.

The difference in the mean values of soft tissue thickness of face in the right and left occlusal line in males showed no statistical significance in different age groups. For right occlusal line the value was more consistent in the group II and for left occlusal line, in the group I

16) Right and left occlusal line in females.

The difference in the mean values of soft tissue thickness of face in the right and left occlusal line in females showed a statistical significance in the different age groups. For right occlusal line the value was more consistent in the group III and for left occlusal line, in group IV.

Table 5. The mean values of soft tissue thickness of face in the region of right and left occlusal line in females in different age groups.

Occlusal line in female						
Age group	Right			Left		
	Mean (mm)	SD	CV	Mean (mm)	SD	CV
I	13.45	3.234	24.1	13.76	2.402	17.5
II	14.32	3.841	26.8	15.42	2.714	17.6
III	16.60	2.496	15.0	16.28	2.494	15.3
IV	16.16	2.517	15.6	16.40	1.971	12.0

The F value and p value in right occlusal line were 4.272 and 0.008 and for left occlusal line, 4.604 and 0.005 respectively.

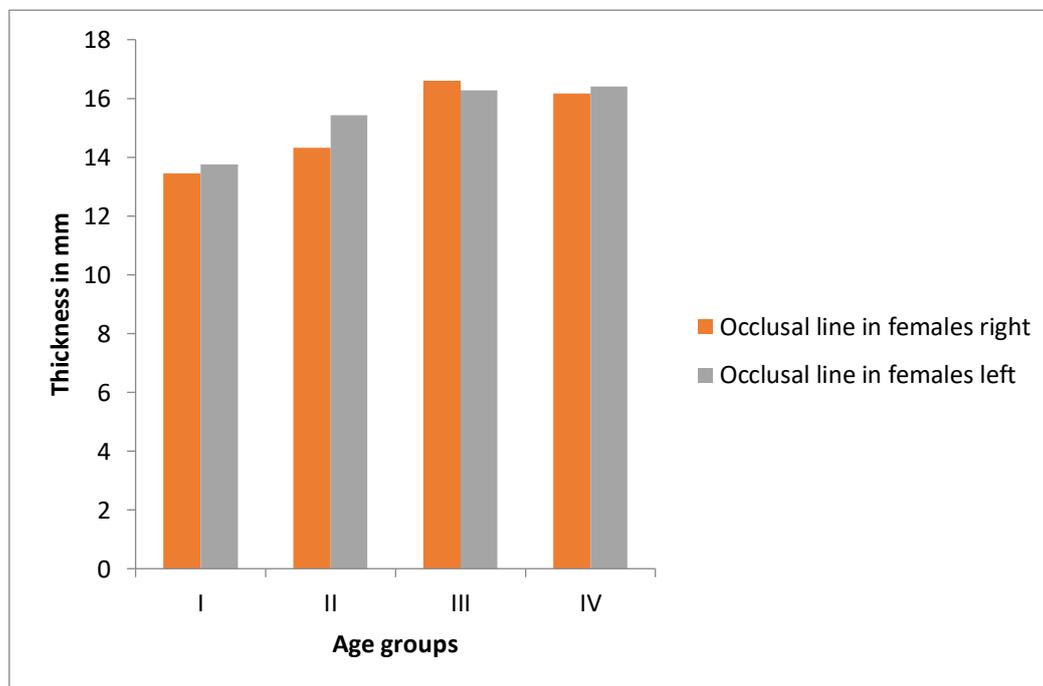


Fig 1. The mean values of soft tissue thickness of face in the right and left Occlusal line in females in different age groups.

17) Right and left region of gonion in males.

The difference in the mean values of soft tissue thickness of face in the right and left gonion in males showed a statistical significance in different age groups. For right and left gonion the values were more consistent in the group III in males

Table 6. The mean values of soft tissue thickness of face in the region of right and left gonion in males in different age groups.

Gonion in male						
Age group	Right			Left		
	Mean(mm)	SD	CV	Mean(mm)	SD	CV
I	10.78	3.732	34.6	11.10	3.515	31.7
II	10.06	4.458	44.3	10.28	4.153	40.4
III	11.13	3.110	27.9	11.06	2.886	26.1
IV	7.87	3.110	39.5	7.98	3.352	42.0

The F value and p value in right gonion were 2.897 and 0.041, and for left gonion 3.154 and 0.030 respectively.

18) Right and left gonion in females.

The difference in the mean values of soft tissue thickness of face in the right and left gonion in females showed no statistical significance in different age groups. For right and left gonion the values were more consistent in the group IV females.

19)Right and left subm2 in males.

The difference in the mean values of soft tissue thickness of face in the right and left subm2 regions of face in males showed no statistical significance in different age groups. For right sub m2 the value was more consistent in the group II and for left sub m2 in group I in males.

20) Right and left sub m2 in females.

The difference in the mean values of soft tissue thickness of face in the right and left subm2 regions of face in females showed no statistical significance in the different age groups. For right and left sub m2 the values were more consistent in the group II in females.

21) Right and left supra m2 in males.

The difference in the mean values of soft tissue thickness of face in the right and left supra m2 in males showed no statistical significance in different age groups. For right supra m2 the value was more consistent in the group I and for left supra m2 in group III in males .

22) Right and left supra m2 in females.

The difference in the mean values of soft tissue thickness of face in the right and left supra m2 in females showed no statistical significance in different age groups. For right and left supra m2 the values were more consistent in the age group IV in females.

DISCUSSION

The study was conducted in the Department of Forensic Medicine, Medical College, Thiruvananthapuram, for a period of one year. The study included 144 cases aged 21 to 60 years that were brought for medicolegal autopsy which were divided into four different groups and soft tissue thickness of corresponding points on both sides were compared in both sexes.

At certain bilateral points, significant differences were noted between similar points in both sexes.

Age group	Land marks	
	Male	Female
Group 1	Nil	1) Left suborbital. 2) Left mid zygomatic arch.
Group 11	Nil	Nil
Group 111	Right supraorbital.	Left occlusal line.
Group 1V	Right and left gonion	Left occlusal line.

This can be explained by the facial asymmetry. Forensic reconstruction of a bilaterally symmetrical perfect face is almost a theoretical concept, because it rarely occurs in nature. Sahni et al. studied facial soft tissue thickness in 173 men and 127 women using MRI and reported mild asymmetry at most bilateral landmarks. They observed that the measurements on the left side were generally greater than those on the right side [8]. Domaracki and Stephan found asymmetry at only one reference point on the left side. Sutton, however, reported greater tissue thickness on the right side [9]. These differences in findings indicate variability in facial asymmetry between studies. Hager and Ekman [10] suggested that even a normal face may appear asymmetrical, especially during facial expressions, which could explain such variations. In a study conducted by, Torres M. S. R et al [11] on analyzing the left and right sides in men, no differences were observed.

In this study, it was shown that both sexes have variations in the soft tissue thickness at different points in different age groups. A mild degree of facial asymmetry may not be obvious and it may even play a positive role in human attraction and identification. The real significance of facial asymmetry on both sides of the face is not considered when making an approximation of the morpho facial characteristics of an individual. Asymmetry exists in the thickness of homologous tissues on both sides for each sex. This asymmetry determines the presence of sexual characteristics, which helps to assess the facial expressive characteristics for everyone.

CONCLUSION

The present study demonstrates that facial soft tissue thickness exhibits measurable age-related and sex-specific variations, with evident bilateral asymmetry at selected anatomical landmarks. Specific points like the supraorbital region and gonion in males, and the suborbital, mid zygomatic, and occlusal line regions in females showed significant variation bilaterally. The findings point that perfect bilateral symmetry is not common and soft tissue distribution changes with age in males and females. These variations have relevance in forensic facial reconstruction, personal identification, and anthropological studies. These can improve the accuracy and reliability of facial approximation techniques along with the use of soft tissue thickness of specific midline points of face.

Limitations

The measurements were obtained from cadavers during medicolegal autopsy, and postmortem changes such as dehydration, loss of tissue tone, and variation in postmortem interval may have influenced soft tissue thickness values. Human errors in needle placement and measurement can cause errors in determining the depth. Regarding the accuracy in determining the soft tissue thickness, Computed Tomography and Magnetic Resonance Imaging are generally considered more accurate and reliable in determining the soft tissue thickness compared to needle penetration method. But the disadvantages in imaging techniques are higher cost and radiation. In modern research, imaging based methods are preferred to eliminate the measurement errors. The exact postmortem interval was not standardized, which could introduce measurement variability.

Ethical considerations – Study started after getting clearance from human ethics committee, Government Medical College, Thiruvananthapuram.

Conflict of interest – NIL

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