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Original Research Article

A Study on Fetal Palatal Growth with Respect to Different Anatomical Landmarks and Its Clinical Relevance: A Cadaveric Study

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ABSTRACT

Background & objectives: Cleft lip and cleft palate are the most common facial malformations in newborn. Currently, ultrasonography is used to detect clefting prenatally as early as 16 weeks. The purpose of this anatomic study was to clarify the morphometry of the soft palate during the second and third fetal trimesters in order to improve the ultrasonographic visualization of the soft palate in the fetus.
Methods: The study was done using sagittal sections of 24 formalin fixed dead fetuses of second and third trimester recruited from department of Anatomy, Kasturba Medical College, Manipal. The length of the hard palate, the length of the soft palate and the hard palate/soft palate angle were measured. The distances measured were from atlas vertebra to soft palate, hyoid to soft palate and hyoid to gnathion.
Results: The significant difference between means was seen for the length of hard palate ($p=0.004$), length of soft palate ($p=0.017$), C1 to soft palate ($p=0.032$) and hyoid bone to gnathion ($p<0.001$) between second and third trimester. A positive correlation was found between gestational age (GA) and length of hard palate ($r=0.5$), GA and soft palate ($r=0.3$) and between GA and Gn-Hy ($r=0.8$).
Conclusion: The growth of hard and soft palate was significant with respect to increase in GA, whereas the velopalatal angle did not vary much. The parameters of this study would be useful in the ultrasonographic assessment of the soft palate and prompt diagnosis of isolated cleft palate.

Key words: cleft lip, cleft palate, gnathion, soft palate, velopalatal angle.

INTRODUCTION

Cleft lip and cleft palate are the most common facial malformations in newborns. Currently, ultrasonography is used to detect clefting prenatally as early as 16 weeks (Captier et al 2008). Cleft palate is a separate entity and a prenatal diagnosis of isolated cleft palate is still difficult, with only 0% to 22% of cases being detected prenatally (Clementi et al., 2000; Cash et al., 2001; Sohan et al., 2001). Poor visualization of the hard and soft palate during prenatal ultrasonography has meant that prenatal diagnosis of isolated cleft palate is low. The soft palate is recently drawing attention due to its involvement with snoring and obstructive sleep apnea(Demin et al 2002, Lee et al 2012, Rama et al 2002). Cleft

palate can be associated with glossoptosis and micrognathia as in Pierre Robin sequence (Cole et al 2008).

During antenatal development the palatal component of intermaxillary segment will give rise to primary palate. Outgrowths of maxillary prominences, the palatine shelves which appear in the sixth week of development form the secondary palate. Anteriorly, the shelves fuse with the triangular primary palate, and the incisive foramen is the midline landmark between the primary and secondary palates. At the same time as the palatine shelves fuse, the nasal septum grows down and joins with the cephalic aspect of the newly formed palate(Sadler TW 2006). Ventral three forth of the secondary palate ossifies in membrane and persists as hard palate. Dorsal one fourth does not ossify and persists as soft palate (Datta AK 2007).

The purpose of this anatomic study was to clarify the morphometry of the fetal palate during the second and third trimesters in order to improve the ultrasonographic visualization. Its position was studied in relation to the atlas vertebra, hyoid bone and gnathion in the sagittal plane.

MATERIAL AND METHODS

The present observational study was done using sagittal sections of 24 formalin fixed dead fetuses of known gestational age (GA) of second and third trimester recruited from department of Anatomy, Kasturba Medical College, Manipal. Fetuses with any noted facial malformations were excluded from the study. The specimens ranged from 25 to 38 estimated gestational weeks. In the sagittal section of fetus the following points were taken. The landmarks selected were: anterior nasal spine (A), the posterior nasal spine (P), the center of the ventral arch of atlas (C1), the tip of the uvula (U), the center of the body of the hyoid bone (Hy), and the gnathion (Gn). The landmarks are shown in figure 1. The points were marked using pins and the distance between the points was measured using a scale.

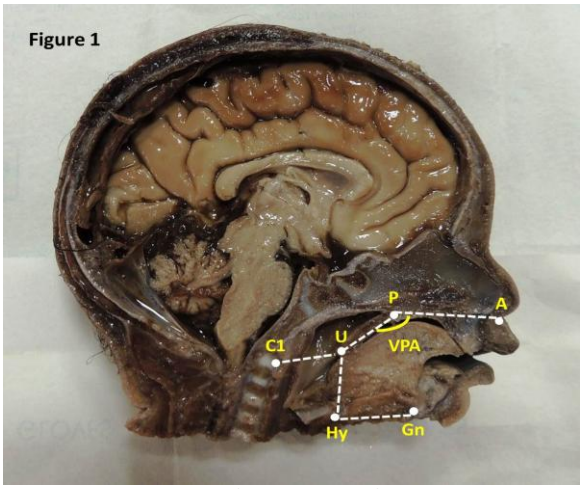


Figure 1: Sagittal section of third trimester fetus showing landmarks and measurements taken.
A: Anterior nasal spine, P: Posterior nasal spine, U: Uvula, Gn: Gnathion, C1: Atlas, Hy: Hyoid, VPA: Velopalatal angle

The length of the hard palate (A-P), the length of the soft palate (P-U), and the hard palate/soft palate angle (velopalatal angle) were measured, and a soft/hard palate ratio was calculated. The distances measured were: Atlas vertebra to soft palate (C1-U), hyoid to soft palate (Hy-U) and hyoid to gnathion (Hy-Gn).

RESULTS

The present study was done using 24 formalin fixed fetuses of second (N=8) and third trimester (N=16). The fetuses were divided into two groups according to the trimester they belong to. The mean and standard deviation of various parameters measured are shown in table 1.

Table 1: Descriptive statistics of various parameters measured.

Measurements In centimeters	Second trimester (mean and SD) (N=8)	Third trimester (mean and SD) (N=16)	P value
Length of hard palate (A-P)	2.97 ± 0.2	3.56±0.37	0.004*
Length of soft palate (P-U)	1.25 ± 0.26	1.4 ± 0.23	0.017*
Velopalatal angle	141.75º ± 13.16	140.88º ± 11.72	0.87
C1-U	1.52 ± 0.27	1.38 ± 0.32	0.032*
Hy-U	1.22 ± 0.28	1.25 ± 0.17	0.079
Gn-Hy	2.27 ± 0.19	2.97 ± 0.22	<0.001*

*Student t- test showing significant p value.

Student t test was applied to compare the means between two groups. The significant difference between means was found for the length of hard palate (p=0.004), length of soft palate (p=0.017), C1 to soft palate (p=0.032) and hyoid bone to gnathion (p<0.001). The remaining parameters including velopalatal angle did not show any statistical significance. Soft palate to hard palate ratio (SP/HP) was calculated. In second trimester it was 0.4 ± 0.09 and in third trimester 0.42 ± 0.75 which was not statistically significant.

Pearson's correlation test was done to correlate the gestational age with the parameters measured. The results were tabulated (table 2).A positive correlation was found between GA and length of hard palate (r=0.5), GA and soft palate (r=0.3) and between GA and Gn-Hy (r=0.8) which are shown in graphs 1, 2.

Table 2: Pearson's correlation test against gestational age.

Measurements In centimeters	R value	Significance (p value)
Length of hard palate (A-P)	0.5	0.003*
Length of soft palate (P-U)	0.3	0.2
Velopalatal angle	0.03	0.86
C1-U	0.02	0.22
Hy-U	0.03	0.87
Gn-Hy	0.8	<0.001*

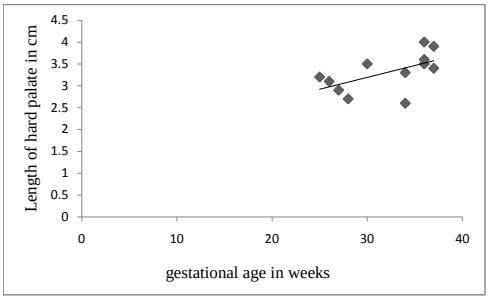
*Pearson's correlation test showing significant p value.

As significant correlation was found only for length of hard palate and Gn-Hy with respect to GA, regression equation was calculated for the same.

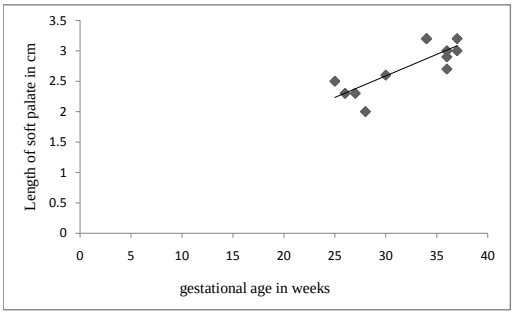
GA=1.564 + 0.054 (length of hard palate)

GA= 0.46 + 0.071 (Gn-Hy)

Graph 1: Scatter diagram showing the length of hard palate against gestational age



Graph 2: Scatter diagram showing the length of soft palate against gestational age



DISCUSSION

The use of 3D and 4D ultrasonography with specific planes has improved the visualization of the hard palate (Campbell et al., 2005; Faure et al., 2007),but the soft palate is not visible because it is not in the same plane as the hard palate. The present study was done to calculate the measurements of hard and soft palate in gross specimens so that to enhance the accuracy of measurements.

In a study done by Captier et al (2008) showed length of hard palate in second trimester was 16.52 ± 0.34mm, and in third trimester it was 27.44 ± 0.34mm. In present study the measurements were 2.97 ±

0.2cm and 3.56 ± 0.37cm respectively. According to Captier et al the velopalatal angle was found to be 150.33º±7.62, 150.20º±6.67 in second and third trimesters respectively. A 3D ultrasound study done by Faure et al (2007) calculated the velopalatal angle at GA of 20- 25 weeks which was 150º ± 7. In the present study the angle was 141.75º ± 13.16, 140.88º ± 11.72 in second and third trimester respectively indicating there was no significant growth of this angle, that the angulation between hard and soft palate did not vary much with increase in GA.

In an ultrasonographic study of the hard palate, Sherer et al. (2004) demonstrated that the growth of the hard palate in length and width correlated strongly with gestational age. In the present study the length of hard and soft palate was significantly increased in third trimester indicating the rapid growth of palate at the end of third trimester. But the velopalatal angle remained unchanged.

Captier et al studied the Gn-Hy distance which was increased significantly in third trimester same as the present study.

CONCLUSION

Therefore, the parameters of this study would be useful in the ultrasonographic assessment of the soft palate and prompt diagnosis of isolated CP without hard palate clefting. In particular, data on the angle between the hard and soft palates and the angle of the soft palate in relation to the anterior cranial base could contribute to the development of antenatal visualization of the soft palate.

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