



Microscopic study of human fetal retina in different gestational ages

Anatomy

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ABSTRACT

The purpose of the study was to observe the changes in histological thickness of retina in developing human fetuses. The total thickness of human fetal retina from 13 to 40 weeks of gestational ages was measured on 56 eyeballs of 28 fetuses. Thickness of retina was measured on both side of optic nerve on nasal and temporal side under light microscope by ocular micrometer in micron meter. The total thickness of retina increases as gestational age increases also the retinal layers develops at different gestational ages.

KEYWORDS:

Gestational age, Human fetal retina, Thickness.

Introduction

Retina is photosensitive layer of the eye. Retina starts to develop at 4th week and it completes after the birth. So the visual system is one of the last systems to develop structurally and functionally in human fetuses.⁵ The differentiation and maturation of the fovea and macular retinal layers begin 24 to 27 weeks after conception and continue until 8 months of age.^{6,7} Preterm birth immensely changes the infant's environment, and evidence suggests that this could lead to the disruption of normal retinal development and function. Recent studies have been done on thickness of retina by using optical coherence tomography and revealed that preterm children have thicker central maculae than that of children born at term, regardless of the presence of ROP.^{2,16} Another recent study has shown that premature birth is associated with the failure of inner retinal layers to migrate away from the fovea, resulting in increased foveal thickness in patients with ROP.¹⁷ Most of the studies have been done to measure the thickness of retina in premature babies by the optical coherence tomography but the OCT images is of lower resolution than histology and quality of the images is affected by ocular media, movement, shadowing and inability to separate adjacent tissues with similar relative reflectivity.¹⁰ However, there is still little detailed description of histological development and almost no quantitative information about human retina from 13 weeks to the birth.

So the aim of the present study was to measure the histological thickness in developing human fetuses. So this study will be helpful to judge the structure of the retina in preterm babies.

Materials and Methodology

56 fetuses from 13 to 40 weeks were collected from MGM Hospital Kalamboli and MGM Hospital Aurangabad Maharashtra, India after the approval from institutional ethical committee of MGMIHS. CRL (crown rump length), CHL (crown heel length) and foot length were measured with thread and scale in cm. for estimating the gestational weeks followed by recording the weight of foetus in grams. Then we were done the grouping of foetuses and each group contains 4 foetuses.

The study was done on 56 eyeballs from 28 male and female foetuses at MGM Medical College, Kamothe, Navi Mumbai, India.

Inclusion criteria: Spontaneous aborted Fetuses from normal mother (from 13 to 40 Weeks of gestational age)

Exclusion criteria: Decomposed and developmental anomalies fetuses.

Eyeballs were taken out through the orbit its anterior aspect along with optic nerve. Then the eyeball cut in horizontal section in the corneal centre and optic nerve projection. Then the eyeballs were immersed in Davidson's fixative for 24 hours and then in 10% neutral formalin. Then retina were subjected to routine processing by dehydration in graded alcohols, clearing in xylene and embedded in paraffin. Two Sections of 8µm thickness were cut using microtome. The slides

(sections) were treated for 3 min with 95% and 75% absolute alcohol, washed in running water and stained with Haematoxylin for 4 min and with Eosin for 3 min. The sections were passed through grades of alcohol, cleared in xylene, mounted in DPX. Then the total thickness of retina was measured at six different fields of two sections using ocular micrometer under the light microscope. Then the recorded measurement were statistically analysed by mean and standard deviation.

Observation and results:

The adult retina has basically ten layers. In our study we measured histological thickness of fetal retina from 13 weeks 40 weeks. The foetuses were divided into seven groups and the each group contain 4 fetuses. The retina before the 20 weeks has retinal pigment epithelium, neuroblastic layer, inner plexiform layer, ganaglion cell layer and nerve fibre layer but after 20 weeks the neuroblastic layer differentiate into inner nuclear layer and outer nuclear layer by the formation outer plexiform layer (figure 1&2) so we measured the total thickness of fetal retina from outer side retinal pigment epithelium to inner side inner nerve fibre and the total thickness of retina increases linearly as gestational age increases and it shown in table (1) & (graf-1).

Table-1

Gestational Weeks	Total Thickness (µm) Mean & SD
13 - 16 Weeks	124.88 ± 11.45
17 - 20 Weeks	153.73 ± 9.64
21 - 24 Weeks	177.60 ± 7.99
25 - 28 Weeks	201.35 ± 10.67
29 - 32 Weeks	231.05 ± 9.54
33 - 36 Weeks	258.33 ± 10.18
37 - 40 Weeks	294.83 ± 11.58

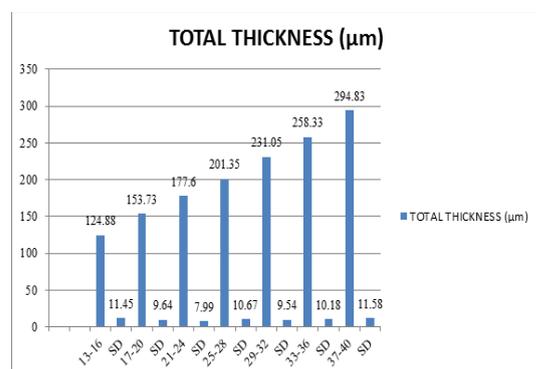


Figure-1 (14 weeks)

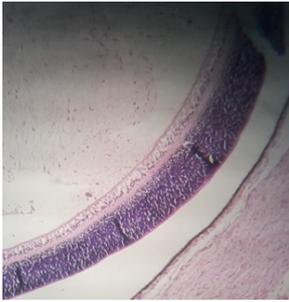


figure-2 (21 weeks)



Figure - 3 (32weeks) Histological measurement of retina



Discussion

Many ophthalmological diseases have the changes in retinal thickness e.g. diabetic macular lesions can result in the thickening of retina so the present study of measurement of histological thickness of fetal retina can be compared with fetus of the diabetic mother. Our description of normal histological development will be helpful in diagnosing and understanding the paediatric retinal diseases. So that the present study was done In the present study we have recorded histological thickness of human fetal retina from 13 weeks to 40 weeks. Most of the retinal thickness measurement studies have been done in premature babies by the OCT after birth and few of the studies have been done by histology for the retinal thickness measurement on animals. In our study the retinal thickness increases as gestational age increases this was also shown by A. Styszynski et al and studied on human fetal retina up to 60 days of fetal age and stated that retinal thickness increases as gestational age increases. Marry hydrina studied the effect of 2G cell phone on retina chick embryo and stated that the histological thickness increases as age of the chick embryo increases both in control and experimental group but the thickness of experimental group was more. Hammer et. al. and wang et. al. reported that outer nuclear and inner nuclear were significantly thicker in preterm children than those in full term children. T C Nag and Shashi Wadhwa stated the outer plexiform layer develops at 17 weeks of gestational age and Tulika Gupta et. al. stated the outer plexiform layer develops at 19 weeks but in our study the outer plexiform layer develops at 20 weeks of gestational age.

Conclusion

Histological thickness of human fetal retina increases as gestational age increases. After the 20 weeks of gestational age the neuroblastic layer differentiates by the formation of outer plexiform layer into inner nuclear layer and outer nuclear layer.

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