

Macular Thickness in Retinitis Pigmentosa

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Abstract

Aim: To determine the macular thickness in patients with Retinitis Pigmentosa.

Methodology: Patients already diagnosed with RP, aged above 18 years were included in the study. Patients with nystagmus, other retinal disorders or any systemic diseases like diabetes or hypertension were excluded. After carrying out the ophthalmic examinations like visual acuities, tangent screen, colour vision, OCT were performed on all the patients.

Result: 34 RP and Normal patients were enrolled in the study. Their mean age were found out to be 42.95 ± 13.18 years of the normal eyes and 37.53 ± 14.66 years of the RP eyes. Statistical analysis was carried out using correlation, wherein it was seen that all visual function had strong correlation with the thickness of fovea, and the correlation decreased outward to the outer ring.

Conclusion: It was seen that in the RP patients the macular thickness decreased for the age group < 40 years whereas an increased thickness was observed in the age group of > 50 years. In addition, the inferior area was found out to be most fragile and the superior area was the least affected.

Keywords: Macular Thickness; Retinitis Pigmentosa; Optical Coherence Tomography

Introduction

Retinitis Pigmentosa

Retinitis pigmentosa (RP) is a heterogeneous group of inherited retinal diseases causing primary degeneration of rod photoreceptors and secondary critical degeneration of cone photoreceptors [1]. In early stages of the disease, the function of either peripheral or central cones may be abnormal, and it tends to deteriorate as the disease progresses [2-5]. The condition can be inherited in an autosomal dominant, autosomal recessive or X-linked manner [6,7]. It has a worldwide prevalence of approximately 1:4000 [6].

A clinical diagnosis of RP is made based on the family history, presence of nyctalopia, visual field constriction, characteristic pigmentary retinal changes, bone spicule pigmentation in the periphery and reduction in the standard full-field ERG, consistent with rod-cone dystrophy [8].

Atypical forms of the condition were reported both firm and tenuous associations with other ocular and systemic abnormalities were noted and therefore RP is the subject of vast literature [9].

Retinitis Pigmentosa is known for over 140 years for a number of related dysfunctions in the retina [10,11]. The disease can be classified into 3 groups based on clinical symptoms, electroretinographic phenotypes and genetics [12-14]. In addition to typical forms of RP there are a number of related or allied diseases. There are also syndromic forms of RP in which the disease is present as a component of multisystem disorder. RP is related with the allied disease and syndromes such as Leber congenital amaurosis [15], Stargardt disease and fundus flavimaculatus [16], macular degeneration [17], cone dystrophy [18] and the Refsum diseases [19].



Clinical Description of RP

Historically, RP patients were believed to suffer from retinal inflammation in conjunction with observed retinal pigmentary changes [10]. Inflammation is no longer considered causal in RP, and cases of true RP are now viewed as genetic in origin. The pigmentary changes are a common factor in RP diagnoses. The pigment granules accumulate in perivascular clusters, known as "bone-spicule formations" due to their morphological appearance in the neural retina. Consequently early in the disease the pigmented posterior pole of the eye, the fundus, develops a mottled or granular appearance. This is followed by the development of bone-spicule pigmentary deposits overlying the depigmented fundus. Variability in the course of pigmentary changes can cause hypopigmentation, translucence or window-like holes through the RPE and rounded clumps of pigments to form in the neural retina [20].

In typical cases, known as rod-cone RP, the rods are the predominantly affected photoreceptor cells [10,20]. This generates a number of characteristic, clinical symptoms including night blindness at an early age, and bilateral symmetrical loss of the mid-peripheral visual fields. Although there is usually relative preservation of macular vision, the visual field defects gradually increase both centrally and peripherally. With progression, cone photoreceptor cells are also affected and day vision and central visual acuity are compromised. The rate of visual failure is variable, but total blindness is eventually possible [13,21-23].

The age of onset of RP can vary from infancy through late middle age [10,24]. The age at which symptoms become clinically apparent is correlated with the mechanism of inheritance: X-linked RP, autosomal recessive RP and autosomal dominant RP generally have their onsets at successively greater ages, although the age ranges overlap considerably. Frequently, a case may present with visual symptoms in late adolescence. Leber congenital amaurosis, an RP allied disease, is a severe congenital retinal dystrophy. Syndromic forms usually present at younger ages than typical cases.

As the retina atrophies, the retinal blood vessels attenuate [10,25]. This, in turn, causes ophthalmoscopically visible changes in the color of the optic nerve head through which the vessels enter the eye.

In summary, a typical case of RP will show atrophy and pigmentary changes to the retina and RPE, early night blindness, loss of the visual fields, loss of central visual acuity, attenuation of the retinal vasculature and changes to the optic nerve head during the course of the disease. In atypical cases of RP or in the closely related allied diseases, any combination of these symptoms may be altered to a greater or lesser extent. This heterogeneity has, in part, led to the difficulties in consistent clinical classification of the various forms of RP.

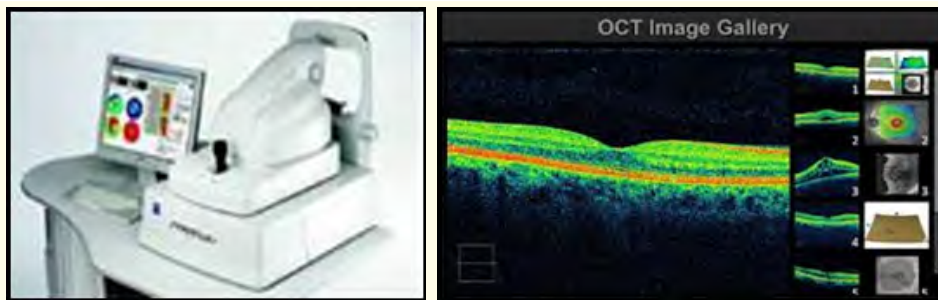
Genetic Classification of RP

Early genetic classifications of RP were derived mainly from the modes of inheritance: autosomal dominant, autosomal recessive, X-linked or mitochondrial. Cases for which no family history was evident were known as isolate, sporadic or simplex. With the advents of link-

age mapping based on the direct analysis of DNA, of positional cloning and of the molecular analysis of candidate genes, the description of genetic loci for RP has explored. There are now 36 known or predicted RP genes and many more loci for allied diseases and syndromic forms [26-28]. In general, RP genes are known or expected to be expressed in the photoreceptor cells of the retina or in the RPE. In the cases of 19 of the RP loci, the precise gene has been described. These known genes can be grouped into several functional classes.

Optical Coherence Tomography

OCT was introduced to the world by Huang, *et al.* in 1991 and became an important diagnostic tool in ophthalmology [24]. OCT is useful in retinal diseases and glaucoma [29] and it is a non-invasive, non-contact procedure that provides a cross sectional image and enabled the investigator to assess the morphologic changes in each retinal layers and the overall retina [30]. OCT requires a relatively short measurement time and it uses a simple operation technique. OCT also has a good penetration and high resolution in both the axial and transverse images. Thus OCT can provide a clear visualization of the major intraretinal layers [31,32].



Literature Review

Many studies have used OCT to focus on the gross retinal morphology in patients with RP [27,33-35], and current higher resolution OCT technology allows more subtle retinal structures to be viewed.

Aizawa, *et al.* [36] evaluated that the inner/outer segment junction was associated with better visual acuities [37]. Walia, *et al.* [38] used OCT to examine the retinal nerve fibre layer defects in RP patients and reported that two thirds of the RP patients has some degree of RNFL defects, especially patients with a pale optic nerve head.

Another study was conducted by Saloni Walia, *et al.* concluded that patients with retinitis pigmentosa may have a measurable degree of Retinal Nerve Fibre Layer thinning as determined by OCT [38]. It was observed that retinal thickening was associated with subject with lower visual acuity and also with patients with typical retinitis pigmentosa.

Structure and function of the macula in patients with advanced RP was concluded with OCT images for macular thickness which concluded that the OCT report segmentation enables objective evaluation of retinal structural changes in RP.

Recent study done by Chen, *et al.* in April 2012, on macular thickness and aging in RP patients concluded that the macular thickness decreased in middle age group in RP patients [39].

Hence the aim of research was to study the macular thickness in patients with retinitis pigmentosa.

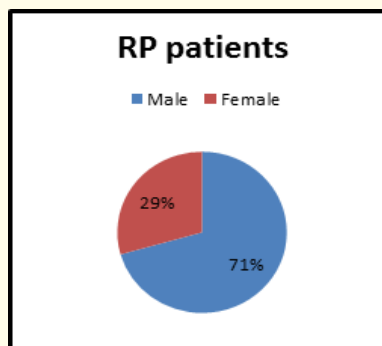
Study

Aim: To determine the macular thickness in patients with Retinitis Pigmentosa.

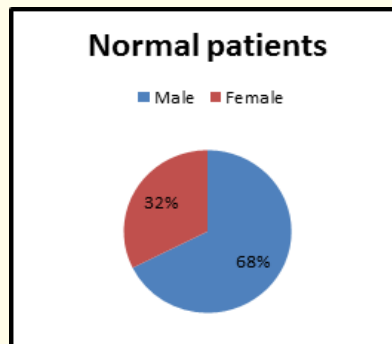
Methodology: It is a retrospective study design conducted at the Low Vision Department of the Lotus Eye hospital and lotus College of Optometry where the patients already diagnosed to have RP were selected for the study.

After stratifying the samples into 3 groups based on age we got: In the age group of < 40yrs 14 normal eyes and 22 RP eyes where their male: female ratio was 10:4 in normals and 14:8 in RP, mean age was 30.13 ± 7.72 yrs in normals and 28.5 ± 8.21 yrs in RP, mean visual acuity was 0.32 in normals and 1.08 in RP, mean tangent screen was 75.5 in normals and 32.59 in RP and mean foveal thickness was 250 in normals and 192.86 in RP. In the age group of 40 - 50yrs we got 9 normal eyes and 6 RP eyes where their male: female ratio was 5:4 in normals and 4:2 in RP, mean age was 43.5 ± 2.07 yrs in normals and 45.33 ± 4.04 yrs in RP, mean visual acuity was 0.33 in normals and 1.23 in RP, mean tangent screen was 70.44 in normals and 28 in RP and mean foveal thickness was 241.56 in normals and 164.67 in RP. In the age group of > 50 yrs we got 11 normal eyes and 6 RP eyes, their male: female ratio was 8:3 in normals and 6:0 in RP, mean age was 57.14 ± 7.17 yrs in normals and 58.75 ± 6.70 yrs in RP, mean visual acuity was 0.38 in normals and 0.97 in RP, mean tangent screen was 69.64 in normals and 31.33 in RP, mean foveal thickness was 243.45 in normals and 239.67 in RP.

The gender ratio of the RP and the Normal patients were taken which shows the following:



Graph 1: Gender Ratio of RP patients.



Graph 2: Gender Ratio of normal patients.

Results

When the thickness of the 3 circular zones of the macula i.e. the Fovea, Inner ring and Outer ring was measured it was found that:

In RP patients foveal and inner ring thickness is least in the age group of 40 - 50yrs and maximum in the age group of > 50yrs whereas the outer ring thickness is least in the age group of > 50yrs and maximum in the age group < 40yrs.

In Normal patients foveal thickness is least in the age group of 40 - 50yrs and maximum in the age group of < 40yrs whereas the inner ring and outer ring thickness is least in the age group of 40 - 50yrs and maximum in the age group of > 50yrs.

When the thickness of the 4 quadrants of the macula i.e. Superior, Temporal, Inferior and Nasal was measured it was found that:

In RP patients inferior quadrant shows least thickness in all the age groups, while age group of < 40yrs shows maximum thickness at temporal quadrant, the age group of 40 - 50 yrs shows maximum thickness at nasal quadrant and the age group of > 50yrs shows maximum thickness in superior quadrant.

In Normal patients the age group of > 50yrs shows maximum thickness at superior and nasal quadrants, age group of 40 - 50yrs shows least thickness in the superior, temporal and inferior quadrant and age group of < 40yrs shows maximum thickness at temporal and inferior quadrants.

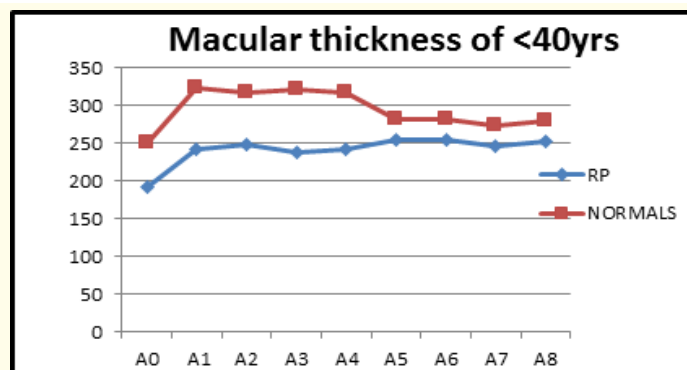
When the thickness of the 9 areas of the macula i.e. A0, A1, A2, A3, A4, A5, A6, A7, A8 was measured it was found that:

In RP patients age group of > 50yrs shows maximum thickness at A1, A2, A3, A4 and least thickness at A5, A6, A8, age group of 40 - 50yrs showed least thickness at A1, A2, A3, A4, A7 and age group of < 40yrs shows maximum thickness at A5, A6, A7, A8.

In Normal patients age group of 40-50yrs shows least thickness at A4, A7 and age group of < 40yrs shows maximum thickness at A7, A8 and in other areas no significant variations were observed.

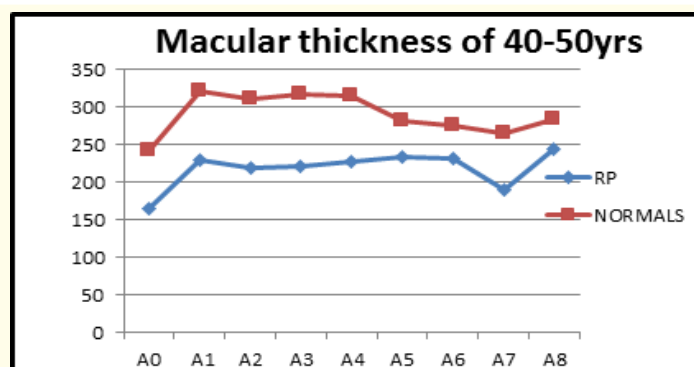
When the macular thickness of all the 9 areas of RP and Normal patients were compared according to their age groups we got the following findings:

In normal patients < 40yrs, maximum thickness is seen at A1, A2, A3, A4 and minimum at A0 whereas in RP patients < 40yrs, maximum thickness is seen at A5, A6, A8 and minimum thickness at A1.



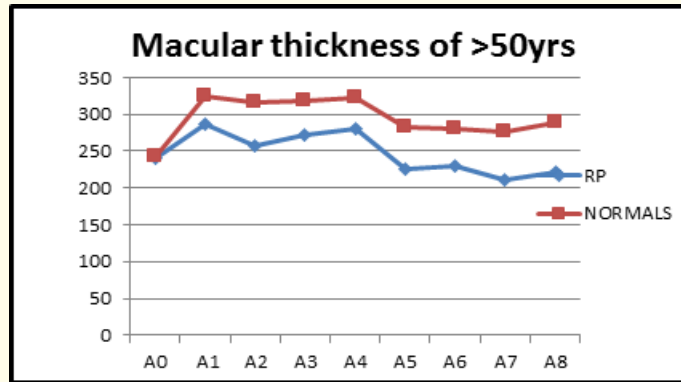
Graph 3: Macular thickness of < 40 yrs.

In normal patients 40 - 50yrs, maximum thickness is seen at A1, A2, A3, A4 and minimum at A0 whereas in RP patients 40 - 50yrs, maximum thickness is seen at A8 and minimum at A0, A7.



Graph 4: Macular thickness of 40 - 50 yrs.

In normal patients > 50yrs, maximum thickness is seen at A1, A2, A3, A4 and minimum at A0 whereas in RP patients > 50yrs, maximum thickness is seen at A1, A4 and minimum at A5, A6, A7, A8.



Graph 5: Macular thickness of > 50 yrs.

Statistical Analysis

Statistical analysis was carried out using the correlation test.

Visual acuity shows positive correlation for inner and outer ring thickness whereas foveal thickness shows negative correlation.

Tangent screen shows positive correlation for foveal and inner ring thickness whereas outer ring shows negative correlation.

In addition, all visual function had strong correlation with the thickness of fovea, and the correlation decreased outward to the outer ring.

Discussion

This study was done to investigate the age related changes of the macula in RP patients and compare them with their age and gender matched normals using OCT. Our study revealed that all visual functions had a strong correlation with the thickness of fovea, and the correlation decreased outward to the outer ring.

Also it revealed that the inferior quadrant was the most fragile and the superior area was least affected which contraindicated from the previous study done [34].

The sample size decreased as many RP patients were diagnosed to have nystagmus and their OCT results were not appropriate so was excluded.

Conclusion

It was seen that in the RP patients the macular thickness decreased for the age group < 40 years whereas an increased thickness was observed in the age group of > 50 years.

In addition, the inferior area was found out to be most fragile and the superior area was the least affected.

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