Reflections from the Retinal Surface:
Some Clinical Implications.

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Abstract

Abnormalities ahead of, within, and behind the retina may alter the manner in which light is reflected from the retinal surface during ophthalmoscopy.

Abrégé

Des anomalies anterieures, interieures et posterieures à la retine peuvent modifier la façon que la lumière reflette de la surface de la retine durant une ophtalmascopie.

Normal Reflections

1. Retinal sheen in younger patients

In younger patients, an overall sheen gives the retina a 'wet look'. Fresnel's law of reflection states that the proportion of light reflected from a surface varies directly with the difference in refractive index on either side of the surface. The healthy young retina would have an index higher than the vitreous, so there would be considerable reflection of light at the retina/vitreous interface. An alternate (or additional) theory for disappearance of the foveal reflex with age has been offered by Millodot and O'Leary[1]: they suggest that the index difference between retina and vitreous is reduced due to an increase in the refractive index of the vitreous with age.

2. Effects of Aging

Retinal reflections are decreasingly observed with age: it is likely that there is some overall loosening of the retinal structure with the accumulation of some extra fluid in the retina. In addition, this may explain the well-known disappearance of the foveal reflex with age.

3. Normal retinal depression: the fovea centralis

Indirect ophthalmoscope views of the young retina almost invariably include a circular reflection from the thickest portion of the retina (see Figs. 1 and 2), where the convex retinal surface causes a distinct reflex, similar to the reflex seen running along the central retinal vessels. This reflection may also be seen during direct ophthalmoscopy, although usually only one portion at a time, due to the smaller field of view. The retinal thickness is 370 microns at the beginning of the retinal downslope of the fovea centralis, while the thickness at the foveal pit is 130

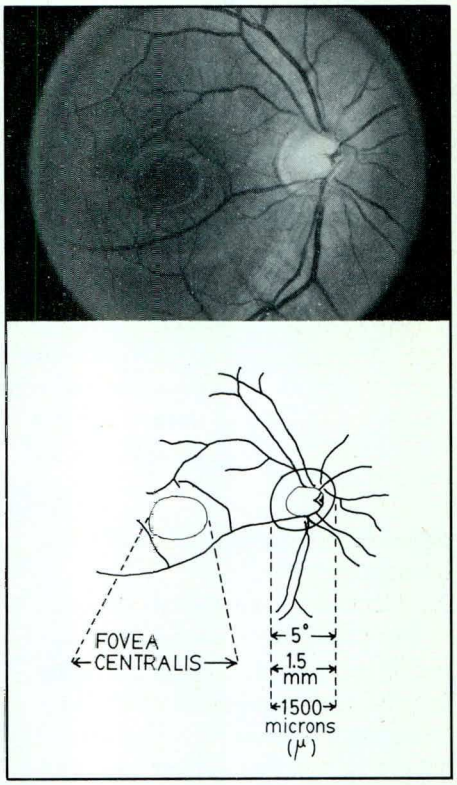

Fig. 1
Right eye of healthy male, aged 20 years. Note circular reflex from rim of fovea centralis. Sketch below shows location of circular reflex and some dimensions for comparison with Fig. 2.

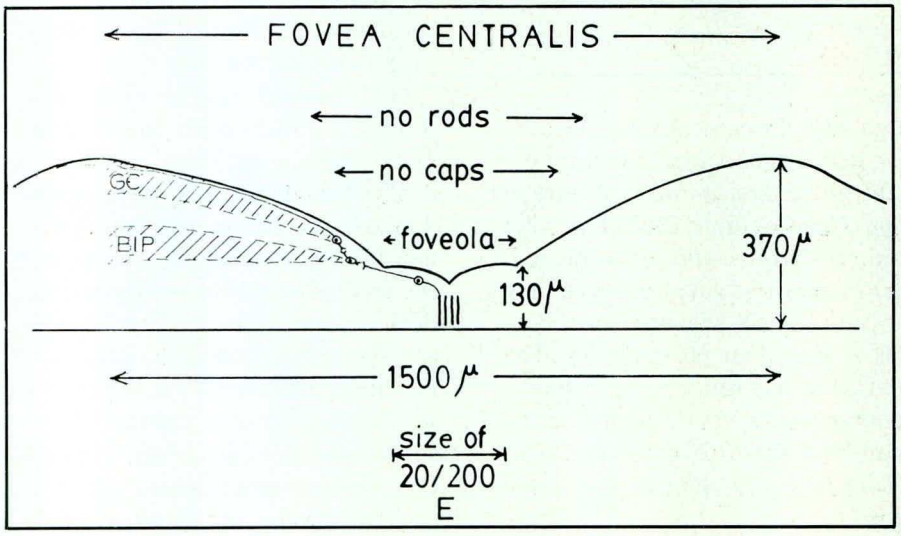

Fig. 2
Schematic cross section of retina through center of foveola. Thickness of retina at rim of fovea centralis is 370 microns and at foveola is 130 microns. Rod-free and capillary-free areas are also marked, as is linear size of retinal image of 20/200 E.

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microns; thus there is a retinal depression of 240 microns (nearly ¼ mm) here. In healthy young eyes, the circular reflection will have a diameter equal to that of the nerve head. There is usually little reflection from the downward slope of the retina. The pit of the foveola provides the foveal reflex.

Abnormal Reflections

1. Effects of retinal edema

The presence of edema fluid would lower the index of refraction of the retina, thus decreasing the amount of light reflected in the edematous area. In Fig. 3, considerable retinal sheen is noted everywhere but in the fovea centralis area. This young black patient has a reduced acuity (20/50) in this eye due to recent head injuries. It appears that the loss of retinal reflection in this case relates to the presence of edema fluid within the retina.

Fig. 3
Left eye of black male, aged 9, who had recently received a blunt injury to the left side of the head. Note considerable retinal sheen in most areas, but not in disturbed fovea centralis area.

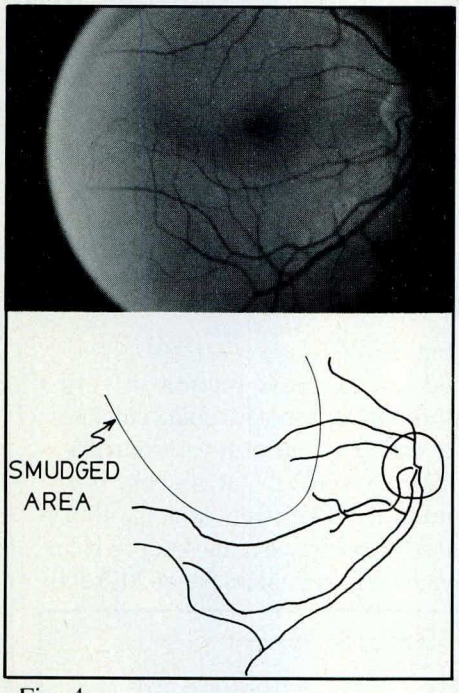

Fig. 4
Right eye of woman aged 41. Gradually decreasing acuity noted by patient for several months. Acuity at time of photography 20/200. Amsler grid distortions were pronounced, photostress test gave recovery time of 1 minute 58 seconds (normally this is less than 60 seconds). The central serous retinopathy resolved spontaneously. VA during recheck 4 years later was 20/20 in this eye, with .75 D less plus than at the initial visit.

2. Central Serous Retinopathy

The presence of edema fluid between the receptor outer segments and the retinal pigment epithelium causes an alteration in both the retinal level and retinal reflectance. The elevation of the retina has been shown to cause a shift toward hyperopia in such cases. It appears that some of this edema fluid must also enter the retina proper, because the affected retina usually appears rather dull or smudged (see Fig. 4): it does not reflect light in the same manner as the surrounding retina.

3. Abnormal Retinal Depressions

(a) Sickle Cell Anemia

Goldbaum[2] has recently described a group of patients, mostly under the age of 30, who suffered death of small portions of the retina due to sickle cell anemia (clumps of deformed red blood cells obstructed the arterial supply to small portions of the retina). Initially, cotton-wool spots were observed in the dying retinal areas; however, 4 months later it was possible to note retinal depressions in the damaged areas. The loss of retinal substance caused a shallow cavity to develop in the retina, which behaved similarly to the fovea centralis depression shown in Fig. 1: the outer edges of the cavity tended to be relatively bright, while the interior of the cavity appeared dark (with the occasional reflection from the concave floor of the depression in some cases).

(b) Retinitis pigmentosa

Figs. 5 and 6 are fundus photographs of a 12 year old female with RP. Visual acuities are 20/25 OU and color vision is normal; however, clinical dark adaptometry shows a range of 1.5 log units, as compared to a normal of over 4.0 log units. The posterior pole shows no clumps of pigment (these are confined to the mid-periphery). The arterioles do not appear particulary narrowed. The chief ophthalmoscopic anomalies in the posterior pole consist of an orangy-yellow irregular 'rippled' surface sheen in the macular area and a circular reflex which is 2½ times the diameter of the nerve head. The normal circular reflex (see Fig. 1) should be the same size as the nerve head. I propose the following explanation for this widened circular reflex: considerable portions of the posterior retina have be-

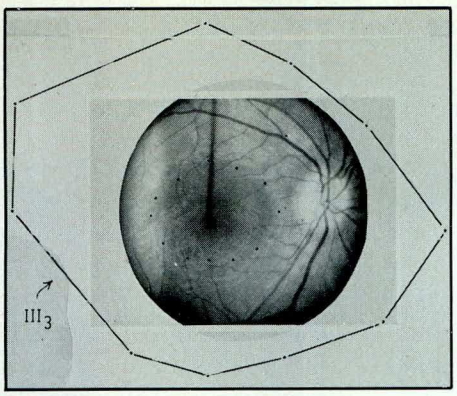

Fig. 5
Right eye of young white female aged 12. Note enormous circular reflex and unusual rippled appearance of retinal surface reflections within circular reflex. Goldmann I_2 isopter is shown as black dots, which are seen to lie just inside or close to the circular reflex. The patient has retinitis pigmentosa.

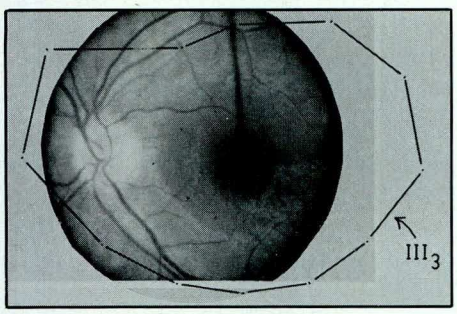

Fig. 6
Left eye of patient shown in Fig. 5. Similar appearances to those noted in Fig. 5.

come atrophic, with a resultant depression of the retinal level, so that the extent of the 'dished out' retina is now 2½ times its normal size. The visual fields of this patient (Figs. 7 and 8) show a marked constriction of the standard I_2 Goldmann isopter (this isopter is equivalent to a 1/1000 W tangent screen isopter). When the field test results are superimposed on the fundus photographs (dots in Figs. 5 and 6 represent the I_2 isopter), it is interesting to note that the points of the I_2 isopter correspond approximately to the beginning of the retinal downslope. Visual field testing for this patient reveals that the retina within 5 degrees of the foveola is still functional, even though ophthalmoscopy shows evidence of a considerable thinning of the retina in this area.

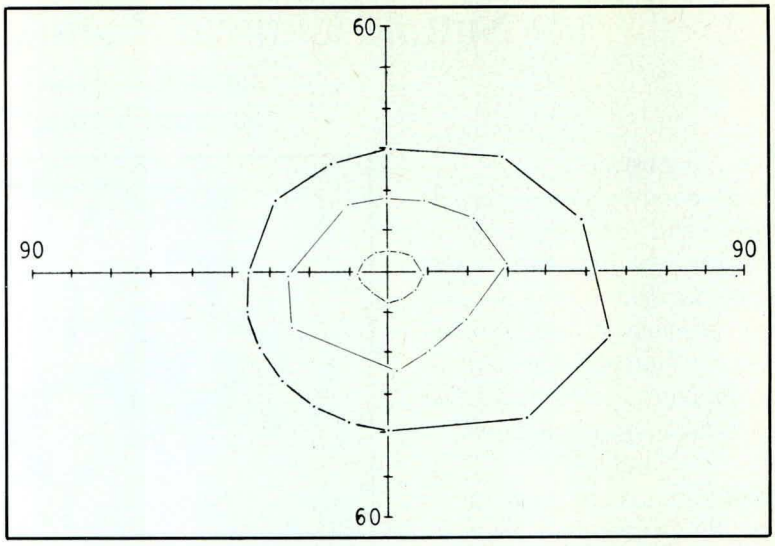

Fig. 7
Perimetry results for right eye of patient shown in Figs. 5 and 6. Innermost isopter is for standard stimulus I_2, middle isopter for much larger and brighter stimulus III_3. For comparison, the I_2 isopter for a normal 20 year old is included (outermost isopter).

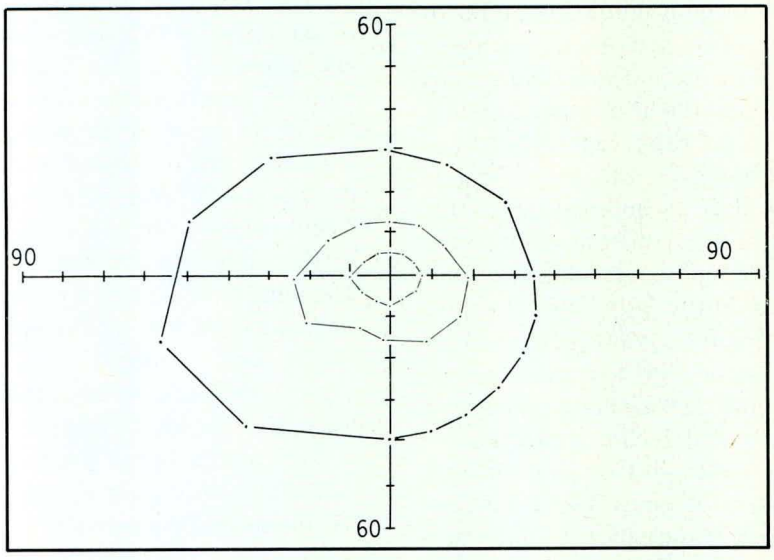

Fig. 8
Left eye perimetry results for patient shown in Figs. 5 and 6. Details given in caption of Fig. 7

The orangy-yellow surface reflections which appear within the widened circular reflex are due to gliosis: when retinal tissue is lost, glial tissue proliferates, frequently on the retinal surface.

Attention to the reflective characteristics of the retinal surface can provide useful additional information about the health of the retina.

Acknowledgement:
Dr. E.M. Fretz referred the patient shown in Figs. 5, 8

References

1. Millodot, M. and D. O'Leary, The discrepancy between retinoscopic and subjective measurements: effect of age, *Am. J. Optom. & Physiol. Optics* 55(5): 309-316, May, 1978.
2. Goldbaum, Michael H. , Retinal depression sign indicating a small retinal infarct, Am J. Ophthalmol 86(1): 45-55, July 1978.