HYALINE RIDGES ON THE POSTERIOR CORNEA*†

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HYALINE or glassy ridge formation on the posterior corneal surface appears to be a not uncommon phenomenon, the recognition of which may be missed without careful examination with the slit-lamp microscope.

Normally, Descemet's membrane is secreted as a hyaline tissue by the endothelial corneal cells during intra-uterine life; the exact point of development at which it appears is not definitely known, but may be at the 49 mm. stage (Mann, 1964).

In some pathological conditions, these endothelial cells may exhibit exuberant hyaline formation, so that elevated plaques or ridges may form on the posterior corneal surface. Elsewhere in the eye, similar abnormal hyaline formation has long been recognized as occurring in circumstances of chronic irritation affecting ocular cellular layers, such as the lens and retinal epithelium and iris endothelium, and in such conditions as simple glaucoma and chronic iridocyclitis (Herbert, 1927).

Hyaline ridges or membranes on the cornea are of two kinds: the first and more common is closely applied to the cornea throughout its extent and the second lies mainly in the anterior chamber but is attached to the cornea at one or more extremities. The three cases discussed below are all examples of the former type.

Either may consist of a simple pattern of one or more partially transparent ridges or plaques, or may assume a more complicated interlacing arrangement. Both, when formed, appear to be permanent in nature. They vary in width from fairly easily seen plaques of about 0.5 mm., to fine fibrin-like threads.

Pathogenesis

Unlike Bowman's membrane, when Descemet's membrane is interrupted a new membrane is elaborated by the lining endothelial cells. This process begins fairly soon so that a new layer appears by about the third week and gradually thickens till approximately one-half of the original structure has been regained at the end of 3 months (Morton, Ormsby, and Basu, 1958).

However, the cells may exhibit hyperplastic activity so that an excessive amount of hyaline material is laid down at the site of the rupture leading to increased thickness of the cornea at this point.

Again, extensive tears in Descemet's membrane may be followed by detachment of that membrane, sometimes over a wide area, so that rolled-up remnants in the form of ribbons

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or a curtain of membrane hinged to the cornea may be seen (Ballantyne, 1926). These detachments would appear to remain as permanent defects lying in the anterior chamber though the area of cornea from which they had originally been stripped later receives a fresh layer of Descemet's membrane.

Also, in inflammatory corneal conditions such as interstitial keratitis, degeneration of some endothelial cells may occur and the regenerative activity of the remaining cells may be excessive, being stimulated by the presence of fibrin and inflammatory cells from the anterior uvea and sometimes folds in Descemet's membrane so that, again, increased hyaline is formed in some places.

During development, the rather indefinite tissue, the "anterior vitreous", which lies between the surface ectoderm and lens vesicle is invaded by mesodermal tissue from the region of the optic cup rim, and this mesoderm gives rise to the corneal endothelium in front, the trabecular meshwork laterally, and the superficial iris leaf behind. The anterior chamber is also formed in this region by a process of atrophy or by stages of differential growth to which ectodermal elements from the anterior vitreous may give a determining role. It is postulated that anomalies in development of these mesodermal tissues, perhaps due to intra-uterine inflammation in some cases, may give rise to formation of hyaline membranes on the posterior cornea which would be mainly situated peripherally and sometimes associated with other anomalies of the iris stroma and angle of the anterior chamber.

Aetiology

Hyaline ridges have been described in the following corneal conditions:

(1) *Post-traumatic*, the commonest being probably birth injury. These form a variety of the third type of corneal opacity, described by Thomson and Buchanan (1903) in their classical paper as "linear and permanent". The essential cause is a split in Descemet's membrane.

(2) *Ectatic*, as in infantile glaucoma and probably in keratoconus and progressive myopia. Again, splits in Descemet's membrane are the predisposing factor.

(3) *Inflammatory*. Ridges have often been described in interstitial keratitis where Lehmann (1927) claimed that they occurred in about 17 per cent. of cases of the syphilitic variety, and they also may follow tuberculous kerato-uveitis (Lloyd, 1930) and herpetic keratitis (Malbrán, 1937). More recent clinical descriptions were given by Trevor-Roper (1949) and Swartz (1953).

(4) *Congenital*, first noticed probably by Stephenson (1908) but well described by Mann (1933). These represent a variety of Rieger's anomaly.

Case 1, a man aged 36 years, gave a history that he knew his birth had been difficult as it was a family joke that he had been born with a right black eye. His birth weight was said to be 12 lb. and his mother's height 4' 10", and not surprisingly forceps had been used to procure delivery.

Examination.—The left eye was normal. The right eye had a corrected visual acuity of 6/18 and this was considered to be mainly due to macular degeneration following the onset of a retinal detachment which brought the patient to hospital. The right cornea was clear apart from two posterior ridges both lying almost vertically (Fig. 1), one easy to see and about 5 mm. long tapering off at its extremities, the other shorter and less thick. There was some adjacent corneal opacity in front of the ridges and at their sides.

Cross-striations could be easily seen in the ridges using indirect illumination on the slit lamp. Also, specular reflection was obtained from the sides of the ridges. Apart from the evidence in the fundus of the previous operation, no other abnormality was found. On the keratometer, the right cornea showed 2.5 dioptres of myopic astigmatism more than the left when measured in the vertical meridian.

FIG. 1.—Two posterior corneal ridges, the end-result of a birth injury to the right eye.

FIG. 2.—Slit-lamp photographs of interstitial keratitis: (a) posterior corneal scarring. (b) almost vertical posterior ridge formation.

Case 2, a woman aged 54 years, had a history of severe eye trouble beginning at the age of 16 years, when she was diagnosed as having interstitial keratitis and had a positive Wassermann reaction and Kahn test. In all, she was off work for nearly 2 years and received treatment to her eyes for 15 years. Her present attendance at hospital was for treatment of conjunctivitis.

Examination.—She showed some stigmata of congenital syphilis. The corrected right and left visual acuities were 6/18 and 6/9 respectively. Both corneae showed a moderate amount of mainly posterior scarring (Fig. 2a) with some associated deep vascularization. There were also several areas of increased corneal thickness, due to excess hyaline membrane formation mainly in the region of keratic precipitate deposition. In the left eye, this hyaline formed some shallow branched figures, and in the right the most marked feature was an almost vertical ridge (Fig. 2b) very similar to that described in Case 1. There was also some peripheral fundus scarring due to healed choroiditis.

On the keratometer, both corneae showed about 0.5 dioptres of astigmatism, the more curved principal meridian on the right side being at 30° .

Case 3, a male Jamaican aged 33 years, complained of blurring of vision which he said he had had for as long as he could remember, though he had never attended an Eye Hospital before (see Fig. 3, overleaf).

Examination.—The corrected right and left visual acuities were 6/24 and 6/9. The only ocular abnormalities found were unusual posterior corneal ridges (Fig. 3a), which formed a series of almost parallel rows in each eye stretching across the cornea in a mainly oblique direction tapering off at either end. Cross-striations were clearly visible, and show up in the slit-lamp photograph (Fig. 3b) with indirect light. Some pigment deposition was also seen, mainly close to these ridges. Inferiorly, some corneal bullae were present, and these tended to burst at intervals giving episodes of pain. The right cornea showed 3 dioptres of astigmatism and the left 2.5 dioptres, the more curved axis on each side being at almost 170° .

Discussion

Of the three cases described above, the cause of the ridge formation was apparent in the first two but not known with certainty in the third.

Case 1 was a typical case of birth injury brought about by the instrumental delivery of a

FIG. 3.—Oblique corneal ridges probably secondary to splits in Descemet's membrane:
 (a) general appearance showing bullae below.
 (b) cross-striations visible in slit-lamp photograph.

large infant from a presumably deformed pelvis, during which the cornea was probably injured by a forceps blade. This was unusual in that the right eye was involved, for the left is more often affected because of the prevalence of left occipito-anterior positions of the foetal head. The right cornea demonstrated increased astigmatism in the axis of the original tear in Descemet's membrane.

Case 2 appeared to be a classical example of syphilitic interstitial keratitis, showing much excess hyaline formation on the posterior corneae accentuated to a ridge in one area. The direction of this ridge was almost vertical, at an angle of about 60° from the more curved principal meridian of astigmatism, and it was therefore assumed that Descemet's membrane was not split in the active phase of the corneal condition.

Case 3 presented a more difficult diagnostic problem. This patient was investigated thoroughly and kept under observation. The only abnormality found was microfilariae in some night blood films, and this with the variable eosinophilia of 6 to 12 per cent. and the presence of cross-striations on the corneal ridges suggested that the lesions were due to onchocerciasis. However, this was considered impossible because the ridges were much too large to be microfilariae and would not have persisted unaltered on the cornea. Also there are no microfilariae in the blood-stream in onchocerciasis and Jamaica is not an endemic area for this condition. The fact that similar cross-striations were visible in the lesions of the first two cases suggested that this was a common optical property shared by ridges of different aetiology.

Another interesting feature was the presence of the corneal bullae which appeared through interference with the fluid-regulating function of the endothelium. They were present mainly below but at other times occurred at different sites before rupturing and healing. This patient has been now followed-up for about 2 years and his corneal condition has not changed; bullae were still present below at his last attendance. It is considered that his corneal ridges are secondary to splits in Descemet's membrane though the axis and amount of astigmatism does not fully support this. They may even have occurred before birth, giving rise to a form of corneal dystrophy.

Summary

Three cases of hyaline ridge formation on the posterior cornea are discussed and the general aetiology of this condition is described. Special mention is made of the optical phenomenon of cross-striations on these ridges which does not appear to have been noted before.

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