of disease and may become thicker when detached. Through such a tear clear fluid passes to fill the space behind the vitreous. The membrane may contract and form opacities which float in the degenerate vitreous. It may, by tearing the retina, play some part in the evolution of one type of retinal detachment.

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DISLOCATION OF THE RING OF SOEMMERING, ITS REMOVAL. WITH SOME NOTES ON ITS PATHOLOGY*

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THE Ring of Soemmering may briefly be defined as the capsular remains of a cataractous lens containing, as is usually the case, some retained cortical cells, the centre of the lens having been penetrated and an aperture created by some intentional operative procedure; or possibly by a penetrating wound of unintentional or accidental character. It can readily be detected, in some cases naturally more clearly than in others, in the average aphakic eye where the lens has not been removed in its capsule. A very beautiful example of the Ring *in situ* is seen in a specimen supplied me by Dr. MacMillan, showing it held in suspension by the zonule of Zinn, and demonstrating certain pathological features common to the retained capsule as a rule, but peculiar to the case to which I am presently to refer (Fig. 2).

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Cases of dislocation of the Ring of Soemmering are usually found in myopic eyes, and probably for two very good reasons. The first is on account of a more or less atrophied, shrunken, or devitalized ciliary body, with ciliary processes which have, in consequence, to a large degree lost their tonicity, and they, with the zonule, have ceased to function in the process of accommodation. The second is because of the relative change in the character of the vitreous humour, a more or less liquid or fluid material having replaced the viscid or albuminous contents of the vitreous cavity.

The very few cases reported of dislocation of the Ring have been associated mostly with myopia, for the reasons which I have attempted to explain, and most of these can point back to an early dissection of the lens in an endeavour to arrest a progressive course of myopia, following a procedure suggested by Fukala many years ago, but now more or less abandoned. The case which I am reporting is no exception to this general rule and comes practically under the same category, involving the same general principles.

After a careful search through the literature I have found that the cases reported of dislocation of the Ring are very few. Scarcely more than a scant half-dozen, and of these only one comes from an Anglo-Saxon source, the remainder appearing in German ophthalmic literature. This may possibly be due to the fact that myopia is more prevalent in Teutonic countries, or possibly that Fukala's operation was given a more extensive trial in Germany than in English-speaking countries. Of all the cases recorded, however, there is not one in which the author has been able to tabulate a thoroughly complete case report, more particularly regarding an operative procedure and the subsequent pathological findings. This failure is, however, in more than one instance quite excusable owing to the site of dislocation of the Ring when, in consequence, material could not possibly be removed for subsequent pathological investigation and study. The present case, fortunately, presented none of these handicaps, and it will be, I think, the first one to appear in ophthalmic literature where all the requirements of a complete case report have been fulfilled.

To refer briefly to the cases which have already appeared in the literature.

Schneider (*Amer. Jl. of Ophthal.* 1927, Vol X, p. 273) reports a case occurring in a patient 40 years of age. The eye had been operated upon many years previously for the relief of myopia. The Ring was dislocated forward into the anterior chamber. The chamber was opened with a keratome and an endeavour was made to remove the lens remains. This was, however, found to be impossible as the capsule broke and the contents simply

melted away and was lost like so much milky substance. The Ring behaved exactly like a Morgagnian or hypermature cataract, and undoubtedly possessed the same pathological composition, although no pathological data were recorded.

Wessely (*Arch. f. Augenheilk.*, 1910, Vol. LXVI, p. 277) reports a case in a man 72 years of age. The dislocation had occurred backwards and outwards into the vitreous chamber. The eye involved showed extensive high myopic changes. There was a spot in the cornea as though produced by some previous penetrating wound. The Ring was held in position by organised fibres in the vitreous. It appeared blue-white in colour, and the details of the fundus could be seen through the aperture in the centre of the Ring.

F. Poos (*Klin. Monatsbl. f. Augenheilk.*, Apr., 1931, Vol. LXXXVI, p. 449) reports two cases:—

Case 1.—Occurred in a man 47 years of age. Twenty-five years earlier Fukala's operation had been performed with an apparently excellent result. The patient was a stone-cutter, and seemingly had sufficient vision to allow him to follow his relatively rough trade, and enough myopia remaining to allow him to read ordinary newspaper print without glasses. This Ring, as in Wessely's case, was dislocated backward, and as vision was apparently very little disturbed the eye was left alone. The tension was not raised. It was the patient's only eye, the other having been lost through an accident.

Case 2.—A patient 40 years of age had worn glasses for short-sight since 10 years of age. Fukala's operation had been performed in each eye and vision in one eye had been lost through retinal detachment. In the second eye the dislocation of the Ring had occurred upwards in the fluid vitreous. There were characteristic myopic changes about the disc. Vision with -4.00 D. Sph. = 6/15, and tension with Schiötz's tonometer was 22 mm. Hg.

A. Jess (*Klin. Monatsbl. f. Augenheilk.*, 1931, Vol. LXXXVI, p. 98) reports two cases:—

Case 1.—A patient 57 years of age. At the age of 17 he was operated upon for the relief of a congenital cataract, and glaucomatous changes had followed. There had been calcareous changes in the lens remains for several years following the cataract extraction. This dislocation had apparently been spontaneous, and it occurred into the anterior chamber. Tension was triple plus, and as the eye was painful and blind it was enucleated. The glaucoma was seen to have been produced by pressure of the root of the iris against Descemet's membrane; but a detailed description of the microscopic findings of the lens remains was not given.

Case 2.—A patient aged 62 years had been operated upon for the relief of cataract. Nine months following the operation the eye had suffered a blow from a piece of wood. There was no appreciable pain, but for two months there was gradual diminution of vision and glaucomatous symptoms became manifest with oedema of the cornea. A forward dislocation of the Ring had occurred into the anterior chamber; tension was raised to 30 mm. Hg (Schiötz). The Ring was removed with capsule forceps, and vision was improved from hand movements to 3/36. There was no pathological description of the removed Ring.

The case which I am about to describe occurred in a male, aged 43 years. At the outbreak of the War, with commendable patriotic zeal, he presented himself before me as a volunteer for service in the Canadian forces. He stated that he had been operated upon fifteen years earlier for the relief of short-sight, and that following the operation the sight of the right eye had been lost. Loss of vision in the right eye was seen to be due to a complete retinal detachment. Vision in the left eye was 6/15, with -1.5 Sph., +1.0 cyl. 120°. The pupil was regular, and no capsular remains appeared to occupy the pupillary area. A proper glass was prescribed for him, but he was naturally discharged as unfit for service. Fifteen years later, when working in a sawmill, he was struck by a chip of wood on his only functioning eye. There was no appreciable pain; but vision was manifestly reduced. The patient was referred to the ward of the Royal Victoria Hospital, Montreal, where the following clinical observations were recorded: Vision in the right eye equalled no perception of light, due to complete retinal detachment. The left eye was apparently quiet and free from pain. The cornea was clear, in so far as one could determine, and the anterior chamber of normal depth. The iris was not oedematous, and the pupil was semi-dilated and fixed. Through the pupil, and lying obliquely forward and outward, appeared the Ring. It was situated partly in the posterior, and partly in the anterior chamber, and it seemed to come as far forward as Descemet's membrane. It did not alter its situation with any change in position of the body. The Ring appeared like a tiny swollen pessary, round, and measured from 12 to 14 mm. in diameter: pearl-grey in colour, and with a very definite hole in its centre (Fig. 1). The situation of this hole and the oblique position of the Ring prevented a satisfactory view of the fundus. His best vision with correction was 6/36. Viewing the Ring with the slit-lamp, it appeared in many respects like the average completely

FIG. 1.

Dislocated Ring of Soemmering following discission.

FIG. 2.

Specimen of a Ring of Soemmering in its natural position, obtained following cataract extraction.

matured cataractous lens which had become dislocated. Its surface was bright and glistening, and the capsule presenting itself anteriorly was taut or tense to an extreme degree, without the slightest vestige of a wrinkle or crease on its surface. It was not a mere shrunken remains of a cataractous lens capsule, but rather a cataractous lens largely preserved in an almost tumescent capacity, possessing a distinct hole in its centre. There was no hyperplasia of the cuboidal epithelial cells which line the anterior lens capsule, and the retained cortical fibres within the capsule were more or less disintegrated or in a state of hypermaturity, although no calcareous or hyaline changes had occurred in them. The capsule, as one saw it, was intact: there were no signs of pigment or of synechiae suggesting a previous iritis, nor any evidence of leucocytes or vitreous cells in the anterior chamber. The intra-ocular tension was not raised.

The removal of the Ring was approached in the following manner:—A crescentic flap measuring about 5 mm. was raised from above the upper limbus, through which a double needle suture was passed, the needle subsequently being imbedded close to the insertion of the superior rectus muscle. A Ziegler's knife-needle was then inserted subconjunctivally from the temporal side, passed into the anterior chamber, through the aperture in the Ring, and fixed at the nasal side of the filtration angle. A very fine Graefe knife was then selected and a carefully guarded corneal section made above and towards the nasal side, passing behind the crest of the lens and beneath the previously dissected conjunctival flap. A pair of Kalt forceps was then introduced into the anterior chamber, one blade passing about either side of the Ring, and meeting at the centre of the aperture. The knife-needle was then withdrawn. Gentle traction was then exerted, and the Ring was almost completely withdrawn with the exception of a small portion of capsule and cortex which remained below, to be subsequently absorbed, undoubtedly, where it had been held back or retained by some zonular fibres which had not been torn through. There was not a particle of vitreous escaped, the pupil was not distorted, the conjunctival flap was drawn into position, and both eyes were bandaged. Recovery was uneventful. Subsequent vision was 6/15, with - 6 Sph., +1.5 cyl. 85°, and J.1, partly, with the necessary addition.

Slit-lamp investigation showed a moderate degree of parenchymatous blurring of the cornea in the centre of the pupillary area, doubtless the result of trauma, and not noticed prior to the removal of the Ring, owing to its proximity to Descemet's membrane. There was absolutely no evidence of capsular remains, but there was some sign of degeneration of the anterior vitreous fibres. There were no vitreous fibres in the anterior chamber itself. Tension with the Schiötz tonometer registered 20 mm. Hg.

FIG. 3.

The lens capsule is divided into two portions; an anterior or zonular lamella, and the lens capsule proper, which here is split into at least two strands. The edges of these adjacent bands are regularly outlined and clearly defined, and the spaces between these are not occupied by cortical debris. The cuboidal cells lining the capsule are simple in their arrangement, even when detached and adjacent to the underlying tumescent cortical remains.

FIG. 4.

Cortex has been clearly separated from the lens capsule. Cortex consists of many fibres which are intact, but a larger number form large tumescent spaces filled with broken-down amorphous debris. No sign of calcareous plaques. The capsule is seen to be split into two lamellae, the inner one, or that directed towards the cortex having ruptured.

Paraffin sections were made of the remains of the Ring and the following features were observed. They were, in the main, those of the ordinary cataractous lens, with one or two exceptions.

One feature which struck my attention most forcibly was the peculiar structure at one or two points of the elastic tissue lamina, known as the anterior lens capsule. Here it is shown to have split into one, two, or even more strata of even regular strands or bands, not wrinkled, and the inter-lamellar spaces not containing anything of manifest cellular character (Fig. 3). Indeed in some places, separation of the lamella had been observed where no actual rupture of the capsule had occurred. That a definite or manifest rupture of the capsule did take place cannot possibly be gainsaid, as is clearly demonstrated in Fig. 4; but here the rupture is directed towards the cuboidal cells and the lens cortex, where an aperture has been created, rather than forward where the zonular lamella is intact. Even at this very evident aperture, and in the inter-lamellar aperture thus created, no cortical remains are to be found.

It was impracticable to employ Weigert's or other selective tissue staining reagents, owing to the fact of the specimen having been

FIG. 5.

The zonular lamella is clearly outlined, but adjacent to the underlying capsule, which is here intact. Cuboidal cells lining the capsule are simple in their arrangement. The cortical remains have been distinctly separated from the enveloping capsule. Some of the lens fibres are intact; others have broken down to form large swollen spaces (Morgagnian globules) filled with amorphous broken-down debris. There is no evidence of calcareous degeneration.

FIG. 6.

Specimen obtained from eye following cataract extraction. Lens remains show many fibres more or less intact. Many Morgagnian globules are present, with a number of areas where calcareous degeneration has ensued. Note proliferation of cuboidal cells outlining cortical cells, and clearly defined by iris pigment.

FIG. 7.

Specimen obtained from eye following cataract extraction. Cortex remains show many lens fibres relatively intact, but aperture about periphery of Ring is practically blocked by proliferation of cuboidal cells.

embedded in paraffin. The next feature to be observed, and rather unusual as applied to the appearance of the cuboidal cells lining a retained capsule, was the fact of the simplicity of their arrangement. One usually anticipates a multiplicity of these cells (Fig. 7); but here they are clearly shown to exist as a single regular row (Fig. 5). Some cells are detached, it is true, but when this is the case they are found to be adherent in the same simplicity of arrangement against the adjacent anterior cortical lamellae, as against the capsule itself (Fig. 3). The cells of the cortex absolutely verify the slit-lamp findings. Some of the fibres are relatively intact and take the ordinary staining quite deeply, while most of the retaining lens substance consists of large regular spaces, Morgagnian globules, containing broken-down cells of an amorphous character (Fig. 5). There is nothing in any of the sections to suggest either calcareous or hyaloid degeneration in the lens remains, this in spite of a period of thirty years lapse of time. You will note by way of contrast the very definite calcareous deposition in the section shown from a regular aphakic eye in which the Ring of Soemmering had been retained in position (Fig. 6).

Cases of exfoliation of the most superficial lamella of the anterior capsule of the crystalline lens have been reported by Alling (*Arch. of Ophthalm.*, Jan., 1927, Vol. LVI) and Kirby (*Arch. of Ophthalm.*, July, 1930), but are comparable in some respects only, and unfortunately do not provide him with pathological material. Vogt found his cases definitely possessing a glaucomatous diathesis.

The case here reported differs entirely from those of Alling and Kirby in that there were no plates of exfoliated cells on the capsule itself, or about the pupillary margin of the iris. Indeed, the slit-lamp picture was in no way comparable.

The cases reported by Meyer, working in Elschinig's clinic (*Arch. of Ophthalm.*, Mar., 1928), of glass-blower's cataract, also do not provide one with a pathological background to substantiate the clinical findings, although the very complete and accurate slit-lamp observations endorse the conclusions at which earlier observers had arrived, *e.g.*, Buberchin and Arnold (cited by Becker: *von Graefe-Saemisch Handb.* Vol. I, Aufl.). Arnold held that the anterior capsule was composed of two or possibly of three layers, the outer belonging to the zonule of Zinn, and the inner to the lens capsule. Berger (*Zentralbl. f. Augenheilk.*, 1882, p. 2), through maceration of the lens capsule, was the first to demonstrate the outer layer or the zonular lamella of the lens capsule. He found that by unravelling the macerated lens capsule with permanganate of potash, the outer layer revealed a different physical property from the inner or deeper layer, in that in

contrast to the more irregular zig-zig marginal rents, it possessed straight torn edges. He considered this as due to a greater elasticity of the zonular lamella. In the pathological specimen which I am presenting, maceration of the lens capsule had not been resorted to, and chemical reagents had not been required to produce this demonstration; and the edges of the various layers appear to be of very much the same character and not different as Berger demonstrated by chemical means. Jess considers that these separations of the zonular lamella originate at the periphery or equator. The sections under consideration would rather point to the fact of their being more centrally situated, owing to the simple arrangement of the cuboidal cells.

The question very logically arises, that with the separation of the zonule so manifest pathologically, why was it not seen by means of the slit-lamp? The explanation is obvious, that with the dislocation of the Ring, rotation forwards took place, and that, in consequence, the anterior capsule occupied a relatively posterior position, naturally prohibiting a positive finding in this respect.

In conclusion, the separation of the layers of the anterior lens capsule could not have been caused by a tear produced by the forceps, for in that event the rent would have been anterior or forward, while in the case in question the opening in the capsule is directed backwards or inwards in the direction of the cortical remains of the lens.

One naturally enquires, why should the rent in the capsule have been directed backwards or inwards toward the lens cortex, rather than outward in the direction of the zonular lamella? The only logical explanation that one has to offer is that the patient, at the time of his accident, was practically in possession of a tumescent lens with an aperture in its centre, rather than of a shrunken lens capsule. Following the blow over the eye, a rupture *à contre coup* had occurred in the capsule, in this instance, quite comparable to similar ruptures and tears occurring in other membranes or tissues of the eyeball following injuries of a like character. In other words, accounting at once for the rupture in the lens capsule, as well as supporting, with a reasonable element of conjecture, a cause for the original dislocation of the Ring.