The interest in pseudo-exfoliation of the lens capsule lies in its relationship to and its association with glaucoma, nearly always of the chronic open-angle type; in the mechanism by which it causes the glaucoma, if it be the cause and not a mere associated phenomenon; in its racial incidence; and in its apparently uneven distribution in Great Britain. This study was carried out in an area in the West Riding of Yorkshire.

Material
In the past 6 years 73 patients with pseudo-exfoliation have been seen. Twenty (Group A) attended one clinic where all cases of glaucoma were personally analysed and the incidence of pseudo-exfoliation amongst them assessed. The remaining 53 (Group B) were seen in the course of hospital and other practice, but it was not possible to analyse their relationship to the glaucomas as a whole. All were resident in the West Riding of Yorkshire.

Findings
In Group A the total number of cases of glaucoma examined was 201; these included glaucomas of all types—acute, chronic, open-angle, closed-angle, secondary, and thrombotic. Of the twenty patients with pseudo-exfoliation, fifteen had glaucoma (an incidence of 7.5 per cent. of the total). Of the 201 cases of glaucoma, 139 were of the chronic open-angle type, and thirteen of the fifteen patients with pseudo-exfoliation and glaucoma were of the open-angle type—an incidence of 9.2 per cent. with pseudo-exfoliation in cases of chronic open-angle glaucoma.

In four of these fifteen patients with pseudo-exfoliation and glaucoma, no glaucoma was apparent in either one or both eyes when the pseudo-exfoliation was first noted. Subsequently raised tension and glaucoma appeared, and in one instance the aqueous outflow was reduced at first, manifest glaucoma developing later. Patients with pseudo-exfoliation have developed glaucoma while under observation, but no patient with glaucoma in the first place has been seen to develop pseudo-exfoliation; thus pseudo-exfoliation undoubtedly comes first. However, if the 139 cases of chronic open-angle glaucomas were to be examined under mydriolate (a harmless but time-consuming procedure), further instances of pseudo-exfoliation would probably be found.

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Age

The age at onset of pseudo-exfoliation is uncertain. In this series the diagnosis was not made before 1961, although many patients had been attending with glaucoma for some years before that, presumably with pseudo-exfoliation as well. One patient, for example, was noted to have pseudo-exfoliation when she was 61 years old and at that time she showed no definite signs of glaucoma, but when she was 63 the ocular tension began to rise. Nevertheless, she had been only 48 years old when she first attended the eye clinic with defective vision attributed to optic atrophy. It is difficult to envisage just when the pseudo-exfoliation had first appeared.

Apart from this patient, 54 years is the youngest age at which the condition was first observed in this series. This is in accord with reports in the literature. Gifford (1957) gave his youngest patient as 46, and Sugar (1951) as 41 years old. In the present investigation the bulk of the patients were over 60 years of age, which suggests that the condition is degenerative rather than inflammatory.

Sex

There was a predominance of males (46) over females (27); chronic glaucoma is commoner in men than women, but on the other hand there are more women than men over the age of 60 years. The conclusion from these two facts is that pseudo-exfoliation and glaucoma are interrelated.

Relation to Glaucoma

Of the 73 patients in the two groups combined, only seven so far have shown no sign of clinical glaucoma. During the period of this study most patients over the age of 50 years attending the clinic from which Group A is drawn were examined with the slit lamp to find out how common pseudo-exfoliation was apart from glaucoma. These seven with pseudo-exfoliation and, as yet, no glaucoma represent the sum total of several hundred examinations. This is selected material, however, in so far as they attended for examination in the first place for some ophthalmic reason. In addition to this, 82 inmates of an old people’s home were examined and only one found to have pseudo-exfoliation. The incidence of pseudo-exfoliation without glaucoma in older persons in general would thus appear to be low—perhaps about 1 per cent.

Laterality

No great significance or importance needs to be attached to the laterality of the condition; it was bilateral in 70 per cent. of the whole series, and in the remaining 30 per cent. it would probably become bilateral in time. Occasionally, when pseudo-exfoliation is manifestly present in one eye and glaucoma is present in both, pseudo-exfoliation is likely to appear in the other eye as well.

Type of Glaucoma

The great majority of the glaucomas are of the chronic open-angle type and their course, natural history, and behaviour are indistinguishable from those in cases of open-angle
glaucoma in which pseudo-exfoliation is not apparently present. The two reservations in this connexion are:
(1) The presence of free pigment in the anterior chamber.
(2) Response to surgery.

(1) Pigment.—The presence of free melanin along with pseudo-exfoliative material is a feature of the condition. The pigment is present on the back of the cornea, on the anterior surface of the lens, and on the anterior surface of the iris; gonioscopy usually shows a marked pigmentation of Schwalbe’s line and the whole of the angle. On the other hand, pseudo-exfoliation was not especially observed in eyes in which the iris was heavily pigmented.

(2) Response to Surgery.—Many surgeons feel that the surgical results in glaucomatous eyes with pseudo-exfoliation are worse than the average results in its absence. The impression from this series is that the results are neither better nor worse. Many glaucomas were well advanced when first seen and surgery was tried in an effort to save what little sight was left. Tension was usually controlled after operation. Cataract often developed later. One of the bugbears of glaucoma surgery is the showering of pigment through the anterior chamber after operation. The pigment deposits itself in considerable quantity on the anterior surface of the lens with consequent diminution of vision. This occurred in three patients in Group A with serious visual impairment although the tension was controlled, and in one of these the lens had to be extracted. This post-operative complication of pigment deposition was encountered relatively more frequently in cases with pseudo-exfoliation than in those without it in the 201 glaucoma cases from which Group A was taken.

Leaving aside post-operative pigmentation, ocular tension in most cases was controlled, but this did not always prevent further deterioration in visual acuity and loss of visual field. This is an unhappy state of affairs which is found only too often in glaucoma in the absence of pseudo-exfoliation.

Sugar (1951) advised removal of cataractous lenses in such cases, presumably because, in his view, the capsule was the source of the trouble. The conclusion from the present investigation was that lens removal is only of advantage if it assists vision, and that the lens is probably not the origin of the trouble.

So far as the choice of operation is concerned, the presence of pseudo-exfoliation makes no difference. A drainage operation with the minimum of intra-ocular disturbance is desirable, in that it lessens the likelihood of post-operative pigment complication, and for this reason Scheie’s procedure is favoured.

Thrombosis of the Central Retinal Vein

Secondary glaucoma often occurs after thrombosis of the central retinal vein, and branch thrombosis is commonly found in the course of chronic glaucoma.

Group A included three patients in whom absolute glaucoma with pseudo-exfoliation was found at the first examination, though the pseudo-exfoliation was not easily detected; two were certainly thrombotic glaucomas and the third probably. The other eye of each of the three patients showed pseudo-exfoliation with or without glaucoma.

In Group B a similar patient was seen, but there was no pseudo-exfoliation in the other eye. Two patients developed branch thrombosis while under treatment. There were other
instances in this group of absolute glaucoma with pseudo-exfoliation, which might well have been thrombotic in the first place.

Compared with the total number of glaucomas examined, the incidence of venous thrombosis was above average but not significantly so.

Prognosis

In assessing the current state of affairs in any patient with glaucoma the following must be taken into consideration:

(1) Tension control;
(2) Central vision;
(3) Visual fields.

All but seven of the total patients with pseudo-exfoliation in both groups had glaucoma. 46 per cent. of the eyes with glaucoma had central vision of 6/60 or worse, and a few had been enucleated. The majority of these eyes were in that state when first seen. This is no more than an indication of how insidious chronic glaucoma is; it is no reflection on the treatment. In most of the eyes in which useful vision was present when first seen, tension was controlled either by miotics or surgery.

Nineteen patients with glaucoma had cataract which obscured vision in one or both eyes. It is interesting to note that, of the seven patients who had pseudo-exfoliation but so far no glaucoma, six had cataracts. Too much must not be deduced from this because it was the cataract that brought them to the eye clinic.

The field losses as a whole were similar to those found in the total of 201 cases of glaucoma from which Group A was drawn.

On the whole this investigation indicates that the prognosis is no worse in cases of glaucoma with pseudo-exfoliation than in those without, except that there is a greater risk of post-operative visual loss through pigmentation in the anterior chamber. Should this be of serious degree the lens must be extracted.

Geographical Distribution

This yielded some very interesting facts. In Scandinavia the incidence of pseudo-exfoliation in chronic glaucoma is astonishingly high. Hörven (1937), Thomassen (1949), and Petersen (1958) all attest to this, the last having observed it in 47 out of 57 cases of chronic open-angle glaucoma in Norway but in only one out of fifty cases in Great Britain. The condition is sufficiently common in Scandinavia to be looked upon as the main cause of chronic open-angle glaucoma, yet its incidence in the non-glaucomatous inmates of old people's homes is much the same as elsewhere, about 1 per cent. This could be explained by the fact that those with pseudo-exfoliation soon become clinically glaucomatous.

In England the incidence of this condition appears to be much higher in the North. Personal communications (J. R. Hudson; S. J. H. Miller; A. G. Palin; W. C. Thornhill) show it to be comparatively rare South of the Trent, whereas in the West Riding of Yorkshire it is found in 9 per cent. of patients with chronic glaucoma. The diagnostic index of Moorfields Eye Hospital, London, contains no reference to the condition (J. R. Hudson). Of 200 patients seen in the glaucoma clinic at the High Holborn Branch of Moorfields in one particular month, only one had pseudo-exfoliation (S. J. H. Miller). The condition is also considered to be rare in the Bristol area (A. G. Palin). A distribution map of its incidence in Britain would be of great interest.
Taking into account the high incidence in Scandinavia, an intriguing hypothesis is that pseudo-exfoliation is a genetically-determined weakness passed down over the generations from the Norse invaders of Pre-Conquest England. The Norsemen settled mainly in the North and East, the approximate dividing line being Watling Street, and only in the past 40 years or so has there been free population movement between North and South.

**Summary**

1. 9.2 per cent. of patients with chronic open-angle glaucoma in a series examined in the West Riding of Yorkshire were found to have pseudo-exfoliation.
2. Glaucoma with and without pseudo-exfoliation is compared and contrasted with special reference to surgical procedures.
3. Pseudo-exfoliation appears to be much commoner in the North of England than in the South. A possible explanation is suggested.

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