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# Anterior chamber angle in the exfoliation syndrome

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**SUMMARY** The gonioscopic findings of 76 patients with the exfoliation syndrome were reviewed. A high frequency of narrowness of the anterior chamber (AC) angle was found (32%). 18% had angles considered occludable, and 14% had obvious angle-closure glaucoma as shown by the presence of peripheral anterior synechias (PAS). Increased pigmentation of the posterior trabecular meshwork (PTM) was noted in all cases. When this pigmentation was markedly asymmetrical, unilateral exfoliation with glaucoma was common in the more pigmented eye. In addition heavy angle pigmentation in the absence of exfoliation was noted in the fellow eye of patients with characteristic exfoliated material in the other eye. Increased pigmentation of the PTM may be the earliest detectable sign of the exfoliation syndrome (ES). The clinical significance of our estimating PTM pigmentation at the 12 o'clock position is discussed. In view of the accelerated optic nerve damage associated with the development of glaucoma secondary to ES, routine estimation of the pigmentation of the PTM at 12 o'clock is recommended in the hope of early detection of cases of otherwise inapparent ES.

The exfoliation syndrome (ES) is a condition in which a whitish-grey material of uncertain origin is deposited on surfaces within the anterior segment of the eye: lens, iris, zonules, and ciliary processes. The ES is usually recognised by the appearance of these deposits on the anterior surface of the pupil margin. The exfoliated material may be present on the corneal endothelium and in the angle of the anterior chamber (AC). This exfoliated material has a multifocal origin. It may be the result of an abnormal basement membrane synthesis by aging cells.<sup>1</sup>

Atrophy of the pupil margin and adjacent iris transillumination defects are frequently found.<sup>2</sup> Increased trabecular pigmentation has been described and is believed to be a result of depigmentation of the iris.<sup>3</sup> A wavy, pigmented line present on the corneal endothelium in the inferior portion of the angle anterior to Schwalbe's line has been described by Amalric *et al.*<sup>4</sup> and Sampaolesi<sup>5</sup> and is so characteristic that it strongly suggests the presence of ES. That glaucoma is associated with ES has been well demonstrated, though estimates of the closeness of the relationship vary widely.<sup>6,7</sup>

A relationship between angle-closure glaucoma

and ES has been mentioned, but authors in the past appear to believe that the relationship is only coincidental.

## Materials and methods

The source of the patients in this study was a hospital-based private practice. The records of all patients diagnosed as having ES who were examined on initial or return visits between January 1982 and May 1983 were studied retrospectively. All patients had optic disc drawings or photographs taken, applanation tonometry, visual field testing, and Zeiss four-mirror pressure gonioscopy.<sup>8</sup> A diagnosis of ES was made when the characteristic deposits of exfoliated material were seen on the pupil margin or anterior surface of the lens. Glaucoma was diagnosed by the presence of characteristic glaucomatous nerve damage and/or field loss associated with raised intraocular pressure (IOP). Every case was examined by one of the authors (G.L.S.). The analysis of data and a re-examination of selected cases were done by P.K.W. The following characteristics were recorded: (1) Wills Eye Hospital angle configuration grading the angular approach to angle recess, curvature of the peripheral iris, and position of iris insertion.<sup>9,10</sup> (2) Pigmentation of PTM at 12 o'clock graded 0-nil to 4+

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severe. (3) Pigment deposition in the inferior angle recess (at 6 o'clock). (4) Presence or absence of peripheral anterior synechias (PAS).

The records of all 88 patients coded as having ES were reviewed. Twelve cases were excluded because of extraneous factors that would influence the angle appearance. Exclusions include: three cases with previous trauma causing angle recession, one case with anterior uveitis, two cases with previous laser trabeculoplasty, and six cases with previous intraocular surgery.

To compare these findings with a glaucomatous population 150 records were chosen randomly for review, all cases having been examined during the same time interval and in the same office by the same examiner (G.L.S.). All patients with secondary glaucoma, previous intraocular surgery, trauma, or other eye disease were excluded. To achieve age matching, patients less than 58 years old were also excluded.

## Results

Seventy six patients were included in this study. Seventy three had glaucoma, and three showed no evidence of glaucoma. The three patients with no evidence of glaucoma had bilateral ES and open angles. Deposits of exfoliated material were seen on the pupil margin in 24 patients and on the anterior lens capsule in 67 patients. The frequency of open, narrow, and closed angles is shown in Table 1.

Forty eight patients (64%) had 3+ or more pigmentation of the PTM (Fig. 1). Twenty one (27%) had 2+ pigmentation and seven (9%) less than 2+ pigmentation (Table 2). Of the 76 patients 16 showed marked pigment asymmetry (pigment grading different by more than two units). Of these 16, 13 (81%) had significantly more glaucomatous damage in the eye with the heavier pigmentation, while three (19%) showed no difference in the degree of glaucomatous damage.

Of the 76 patients none was seen in whom the eye with less pigmentation showed more glaucomatous

Table 1 Relation between width of angle and ES

Angle	No of cases	Bilateral ES+	Unilateral ES+
Open-angle*	51 (68%)	34	17
Narrow-angle†	14 (18%)	3	11
Angle-closure‡	11 (14%)	6	5
Total	76	43	33

\*Open-angle. An angle width greater than 25° with little curvature of the iris (r).

†Narrow-angle. An angle width less than 25° with the iris curved anteriorly (s).<sup>25</sup>

‡Angle-closure. Defined as such by the presence of peripheral anterior synechias (PAS).

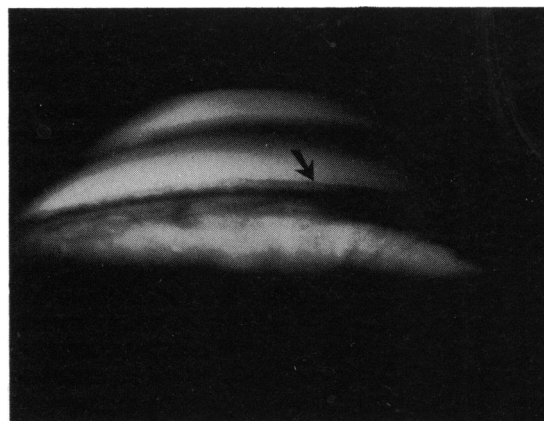


Fig. 1 Gonioscopic view shows intense pigmentation of the posterior trabecular meshwork and presence of a Sampaoles line (arrowed) characteristic of the exfoliation syndrome.

damage than its more heavily pigmented fellow. In 75 of the 76 patients pigment deposition at 6 o'clock was greater than the pigmentation of the PTM at 12 o'clock. The characteristics of the 80 patients who satisfied the criteria for selection as an age matched group of primary glaucoma controls are shown in Table 3.

Table 2 Pigmentation of the posterior trabecular meshwork at the 12 o'clock position\* in 76 cases of ES

Glaucoma	No of cases	Pigment of 3+ or more	Pigment of 2+	Pigment of less than 2+
No glaucoma	3	1	2	0
Open-angle	48	29	14	5
Narrow-angle	14	10	3	1
Angle-closure	11	8	2	1

\*In cases where pigmentation was asymmetric the more darkly pigmented eye is recorded.

Average age 70 years. Sex ratio 33 men: 43 women.

Table 3 Characteristics of an age matched population of glaucoma cases without the exfoliation syndrome or other secondary glaucoma

	No of cases
<b>Diagnosis</b>	
Primary open-angle glaucoma	63
Glaucoma with narrow but open angles	11
Primary angle-closure glaucoma	6
<b>Pigmentation of posterior trabecular meshwork at 12 o'clock</b>	
3+ or more	7 (9%)
2+	14 (17%)
Less than 2+	59 (74%)

Average age 68 years.

Sex ratio 32 men: 48 women.

Of 31 patients with bilateral ES and bilateral open-angle glaucoma only two (6%) showed marked pigment asymmetry of the PTM at 12 o'clock. Of nine patients with unilateral ES and bilateral open-angle glaucoma three (30%) showed marked asymmetry, and of the eight patients with unilateral ES and ipsilateral unilateral open-angle glaucoma six (86%) showed marked pigment asymmetry.

## Discussion

### AC DEPTH AND ANGLE CLOSURE

The accepted view that the AC angle in cases of ES is generally open, and the AC of normal depth<sup>2 11-14</sup> was challenged by the report of Layden and Shaffer<sup>15</sup> citing an incidence of narrow angles in 23% of their cases of ES. In the normal elderly population narrow angles occur in only 4% of patients,<sup>9 16</sup> and less than 1% of the general population is thought to have critically narrow angles.<sup>17 18</sup> This corresponds with estimates of the frequency with which primary angle closure occurs clinically.<sup>9</sup> In other reported series of ES the incidence of angle closure is generally 4% or less,<sup>12 13 19 20</sup> whereas 25 (32%) of our 76 patients had narrow or closed angles.

We believe the high incidence of closed angles in our population may reflect the increased visualisation of PAS made possible by indentation gonioscopy<sup>8</sup> performed routinely on all our patients. The much higher incidence of narrow and closed angles in our patients with ES compared with our primary glaucoma control group makes it unlikely that we are describing a drug-induced effect. It should be noted that treatment with ecothiopate has been thought to be related causally to the occurrence of angle closure glaucoma in patients with ES.<sup>15</sup> In our series of cases



Fig. 2 Narrow anterior chamber angles are more common in patients with the exfoliation syndrome than in age matched controls. This appears not to be merely a factor of the use of miotics but an aspect of the disease itself.

of ES only one was receiving ecothiopate, and in this case the angle was narrow but open. None of the other 75 patients was receiving this drug (Fig. 2). We believe that the association of a narrow AC angle and ES is real, and that early reports indicating no association between them represent incomplete observation. A possible explanation for this narrow angle has been given by Herbst, who believes that it relates to pupil block.<sup>21</sup>

Special attention should be paid to the monitoring of the AC angle of patients with ES in order to prevent the development of angle closure glaucoma, a condition to which patients with ES are predisposed.

### PIGMENTATION

A densely pigmented trabecular band is regarded as a sign of ES.<sup>2 19 22</sup> However, few reports of ES actually record their assessment of pigmentation, and, in those that do, incidences of 35% to 70% of no remarkable TM pigmentation are found.<sup>12 15</sup> Furthermore ES occurs in the elderly,<sup>15 19</sup> and pigmentation of PTM and inferior angle recess have been shown to increase with age.<sup>9 18</sup> Reports of TM pigmentation in the ES would therefore be more instructive if the site of assessment of TM pigmentation had been given.

It has been shown that pigmentation of PTM is of most diagnostic significance if assessed at the 12 o'clock position, and at this position 65.8% of normal eyes showed no pigmentation of their PTM. Only 2.5% of normal eyes showed pigment grading 3+ or more (average age 70 years).<sup>9</sup>

Table 4 clearly shows that there is a much greater incidence of dense pigmentation of the PTM in patients with ES than in normals or cases of primary glaucoma.

A significant relationship between increased angle pigmentation and glaucoma has been affirmed by some authors<sup>12 19 23</sup> though denied by others.<sup>15</sup> In our study marked pigmentation of the PTM (when assessed at 12 o'clock) appears to be part of the ES and to be related to the presence of glaucoma. Furthermore as a prognostic factor, when marked pigment asymmetry was found, 81% of the more heavily pigmented eyes showed the more severe glaucoma.

Table 4 Pigmentation of posterior trabecular meshwork at 12 o'clock

Pigmentation of PTM	Normal cases	Primary glaucoma cases	Glaucoma with ES cases
Less than 2+	87.9%	74%	9%
2+	9.5%	17%	27%
3+ or more	2.5%	9%	64%

Richardson and Epstein have noted that the trabecular cells of eyes with ES appear normal and do not contain exfoliated material.<sup>24</sup> They found the major pathology to be destruction of Schlemm's canal and accumulation of exfoliated material in the juxtacanalicular region. Accumulation of pigment was minimal. In contrast, studies of pigmentary glaucoma show that pigment deposition within the cells of the trabecular region is prominent and appears to play a significant pathogenetic role in the development of glaucoma.<sup>25-27</sup> Further histological studies are needed in this regard.<sup>28</sup>

#### DIAGNOSTIC VALUE OF PIGMENTATION

27% of our ES showed a 2+ pigmentation of PTM and 64% 3+ or more when pigment was assessed at the 12 o'clock position (total 91%). These results indicate that increased pigmentation of PTM is a reliable sign of ES. The diagnostic pupil border deposits of ES were only visible in 32% of our patients and therefore represent a much less frequently seen sign of the ES than increased pigmentation of PTM.

We observed the development of lens or pupil deposits of exfoliated material in six patients who were not thought to have ES when first seen, because no exfoliated material was observed. Four of these were recorded at the initial visit as having pigmentation of the PTM of grade 2+ or more.

The demonstration by cycloscopy of exfoliated deposits on zonules and ciliary processes in more than half the fellow eyes of unilateral cases of ES shows that exfoliated material may be present, even if lens or iris deposits cannot be seen.<sup>29</sup> In the absence of cycloscopy, intense pigmentation of the PTM may be the earliest sign of ES actually predating the development of visible 'dandruff.'

As has been found with other studies, when glaucoma is associated with ES, the IOP is difficult to control, and there is a high incidence of severe optic nerve damage.<sup>30,31</sup> Of the 76 patients in our series 51 eyes showed severe optic nerve damage associated with gross glaucomatous visual field loss. Early detection of the first sign of glaucoma in a patient with ES is important, so prompt therapy may be given.

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