

Light and Electron Microscopy of the Wall of Iris Vessels in Eyes with and without Exfoliation Syndrome (Pseudoexfoliation of the Lens Capsule)

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Licht- und Elektronenmikroskopie der Irisgefäßwände in Augen mit und ohne Exfoliations-Syndrom

Zusammenfassung. Es handelt sich hier um die Beschreibung einer lichtmikroskopischen Technik zum Nachweis von Exfoliationsmaterial in der Gefäßwand der Iris. Man untersuchte Irisgewebe von 4 kataraktbetroffenen Augen ohne und 8 kataraktbetroffenen Augen mit Exfoliationssyndrom.

Von einer Gesamtmenge von 499 Gefäßen von kataraktbetroffenen Augen mit Exfoliationssyndrom zeigten 386 ein normales Aussehen. Die übrigen 113 Gefäße wiesen ein hellblaues Material außerhalb der Cellulärschicht der Gefäßwand in der normalerweise ungefärbten Zone auf, das sich bei elektronenmikroskopischer Untersuchung als Exfoliationsmaterial erwies.

Summary. A light microscopic technique is described for identifying exfoliation material in the wall of iris vessels. Iris tissue from four cataractous eyes without and eight cataractous eyes with exfoliation syndrome was studied.

Of a total of 499 vessels from cataractous eyes with exfoliation syndrome, 386 appeared normal. The remaining 113 vessels showed a light blue material in the normally unstained zone adjacent to the cellular layer of the vessel wall. In the electron microscope this light blue material proved to be exfoliation material.

Introduction

The light microscopic structure of normal human iris vessels has been described by several authors. According to Gregersen (1959) they are built up of two concentric tubes, which are separated by a circular, fairly wide, lighter zone. Little or no stainable tissue is present in this zone, but electron microscopic studies have shown numerous collagen fibrils in the corresponding region (Purtscher, 1966; Vegge and Ringvold, 1969).

Light microscopic changes in the wall of iris vessels from eyes with exfoliation syndrome have been reported, although the presence of exfoliation material in this region has not been shown. Thus, Busacca (1928) found hyaline degeneration of vessel walls, and Dvorak-Theobald (1954) reported narrowed, sometimes obliterated, lumina of iris vessels from eyes blinded through glaucoma capsulare. Electron microscopic investigations have demonstrated changes in iris vessels from eyes with exfoliation syndrome (Shakib *et al.*, 1965; Ringvold, 1969).

This study was undertaken in order to see whether such changes are identifiable in the light microscope. The material for the present work was taken from eyes that also showed senile cataract. The structure of iris vessel walls from cataractous eyes as seen in the light microscope will be demonstrated in the present study and compared with the corresponding structures from cataractous eyes without exfoliation syndrome.

Material and Methods

Iris tissue from 12 cataractous eyes were studied. Exfoliation material was demonstrated in 8 of these eyes, while the remaining 4 eyes (examined in mydriasis) showed no sign of exfoliation syndrome. The same material has already been used in an earlier investigation (Ringvold, 1969), and further details are found in that work.

Araldite embedded tissue blocks were sectioned on an LKB Ultratome. Sections measuring 2–3 μ thickness were placed on microscope slides, and a few drops of toluidine blue (1 % buffered to pH 7.3 with phosphate buffer) were added. The slide was heated 10–20 seconds over a spirit lamp without boiling, and then placed in isopropylalcohol for a few minutes until no more color was dissolved from the section. A prolonged decolorization for several hours did not change the results. Sections were mounted with cover slips in Araldite.

Results

Because of the always scanty media the difference between arteries and veins is so little that many iris vessels are not classifiable according to this terminology. This subgrouping of the vessels will therefore be avoided.

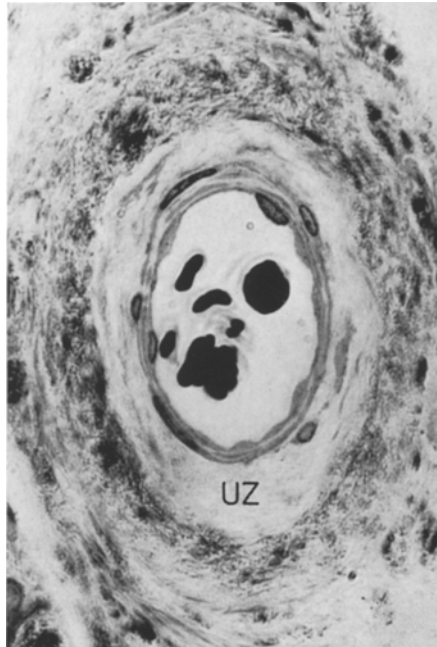


Fig. 1. Light micrograph from an eye without exfoliation syndrome. The so-called unstained zone (*uz*) did not appear completely unstained. $\times 1,170$

The lighter zone in the normal vessel wall (Gregersen, 1959) will be called "unstained zone" although discontinuous color streaks sometimes were found in this region. By checking such streaks in the electron microscope only collagen fibrils were found (Figs. 1–3).

The ultrastructure of iris vessels in cataractous eyes without exfoliation syndrome appears normal (Ringvold, 1969). The light microscopic appearance of these vessels in toluidine blue stained sections is shown in Figs. 4–6.

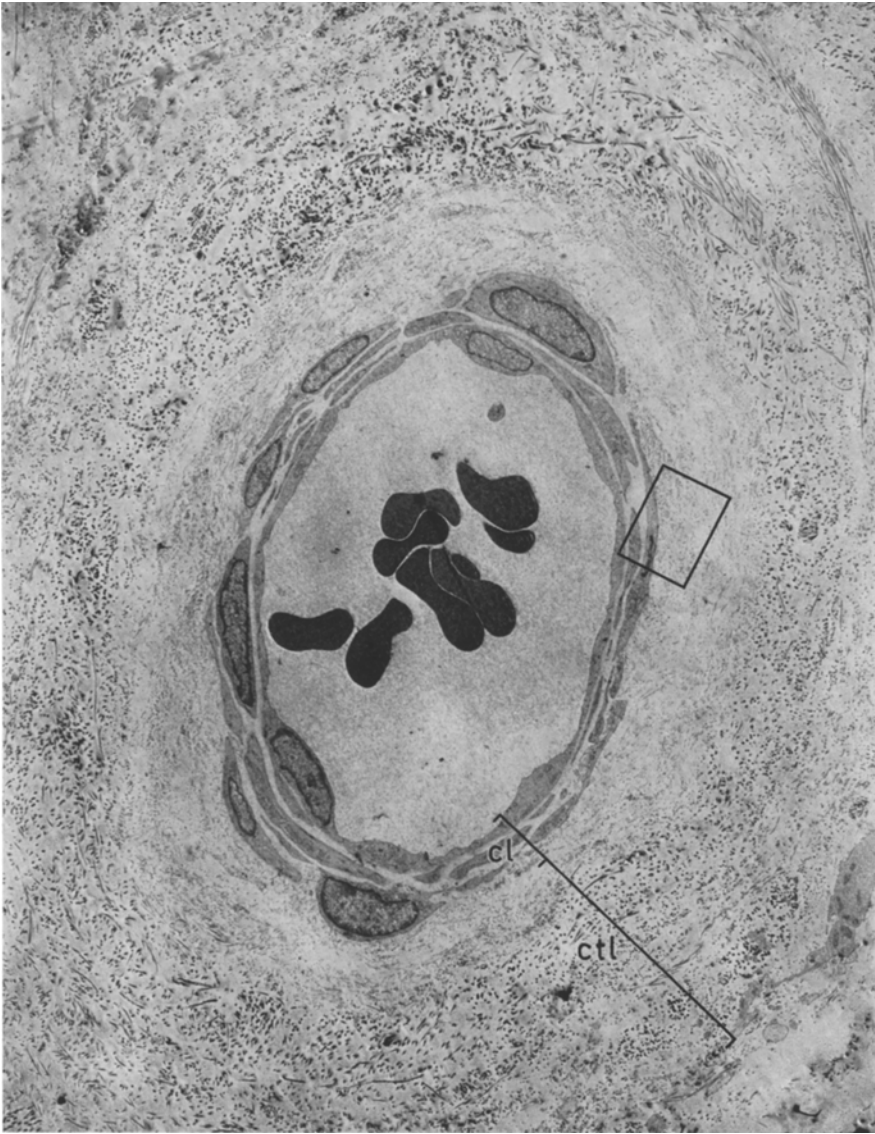


Fig. 2. Electron micrograph of the same vessel as shown in Fig. 1. *cl* cellular layer of the vessel wall; *ctl* connective tissue layer of the vessel wall. $\times 2,000$

Cataractous Eyes with Exfoliation Syndrome

A total of 499 vessels were studied, and 386 of them appeared normal (Fig. 10). The remaining 113 vessels showed changes, and such vessels were found in all 8 eyes. The changed vessels showed in toluidine blue stained sections a light blue material in the normally unstained zone (Figs. 7—9). This material was always lying in a zone adjacent to the cellular layer of the vessel wall, and its outer

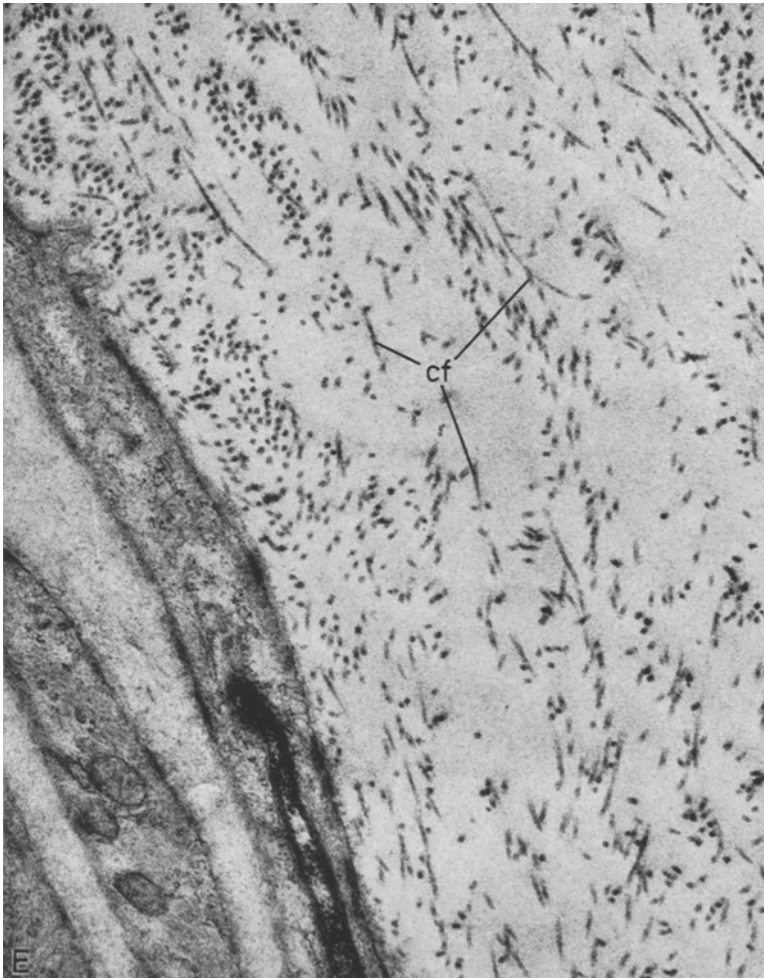
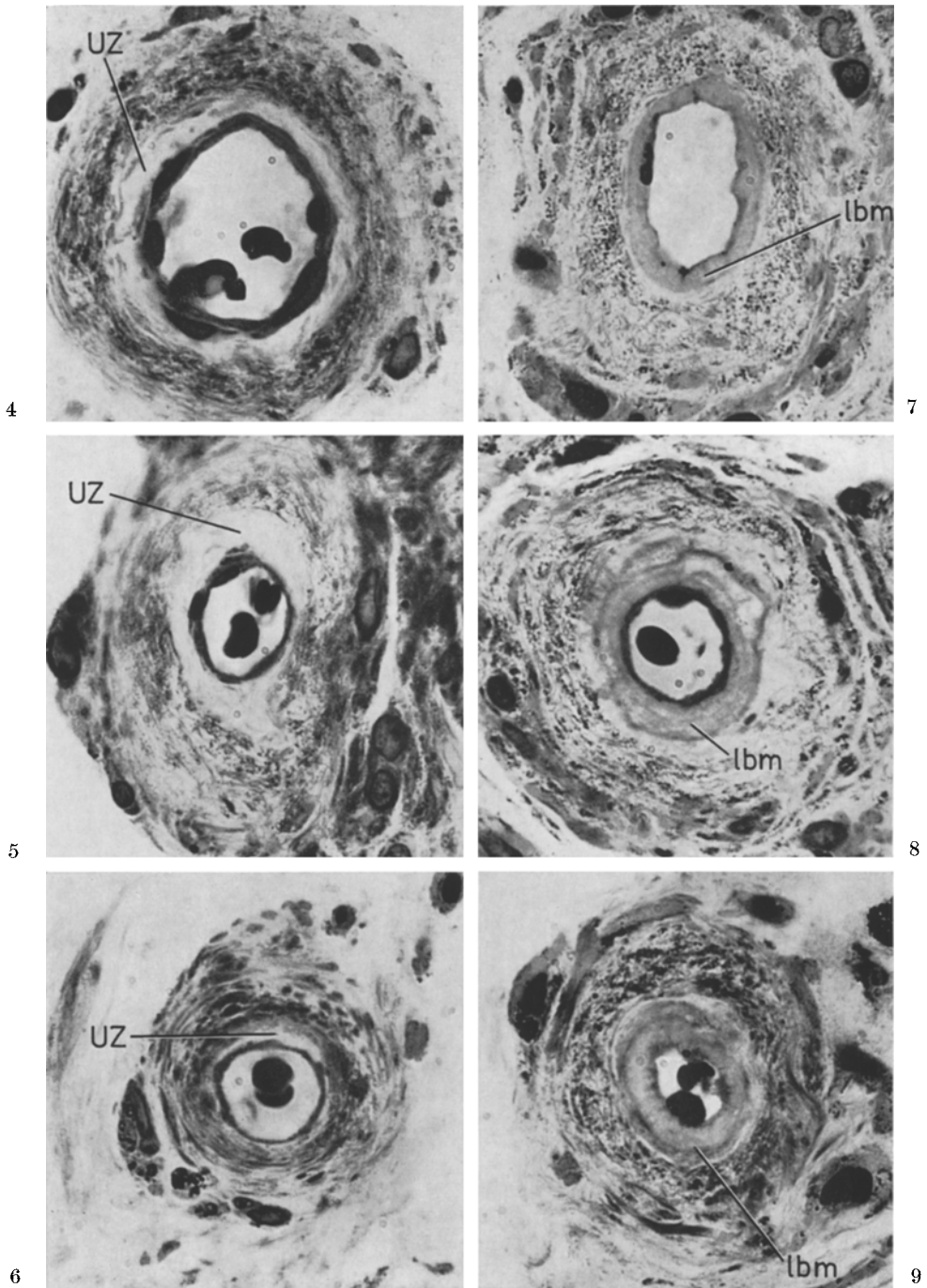


Fig. 3. Detail from Fig. 2. Only collagen fibrils are visible in the region corresponding to the light microscopic unstained zone. *cf* collagen fibrils; *E* endothelial cell. $\times 18,400$

border sometimes showed a wavy course. The amount of this material varied independently of lumen diameter, and it was unevenly distributed in the circumference of the vessel. However, it never completely filled the unstained zone, and usually had a fairly distinct peripheral limitation (Fig. 7). The material was homogeneous, but circumferentially running, weakly stained bands, or round to oval lighter fields sometimes appeared within it (Fig. 8).

Electron microscopy of this blue material always showed the presence of exfoliation material (Figs. 11—13). Only vessels with a continuous light blue zone in the wall were counted as changed. As one might expect, some of the vessels that appeared normal in the light microscope, showed small amounts of exfoliation material in the electron microscope. Apart from the presence of the blue material, the structure of the changed vessels coincided with the appearance of iris vessels



Figs. 4—6. Light micrographs of iris vessels from eyes without exfoliation syndrome. Note the unstained zone outside the cellular layer of the vessel wall. $\times 1,170$

Figs. 7—9. Light micrographs of iris vessels from eyes with exfoliation syndrome. Note the light blue material (*lbm*) in the normally unstained zone. $\times 1,170$

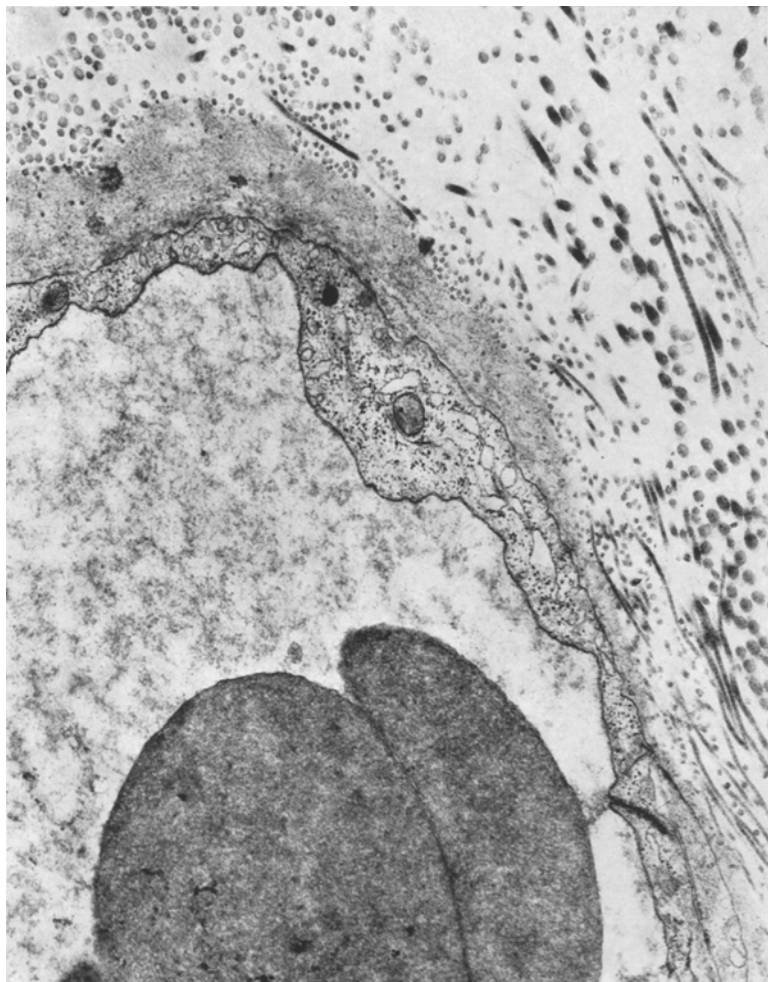


Fig. 10. Normal appearing vessel from an eye with exfoliation syndrome. $\times 18,400$

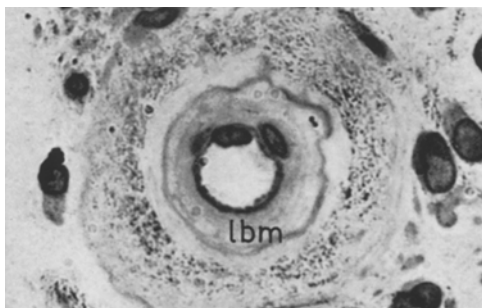


Fig. 11. Light micrograph from an eye with exfoliation syndrome. The light blue material is lying adjacent to the cellular layer of the vessel wall. $\times 1,170$

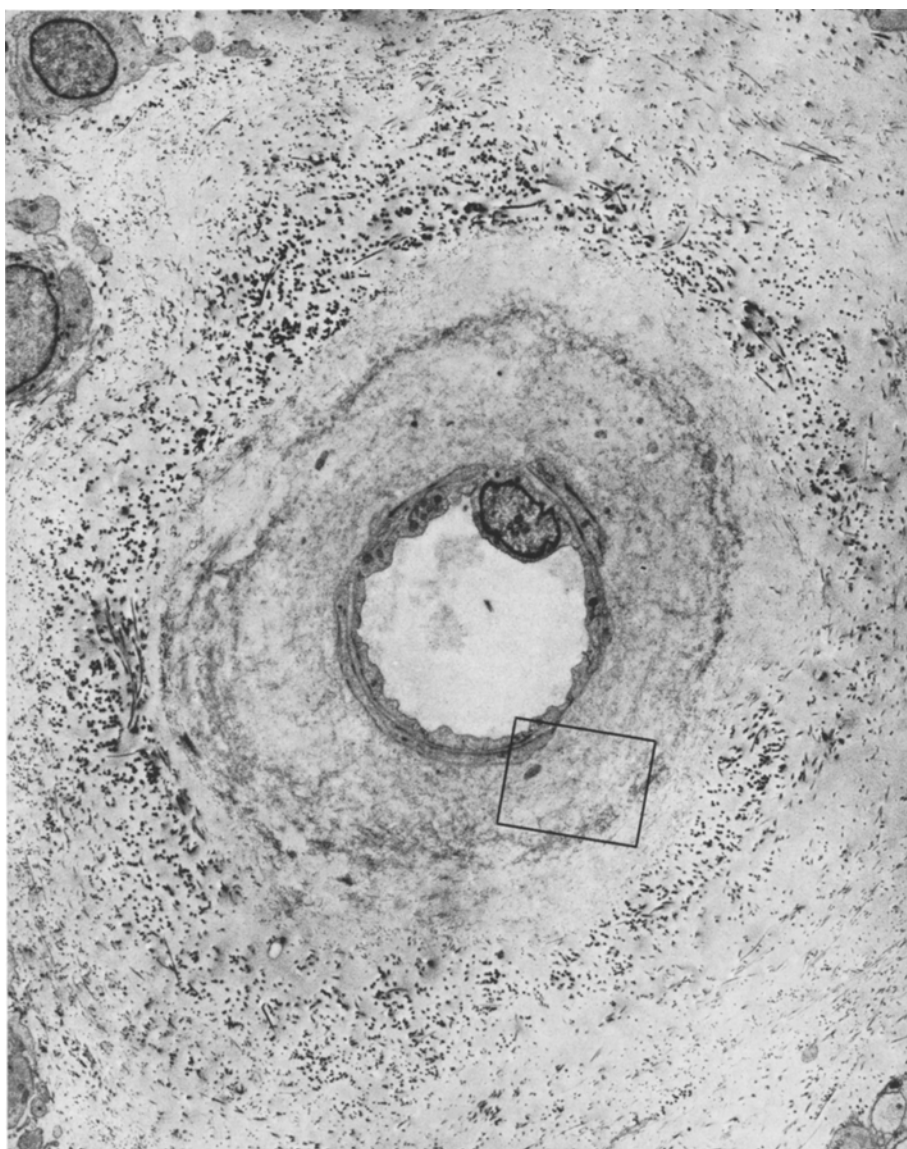


Fig.12. Electron micrograph of the same vessel as shown in Fig. 11. $\times 3,000$

from cataractous eyes without exfoliation syndrome. It was noticeable that vessels with a normal appearance were found close to vessels showing the described changes. Changed vessels were found throughout the iris stroma.

Discussion

The ultrastructure of iris vessels in eyes with senile cataract appears normal (Ringvold, 1969). The present light microscopic study confirms this observation.

Exfoliation material showing the characteristic appearance (Busacca, 1928) on the posterior iris surface stained light blue with toluidine blue in this study. In

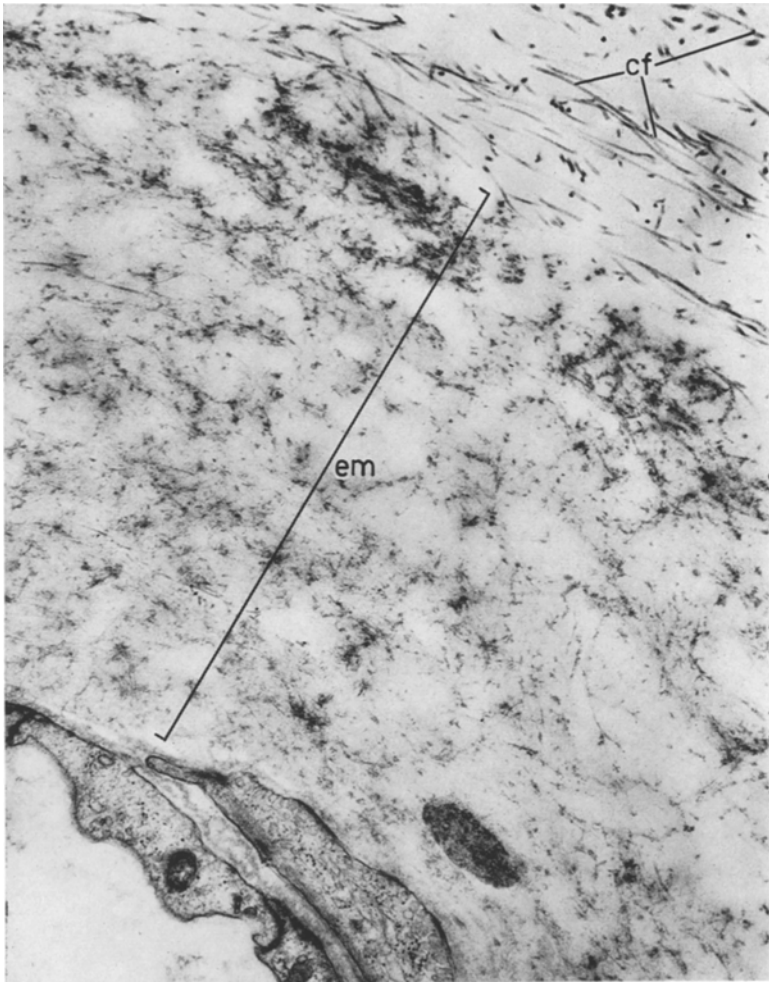


Fig. 13. Detail from Fig. 12. The light blue material in Fig. 11 is shown to be exfoliation material (*em*). $\times 18,400$

some iris vessels from cataractous eyes with exfoliation syndrome a similar light blue stain appeared circularly in the normally unstained zone of the vessel wall. Electron microscopy of adjacent ultrathin sections always showed exfoliation material to be present in this zone whenever it was stainable with toluidine blue. Thus, the presence of the described blue stain in the normally unstained zone indicates the presence of exfoliation material in the vessel wall.

Toluidine blue does not only stain exfoliation material, of course. Therefore the material was only identified when forming a complete circle. It could not be identified when occurring in patches.

The fact that a majority of the vessels appeared normal must not be taken as evidence that some vessels are normal in their whole extent while others show changes. Rather, it should be taken to indicate that in iris vessels from eyes with

exfoliation syndrome, exfoliation material appears in aggregates of limited extent along the vessels.

The relation between normal and changed vessels in the present material of normotensive eyes with exfoliation syndrome was 386:113. Further studies are necessary to elucidate this relation in eyes with glaucoma capsulare.

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