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Histomorphological approach of hypertensive and diabetic cataractous lenses

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Abstract: Light microscopic study shows nuclear opacification and lysis, cortical degeneration and thickening, fibre fragmentation with partial dissolutions of the lenticular tissue, subcapsular degeneration, cell separations, dissolution and lens tissues with anteroposterior thickening in subcapsular cataract lens when compared with normal lens. In Scanning electron microscopic study cataractous lenses shows lamellated band of lens fibres of different density, disarranged and degenerated lens fibres with vesicles or globules, cortical rupture, large opacities or lesions, uneven cloudiness in the subcapsular region, necrosis, the swelling of the broken ends (asterisks),the porosity and granulation of the lens fibres and vacuoles or vesicles fused together in the form of spherical bodies or balloon like appearance when compared with the normal lens.

Key words :- hypertensive cataractous lens, diabetic cataract lens,Histomorphology, Light microscopy, Scanning electron microscopy,

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I. INTRODUCTION

According to Kalariya*et al*., (1998) in the lens fibers three main age-related fine structural alterations were found: i) membrane ruptures, ii) water vacuoles and iii) multilamellar bodies. The frequency of these alterations increased with age and they remained restricted to the superficial equatorial cortex. They were absent in the anterior and posterior cortex, supra nuclear equatorial cortex and nucleus. The membrane ruptures and water vacuoles are in morphological support of the view, based on biochemical evidence, that oxidative stress leads to destabilization and disintegration of membranes and consequently disturbs the water balance of fibers. It is postulated that the lamellar bodies are involved in the repair of ruptured membranes and breakdown of affected proteins thus explaining the late onset of senile cataractous changes

Cataract associated with aging (senile or age-related cataract) most often occurs in both eyes, with each cataract progressing at a different rate. Generally normal aging and cataractous changes in the lens are related to its metabolic activity. Cataract is a public health problem in many developing countries including India. Formation of granular and plaque-like opacities in the posterior subcapsular cortex often heralds the formation of posterior subcapsular cataracts. Posterior Subcapsular (PSC) cataracts-Posterior subcapsular cataract (PSC) is located just beneath the posterior capsule and takes place due to abnormal differentiation and migration of lens epithelial cells (LEC). This type of cataract, which develops between the back of the lens and the lens capsule, is the softest and most rapidly growing type. PSC cataracts tend to scatter light at night and thus interfere with night time driving. People with diabetes, high farsightedness or retinitis pigmentosa or those taking high doses of steroids may develop a sub capsular cataract.

According to Kalariya*et al*., (1998) in the lens fibers three main age-related fine structural alterations were found membrane ruptures, water vacuoles and multilamellar bodies. The frequency of these alterations increased with age and they remained restricted to the superficial equatorial cortex. They were absent in the anterior and posterior cortex, supra nuclear equatorial cortex and nucleus. The membrane ruptures and water vacuoles are in morphological support of the view, based on biochemical evidence, that oxidative stress leads to destabilization and disintegration of membranes and consequently disturbs the water balance of fibers. It is postulated that the lamellar bodies are involved in the repair of ruptured membranes and breakdown of affected proteins thus explaining the late onset of senile cataractous changes.

II. METHODOLOGY

Human subcapsular cataract lens were obtained from patients admitted for cataract extraction in the ophthalmology department of District hospital, Kottayam. Their clinical findings were recorded. The samples collected in small vials immediately after extra capsular extraction and fixed and embedded for light and scanning electron microscopy.

The samples for scanning electron microscopic study was fixed in 2.5% gluteraldehyde and light microscopic samples fixed in bouin's fluid. The fixed specimens were passed through tissue processing, according to the procedure shown below (Culling,1985). Fixed SEM specimens processed through the following procedures for scanning electron microscopic studies as shown below (Glauert, 1974).

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III. RESULT

1. Light microscopy

1) Diabetic cataract

Diabetic cataract sections (Plate- 6) show lens tissues with cortical degenerations, fragmentation and partial dissolutions of the lenticular tissue (Fig. F1). Well degenerated cortical region (Fig.F2) and cortical fragmentation (Fig. F3) is clearly visible. In Fig. F4 &F5 a clear cloudy nuclear region or area of nuclear sclerosis and partial dissolution of lenticular tissue can be seen (arrow) .

2) Hypertensive cataract

Hypertensive cataract lens tissue show cortical degenerations, fragmentation and partial destructions. (Fig.G1).The nucleus is only partially lysed and thinner (Fig.G2). Focal area of cortical degeneration and fragmentation in Fig.G3 & G4. Equatorial disarrangement and destruction is high in one equatorial region (Fig. G5) but is less in the other equatorial region Fig. G6 (Plate-7).

3) Normal lens

Normal lens section shows normal configuration. In the normal lens nuclear area appears as a compact mass (Fig.H1). A fibreto fibre arrangement and little inter-fibril space are peculiar to the normal cell morphology that is visible in Fig.H2. Fibril arrangement of the cortical region is visible in the figures (Plate- 8).

2. Electron Microscopy

1) Diabetic cataract

Very well lamellated band of lens fibres with spaces of different density can be observed through the anterio- posteriorly cut surface(Fig.6a-1). Well degenerated nuclear region results in necrosis or sclerosis (Fig.6a-2), some nuclear fibres with gentle undulations on the long flat surface with a superimposed fingerprint pattern and ball and sockets are seen. Cortical fibres are broken and degenerated observed through low (Fig.6a-3) and high magnification(Fig.6a-4).The extensive swelling of the broken ends (asterisks) is evident. In the capsular region degenerated fibres with rings of small and large opacities and broken edge of the cortical region can be observed (Fig.6a-5). Uneven cloudiness is seen in the anterior sub capsular region (Plate- 14a).

Through the dorsal side of the broken diabetic cataractous whole lens (Fig.6b-1), shows broken lens fibres in the anterior region arranged and different layers of elongated lens fibres in the equatorial region and in close view broken central region (Fig.6b-2). Through the broken side disarranged, degenerated and separated lens fibres and many small vesicles can be observed (Fig.6b-3). Disruption of the lens fibre membrane and a disturbance of the cytoplasm content of the lens fibres having a mass of vacuoles is seen in diabetic cataract lens (Plate- 14b).

2) Hypertensive cataract

In Plate- 15a, there is well lamellated cortical region and less lamellated nuclear region in hypertensive cataractous lens. Lens fibres with degenerated spaces(gaps) in the nuclear and cortical region and broken equatorial region are seen (Fig.7a-1). Degenerated and broken nuclear region is seen in Fig.7a-2. Degenerated and disarranged cortical region(Fig.7a-3) shows edge and grove pattern. Broken lens fibres in the equatorial region can be clearly visible (Fig.7a-4)due to the swelling of the lens fibres. Degenerated lens fibres of different layers can be seen in the outer side (Fig.7a-5).

3) Normal lens

Normal lens viewed through the equatorial region of the whole lens (Fig.8a-1). Arranged cellular architecture in the nuclear region in low power (Fig.8a-2) and fiber arrangement in the nuclear region in high power can be seen in Fig.8a-3. Normal fibre to fiber arrangement in the cortical region can be clearly visible (Fig.8a-4). A fibre to fibre arrangement and little interfibre spaces are peculiar to the normal lens morphology. Normal sub capsular region can be viewed through the whole lens in Fig.8a-5 (Plate- 16a).

IV. DISCUSSION

Tarwadi&Agte (2009), the section of lenses of hypertensive etiology showed homogenous areas and fine lamellated areas dispersed with fine space. According to Dorairaj*et al.*, (2002) lens of diabetic etiology showed lamellated bands of fibres of different density, senile cataract lens of cream colour showed fine lamellations .A sequence of histological changes was identified from the equatorial region to the posterior pole, extracellular granular and fibrillar material were produced Eshaghian& Streeten.,1980). Nucleus shrinkage (5 microns) was more evident in nuclear cataracts; in subcapsular cataracts most of the nuclei were large (average 9 microns diameter). Variation in morphological changes like vacuolization of cytoplasm and nuclei, pyknotic nuclei, and superimposed cells was more evident in the mixed type of cataracts (Vasavada*et al*., 1991).

Cortical cataracts usually begin with either sharp limited clear fluid clefts, resulting in opaque spokes, or clear lamellar separations, resulting in cuneiform opacities. In cortical and subcapsular cataracts and lens perforations the main cause of grey opalescence appears to be the result of lens proteins (water-soluble crystalline) coming into direct contact with free fluids (water). In cortical cataracts this happens in the area of sharp limited mechanical cortical ruptures (fluid clefts), and in subcapsular cataracts during passive, external fluid entry, resulting in subcapsular fluid vacuoles.

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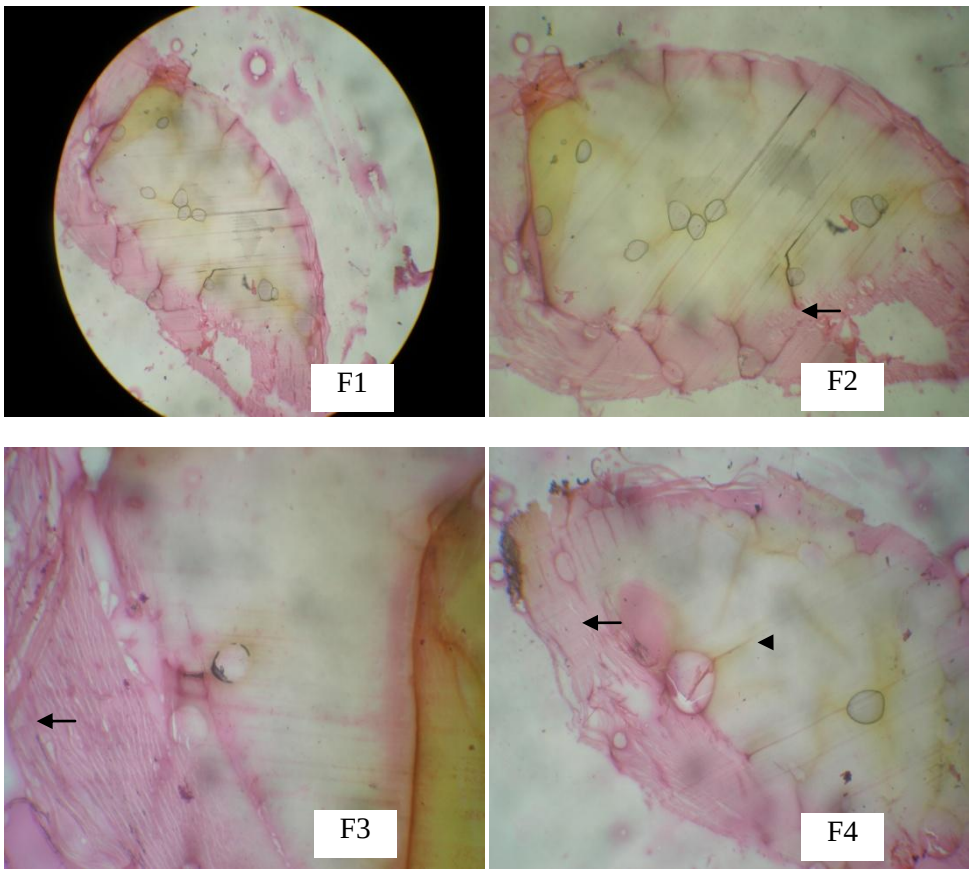

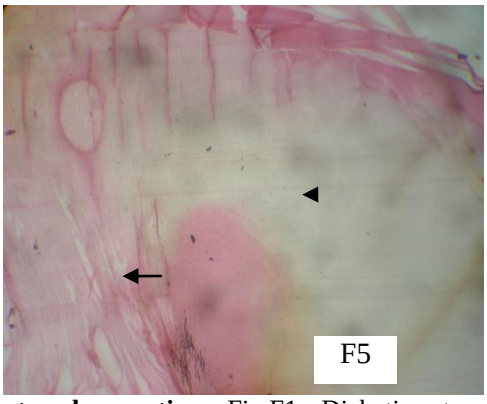

Plate - 6. Human diabeticcataractous lens section:- Fig.F1 - Diabetic cataract lens section whole view × 400. Fig. F2 - Well degenerated cortical region (arrow). Fig.F3 - Cortical fragmentation (arrow). Fig.F4 &F5- Nuclear sclerosis (arrow head) and partial dissolution (arrow) × 1000.

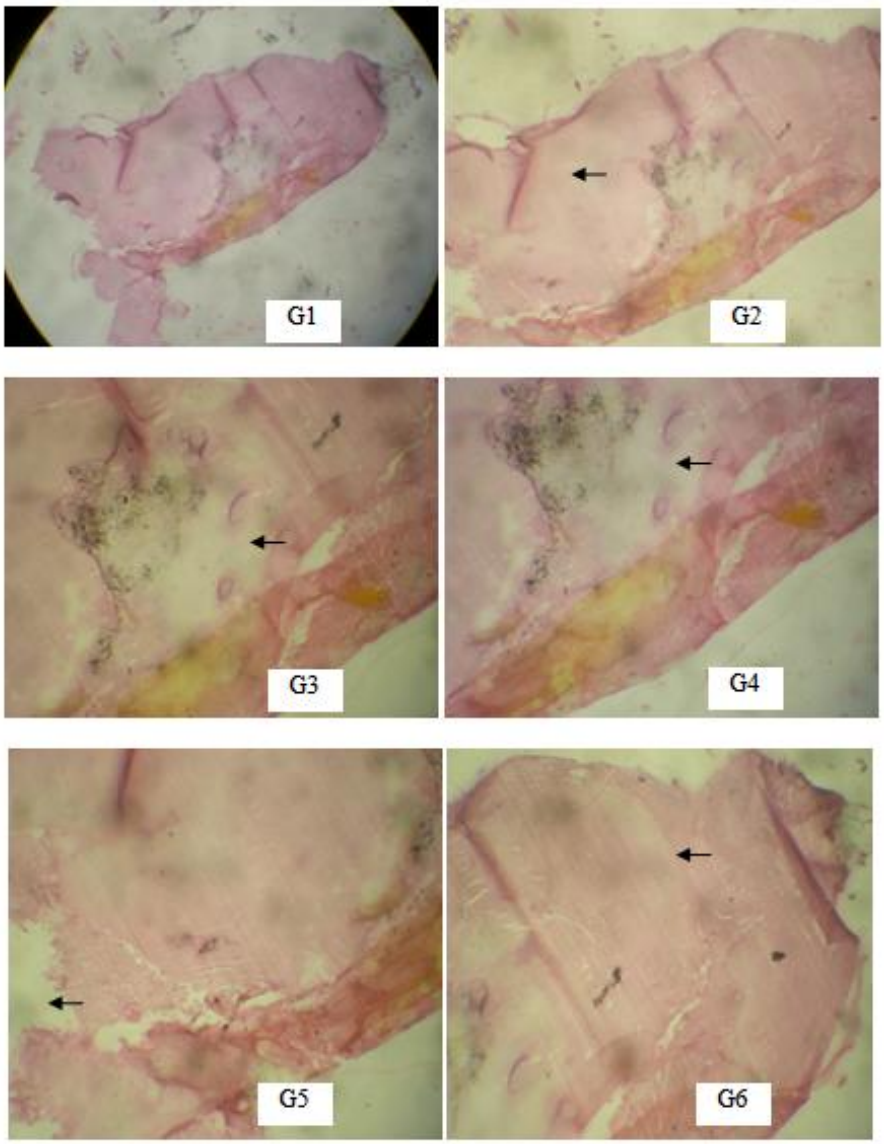

Plate-7. Human hypertensivecataractous lens section:- Fig.G1- Hypertensive cataract lens section whole view× 400. Fig.G2 - Partially lysed and thinner nucleus (arrow). Fig.G3 & G4 - Focal area of cortical degeneration and fragmentation (arrow). Fig.G5 - Equatorial disarrangement and destruction (arrow). Fig.G6- Less destruction in the other equatorial region× 1000 (arrow).

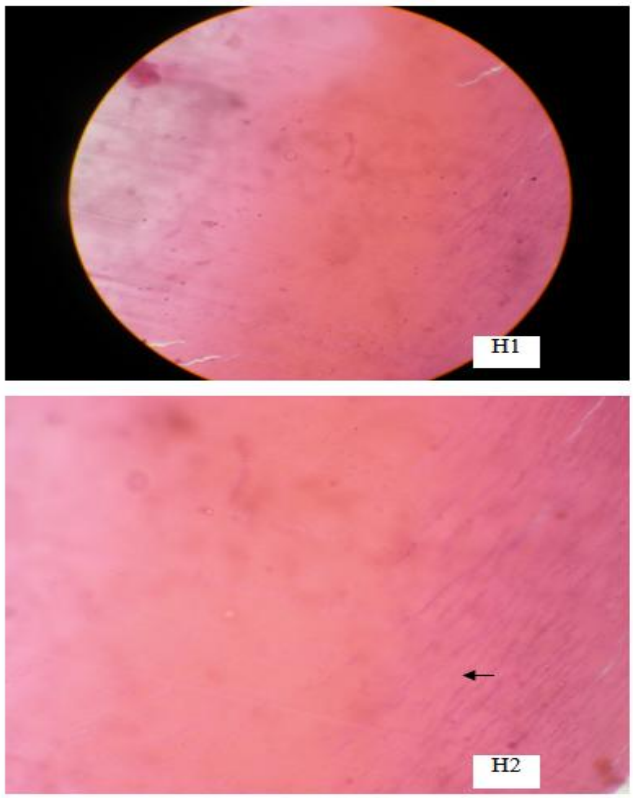

Plate- 8.Human normal lens section:- Fig.H1:- Normal lens section whole view × 400. Fig.H2- Fibril arrangement of the lens fibres (arrow) × 1000.

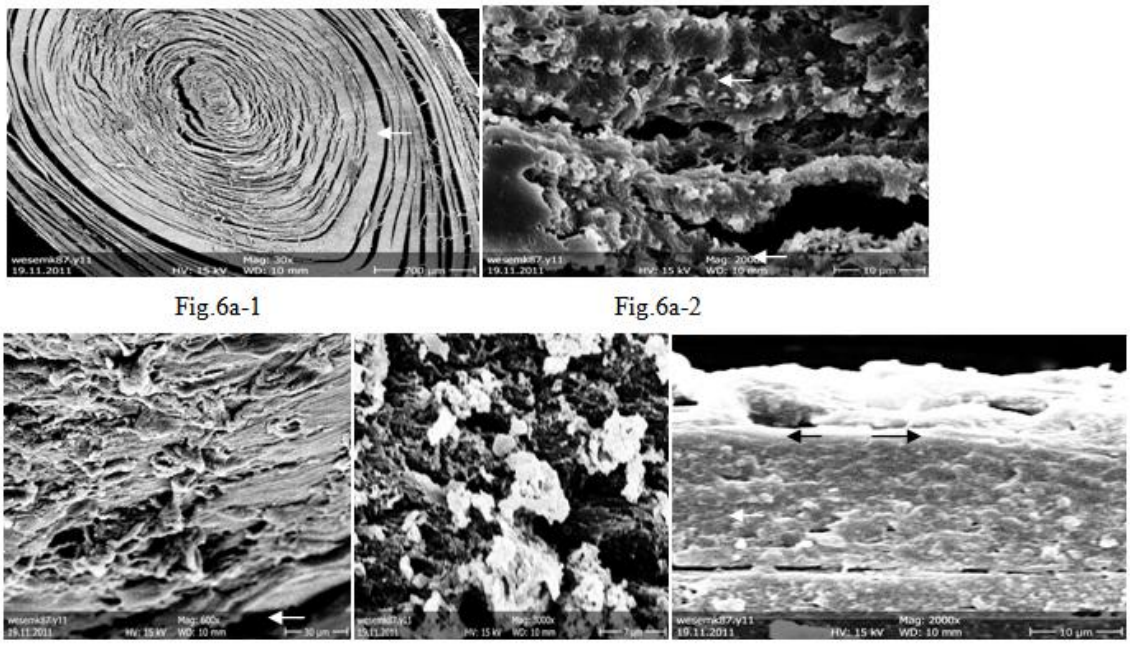

Fig.6a-1 Fig.6a-2

Fig.6a-3 Fig.6a-4 Fig.6a-5

Plate 14a: Human diabetic cataractouslens :- view through the anterio-posterioly cut surface. Fig.6a-1-Very well lamellated band of lens fibres (arrow) × 30x.Fig. 6a-2- Necrosis in the nuclear region (arrow) × 2000x.Fig 6a-3-Degenerated cortical fibres in low (arrow) × 600x and with asterisks in high magnification (arrow) × 3000x (Fig.6a-4).Fig.6a-5- Subcapsular region with opacities or lesions (arrow) × 2000x.

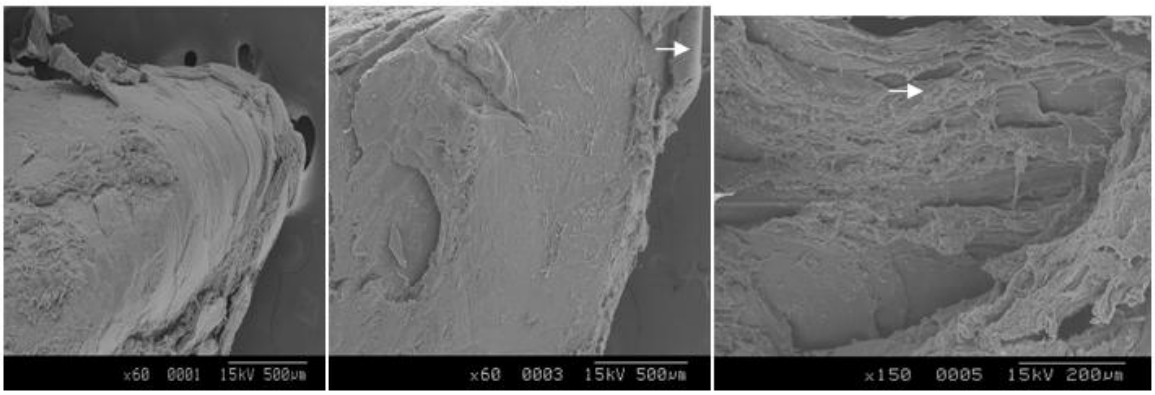

Fig.6b-1 Fig.6b-2 Fig.6b-3

Plate 14b:Human diabetic cataractous lens:- view through the dorsal side of the equatorial region of the whole lens × 60 (Fig.6b-1), Fig.6b-2-Posterior equatorial region (arrow) × 60.Fig.6b-3- Degenerated lens fibres with many small vesicles (arrow) × 150.

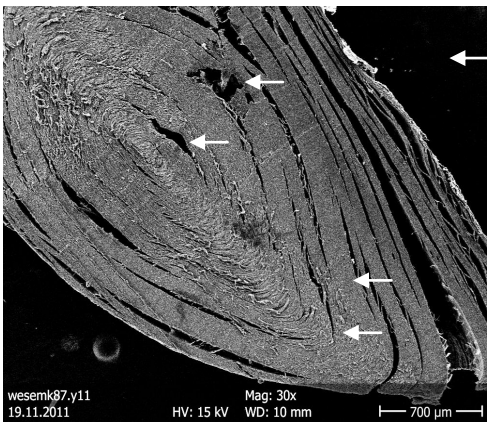

Fig.7a-1

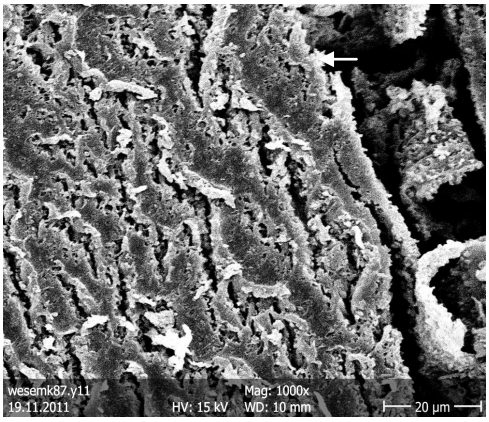

Fig.7a-2

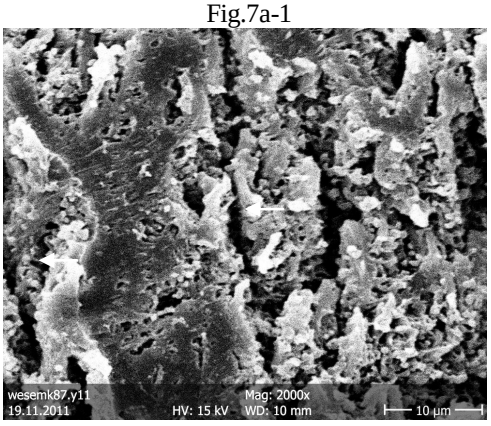

Fig.7a-3

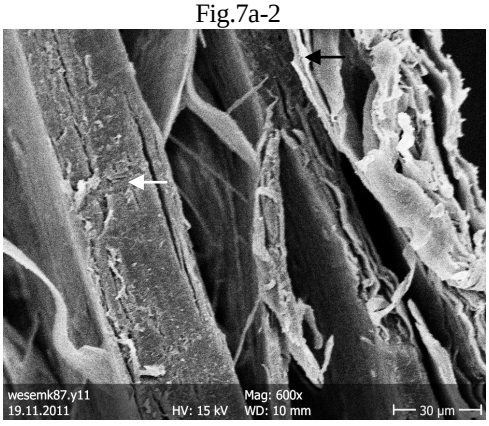

Fig.7a-4

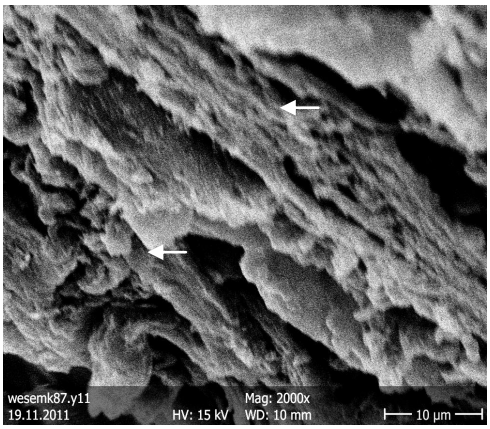

Fig.7a-5

Plate 15a: **Human hypertensive cataractous lens:**- view through the anterio-posterioly cut surface.Fig.7a-1-Finelamellated lens fibres with degenerated space in the nuclear and cortical region (arrow) × 30x. Fig.7a-2-Degenerated and disarranged nuclear region (arrow) × 1000x. Fig.7a-3- Degenerated cortical region (arrow) × 2000x.Fig.7a-4-Broken lens fibres in the equatorial region (arrow) × 600x. Fig.7a-5-Degenerated layers of lens fibres of outer side (arrow) × 2000x.

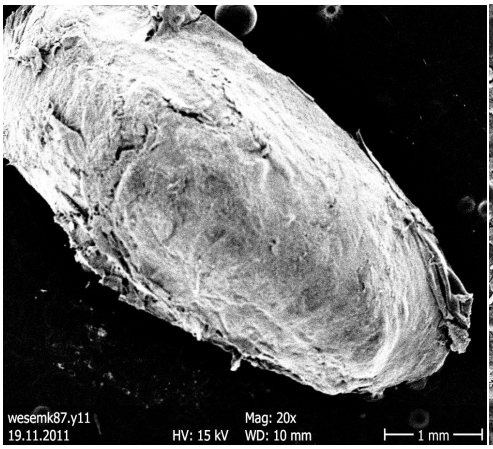

Fig. 8a-1

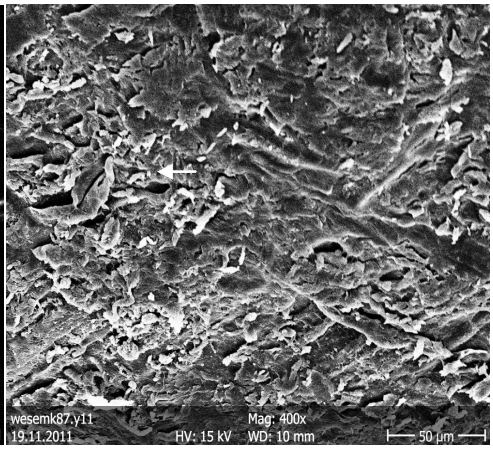

Fig. 8a-2

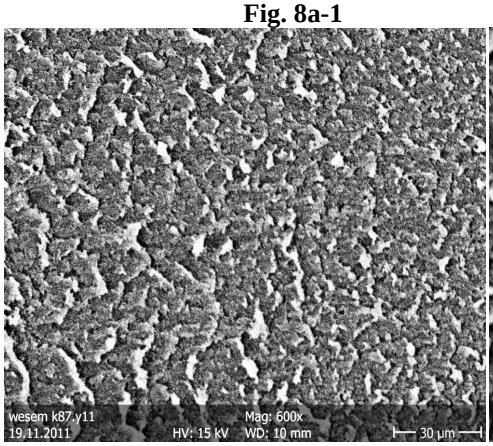

Fig. 8a-3

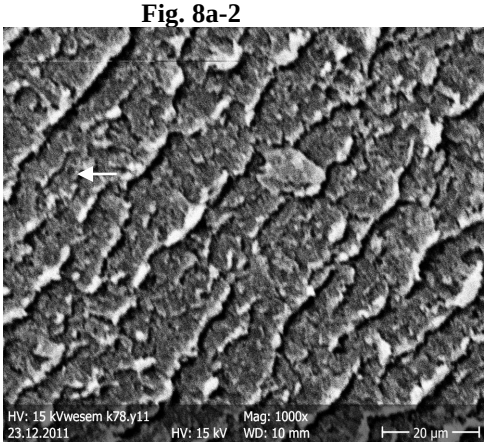

Fig. 8a-4

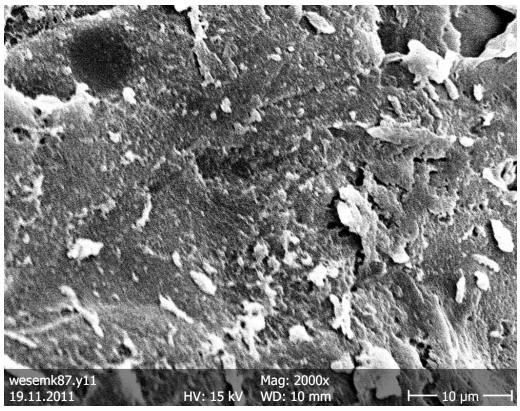

Fig. 8a-5

Plate 16a: **Human normal lens**- Normal lens view through the longitudinal side × 20x (Fig.8a-1). Fig.8a-2- Arranged cellular architecture in the nuclear region × 400x.Fig.8a-3-Fibre arrangement in the nuclear region × 600x.Fig.8a-4- Fibre to fibre arrangement in the cortical region × 1000x view through toheanterio-posteriorly cut surface. Fig.8a-5- Normal subcapsular region view through the whole lens × 2000x.

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