Filaments of the vertebrate lens[1]

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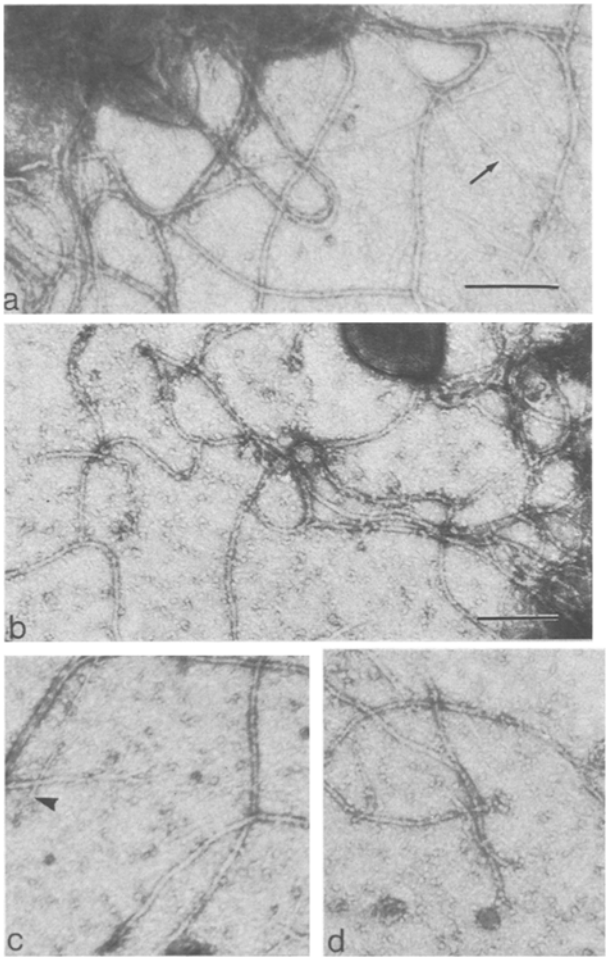
Summary. Filaments of an average diameter of 10–12 nm have been identified in the eye lens fibre cells of representative species of each vertebrate order. These filaments presumably serve a cytoskeletal role in the lens fibre cells.

The cytoplasm of vertebrate smooth muscle contains 3 sets of relatively long filaments[2]. The thin filaments of diameter 5–8 nm represent actin[3] and the thick filaments correspond to myosin[2]. The identity of the intermediate sized 10 nm filaments remains uncertain, although it is postulated that they have a cytoskeletal function[4]. Such intermediate sized filaments have been reported in a variety of cells, including chick lens fibre cells[5], pulmonary lymphatic endothelial cells[4] and human mammary epithelial cells[6]. Thin filaments have been found in injured mouse lens fibre cells[7]. This study reports on the presence of intermediate sized filaments as a constituent of the vertebrate lens cortical fibre cells.



Negative stain analysis of the water-insoluble material from turkey (A), rabbit (B), rat (C), and human (D) lenses, showing filaments of 10 nm diameter. The arrows in figures A and D indicate thin filaments of 5 nm diameter. The bar in each figure indicates 0.2 μm. × 90,000.

Lenses were obtained from the following species of adult animals immediately after death: New Zealand white rabbit, cow, Sprague-Dawley rat, Swiss-Webster mice, White Leghorn chicken, frog (Xenopus laevis), turkey and fish (Carp). Non-cataractous human lenses were obtained with 36 h of death. The lenses were dissected free of capsule and epithelial cells, and the fibre cell mass homogenized at 4 °C with 9 vol. of a 0.05 M-Tris-HCl, 0.005 M-$MgCl_2$, pH 7.4 solution, containing 0.01 M B-mercaptoethanol. Each lens homogenate was centrifuged at 37,000 × g for 20 min. The supernatant was collected and the pellet resuspended in the buffer. Each fraction was examined by negative stain as previously described[5]. In separate experiments superficial cortical and deep nuclear fibre cells were isolated from the lenses and treated as above.

Negative stain analysis of the water insoluble pellet material of each species revealed the presence of filaments with transluscent core and an average diameter of 10–12 nm. These filaments of varying length, some reaching 2 μm are predominant in the cortical fibre cells and scanty or absent from the deeper (and older) nuclear fibre cells of all lenses. Although the filaments were concentrated in the pellet material, they were also observed in the supernatant fraction of each species. On rare occasion a few thin filaments were observed in the chick and rat cortical fibre cells. Whether these represent actin filaments requires further study.

The results obtained in this study indicate that filaments of 10–12 nm diameter are present in a wide variety of vertebrate lenses. They are water-insoluble and can be pelleted with plasma membrane, as the water-insoluble material of the lens. The chemistry of these filaments is still uncertain[4]. These filaments presumably have a cytoskeletal role in the lens fibre cell, a cell lacking a nucleus and consisting essentially of plasma membrane filled with protein. Such a cell must remain stable and transparent for the lifetime of the individual; and it is possible that the filaments play a role in this. Indeed it is of interest that the filaments are scanty or absent in the older deeper fibres of the lens, a common site of cataract formation in man.

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