Phakochronology: using fossilised lenticular scar to calculate rate of lens growth

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DESCRIPTION

A 58-year-old man gave a history of injury with chisel while hammering 16 years ago for which he did not seek any form of treatment and had no vision loss at the time. On examination, he had a self-sealed corneal perforation with a localised iris defect (figure 1A). On pupillary dilatation, a localised anterior fibrotic plaque was seen on the lens capsule and behind it was a lenticular opacity (figure 1B,C); with a clear lenticular area between the two (figure 2A,B). Fundus showed a well-capsulated foreign body inferonasal to the disc with localised pigmentary changes (figure 2C). The corneal perforation, the iris defect and the lenticular opacities all were present in the same straight line and were somewhat collinear with the location of foreign body in the posterior segment. They clearly represent the trajectory of the foreign body. Anterior segment optical coherence tomography was done through the lenticular opacity trajectory and the intralenticular opacity was found to be 480 μ m behind the anterior fibrotic capsule (figure 2A,B).

Crystalline lens is a unique organ in that it grows throughout life. Equatorial cells keep proliferating to produce new lens fibres which keep on accreting behind the anterior lens capsule. The old fibres are not shed but keep on accumulating interiorly causing what we know as nuclear sclerosis.^{1,2} So hypothetically, a mark if left on a lens fibre should embed deeper in the lens with time. In our case, the entry point opacity in the lens substance should have been on the surface. The fact that it is located 480 μ m posterior to anterior capsule suggests that equatorial lens epithelium must have remained active to produce 480 μ m of clear lens fibres over the time thus shifting the opacity posteriorly just like a fossil which got preserved inside the crystalline lens. Injury happened on 8 November 2004 (5854 days ago). So the time taken for these many

Figure 2 Anterior segment optical coherence tomography through section (A) of lenticular opacity showing lenticular substance opacity is 480 μ m posterior to lens capsule (B); (C) showing encapsulated foreign body in the posterior segment (white arrow).

microns of lens fibres to accumulate was 5854 days. Theoretically speaking, we can calculate the rate of production of lens fibres to be around 81.99 nm/day or 0.030 mm/year. In vivo lenticular growth rates in adults have been documented in very few studies and range from 0.013 to 0.025 mm/year.^{3–6} In vitro rate of lens growth has been described to be 1.38 mg/year increase of wet weight; 1.24 mg/year in Indian population.^{2,7} The rate of lens fibre production might depend on the age and local environmental milieu with genetic variation as well. The rate of lens growth that we have calculated is individualised to this currently 58-year-old man who had a history of open globe injury with direct lenticular trauma. The rate of lens fibre production in linear dimension (as calculated by us) may not exactly corroborate with the weight gain because nuclear compaction has not been taken into account and can not be predicted. The method we have used is called phakochronology which describes the technique for determining the time of events affecting the lens from the distance between the capsule and the region of interest.⁸ Hypothetically, one way to do is to inject a marker

Figure 1 Right eye of the patient (A) in retroillumination showing iris defect (white arrow); (B) oblique illumination showing anterior capsular plaque (red arrow), lenticular substance opacity (blue arrow); (C) retroillumination in dilated pupil showing entry (blue arrow), passing track (red arrow) and exit (black arrow) of foreign body trajectory through the lens substance.

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Learning points

- ▶ Lens keeps growing throughout life.
- ▶ Any scar in lens (if preserved—if the lens does not turn completely cataractous) can help determine the rate of lenticular growth provided the exact time of lenticular insult is known.

in vivo inside the crystallin lens and note its displacement over time. But, it will have ethical issues and such a study can never be conducted.

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