Relative lens position: The long and short of it

Axial myopia is generally regarded as protective where primary angle closure disease (PACD) is concerned for it is presumed that a long eye will be associated with a deep and open anterior chamber angle (ACA). Nevertheless, primary angle closure (PAC) and glaucoma (PACG), though rare, have been reported in myopes – 0.1 to 9.3%,[1-3] and is likely to increase further with the increasing incidence of myopia. Yet, on the other hand, a short eye may have an open angle, with or without glaucoma. An infrequently used ratio, derived via biometric measurements as obtained by an A-scan, can be a very useful parameter to understand why an axial myope can develop angle closure and a hyperope may have an open angle, with or without glaucoma. This phenomenon is highlighted here in a few cases with the assistance of the ratio of the lens position (LP) vis-à-vis the axial length (AL), known as the relative lens position (RLP).

A 40-year-old axial myope [Patient 1, Table 1] with a vague brow ache and borderline intraocular pressure (IOP) and known bilateral long-standing partial optic atrophy of indeterminate etiology had recent consultations with four other ophthalmologists. He presented with a best-corrected visual acuity (BCVA) of 20/100 and 20/80, borderline IOP of 22 and 23 mmHg in the right eye (RE) and left eye (LE), respectively, and most notably with bilateral shallow anterior chamber (AC) [Fig. 1a and b]. A standard darkroom four-mirror indentation gonioscopy revealed occludable angles with 2 and 1 quadrant each peripheral anterior synechiae (PAS), in the RE and LE, respectively. Temporal pallor of discs was evident through undilated pupils and correlated with the history and presenting BCVA. An ultrasound biomicroscopy (UBM) confirmed relative pupillary block in this axial myope [Fig. 1c and d, prelaser peripheral iridotomy (LPI)]. Post-LPI, symptoms, and IOP normalized, but the AC was still relatively shallow in each eye. Post-LPI occludability was present on gonioscopy and a repeat UBM confirmed features consistent with plateau iris syndrome and relatively increased lens vault [Fig. 1e and f-Post-LPI]. On the other hand, another axial myope (49-year-old male) with a significant family history of blindness due to glaucoma was being followed up routinely for open-angle glaucoma elsewhere for 3 years. BCVA was 20/20 parts in the RE and count fingers vision in the LE with an IOP of 18 and 31 mmHg on three topical antiglaucoma medications. Angles were not only occludable, but the left one had more than three quadrants PAS; discs (and visual fields) were consistent with a diagnosis of PAC and PACG, respectively.

In contrast, a 65-year-old hyperopic lady (currently index myopia due to nuclear sclerosis) and glaucomatous optic neuropathy with controlled IOP in both eyes on a prostaglandin analogue, and deep AC, had 360° open angles on gonioscopy. Her AL were 22.15 and 22.55 mm in the RE and LE, respectively. Furthermore, a 59-year-old hyperope (spherical equivalent of + 3.75 DS) with an even shorter eye (21.34 and 21.35 mm in the RE and LE, respectively) had normal IOP and discs with open angles on gonioscopy.

Gonioscopy may well detect a closed angle but fails to explain why some high myopes may develop it, while some high hyperopes may evade it. The explanation lies in the biometric measurements and the relative placement of the lens in the anterior segment, as determined by the RLP. Most studies that have reported angle closure in myopia have sketchy biometric details, until Yong and colleagues[3] not only found a higher incidence of angle closure in moderate-to-severe myopes (9.3%) but also reported on the RLP. It ranged from 0.20 to 0.21 not only across all grades of myopia but also the entire spectrum of PACD. Notably, an RLP upwards of 0.23[4] is seen in normal and/or open-angle eyes. A lens placed further forward is not only a known risk factor for angle closure[4,5] but has also been implicated in complications postintervention in angle closure disease.[6] Biometry of the patients mentioned here [Table 1] unraveled a RLP of 0.214 and 0.212 in the first myopic gentleman (patient 1) and lesser still (0.198 and 0.196) in the second myopic patient. It was 0.234 and 0.249 in the hyperopic lady with the open-angle glaucoma and 0.27 and 0.26 in the hyperopic lady with no evidence of glaucoma. Therefore, the RLP suggests that the lenses of both the myopes were further forward in the eye as compared to the hyperopic counterparts (with and without open-angle glaucoma) and that the eyes were relatively longer only due to the increased

Table 1: Ocular biometry of the myopic patients with primary angle closure (PAC) and hyperopic patients with and without open-angle glaucoma (OAG)

	Myopic Patient 1 with PAC Right eye	Myopic Patient 1 with PAC Left eye	Myopic Patient 2 with PAC Right eye	Myopic Patient 2 with PAC Left eye	Hyperopic Patient with OAG Right eye	Hyperopic Patient with OAG Left eye	Hyperopic Normal Patient Right eye	Hyperopic Normal Patient Left eye
Spherical equivalent in dioptre sphere	-6.50	-6.0	-7.50	-6.75	plano (index myopia)	plano (index myopia)	+3.75	+3.75
Anterior chamber depth (ACD) in mm	3.01	2.92	2.93	2.49	3.24	3.24	3.12	3.13
Lens thickness (LT) in mm	4.63	4.71	3.63	4.05	3.89	4.84	5.38	5.10
Lens position (LP) ½ LT + ACD	5.325	5.275	4.745	4.515	5.18	5.66	5.81	5.61
Axial length (AL) in mm	24.86	24.84	23.99	23.02	22.19	22.69	21.34	21.35
Relative lens position (LP/AL)	0.214	0.212	0.198	0.196	0.234	0.249	0.27	0.26
Vitreous length in mm	17.24	17.28	17.43	16.45	15.06	14.54	12.91	13.21

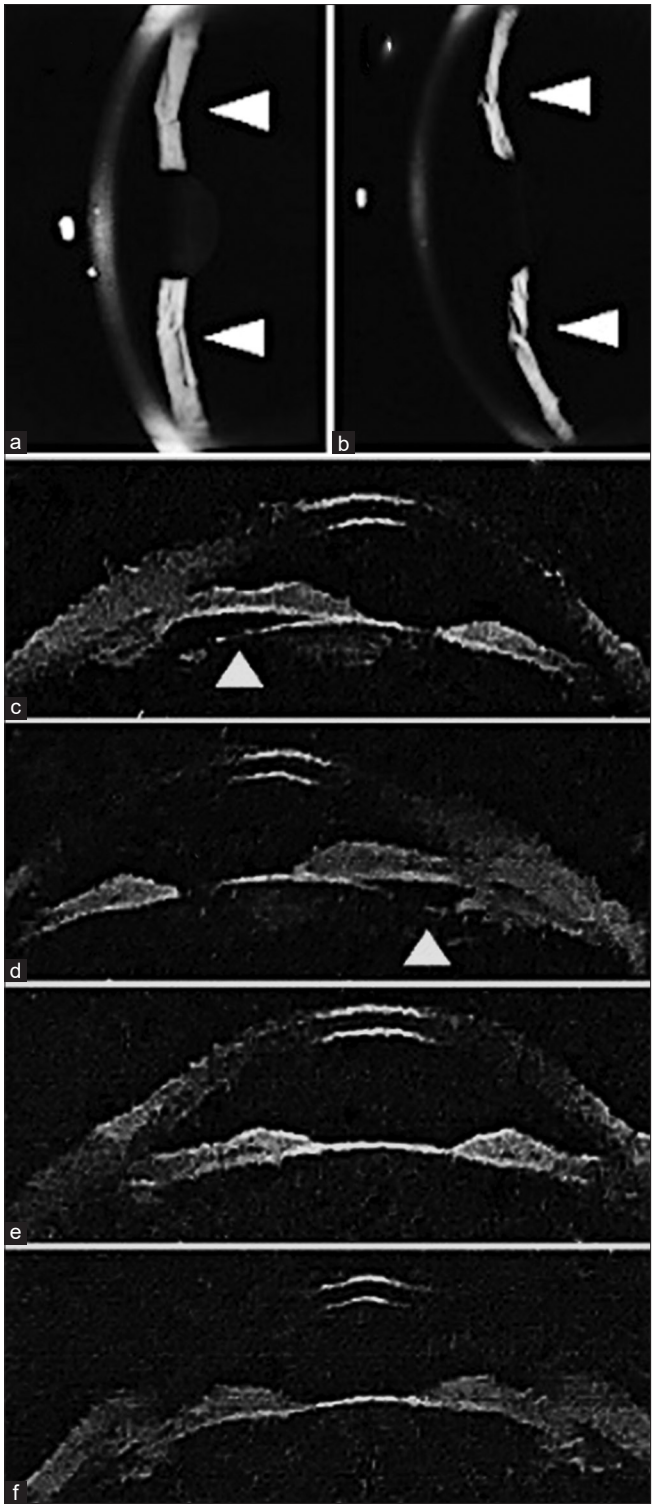

Figure 1: Slit-lamp photographs showing relatively shallow anterior chamber in a high myope along with convex bowing of the iris (long arrowheads) suggestive of relative pupillary block in the right (a) and left eye (b), respectively. Ultrasound biomicroscopy confirming shallow anterior chamber, convex irides with expanded posterior chamber (short arrowhead/s) in the right eye (c) and left eye (d), respectively, prelaser peripheral iridotomy (LPI). Anteriorly positioned ciliary processes, absent irido-ciliary sulcus, and relatively increased lens vault in the right eye (e) and left eye (f) post-LPI

vitreous length. The hyperopic normal eyes were the shortest, yet the RLP demonstrates that the lens was placed farthest in the anterior segment of these eyes and therefore the angles were open, despite lens thickness being the greatest compared to the others.

A well-performed standard four-mirror darkroom gonioscopy in all cases of glaucoma or glaucoma-suspect, be it a myope, emmetrope, or a hyperope, cannot be overemphasized. Failing this, detection of the angle closure may be "missed," or when not performed well, it may be "mis"-interpreted with potentially disastrous visual consequences, both illustrated here. Despite the limitations of low reproducibility and technique induced errors, gonioscopy continues to be the gold-standard subjective evaluation of the ACA. However, of late Anterior Segment Optical Coherence Tomography (ASOCT) is making inroads as an objective measurement,[7] but also has drawbacks – in terms of portability, cost, acquisition of nongradable images, and over diagnosis of angle closure. All these issues need to be addressed and resolved before its widespread acceptance.

In summary, angle closure usually occurs in short eyes, and it remains a rare entity in myopes, but presumptions aside, only a clinical suspicion will prompt either gonioscopy or ASOCT (or both) of these two methodologies to be employed for it to be detected. However, neither can explain the phenomenon of why angle closure can occur in high myopes nor the existence of open angle in high hyperopes. It is the ubiquitous A-scan biometer and the estimation of the RLP that elucidates this paradox, by demonstrating anteriorly positioned lens in axial myopes, or the lack of it in high hyperopes. It also demonstrates that these axial myopes have long eyes only due to increased vitreous length.

Vanita Pathak-Ray

Department of Glaucoma, Centre for Sight, Banjara Hills, Hyderabad, Telangana, India.
E-mail: vpathakray@gmail.com

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About the author

Dr. Vanita Pathak-Ray

Vanita Pathak-Ray FRCS (Ed), FRCOphth (Lon), graduated in medicine from the University of Calcutta and completed her basic ophthalmology training in London and higher training in Cardiff, UK. She completed a clinical fellowship in glaucoma at the University of Toronto, Canada, under Dr. Ike Ahmed, where she gained experience in advanced glaucoma surgery. In 2005, she obtained her Certificate of Completion of Specialist Training (CCST) from UK and was appointed consultant at The Royal Glamorgan Hospital, UK. She is currently Senior Consultant, Glaucoma and Cataract, at Centre for Sight and at Neoretina Eyecare Institute, Hyderabad, India. She is the first Indian Glaucoma specialist to perform minimally invasive glaucoma surgery (MIGS) in angle closure glaucoma (phaco-endocycloplasty) and first to use Kahook Dual Blade to perform trabeculotomy in adults. She is one of a handful of Glaucoma specialists in the country performing Aurolab Aqueous Drainage Implant (AADI). She has several prize-winning presentations, most notably in innovative glaucoma procedures - at the International Congress on Glaucoma Surgery Montreal Canada Sept 2018 and Muscat Oman Feb 2016, at the 7th World Glaucoma Congress, Helsinki Finland July 2017, at the All India Ophthalmology Conference Jaipur, India Feb 2017, at the Glaucoma Society of India annual conference, Mumbai 2015 - amongst others. She has been felicitated as 'International Hero' by the All India Ophthalmological Society three times in a row – 2017, 2018 and 2019. She has a keen interest in teaching and research, has published widely in peer-reviewed journals, presented as invited faculty at numerous national and international meetings and is a reviewer for several prestigious national and international journals. She is passionate about spreading awareness in Glaucoma and hosts an annual CME event on World Glaucoma Day.