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Surgical considerations for myopic eyes: A snapshot of recent literature

Evidence-based medicine combines current data and practical experience to guide and improve healthcare decisions. At the same time, the exponential increase in professional journals represents both a blessing and a curse – with a seemingly endless supply of evidence ranging from expert opinions to well-designed meta-analyses.

What does this mean on a practical level for patients with myopia who require surgery?

There are multiple preoperative, intraoperative and postoperative considerations when performing surgery in myopic eyes.[1] In this paper, I provide a snapshot of recent research articles that could affect these surgical considerations and, therefore, optimal management of patients.

Specifically, I have focused on research that could enhance patient counselling by the optometrist or ophthalmic surgeon, or contribute to my decision to offer a specific technology. These articles only represent a small subsection of the ongoing literature in this fast-growing cohort of patients.

Epidemiology of rhegmatogenous retinal detachment in commercially insured myopes in the United States

Ludwig CA et al. Sci Rep. Jun 2023[2]

This was a retrospective cohort study of more than 85 million commercially insured, phakic patients enrolled in the Merative™ Marketscan® Research Database in the United States. High myopes had a 39-fold higher incidence rate of rhegmatogenous retinal detachment (RRD) than non-myopes, while myopes had a 3-fold higher rate than non-myopes. In each category, the incidence rate was significantly higher in males.

From 2007 to 2016, the combined incidence rate in phakic patients in the United States was 25.27 RRDs per 100,000 person-years. This rate is higher than those reported in prior studies in North America, South America, Europe, Asia and Australia. During this period, the absolute risk of myopia and high myopia for the US cohort increased, while the RRD risk in phakic high myopes rose with age.

In recent years, access to Medicare, insurance and research registries has helped increase our understanding of shifting patient parameters – often reflecting what one may anecdotally report from clinical experience. Much has been made of greater myopia incidence due to an increase in near-focus activities, and this large-scale, retrospective cohort review suggests that both the levels and risk of myopia are indeed developing. Curiously, the risk of RRD in this US cohort is higher than in other published studies. Assuming no significant racial differences (not included in the database), this may reflect statistical bias.

The key message is prudent for all within optometry and ophthalmology – continue monitoring our myopes.

Visual and patient-reported outcomes of a diffractive trifocal intraocular lens in highly myopic eyes: a prospective multicenter study

Meng J et al. Eye Vis (Lond). April 2023[3]

Meng and colleagues investigated the visual and patient-reported outcomes of a diffractive trifocal intraocular lens (IOL) (Zeiss AT LISA) in 456 highly myopic eyes and reported according to baseline axial length (AL; control group, AL < 26 mm; high myopia group, AL 26 to 28 mm; extreme myopia group, AL ≥ 28 mm). Uncorrected distance visual acuity (VA) improved in all groups, with about 60% of eyes achieving uncorrected near and intermediate visual acuity of 0.10 logMAR or better (albeit this was significantly fewer eyes in the extreme myopia group). By comparison, defocus curves and contrast sensitivity were significantly lower in the extreme myopia group. Further, these patients exhibited lower Visual Function Index (VF-14) scores, more glare and halos (see **Figures 1a** and **1b**) and, consequently, lower patient satisfaction than others.

Unsurprisingly, the extreme myopia group did not appear to achieve quite as good overall quality due to higher prediction errors in IOL power calculations. Yet, this paper also highlights the potential benefits of a trifocal IOL for some patients.

Choosing the right IOL for a patient is a nuanced discussion incorporating clinical parameters and patient preference. In addition to the potential surgery risk factors, high myopes may not represent the ideal trifocal IOL candidate because of the level of near vision clarity expected by the patient. However, if a high myope is highly motivated for spectacle independence and understanding of the potential risks and outcomes, then a trifocal IOL may still be a reasonable option. →

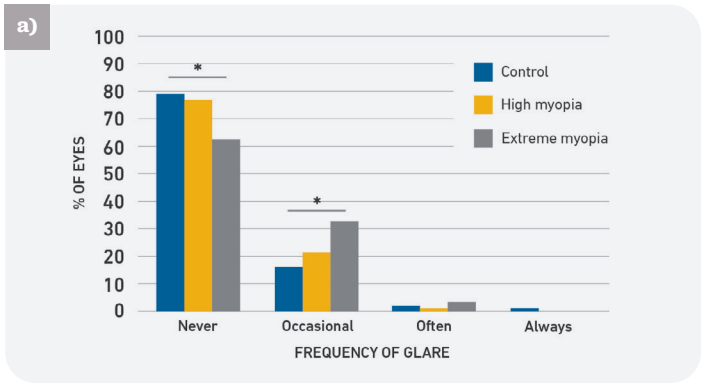

Figure 1a. Frequency of glare following implantation of the Zeiss AT LISA diffractive trifocal intraocular lens (adapted from Meng et al., 2023[3])
*Statistically significant difference ($p < 0.05$)

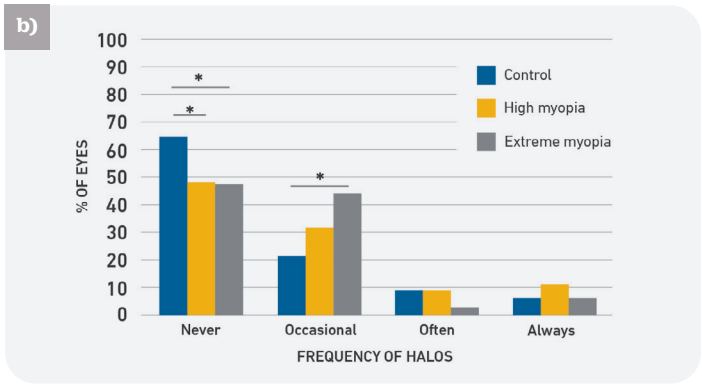

Figure 1b. Frequency of halos following implantation of the Zeiss AT LISA diffractive trifocal intraocular lens (adapted from Meng et al., 2023[3])
*Statistically significant difference ($p < 0.05$)

Long-term outcomes of posterior capsular opacification in highly myopic eyes and its influencing factors

He W et al. Ophthalmol Ther. August 2023[4]

The authors looked at long-term (1 to 5 years) outcomes of posterior capsular opacification (PCO) in 673 highly myopic eyes, as well as influencing factors. The mean follow-up time was 34.0 ± 9.0 months. PCO was more severe in highly myopic eyes (axial length [AL] ≥ 26 mm) compared with controls (AL < 26 mm). These patients also had a higher capsulotomy rate (see **Figure 2a**) and shorter PCO-free survival time.

Patients with extreme myopia (AL ≥ 28 mm) would further experience higher clinically significant PCO rates compared with other myopic eyes (see **Figure 2b**). AL and follow-up duration were independent risk factors for clinically significant PCO after cataract surgery.

Following cataract surgery, high myopes are at greater risk of retinal detachment and tear. This paper further suggests that they remain at greater risk of PCO and at an earlier stage. This matches my experience and is worth considering during the preoperative patient discussion and by optometrists at regular, post-discharge check-ups.

The Zhu-Lu formula: a machine learning-based intraocular lens power calculation formula for highly myopic eyes

Guo D et al. Eye Vis (Lond). June 2023[5]

The authors aimed to develop a novel machine learning-based IOL power calculation formula for highly myopic eyes using a subset of 1828 highly myopic eyes undergoing cataract surgery. The Zhu-Lu formula was based on the eXtreme Gradient Boosting machine learning library and the support vector regression algorithms. Its accuracy was compared in the internal and external test datasets with current best-practice formulae. The novel Zhu-Lu formula for highly myopic eyes appeared to perform favourably compared with other artificial intelligence-based formulas, presenting a further option for surgeons.

Patients with unusual refractive or anatomical parameters are at greater risk of postoperative refractive surprise. Newer IOL power formulae have continued to evolve –attributed to a combination of experience and big data, incorporated in most fourth-generation formulae. The Zhu-Lu formula takes this to another level, highlighting the potential benefits of artificial intelligence in healthcare, including ophthalmology. Early outcomes appear to match existing best practice and increase potential accuracy in these problematic calculations. However, clinical validation is required before it becomes a mainstay.

Incidence and risk factors for retinal detachment and retinal tear after cataract surgery: IRIS® Registry (Intelligent Research in Sight) Analysis

Morano MJ et al. Ophthalmol Sci. Apr 2023[6]

This retrospective audit of the American Academy of Ophthalmology IRIS® Registry (Intelligent Research in Sight) investigated the incidence, demographics, ocular comorbidities and intraoperative factors for RRD and retinal tear following cataract surgery. Analysis of 177,195 eyes found a low incidence of RRD (0.21%) and RT without RRD (0.17%) within 1 year after cataract surgery. This equates to approximately 1 in 500 cataract surgeries in patients > 40 years old.

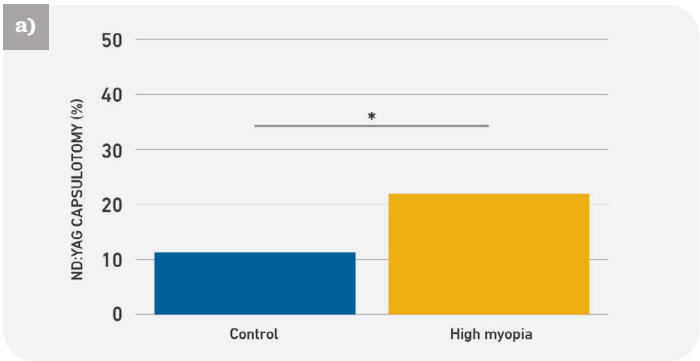

Figure 2a. Comparison of Nd:YAG capsulotomy according to axial length (adapted from He et al., 2023[4])

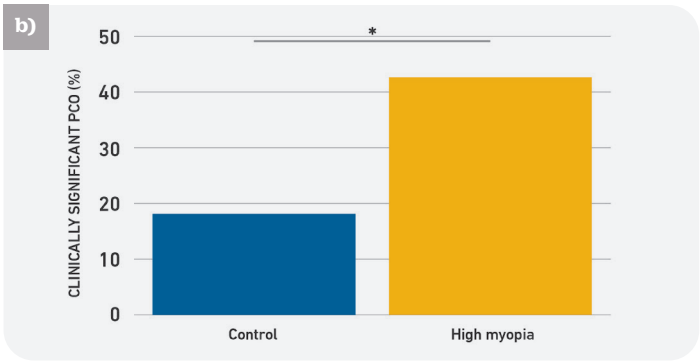

Figure 2b. Comparison of clinically significant PCO rate according to axial length (adapted from He et al., 2023[4])

Significant risk factors for RRD and RT were co-existing lattice degeneration, male gender and younger age compared with patients aged > 70 (peaking at age 40–50 for RRD and age 51–60 for RT). Other risk factors for RRD included hypermature cataract, complex cataract surgery, posterior vitreous detachment and high myopia.

The potential benefits of big data are highlighted again here – this time in terms of developing better evidence-based discussion. The IRIS registry has enabled significant data collection, confirming the known risk factors for RRD in myopic patients after cataract surgery. This information is useful for clinicians during the consent discussion and surgery and could help identify the patients at greatest risk of postoperative retinal complications.

Visual acuity improvement in low, moderate and high myopia after posterior-chamber phakic implantable collamer lens surgery in a large patient cohort

Zaldivar R et al. Clin Ophthalmol. April 2023[7]

This was a prospective, registry-based study of 770 patients with myopia who received implantable contact lenses (ICLs). At one-month follow-up, 69% of eyes achieved a best corrected visual acuity (BCVA) of 20/20, 87% obtained 20/25 or better and 96% had a BCVA of 20/40 or better.

When grouped by the baseline level of myopia, there was a significantly higher line gain among eyes with higher degrees of myopia (see **Figure 3**; $p < 0.0001$). The low myopia group (0 to -6 D) gained 0.22 ± 0.69 lines compared to patients with moderate myopia (-6 to -10 D; gained 0.56 ± 1.1 lines) and high myopia (> -10 D; gained 1.51 ± 1.9 lines). The safety and efficacy indexes were 0.083 ± 0.1 and -0.001 ± 0.1, respectively.

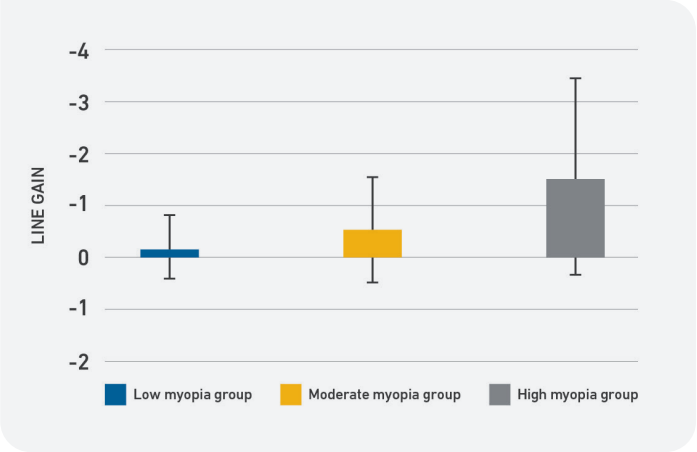

Figure 3. Line gain following ICL surgery according to baseline degree of myopia (adapted from Zaldivar et al., 2023[7])

Although laser refractive surgery remains an excellent option for most motivated myopic patients seeking optical independence, a portion will be considered unsuitable for standard corneal refractive procedures. The phakic IOL can represent an excellent alternative, and this paper highlights the potential results in such patients.

Notably, the high myopes did appear to gain approximately 1.5 lines of distance VA, reflecting the relative magnification of image postoperatively after ICL procedure compared to glasses. It is not something a surgeon would promise as a benefit, but it is worth considering.

KEY LEARNINGS

- **A large-scale, retrospective cohort review suggests that myopia levels and risk are increasing.**
- **A trifocal IOL can still be a reasonable option in high myopes if the patient is highly motivated for spectacle independence and understands the potential risks and outcomes well.**
- **Following cataract surgery, high myopes have an increased risk of retinal tear and detachment and a higher risk of PCO (and at an earlier stage).**
- **In recent years, newer IOL power formulae have applied artificial intelligence to improve accuracy in difficult IOL calculation situations.**
- **Big data can help clinicians choose the most relevant topics to discuss with patients during the consent process.**
- **The phakic IOL can be an excellent alternative for high myopia patients seeking optical independence when refractive laser is not an option.**

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About the author

Dr Uday Bhatt is a highly experienced cataract and corneal ophthalmologist. He is actively involved in IOL research and can offer his patients the latest technological advances. Dr Bhatt is also an experienced refractive surgeon with expertise in laser corneal procedures, refractive lens exchange and lens implants. Dr Bhatt treats the full range of corneal conditions, including keratoconus, pterygium and recurrent corneal erosion. He consults at Vision Eye Institute Camberwell, Coburg and Footscray.

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