# PLiS Fix – Personalised Liverpool Scleral-Fixated IOL Calculator

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## Purpose

To develop and validate a calculator aimed at recommending the optimal scleral anchoring point and biometric target to improve outcomes in scleral-fixated intraocular lens (Figure 1).

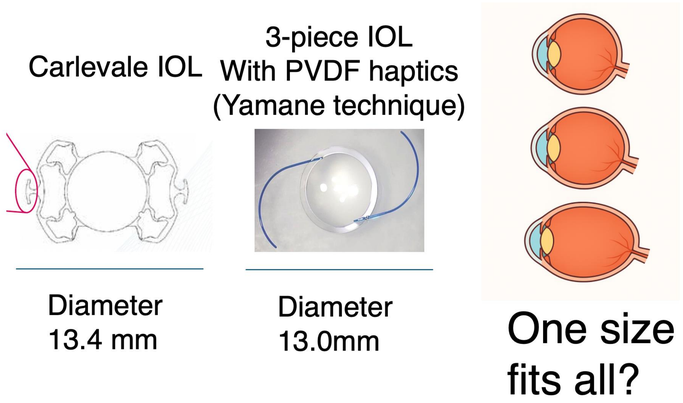


Figure 1. *Left:* Intraocular lenses (IOL) considered in this study. *Right:* Schematic representations of short, normal, and long eyes (from top to bottom).

## Methods

A MATLAB-based algorithm was developed using finite element method eye model incorporating localised, element-specific material properties derived from Zernike-parametrised geometry and regional collagen-microstructure data. (Figure 2) The model combines population corneo-scleral profiles from 118 eyes with high-resolution x-ray fibril-density mapping from six human donor eyes, providing a physiologically realistic basis for predicting effective lens position (ELP).
Because Carlevale/Yamane IOLs have an overall length of 13.4/13 mm, the algorithm identifies the scleral fixation point where the horizontal scleral diameter (HSD) best matches this length by adjusting the distance from the limbus. A personalised model can be generated for each eye using its biometric parameters.
In vivo manual measurements of the HSD were performed in eyes with an AL of 24.0 mm ± 0.5 mm undergoing pars plana vitrectomy. Wilcoxon signed-rank test was performed using Stata (16.1, StataCorp LLC, College Station, TX).

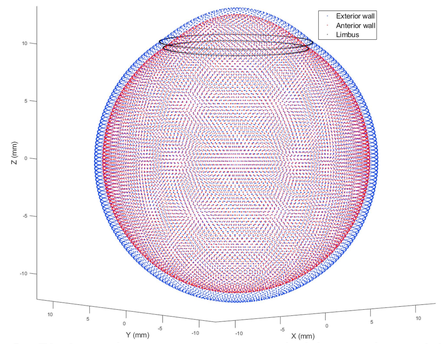


Figure 2. Finite element eye model based on 118 eyes.

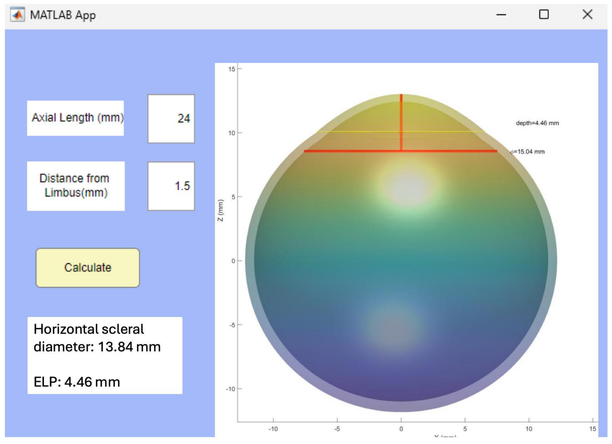


Figure 3. Screenshot of the current version of the Matlab calculator. HSD is considered subtracting scleral thickness.

| Position (mm from limbus) | HSD (mm) | ELP (mm) |
|---|---|---|
| **AL- 20 mm** | | |
| 1.5 | 12.74 | 4.18 |
| 2.0 | 13.56 | 4.58 |
| 3.0 | 15.33 | 5.59 |
| **AL- 24 mm** | | |
| 1.5 | 13.84 | 4.46 |
| 2.0 | 14.73 | 4.86 |
| 3.0 | 16.64 | 5.87 |
| **AL- 28 mm** | | |
| 1.5 | 14.32 | 4.74 |
| 2.0 | 15.23 | 5.14 |
| 3.0 | 17.20 | 6.15 |

Table 1. Estimated horizontal scleral diameter (HSD) and effective lens position (ELP) in a short eye (AL=20mm), in a normal eye (AL= 24 mm) and in a long eye (28 mm). Recommended fixation distance is showed in red.

## Results

The calculator determines the optimal scleral fixation distance from the limbus between 1.5 and 3 mm required to approximate a 13 mm horizontal path and predicts the resulting ELP.
Three representative eye models were created—short (AL =20 mm), normal (AL=24 mm), and long (AL=28 mm)—to facilitate interpretation and highlight the variability in ELP behaviour across different eye types. In a validation cohort of 10 eyes AL of 24.0 mm ± 0.5 mm , the predicted HSD closely matched intraoperative measurements, with a mean difference of 0.27 mm ($p>0.05$).
In our model, for eyes with ALs of 20, 24, and 28 mm, the HSD and predicted ELP increase progressively as the fixation point moves farther from the limbus. At 1.5 mm, the HSD/ELP values are 12.74 mm/4.18 mm (AL 20 mm), 13.84 mm/4.46 mm (AL 24 mm), and 14.32 mm/4.74 mm (AL 28 mm). At 2.0 mm, they rise to 13.56 mm/4.58 mm, 14.73 mm/4.86 mm, and 15.23 mm/5.14 mm, respectively. At 3.0 mm, the values further increase to 15.33 mm/5.59 mm, 16.64 mm/5.87 mm, and 17.20 mm/6.15 mm, reflecting the combined effect of larger AL and more posterior fixation position on both HSD and ELP (Table 1).

## Conclusion

In normal eyes, fixation at 1.5 mm predicts an implant position similar to the in-the-bag plane; if a 2 mm implant is preferred, the HSD will still accommodate it, but a hyperopic shift should be expected and compensated with a slightly myopic target.
In small eyes, the main issue is the biometric target—small ELP errors can cause significant refractive surprises. However, the HSD is usually sufficient for a 13-mm IOL and the IOL should be implanted at least at 2 mm.
In long eyes, the AL and HSD are increased, so if the IOL is placed too posteriorly it may become stretched or tilted. However, an ELP error is generally less impactful.
Further clinical validation is needed to confirm the applicability of this results in surgical practice. The next version of the calculator will also include keratometry and IOL power recommendation.

**Disclosures:** The authors have no relevant financial or non-financial interests to disclose.
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If you are interested in joining the project and sharing your data, please scan the QR code →

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