

# Predicting Dual-Elevation Scleral Lens Rotation Based on Front Corneal Elevation Map

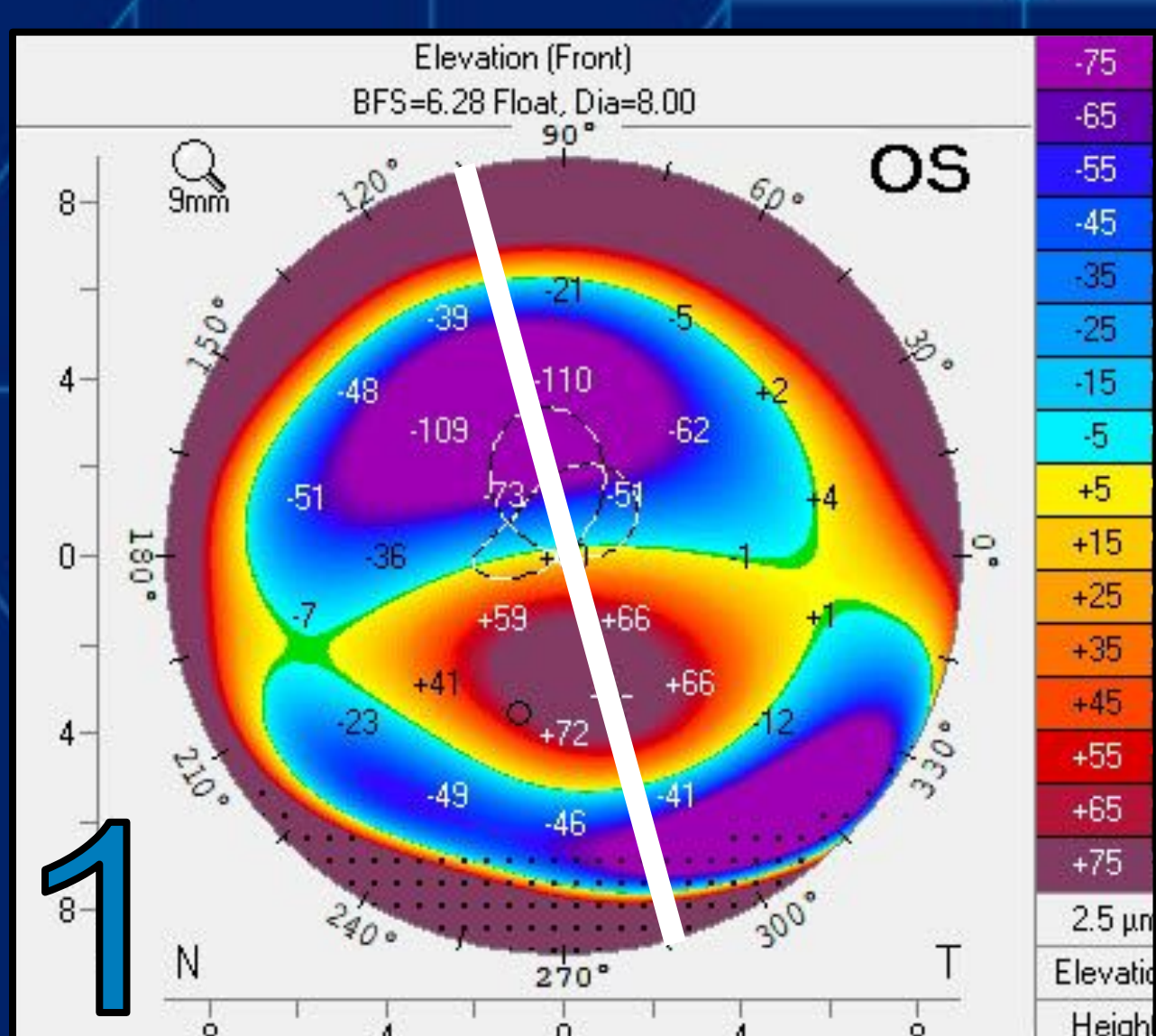
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## Background:

Scleral lenses (SL) with dual sagittal depth (DSD) allow advanced fitting on eyes with front corneal elevation differences, specifically those with keratoconus. Many SL patients may need front toric or multifocal optics to achieve best vision. Predicting on-eye rotation can maximize fit success and shorten chair time in absence of DSD trial lenses. The study aims to predict the expected amount of SL rotation based on front surface corneal elevation maps.

## Methods:

- Retrospective analysis of 32 patients (40 eyes) fitted with DSD lenses at the Department of Ophthalmology, Emory University from June to September of 2023
- All fitted lens had shallow elevation along the horizontal meridian and higher elevation along the vertical
- We evaluated:
  - Fitting indications
  - Scleral lens sagittal depth difference
  - Presence of toric peripheral curves
  - Amount of post-settling rotation
- Pentacam meridional analysis was performed to determine shallow versus tall meridian axes of the front corneal surface. Meridian axis approximation was obtained by utilizing the front elevation display from four refractive map analysis (**Figure 1**).

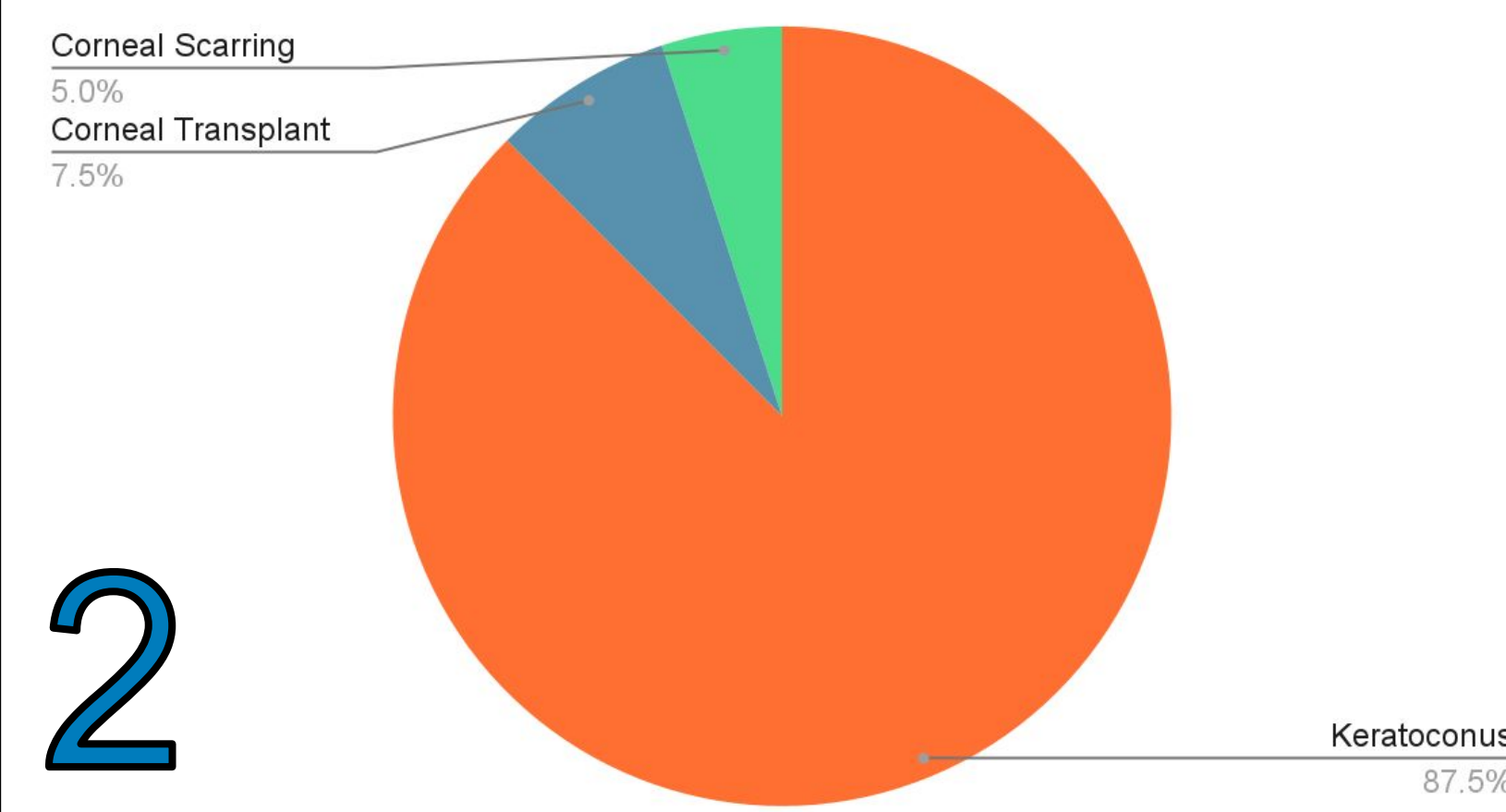


**Figure 1 (left):** Pentacam front elevation corneal map showing significant elevation differences. White line shows estimated axis of shallow meridian.

**Figure 4 (up right):** The average DSD difference was 263±56 um. A difference of 200-300 um was the most frequently utilized (87.5 % of fitted eyes). In general, the DSD lens meridian with higher elevation rotated toward the shallow front corneal meridian.

**Figure 5 (right):** 17 out of 40 lenses fitted had spherical peripheral curves while 17 lenses utilized minimal peripheral toricity differences of ≤90 um. The remaining 6 lenses had peripheral toricity differences >90um.

## Ocular Disease Breakdown



**Figure 2 (left):**

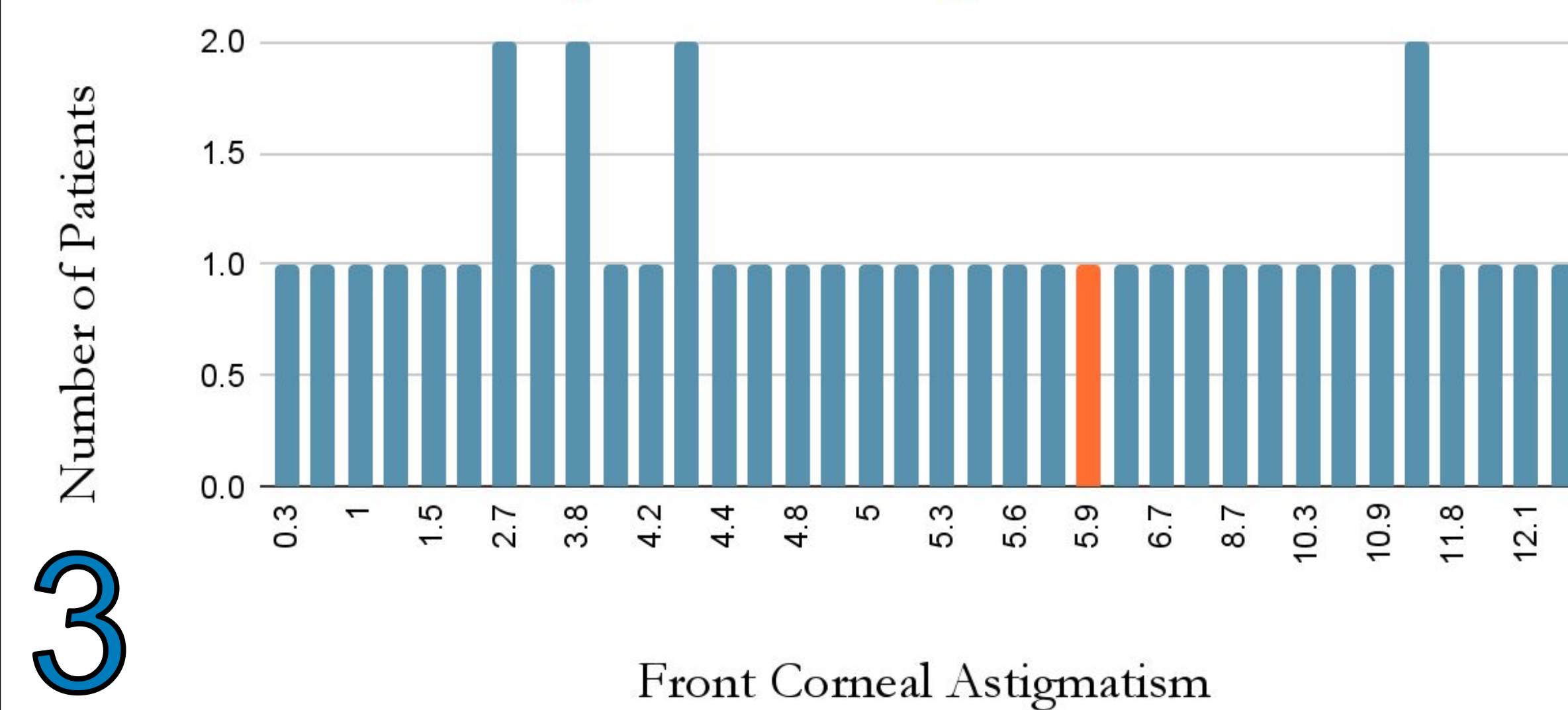
- Out of the eyes fitted:
  - 35 eyes were keratoconic
  - 3 were after corneal transplant
  - 2 had corneal scarring

**Figure 3 (below):**

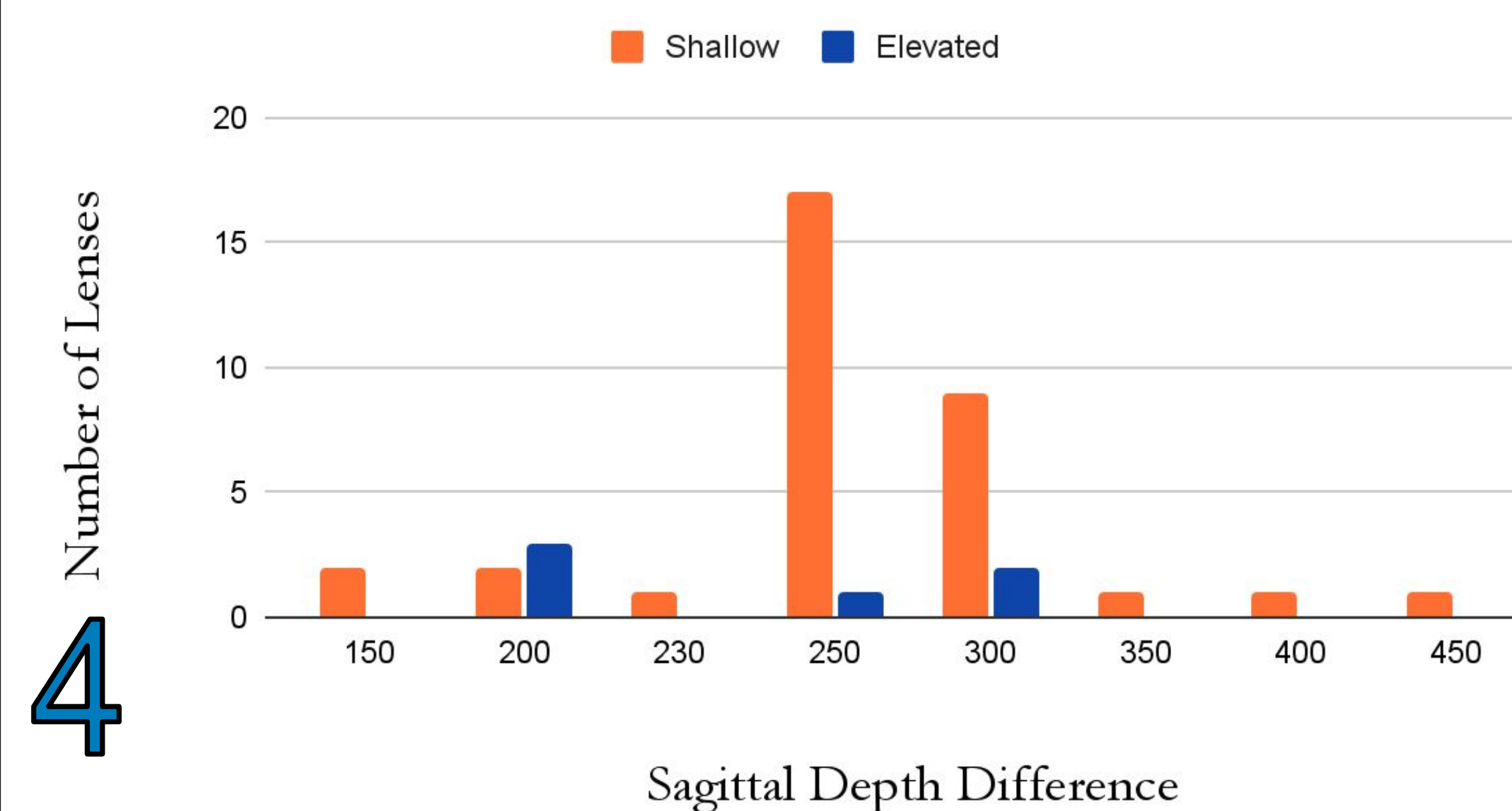
Mean front corneal toricity was 5.9 (range 0.5 to 13.4) diopters, with SD 3.59.

## Front Corneal Astigmatism Range

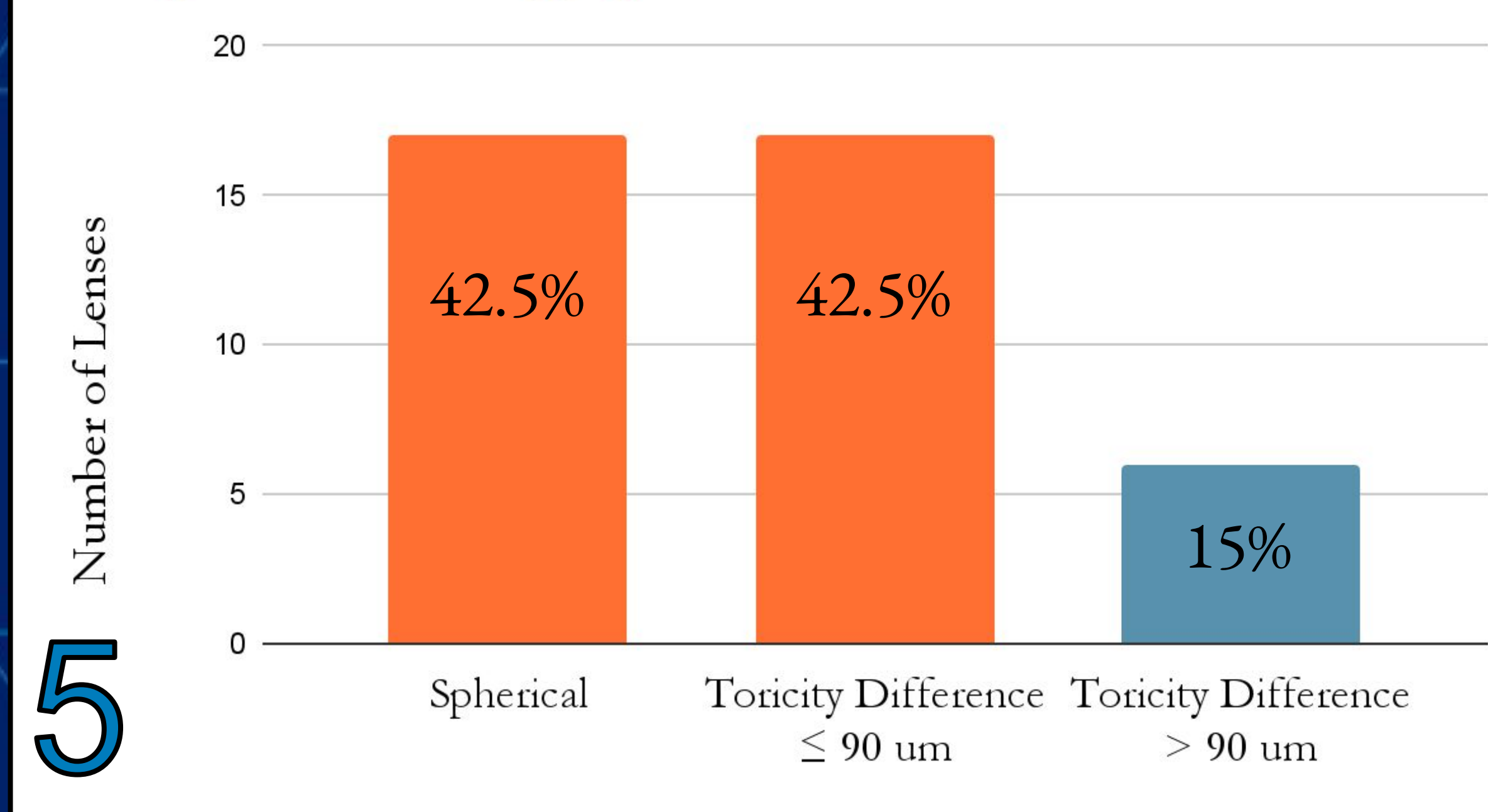
SD = 3.59



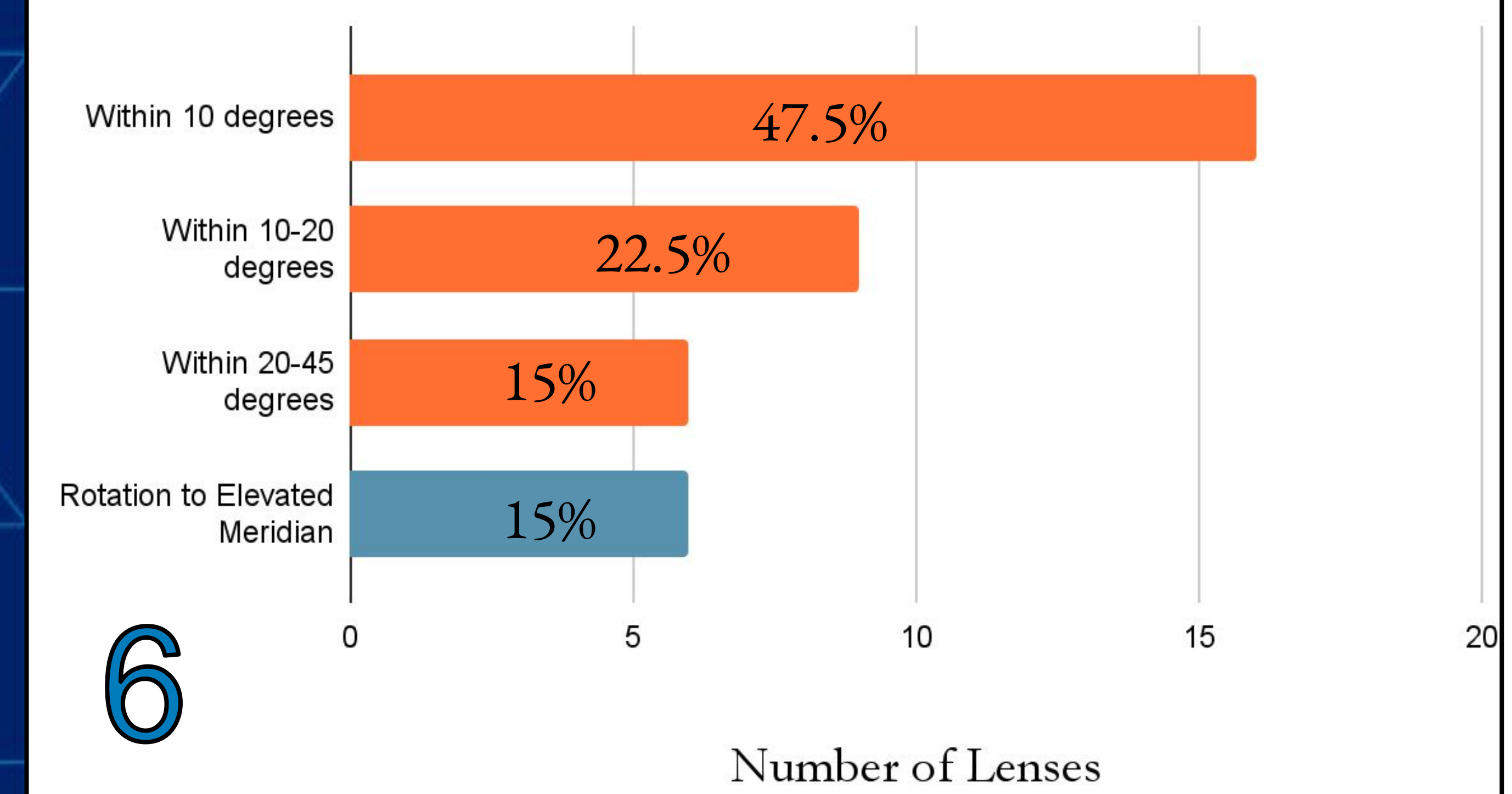
## Lens Rotation Meridian



## Peripheral Landing System



## Amount of Rotation from Predicted Shallow Meridian



**Figure 6:**

Average rotation was 19.7±20.5 degrees. In 19 eyes (47.5%) the amount of rotation was within 10 degrees, in 9 (22.5%) eyes 10 to 20 degrees and 6 (15%) eyes 20 to 45. The other six eyes had rotation toward the elevated meridian.

## Results:

- 35 eyes were keratoconic, 3 after corneal transplant, and 2 with corneal scarring (**Figure 2**)
- Mean front corneal astigmatism was 5.9 (range 0.5 to 13.4) diopters, with SD of 3.59 (**Figure 3**)
- Average DSD difference was 263±56 um, & difference of 200-300 um was most utilized (87.5% of eyes) (**Figure 4**)
- In most instances (85%), DSD lens meridian with higher elevation rotated toward the shallow front corneal meridian. Average rotation was 19.7±20.5 degrees (**Figure 6**)
- Most lenses had spherical/minimally toroidal landings (**Figure 5**), but all fitted lenses exhibited on-eye stability in follow up

## Conclusions:

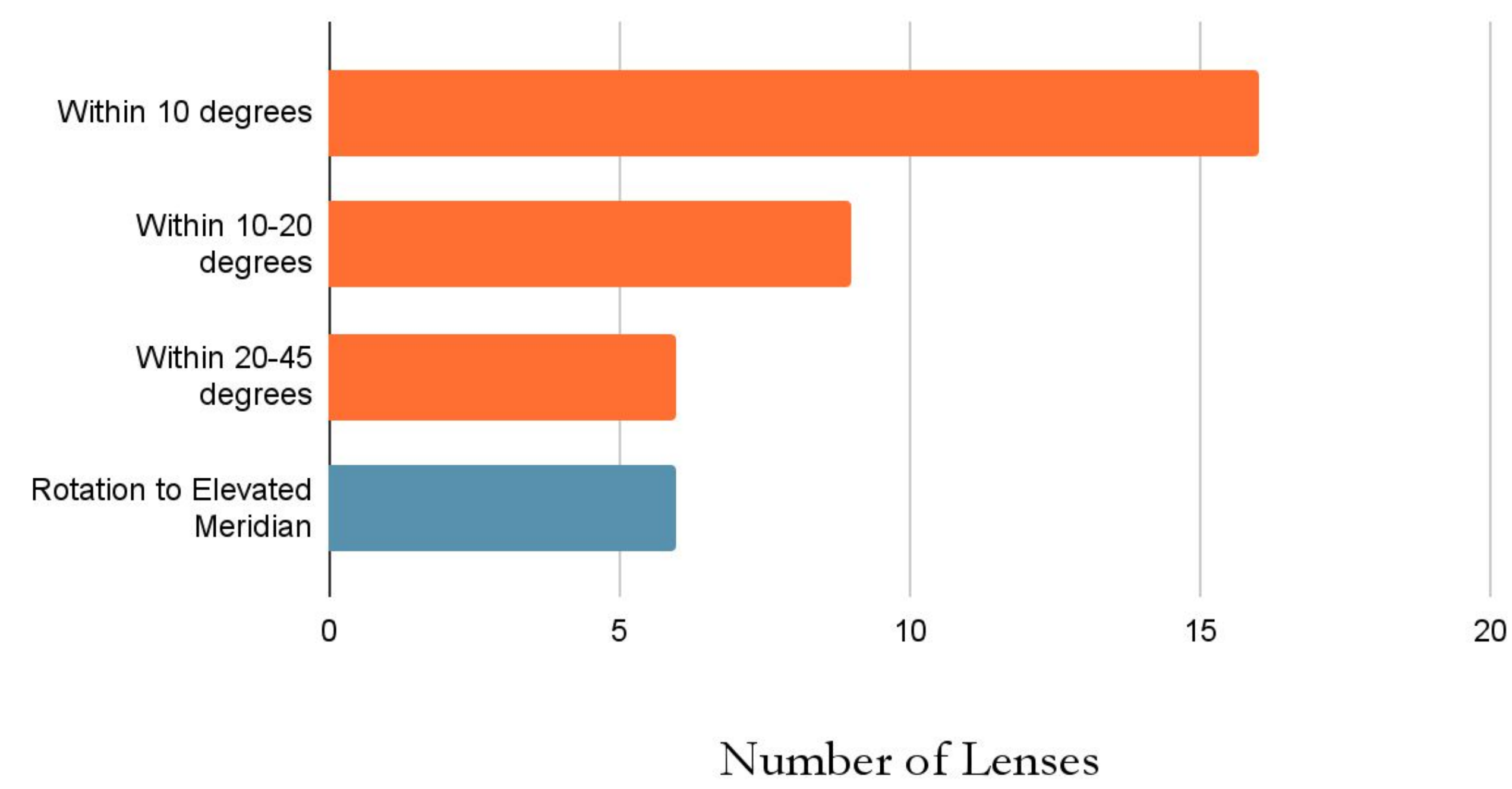
Higher sagittal depth meridian of DSD scleral lens tends to rotate toward the shallow front corneal meridian, with misalignment of up to 20 degrees in vast majority of cases. Utilizing this technology may provide on-eye stability achieved by the elevation differences of cornea and contact lens meridians. 85% of eyes required minimal or non-toric peripheral curves. Accurate prediction of SL rotation allows for efficient factoring in of toric or multifocal front optics due to predictable stability of DSD lens.

## References:

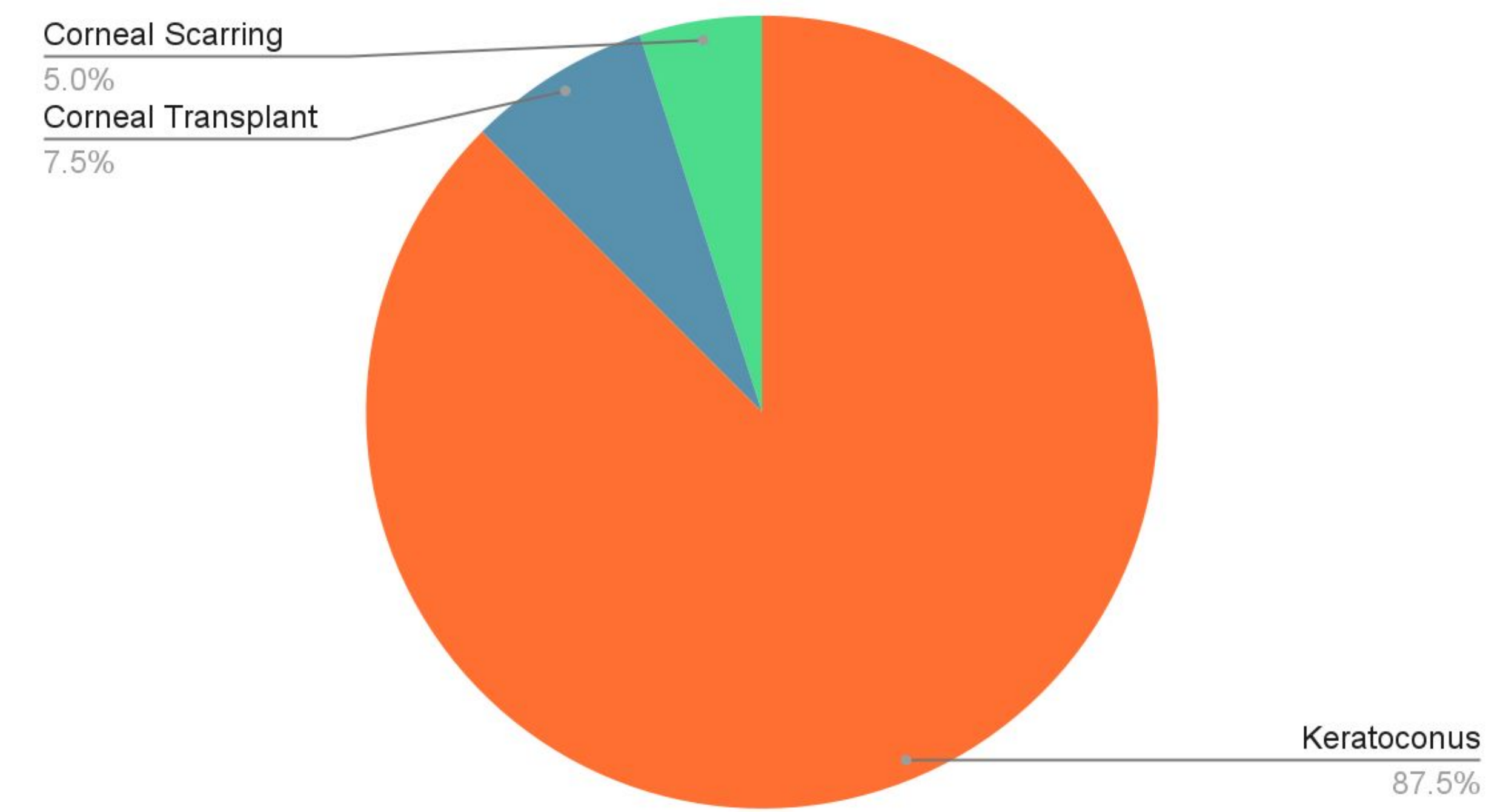
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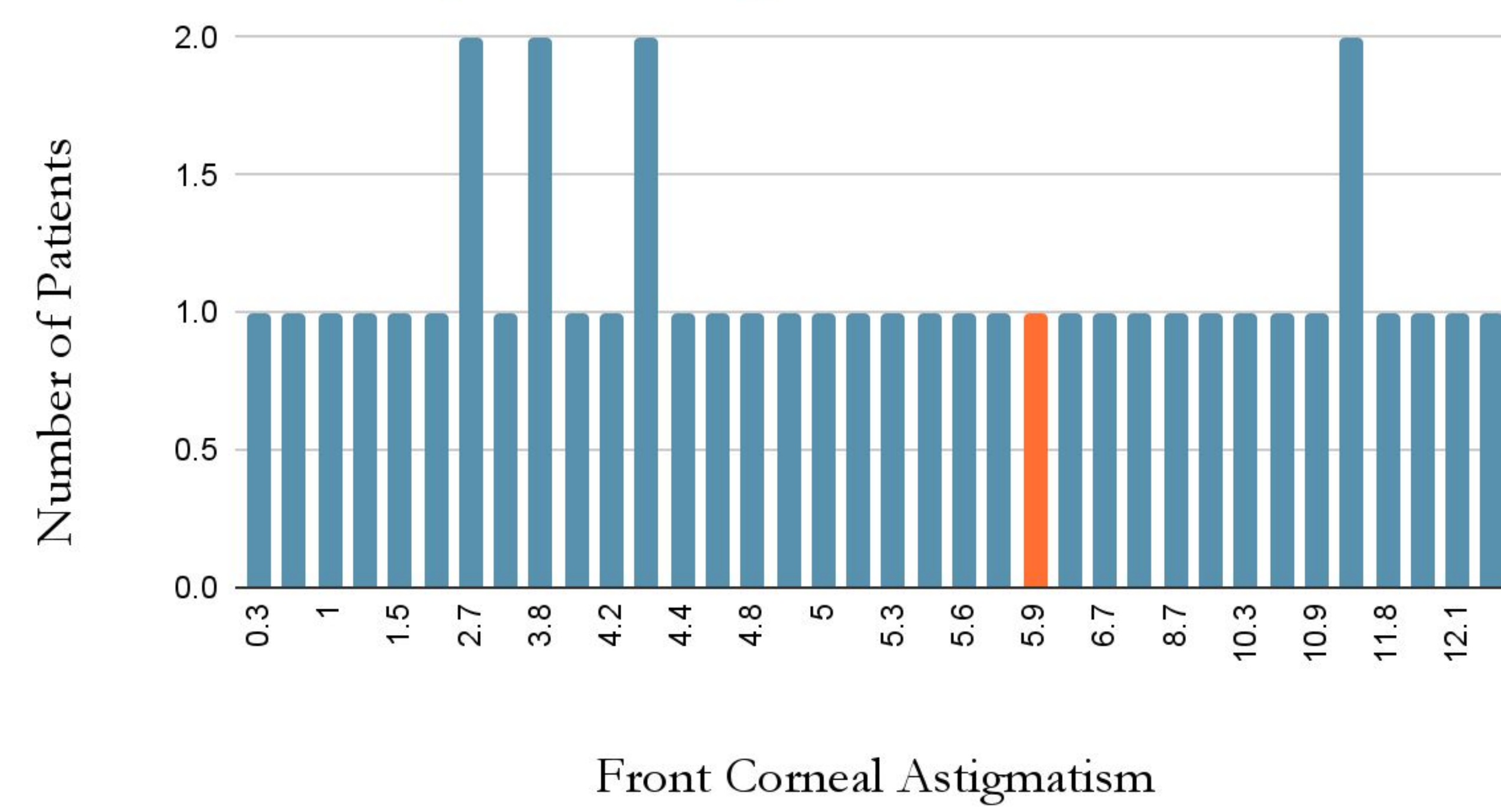
### Amount of Rotation from Predicted Shallow Meridian



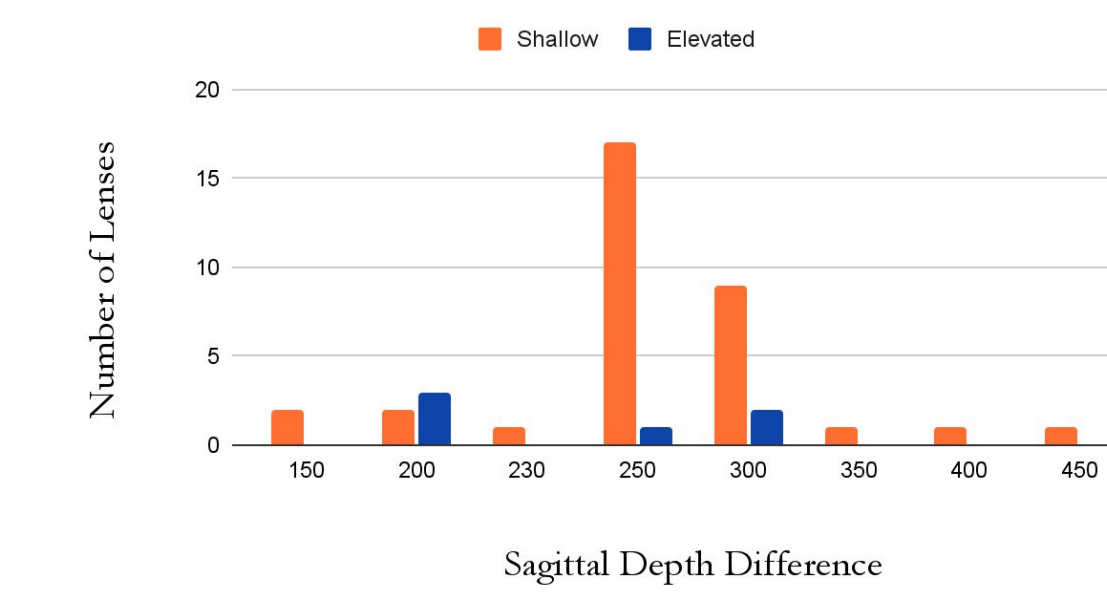
### Ocular Disease Breakdown



### Front Corneal Astigmatism Range



### Lens Rotation Meridian



### Peripheral System

