# Is There Synchronicity Between Topographic Eccentricity?

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## Introduction

Eccentricity has been shown to play an important role in evaluating corneal shape. Most normal corneas have an eccentricity between 0.4 and 0.6; if the cornea has a higher eccentricity value, then it has a faster rate of flattening. Eccentricity has been cited as an important factor in a patient's candidacy for orthokeratology because of its impact on eye shape and, subsequently, lens fitting. Some newer orthokeratology designs focus on the value of eccentricity when determining peripheral fitting curves. The difference in eccentricity between the steep and flat corneal meridians is also being considered in designing toric orthokeratology lenses. Therefore, we can establish the importance of eccentricity in orthokeratology lens design; however, there seems to be variation between topographers when measuring it. This pilot study evaluated the difference eccentricity measurements along the flat and steep meridians between different topographers and how these values compared to corneal astigmatism and corneal elevation differences.

## Methods

This research study took place at The Eye Institute (TEI) at Salus University where 11 optometry students had their topographies measured with both the Medmont E300 and Pentacam instruments. The eccentricity values were measured for the flat and steep meridians at the 8mm chord. This data along with the subjects' updated spectacle Rx and keratometry values were used for empirical design of orthokeratology lenses. These lenses were then evaluated and dispensed.

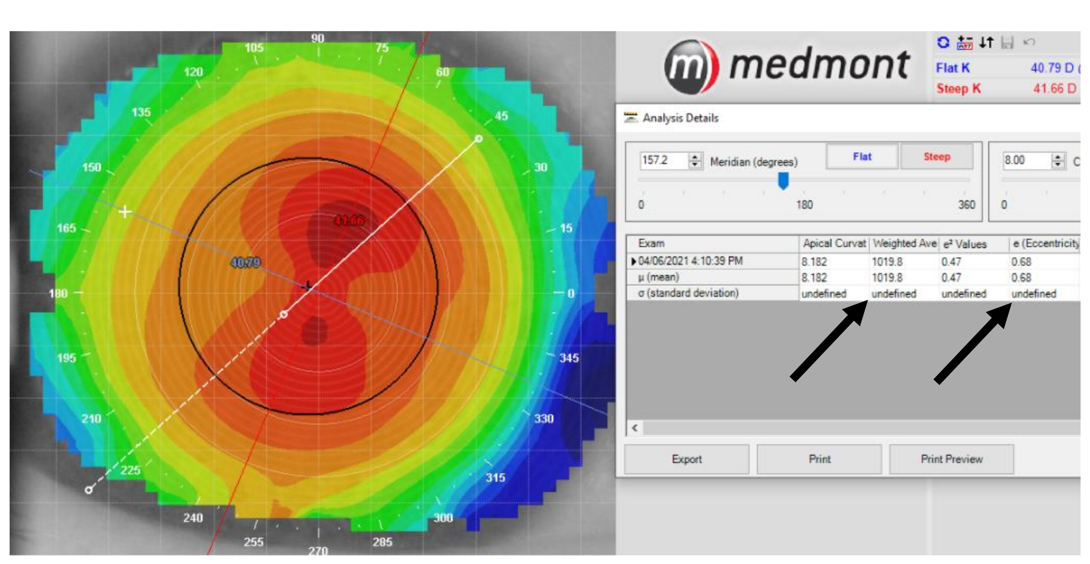


**FIGURE 1:** The Medmont analysis tool can be used to measure eccentricity and sagittal height along the flat and steep meridians at the 8.00 mm chord

Topographies were also analyzed to compare eccentricity differences to corneal cylinder and sagittal elevation difference.

The subjects trialed the lenses and their post treatment topographies were measured with uncorrected acuity and subjective refractions.

## References

Available upon request

## Methods Continued

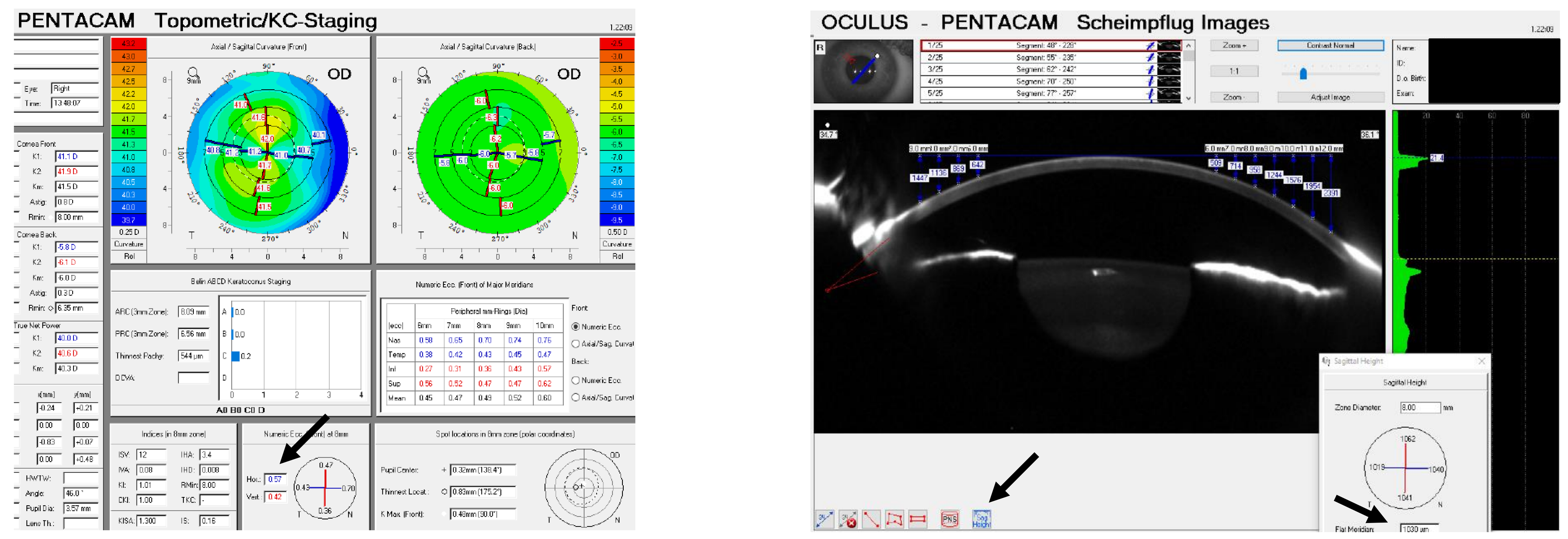


**FIGURE 2:** The Pentacam KC Staging page can be used to determine eccentricity along the flat and steep meridians (left). The Scheimpflug images can be used to measure sagittal height values for both meridians (right).

## Results

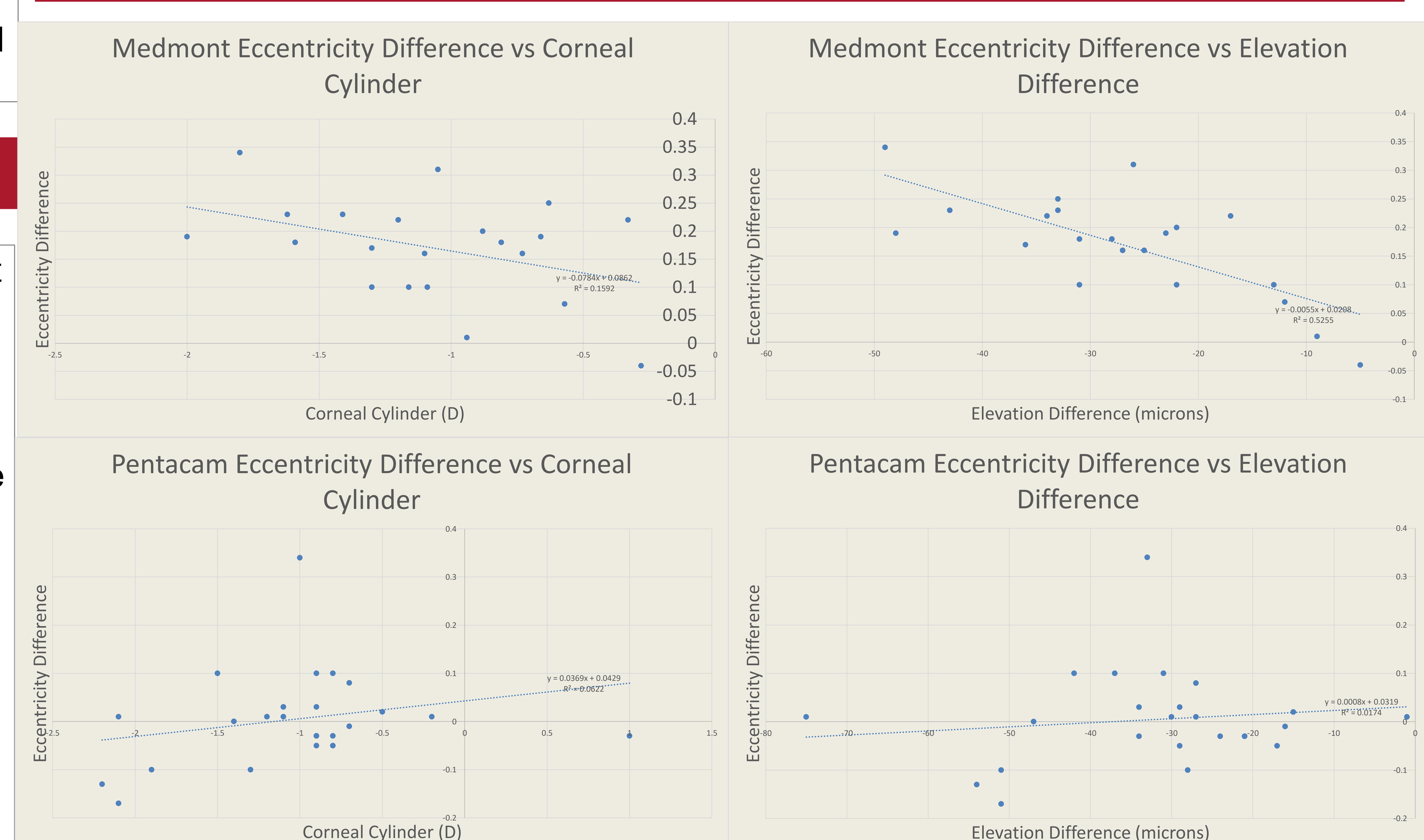


**FIGURE 3:** Plots showing eccentricity difference compared to elevation and cylinder for both Medmont and Pentacam

**Eccentricity Difference Between Instruments**

| OD | | OS | |
|---|---|---|---|
| flat | steep | flat | steep |
| 0.07 | -0.13 | -0.08 | -0.03 |
| 0.08 | -0.15 | 0 | -0.13 |
| -0.01 | -0.16 | -0.04 | -0.25 |
| 0.01 | -0.21 | 0.04 | -0.19 |
| 0.06 | 0.04 | 0.01 | -0.11 |
| 0.04 | -0.09 | 0 | -0.13 |
| -0.23 | -0.33 | -0.19 | -0.4 |
| 0.06 | -0.09 | 0.08 | -0.07 |
| 0.07 | 0.19 | 0.13 | -0.03 |
| 0.16 | 0.02 | 0.17 | -0.07 |
| 0.02 | -0.23 | 0.06 | -0.14 |
| 0.13 | -0.23 | 0.11 | -0.33 |

**Table 1: The data shows there is more disagreement between the eccentricity values of the topographers along the steep (vertical) meridians. The values were calculated by subtracting the Pentacam eccentricity from the Medmont eccentricity. The negative differences in many of the steep results shows that the Medmont tends to measure lower eccentricity values along the steep meridian.**

## Results Continued

The corneal cylinder and sagittal height values were in very close agreement between the Medmont and Pentacam. There was also agreement between the instruments when measuring eccentricity along the flat meridian; however, variation was seen between the Medmont and Pentacam when measuring eccentricity along the steep meridian (Table 1).

The Medmont generally measured lower eccentricity along the steep meridian and the Pentacam generally measured a more similar amount of eccentricity between the two meridians. This is of interest since some empirical lens designs may look at eccentricity values to calculate initial lens curves, including lens toricity.

Some empirically designed lenses from the Medmont exhibited tighter, inferiorly decentered, topography patterns. This appeared to be due to excess toricity which may have resulted from the greater eccentricity difference between the steep and flat meridians. Upon decreasing peripheral toricity, some of these fitting issues were resolved.

## Discussion

The difference between the instruments' calculation of the steep eccentricity is likely a resultant difference of the software and how the eccentricity is calculated from the different scans (Placido disc vs Scheimpflug).

The Medmont generally showed lower eccentricity values along the steeper meridian, suggesting more peripheral toricity, while the Pentacam generally showed more similar values between both meridians, suggesting a more spherical shape. It would make sense that more limbus-to-limbus toric corneas would show greater difference between the eccentricities; however, the graphs showed a lot of variability between eccentricity difference compared to cylinder.

The $R^2$ values of the linear regression lines between the eccentricity differences and the elevation difference and corneal cylinder show high levels of variation for both instruments. This may suggest that eccentricity difference does not correlate to corneal cylinder or elevation difference. Therefore, eccentricity may not be a suitable replacement alone when considering when and how to design toric peripheral curves.

## Conclusion

Eccentricity is still an important value when describing corneal shape. However, it may not be sufficient alone to determine lens toricity. Corneal cylinder and elevation difference values should still be considered when designing peripheral curves, especially in larger diameter corneal lenses like orthokeratology lenses. More research is recommended to study eccentricity between different topographers and its application to custom contact lens design.