A Novel Topographical Analysis Software in Myopia Control

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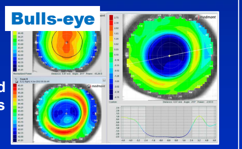
Introduction

In orthokeratology treatment, the topographical goal is a "bulls-eye" which indicates the lens was centered during closed eye wear. The resultant treatment zone that is well positioned over the pupil provides quality vision throughout the day. In the pursuit of myopia control in children, how do we distinguish a bulls-eye topographical outcome that will slow down eye growth from one that may not? Numerous studies have suggested the greater the power shift in the pupil, the better the myopia control[1,2]. This means an optimal myopia control bulls-eye will create the target Rx change at the corneal apex but exhibit increasing plus power towards the pupil margin and beyond. The greater the plus power shift or what the authors call the "Myopia Defocus Dosage" (MDD), the better the myopia control. This research project set out to create a software program to quantify these topographical changes following orthokeratology.

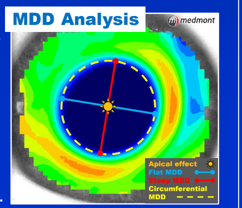
Methods



A software platform was constructed to assess corneal power changes on pre and post wear topographies. Using an axial interpretation on both maps, the apical power (☀) was compared to determine the orthokeratology effect (Rx change) that presents to the fovea. The differential between the apical corneal power change and the peripheral power change at 5mm provides an MDD value. Three independent MDD assessments are calculated:

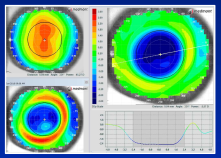
- Flat Meridian MDD: Compares the apical corneal power change to two opposing points (at a 5mm pupil) along the flat meridian.
- Steep Meridian MDD: Compares the apical corneal power change to two opposing points (at a 5mm pupil) along the steep meridian.
- Circumferential MDD: 32 sample points are selected at a 5mm pupil around the circumference of the eye (11.25° separation)

The software allows the user to define the pupil diameter of analysis for all three MDD options. Additionally the Circumferential MDD can sample up to 360 points (1° separation).

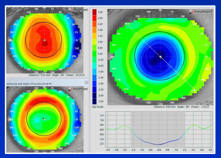


Case Examples

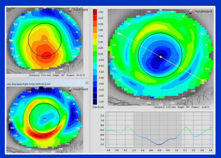
The software was employed on three orthokeratology cases below with the various MDD assessment options displayed (Flat, Steep & Circumferential). Each patient had an approximately 2.50D Rx change for comparison consistency.



Apical Effect: -2.57D
Flat MDD: +1.59D
Steep MDD: +1.64D
Circumferential MDD: +1.55D



Apical Effect: -2.54D
Flat MDD: +1.89D
Steep MDD: +2.11D
Circumferential MDD: +2.04D



Apical Effect: -2.48D
Flat MDD: +2.25D
Steep MDD: +2.35D
Circumferential MDD: +2.49D

Discussion

This topographical analysis software is best employed after the corneal response has reached its full effect which is following approximately 7-10 nights of consecutive orthokeratology lens wear[3]. Assessing MDD while the corneal epithelium is still changing wouldn't provide a definitive answer of the plus power being created within the pupil and the likely myopia controlling effect.

This poster does not seek to determine the appropriate MDD necessary for each child in orthokeratology treatment. Nor does it suggest a minimum or maximum MDD range that practitioners should target during orthokeratology lens wear. This analysis platform could be employed in long term myopia control studies to determine how the MDD values can be utilized on each patient in orthokeratology. For instance, which MDD analysis, if any, is most predictive of myopia controlling efficacy - the flat, steep or circumferential analysis? Is there an average MDD appropriate for a broad cross-section of children or should MDD values be different for each Rx, eye shape, pupil, corneal diameter, etc.?

Additionally, understanding when to alter orthokeratology lens construction early in treatment could assist in creating improved myopia controlling outcomes.

Conclusions

This analysis software could provide researchers and clinicians alike with a tool to efficiently assess the potential myopia controlling effect of orthokeratology treatment in the initial weeks of wear. More study is warranted to better understand the software and its findings in myopia control.

References

1. Zhong et al, Central and Peripheral Corneal Power Change in Myopic Orthokeratology and Its Relationship With 2-Year Axial Length Change, Optom Vis Sci. 2014 Apr;91(4):404-11
2. Hu et al, Areal summed corneal power shift is an important determinant for axial length elongation in myopic children treated with overnight orthokeratology, Br J Ophthalmol. 2019 Nov;103(11):1571-1575
3. Alharbi A, Swarbrick HA. The effects of overnight orthokeratology lens wear on corneal thickness. *Invest Ophthalmol Vis Sci*. 2003;44(6):2518-2523. doi:10.1167/iovs.02-0680

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