Development and Evaluation of a novel tool to measure the pupillary and contact lens decentration

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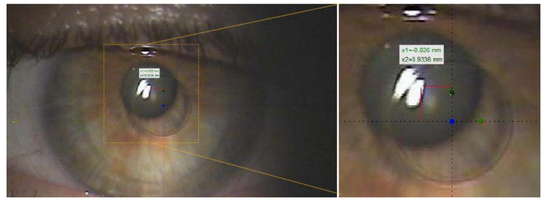
Introduction:

Options to measure decentration of eye structures and contact lens positions are required especially in toric and presbyopic CL fitting. Mostly, measuring eye-pieces are used for this task. A disadvantage of this method is the dependence of correct alignment to the investigators refractive error[1]. Furthermore, the scales show the correct value for only one magnification directly. Decentrations are also measureable with *Placido* ring topographers or *Scheimpflug* cameras. Structures which are located inside the corneal area could be determined very precisely with these devices[2]. Structures outer the limbal region, e.g. SCL-edge, cannot be located. *Brückner* developed a procedure for measuring decentrations of soft concentric multifocal CL to pupil center[3]. He used contact lenses with central circle engraving. By a virtual measuring tool horizontal and vertical differences between pupil center and CL center could be measured on slit lamp pictures. A problem is the precise definition of the near optic zone and the pupil center.

▲ Fig.1: circle-engraving on a soft multifocal contact lens[4]



▲ Fig.2: Measuring of contact lens decentration according to the method of *Brückner* [3]

A novel measuring method was developed, which enables to measure the pupillary decentration and contact lens decentration.

Purpose:

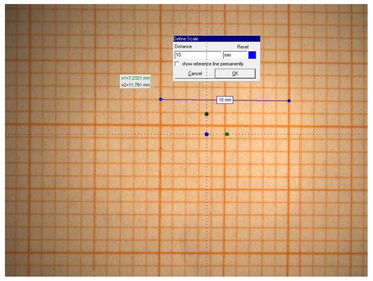
Development of a novel tool to measure the difference between the corneal and the pupillary center as well as difference between the pupillary and the contact lens center based on a photograph of the anterior eye captured with a conventional slit lamp.

Methods:

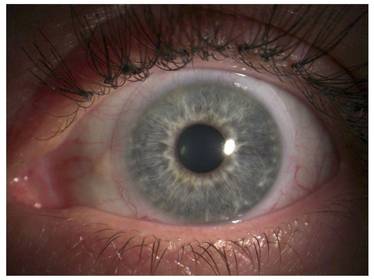
The novel tool to measure the distances was developed as a double-triangle. To evaluate the center of the pupil, the cornea or the CL, a photograph of the eye was taken with a conventional video slit lamp. Then, the double-triangle was masked on the photograph of the eye. To find the position at least three of four edges of the double-triangle must touch the edge of the pupil, the cornea and the CL. To determine the difference between the centers, the distance between the double-triangle centers were measured.

To evaluate the tool a prospective study by means of a conventional video slit lamp and a SIRIUS - 3D Rotating *Scheimpflug* Camera & Topography System[5] (bon Optic) in 20 subjects (50% male; aged (54.9±6.3 years with a range of (45 to 71) years) was conducted. The differences between the pupillary center and the corneal vertex were measured with both devices.

Step 1 Taking photos of a reference object and the eye in the same magnification plus calibration of the measuring software

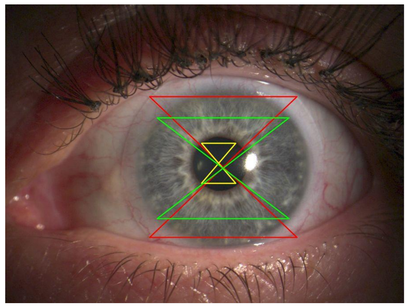


▲ Fig. 3: photo of the reference object (in this case millimeter paper) and calibration of the measuring software



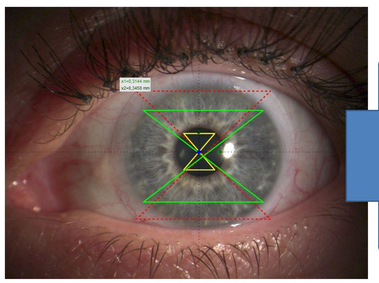
▲ Fig. 4: photo of the eye with a soft contact lens

Step 2: Masking the photo of the eye with the three double-triangles

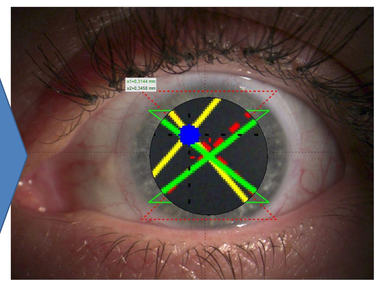


▲ Fig. 5: Masking the photograph with the double-triangles for pupil center (yellow), cornea center (green) and contact lens center (red)

Step 3: Measuring the distance between the centers of the double-triangles to determine the pupil or contact lens decentration



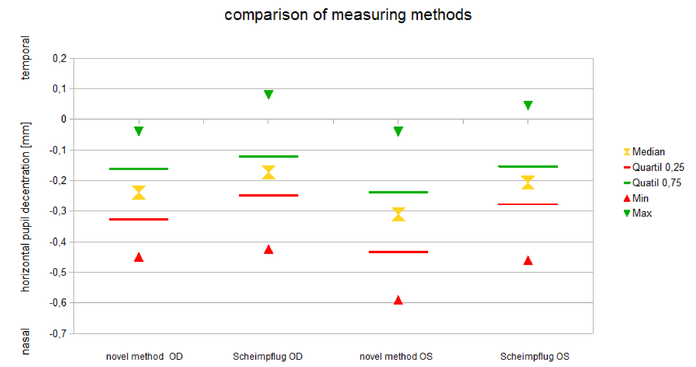
▲ Fig. 6: measurement of the distance between pupil center and corneal center



▲ Fig. 7: more accurate measurement of the distance between pupil center and cornea center by using the loupe-tool of the measuring software *MB-Ruler*

Results:

The pupillary decentration by means of the novel tool was measured by OD (-0.24±0.13)mm and OS (-0.33±0.14)mm and by means of the Rotating *Scheimpflug* Camera by OD (-0.18±0.11)mm und OS (-0.21±0.12)mm. Comparing both methods the mean differences were OD (0.06±0.02)mm and OS (0.12±0.02)mm.



▲ Fig. 8: comparison of the results of the novel method with the results of the *Scheimpflug* camera measurements

Conclusion:

The novel measuring tool combines the advantages of the conventional reticule and software based analyzing tools of modern video topographers. Especially for fitting simultaneous presbyopic contact lenses, the difference between the CL center and pupil center can be visualized and measured more easily. Furthermore, the tool could be used for similar tasks, e.g. measuring intra ocular lens decentration.

References:

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