

Digital Imaging Analysis of Pupil Shape and Size in Reference to Cornea Apex in Cataract Surgery



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Purpose

- To implement digital analysis of pupil imaging (shape and size) in relation to cornea apex position and compare preoperative and postoperative data to measure the extent of pupil centration changes following cataract surgery.



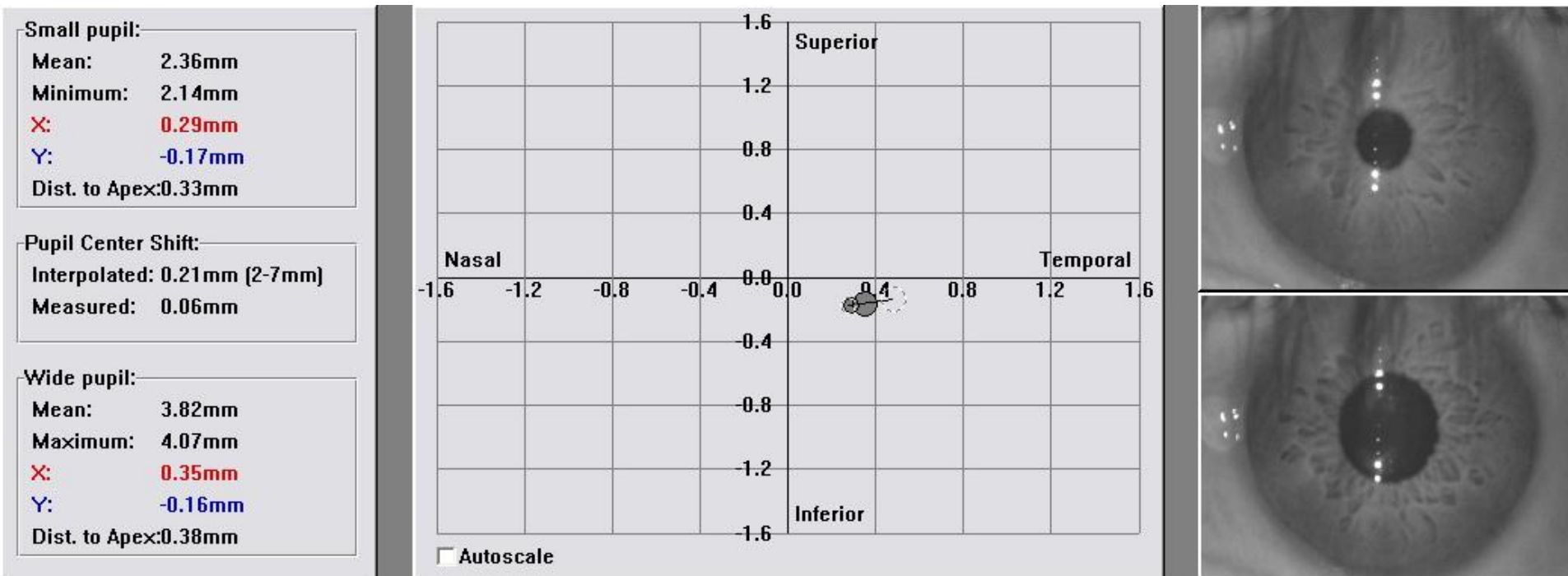
Methods

- 35 consecutive cataract cases (70 eyes) were digitally imaged pre- and post-operatively by Placido Topography (Vario Topolyzer, WaveLight, Erlagen, Germany) providing accurate pupil imaging and cornea apex identification.
- Digital analysis implemented on the images investigated the Cartesian coordinates (nasal – temporal being the horizontal, and superior-inferior the vertical axis) of the corneal apex (approximating the intersection of line of sight with the cornea) to the pupil geometric center (approximating the visual axis).
- The Cartesian changes of the differences were associated with postoperative pupil centroid shift.



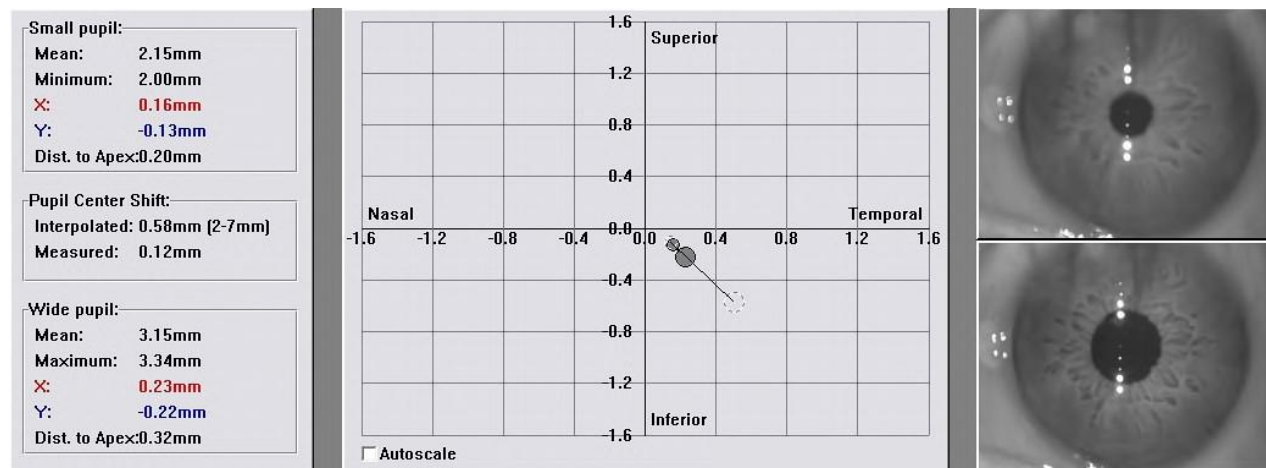
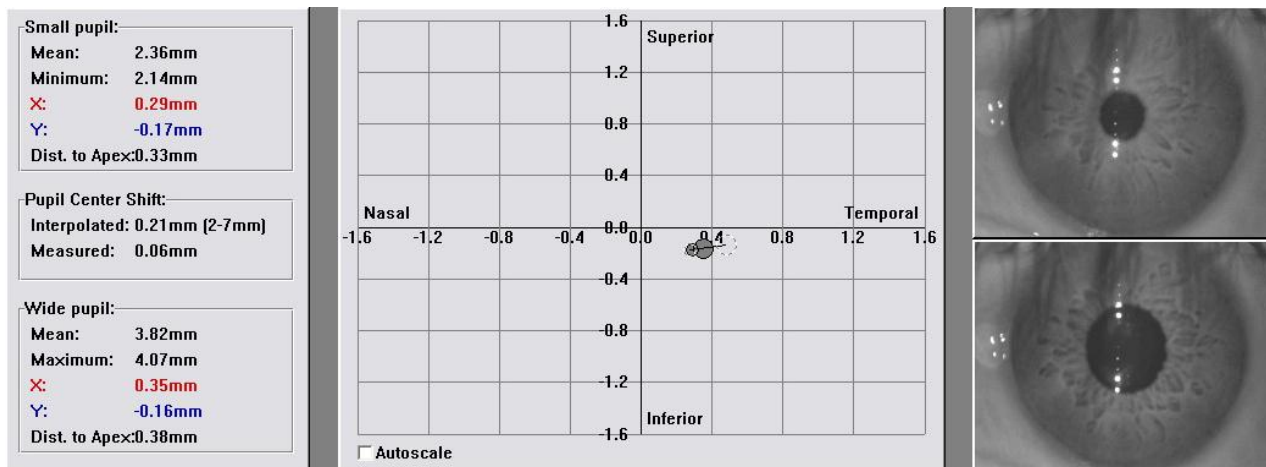
Data Processed

- Shown are the data employed in the study in the form of table at the left of each image, the pupil center in relation to cornea apex in the Cartesian coordinates plot, and the actual photopic and mesopic pupil images.
- In the Cartesian plot, the small circle corresponds to the 'small' pupil apex coordinates, while the large circle to the 'large' pupil.



Post-Operative vs Pre-Operative

- Pre-operative (top) and one-month post-operative (bottom) pupil of the same -left-eye.



Results

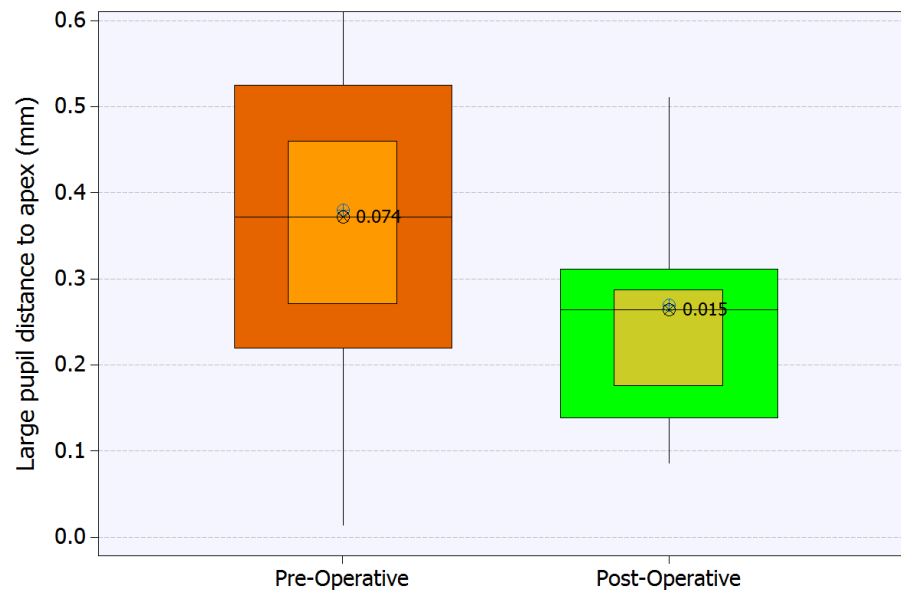
- The pupil size diameter change corresponded to a relative reduction by -9.8 % for the photopic and -9.1% for the mesopic pupil, with a statistically significant difference (p 0.045 and 0.011).
- Additionally, there is a noted reduction in the centroid shift from an average (all eyes) of 0.12 mm pre-operatively to 0.05 mm post-operatively, as a result of the post-operative less temporal horizontal difference between the corneal apex and the pupil center.



Photopic and Mesopic pupil diameter



Small Pupil vs Large Pupil Distance to Apex



Discussion

- The present study suggests a statistically significant reduction in pupil size: the postoperative pupil size reduction averaged between -9.8% for the small pupil and -9.1% for the large pupil.
- These findings may be further suggestive of the safe use of a 6-mm optic zone diameter IOL instead of larger zone.
- The noted post-operative reduction in the pupil size suggests that even a pre-operative pupil diameter of 5.5 mm may be postoperatively 5.0 mm as an indirect result of the cataract surgery



Discussion

- Additionally, there is a noted reduction in the centroid shift from an average (all eyes) of 0.12 mm pre-operatively to 0.05 mm post-operatively, as a result of the post-operative less temporal horizontal difference between the corneal apex and the pupil center.
- These changes may be related to the increased anterior chamber depth and volume following the extraction of the bulky crystalline lens. As it develops into a cataract, an intumescent crystalline lens has measured average thickness 4.4 mm; this lens is replaced with a thin IOL, of thickness often less than 1 mm.



Conclusions

- Cataract surgery results in pupil size reduction of the order of 10% for both mesopic and photopic conditions and in improved centration, towards a smaller centroid shift
- Specifically, a smaller pupil size and a less temporal shift was recorded.
- These data may have clinical reference in targeted intraoperative IOL centration.

