Effect of gaze direction and lid squeezing on intraocular pressure in glaucoma patients using a novel implantable intraocular sensor

J. van den Bosch[1,2], V. Pennisi[2], H. Thieme[2], L. Choritz[2]
[1]Implandata Ophthalmic Products GmbH, Hannover, Germany
[2]University Eye Clinic, Otto-von-Guericke University Magdeburg, Germany

CONTACT J. van den Bosch
jvandenbosch@implandata.com

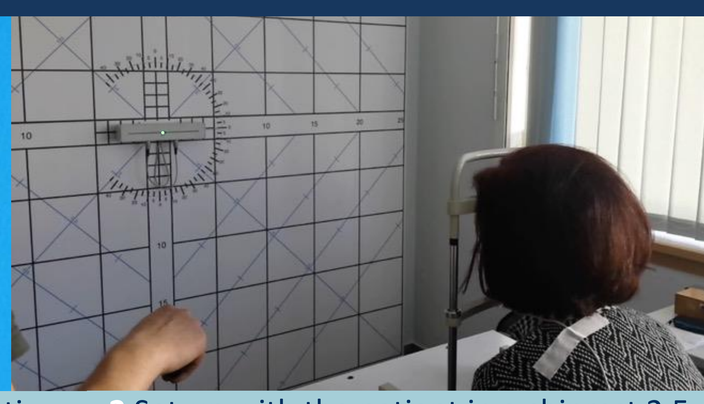
Purpose

Quantification of immediate intraocular pressure ('IOP') changes in response to voluntary eye globe movement and lid squeezing

Methods

- Eight glaucoma patients implanted with the EYEMATE-IO IOP sensor, measured every 0.1 second via an external antenna around the study eye (Fig. 1).
- Seated towards a static grid with determined gaze angle positions (Fig. 2).
- Clockwise directed gaze positions in 8 directions, intervals alternated by primary position as baseline measurement. Circles completed in increased eccentricity (10, 20 and 25° , Fig. 3).
- IOP fluctuations depicted as mean IOP change (Fig. 4-6).
- Instructed lid squeezing alternated by primary position, depicted as peak IOP change (Fig. 7, 8).

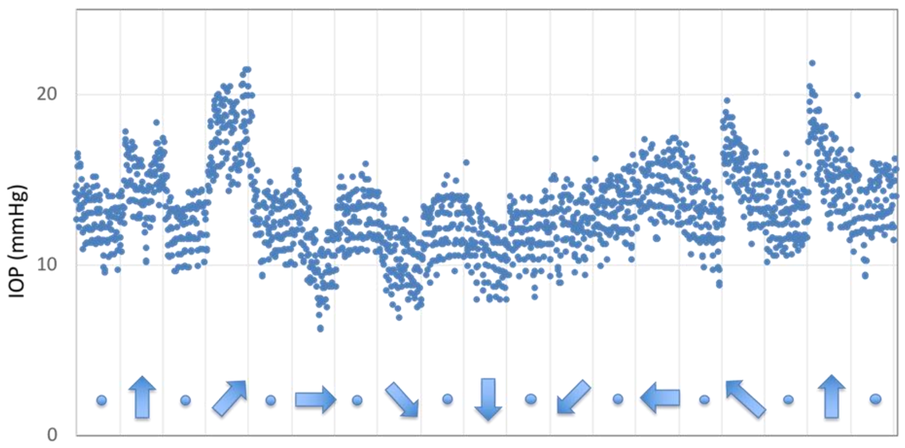
1 EYEMATE ™ sensor. Implantation during cataract surgery in the ciliary sulcus, in front of the intraocular lens.



2 Set-up with the patient in a chinrest 2.5 meters in front of the Harms wall, fixating at the center as primary position.

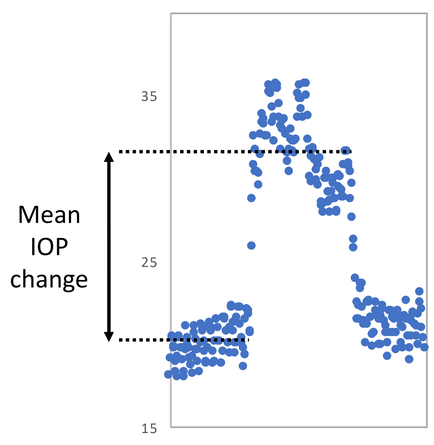
Results

Continuous IOP recordings during different gaze positions



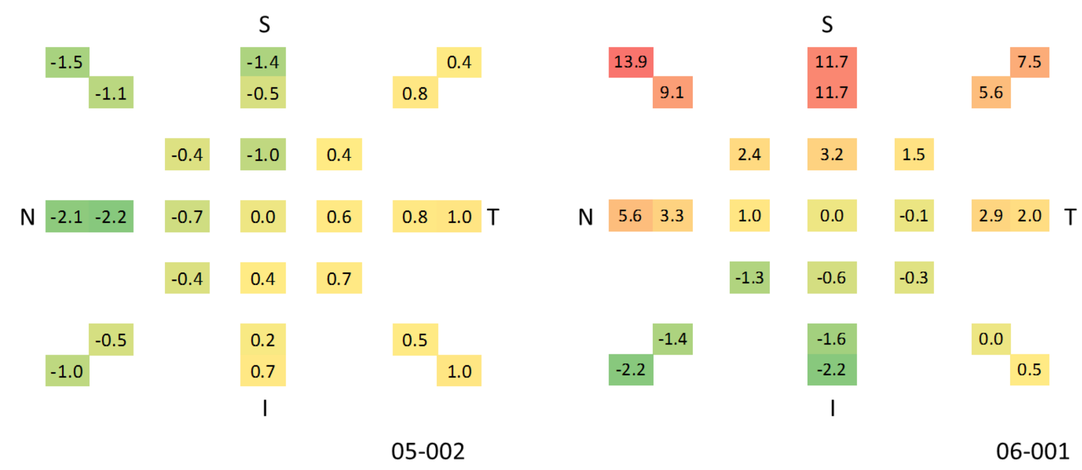
3 Example of 8 different gaze positions in 12-second intervals following a 25° circle. Primary position is indicated with a dot. Upward gazes provoke IOP increases up to 10 mmHg.

Analysis



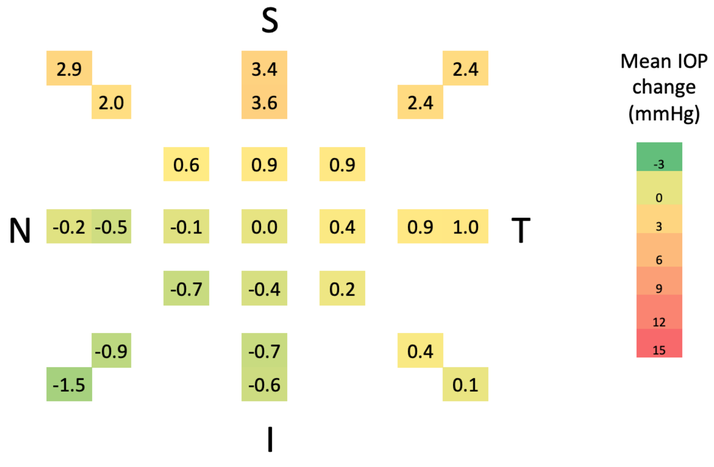
4 Change in IOP expressed as the mean IOP during the gaze position compared to the mean of the previous primary position.

Intersubject variability in mean IOP changes



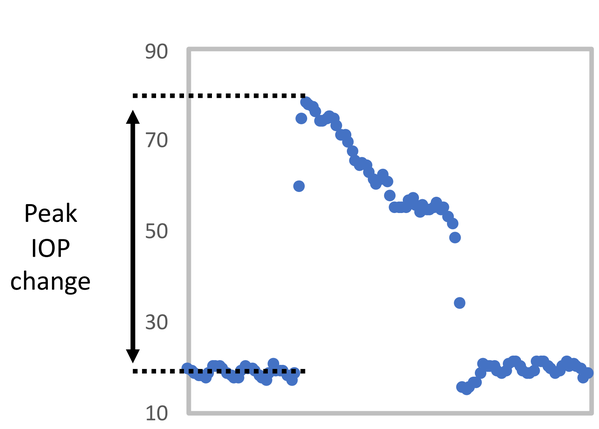
5 Two individual heat maps (study eye is the right eye). Subject specific differences in IOP range and changes in respect to gaze positions are present (color legend Fig. 6).

Combined overview per gaze position



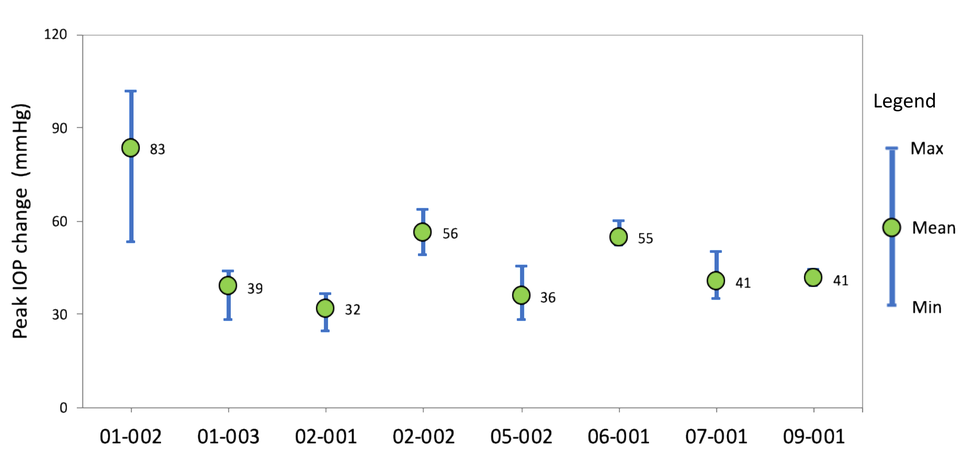
6 Heat map of the combined change in mean IOP per gaze direction (mean of 3 repetitions). Vertical and temporal gazes increase IOP while nasal and downward gazes decrease IOP.

IOP recordings of lid squeezing



7 Example lid squeeze, alternated by 10-second baseline intervals. The ocular pulse amplitude is apparent. Change in IOP expressed as the peak IOP during lid squeezing compared to the previous baseline mean.

Intersubject variability in peak IOP change



8 Peak IOP change during lid squeezing in 8 patients, averaged over 5 repetitions (mean as green circle; lines as minimum and maximum values).

Conclusions

- The Eyemate-IO IOP sensor enables short term observation of IOP fluctuations in glaucoma patients without movement restriction.
- Asymmetry in IOP response in different gaze directions and profound IOP increases during lid squeezing, in line with previous literature.[1,2] Extend of observed intersubject variability has not been described.
- Future analyses should explore ocular pulse amplitude as well as aqueous humor outflow dynamics in response to controlled increases in IOP.

References

1. Nadine, M. Intraocular pressure changes in secondary positions of gaze in normal subjects and in restrictive ocular motility disorders. Graefe's Arch Clin Exp Opthalmol. 1988; 226: 8-10.
2. Coleman, J. Trokel, S. Direct-recorded Intraocular Pressure Variations in a Human Subject. Arch Ophthal. 1969; 82: 637-641.

Funded by the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No.675033