New methods for estimating normal limits of optic disc rim area with the Heidelberg Retina Tomograph.

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Purpose
To demonstrate the use of quantile regression to derive better normal reference limits for the relationship between optic disc size and rim area measurements from the Heidelberg Retina Tomograph.

Background
Expected healthy rim area varies with optic disc size, with large optics discs having larger rim area than smaller discs. Diagnostic analyses used in the Heidelberg Retina Tomograph (HRT) attempt to account for this relationship (e.g. Moorfields Regression Analysis). However, large optic discs are commonly classified as outside normal limits more often than small optic discs.

Methods and Data
HRT data from two independent datasets. One eye of each participant.

• Halifax Glaucoma Study (Ford et al, Ophthalmology 2003)
  76 controls, 106 glaucoma
• Manchester Glaucoma Imaging Study (Coops et al, IOVS 2006)
  88 controls, 146 glaucoma

Moorfields Ordinary Least Squares (OLS) regression (models the mean log rim area)

New: Quantile regression analysis

Moorfields Ordinary Least Squares (OLS) regression

Quantile regression

• Each data set considered separately (HFX and MAN).
• Controls used to establish the 5% prediction limit for the Moorfields Model (OLS) and the 95th quantile regression line.
• Applied to each of the 6 sectors and global value. Each eye (patient and controls) was then compared to these ‘cut-off’ values.
  • A measurement outside the limit for at least 1 sector would define the eye to be ‘abnormal’.
• Sample sensitivity and specificity for small, medium and large discs calculated and plotted in an ROC space.
• All analyses performed in the statistical programming language R.

Conclusions

• Normative limits for rim area derived from quantile regression help remove the disc size bias in HRT Moorfields Regression Analysis.
• Further work will use more data and consider a non-linear version of quantile regression typically used to model growth curves in children.
• Quantile regression could be used in other vision measurements (e.g. estimating age-related limits for normality in visual fields)

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Appendix

Supplementary data

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