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Heidelberg Retina Tomograph (HRT3) in population-based epidemiology: normative values and a definition of glaucomatous optic neuropathy

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Purpose:

To establish normative values for Heidelberg Retina Tomograph (HRT3) variables and to develop an HRT3-based definition of glaucomatous optic neuropathy (GON) for epidemiological research. Clinically used HRT parameters and cut-off points cannot be used for epidemiological purposes as a matter of course, since case selection might differ between clinical and epidemiological populations. Furthermore, in epidemiology very high specificities of typically 97.5% are used, accepting the corresponding lower sensitivity, whereas in a clinical setting a good sensitivity is more important. Therefore, we measured several HRT parameters in an elderly (mainly) white population, the cohort of the Rotterdam Study. Data obtained with simultaneous stereoscopic photography (ImageNet) system were available in a subset of this cohort and were compared to the HRT data.

Methods:

Consecutive participants in the population-based Rotterdam Study were examined with both HRT and ImageNet in addition to other ophthalmic examinations including visual field testing. A random eye was used for all analyses. Normative values for all HRT3 variables were determined in participants without glaucomatous visual field loss (GVFL; data not shown on poster).

Receiver Operator Characteristic (ROC) curves were made for all continuous variables, including linear discriminant functions (LDFs) and the Glaucoma Probability Score (GPS global and sectorial), using participants with GVFL to establish sensitivity. Area under the ROC curves (AUC) and sensitivities at a fixed high specificity of 97.5% were calculated for all these variables.

Results:

2516 participants were included in this study of whom 66 had GVFL in at least one eye. Variables with the highest sensitivities at a fixed specificity of 97.5% were HRT3 linear cup-disc ratio (LCDR) and GPS segment temporal/inferior and nasal/superior (Table 1). The HRT3 software often failed to calculate the sectorial GPS values (in 872 of 4544 scans with a topographical standard deviation of 50 µm or less) and even the global GPS value (in 330 scans). Previously published LDFs showed a lower sensitivity than LCDR at this high specificity despite better AUC (Figure 1).

Table 1. AUC and sensitivity at 97.5% specificity for HRT3 variables

Variable	AUC	Sensitivity (%)
Linear cup-disc ratio	0.705	24.2
GPS temporal/inferior	0.741	24.5
GPS nasal/superior	0.736	24.5
FSM discriminant function value	0.737	6.3
RB discriminant function value	0.720	3.3
Bathija, et al. LDF	0.747	6.4

Hence, we focussed on LCDR, and further improved its diagnostic performance by adjusting for disc area. The 97.5th percentile was 0.67 for small discs (up to 1.5 mm^2), 0.73 for normal discs and 0.79 for large discs (above 2.0 mm^2; Figure 2).

Figure 1. Receiver operating curves of HRT3 linear cup-disc ratio (LCDR) and the three linear discriminant functions as published by Mikelberg et al. (FSM), Burk et al. (RB) and Bathija et al.

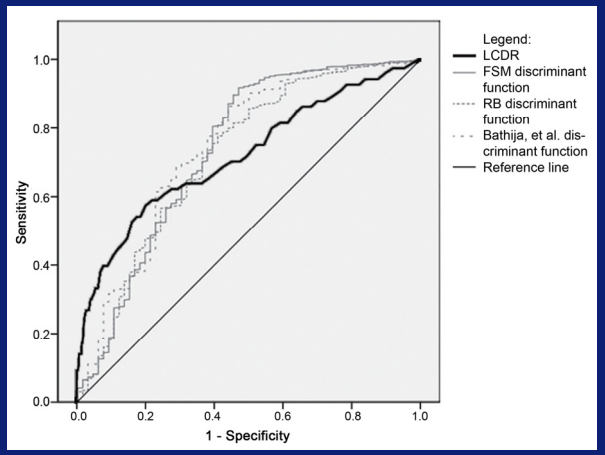
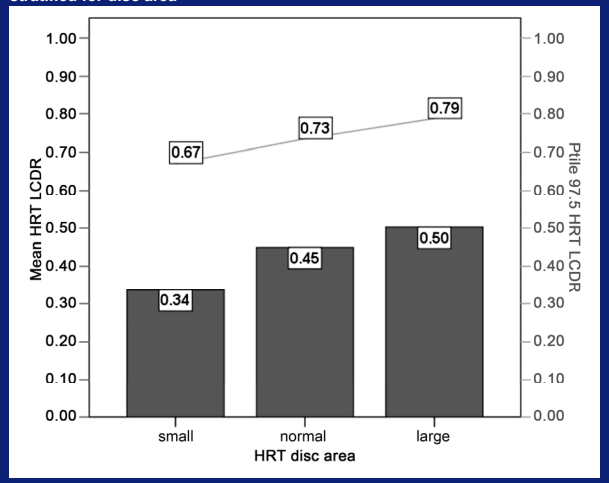


Figure 2. Mean values (bars) and 97.5th percentiles (lines) for HRT3 LCDR, stratified for disc area



The corresponding sensitivities were 31% for HRT3 LCDR and 17% for ImageNet VCDR (p=0.02; McNemar's test), based on the disc-area corrected 97.5th percentiles. Table 2 presents the sensitivity for several other cut-off points.

Table 2. Positive predictive values and sensitivities for a range of cut-off values for disc-area corrected HRT3 LCDR

Percentile	Positive Predictive Value (%)	Sensitivity (%)	N (both GON and GVFL)
50th	3.4	75.0	36
80th	6.8	64.6	31
90th	11.8	56.3	27
95th	14.8	41.7	20
97.5th	21.4	31.3	15
99th	24.2	16.7	8

Conclusions:

LCDR, stratified for disc area, turns out to be the most suitable candidate for an HRT3-based GON definition for epidemiological purposes in this white population.