

Diagnostic Accuracy of Frequency Doubling Technology and Moorfields Motion Displacement Test for Glaucoma

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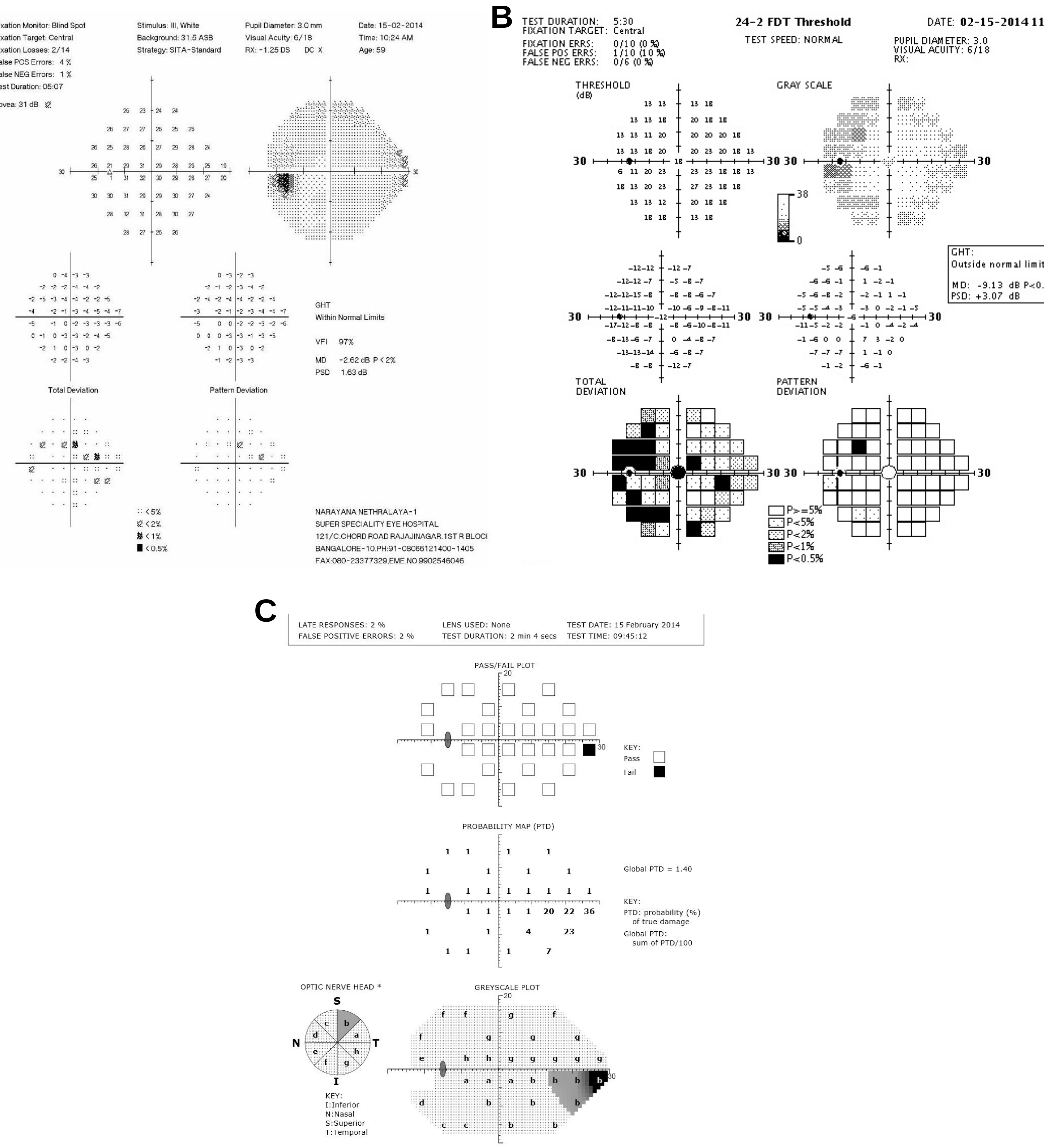
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Background and Aims

Glaucoma stands as the leading cause of irreversible blindness worldwide.¹ Portable perimeter tools are exciting as they have potential community-based screening tools due to their easy transportability and cost-effectivity given that a portable perimeter could be used by multiple clinics. However, studies exploring the diagnostic abilities of portable perimeters such as frequency doubling technology (FDT), Moorfields motion displacement test (MDT), and tablet-based perimeter have variable results. This study explored the diagnostic accuracy of FDT and MDT parameters for visual field defects and glaucoma.

Figure 1. Perimetry printouts from Humphrey field analyzer (A), frequency doubling technology (B), and Moorfields motion displacement test (C) from same eye.



Experimental Design

Overview.

- Participants received HFA, FDT, and MDT testing in random order at Narayana Nethralaya in Bangalore, India. Receiver operating characteristic (ROC) curves were created to assess optimal thresholds for field defect and glaucoma detection.

Eligibility.

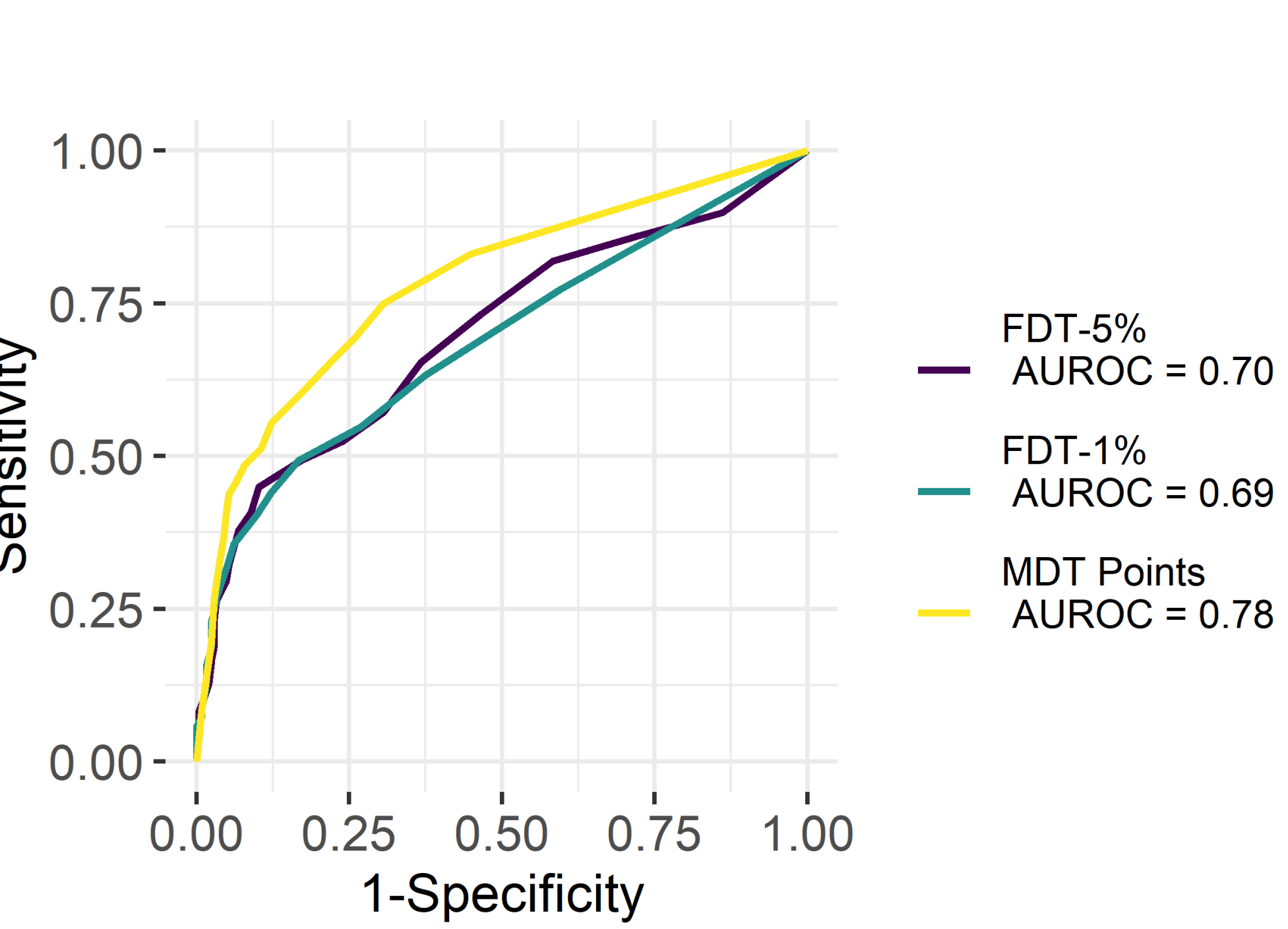
- Glaucoma clinic patients who were i) 50 years of age or older ii) had no prior glaucoma diagnosis, and iii) had never undergone HFA.

Reference Standard.

- 24-2 SITA HFA printout and optic nerve head photographs were used to determine presence of field defect or glaucoma.

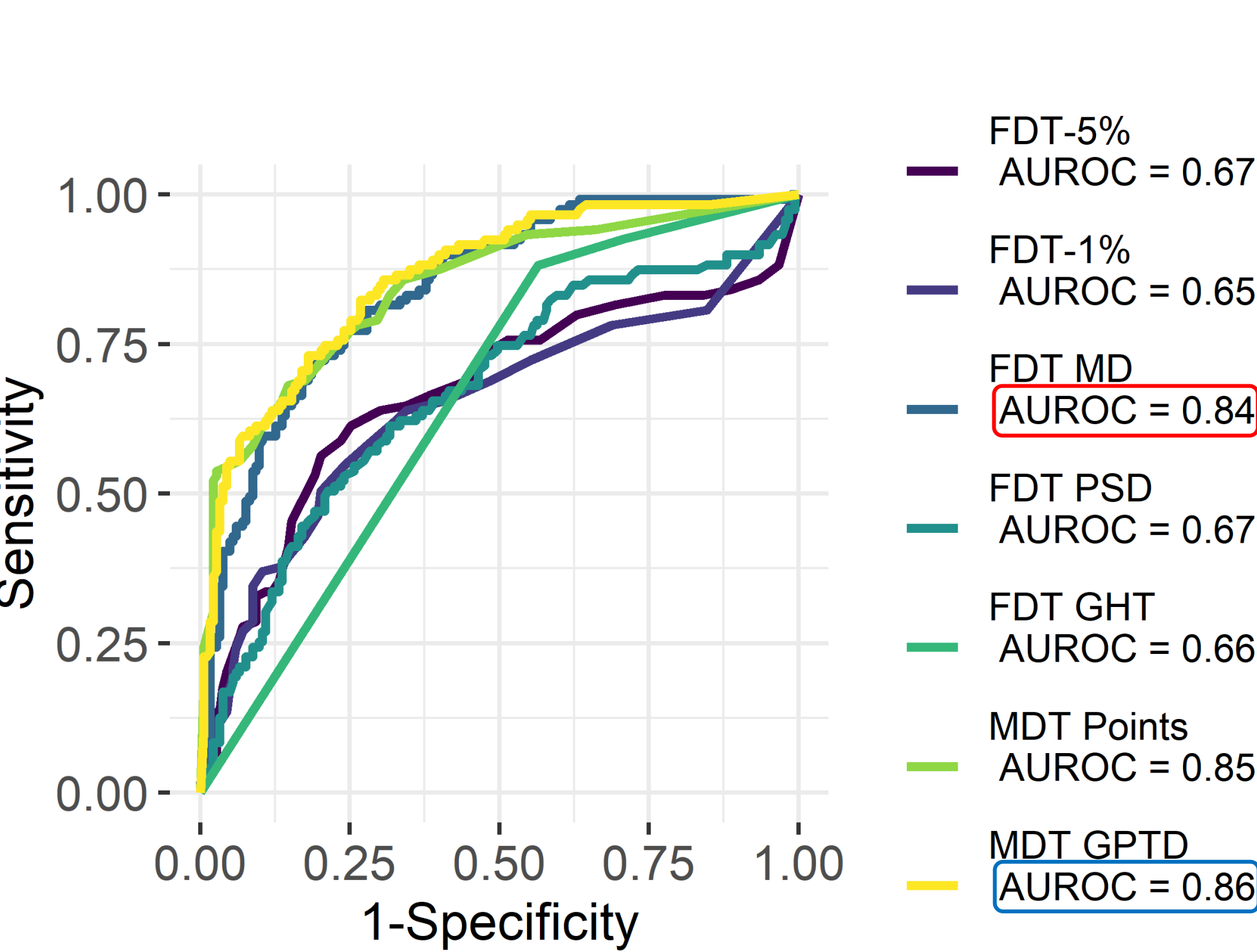
Results

Figure 2. ROC curves for detection of hemifield-level visual field defects by FDT and MDT. Analysis included 588 hemifields.



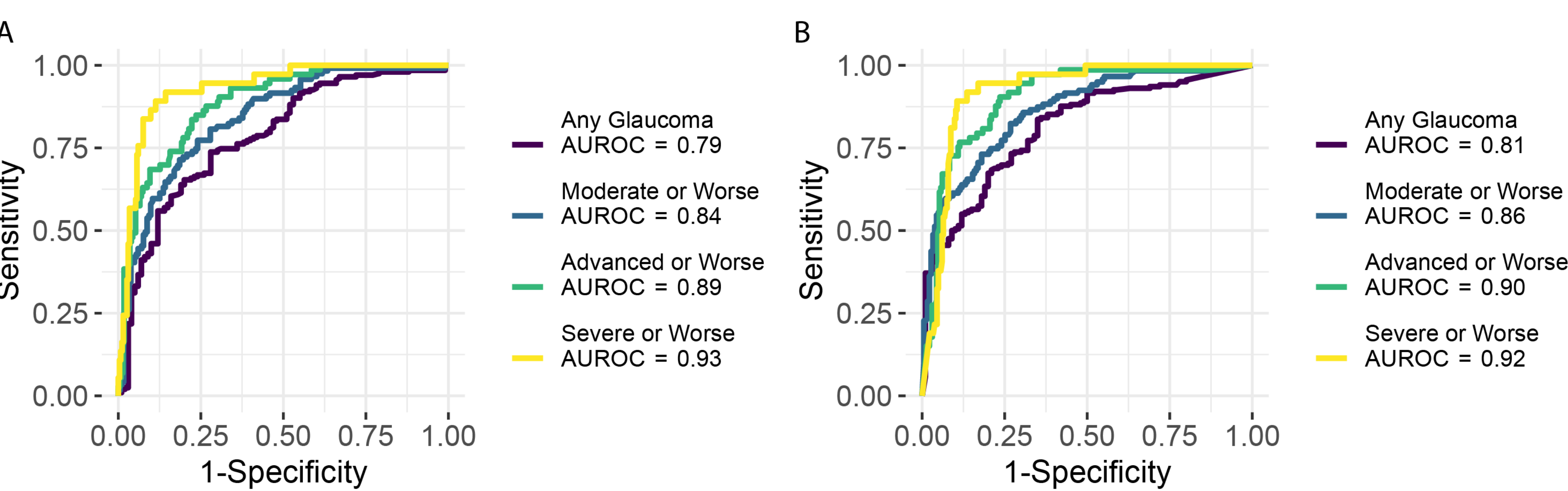
FDT-5% = points missed on the FDT pattern deviation plot at the 5% significant level, AUROC = area under the ROC curve, FDT-1% = points missed on the FDT pattern deviation plot at the 1% significant level, MDT Points = points missed on the MDT pass/fail plot

Figure 3. ROC curves for detection of moderate or worse glaucoma using FDT and MDT. Analysis included 302 eyes.



AUROC = area under the ROC curve, MD = mean deviation, PSD = pattern standard deviation, GHT = glaucoma hemifield test, GPTD = global probability of true damage

Figure 4. ROC curves for detection of various glaucoma severities using FDT mean deviation (panel A) and MDT global probability of true damage (panel B). Analysis included 302 eyes.



AUROC = area under the ROC curve

Table 1. Sensitivities of FDT and MDT for visual field defects and glaucoma relative to the HFA at a set 90% specificity.

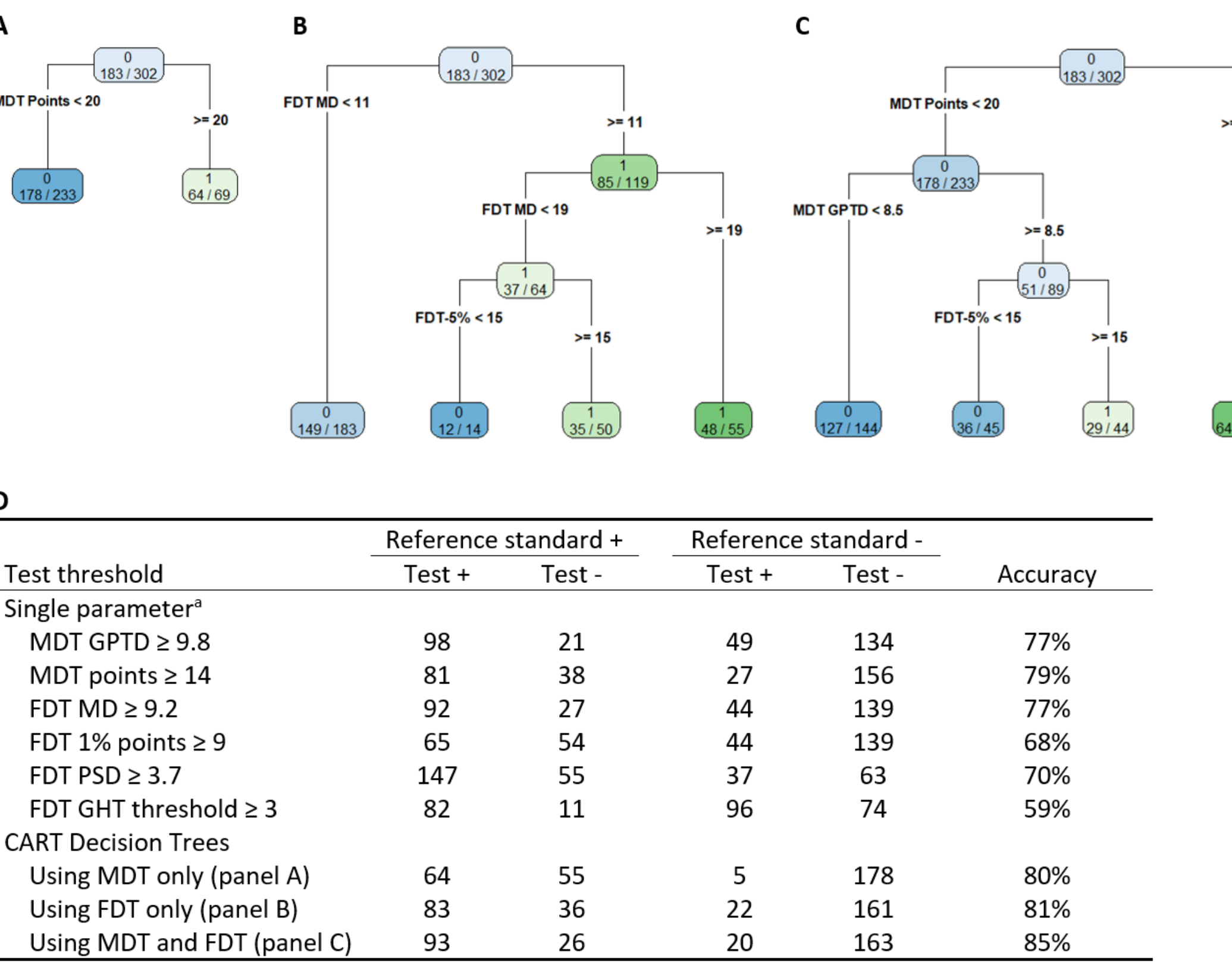
Reference standard definition	Num/Total ^a	FDT-5% Level		FDT-1% Level		MDT Points		FDT MD		FDT PSD		MDT GPTD	
		Pts ^b	Sensitivity	Pts ^b	Sensitivity	Pts ^b	Sensitivity	Pts ^b	Sensitivity	Pts ^b	Sensitivity	Pts ^b	Sensitivity
Hemifield-level defect													
Any defect	343/588	10	41% (31-50)	6	40% (29-48)	8	48% (40-60)						
Glaucomatous defect	280/588	10	41% (31-50)	6	40% (29-48)	8	48% (40-60)						
Eye-level glaucoma stage													
Any glaucoma	202/302	18	44% (18-60)	12	36% (17-52)	14	49% (36-63)	12.8	46% (28-64)	5.3	37% (16-49)	14.6	51% (40-65)
Moderate or worse	119/302	25	33% (19-46)	16	35% (18-46)	18	58% (48-72)	15	58% (39-70)	6.3	25% (15-45)	17.9	61% (51-73)
Advanced or worse	73/302	25	47% (27-57)	18	40% (25-58)	20	70% (55-81)	16.3	69% (52-79)	6.4	33% (21-48)	21	73% (60-83)
Severe or worse	37/302	30	35% (19-52)	21	27% (12-46)	26	78% (43-91)	18.3	87% (68-97)	7.1	22% (07-35)	25	84% (49-97)

^aNumber with the reference standard classification over the total number of observations.

^bThe number of points that define the test threshold; a positive test is greater than or equal to the listed number of points.

MD = mean deviation, PSD = pattern standard deviation, GPTD = global probability of true damage

Figure 5. Diagnostic accuracy of combinations of index test metrics using classification and regression tree (CART) analysis.



Threshold determined by Youden index
To allow for receiver operating characteristic (ROC) curve analysis, FDT GHT outputs were transformed into numbers as follows: "Within normal limits" = 1, "Borderline" = 2, and "Outside normal limits" = 3. FDT PSD and MD are expressed in decibels.

MD = mean deviation (decibels), GPTD = global probability of true damage, PSD = pattern standard deviation, GHT = glaucoma hemifield test

Summary

- Portable perimeter devices have potential to decrease glaucoma-related blindness through early screening and intervention.
- FDT and MDT show suboptimal diagnostic accuracy as sole tools for glaucoma and visual field defect screening due to limited sensitivities for mild-moderate glaucoma.
- FDT and MDT show high accuracy for severe glaucoma suggesting some utility as tools for monitoring known disease.

Acknowledgements

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References

- GBD 2019 Blindness and Vision Impairment Collaborators; Vision Loss Expert Group of the Global Burden of Disease Study. Causes of blindness and vision impairment in 2020 and trends over 30 years, and prevalence of avoidable blindness in relation to VISION 2020: the Right to Sight: an analysis for the Global Burden of Disease Study. *Lancet Glob Health*. 2021;9(2):e144-e160.