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Purpose:

- AMD is a leading cause of blindness worldwide.
- The diagnosis and staging of AMD has improved substantially using advanced imaging.
- However, the utility of infrared (IR) imaging is still evolving.^{1,2}
- We performed a *cross-sectional, retrospective* study to calculate the sensitivity and specificity of IR imaging for signs of early and intermediate AMD, relative to the gold standard of colour fundus photography (CFP).

Methods:

- CFP (Kowa Nonmyd WX3D retinal camera, Kowa, Japan) and IR images (Spectralis HRA2, $\lambda=815\text{nm}$, Heidelberg Engineering, Germany) from 104 eyes with early or intermediate AMD qualified for inclusion.
- Two experienced observers independently graded the presence and location (using the ETDRS subfields) of small, medium and large drusen, reticular pseudodrusen (RPD) and pigmentary changes in each eye. Disagreements were resolved by a third grader.
- The order of images was randomised and the graders were masked to the stage and signs of disease.

Results:

- Using CFP, small, medium and large drusen were observed in 91%, 75% and 45% of eyes respectively.
- RPD and pigmentary changes were each present in 7% and 13% of eyes.
- Agreement between CFP and IR imaging for all signs ranged from 71-97%.
- Sensitivity of IR imaging was highest for RPD (100%) and small drusen (82%), and lower for large drusen (45%), medium drusen (41%) and pigmentary changes (29%).
- Specificity of IR imaging was also high for RPD (95%), pigmentary changes (94%) and large drusen (84%).
- Specificity for medium and small drusen was 69% and 22% respectively.
- Using CFP as the grading standard, RPD were found in 84% of the same locations. This concordance was lower for other lesions: small drusen (39%), large drusen (31%), pigmentary changes (22%), and medium drusen (16%).

Table 1. Inter-grader agreement (averaged across the nine ETDRS subfields)

	Agreement rate		Kappa coefficient	
	CFP	IR	CFP	IR
Small drusen	76%	71%	0.37(Fair)	0.20(Slight)
Medium drusen	79%	86%	0.35(Fair)	0.12(Slight)
Large drusen	92%	92%	0.62(Moderate)	0.44(Fair)
Reticular pseudodrusen	96%	94%	0.21(Fair)	0.54(Moderate)
Pigmentary changes	97%	92%	0.37(Fair)	0.02(Slight)

Table 2. Diagnostic indices for IR imaging in AMD

	Agreement	Cases detected	Sensitivity	Specificity	Positive predictive value	Negative predictive value
Small drusen	77%	78/95	82%	22%	92%	22%
Medium drusen	48%	32/78	41%	69%	80%	69%
Large drusen	66%	21/47	45%	84%	70%	84%
Reticular pseudodrusen	95%	7/7	100%	95%	58%	95%
Pigmentary changes	86%	4/14	29%	94%	44%	94%

Discussion:

- IR imaging displays excellent sensitivity and specificity for RPD, which are more likely to be seen in the superior macula (consistent with the literature).^{3,4}
- Detection and agreement for other AMD lesions was more imperfect.
- Clinicians should be aware of the limitations of this technology during its application.

Conclusion:

- IR imaging displays excellent sensitivity for RPD compared to CFP. However, its utility in the detection of large drusen and pigmentary changes in AMD appears more limited.

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 4. Ueda-Arakawa, N., et al. (2013). "Sensitivity and specificity of detecting reticular pseudodrusen in multimodal imaging in Japanese patients." *Retina* **33**(3): 490-497.

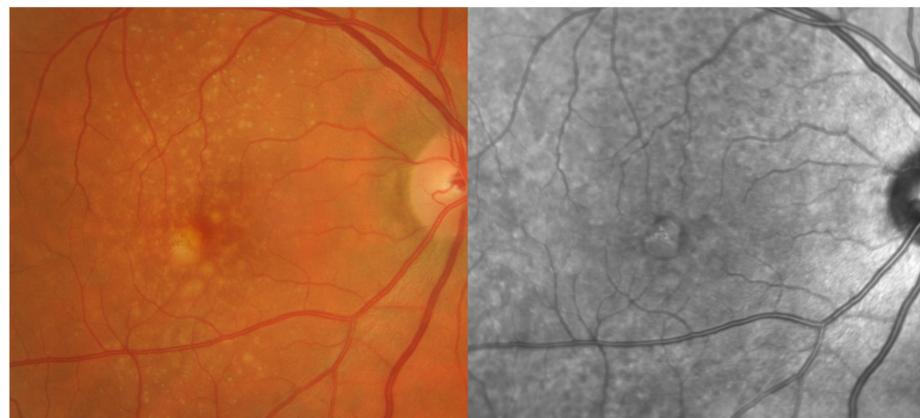


Figure 1: CFP and corresponding IR image both graded positive for large drusen, pigmentary changes and RPD.

Figure 2: Numbers represent affected eyes out of a total cohort of 104. The diameter of the inner, middle and outer circle is 1mm, 3mm and 6mm respectively. Orientation is as for a right eye.

Figure 1. Example of two images graded during the study

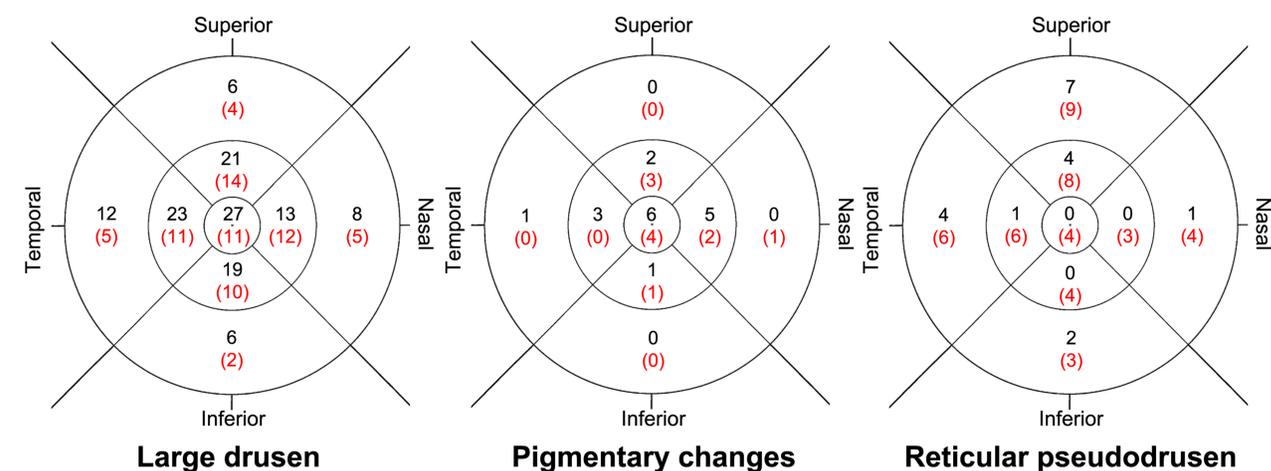


Figure 2. Distribution of key AMD lesions using CFP (black) and IR imaging (red)