A handheld radial shape discrimination hyperacuity test: Assessment of variability in a clinical population

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Purpose
Neovascular Age Related Macular Degeneration (nAMD) is a major cause of visual disability in developed countries. Research suggests that better visual acuity (VA) at commencement of treatment leads to a better final visual outcome\(^1\), meaning that early detection and intervention is desirable.

A handheld Radial Shape Discrimination test (hRSD), presented on an Apple iPod Touch (Fig 1), has been reported to differentiate between early (i.e. non nAMD) and nAMD and to be well-accepted among patients with maculopathy\(^2\). Given the convenience and low cost of this test, it could have a role in screening for nAMD.

The aim of this study was to assess two important aspects of performance of this test in a clinical population: test-retest reliability and the importance of near correction during the test.

Methods
The test consists of a three alternative forced choice procedure in which one out of three circles is artificially distorted (Fig 1). A staircase procedure returns the threshold for detection of radial shape deformation as a logMAR value.

Participants
We recruited 55 non-diabetic patients (78±7 years old, 61 to 93; 32 female) with nAMD in one eye (on treatment) and no nAMD in their fellow eye (Study Eye). Study eyes had no geographic atrophy and their visual acuity was 0.04±0.14 logMAR.

Procedures
All participants performed the hRSD test with their study eye on two consecutive clinical visits, 46±13 days apart. 31 participants also performed the test with and without near addition (Add) in the same session.

Analysis
Bland Altman plots and the intraclass correlation coefficient (ICC) were used for assessment of intersession repeatability. A paired t-test was used to assess the effect of not using near correction.

Results
The distribution of thresholds obtained from the patients in the first and second sessions are shown in Fig 2a. Mean (±SD) hRSD thresholds for the first and second sessions were -0.54±0.17 and -0.56±0.18 logMAR. A paired t-test showed no statistically significant difference between the first and the second session (t(54)=0.72, p=0.48), Fig 2b. Bland Altman analysis confirmed the good agreement (mean bias = 0.01; Fig 2c), showing upper and lower Bland-Altman 95% limits of agreement of 0.25 and -0.27 logMAR. The ICC (95%CI) was 0.71 (0.55 to 0.82; p<0.001; Fig 2d).

A paired t-test was used to assess the effect of not wearing near addition on hRSD threshold. A statistically significant decrease in threshold from -0.49±0.20 to -0.36±0.23 logMAR was seen when near addition was not used (t(30)=3.34, p=0.002), Fig 3a.

The mean difference (95%CI) equivalent to the mean bias was 0.13 (0.05 to 0.21) logMAR, Fig 3b and the mean unsigned difference was 0.20±0.14 logMAR. 68% of participants showed a deterioration in hRSD threshold without near addition (mean 0.25±0.16 logMAR) while 32% showed a mean improvement of 0.11±0.07 logMAR.

Conclusions
The hRSD test has good interobserver test-retest repeatability when performed under supervision in a clinical setting. The bias and limits of agreement found in this study are similar to that of healthy adults across a wide age range\(^4\). This means that normal ageing and early (i.e. non neovascular) macular disease do not seem to adversely affect the repeatability of the test.

However, we did find a statistically significant decrease in threshold when near correction was not used. We estimate that if the hRSD test was performed without near correction in this clinical population, 30% of those without nAMD would fall above the -0.37 logMAR value currently suggested as the cut-off value for detection of nAMD\(^7\) (Fig 2a), leading to an increase of false positives. This is an important consideration, particularly in the context of screening. We therefore recommend that the hRSD test is always performed with near correction in this population.

References

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