The Accuracy of Visual Acuity Measurement Using the Arclight Cloth Chart

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Introduction

Visual acuity (VA) assessment is an essential part of any eye examination. Sight loss is most common in low resource settings where access to medical equipment is least. This need has driven the development of the Arclight ophthalmoscope package (Figure 1) which includes a foldable low-cost cloth 3m distance VA chart (Figure 2).

In this study we aimed to:
1) Assess the accuracy of the Arclight compared to a gold standard ETDRS chart
2) Evaluate the practicality and accuracy of the Arclight chart to classify patients into low vision groups compared to a WHO Primary Eye Care (PEC) chart



Figure 1 Arclight package and foldable 3m cloth visual acuity chart

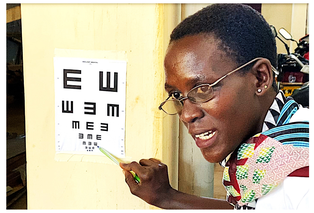


Figure 2 Use of Arclight cloth chart in Kenya

Arclight Chart

The Arclight (Figure 1) is an inexpensive LogMAR chart that has been designed for use in low-middle-income countries. It is printed onto 17 x 22cm washable cloth. It differs from the standard ETDRS chart in having a reduced number of letters per line (2 or 3 letters per line) and a reduced number of lines (0.2 LogMAR steps between lines) and is measured at 3m. The chart is also reversible with one side showing E optotypes (figure 1) and the other a series of four Sloan letters (which was assessed in this study).

WHO Primary Eye Care Chart (PEC)

This chart presents 5 optotypes at two VA levels, 6/12 and 6/60 measured at 3m. A screening pass occurs when the patient can identify 4/5 optotypes correctly in each eye. A screening fail requires investigation or referral.

Methods

Participants

20 young subjects with BSCVA better than or equal to LogMAR 0.0 were recruited to the study. Refractive errors ranged from emmetropia to -7.50DS.

We compared VA measured using the Arclight, PEC and a 6m computerised EDTRS chart. VA was measured monocularly fully corrected and at 6 sequential levels of blur: +3.00DS, +2.50DS, +2.00DS, +1.50DS, +1.00DS, +0.50DS.

Analysis

To compare VA between the Arclight and ETDRS the data was grouped by levels of blur. Bland-Altman and Regression analysis was used to compare results.

Sensitivity and specificity values were calculated to compare all 3 charts using 2 different screening criteria as described for PEC screening:
1) For detecting vision <0.3 LogMAR (ETDRS v PEC ETDRS v Arclight)
2) For detecting vision 1.0 LogMAR or better (ETDRS v PEC and ETDRS v Arclight).

Results

There was good correlation between Arclight and ETDRS charts (y = 0.996x-0.093, R^2 = 0.88, Figure 3). The Arclight chart did record more minus VA than ETDRS (mean LogMAR difference = -0.10 ± 0.14, Figure 4).

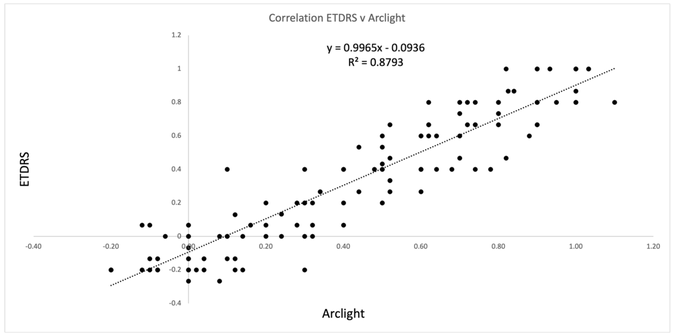


Figure 3 Scatterplot showing correlation between ETDRS and Arclight VA measures. Dotted line represents line of best fit.

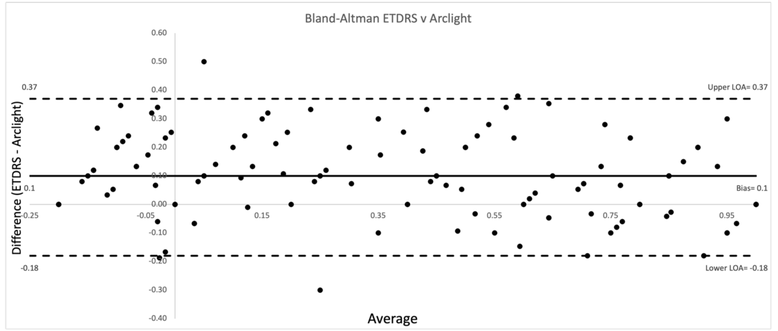


Figure 4 Bland-Altman analysis plot, solid line represents bias (0.1) with dashed limits representing upper and lower limits of agreement (1.96 confidence limit) between ETDRS and Arclight VA measures.

Results

Both the PEC and Arclight chart were found to have high test validity and managed to classify patients into low vision groups well (Table 1), with Arclight being less more specific (96 (91-100%) at detecting 0.3 LogMAR, with PEC being more sensitive (100%) at this level.

Screening Detection Level	*Comparison*	*Sensitivity (%)*	*Specificity (%)*
0.3 logMAR	**ETDRS v PEC**	**100**	**79 (69-90)**
0.3 logMAR	**ETDRS v Arclight**	**87 (79-94)**	**96 (91-100)**
1.0 logMAR	**ETDRS v PEC**	**90 (85-95)**	**67 (10-100)**
1.0 logMAR	**ETDRS v Arclight**	**100**	**/**

Table 1: Sensitivity and Specificity values for the PEC and Arclight charts compared to the EDTRS at 2 screening VA cut off levels.

Conclusions

This study provides promising evidence that the Arclight chart can be used as a quick and reliable means of measuring VA and categorising patients into low vision groups.

The reduction in both the number of letters and lines may result in an underestimation of VA using the Arclight chart compared to ETDRS, irrespective of the level of vision.