



# Virtual Reality Perimetry with Eye Tracking Compared with Standard Automated Perimetry

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## Purpose

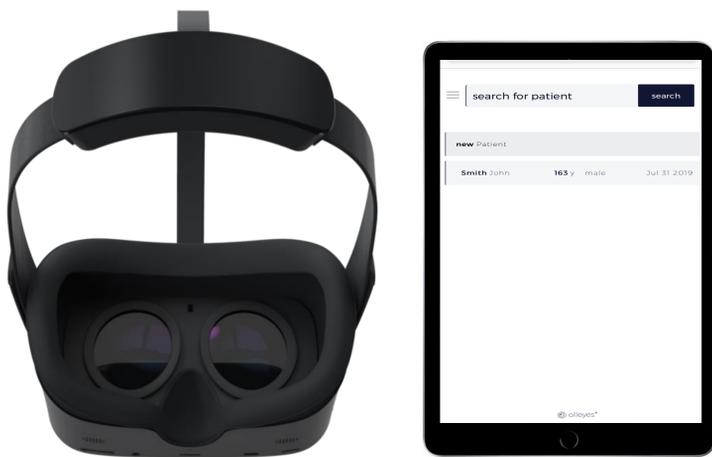
To determine the age-adjusted reference values of the Visu**ALL** ETS (*Eye Tracking System*) Perimeter and its correlation with Humphrey Field Analyzer (HFA) parameters.

## Methods

- This prospective clinical study protocol was approved by the Institutional Review Board of Wills Eye Hospital.
- Participants:
  - Control group: 25 (50 eyes) healthy subjects.
  - Glaucoma group: 26 (52 eyes) glaucoma patients.
- The control group were recruited from hospital personnel and volunteers with a normal eye examination, normal Humphrey visual field, and no prior eye surgery.
- The glaucoma group were mild or moderate glaucoma patients who had reproducible HVF tests.
- The Visu**ALL** system (Olleyes, Inc. Summit, NJ) is composed of a Virtual Reality (VR) headset and the WebApp installed on a cell phone, tablet, or computer (Figure-1)
- The VR headset weighs 520g and includes a Wide Quad High Definition Organic Light Emitted Diode (WQHD OLED) display with a resolution of 2560x1440 pixels with a refresh rate 70Hz. The display is divided in two halves (one for each eye) with a resultant resolution of 1280x1440 pixels on each half subtending a field of view up to 100 degrees.
- The ETS includes 2 eye-tracking system includes infrared cameras with a frame rate of 120fps. The eye-tracking system has a resolution of less than 1 degree.

## Results

Figure-1: The Visu**ALL** headset and the WebApp.



- The demographic characteristics are presented in Table-1.
- The study included 36 eyes with mild and 16 eyes with moderate glaucoma.
- The results of Receiver Operating Characteristic (ROC) curves are presented (Figure-2). Visu**ALL** mean sensitivity (A) had greater ROC than HFA mean sensitivity (B), indicating a better discrimination between healthy and glaucomatous eyes.
- The global mean sensitivity of the Visu**ALL** and the HFA correlated significantly in both control ( $r=0.54$ ,  $P<0.001$ ) and glaucoma ( $r=0.77$ ,  $P<0.001$ ) groups (Figure-3). The mean sensitivity of all quadrants also correlated significantly in the control (SN  $r=0.47$ ,  $P=0.003$ ; IN  $r=0.33$ ,  $P=0.04$ ; ST  $r=0.39$ ,  $P=0.01$ ; IT  $r=0.58$ ,  $P<0.001$ ) and glaucoma groups (SN  $r=0.65$ ,  $P<0.001$ ; IN  $r=0.76$ ,  $P<0.001$ ; ST  $r=0.62$ ,  $P<0.001$ ; IT  $r=0.67$ ,  $P<0.001$ ).

Figure-2: Receiver operating characteristic (ROC) curve of the mean sensitivity of Visu**ALL** (A) and HFA (B) of 0.98 and 0.93 respectively.

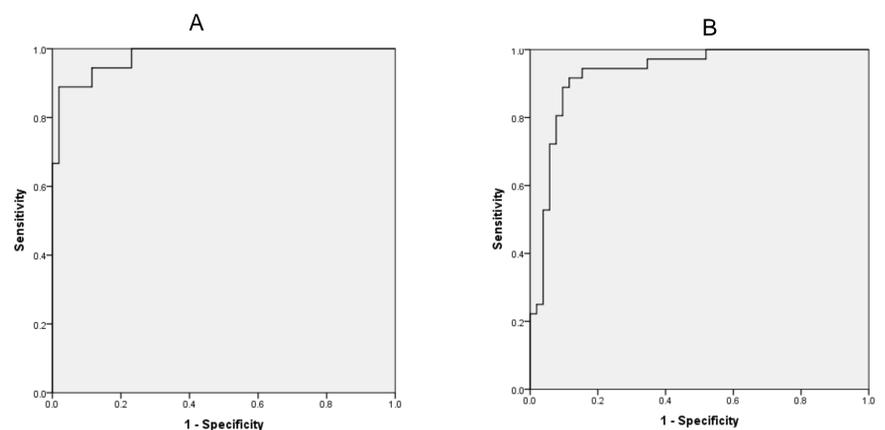
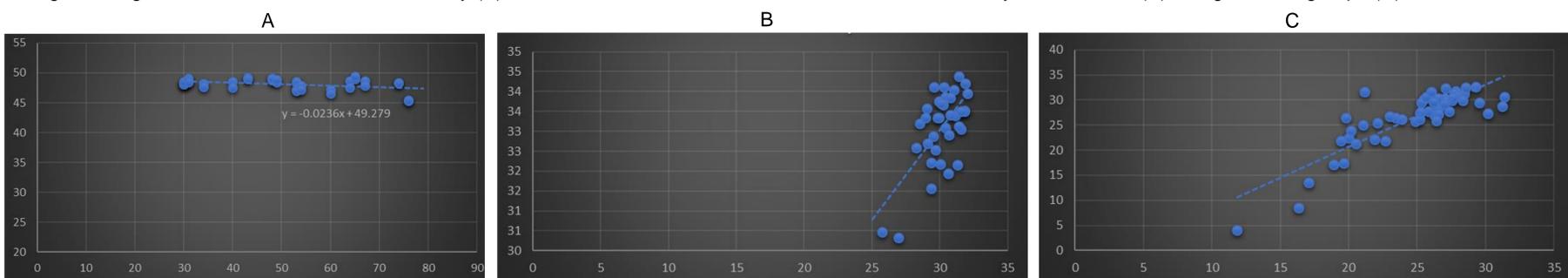


Table-1: The demographic characteristics of control and glaucoma groups.

	Control group	Glaucoma group
Participants	25	26
Eyes	50	52
Age (years)	53.96 (30-79)	66.04 (23-86)
Sex (F/M)	17/8	13/13
Caucasian	13	13
African-American	8	13
Hispanic	3	-
Asian	1	-

Figure-3: Age effect on Visu**ALL** mean sensitivity (A); Correlation between Visu**ALL** and HFA mean sensitivity in the control (B) and glaucoma groups (C).



## Discussion

In this study, the assessed parameters of Visu**ALL** ETS and HFA were well correlated. The Visu**ALL** promises several advantages. The patient can be tested in virtually any position, the head can be freely moved during the test, the Visu**ALL** efficiently controls the testing environment luminance and this VR-based perimetry does not require a dedicated room or technician support and could be performed outside the doctor's office.

## Conclusion

The perimetric results of the Visu**ALL** and the HFA were correlated. The Visu**ALL** has the potential to be an effective and versatile clinical perimetry device.

## References

- Wu Z, Medeiros FA. Recent developments in visual field testing for glaucoma. *Curr Opin Ophthalmol*. 2018 Mar;29(2):141-146.
- Wroblewski D, Francis BA, Sadun A, Vakili G, Chopra V. Testing of visual field with Virtual Reality Goggles in Manual and Visual Grasp Modes. *BioMed Research International*. Feb 2014.