The impact of using eSight Eyewear on visual performances and oculo-motor control in low vision subjects

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Scientific context

WHO: 285 million people visually impaired, 40 million people blind

Magnification devices: among the most common forms of aids in low vision rehabilitation

High-tech solutions electronically based: the future of low vision rehabilitation

Increase the level of independence and function during activities of daily living

Limitation to performing a single type of task at a specific distance

Recently, novel head-mounted displays more and more available, efficient and increasingly being utilized.
Head-Mounted Displays (HMDs): A History

1990s
- Low Vision Enhancement System (LVES)

2000s
- Joint Optical Reflective Display (JORDY)

2010s
- eSight Eyewear
Things to know about HMDs

• Benefit of hands-free magnification, control over contrast & brightness (Culham, et al., 2004; Geruschat, et al., 1999)

• Initial challenges with size, weight, limited magnification & auto focus (Li et al., 2002)

• Reading can be faster for longer duration and at smaller print sizes than with other optical devices (Owsley, et al., 2009; Papageorgiou, et al., Trauzettel-Klosinski, 2010)
eSight Eyewear

1) User spots object of interest
2) Capture live video
3) Digitally optimize the video for the individual in real time
4) Project optimized image onto retina using near-to-eye displays

Contrast Enhanced, Magnified
What we already know about vision rehabilitation and fixation...

• The impact of interventions on the location and stability of a preferred retinal locus (Verboshi, et al., 2013; Tarita-Nistor, et al., 2009; Verdina, et al., 2013)

• Close link between changes in oculo-motor control and functional improvements (Verboshi, et al., 2013; 2009; Verdina, et al., 2013)
Objective

To assess the **impact** of eSight Eyewear on the **visual performances** and **oculomotor-control** of subjects with various low vision conditions.
Method

• Recruitment:
  – CRIR/Centre de réadaptation MAB-Mackay du CIUSSS du Centre-Ouest-de-l’Île-de-Montréal
  – CRIR/Institut Nazareth et Louis-Braille du CISSS de la Montérégie-Centre

• Inclusion criteria
  – Age 13 – 75, BCVA 20/60 – 20/400
  – Stable central visual loss
  – Min. central field of 20°
  – Ready to wear device in public (e.g. work)
  – Motivated, alert
  – Pass MOCA-Blind cognitive assessment
• Outcome measures

1st visit
- distance visual acuity (ETDRS)
- near visual acuity (MNRead Test)
- contrast sensitivity (Mars Contrast)
- reading speed (MNRead Test)

2nd visit
- distance visual acuity (ETDRS)
- near visual acuity (MNRead Test)
- contrast sensitivity (Mars Contrast)
- reading speed (MNRead Test)
- Fixation study (OCT microperimeter)

3rd visit
- questionnaire

4th visit
- distance visual acuity (ETDRS)
- near visual acuity (MNRead Test)
- contrast sensitivity (Mars Contrast)
- reading speed (MNRead Test)
- Fixation study (OCT microperimeter)
Participant Characteristics

- **N = 13 (7 M, 6 F)**
- **Mean Age: 49 (SD: 10, Range 36-63)**
- **Mean Distance VA: 20/126 (SD: 20/40, Range 20/400 - 20/64)**
- **Diagnoses:**
  - Stargardt’s 2
  - Leber’s 2
  - Retinitis Pigmentosa 2
  - Albinism 2
  - Myopic maculopathy 1
  - Retinophathy of prematurity 1
  - Diabetic retinopathy 1
  - Congenital nystagmus 1
  - Achromatopsia 1
Baseline without eSight

Baseline with eSight

Pre-Screening 29

Prescription Assessment 13

Fitting & Training

At Home (1 month)

Follow-up

At Home (2 months)

Testing

Free Loan

N= 7

Return Device

11 complete data
2 incomplete data
Results

At baseline (T0)
Significant improvement overall of 0.76 logMAR, p < .0001

Between baseline (T0) and endpoint (Tfinal)
Significant improvement overall of 0.12 logMAR with eSight
p = .01

At baseline (T0)
Significant improvement overall of .83 logMAR, p < .0001
At baseline (T0)
Significant improvement overall of .73 log CS
\[ p < .0001 \]

No significant change from baseline to endpoint

At baseline (T0)
Significant improvement overall of 45.19 word/min
\[ p = .003 \]

No significant change from baseline to endpoint
Fujii's Classification - Fixation location remained the same for all participants as categorized by the OCT SLO. Improvements of fixation stability recorded for 3 participants.

Bivariate contour elliptic area (BCEA) Fixation stability using the BCEA did not show significant difference after 3 months, p = .20.
Conclusion

• eSight Eyewear immediately improved
  – distance acuity
  – near acuity
  – reading speed
  – contrast sensitivity

• a 3-months utilisation improved
  – distance acuity
  – Near acuity
    ....indicating the benefit of training and/or practice.

• eSight device does not modify fixation location over 3 months

• may improve its stability over 3 months
Meanwhile...

• 3rd-generation eSight device released Feb. 14th 2017

• Ongoing studies:
  – Changes in device use over time

• Next steps: Which types of ADLs are most profoundly impacted and what is the best user profiles?
Thank you!
eSight, 2nd generation, 2013

- High resolution 30 fps video camera
- Two SVGA OLED displays (800x600 px)
- Embedded computer similar to iPAD and high-end smart phones
- Proprietary image processing circuits and operating system
- Head-borne mass ~200g
- Visual field width 30 deg; diagonal 35 deg (3x4 ratio)
- Max magnification 14x

- A full-color digital image is displayed in real-time on high-resolution near-to-eyes organic-LED (OLED) screens
Fixation classification (Fujii et al., 2002).

- The location of fixation was defined as:
  - Predominantly central: more than 50% of the fixation points were located within a predetermined limit area of variation of a 2° diameter circle centered in the fovea.
  - Poor central fixation: less than 50% but more than 25% of the preferred fixation points.
  - Eccentric fixation: less than 25% of the preferred fixation points were classified as predominantly.

- The fixation stability
  - Stable: > 75% of the fixation points were located within a predetermined limit area of variation of a 2° diameter circle centered in the baricenter of all fixation points.
  - Relatively unstable: < 75% of the fixation points were located within a 2° diameter circle, but more than 75% of the fixation points were located within a 4° diameter circle, the fixation.
  - Unstable: If less than 75% were located within a 4° diameter circle, the fixation was considered.

Fixation stability was also quantified by calculating a BCEA encompassing 68% of fixation points.