The effect of eSight Eyewear on visual function

Walter Wittich, University of Montreal & CRIR
Marie-Céline Lorenzini, University of Montreal & CRIR
Judith E. Goldstein, Johns Hopkins University
Samuel N. Markowitz, University of Toronto
Beatriz E. Patino, University of Toronto
Kristen Lindeman, Johns Hopkins University
Sonya Braudway, Center for Retina and Macular Disease
Scott A. Garter, Lighthouse for the Blind of the Palm Beaches
Lindsay Godsay, University of Michgan
Ashley Howson, University of Michigan
Michael Tolentino, University of Central Florida
Thiran Jayasundera, University of Michigan
Sophia Reyes, University of Toronto
Gislin Dagnelie, Johns Hopkins University

Disclosure

- This trial is funded by eSight
- Marie-Celine Lorenzini holds a peer-reviewed Mitacs Accellerate PhD fellowship, co-funded by Mitacs and eSight

Mitacs Accelerate

Head-Mounted Displays (HMDs): A History

1990s

Low Vision Enhancement System (LVES)

2000s

Joint Optical Reflective Display (JORDY)

2010s

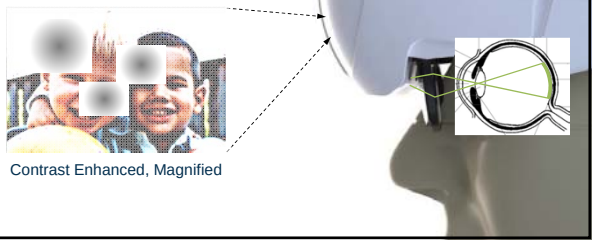
eSight Eyewear

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 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**

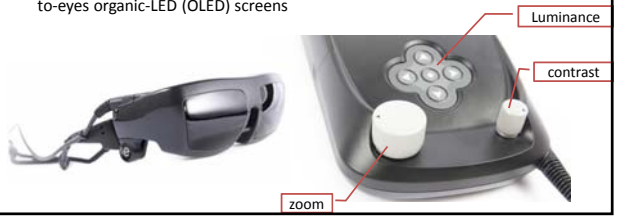


Contrast Enhanced, Magnified

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 37.5 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



eQUEST Study Objective

- To assess the **impact** of eSight Eyewear on the **functional visual performance** in participants with various low vision conditions.

Method

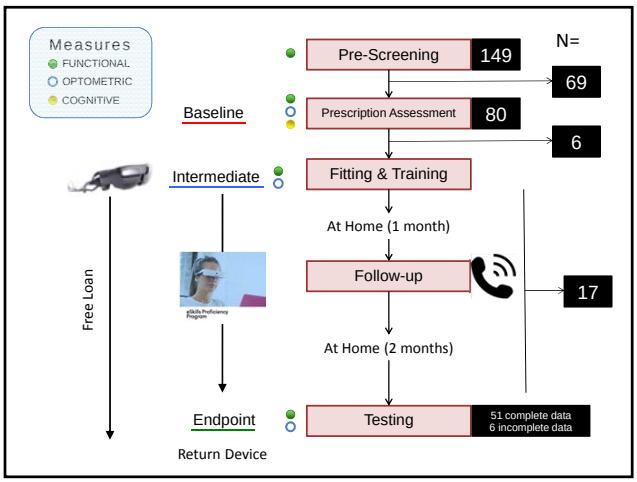
- Sept 2015 – Dec 2016
- 6 data collection sites
  - Johns Hopkins University Wilmer Eye Institute
  - University of Michigan Kellogg Eye Center
  - The Center for Retina and Macular Disease, FL
  - Bascom Palmer Eye Reserarch Institue, FL
  - University of Toronto, Toronto Western Hospital
  - Université de Montréal, School of Optometry

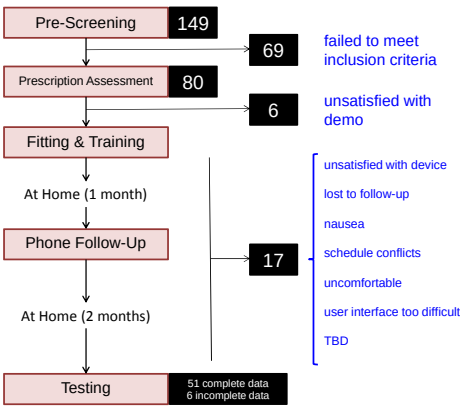
Participant Characteristics

- 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

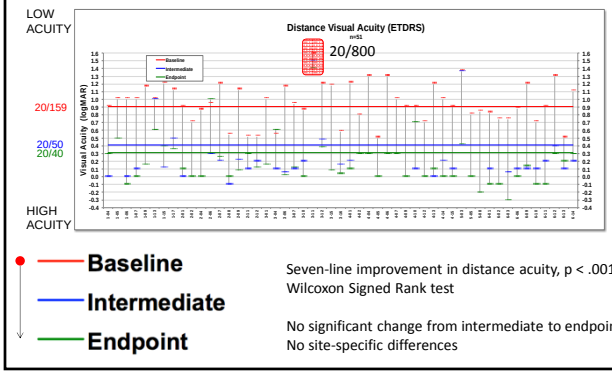
- N = 51 (30 M, 21 F)
- Mean Age: 48 (SD: 17, Range 13-75)
- Mean Distance VA: 20/178 Range 20/63 - 20/800
- Diagnoses:

Stargardt's	11
Leber's	7
Dry AMD	7
Optic atrophy	6
Retinitis Pigmentosa	4
Rod-cone Dystrophy	3
Diabetic Retinopathy	1
Glaucoma	1
Other (e.g. degen. myopia)	11





Distance Visual Acuity (ETDRS)

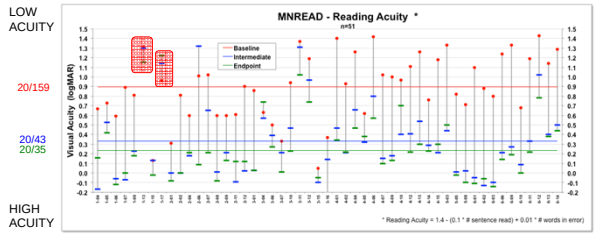


Baseline
Intermediate
Endpoint

Seven-line improvement in distance acuity, $p < .001$
Wilcoxon Signed Rank test

No significant change from intermediate to endpoint
No site-specific differences

Reading Acuity (MNRead)

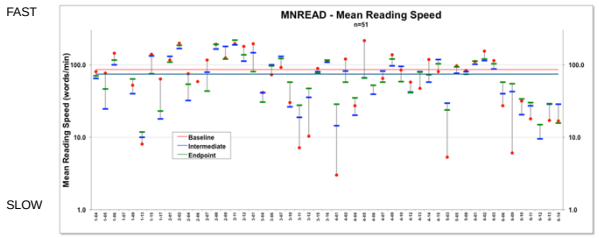


Baseline
Intermediate
Endpoint

Five-line improvement in reading acuity, $p < .001$
Wilcoxon Signed Rank test

One-line improvement in reading acuity, $p < .008$
After 3 months
Some site-specific differences, possibly age-related

Mean Reading Speed (MNRead)

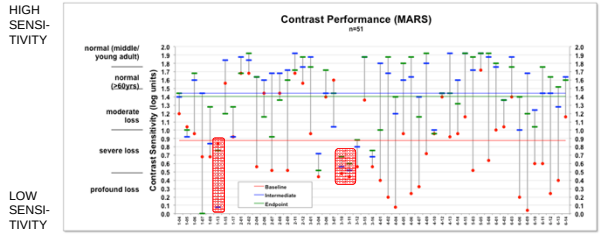


Endpoint
Intermediate
Baseline

No initial improvement in reading speed, $p > .05$
Wilcoxon Signed Rank test

No significant change from intermediate to endpoint, $p = .80$
No site-specific differences

Contrast Sensitivity (MARS)

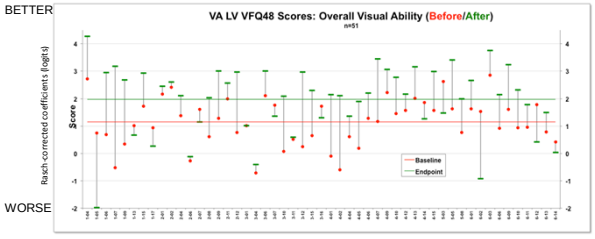


Endpoint
Intermediate
Baseline

12-letter improvement in contrast sensitivity, $p < .001$
Wilcoxon Signed Rank test

No significant change from intermediate to endpoint
No site-specific differences

Overall Visual Ability (VFQ48)

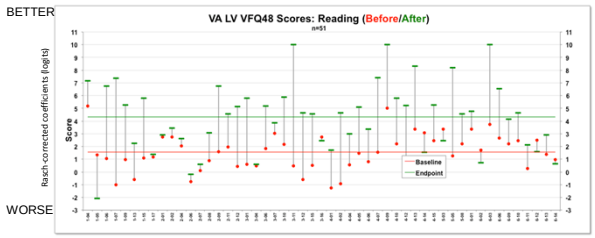


Endpoint
Baseline

Significant improvement overall of .81 logits, $p < .001$

No site-specific differences

Reading Ability



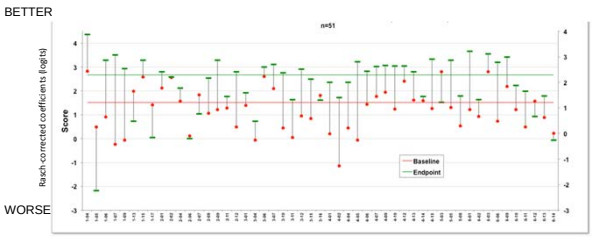
Endpoint

Baseline

Significant improvement in reading of **2.76 logits**, p < .001

No site-specific differences

Visual Information Items



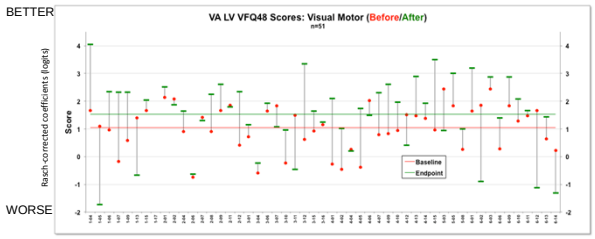
Endpoint

Baseline

Significant improvement in visual information items of **1.08 logits**, p < .001

No site-specific differences

Visual Motor Skill Items



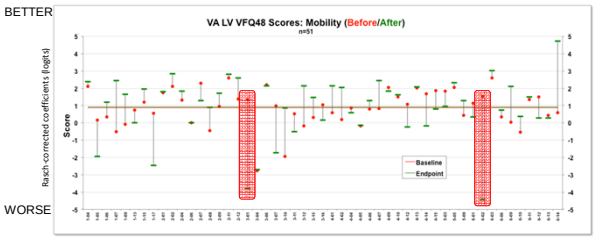
Endpoint

Baseline

Significant improvement in ADLs of **0.48 logits**, p < .001

No site-specific differences

Mobility Items



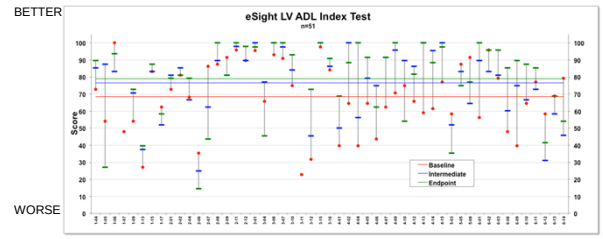
Endpoint

Baseline

No change in mobility items, 0.05 logits, p = .86

No site-specific differences

Activities of Daily Living (Modified Melbourne)



Endpoint
Intermediate
Baseline

Significant improvement on activities tasks, p = .006
Wilcoxon Signed Rank test

No significant change from intermediate to endpoint
No site-specific differences

Overall

- eSight Eyewear immediately improved
  - distance acuity
  - reading acuity
  - contrast sensitivity
  - VFQ 48 domains of reading, visual info & visual motor skills
- We did not observe any significant improvement
  - in reading speed
- Only reading acuity improved further after 3 months of training & practice
- Pilot data (not presented today) indicate benefit on
  - face recognition

Meanwhile…

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

- Parallel studies:
  - Changes in device use over time
  - Benefit of eSight for pianists while reading sheet music
- Next steps: Which types of ADLs are most profoundly impacted?

Questions?

- Thank you / Merci:
- Rob Hilkes – Liaison to eSight
- Robert Massof – Rasch Analysis

walter.wittich@umontreal.ca