Are Referrals from the Plusoptix S09 Significantly More Accurate than the LEA/Random Dot E Referrals For Children Ages 3-5?

Elks Children’s Eye Clinic Preschool Vision Screening Program
Casey Eye Institute at OHSU
Portland, OR
May 2013
Researchers have no financial interest in the findings of this study.

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Special thanks to the vision screening team and the Casey Eye Institute staff who volunteered their time to perform eye exams.
Basic Question of the 2-year study

- Should we change our screening method?
3, 4 & 5 Years Old Screened

- 5 years old, 16, 6%
- 4 years old, 159, 56%
- 3 years old, 108, 38%
Lea Chart In Light Box
Used for Distance Acuity

20/40 critical line at 10 feet
Refer if miss more than 1 on either eye
Medical Tape Used to Occlude Eye
Random Dot E Stereoacuity Test

900 seconds of arc
Pass is 4 out of 5 correct responses
Plusoptix S09 Screened Using Default Settings*
Plusoptix SO9

- Handheld infrared photorefractor
- Binocular autorefraction in <.08 seconds
- Screens for eye misalignment, unequal pupils and media opacities
- Immediate data analysis by computer
- Printed results: “pass” or “refer”
- Can screen children with special needs
- Relatively expensive
  - (PO S09 is $6,000 vs. LEA/Random E kit ~ $500 per kit)
<table>
<thead>
<tr>
<th>Condition</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anisometropia</td>
<td>$\geq 1.00$ D (difference in equivalent sphere)</td>
</tr>
<tr>
<td>Astigmatism</td>
<td>Cylinder $\geq 1.50$ D</td>
</tr>
<tr>
<td>Hyperopia</td>
<td>Spherical equivalent at least $+2.50$ D</td>
</tr>
<tr>
<td>Myopia</td>
<td>Spherical equivalent at least $-1.50$ D</td>
</tr>
<tr>
<td>Corneal reflexes</td>
<td>Asymmetry $\geq 10$ degrees</td>
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*2009 U.S. factory default settings
Vision Screening Result

Surname: Müller
First name: Linschen
Date of birth: 2008-09-09
Date of measurement: 2010-03-30

Spherical equivalent
-0.50
-1.25

Refractive error
+1.50 D -1.00 D 178° -2.75 D -0.75 D 25°

Corneal reflexes

Pupil size
4.4 mm
4.7 mm

Referral criteria

Anisometropia
Spherical equivalent ≠ ±1.00 dpt

Astigmatism
Cylinder ≠ ±1.00 dpt

Hyperopia
Spherical equivalent ≥ ±1.25 dpt

Myopia
Spherical equivalent ≥ ±1.25 dpt

Corneal reflexes
Asymmetry ≠ ±5.0°

Anisocoria
Pupil size ≠ ±1.0 mm

This measurement is part of an eye exam. Vision screening does not replace a complete eye examination by an ophthalmologist or optometrist. Vision screening must be conducted regularly as with any other health exam.

Screening performed at:
 hallucinators
Dr. Smith
123 Main Street
Vision City, FL 49978

www.seevision.com

Refer
Methods

- All children were screened using both the Plusoptix S09 & Light box Lea chart/Random Dot E Stereoacuity screening
  - Head Start teachers administered Lea/Stereoacuity
  - Casey staff administered the Plusoptix S09 screening
- Comprehensive dilated eye exams were performed by Casey Eye pediatric ophthalmologists and optometrists who were masked from the screening results.
The Head Start Participants

414 children provided consent for eye exams

203 refers and 211 passes

58 children absent on exam day

354 eye exams performed on site

73 removed - incomplete screening or duplicate from year 1

283 children qualified for the study
Screening Results

Lea/Random Dot E screening
- Pass: Lea, 207, 73%
- Refer: Lea, 76, 27%

Plusoptix S09 screening
- Pass: PO, 174, 61%
- Refer/Try Again: PO, 97, 35%
- Refer: PO, 12, 4%
Eye Exams

- Distance visual acuity
- Stereopsis test - Titmus Stereo test
- Super Drops and 1% cyclopentolate used to dilate
- Dilated autorefracton using Righton Retinomax K-plus 2
- Cycloplegic retinoscopy performed by OD/MD to measure child’s refractive error
- Dilated fundus examination conducted
### Abnormal Eye Exam Criteria

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<td><strong>Amblyopia suspect</strong></td>
<td>2 line acuity difference, acuity, anisometropia, moderate astigmatism, moderate hyperopia</td>
</tr>
<tr>
<td><strong>Medical Condition</strong></td>
<td>Abnormal anterior posterior segment exam, ptosis, strabismus</td>
</tr>
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</table>
Eye Exam Results

- Normal, 191, 68%
- Abnormal Glasses, 41, 14%
- Specialist, 2, 1%
- Abnormal Exam/ Monitor/ No Treatment, 47, 17%
Eye Exam Diagnostic Results

- 19 amblyopia suspects were detected
  - Plusoptix S09 detected 16, Lea/Random Dot E detected 9
    - 2 amblyopic suspect were missed by both systems (1 treated with glasses, one monitor/return to clinic)

- 4 passed both systems - had abnormal eye exams and required treatment
What did each screening system catch? (true positives)
What did each screening method miss (false negatives)?

![Bar chart showing the number of false negatives for different conditions using two methods: LEA and Plusoptix. The conditions are Astigmatism, Hyperopia, Amblyopia, Myopia, Other, and Aniso. The chart indicates the number of false negatives for each condition for both methods.]
# Sensitivity and Specificity

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<th>Plusoptix</th>
<th>LEA</th>
<th>p-value</th>
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<tr>
<td>Sensitivity</td>
<td>67.74 (57.25, 77.07)</td>
<td>43.01 (32.78, 53.69)</td>
<td><strong>.0004</strong></td>
</tr>
<tr>
<td>Specificity</td>
<td>75.79 (69.06, 81.70)</td>
<td>81.05 (74.75, 86.36)</td>
<td>.2116</td>
</tr>
<tr>
<td>AUC</td>
<td>71.77 (66.10, 77.43)</td>
<td>62.03 (56.25, 67.81)</td>
<td><strong>.0062</strong></td>
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<tr>
<td>PPV</td>
<td>57.80 (47.96, 67.20)</td>
<td>52.63 (40.84, 64.21)</td>
<td>.4956</td>
</tr>
<tr>
<td>NPV</td>
<td>82.76 (76.31, 88.05)</td>
<td>74.40 (67.88, 80.11)</td>
<td><strong>.0403</strong></td>
</tr>
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<tr>
<td>Sensitivity</td>
<td>80.43 (66.09, 90.64)</td>
<td>52.17 (36.95, 67.11)</td>
<td>0.0044</td>
</tr>
<tr>
<td>Specificity</td>
<td>69.62 (63.33, 75.41)</td>
<td>78.06 (72.24, 83.16)</td>
<td>0.0265</td>
</tr>
<tr>
<td>AUC</td>
<td>75.03 (68.53, 81.52)</td>
<td>65.12 (57.36, 72.88)</td>
<td>0.0335</td>
</tr>
<tr>
<td>PPV</td>
<td>33.94 (25.15, 43.64)</td>
<td>31.58 (21.39, 43.25)</td>
<td>0.7607</td>
</tr>
<tr>
<td>NPV</td>
<td>94.83 (90.41, 97.61)</td>
<td>89.37 (84.35, 93.22)</td>
<td>0.030</td>
</tr>
</tbody>
</table>

Sensitivity and Specificity if no treatment counts as normal exam
Comparison Between Plusoptix S09 and LEA/RANDOM Dot E

Based on Treatment

- Plusoptix S09 (AUC = 0.7503)
- LEA/RANDOM Dot E (AUC = 0.6512)
Findings

Plusoptix S09 detected 16 out of 19 amblyopia suspects

LEA/Random Dot E missed 10 out 19 amblyopic suspects.

- 6 were mild suspects
- 4 were moderate to severe
Conclusions

- The Plusoptix S09 is **significantly** more accurate in detecting amblyopia suspects and referral-warranted eye disease in children ages 3-5 than the LEA/Random Dot E screening system.  
  - (p=.0062)

- The LEA/Random Dot E method should be used if the Plusoptix device is not available.

- Screenings should occur every year between ages 3-7.
Questions

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