Fixational Eye Movements in Strabismus

Fatema F Ghasia MD1,2, Aasef Shaikh MD2,3 MD PhD

1Cole Eye Institute,Cleveland Clinic, 2Daroff Dell’s Osso Ocular Motility Laboratory, Cleveland VA Medical Center, 3Case Western Reserve University

INTRODUCTION
• The ability to perceive depth is a tightly coupled process between the visual afferent and visual efferent systems.
• During attempted visual fixation our eyes are never completely still
  • the physiologic involuntary movement comprises of microsaccades, ocular drift and tremor. Despite the constant motion of the eyes the normal fixational eye movements do not prevent binocular vision.
  • Saccades and microsaccades represent an oculomotor continuum and are produced by common neural machinery.
• Horizontal saccades are disconjugate in strabismic patients.
• The purpose of the study was to assess the disconjugacy of fixational eye movements (microsaccades and ocular drift) in strabismic patients and correlate the severity of their disconjugacy with strabismus angle and binocular vision.

METHODS

Study Design:
• Cross-sectional observational study
• 13 strabismic patients with no latent nystagmus or amblyopia, ranging in age from 6-61 years of age (8 female and 5 male)
• Strabismic subjects were divided into three categories based on their strabismus angle
  • ± 4 degrees (n=11; prism diptors)
  • ± 4 degree (15-30; prism diptors)
  • ± 5 degree (≥30 prism diptors)
• Strabismic subjects were divided into two categories based on presence of stereopsis assessed using the Titmus Fly Stereotest.
  • Stereopsis present (detect a fly or better ) n=5
  • Stereopsis absent (could not detect a fly) n=8
• Normal controls with age range from 7-38 years of age (8 female and 6 male) with best corrected visual acuity 20/20 in both eyes and stereopsis of 40 sec arc

Eye Movements:
• Eye movements were non-invasively recorded using a desktop mounted infrared, high resolution camera capable of video-ecography (EyeLink 1000, SR Research)
• The system has an excellent sampling rate of 500 Hz and spatial resolution of 0.01 deg.
• Subjects were instructed to fixate their gaze on a red visual target projected on the computer screen, with a viewing distance of 55 cm. Binocular horizontal and vertical eye positions were recorded under monocular viewing conditions with and without optical correction during the 45 second visual task.

RESULTS

Table 1: Depicts the frequency and amplitude of fixational saccades as a function of strabismus angle and stereoacuity present across all 4 groups. Strabismics had greater amplitude of fixational saccades in the viewing and non-viewing eye as compared to healthy controls.

<table>
<thead>
<tr>
<th>Strabismus Angle</th>
<th>Stereopsis</th>
<th>Fixational Saccades</th>
<th>Fixational Microsaccades</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal angle</td>
<td>Present</td>
<td>1.12 ± 0.53</td>
<td>0.59 ± 0.41</td>
</tr>
<tr>
<td>Large angle</td>
<td>Absent</td>
<td>1.12 ± 0.45</td>
<td>0.58 ± 0.27</td>
</tr>
</tbody>
</table>

Table 2: Depicts the rate and amplitude of visually guided saccades in the viewing and non-viewing eye across all 3 groups. Strabismics had greater amplitude of visually guided saccades in the viewing and non-viewing eye as compared to healthy controls.

<table>
<thead>
<tr>
<th>Strabismus Angle</th>
<th>Stereopsis</th>
<th>Visually Guided Saccades</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal angle</td>
<td>Present</td>
<td>0.09 ± 0.04</td>
</tr>
<tr>
<td>Large angle</td>
<td>Absent</td>
<td>0.02 ± 0.07</td>
</tr>
</tbody>
</table>

Table 3: Depicts the variance of composite eye position of the viewing and non-viewing eye as a function of strabismus angle. Strabimics had greater variance of both the viewing and non-viewing eye compared to normal controls. The variance was greater in patients with large angle strabismus and absent stereopsis.

<table>
<thead>
<tr>
<th>Strabismus Angle</th>
<th>Stereopsis</th>
<th>Eye Position Variance (°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal angle</td>
<td>Present</td>
<td>0.01 ± 0.07</td>
</tr>
<tr>
<td>Large angle</td>
<td>Absent</td>
<td>0.06 ± 0.01</td>
</tr>
</tbody>
</table>

CONCLUSIONS
• Strabismic patients exhibit greater disconjugacy of both fixational and saccadic-drift compared to normal controls.
• The disconjugacy is worse in patients with large angle strabismus and absent stereopsis.
• Strabimics have greater disconjugacy compared to normal controls.
• The amplitude of the fixational saccades do not correlate with the preceding the preceding intra-saccadic drift, as a function of strabismus angle.
• There was no correlation between these parameters in all 3 groups.

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FINANCIAL DISCLOSURE

No conflicts of interest to declare.