Vertical vergence and fusional amplitude

Vertical fusional vergences are movements of the two eyes in opposite directions that serve to reduce vertical image disparity by controlling a hypo- or hyperphoria. Horizontal fusional amplitudes tend to be large (e.g., convergence amplitude is usually >16 prism diopters base-out at near; divergence amplitude – although less well defined – usually >3-4 prism diopters base-in at distance), while vertical fusional amplitudes tend to be very small in patients without longstanding vertical strabismus. Measuring horizontal and vertical fusional amplitudes gives the clinician an understanding of the patient’s ability to control an intermittent deviation, which can shed light on localization and the chronicity of the underlying problem – e.g., a patient with an asymptomatic congenital 4th nerve palsy is likely to have a large vertical fusional amplitude, while a patient with an acute onset acquired vasculopathic 4th nerve palsy will not.

Amplitudes are measured by using a bar prism (base-up over the hypophoric eye or base-down over the hyperphoric eye) as the patient fixes on an accommodative target. The prism power is gradually increased until diplopia occurs, at which point the vertical fusional mechanism can no longer compensate – in other words, the two images can no longer be fused with vertical vergence. While divergence and convergence fusional amplitudes depend heavily on target distance, there is no significant difference in vertical fusional amplitudes between distance and near (Table 1).

Vertical fusional vergence mechanisms are altered by the following:

1. Compensatory mechanism: very large fusional vergences are frequent in long standing, compensated vertical deviations such as congenital 4th nerve palsy.
2. Change in visual acuity: a deterioration in visual acuity may impair the fusional vergence mechanism and cause a previously asymptomatic hyperphoria to (permanently or intermittently) decompensate and transition to a hypertropia.
3. Level of alertness and awareness: any illness, fatigue, loss of concentration, alcohol ingestion or various drugs including benzodiazepines, antiepileptic, antihistamines and antidepressants may impair vertical fusional vergence mechanisms.

Likewise, these processes are common reasons for decompensation of horizontal phorias as well.

Table 1: Average Normal Vertical Fusional Vergence Amplitudes in Prism Diopters

<table>
<thead>
<tr>
<th>Testing Distance</th>
<th>Vertical</th>
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</thead>
<tbody>
<tr>
<td>25 cm</td>
<td>2.6</td>
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<tr>
<td>6 m</td>
<td>2.5</td>
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</tbody>
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