Vertical Misalignment and its Comparison with Head Tilt in Patients with Peripheral Lateral Rectus Palsy

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Aim: *Isolated unilateral abducens palsy is reportedly associated with a subtle hyperdeviation. The pattern of this often unrecognised associated vertical deviation is described and the affected and unaffected sides compared on head tilt.*

Methods: *In a prospective consecutive case series, 20 patients with isolated unilateral abducens paresis were tested for hyperdeviation. Maddox rod and prism test and prism cover test were done in the 9 diagnostic positions to evaluate hyperdeviation after neutralising the primary esotropia. The tests were repeated during static lateral head tilt to either side. A negative Bielshowsky's head tilt test in all the patients and lack of relative ocular torsion on double Maddox rod test were not compatible with vertical muscle palsy.*

Results: *The mean horizontal deviation was 22.7 pd (SD, 11.9 pd) on prism cover test. Hyperdeviation was present in all patients. The mean hyperdeviation of the affected eye was 5.0 pd (SD, 2.1 pd; range, 3 to 8 pd) in the primary position of the prism cover test. The mean vertical deviation by Maddox rod and prism test was 5.7 pd (SD, 2.7 pd). Head tilt to the affected side revealed a mean deviation of 4.6 pd (SD, 2.4 pd) and head tilt to the unaffected side revealed a mean deviation of 4.8 pd (SD, 1.9 pd) with prism cover test. Head tilt to the affected side revealed a mean vertical deviation of 5.0 pd (SD, 2.6 pd) and head tilt to the unaffected side resulted in mean deviation of 5.1 pd (SD, 2.6 pd) by Maddox rod and prism test. Mann-Whitney test revealed a p value of 0.495 for the alternate prism cover test and 0.909 for the Maddox rod and prism test. No significant difference was found between head tilt to the affected and unaffected side. The side of the abducens paresis did not correspond significantly to the side of the hyperdeviation in the primary position.*

Conclusion: *Small hyperphoria of the affected eye is expected in lateral rectus paresis. The relationship between this hyperdeviation, lateral head tilt, and peripheral and central sixth nerve palsy was not found in this study. The amount of deviation may not depend on the head tilt in peripheral sixth nerve palsy.*

Key words: *Abducens nerve diseases, Esotropia, Exotropia, Oculomotor nerve diseases*

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Introduction

Abducens palsy is the most common ocular motor nerve palsy, characterised by an incomitant esodeviation, with or without a visible limitation of abduction. When a vertical strabismus accompanies defective abduction, a differential diagnosis of multiple cranial nerve palsy, skew deviation (brainstem lesion), myoneural junction disease, or orbital dysfunction may be considered.[1-3] This prospective consecutive non-comparative case series performed at the Aravind Eye Hospital, Madurai, India, prospectively examined patients with isolated abducens palsy for the presence of a hyperdeviation.

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Methods

Patients

Twenty patients with isolated unilateral peripheral abducens palsy were tested for hyperdeviation. A complete history was taken and a detailed ophthalmic and neurological work up was performed. The patients were thoroughly examined in the neuro-ophthalmology department, and any associated systemic disease assessed. The age of onset was noted and associated risk factors such as diabetes mellitus and hypertension were medically controlled if present.

Appropriate tests were performed to rule out any other associated diseases. A presumptive aetiology of ischaemic infarction of the peripheral part of the abducens cranial nerve was provided. Informed consent was given by all the patients.

Orthoptic Assessment

The amount of horizontal and vertical deviation was measured in all 9 diagnostic positions. The range of duction was noted and all patients had normal vertical extraocular range of movement. Bielshowsky's head tilt test was negative for all patients, and there was no evidence of cyclodeviation on the double Maddox rod test. The 9 diagnostic positions were as follows:

- the straight ahead position
- 4 secondary positions of 10° to the right and left and 10° up and down
- 4 tertiary positions of 10° up and right, up and left, down and right, and down and left.

The amounts of vertical deviation were also measured by tilting the patients' head 30° towards each shoulder. Both primary deviation (non-paretic eye fixation) and secondary deviation (paretic eye fixation) were measured for both near and distance fixation as appropriate.

The amounts of horizontal and vertical deviation were measured objectively using the prism and cover test (PCT) and subjectively using the Maddox rod and prism test (MT). For the PCT, which measured the magnitude of tropia (manifest deviation), patients fixated at a 6/18 Snellen symbol at 6 m and a cover was placed in front of one eye while the patients fixated with the other eye. Prisms of increasing power were used not only until refixation movement had stopped but also until a reversal of the direction of movement was noted. The increase in prism strength was tailored to each patient and was not performed in uniform steps. The highest prism strength used immediately before the reversal of refixation movement was recorded.

The MT measured the magnitude of phoria (latent deviation). For horizontal deviation, a red Maddox rod was placed over 1 eye with the small glass rods oriented horizontally, while the patients fixated on a small white light at a distance of 6 m. Prisms of increasing strength were used until the red streak was reported to go through the white light. Vertical deviation was measured with the small glass rods oriented vertically.

Data Analysis

Consistent with paralytic strabismus, all patients had an incomitant esodeviation, which increased in the field of deviation of action of the paretic muscle. Only the primary deviations are reported as the results with the secondary deviations were similar. The mean deviations and the standard deviation were calculated for both the objective PCT measurements and the subjective MT measurements for both the horizontal and vertical strabismus components. Correlation between the abduction deficit and the magnitude of hyperdeviation was assessed using linear regression. The hyperdeviation was assessed by both tests in either side head tilt. Independent samples test and Mann-Whitney test were used to examine the relationship between the side of palsy and the side of hyperdeviation.

Results

All the participants had a clinically proven isolated peripheral unilateral abducens palsy. The mean age was 56 years (SD, 10 years; range, 28 to 66 years; median, 59 years). Twelve patients were men and 8 were women. The mean duration of symptoms was 12 months (SD, 8 months; range, 1 week to 32 months). The mean follow-up duration was 8 months (range, 4 to 10 months). Neuroimaging was normal for all patients. Fourteen patients had an associated ischaemic risk factor of diabetes mellitus or hypertension, which was well controlled.

The mean horizontal deviation was 22.7 pd (SD, 11.9 pd; range, 16.0 to 38.0 pd) on PCT. Hyperdeviation was present in all patients. Mean vertical deviation on PCT was 5.0 pd (SD, 2.1 pd; range, 3.0 to 8.0 pd) in the primary position. The mean vertical deviation on subjective testing by MT was 5.7 pd (SD, 2.7 pd; range, 3.0 to 8 pd). Head tilt to the affected side revealed a mean vertical deviation of 4.6 pd (SD, 2.4 pd; range, 3.0 to 8.0 pd) and head tilt to the non-affected side resulted in mean deviation of 4.8 pd (SD, 1.9 pd; range, 3.0 to 7.0 pd) with PCT. On subjective testing with MT, the mean vertical deviation was 5.0 pd (SD, 2.6 pd; range, 3.0 to 8.0 pd) on head tilt to the affected side, and 5.1 pd (SD 2.6 pd; range, 3.0 to 8.0 pd) on head tilt to the non-affected side. Mann-Whitney test revealed a p value of 0.495 for PCT and 0.909 for MT. No significant difference was found between head tilt to the affected and unaffected side.

Discussion

A hyperdeviation was present in all patients with isolated abduction deficit in this study. Although the magnitude of hyperdeviation fell within the normal range of hyperphoria, thus excluding multiple cranial nerve palsies or brain stem lesions, it was clinically significant in the unexplained vertical component of the diplopia it produced in a few representative patients. This correlated well with previous reports of hyperdeviation being significant in primary gaze and in the field of gaze of the paretic lateral rectus muscle.[1,2]

Wong et al found a distinct pattern of vertical misalignment using the MT in patients with peripheral sixth nerve palsy.[4] In peripheral palsy, right head tilt was associated with right

hyperdeviation, and left head tilt was associated with left hyperdeviation. In contrast, in central palsy, the side of hyperdeviation did not change on head tilt to either side. However, there was no such relationship with head tilt in peripheral sixth nerve palsy in the patients in this study. However, no scleral search coils were used and this study was purely clinical.

The previous lack of recognition of a vertical deviation in such cases may be due to several factors.[4] The MT may not be routinely used for quantification of vertical binocular imbalance in patients with abducens palsy without accompanying vertical muscle limitation or other neuro-ophthalmological signs. Secondly, the small hyperdeviation in the primary gaze detected with the PCT may be overshadowed by a larger esodeviation that is invariably present.

Kestenbaum stated that a vertical component may be found in some patients with isolated abducens palsy.[3] This author proposed that there may also be a slight inhibitory effect on vertical movements of the eye. A slight vertical deviation in abducens paresis, which was sometimes noted, was thought to be due to the fact that the eye can be elevated or depressed more than the normal in the direction of the paretic muscle. The incidence or magnitude of the hyperdeviation was not addressed, although 2 to 3 pd of vertical deviation may accompany the abducens palsy.

The static head tilt stimulates receptors in the macula of the utricle leading to ocular counter-roll and a small change in the vertical alignment in healthy people.[4-6] Roll of the head about its naso-occipital axis activates the torsional vestibule-ocular reflex, causing the eyes to rotate around their visual axes. However, when the otolith-ocular reflex pathway is disrupted, ocular torsion and skew deviation are observed.[6,7] This indicates that, under normal circumstances, the otolith-ocular reflex is symmetrical and balanced; it is also suppressed during static head roll. This suppression is probably mediated, in part, by visual mechanisms. Disruption of binocular vision may remove the suppression on the otolith-ocular reflex and lead to the pattern of right hyperdeviation on right head tilt and left hyperdeviation on left head tilt observed in patients with isolated abducens palsy.[4,6,7]

Since most patients with sixth nerve palsy recover within 3 months, they require little investigation at the time of initial presentation if they have no other neurological features, hypertropia falls within the normal range of hyperphoria seen in healthy people, indicating that it is a normal hyperphoria that becomes manifest in the presence of esotropia. In healthy people, the mean vertical deviation in the straight ahead position is 1.5 pd (SD, 1.5 pd).

The magnitude of the vertical misalignment changes with lateral head tilt, but the hyperdeviation does not correlate significantly to the side of the abduction deficit or to the side of the lateral head tilt. The diagnostic position in which the hyperdeviation was most marked did not correlate significantly with the side of the abduction deficit as has previously been reported.

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