Journal of Clinical and Biomedical Sciences

Letter to the Editor

Ocular Tilt Reaction Simplified

Dear Editor,

Ocular tilt reaction (OTR), comprising of a triad of skew deviation, head tilt and ocular torsion, may be a vexing subject to the general ophthalmologist as it is necessary to deal with the anatomy and pathophysiology of the structures of the inner ear responsible for maintenance of balance of the body i.e. the semi-circular canals (SCC) , utricle and saccule.

It is established that the anterior SCC has excitatory projections to the ipsilateral superior rectus (SR) muscle and its yoke i.e., the contralateral inferior oblique (IO) while simultaneously inhibiting the ipsilateral inferior rectus (IR) muscle and its yoke i.e. the contralateral superior oblique (SO). Also, the posterior SCC has excitatory projections to the ipsilateral SO and its yoke i.e. the contralateral IR, while simultaneously inhibiting the ipsilateral IO and its yoke i.e. the contralateral SR. A head tilt causes stimulation of both anterior SCC and the posterior SCC resulting in excitation of ipsilateral intorters (SO and SR) and contralateral extorters (IO and IR) while their antagonists are simultaneously inhibited. The otoliths (utricle and saccule) probably follow a similar pathway. [1]

Normally, a body tilt (along with the initial head tilt) to the right causes a shift of the subjective visual vertical (SVV) to the left resulting in reflex, compensatory orientation of the head to left to realign the SVV to the true vertical. [2] Also, the initial head tilt to right will cause stimulation of the right utricle resulting in excitory signals to pass to the SR and SO (right eye), and IO and IR (left eye). Simultaneously, inhibitory signals pass to their antagonists. The stimulated two intorters (right eye) and the two extorters (left eye) have opposite vertical actions i.e., one is an elevator and the other is a depressor. The opposite vertical actions nearly cancel each other and therefore only a small vertical deviation occurs, whereas their identical torsional actions are additive. [3]

In case of any lesion from the utricle to the brainstem, diminished input from the affected vestibular pathway, for example the left vestibular is the same as stimulation of right vestibular pathway,

Fig 1. Physiologic ocular counter roll to left in response to body tilt to right. Initial head tilt to right causes stimulation of right utricle. The right eye is intorted and elevated while the left eye is extorted and depressed. There is a compensatory head tilt to left to align the subjective visual vertical with the true vertical.

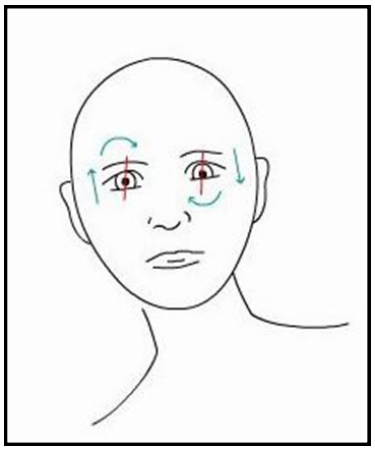

Fig 2. Pathologic ocular tilt reaction due to diminished signal from left utricle (equivalent to stimulation of right utricle), resulting in the perception of a subjective head tilt to right (in the absence of a body tilt), leading to a compensatory head tilt to left. The right eye is intorted and elevated while the left eye is extorted and depressed.

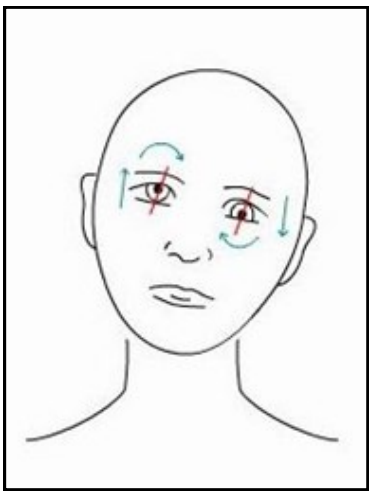

Table 1. Physiologic ocular counter roll as compared to pathologic ocular tilt reaction

	Physiologic ocular counter roll	**Pathologic ocular tilt reaction**
Head tilt (*Initial*)	Tilted to right	Tilted to right (subjective tilt); diminished input from the left utricle in a patient with lesion of left utricular pathway causes the brain to wrongly interpret that the head is tilted to the right even though it is erect.
Subjective visual vertical	Tilted to left	Tilted to left due to erroneous brain interpretation that the head is tilted to right, even though it is erect.
Head tilt (*compensatory*)	Compensatory tilt to left to align with SVV	Compensatory tilt to left to align the erroneous brain interpretation of tilted SVV with the true vertical
Direction of ocular torsion	Stimulation of right utricle causes intorsion of right eye and extorsion of left eye: upper poles of both eyes tilt in direction of reflex head tilt i.e. to left.	Stimulation of right utricle due to erroneous interpretation by the brain that the head is tilted to right causes intorsion of right eye and extorsion of left eye: upper poles of both eyes tilt in direction of compensatory head tilt i.e., to left.

resulting in the erroneous interpretation by the brain that the head is tilted to the right and consequently that the SVV is tilted to the left. This causes reflex rotation of the head to the left, thus realigning the eyes and head to a position that is actually tilted but which the brain interprets as vertical. [4]

Published literature on ocular torsion in physiologic ocular counter-roll are usually not very clear on the type of head tilt inducing the torsion, i.e., initial head tilt causing a tilt in the SVV or the compensatory head tilt to realign SVV with the true vertical. It has been stated that the ocular torsion in physiologic ocular counter-roll appears in the opposite direction as that of the head tilt in contrast to the same direction of ocular torsion as the head tilt in pathologic ocular tilt reaction.[5] However, if instead of the actual head tilt (as compared to true vertical), the direction of the head tilt as interpreted by the brain (subjective head tilt) is given importance, then it is seen that the head tilt and ocular torsion are actually in the same direction in both the physiologic ocular counter-roll and the pathologic ocular tilt reaction.

Conclusion

The subjective head tilt as interpreted by the brain in the presence of asymmetric signals from the inner ear neural afferents is the principal factor in determining the direction of ocular torsion in ocular tilt reaction.

Dr. Keerti Mundey
Assistant Professor,
Dept. of Ophthalmology,
BPS Government Medical College for Women,
Khanpur Kalan, Sonepat, Haryana, India.

Correspondence: Dr. Keerti Mundey
E-mail: keertimannan@rediffmail.com

References

1. Brodsky MC, Donahue SP, Vaphiades M, Brandt T. Skew deviation revisited. Surv Ophthalmol 2006;51(2):105-28.
2. Donahue SP, Lavin PJ, Hamed LM. Tonic ocular tilt reaction simulating a superior oblique palsy: diagnostic confusion with the 3-step test. Arch Ophthalmol 1999;117(3):347-52.
3. Parks MM. Isolated cyclovertical muscle palsy. AMA Arch Ophthalmol 1958; 60(6):1027-35.
4. Parulekar MV, Dai S, Buncic JR, Wong AM. Head position-dependent changes in ocular torsion and vertical misalignment in skew deviation. Arch Ophthalmol 2008; 126(7):899-905.
5. Wong AM. Understanding skew deviation and a new clinical test to differentiate it from trochlear nerve palsy. J AAPOS 2010; 14(1):61-7.