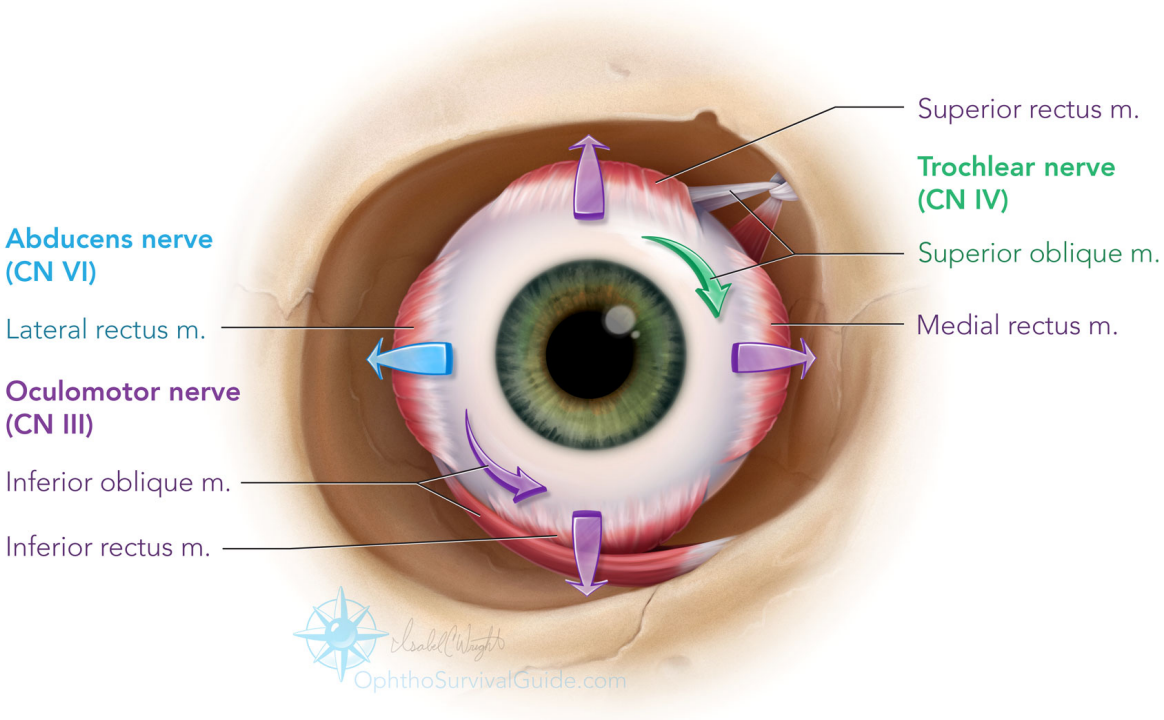
The Ophthalmology Survival Guide

Extraocular Movement (EOM) and Strabismus

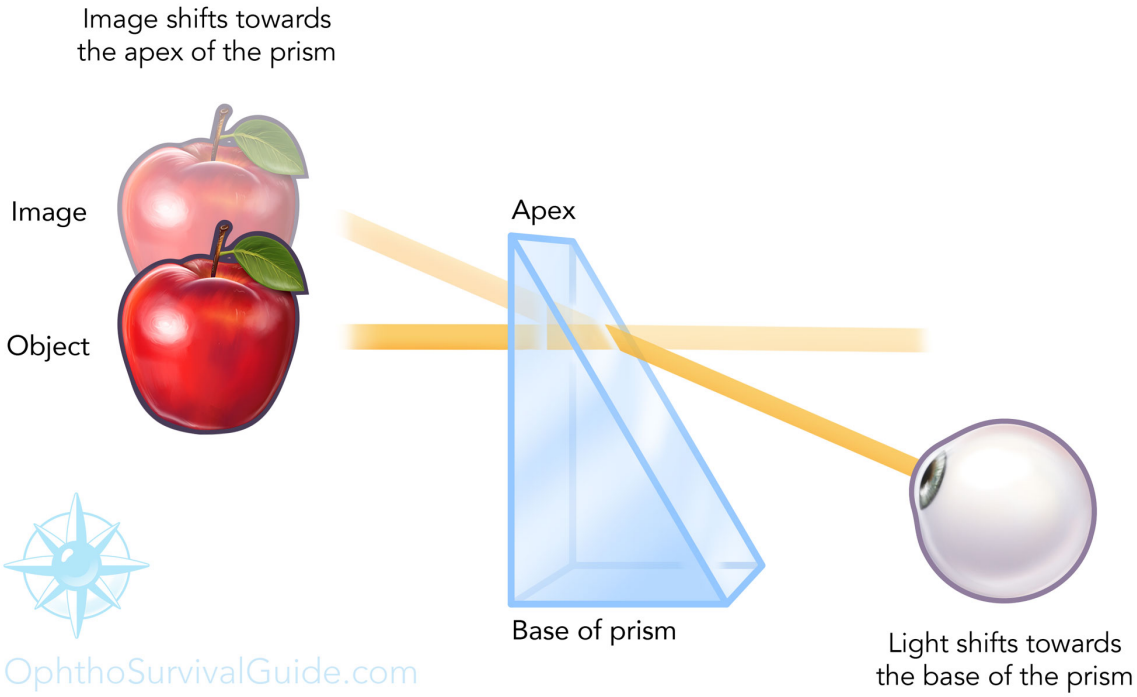
Evaluations of extraocular movement and eye alignment are critical survival skills for essentially the same reason as evaluation of the pupils. Abnormalities of either can be a sign of serious, and occasionally life-threatening pathology. At the most basic level, extraocular movement is controlled by the third, fourth, and sixth cranial nerves. These nerves innervate the six extraocular muscles that control eye movement: 4 rectus muscles (medial, inferior, lateral, superior) and 2 obliques (superior, inferior). The movements of each eye are normally tightly linked to each other so that binocular vision can be maintained. You can't move one eye in one direction and the other eye in another direction. The neural circuitry doesn't work that way.



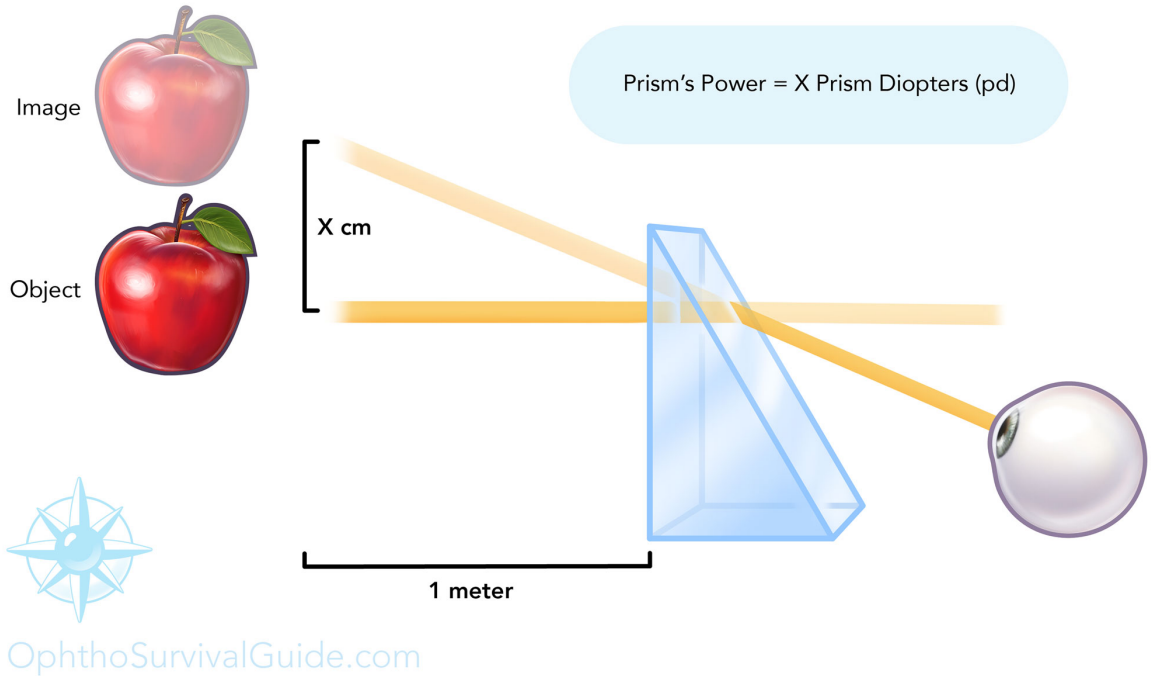
One of the most basic concepts underlying binocular vision and eye movements is fusion, the formation of a single image in the brain by combining the separate images coming from each eye. Fusion not only allows for better visual acuity (i.e. two sources of input are better than one), but also for enhanced depth perception. Strabismus limits or prevents fusion. If the strabismus is non-comitant (ie. varies with gaze or head position) then fusion may be possible in certain positions of gaze or head position, but not others. The presence of a habitual head tilt or face turn is suggestive of strabismus. For example, a 6th nerve palsy on the right may lead to a face turn to the right, thereby keeping the eyes in left gaze to avoid the abduction deficit of the right eye. A 4th nerve palsy on the left may lead to a face turn to the right and head tilt to the right, as doing so minimizes the impact of the palsy on eye alignment and allows fusion. A contracture of the right inferior rectus due to thyroid disease may lead to a chin up posture to keep the eyes in downgaze in order to minimize or eliminate the right hypotropia. Although there are other causes for abnormal head posture, incomitant strabismus is a common one and should be kept in mind, as its presence may be indicative of serious underlying pathology.

Sound easy so far? Not really? It can take some time to process and make sense, and the evaluation of eye alignment is significantly more difficult than the range of extraocular movement. It is without doubt a common source of confusion for the inexperienced examiner. It can even be confusing for those with experience. Although diplopia, or double vision, is the symptom that most strongly suggests an abnormality of eye alignment, it may not always be present (e.g. in children, presence of vision loss). More direct testing is needed. The easiest but least specific way is to look for an asymmetry in the position of the corneal light reflexes on each eye (Hirschberg test) when the patient looks at a light source held by the examiner. A penlight or muscle light works well for that purpose. A much more specific and reliable test to detect strabismus is to test binocular fixation directly using the alternate cover test. The video shows how this test can be easily conducted using a suitable fixation target.

The magnitude of misalignment in strabismus is quantified in units of prism diopters. A prism diopter is different from a lens diopter, which is a unit of refractive power of a spherocylindrical lens. Prisms refract light but do not add convergence or divergence. They simply redirect the light passing through it, shifting its path toward the base of the prism.



The amount of that shift is a measure of the dioptric power of the prism. By definition, the path of a light ray is shifted 1cm off of its original path by a 1 prism diopter (pd) prism at a distance of 1m away. This property allows appropriately oriented and powered prisms to compensate for vertical and horizontal misalignment when placed over the deviated eye.



If the misalignment is horizontal and the visual axes are crossed, the deviation is called esotropia. If the misalignment is horizontal and the visual axes are divergent the deviation is called exotropia. If the misalignment is vertical then the eye with the higher visual axis is said to be hypertropic and the eye with the lower visual axis is said to be hypotropic.. A hypertropia in one eye implies a simultaneous hypotropia in the other eye. Measurement of strabismus using prisms and alternate cover testing can be quite tricky and confusing at times. It requires extra training and experience but is essential for surgical planning and can be quite helpful for establishing the correct diagnosis and monitoring a patient for changes over time. If eye misalignment is torsional (around the antero-posterior axis) then prisms cannot be used for measurement and other techniques are necessary. A full discussion of this subject is beyond the scope of this guide and survival is more dependent on accurate detection than exact measurement with prisms. So let's move on.

If abnormal eye alignment is due to serious underlying pathology, such as cranial nerve palsy, an orbital lesion, or myasthenia gravis, there will also typically be a readily detectable abnormality in the range of extraocular movement in one or both eyes. Abnormal eye alignment in the presence of normal extraocular movement is generally more likely to be benign, but can also occur as a result of vision loss or intracranial pathology that disrupts binocular vision controls. The most appropriate evaluation will depend on the situation and history, but detection and proper documentation is critical.

When documenting extraocular movement and eye alignment it isn't enough to write EOMI (i.e. extraocular movement intact). The presence or absence of strabismus (abnormal alignment) should also be noted as well as its type (e.g. esotropia, exotropia, hypertropia, hypotropia). Accordingly, if the examination of extraocular movement and eye alignment is normal, it is best to document this as follows:

EOM full OU, No strabismus noted.

If, on the other hand, the examination reveals abnormalities, these can be accurately documented using various forms of notation to indicate the direction and magnitude of impaired EOM, or the presence of strabismus. Generally speaking, an eye's range of EOM can either be normal (i.e. full) or reduced. It is never "more" than normal, except

perhaps in the very rare event that an extraocular muscle becomes detached from the globe or severed, allowing rotation in the opposite direction to be farther than normal. The range of EOM should be tested separately for each eye. In terms of strabismus, keep in mind that it can be present in some gaze positions but not others, and can be intermittent or constant. Keeping these things in mind will help you to avoid overlooking key findings, something that's essential to survival.

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