Chapter 7
Ocular Motility Testing in Children

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ABSTRACT

The purpose of this chapter is to provide the main indications, background, and procedures when assessing eye movement function in the pediatric patient. The assessment of extraocular motility function includes version and ductions using the H pattern test in order to determine the presence of underaction or overactions of the extraocular muscles (EOM). EOM testing detects abnormalities in the structural and neurological integrity caused by an acquired or congenital disease of the central nervous system. Deficits in eye movement function can also contribute to poor academic performance which requires a developmental approach to the assessment of saccadic and pursuit eye movements to determine if a referral for optometric vision therapy is indicated. For the older child who is reading to learn, an assessment of reading eye movements using objective tests, such as the Visagraph and/or the ReadAlyzer, will guide the direction of the management plan.

INTRODUCTION

Eye movement testing in the pediatric population assesses a child's visual system on several levels and should be evaluated during the primary care examination. First, the structural and neurological integrity is assessed to rule-out the presence of an acquired or congenital disease of the central nervous system requiring a neurological evaluation (London, 2020; Scheiman & Wick, 2020). Second, visual function and developmental status is assessed to determine the presence of learning related vision problems that may impact academic performance (Birnbaum, 1983; Maples, 2017; Rouse, 2006; Taub 2012).

There is a high prevalence of ocular motility function deficits in children with special needs (Taub, 2012). This can range from congenital or acquired strabismus due to cranial nerve palsies or due to delays in visual development. In addition, growing public health interest in sports-related concussions require clinicians to understand that ocular motility deficits are common visual sequela seen in particularly the

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adolescent population (Graham et al., 2014; Master et al., 2016; Galloway et al., 2017). Although poor reading ability is the main indication for testing in the pediatric population, some additional commonly reported vision symptoms associated with ocular motility deficits include:

- Loss of place, omission of words when reading.
- Poor efficiency with reading and other academic assignments resulting in poor reading comprehension.
- Difficulty fixating, locating, or tracking objects.
- Poor attention and easily distractible with sustained visual activities.
- Vague asthenopic symptoms around the head or eyes.
- Poor coordination of body and eyes.
- Vertigo, dizziness, motion sickness.

This chapter will be divided into two parts: Part I: Structural & Neurological Status and Part II: Visual Function and Developmental Status. Specific clinical procedures to accurately assess versional or conjugate ocular motility function in the pediatric patient will be presented.

PART I: STRUCTURAL AND NEUROLOGICAL STATUS

Versions and Ductions

Versions and ductions assess the structural and neurological integrity by detecting the presence of a congenital or an acquired disease of the central nervous system which may require further neurological evaluation. There are six extraocular muscles in each eye: superior rectus (SR), inferior rectus (IR), lateral rectus (LR), medial rectus (MR), superior oblique (SO), and inferior oblique (IO) (Ciuffreda & Tannen, 1995; Wong, 2008). See Table 1 for the primary, secondary, and tertiary actions as well as the cranial nerve innervation for each muscle. In addition, a mneumonic "RAD SIN" aids in remembering the functions of the muscles. "RAD" refers to the rectus muscles adducting while "SIN" refers to the superior muscles intorting. The actions of each muscle for eye movements depend upon the actual position of the eye (Ciuffreda & Tannen, 1995; Wong 2008).

Versions and ductions testing would rule-out the presence of extraocular muscle underactions or overactions. Cranial nerve palsies may lead to muscle paresis or paralysis. A paralysis occurs when there is complete nerve damage resulting to no movement in the direction of the diagnostic action field. A paresis occurs when there is partial nerve damage resulting in varying degrees of muscle restriction. When differentiating a palsy of recent onset, the secondary deviation (when the deviated affected eye is fixating) is typically larger than the primary deviation (when the unaffected eye is fixating) (Griffin & Borsting, 2010). When a cranial nerve palsy is suspected, the goal is to determine if there is a congenital or a recently acquired cranial nerve palsy. For example, in a child manifesting a constant esotropia in one eye, a sixth nerve palsy can be seen if the lateral rectus of the affected eye does not abduct. If this same child also reported a recent onset diplopia and a recent onset esotropia, a consult is urgently required to determine the presence of an active neurological disease process. The most common cause of acute cranial nerve palsies was found to be neoplasms. About 20% in children (0-14 years) and in 31% in adolescents (15-19 years) (Park et al., 2019).