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Guest Editorial

The red reflex test: A simple tool to detect alarming pediatric eye disease

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Assessment of visual function or screening for ocular disorders in children warrants an approach distinct from that employed in adults, due to the unique nature of a child's evolving developmental status.[1] Arthur Brückner, a German-Swiss ophthalmologist, described a simple "trans-illumination" test to detect subtle strabismus and amblyopia in poorly cooperative young children in 1962.[2] In 1981, Tongue and Cibis popularized this English literature and described the method in detail.[3] Today, it is widely employed in the screening of pediatric eye diseases, such as vision-threatening refractive errors, to life-threatening retinoblastoma.[4]

1. How is the Red Reflex Test Performed?

The red reflex test is traditionally performed using an ophthalmoscope or a retinoscope, preferably in a dimly lit room with the child seated with a caregiver at about an arm's distance from the examiner. The position of the corneal reflex is assessed, which reflects alignment of the pupils. Attention is then directed towards the "fundus reflex" or "red reflex," which is evaluated for the color, brightness, and symmetry across both eyes.[3,5] The red reflex is considered "normal" when the reflex across both eyes is equally clear and comparable in color and intensity.[5] It has been observed that the color of the reflex can vary based on ethnicity and should be considered before referral for an 'abnormal red reflex'.[6]

2. What Can a Red Reflex Test Detect?

Abnormalities of the red reflex can be grouped into (i) an abnormal color or (ii) an abnormal pattern. An absent red reflex or "black reflex" results from any media opacity in the visual axis, such as a corneal scar, hyphema, dense cataract, or vitreous hemorrhage.[5] A "white reflex" or leukocoria can be commonly seen with congenital eye disorders such as congenital cataract, persistent fetal vasculature, vascular disorders such as retinopathy of prematurity, intraocular infections, inflammations, and trauma, and tumors such as retinoblastoma and medulloepithelioma.[7] An abnormal pattern of red reflex can be seen with refractive errors and pupillary anomalies such as an iris coloboma.[6]

3. Who Can Perform a Red Reflex Test?

Being a simple test to perform with adequate training, depending on the setting of screening, a red reflex test can be performed by a pediatrician, primary care physician, school nurse, optometrist, or personnel trained to offer primary eye care.[6] While performance and interpretation can be subjective, there are several devices used for eye screening based on the red reflex principle, which perform an objective assessment to detect pediatric eye diseases such as refractive error, strabismus, amblyopia, and cataract.

4. Guidelines and Recommendations on Performing a Red Reflex Test

The American Academy of Pediatrics recommends the red reflex test as a mandate: "All neonates, infants, and children

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should have an examination of the red reflex of the eyes performed by a pediatrician or other primary care clinician trained in this examination technique before discharge from the neonatal nursery and during all subsequent routine health supervision visits." Children with any abnormality on the red reflex test, as described above, are referred to an ophthalmologist adept at pediatric eye diseases. Children with known risk factors or significant family history are triaged higher.[8]

The Government of India guidelines (Rashtriya Bal Swasthya Karyakram, Ministry of Health & Family Welfare, Government of India) include the red reflex test for universal eye screening of newborns,[9] and the red reflex finds its place in the Indian National Consensus Statement on pediatric eye examinations.[10] The red reflex test is also a part of pediatric screening protocols aimed at the early detection of retinoblastoma in several countries, such as Canada, the USA, the United Kingdom, Australia, and New Zealand.[11]

5. Sensitivity and Specificity of the Red Reflex Test

In a meta-analysis of >8000 infant studies that employed the red reflex test to detect ocular pathology, the sensitivity was estimated at 7.5% and the specificity at 97.5%. For ocular pathology that warranted any form of intervention, the sensitivity and specificity were 17.5% and 97.6% respectively, emphasizing the importance of referral in a child with an abnormal red reflex.[12] Given the simplicity and non-invasive nature of the test, the red reflex test is a useful tool for screening of pediatric eye diseases.

6. Newer Devices and Technology

Several devices, such as photoscreeners, are commercially available that employ the red reflex principle for objective detection of amblyopia and refractive errors.[8] Devices such as ArcLight use the same principle and have been employed in community screening in Africa for the detection of cataract and retinoblastoma.[13] With the use of algorithms that can precisely characterize the pupillary reflex, smartphone-based applications such as CRADLE have evolved that can be used by parents and caregivers to detect a white pupillary reflex of leukocoria.[14,15] With the advantage of being available free of cost, these applications can be used on a larger scale with no training.

In summary, the red reflex test remains a time-tested basic tool for pediatric eye screening. The amalgamation of technology and eventually artificial intelligence to this traditional method has the scope to give rise to scalable, robust, universal screening tools in the future to aid in the early detection of pediatric eye disorders.

7. Conflict of Interest

None.

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