

The Red Reflex Test - Shadow conceals, light reveals

“What are so mysterious as the eyes of a child?” - Phyllis Bottomed

In 1892, Smith observed that the corneal light reflex was more clearly discernable against the bright background of the pupillary light reflex using the coaxial illumination of an ophthalmoscope.^[1] Worth found that the pupil in the deviating eye appeared larger and the fundus reflex brighter as compared to the fixing eye.^[2] Based on these observations, Brückner described in German literature in 1962 a simple screening test to assess the symmetry of binocular fixation by comparing the intensity and quality of red reflex simultaneously in both eyes using the direct ophthalmoscope, which he called “pupillary transillumination”.^[3] Tongue and Cibis popularized it eponymously as the Brückner’s test.^[4] Various aspects of the red reflex test have been extensively studied over the years, beyond what Brückner originally intended it for, and it is currently recommended as an inexpensive tool for rapid opportunistic screening of the newborn by

Table 1: Red reflex test - Recommendations for interpretation and referral^[4]

- All neonates, infants, and children 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.
- The result of the red reflex examination is to be rated as normal when the reflections of the two eyes viewed both individually and simultaneously are equivalent in color, intensity, and clarity and there are no opacities or white spots (leukocoria) within the area of either or both red reflexes.
- All infants or children with an abnormal Brückner reflex or absent red reflex should be referred immediately to an ophthalmologist who is skilled in pediatric examinations.
- The referring practitioner must communicate the abnormal findings directly to the ophthalmologist and receive confirmation back from the ophthalmologist that proper follow-up consultation was performed.
- Infants or children in high-risk categories, including relatives of patients with retinoblastoma, infantile or juvenile cataracts, retinal dysplasia, glaucoma, or other vision-threatening ocular disorders that can present in infancy, should not only have red reflex testing performed in the nursery but also be referred to an ophthalmologist who is experienced in examining children for a complete eye examination regardless of the findings of the red reflex testing by the pediatrician.
- Infants or children in whom parents or other observers describe a history suspicious for the presence of leukocoria in one or both eyes should be examined by an ophthalmologist who is experienced in the examination of children.

Adapted from: American Academy of Pediatrics, Section on Ophthalmology, American Association for Pediatric Ophthalmology and Strabismus, American Academy of Ophthalmology, American Association of Certified Orthoptists. Red reflex examination in neonates, infants, and children. Pediatrics. 2008;122:1401-1404

the pediatricians and other healthcare professionals for common sight-threatening entities such as asymmetrical refractive error, squint, congenital cataract, corneal opacities, and retinoblastoma and other simulating causes for leukocoria.^[4] The joint policy statement by the American Academy of Pediatrics, American Association for Pediatric Ophthalmology and Strabismus, the American Academy of Ophthalmology, and the American Association of Certified Orthoptists recommends red reflex test “as a component of the eye evaluation in the neonatal period and during all subsequent routine health supervision visits” and provides succinct recommendations and outlines indications for referral to an ophthalmologist [Table 1].^[4] The red reflex test is also a part of the Government of India guidelines for universal eye screening in the newborn.^[5] The World Health organization, however, does not include it in its primary care mandates. Fig. 1 shows the common findings seen on the red reflex test and its implications.

Is Red Reflex Test Reliable?

In a recent meta-analysis, Subhi *et al.*^[6] analyzed the diagnostic value of the red reflex test without pupillary dilation versus standard diagnostic examination with pupillary dilation in 8713 infants from five unique studies. The sensitivity of the red reflex test for ocular diseases, in general, was a low 7.5% but with an impressive specificity of 97.5%.^[6] Sensitivity (17.5%) was better for ocular pathologies that required medical or surgical intervention.^[6] The negative predictive value was 99.2%, implying that 99 of 100 infants with a normal red reflex will not have a severe ocular disease.^[6] The positive predictive value was 7.7%, indicating a 7-fold higher risk of severe ocular disease in infants with an abnormal red reflex.^[6] In a large meta-analysis published in this issue of Indian Journal of Ophthalmology, the authors seem to confirm the low sensitivity (23%) and high specificity (98%) of the red reflex test but show that the test is excellent for the detection of anterior segment anomalies (99.2%) as compared to disorders of the posterior segment (14.1%).^[7]

Is Red Reflex Test Useful?

There are detailed guidelines for age- and risk-stratified pediatric eye evaluation.^[8] However, in a real-world setting, with sight and/or life-threatening conditions such as congenital cataracts and retinoblastoma being rare, screening of all neonates by an ophthalmologist or by a dilated fundus examination or wide-field imaging may not be cost- and time-effective and may overwhelm the healthcare system. In this context, the utility of the red reflex test as a simple and inexpensive general neonatal screening tool cannot be undermined. Real-world data shows that congenital cataract is diagnosed earlier in Sweden (where a red reflex test is performed on all neonates) as compared to socioeconomically similar neighboring Denmark (where a red reflex test is not routinely used).^[9] An undilated red reflex test can detect a posterior polar tumor, while a dilated red reflex test may help discern a peripheral tumor as well, thus making the early diagnosis a possibility. Squint would be very evident, but an astute observer may be able to pick up an odd child with an asymmetrical refractive error.

Red Reflex Test

How to perform?

The red reflex test is best performed in a darkened room by holding a direct ophthalmoscope (preferably with a halogen light source and with lens power set at zero) close to the examiner's eye. The ophthalmoscope light should be projected onto both eyes of the child simultaneously from approximately 18 inches distance and the child should be encouraged to look at the source of light. The test is ideally performed with undilated pupil. If the reflex is suboptimal or if an abnormality is suspected, then a dilated (using mydriatics as appropriate for age) red reflex test can be safely performed with parental consent in a child >2 weeks of age.

What is abnormal?

To be considered normal, a red reflex should emanate from both eyes and be symmetric in colour and intensity, and the size of the pupils should be symmetrical. Dark spots in the red reflex, a markedly diminished reflex, the presence of a white reflex, or asymmetry of the reflexes (Brückner reflex) are all indications for referral to an ophthalmologist who is experienced in the examination of children.



Normal

Bright and symmetrical red reflex with equal pupil size



Anisometropia

Asymmetric brightness of the red reflex with a superior crescent (hyperopia) or an inferior crescent (myopia) or a decentred crescent (astigmatism). The test may have to be performed at varying distances up to 4m to achieve better sensitivity. Anisometropia, fixation pattern and squint provide clues to amblyopia.



Squint

The red reflex is more intense in the deviated eye and the corneal reflex is decentred temporally (esotropia) or nasally (exotropia), and the pupil of the deviated eye appears larger.



Corneal, Lenticular or Vitreous Opacity

A corneal opacity or a foreign body shows up as a dark reflex (moves in the same direction as the examiner) in the background of a bright red reflex. An opacity in the pupillary plane (anterior capsular opacity) shows no differential movement. Posterior subcapsular cataract, Mittendorf dot or a vitreous opacity also appear dark in the background of a red reflex, but the movement will be opposite to the examiner.



Cataract

No clear red reflex on the affected side, a white reflex instead, the uniformity and density of which may depend on the location and severity of the cataract.



Retinoblastoma

A yellowish-white reflex is typical of retinoblastoma. Other rare differential diagnosis of leukocoria include astrocytoma, persistent foetal vasculature, familial exudative vitreoretinopathy, toxocariasis or fundus coloboma etc. A golden yellow reflex (xanthocoria) suggests Coats disease.

Figure 1: Red reflex test – how to perform and interpret

Are There Better Screening Tools?

Seemingly better and inexpensive screening tools are emerging as potential alternatives to the classic red reflex test. A recent study from Tanzania showed sensitivities of 97.6% for CatCam, 92.7% for Arclight, 90.2% for PEEK retina as compared to only 7.3% for torchlight in the detection of cataract and retinoblastoma with an ophthalmologist's examination as the gold standard.^[10] Estimated specificities were 100% for CatCam, 96.7% for Arclight and 86.7% for PEEK retina. Smartphone-based infrared imaging for cataracts and App-based tools for retinoblastoma detection are already available. TrackAI project with a novel Device for an Integral Visual Examination (DIVE) plugging onto smartphone-based artificial intelligence algorithms is an exciting new development.^[11]

Future Seems Bright

While the classic red reflex test performed in an ideal clinical setting by a trained observer continues to be the basic screening tool for neonatal eye screening, escalation to a robust age- and risk-stratified screening strategy, where indicated, may help optimize the screening net. Future seems pregnant with possibilities of bright and technologically driven mass screening tools.

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