University of Manitoba

Looking Through a Child's Eyes

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Disclosures

- I have no financial disclosures or conflicts of interest to declare

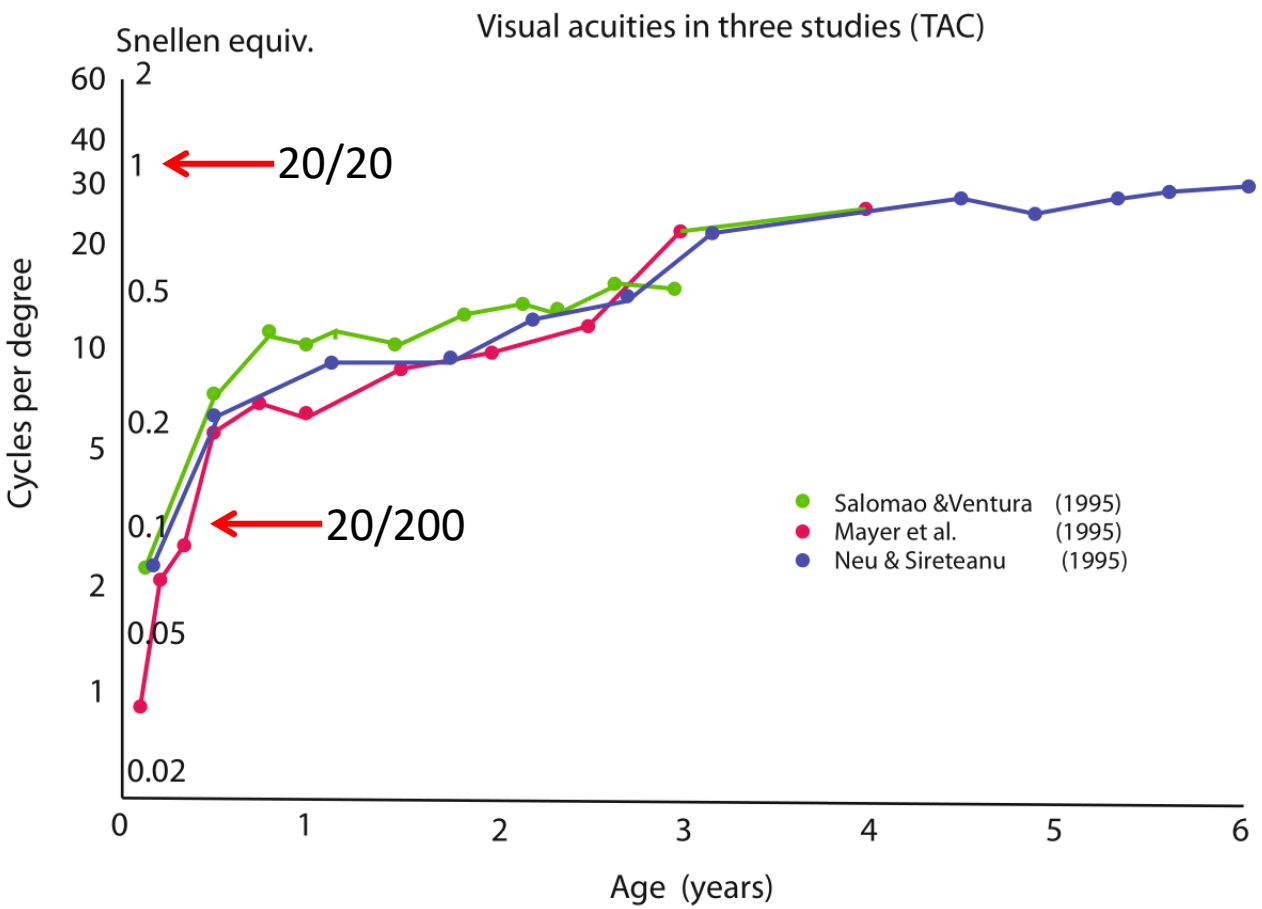
Medical School	2008	University of Toronto
Residency	2013	Ophthalmology, University of Toronto
Fellowship 1	2017	Peds neuro-ophthalmology, Toronto
PhD/CIP	2018	Visual neuroscience, University of Toronto
Fellowship 2	2018	Peds ophthalmology, Perth, Australia
Fellowship 3	2019	Strabismus & peds ophthalmology, London, UK

My clinical interests are pediatric and adult strabismus, pediatric neuro-ophthalmology, retinopathy of prematurity, and pediatric cataract.

Normal visual development

- Human visual system is immature at birth
- Normal binocular experience is required for proper development

Visual acuity development



Functional immaturity correlates with anatomic immaturity

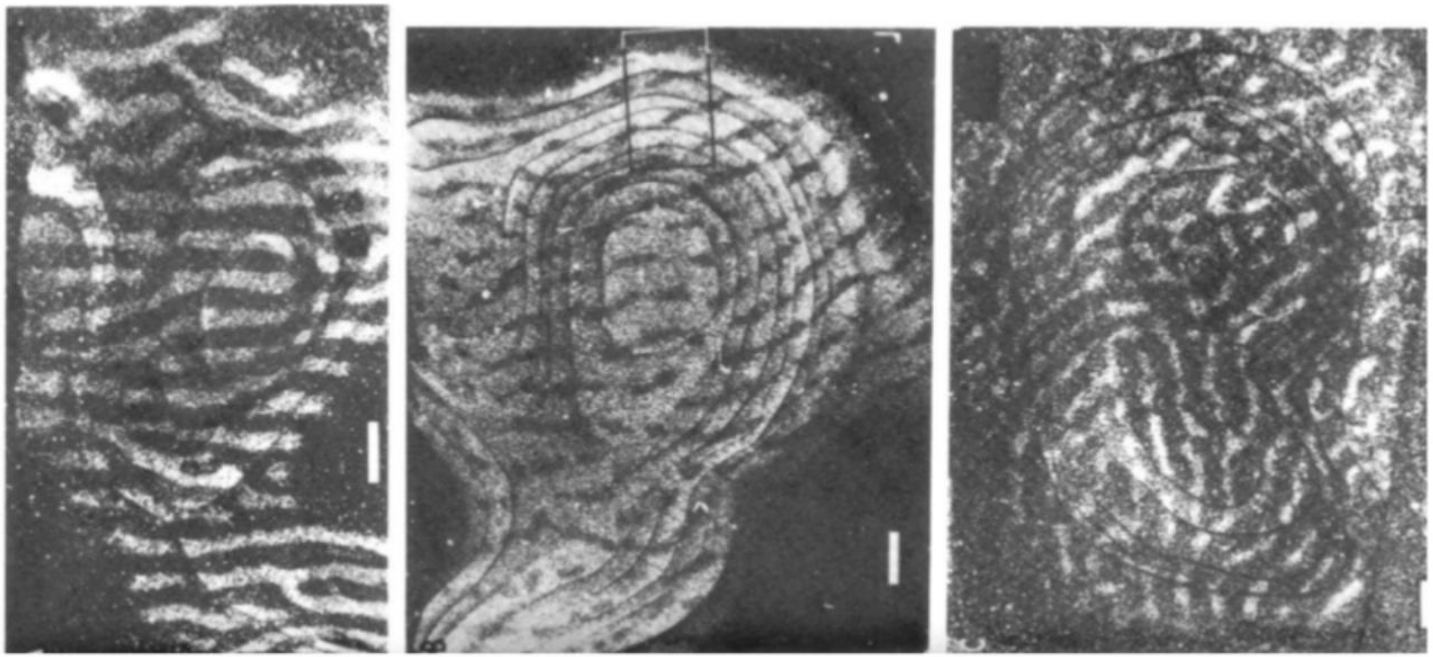
- Retina:
  - RGC are dramatically pruned during first few months of life (from 2.2-2.5 to 1.0-1.5 million)
- Visual pathway
  - Myelination increases rapidly for first 2 yrs, more slowly until age 10
- LGN
  - cell volume increases until age 2 yrs
- Striate cortex (V1)
  - Synaptic connections are refined/pruned by 40% until adult level attained at about age 10 years

Critical periods

- In early postnatal life, there are CRITICAL PERIODS of cortical development, during which:
  - neural circuits exhibit *heightened sensitivity* to environmental stimuli
  - normal sensory experience is *required* for proper development

Effect of monocular deprivation on V1 ocular dominance columns

Autoradiographs from visual cortex, 10 days after tracer injected into one eye



Visual cortex of normal adult monkey

18 months old.
MD at 2 weeks. Label injected into nondeprived eye.

18 months old.
MD at 2 weeks. Label injected into deprived eye.

Hubel, Weisel and LeVay, 1977

Critical periods and amblyopia

- During these critical periods, developing visual system is vulnerable to abnormal input due to:
  - 1) visual deprivation
  - 2) strabismus
  - 3) significant uncorrected refractive errors

- Cortical plasticity in childhood create the *vulnerability* to amblyopia, and opportunity for *reversal* of amblyopia

What is amblyopia?

- Decreased vision caused by abnormal visual experience in early life; usually unilateral
- Affects 3% of children
- Always has a REASON to develop: strabismus, anisometropia (unequal refractive error) or visual deprivation (cataract or severe ptosis)

How is amblyopia treated?

- Always a step-wise approach:
  - refractive correction
  - patching or atropine penalization of ‘stronger’ eye
- Early detection and treatment are essential to prevent permanent vision loss
- Scientific evidence does not support the use of ‘behavioural vision therapy’ for amblyopia

What is strabismus?

- Misalignment of the eyes
- Affects 4% of children
- Importance:
  - May signal serious eye or brain disorder (e.g. cataract, retinoblastoma, brain tumour)
  - May cause vision loss if untreated
  - Impact on psychosocial wellbeing

What causes childhood strabismus?

- Uncorrected refractive error
- Poor vision in one or both eyes
  - e.g. cataract, intraocular tumour, retinal problem
- Orbital problem (e.g. mass, trauma)
- Neurological problem
  - Peripheral cranial nerve III, IV, or VI palsy
  - Brain tumour, raised intracranial pressure
- Idiopathic

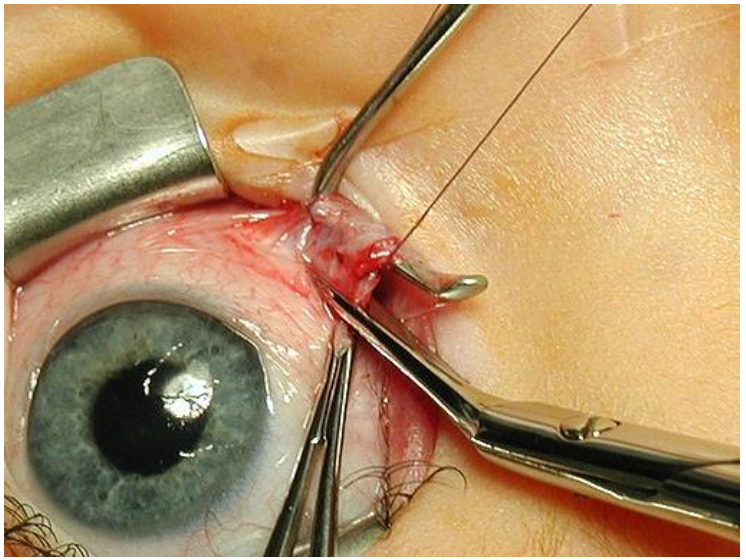
Is strabismus ever normal?

- **In the first 4 weeks:**
  - some normal infants have a SMALL amount of eye misalignment that is VARIABLE
  - CONSTANT or LARGE-ANGLE strabismus is not normal

- **By 4 months of age:**
  - ALL infants should have straight eye alignment

How is strabismus treated?

- Rule out neurological, intraocular pathology
- Refractive correction, monitor for amblyopia
- If strabismus persists:
  - eye muscle surgery
  - botulinum toxin
  - prism glasses for diplopia in older children



Aims of strabismus treatment

IT'S NOT JUST COSMESIS

Allow development of binocular vision
(e.g. depth perception)

Psychosocial wellbeing

Prevention of amblyopia

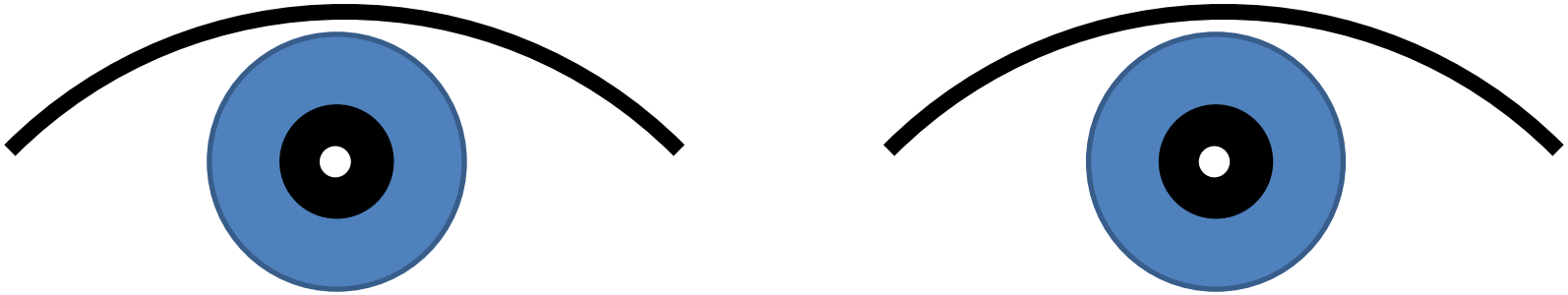
EXAMINATION TECHNIQUES

How to examine for strabismus

4 standard tests

1. Corneal Light Reflection
2. Cover Test
3. Alternating Cover Test
4. Extraocular Movements

1. Corneal light reflection



Hold pen light in front of your face

Have patient LOOK AT LIGHT

Judge position of light reflection in pupils

1. Corneal light reflection

Right Exotropia

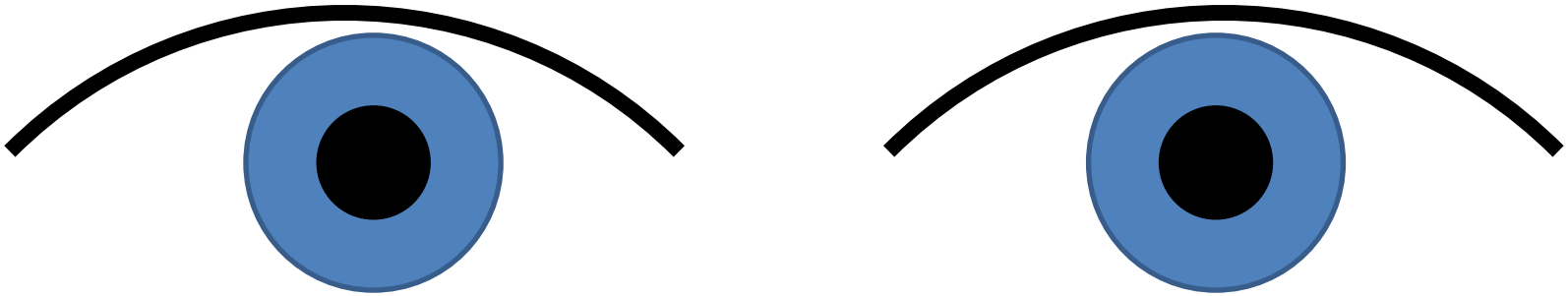
Right Hypertropia

Pseudo-strabismus

wide nasal bridge

epicanthal folds

2. Cover test

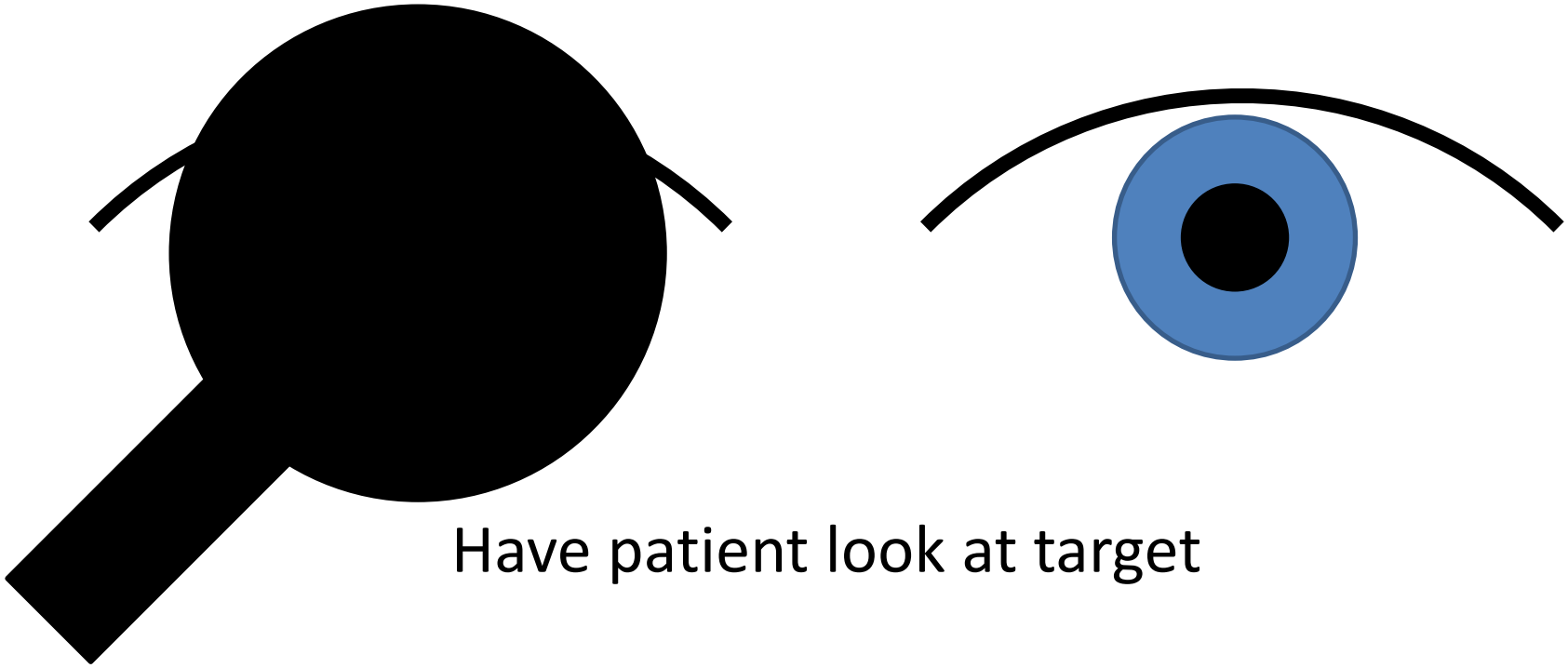


Have patient look at target

Cover right eye

Watch if left eye moves

2. Cover test



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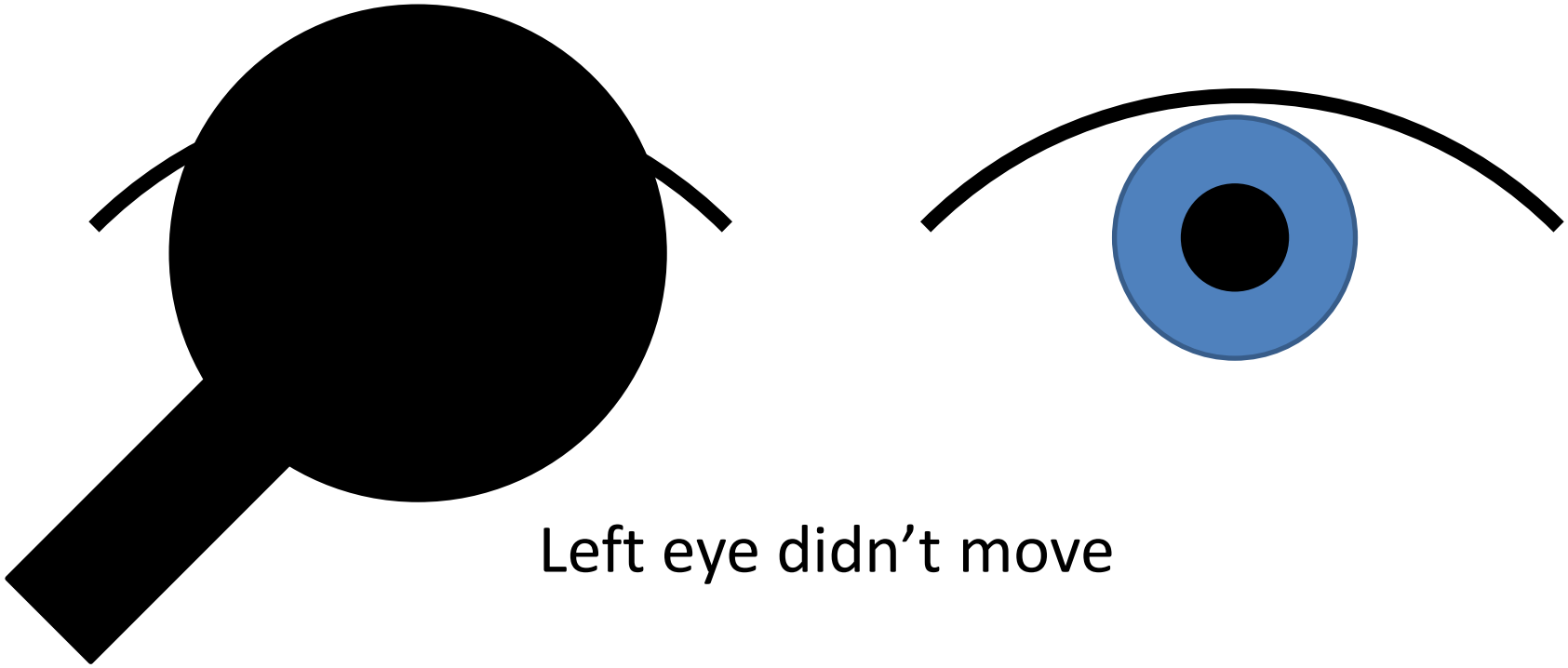
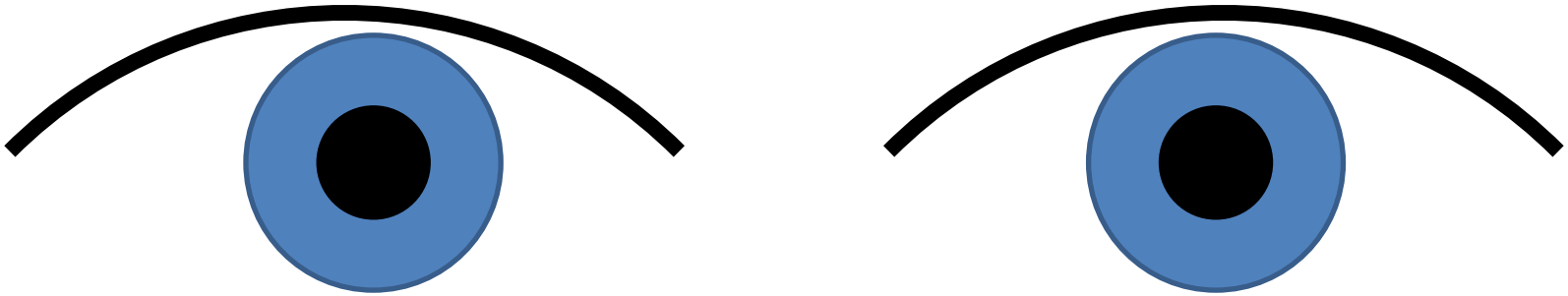


Left eye didn’t move

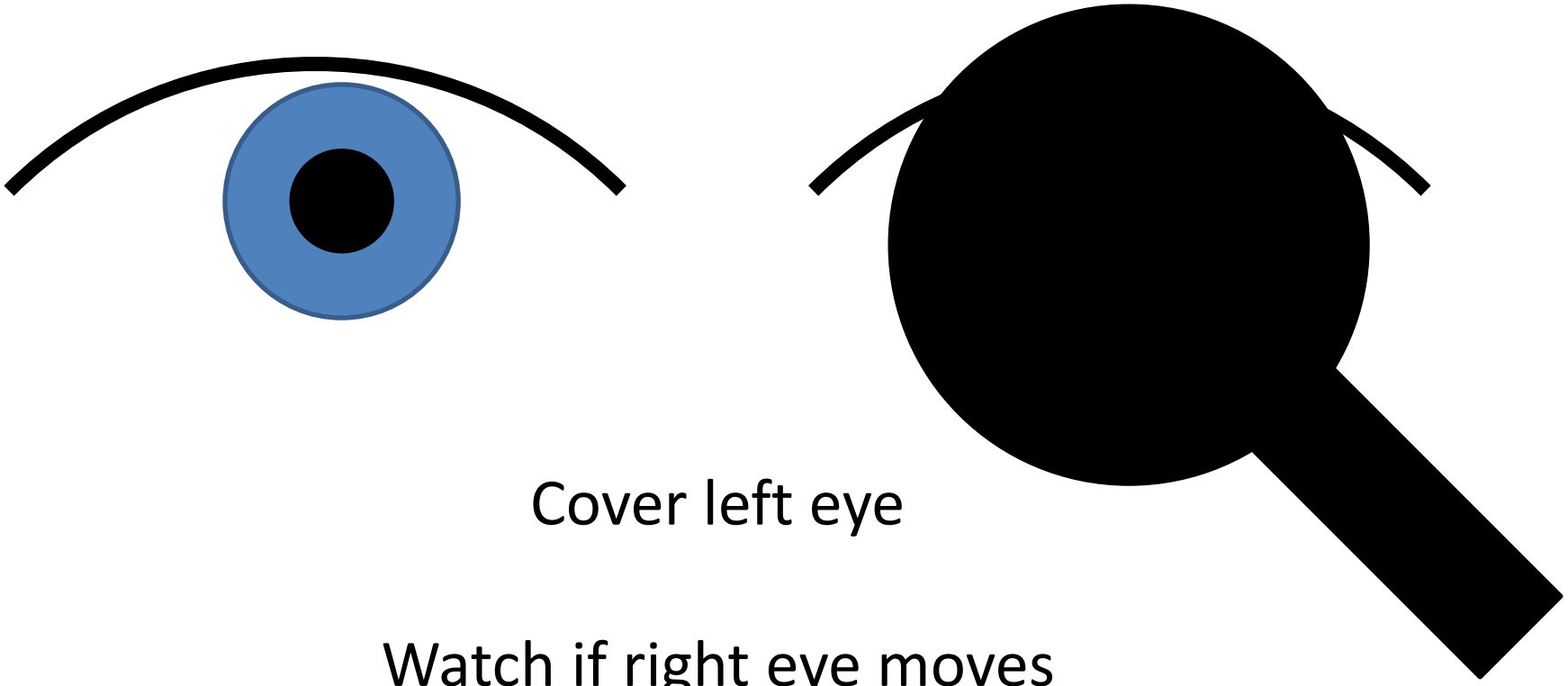
Suggests left eye is aligned with target

2. Cover test



Remove cover

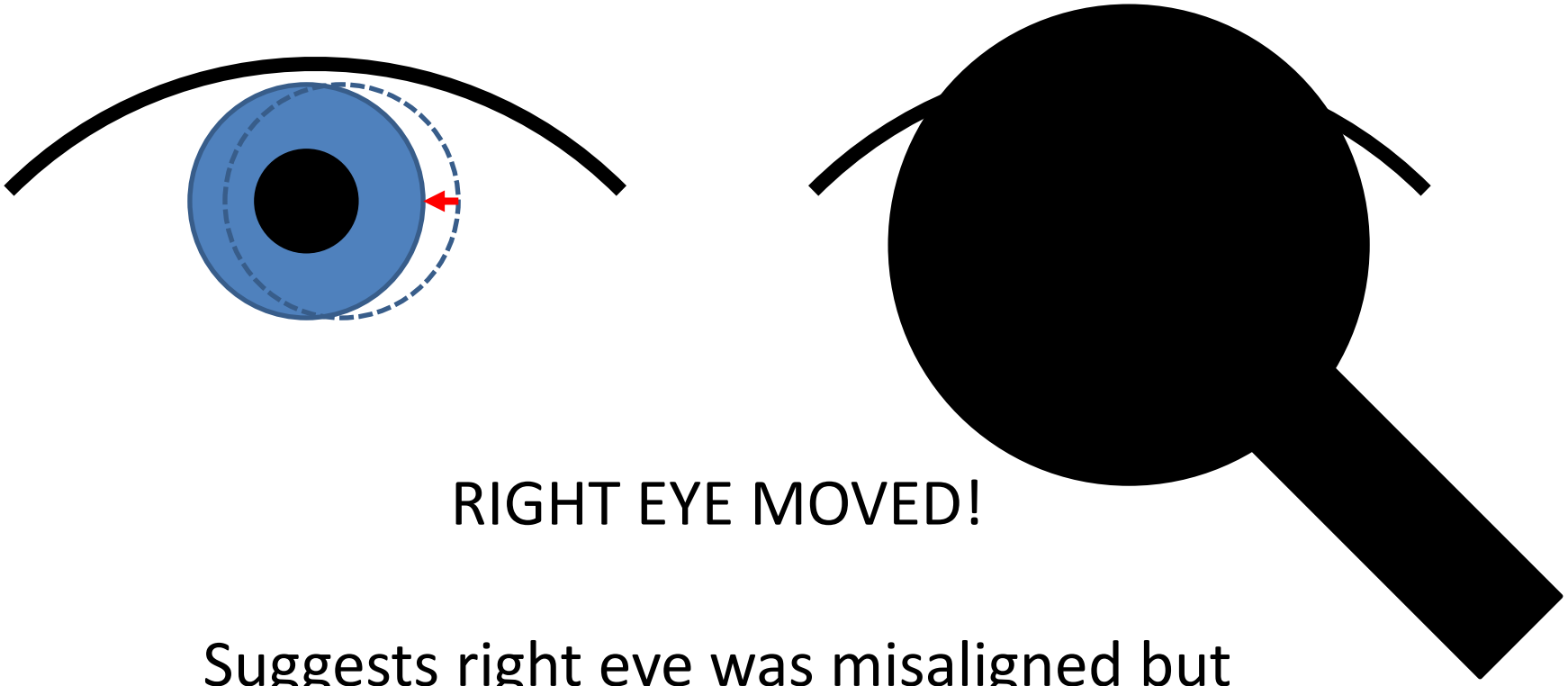
2. Cover test



Cover left eye

Watch if right eye moves

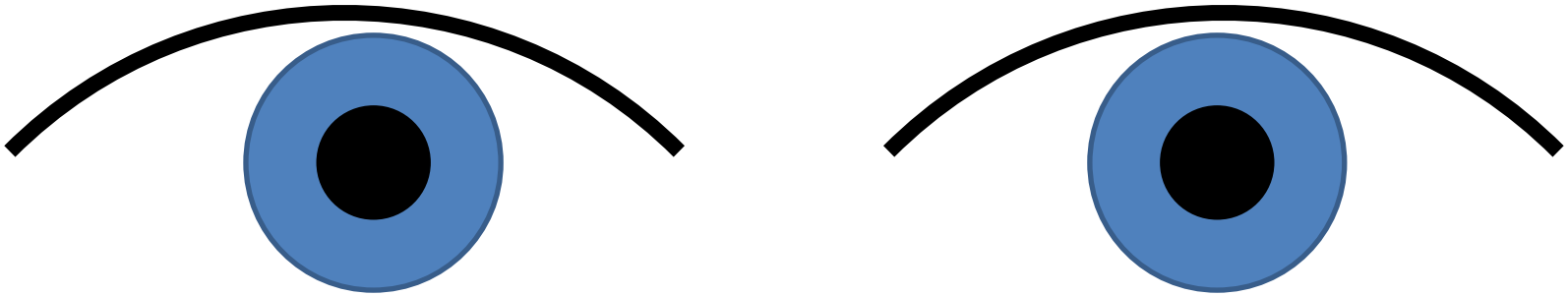
2. Cover test



RIGHT EYE MOVED!

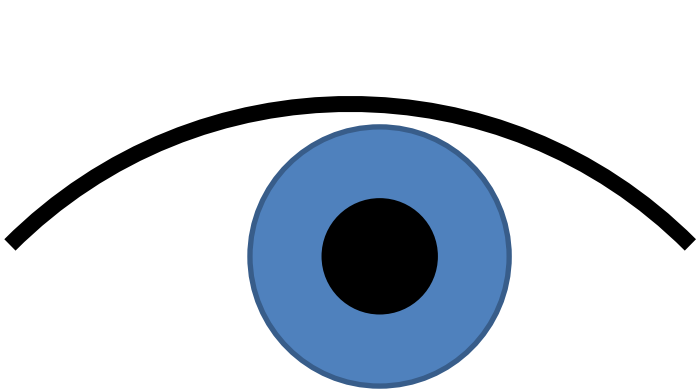
Suggests right eye was misaligned but now picked up fixation

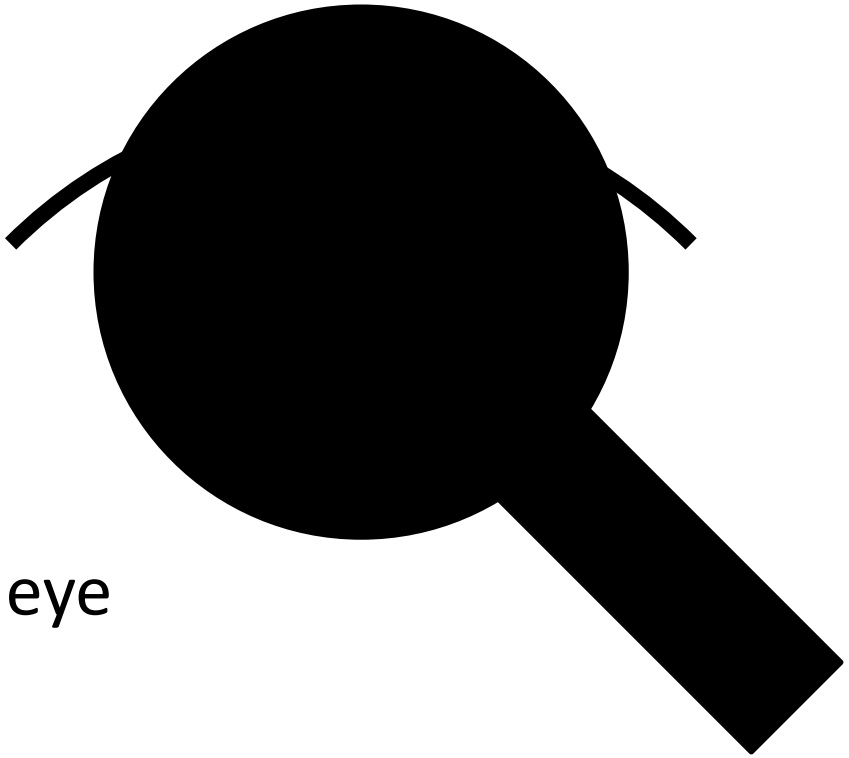
3. Alternating cover test



Have patient look at target

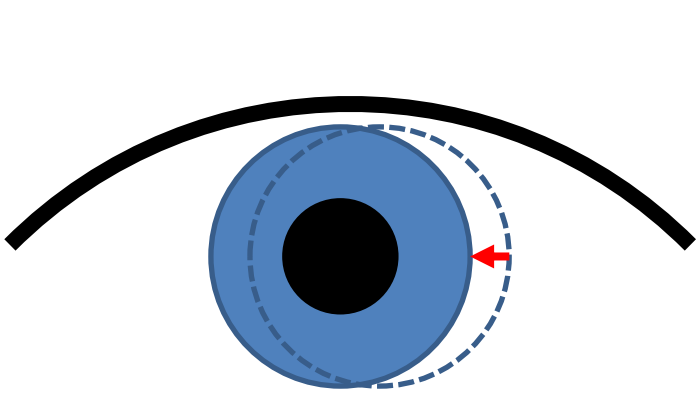
3. Alternating cover test





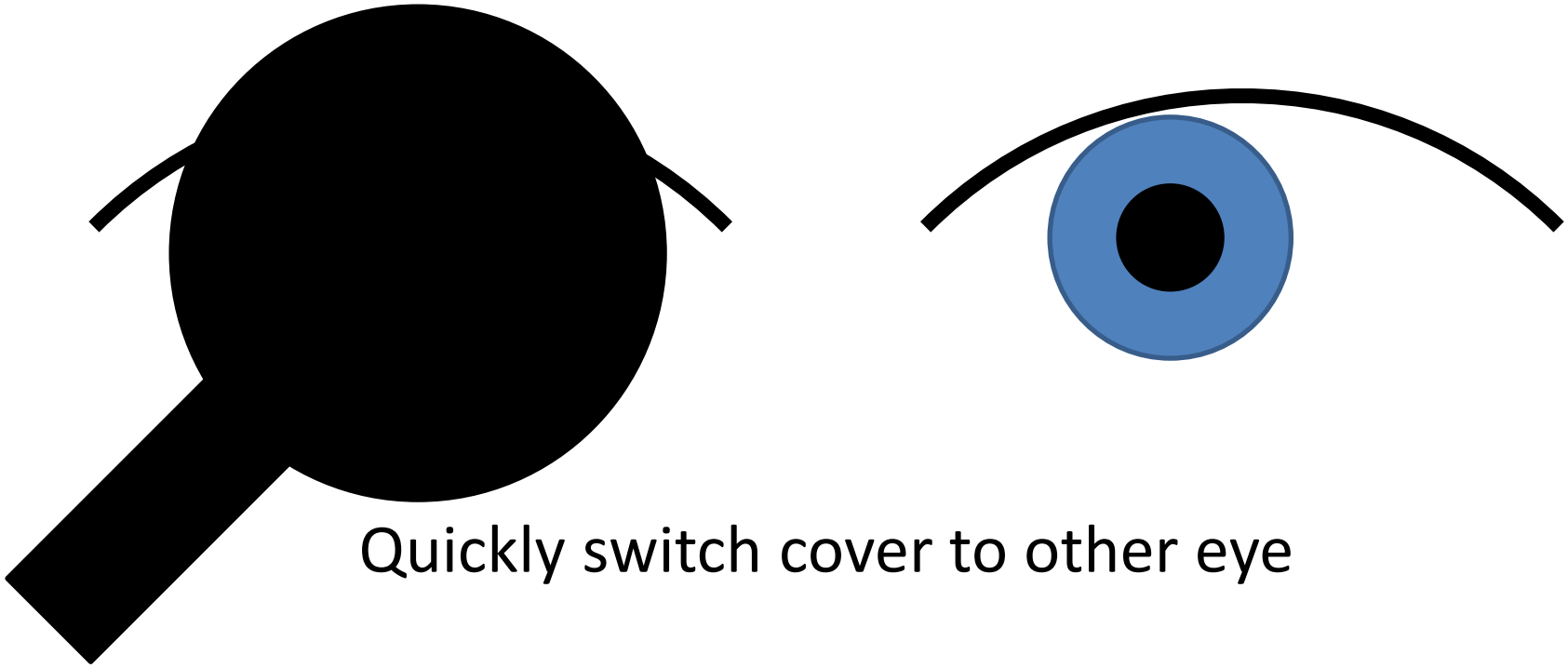
Cover left eye

3. Alternating cover test



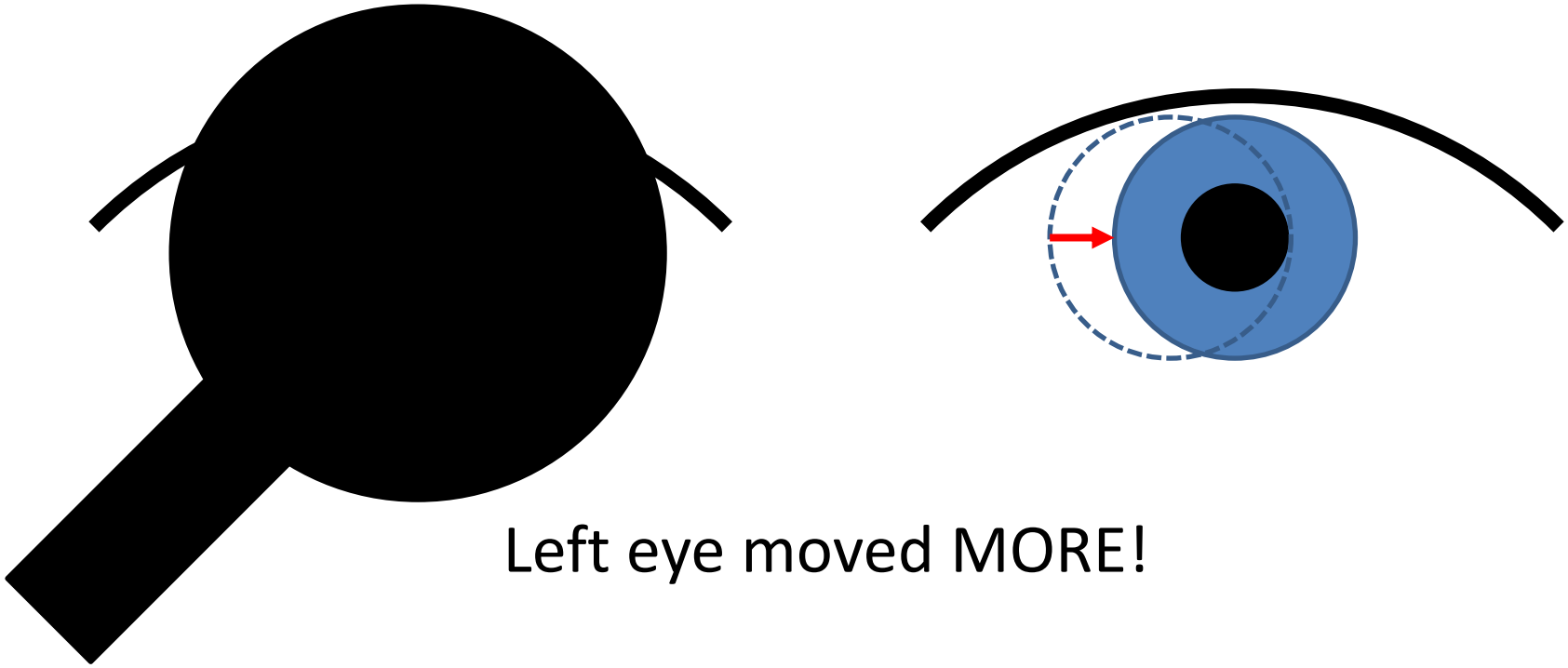
RIGHT EYE MOVED a little bit!

3. Alternating cover test



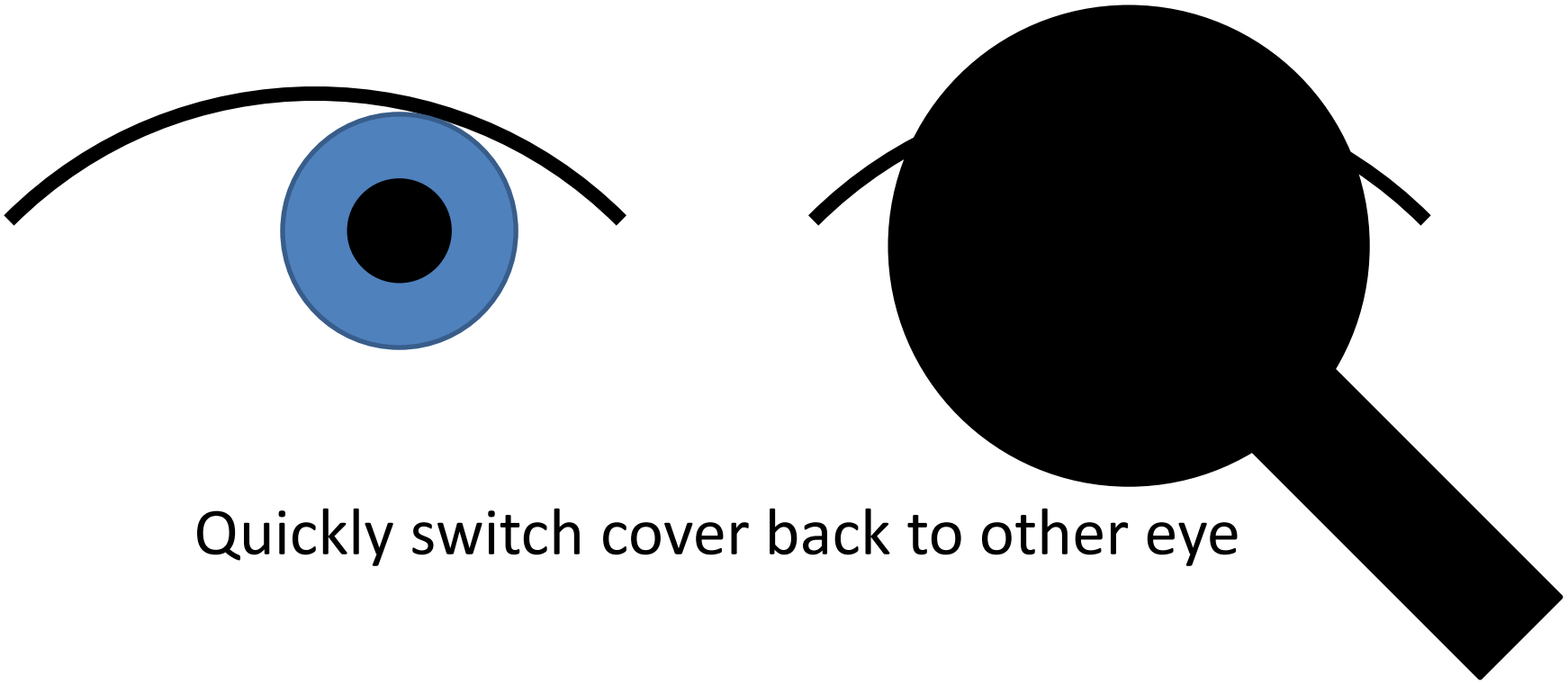
Quickly switch cover to other eye

3. Alternating cover test



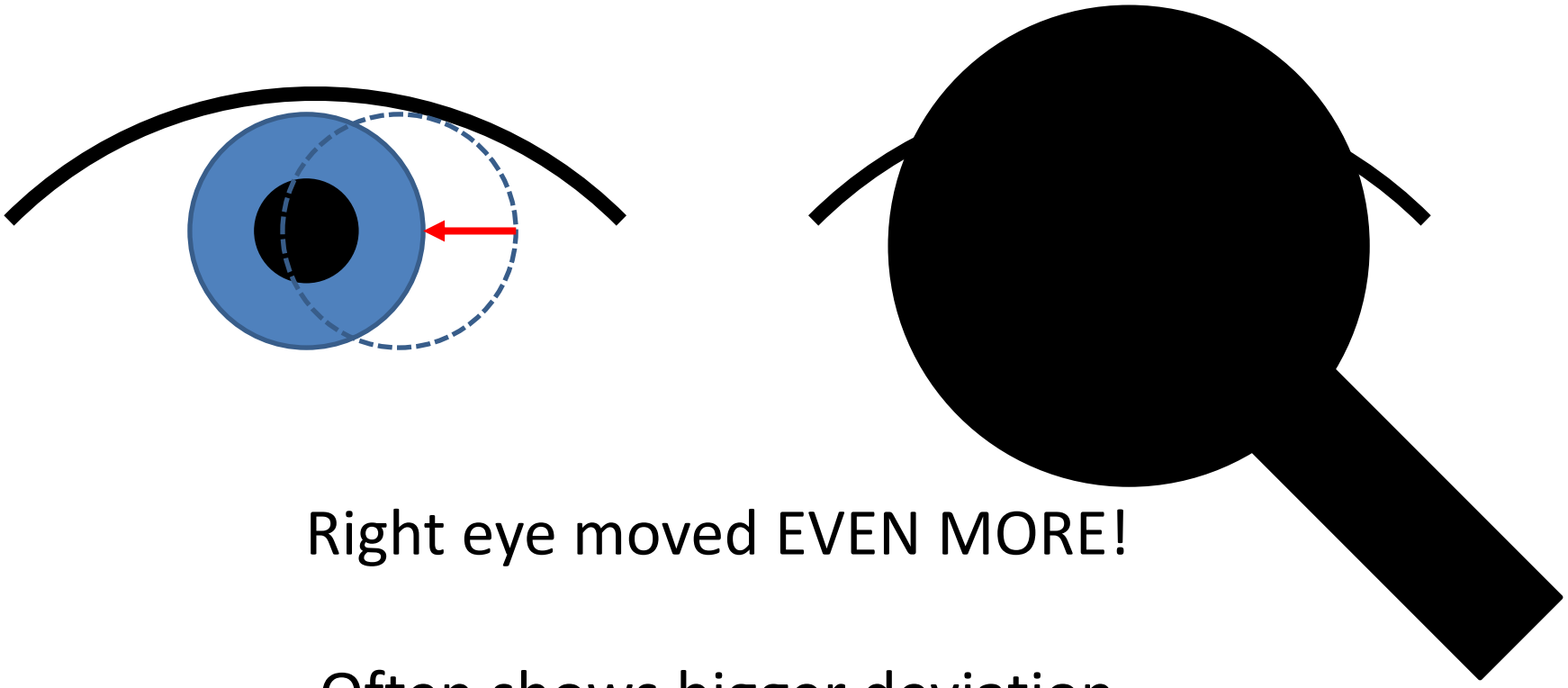
Left eye moved MORE!

3. Alternating cover test



Quickly switch cover back to other eye

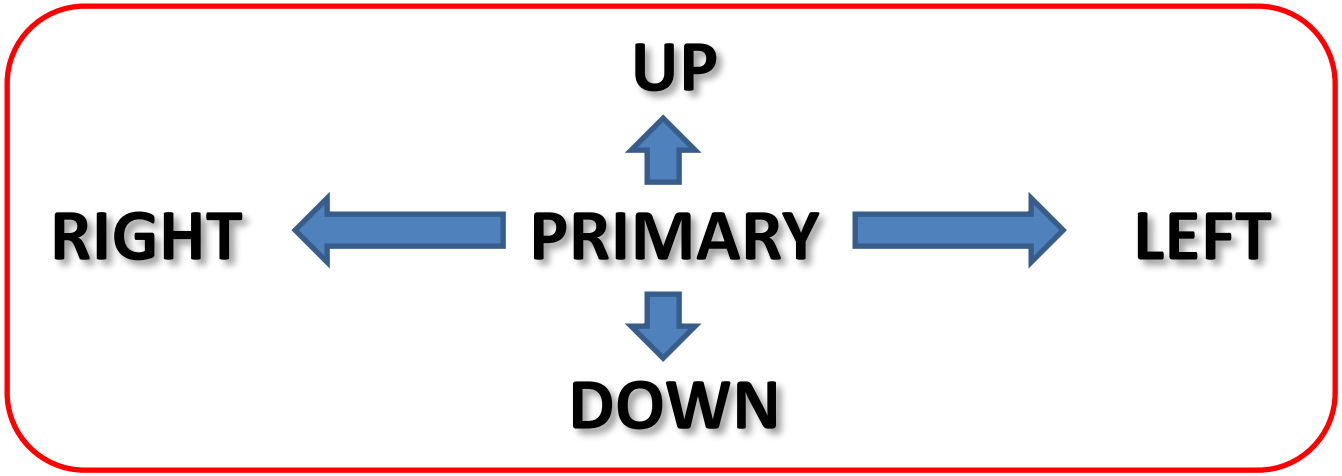
3. Alternating cover test



Right eye moved EVEN MORE!

Often shows bigger deviation
than Cover Test because it reveals
“latent” or “hidden tendency” for strabismus

4. Extraocular movements

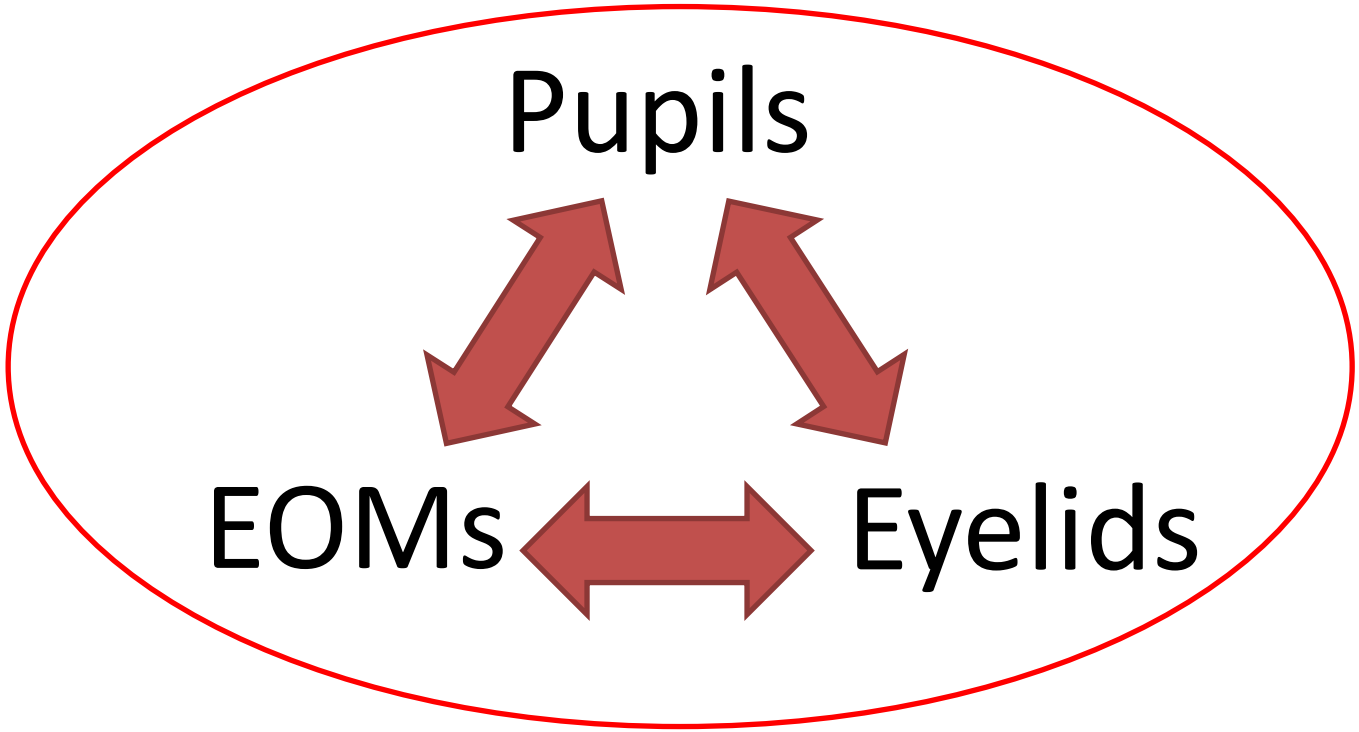


COMITANT
strabismus

INCOMITANT
strabismus

PEARL #1:
EOMs, pupils and eyelids go together

- Abnormality in ONE warrants examination of other TWO ➔ KEY to distinguishing diagnoses



But…

How do I check alignment and pupils in this dark-eyed child?

And…

How do I check ANYTHING in this upset child?

PEARL #2: The Brückner test

- Simple and quick
- Useful for uncooperative and dark-eyed patients
- Screens for strabismus and anisometropia (2 main causes of amblyopia) and includes pupil exam

How to perform the Brückner test

- Darken the room and stand 1m from patient
- Adjust the direct ophthalmoscope:

No polarizing filter

Largest Spot size

Look through peep hole

Focus lens on iris

How to perform the Brückner test

STEP 1: Illuminate both pupils at the same time

1. Check position of corneal light reflection
2. Check pupil size (?anisocoria)
3. Assess red reflex (symmetric = normal)

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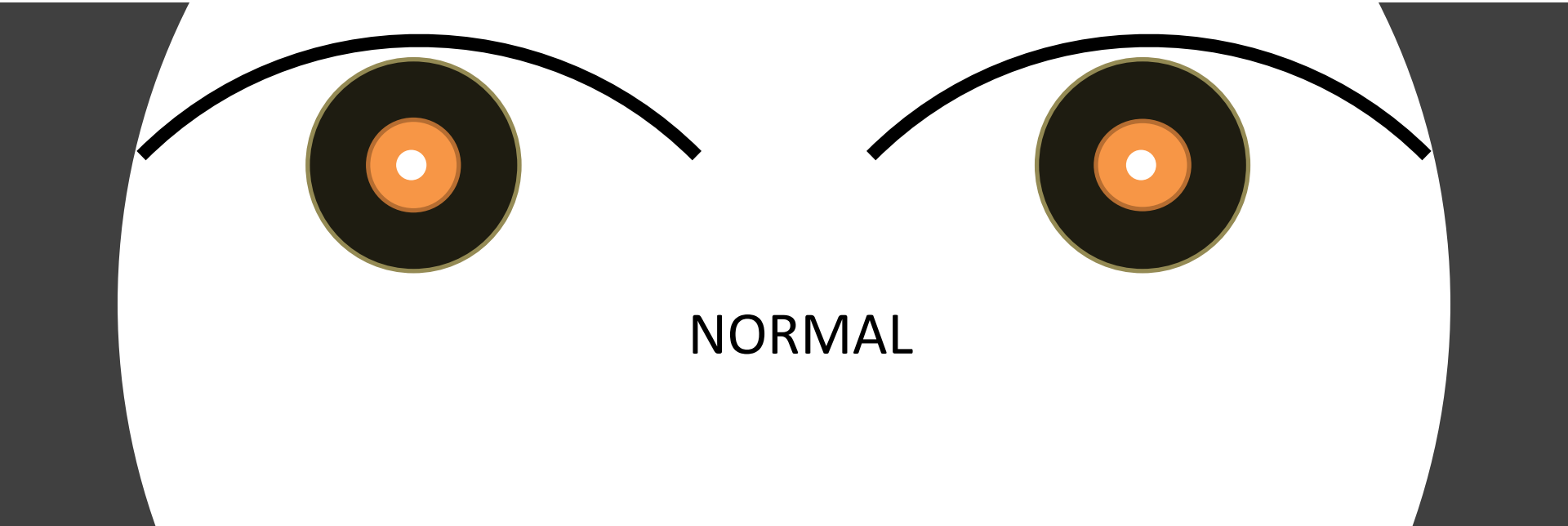

NORMAL

How to perform the Brückner test

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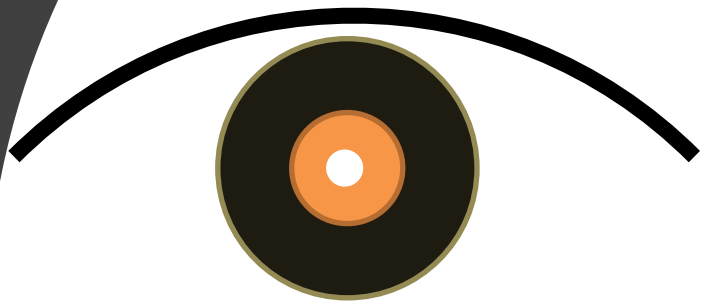
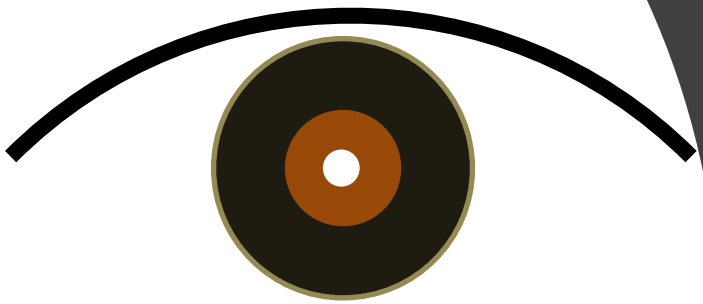


Brighter reflex:
?strabismic eye



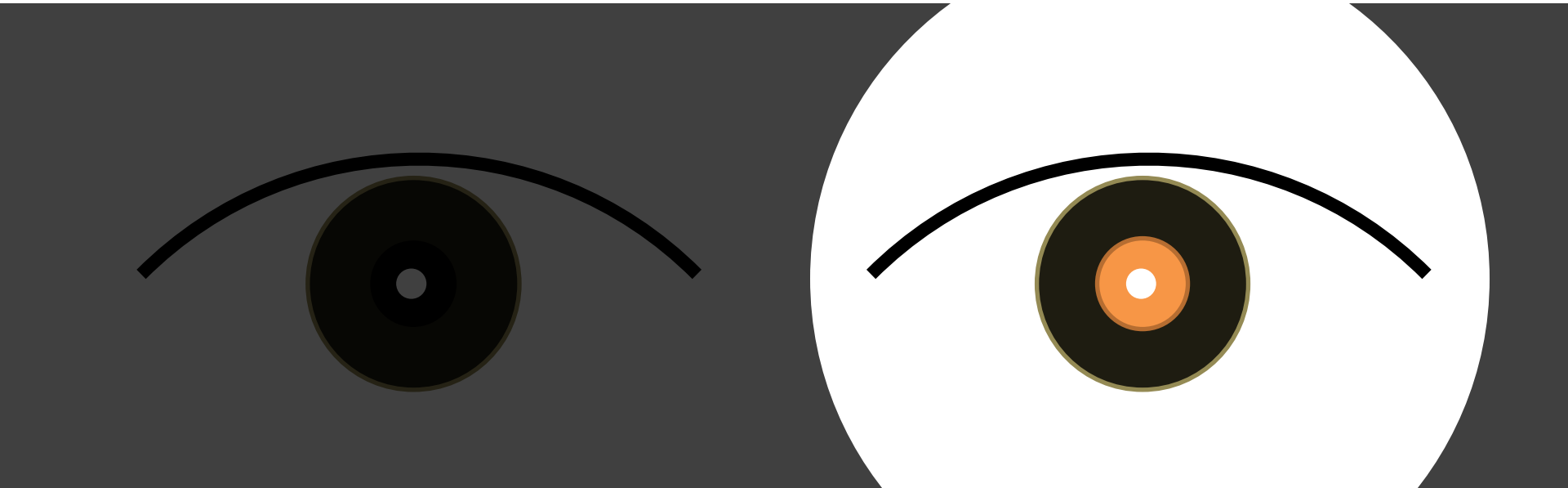
Darker reflex:
?media opacity
?anisometropia

Abnormal Brückner red reflexes

How to perform the Brückner test

STEP 2: Illuminate one eye at a time

4. Check pupillary constriction and ?RAPD
5. Observe for re-fixation eye movements (as in alternating cover test)



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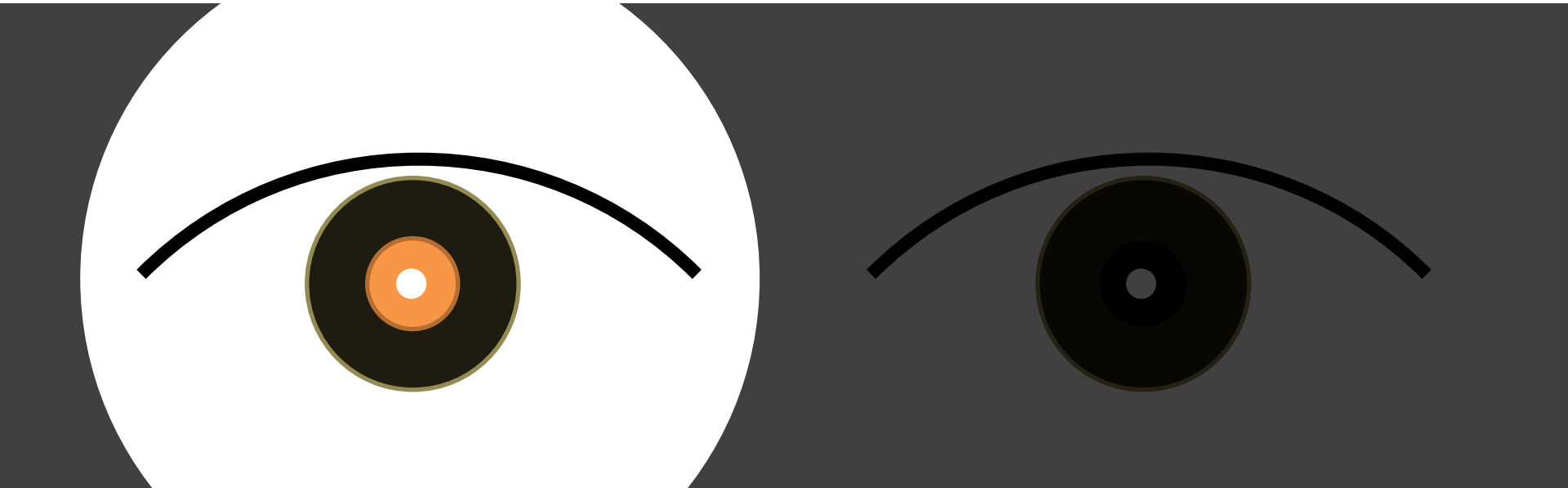

When to refer to ophthalmology

- Constant or large-angle strabismus at any age
- Incomitant strabismus at any age
- Any strabismus persisting at 4 months of age
- Asymmetry of red reflex on Brückner test
- Parent concern about eye alignment or vision

- All children should have dilated eye exam and refraction before starting school

Thank you