Strabismus-
Vertical Deviations

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Superior Oblique Palsy

- Most common cause of isolated vertical deviation
- Congenital
  - may be birth trauma
- Acquired
  - Traumatic most common
  - Vascular disease
    - Diabetes, infarct
  - Iatrogenic (tenotomy)
  - Neoplasm
  - Multiple sclerosis
  - Herpes Zoster

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Superior Oblique Palsy

- Clinical Features
  - Hypertropia or hypotropia
    - Worse contralateral gaze and ipsilateral head tilt
  - Abnormal head position
    - Head tilt to opposite side
    - Face turn to same side
  - Torsional diplopia (excyclotorsion)- in acquired cases

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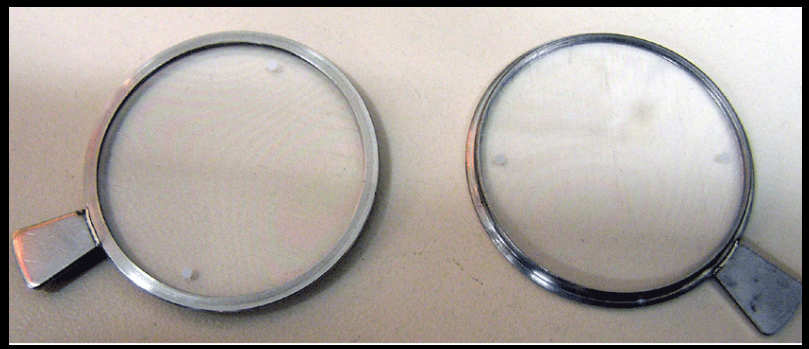
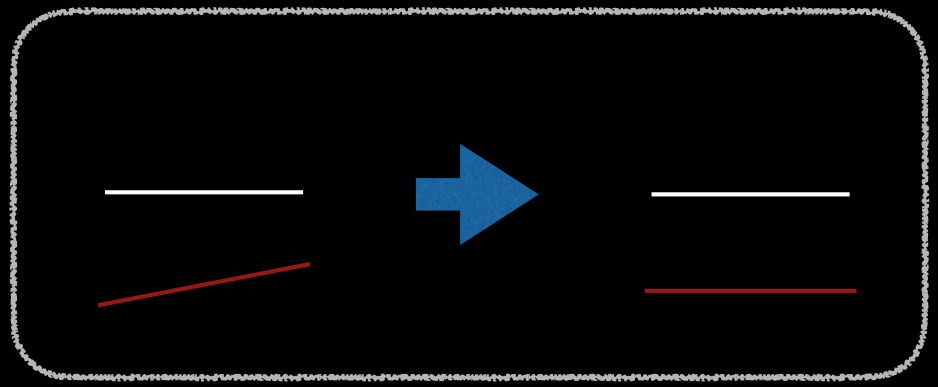
Measuring Torsion

- Double Maddox Rods

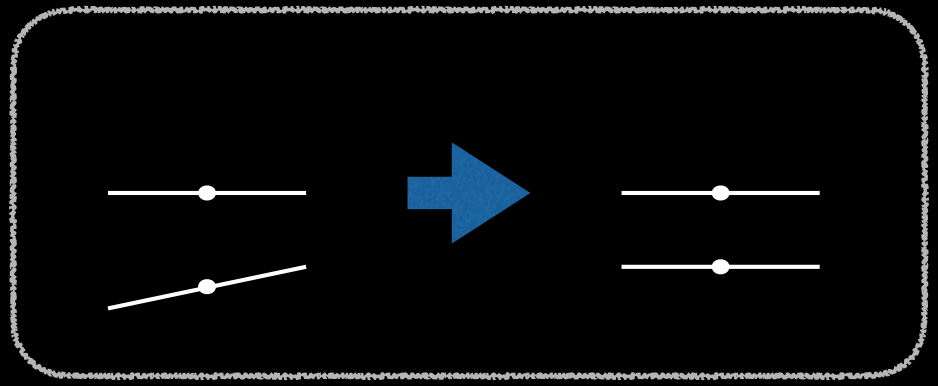
- Bagolini lenses



Double Maddox Rods

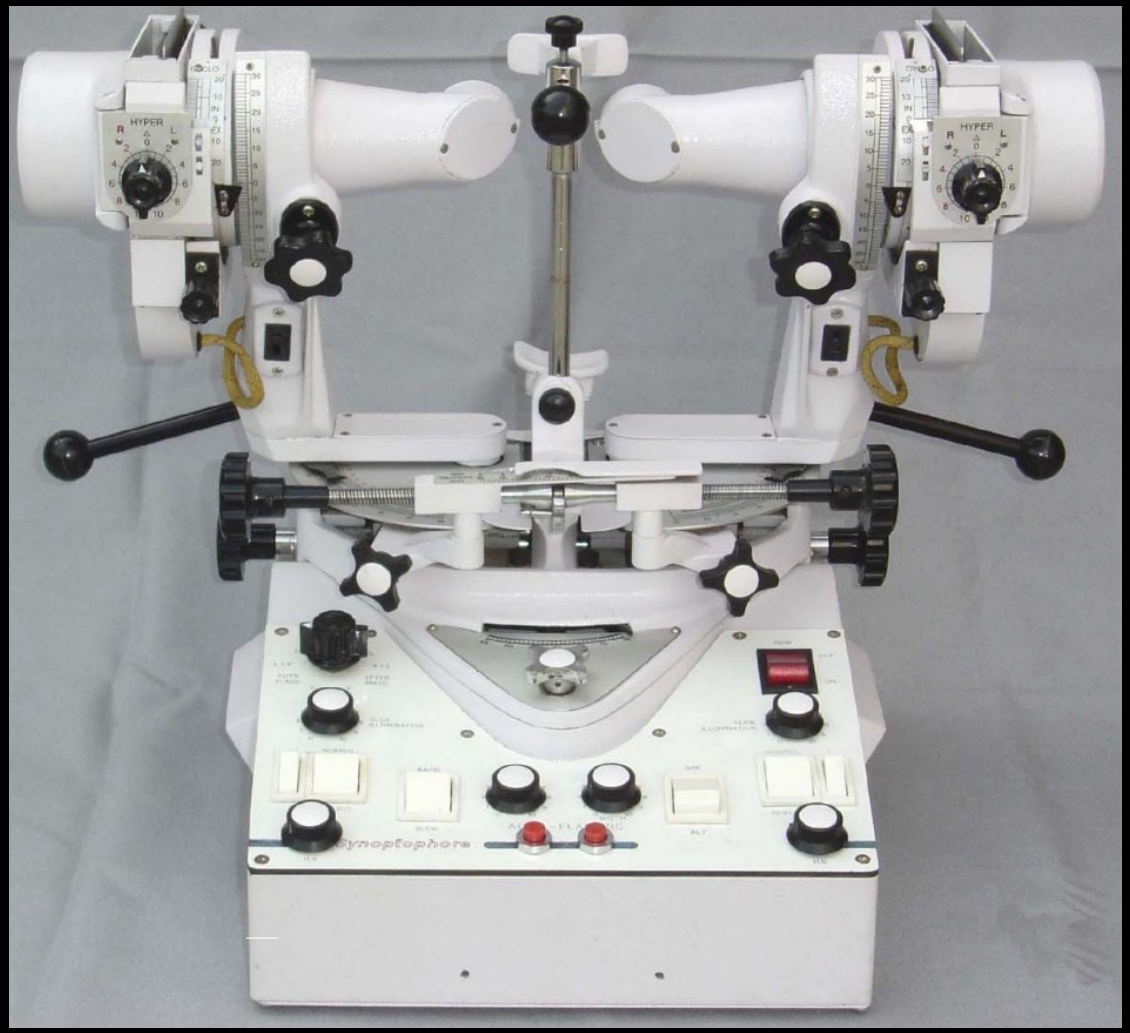


Bagolini Lenses



Measuring Torsion

- Synoptophore



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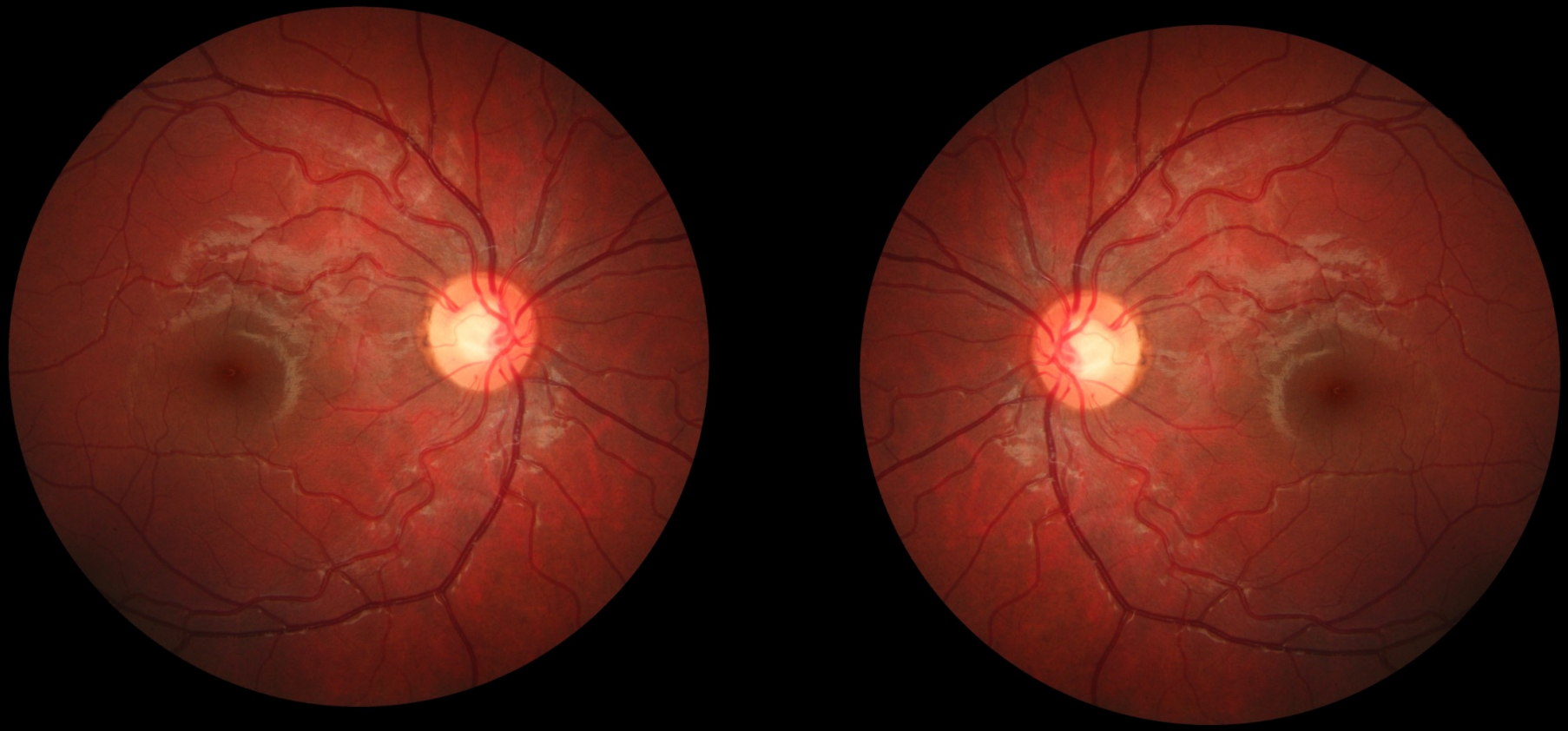
Measuring Torsion

- Fundus Photography



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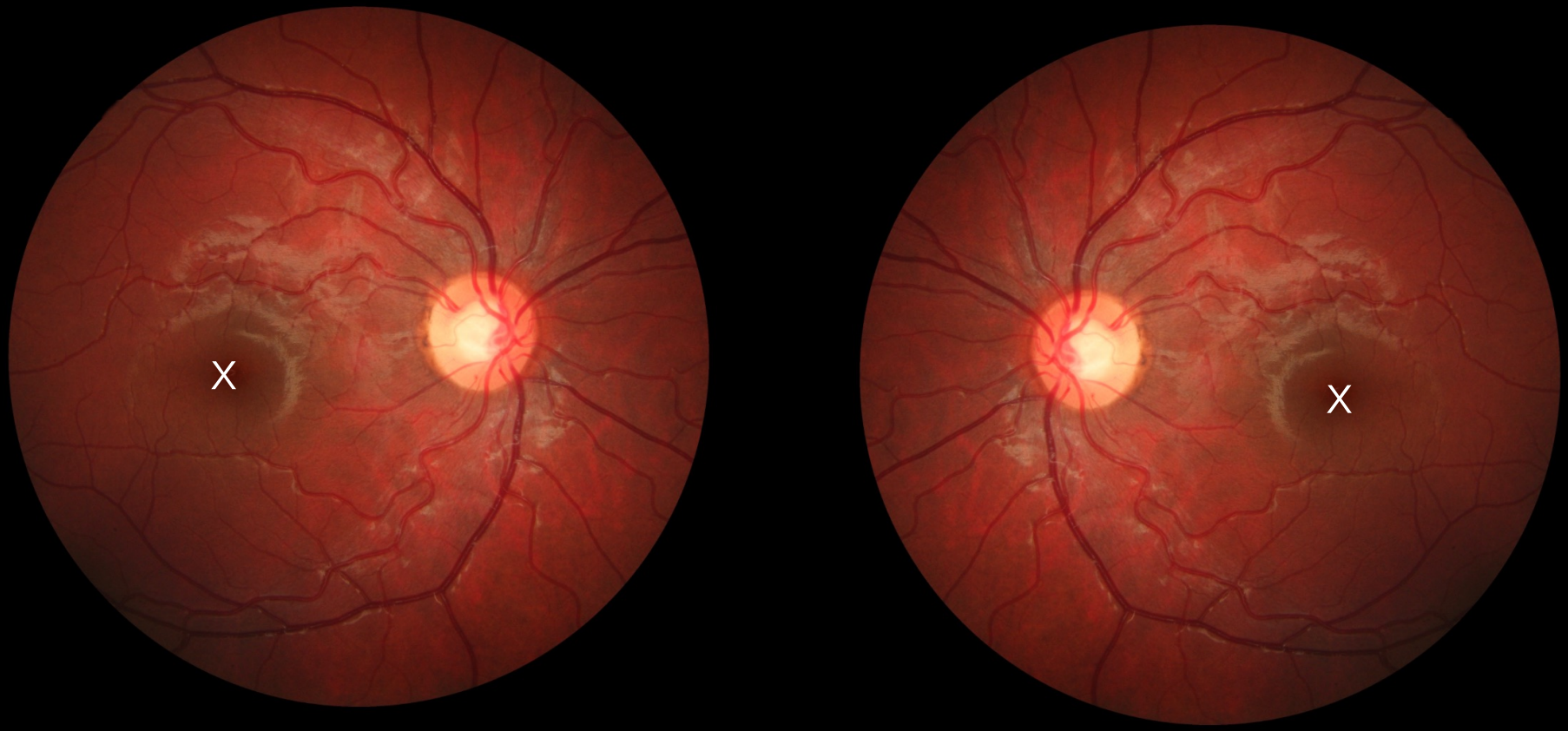

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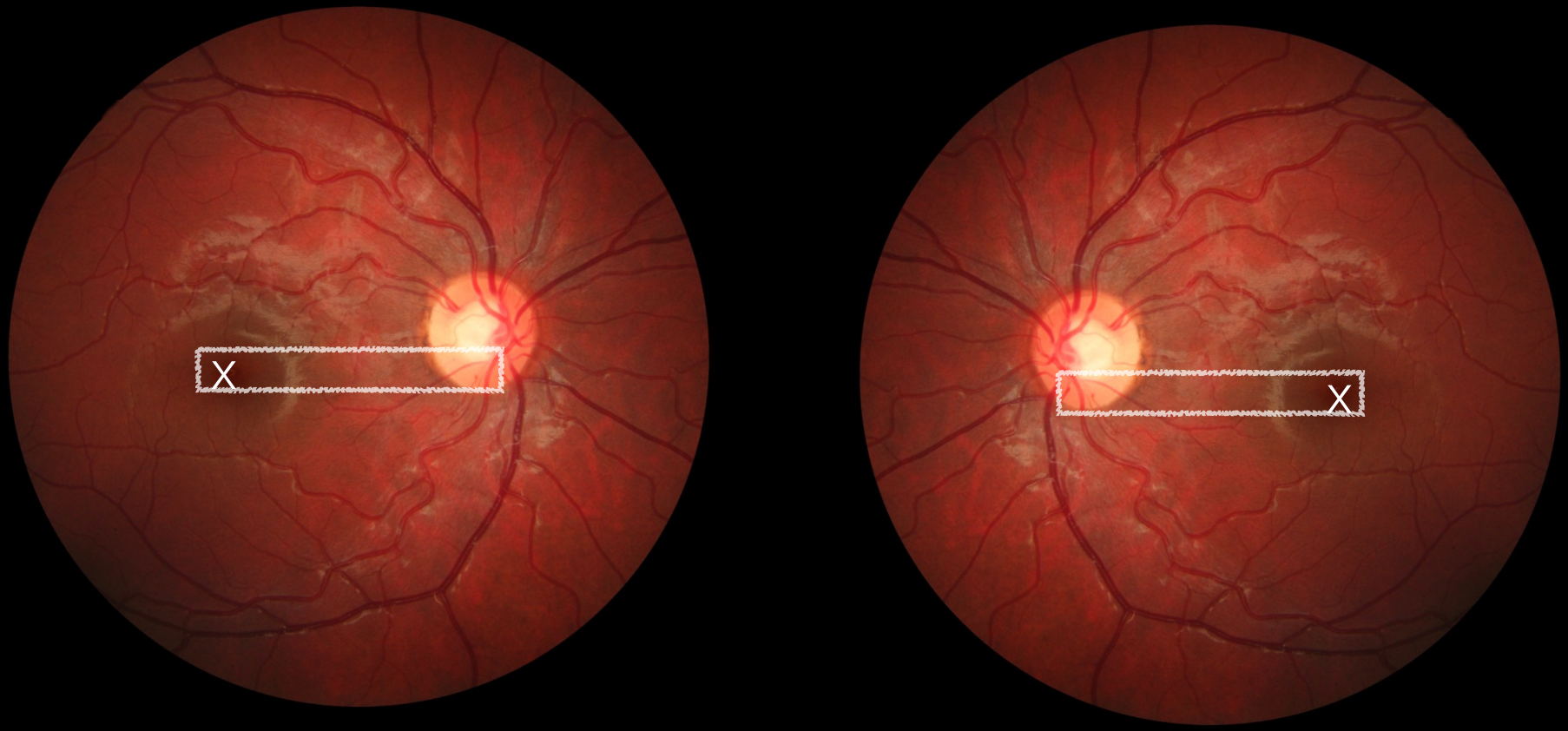

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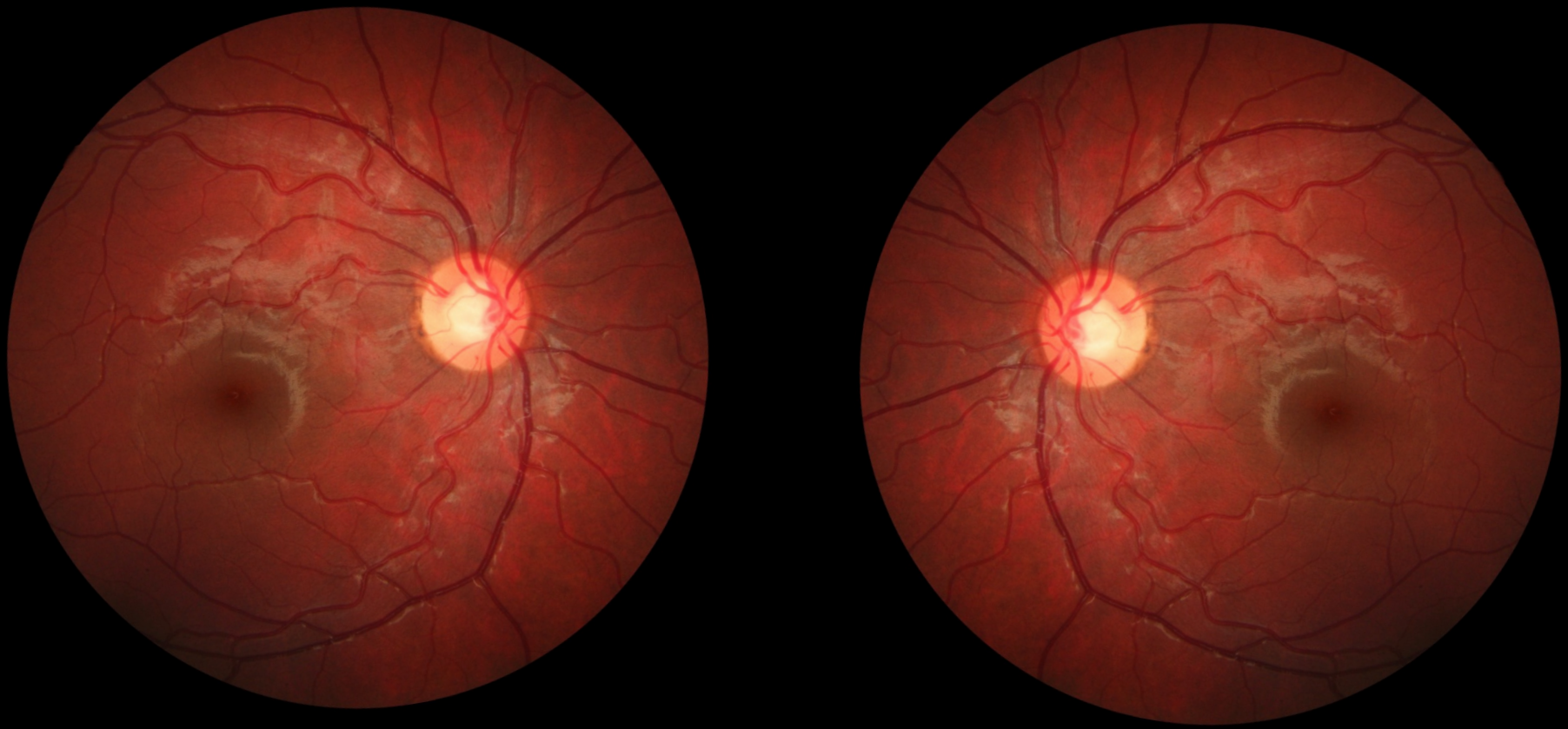

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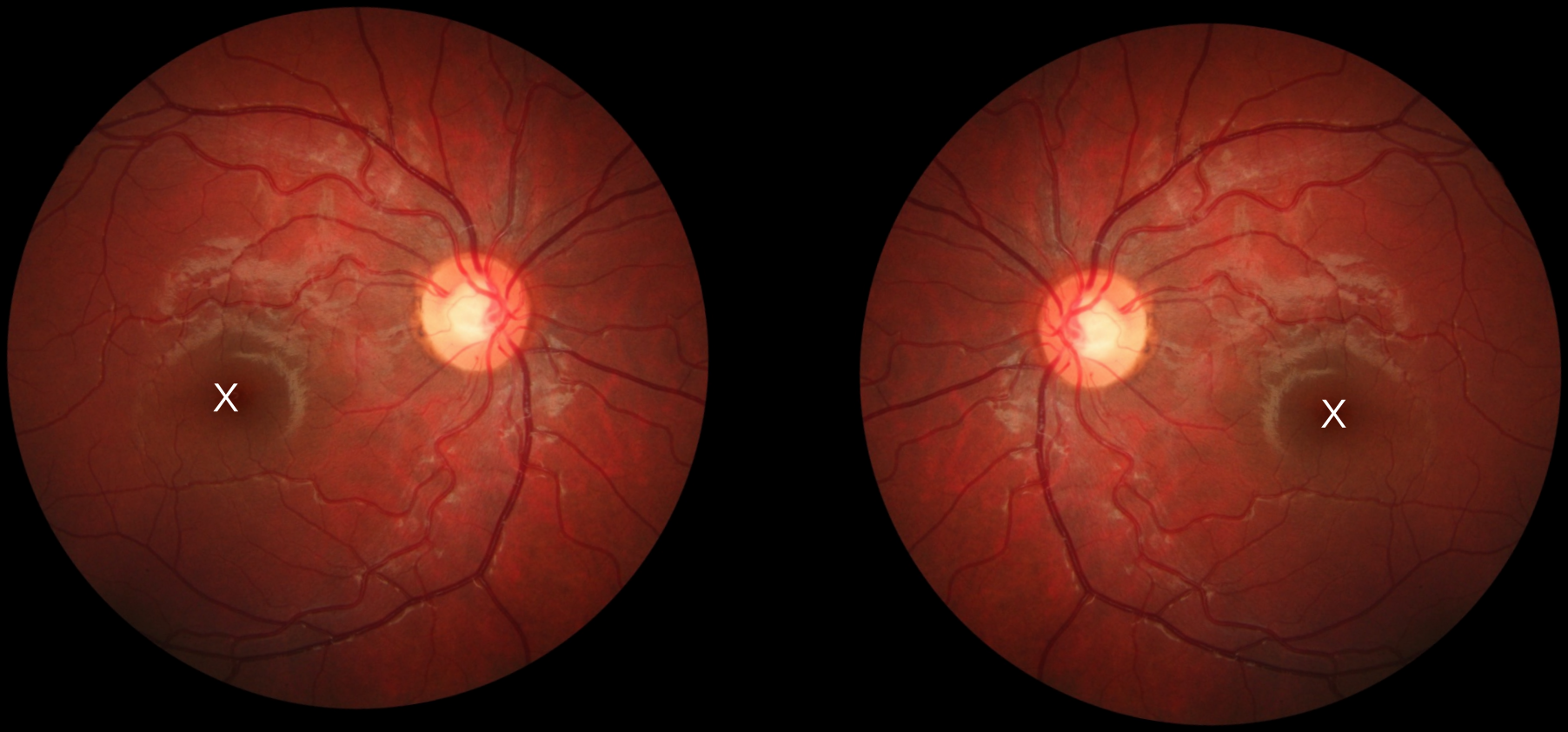

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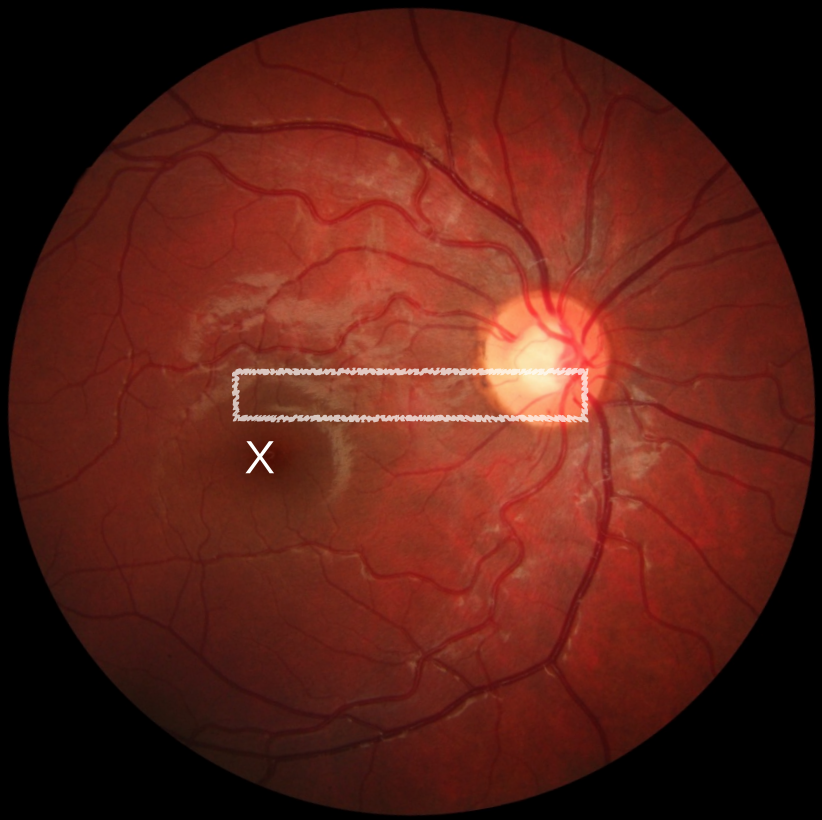

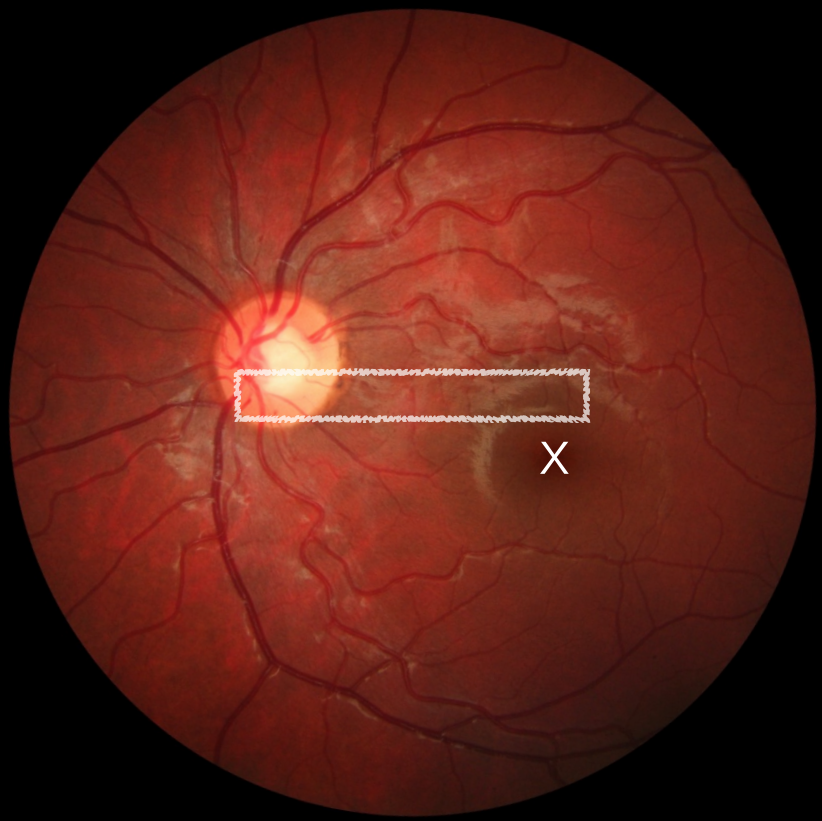

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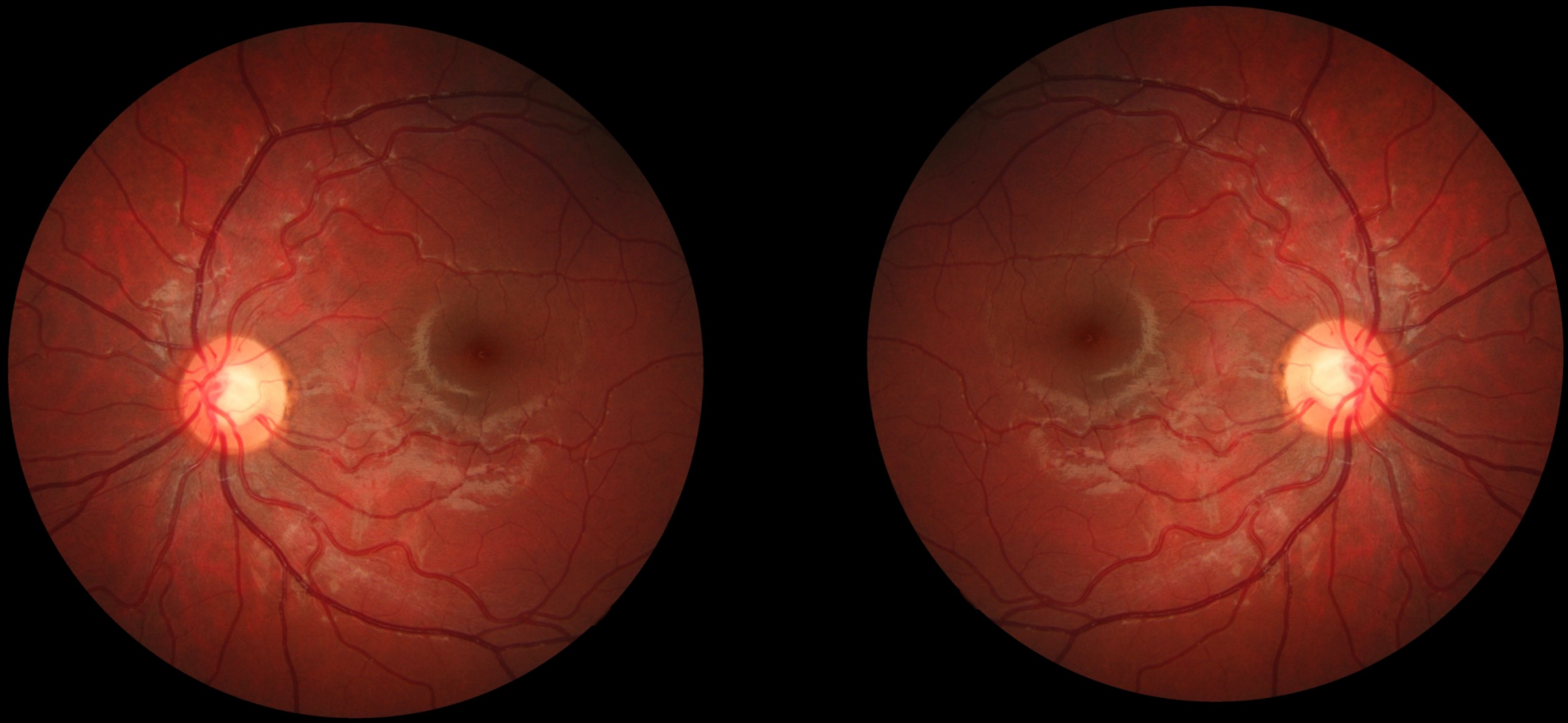
Measuring Torsion

- Indirect View



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Measuring Torsion

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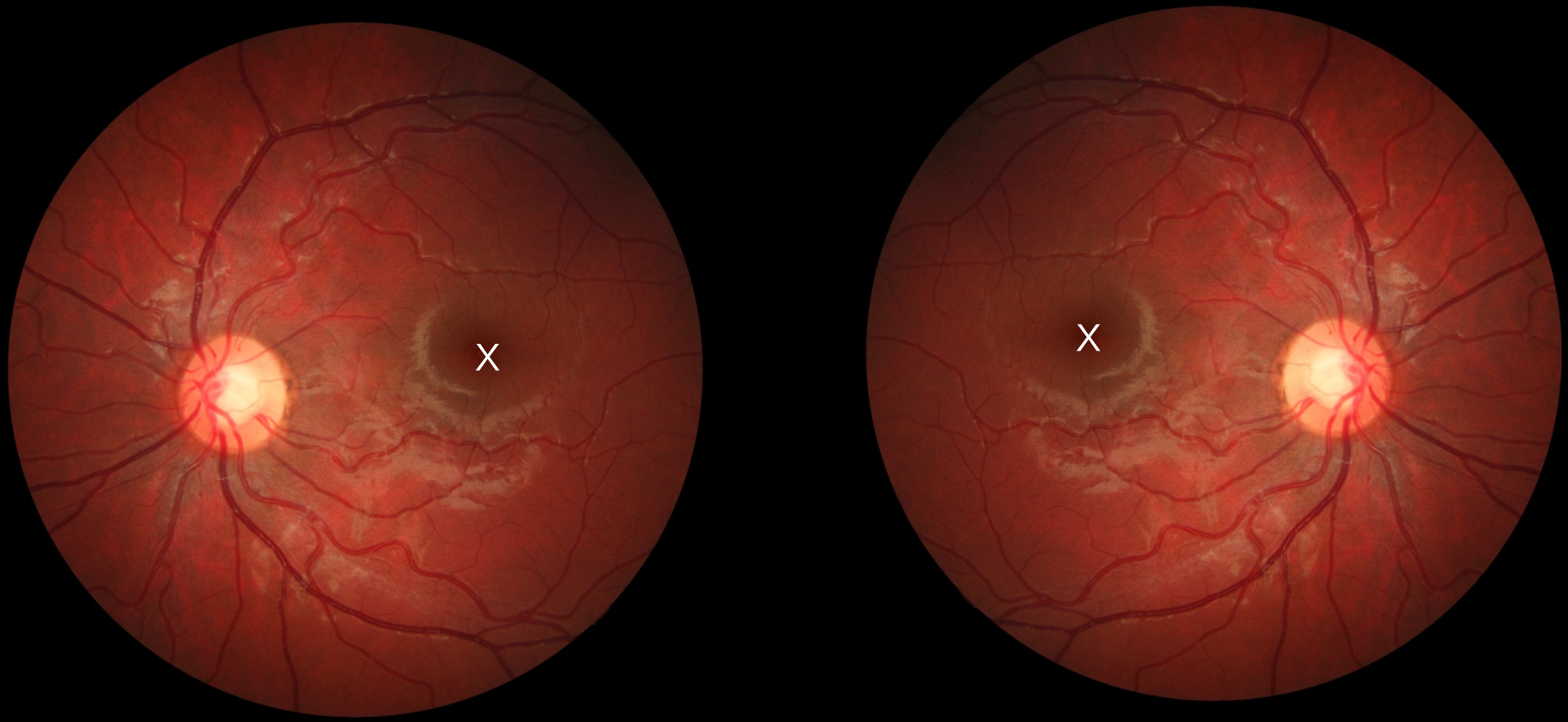

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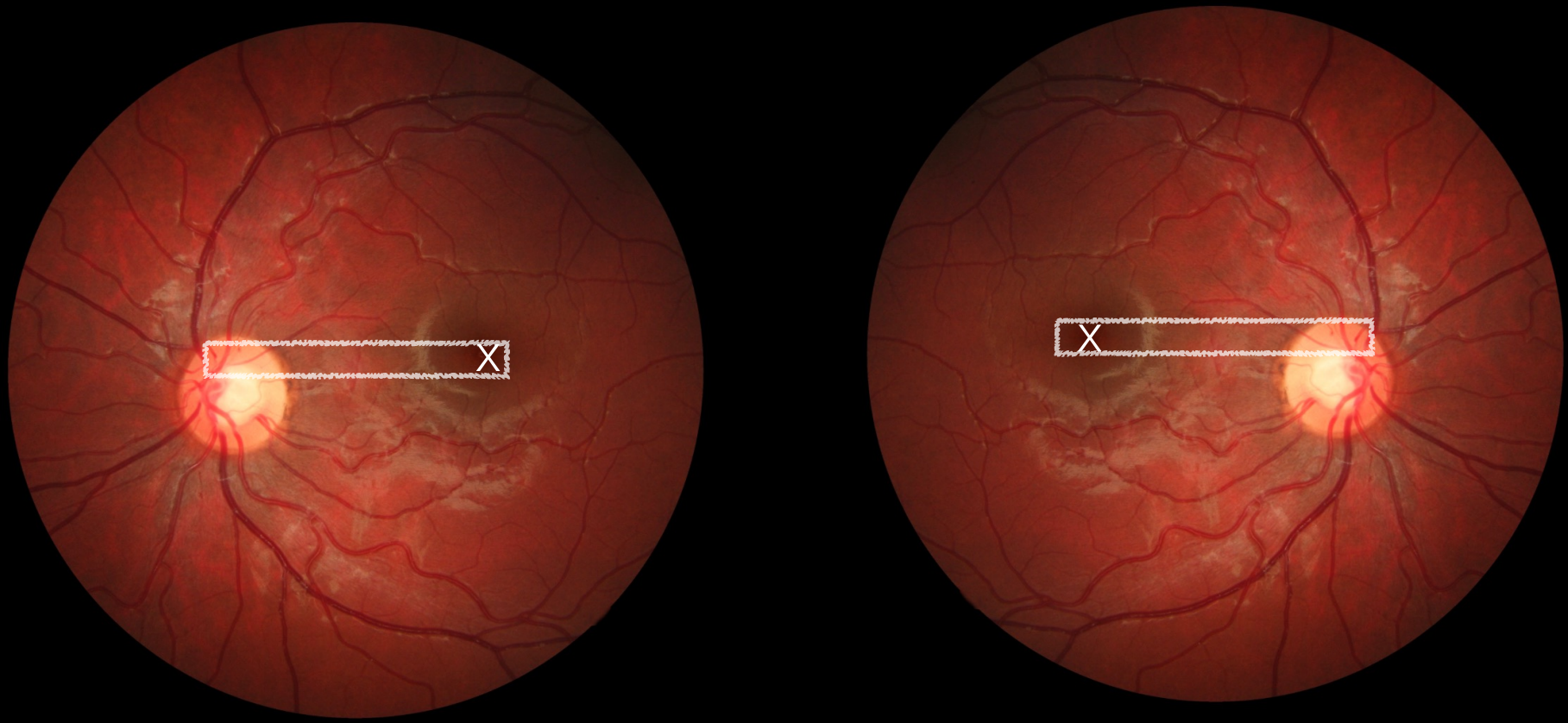

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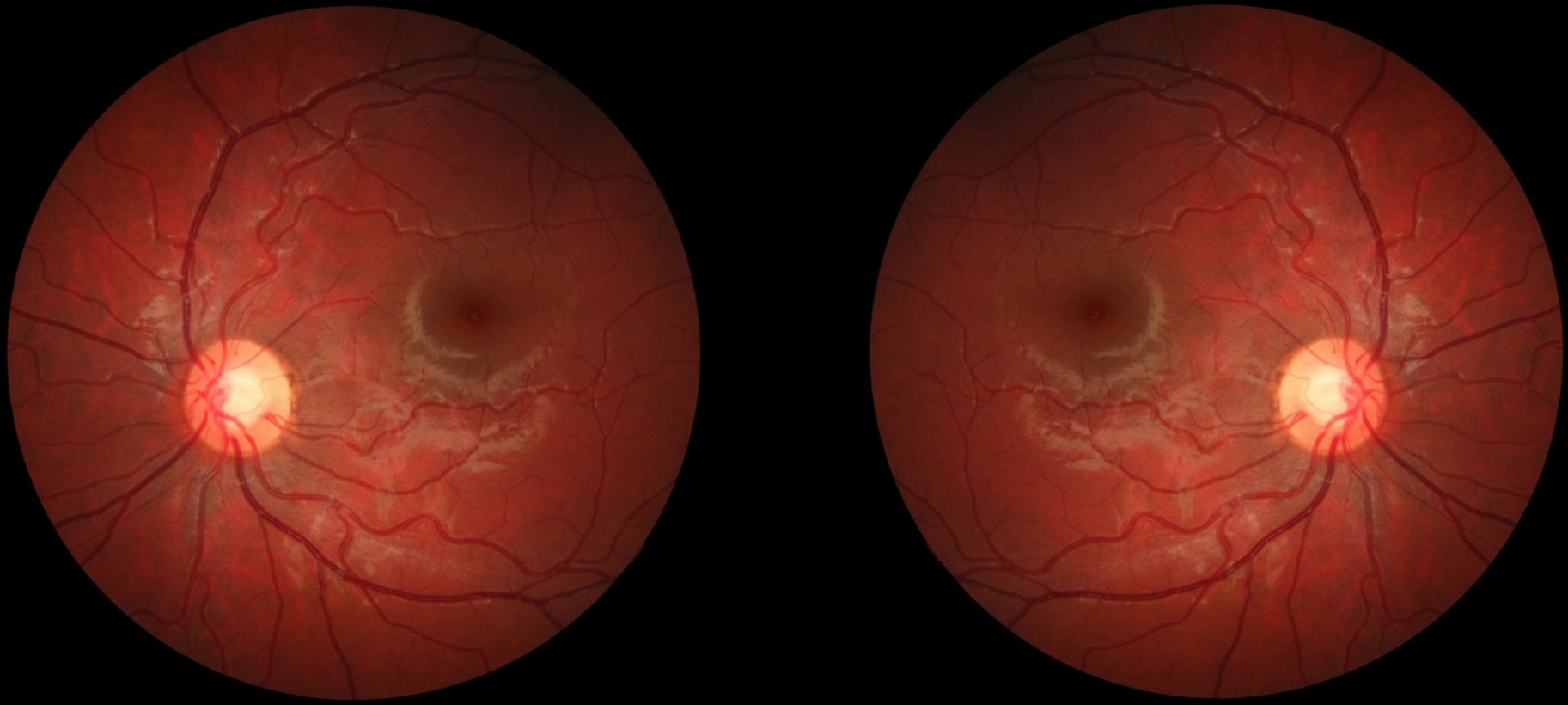

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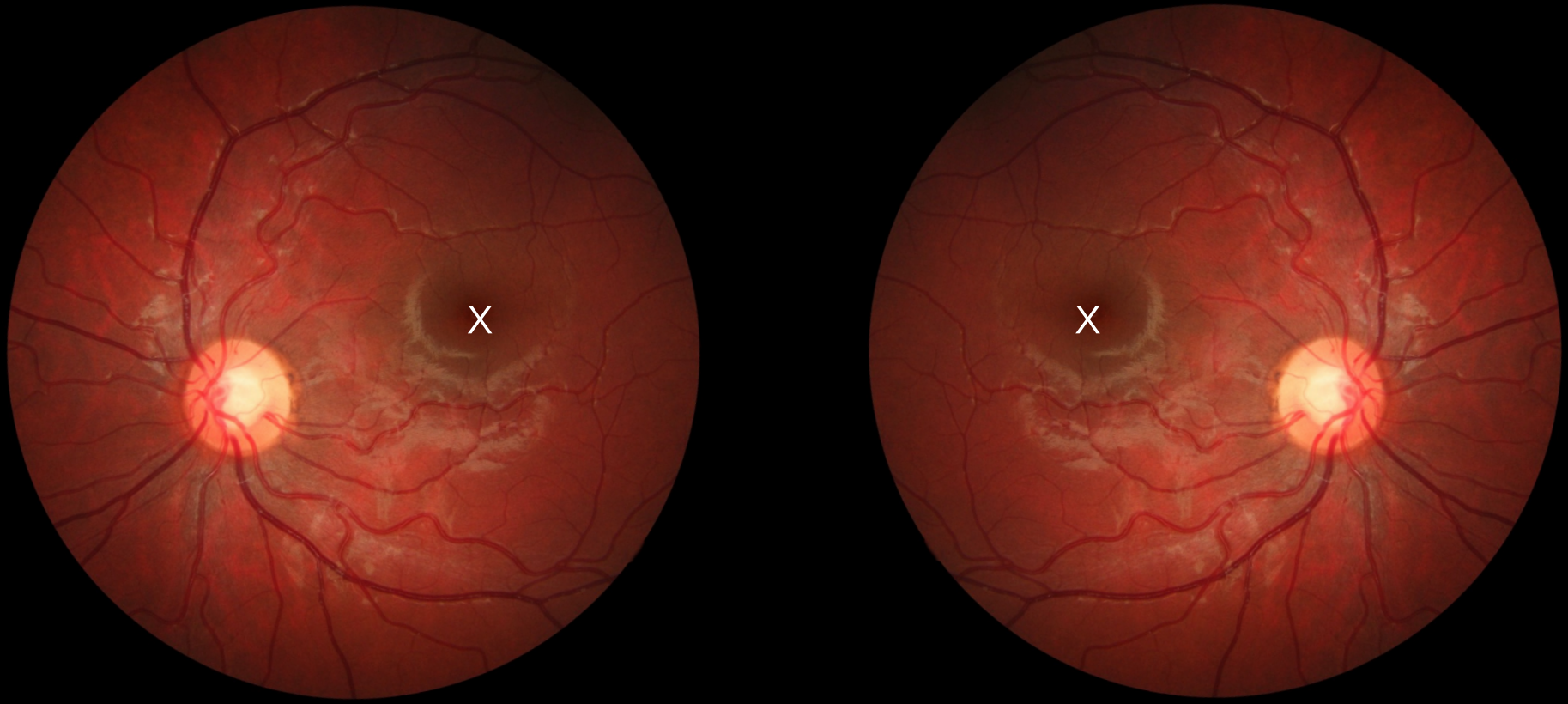

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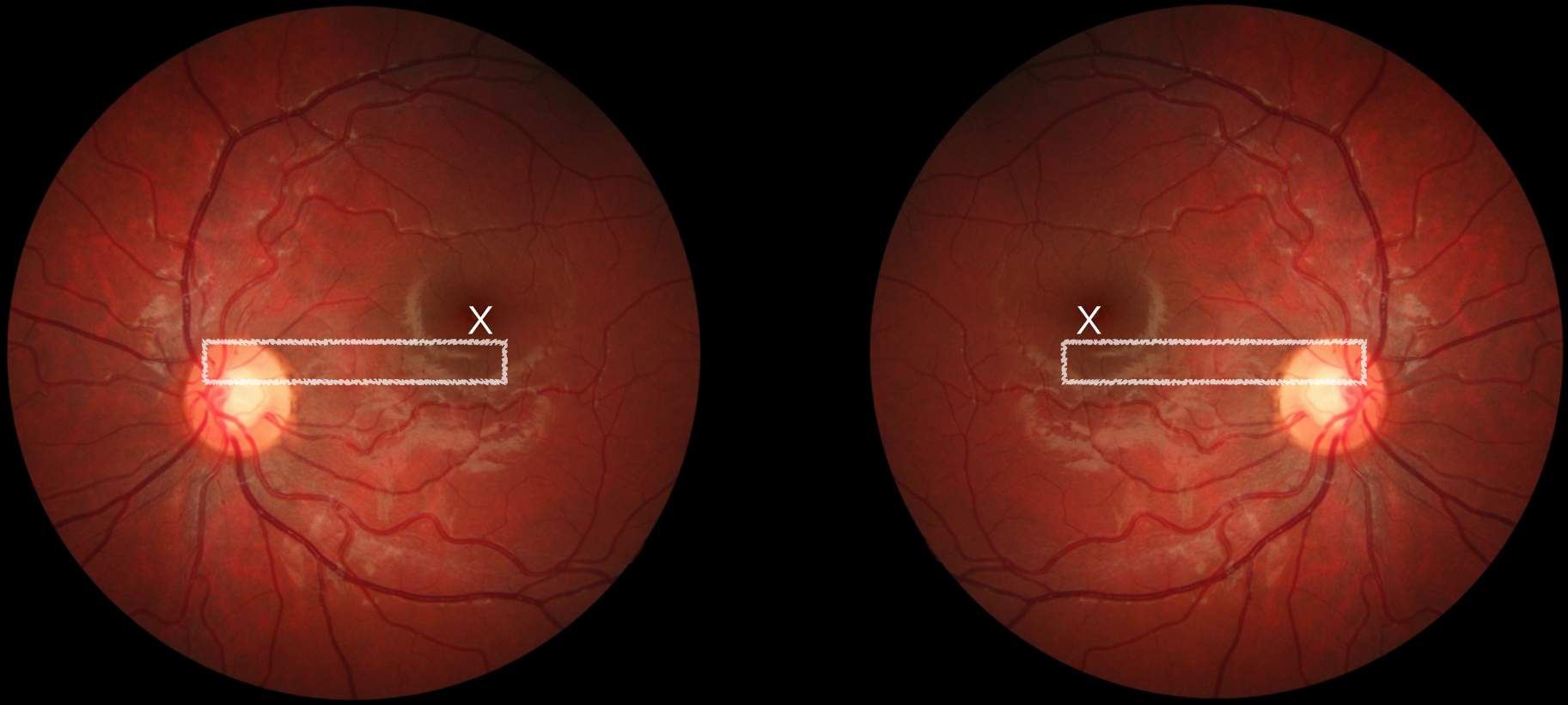

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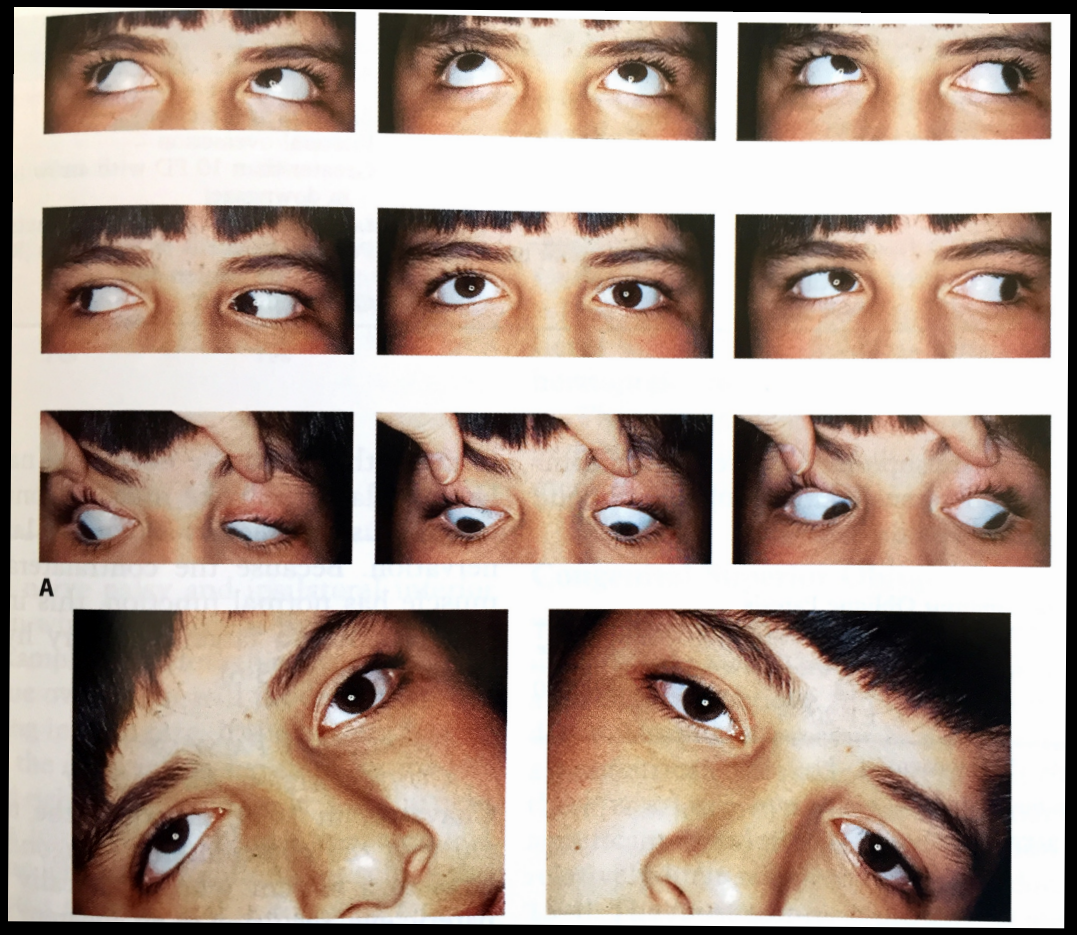
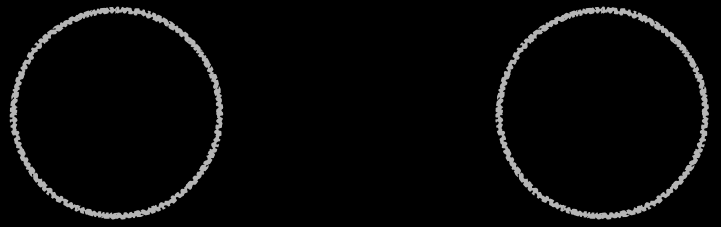
3 Step Test



RSR RIO LIO LSR



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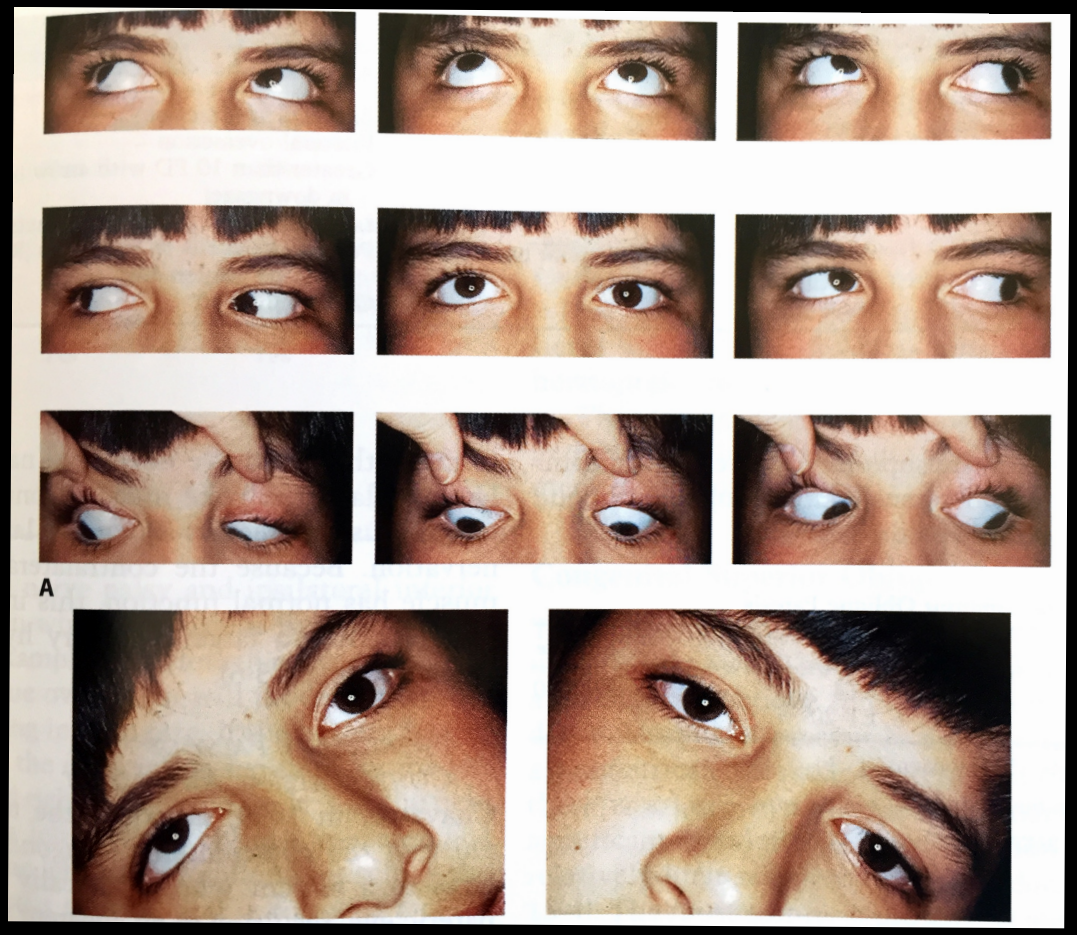

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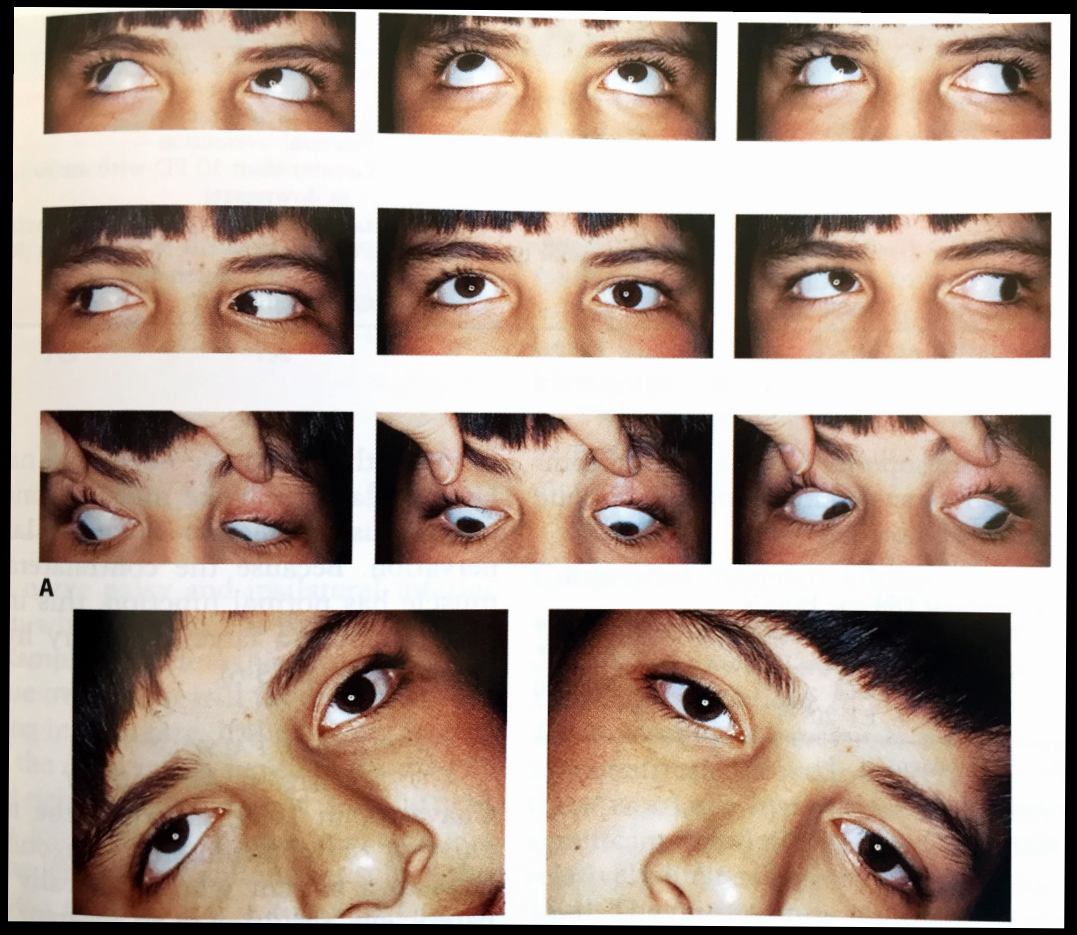

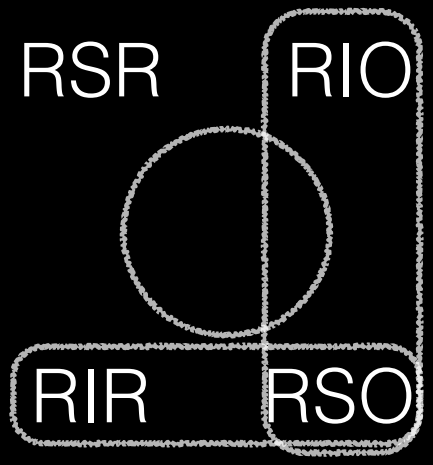

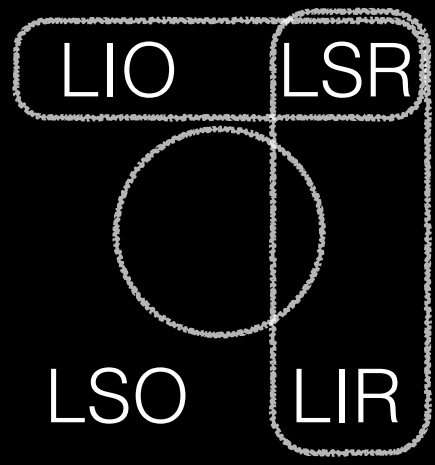

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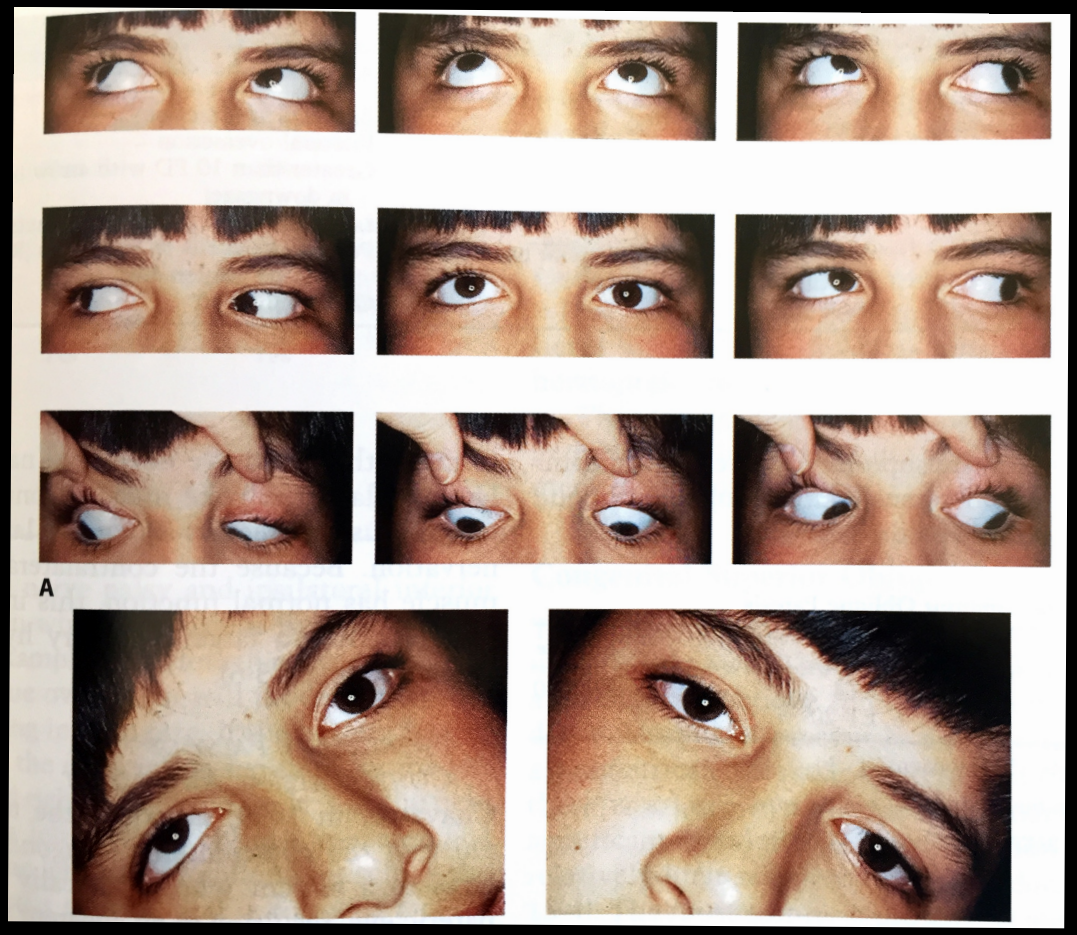

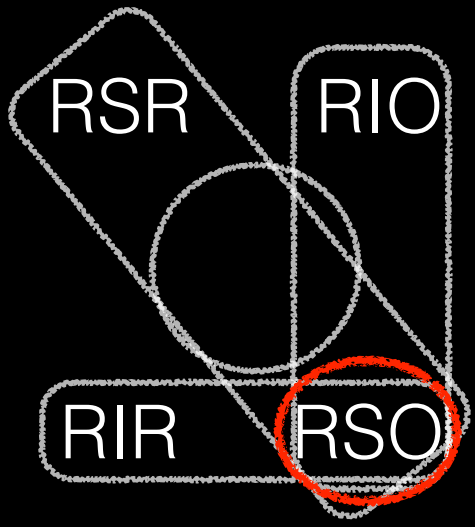

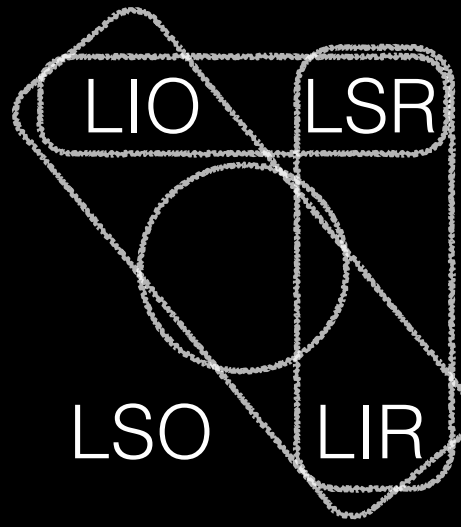

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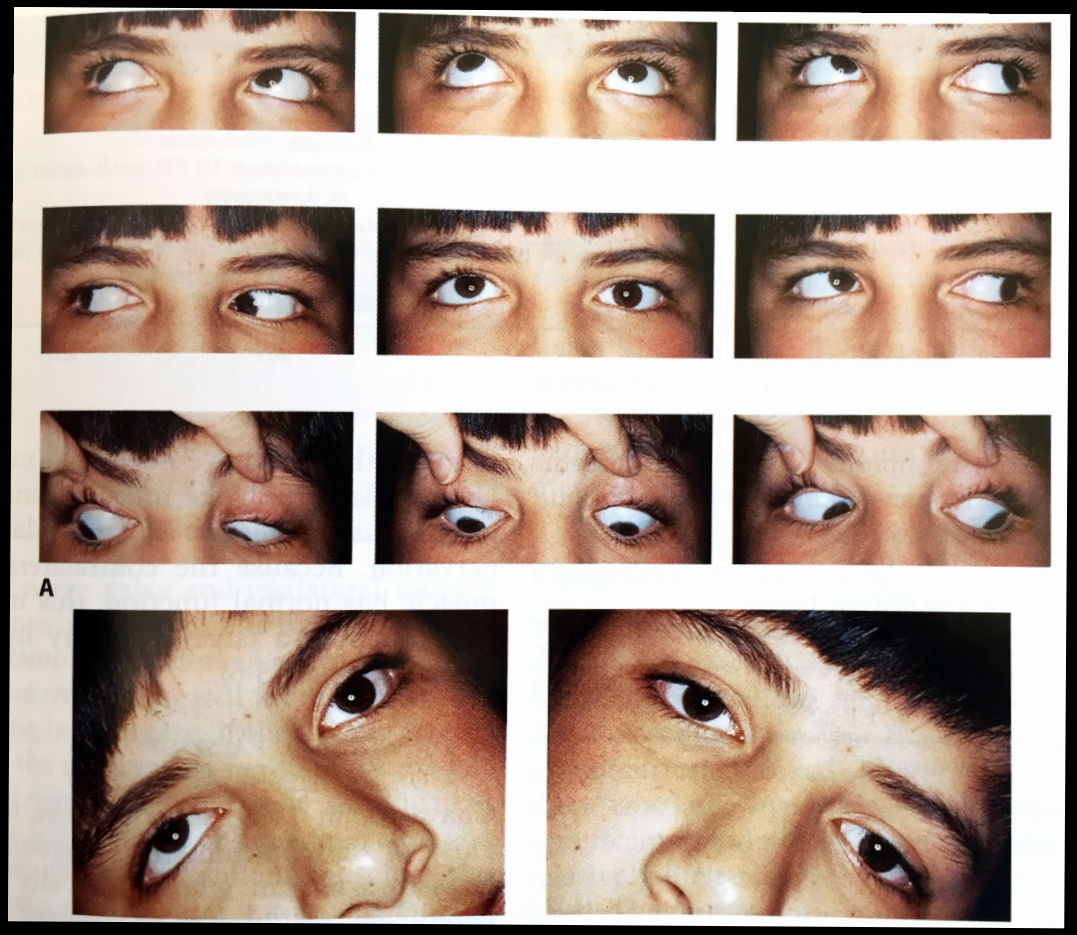

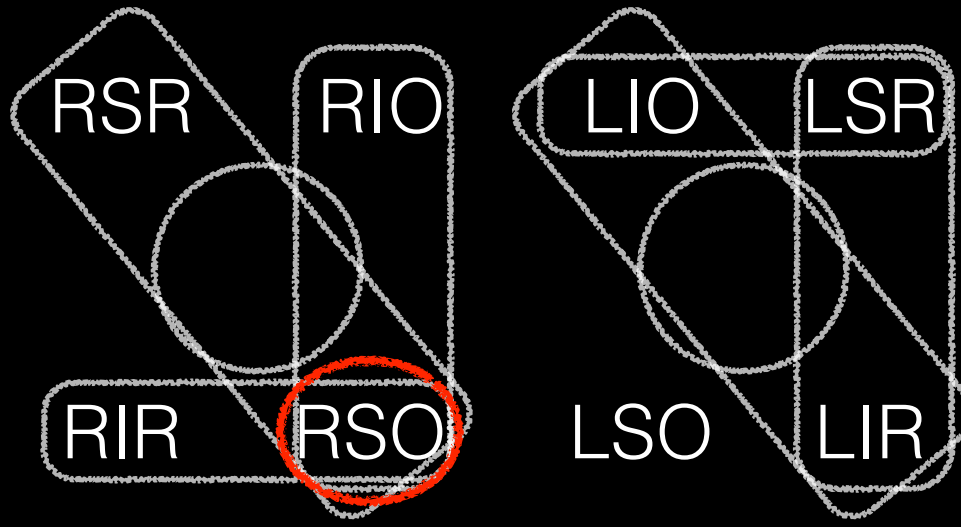

Invalid for:

- Post strabismus surgery
- Multiple nerve palsies
- Restrictive Strabismus
- DVD
- Skew Deviation

SOP- Management

- 8-10% of unilateral cases are masked bilateral

Unilateral SO Palsy	Bilateral SO Palsy
Hypertropia in Primary	May not have hypertropia in primary
Unilateral Oblique dysfunction	Bilateral Oblique Dysfunction
Positive 3 step Test	V pattern
Hypertropia worse on ipsilateral side	Reversing hypertropia on side gaze and head tilt
Excyclotorsion < 12°	Excyclotorsion > 12°

SOP- Management

- Look for the following:
  - Amount of Hypertropia in primary: 13 Δ
  - Vertical deviation in ipsilateral gaze
  - Degree of oblique dysfunction

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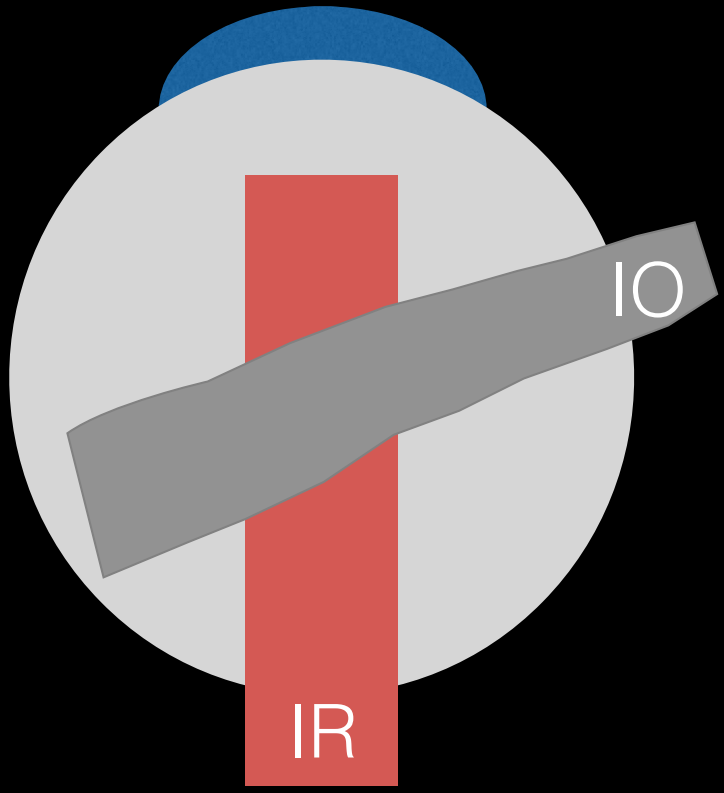
SOP- Mangement General Principles

- < 13 Δ : One vertical muscle
  - IO weakening or SO Strengthening
  - Vertical Rectus
    ("spread of comitance")
- If inferior oblique overacting- weaken it
- Less vertical in upgaze or significant torsion
  - Strengthen superior oblique (tuck)

Inferior oblique Weakening

- Recession



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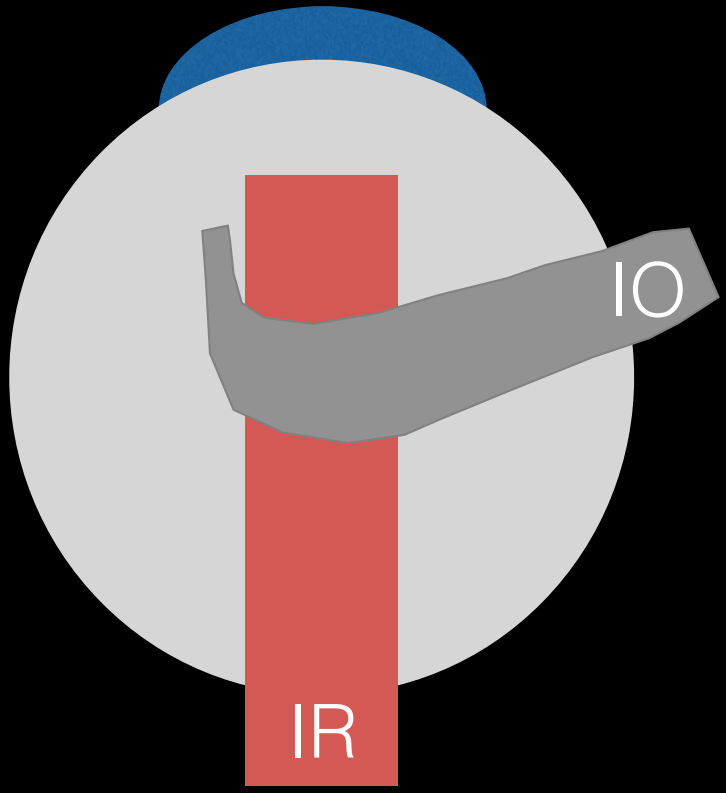
Inferior oblique Weakening

- Recession



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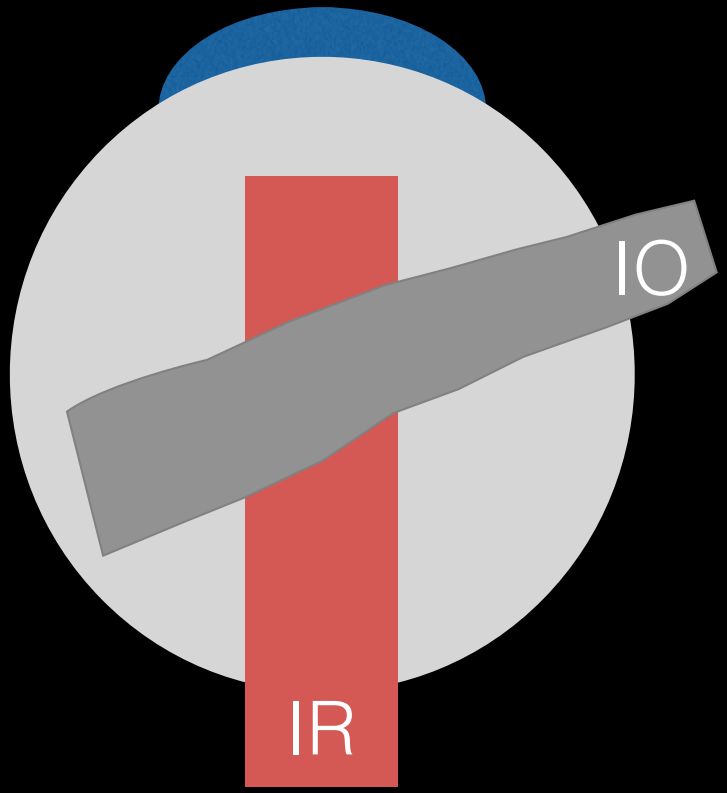
Inferior oblique Weakening

- Myectomy



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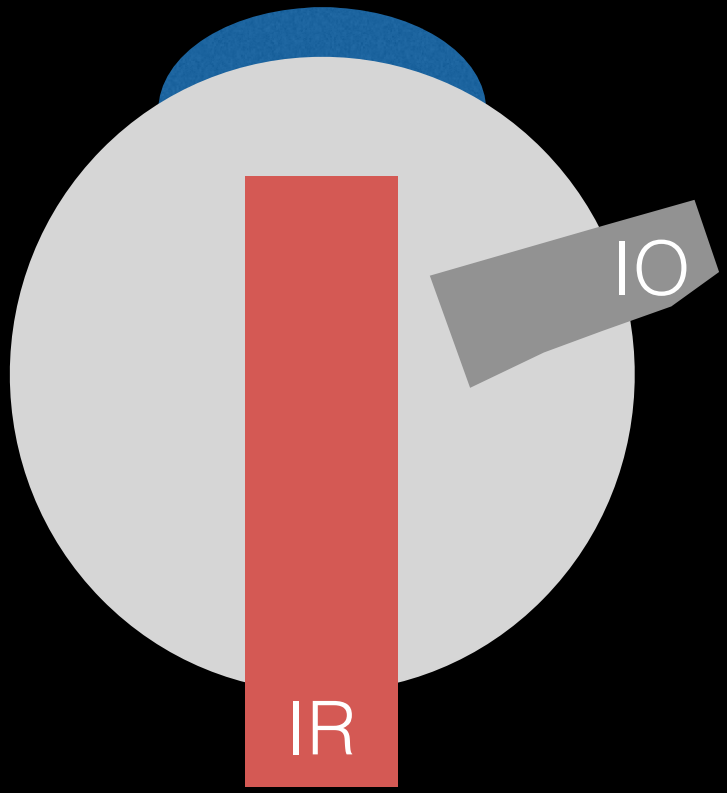
Inferior oblique Weakening

- Myectomy



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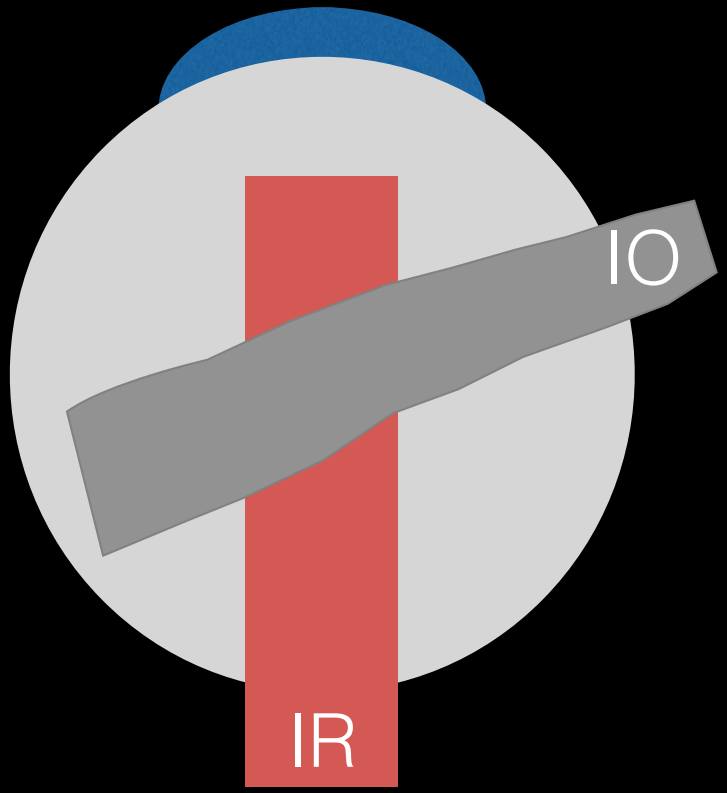
Inferior Oblique Weakening

- Z-myotomy



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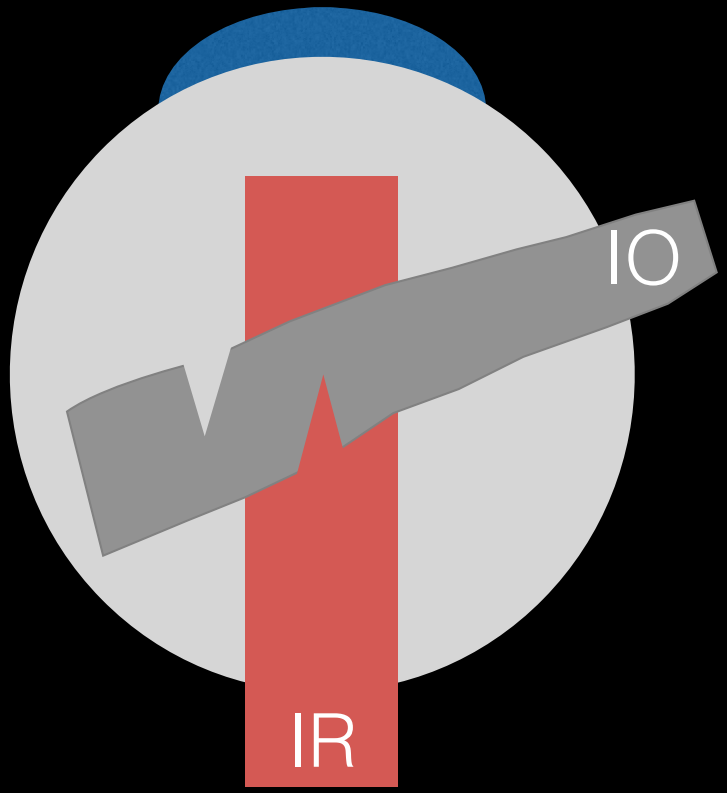
Inferior Oblique Weakening

- Z-myotomy



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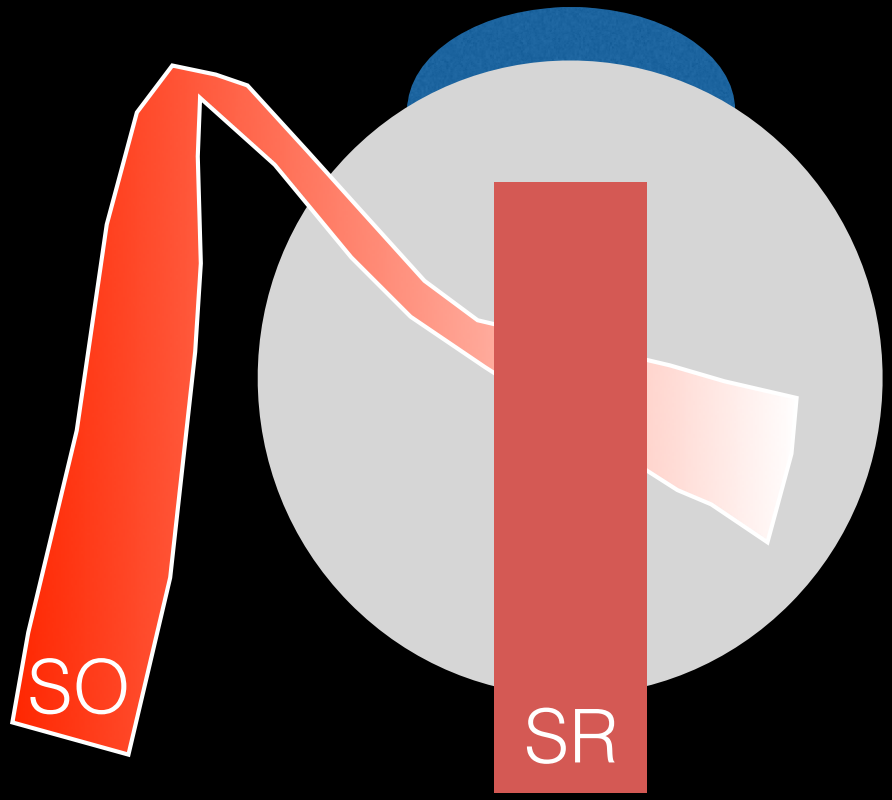
Superior Oblique Tuck



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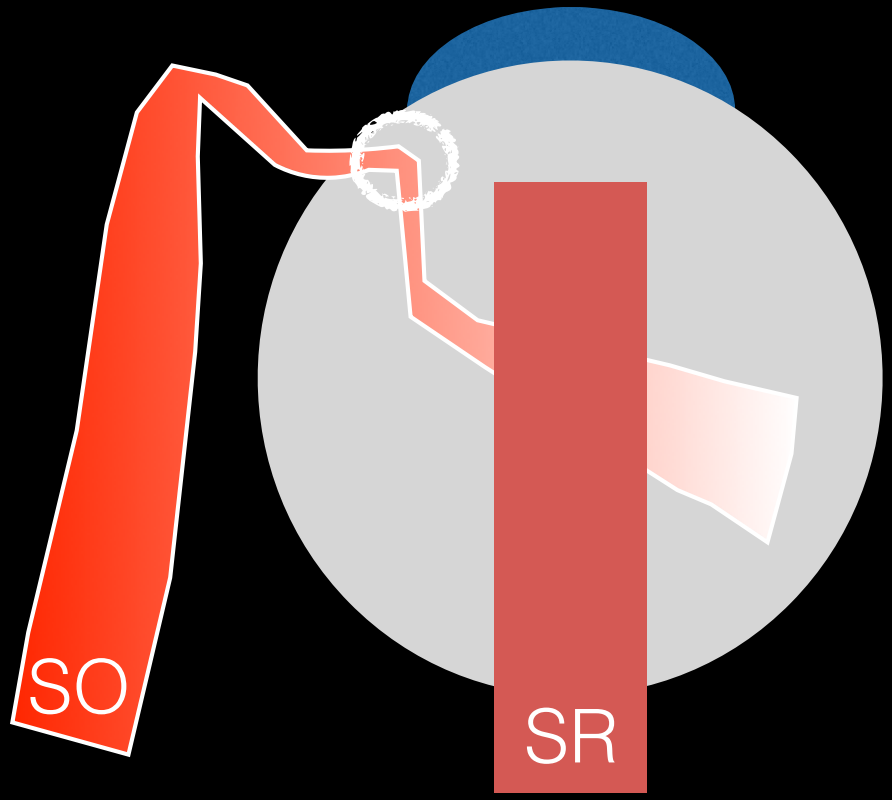

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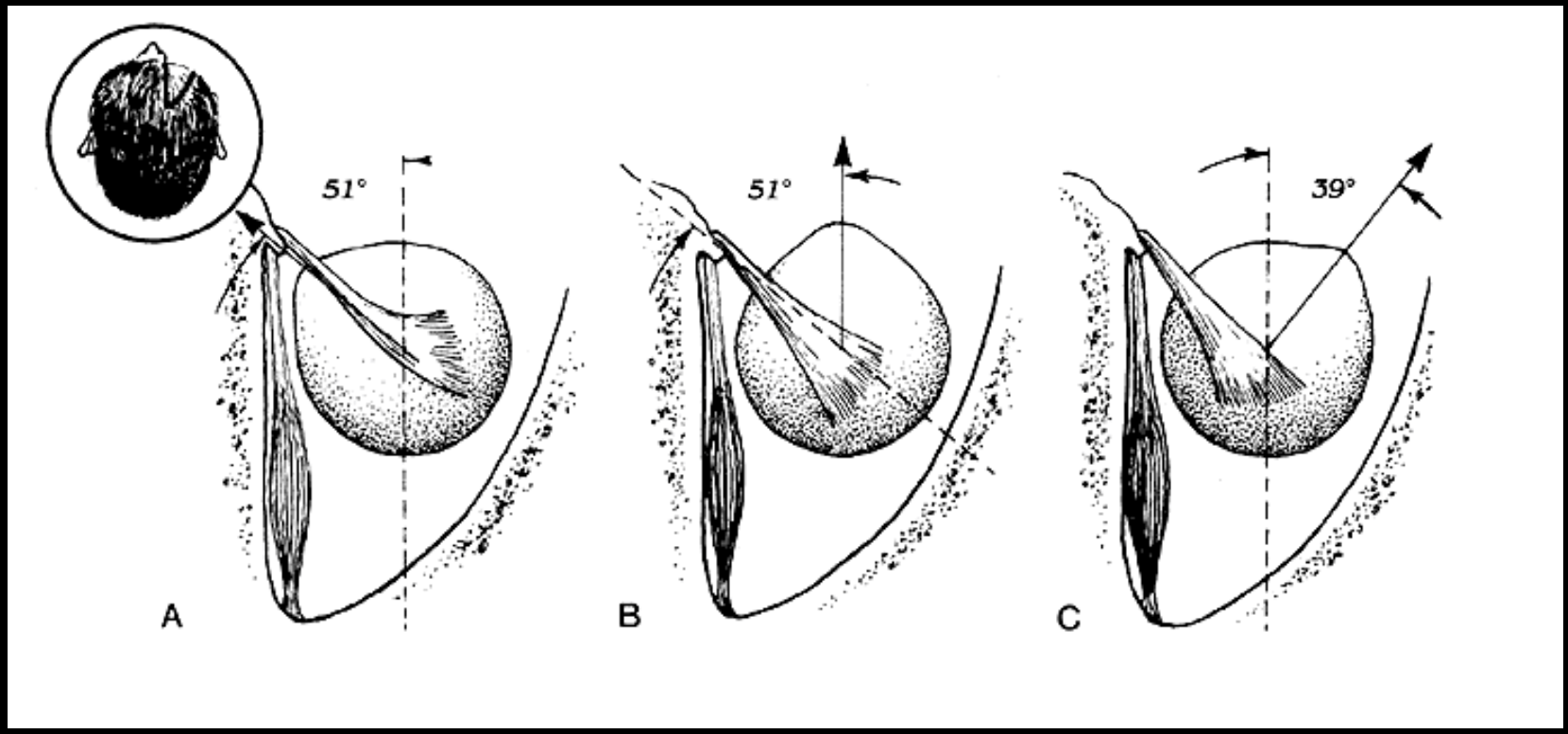
SOP- Management General Principles

- 13-30 Δ : 2 vertical muscles
  - often contralateral inferior rectus recession unless ipsilateral SO is tight
- >30 Δ : 3 muscles or refer to your enemy!

Superior oblique functional anatomy



Parks MM, Parker JE: Atlas of Strabismus Surgery. Philadelphia, Harper & Row

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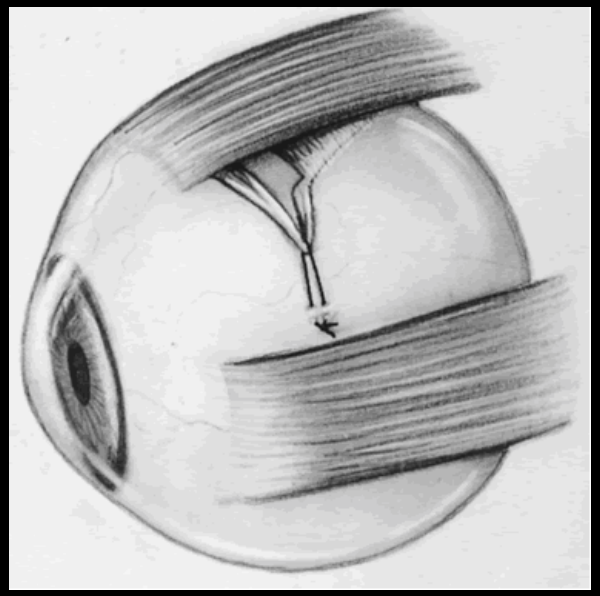
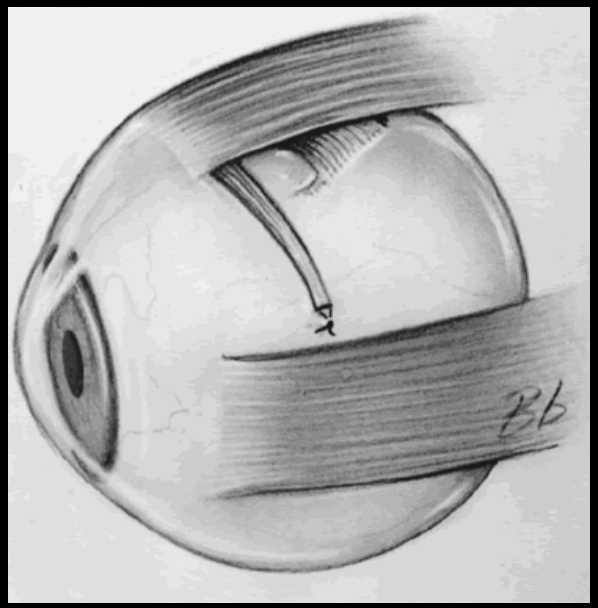
Harada-Ito Procedure

- Improves Excyclotorsion without changing vertical deviation
- Some Esotropic shift in downgaze





Duane's Ophthalmology 2006 Vol 6, Chapter 97

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Dissociated Vertical Deviation

- Spontaneous manifest vertical misalignment
  - Can be horizontal (DHD)
- Many possible explanations
  - compensatory mechanism
  - lack of fusion brings out primitive reflexes
- Result of early childhood strabismus
  - often present by age 2

DVD

- Usually bilateral but asymmetric and variable
- If fixation preference exists: seen in non preferred eye
- Usually no bifoveal fusion
- Occlusion Hyperphoria- latent vertical deviation not seen until fusion suspended

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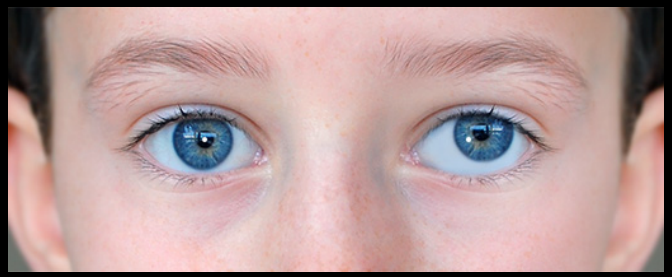
DVD

- Measure with base down prism until no downward movement seen
- No Hypotropia in opposite eye!
- Usually comitant but may be variable
  - same in adduction and abduction
- Contrast to Inferior oblique over-action
  - Hypotropia in fellow eye
  - V pattern common
  - Incommitant deviation
  - 3 Step test
- The two may co-exist!



DVD Treatment

- Patching not effective if vision equal
- Large recessions of superior rectus
  - Unilateral vs bilateral
- Anterior displacement of Inferior oblique if dysfunctional and DVD also present

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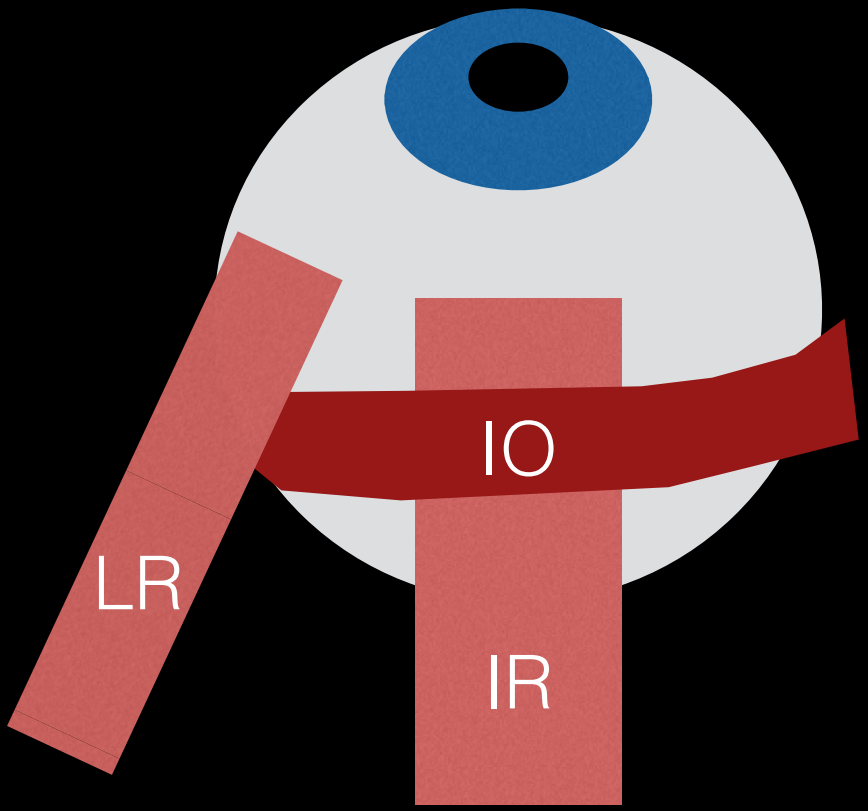
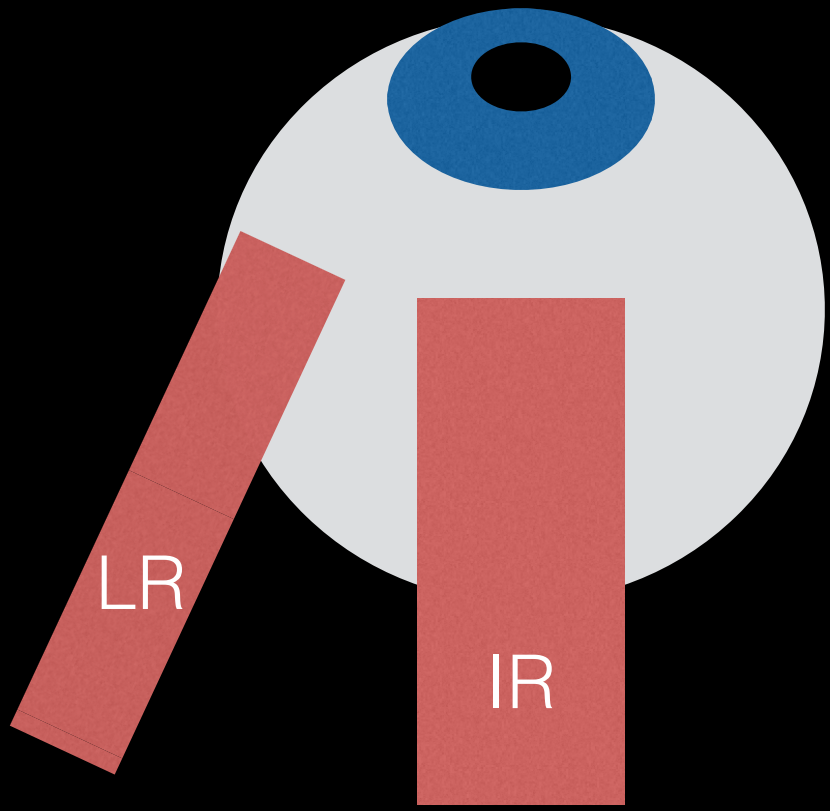
IO surgery for DVD



IO Primary Action:
Elevation



New IO Primary Action:
Depression

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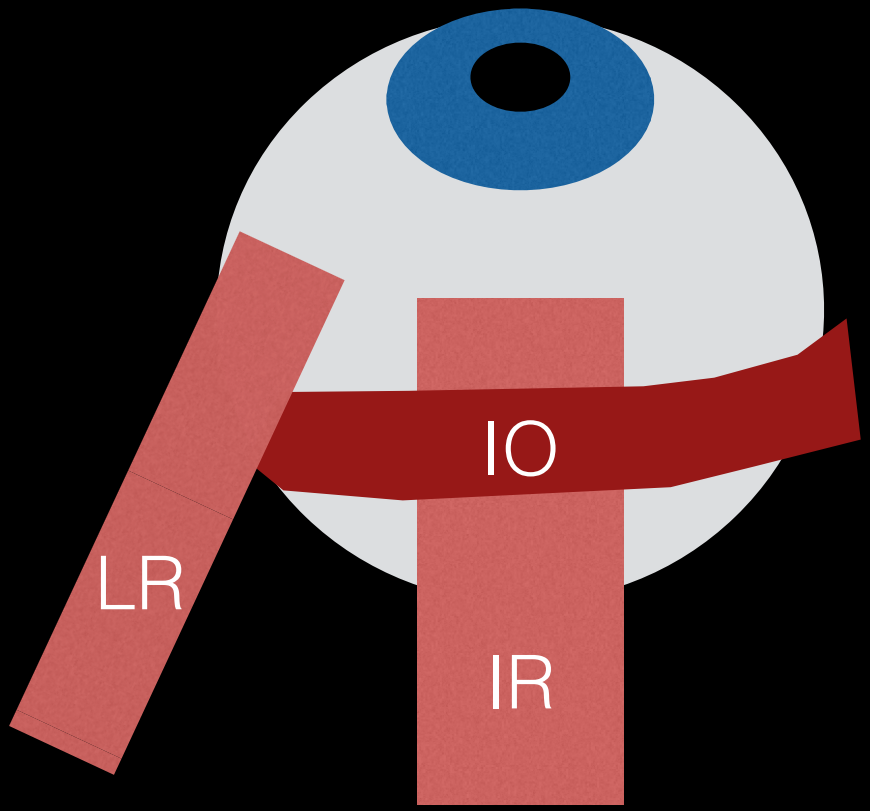
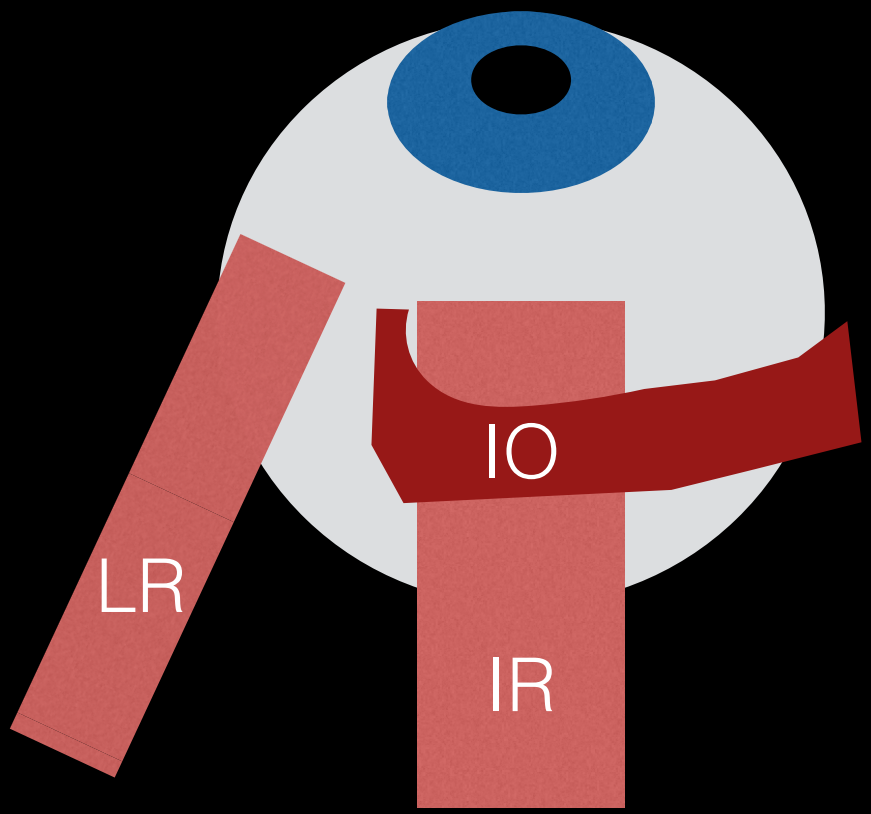
IO surgery for DVD



IO Primary Action:
Elevation



New IO Primary Action:
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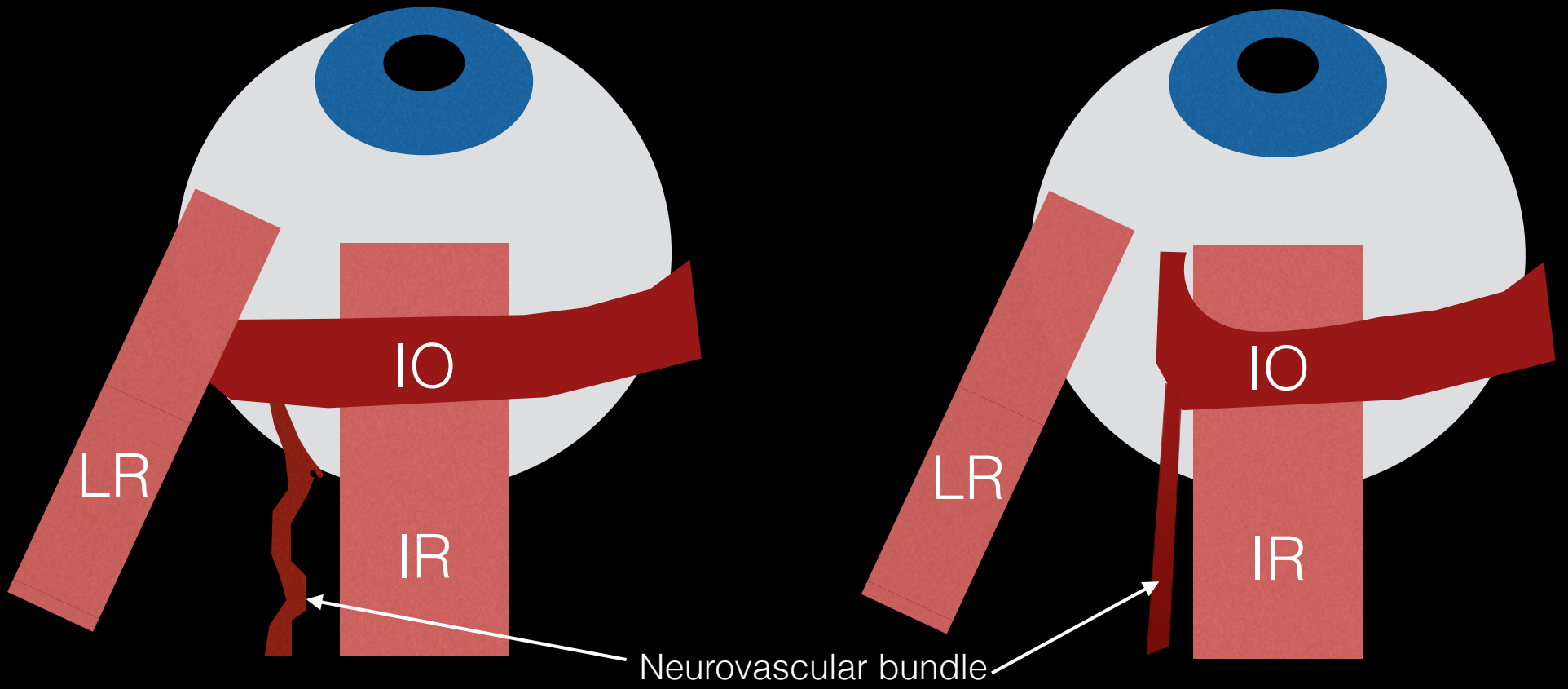

IO Primary Action:
Elevation

New IO Primary Action:
Depression

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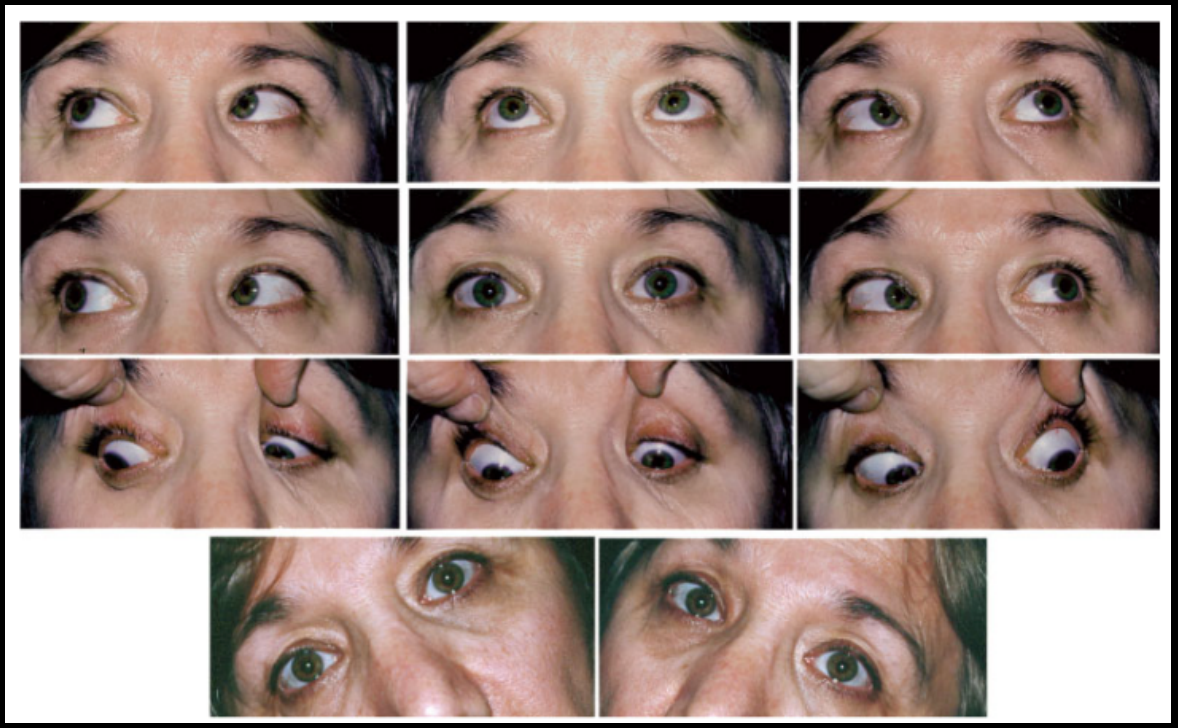
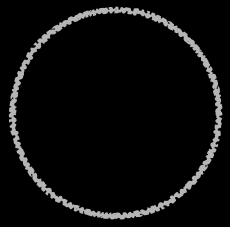
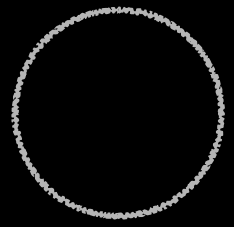
3 Step Test







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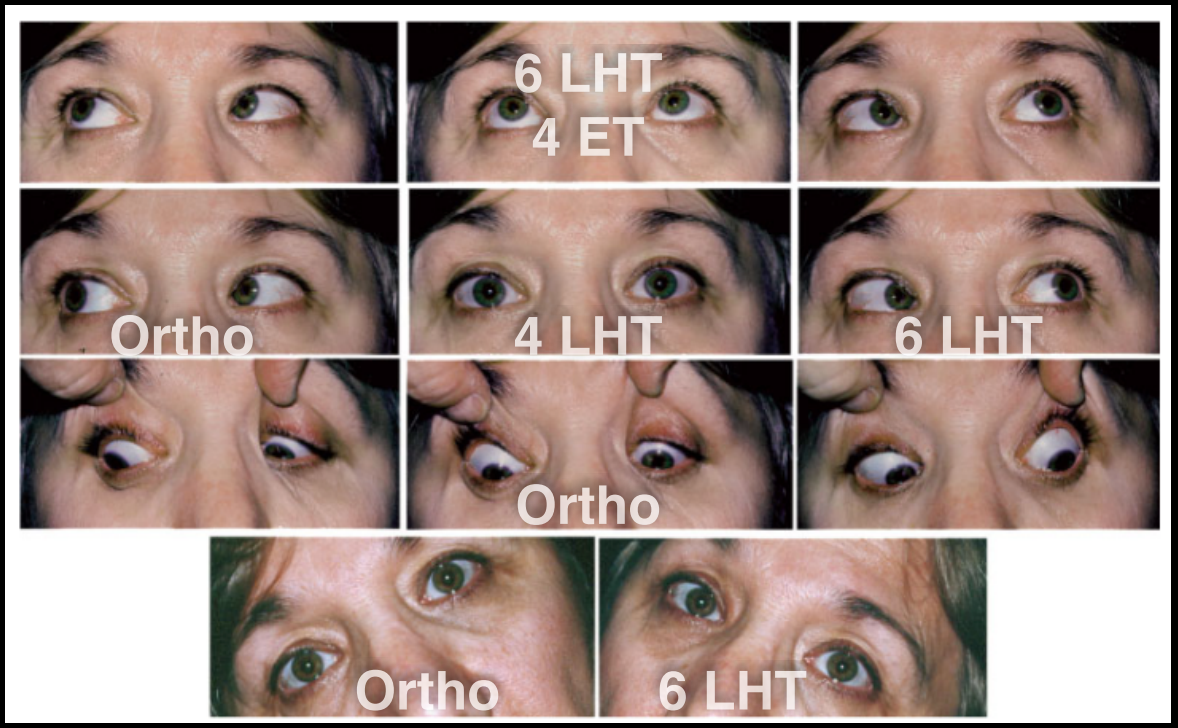
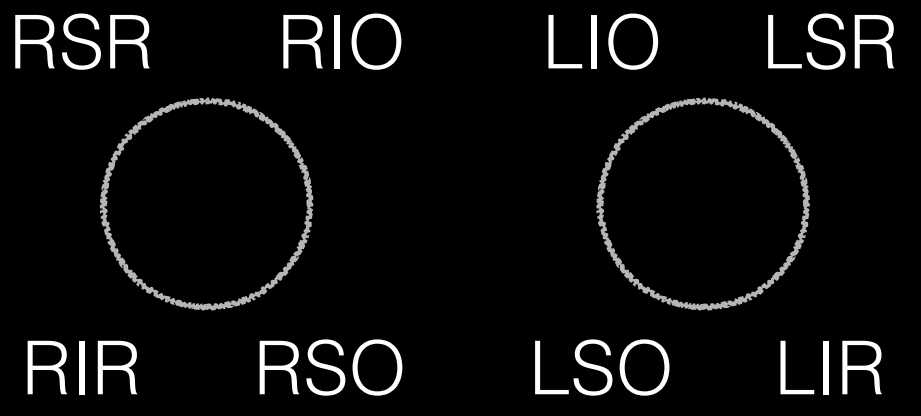
3 Step Test





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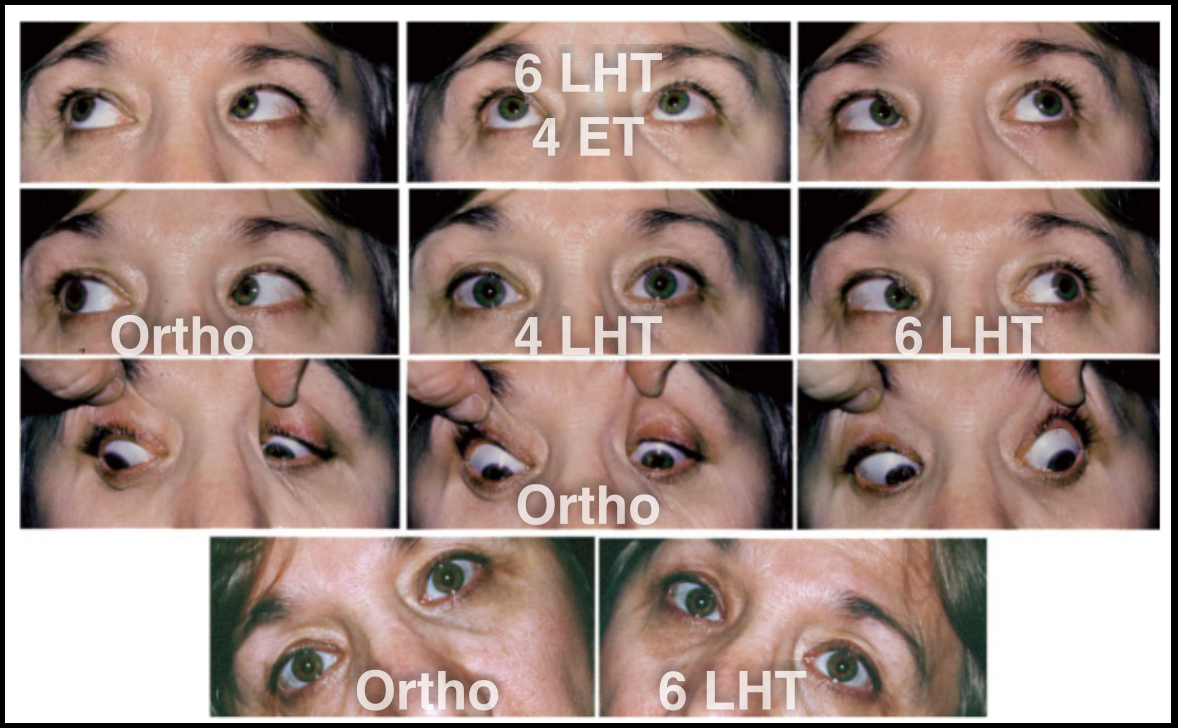

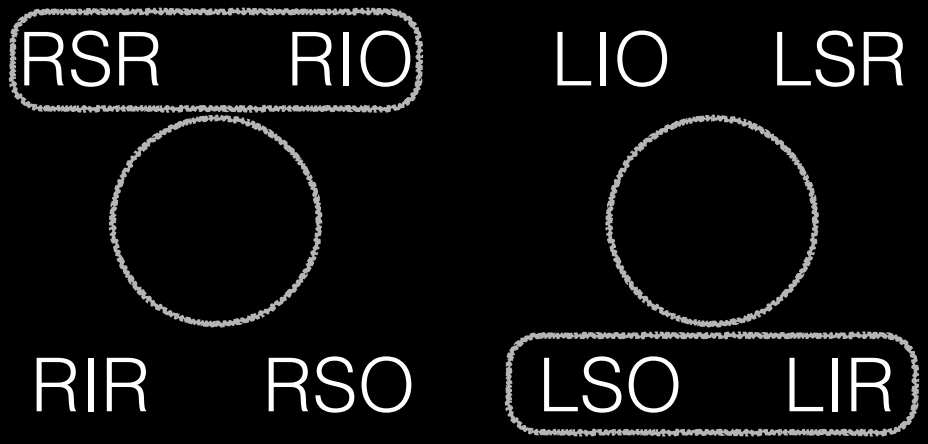

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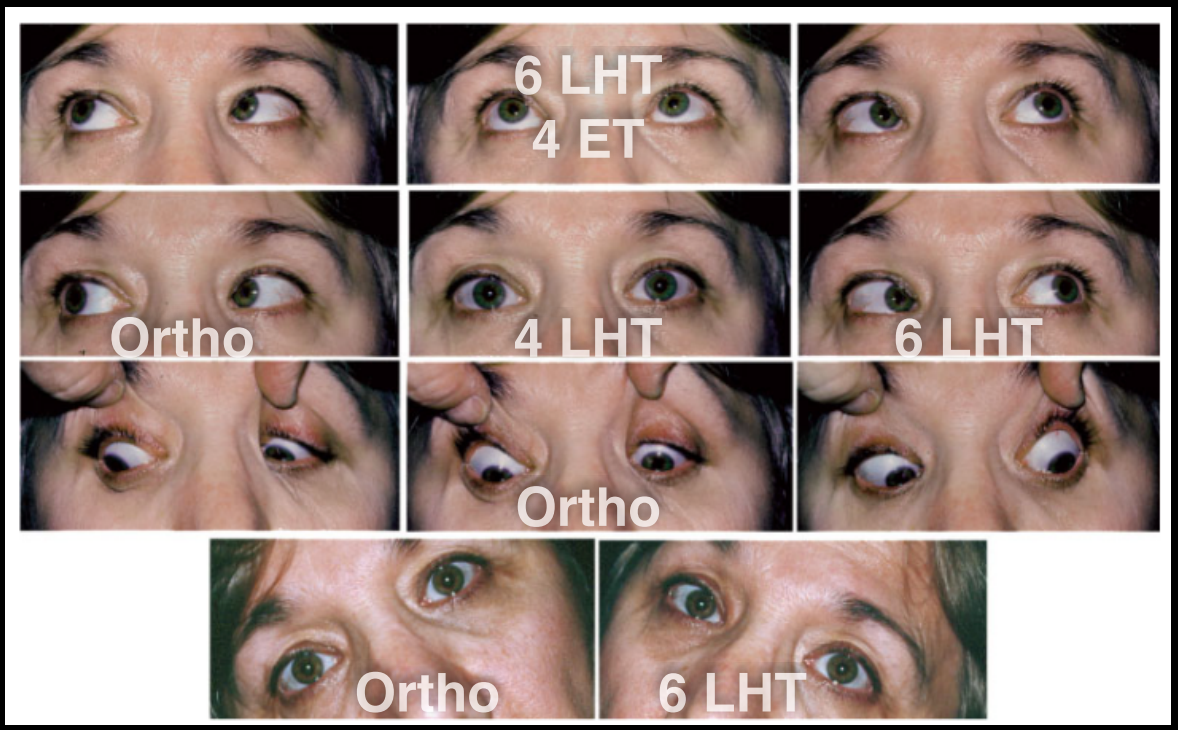
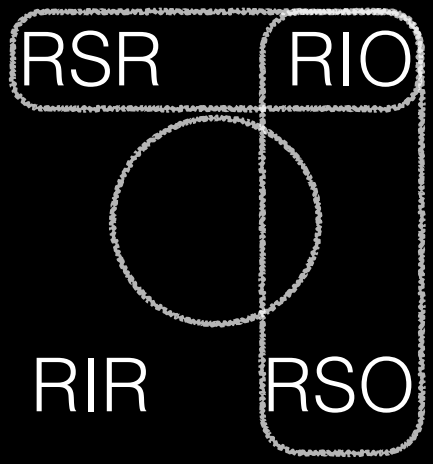
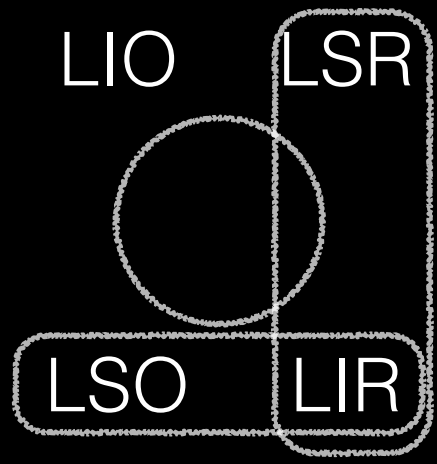
3 Step Test







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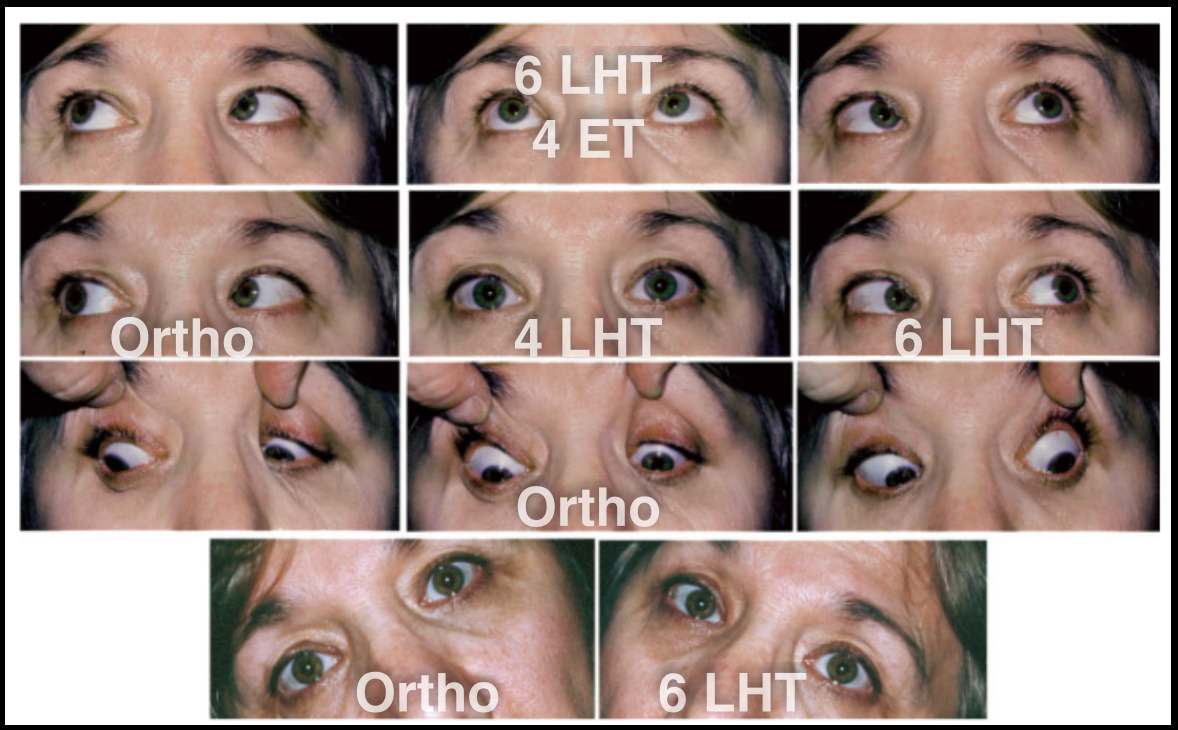
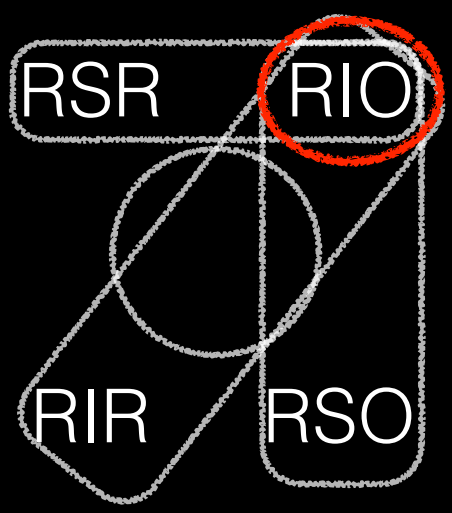
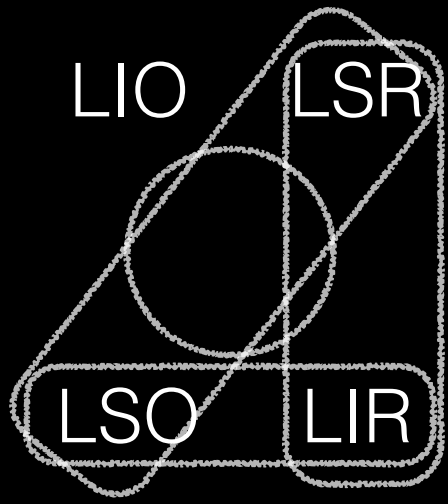
3 Step Test







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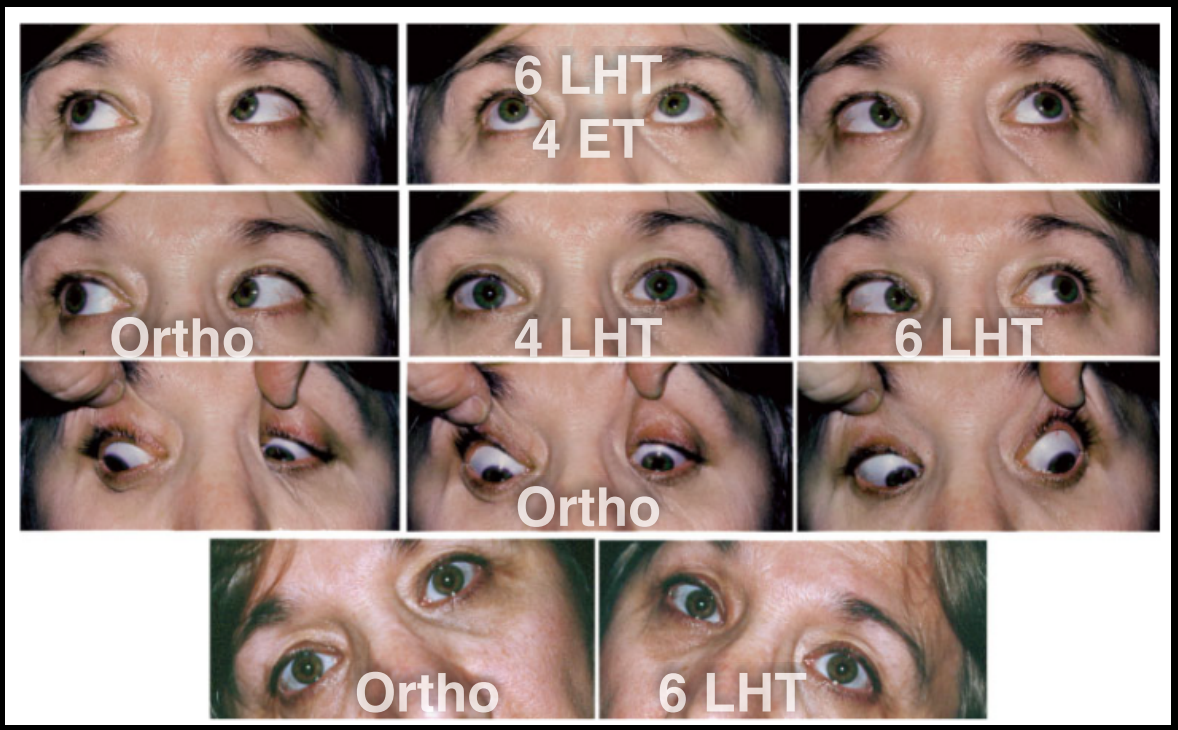
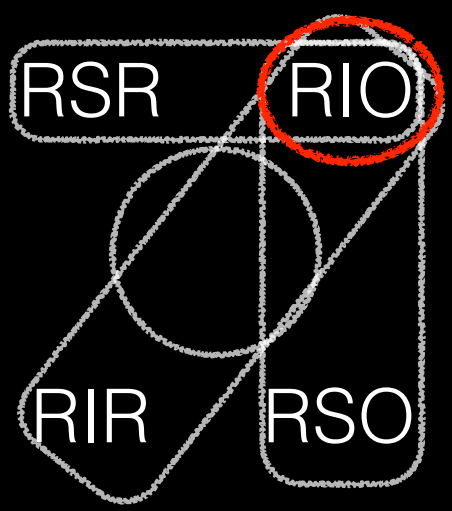
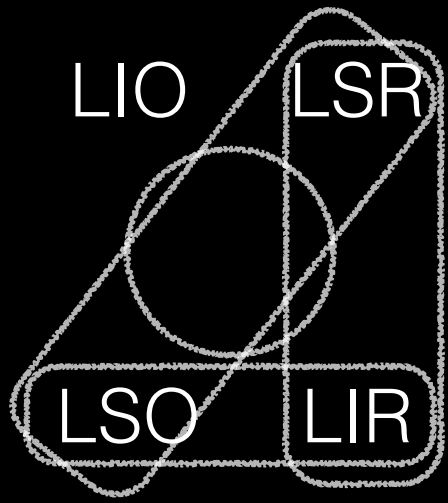
3 Step Test







Right Inferior Oblique Palsy

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Inferior Oblique Palsy

- Congenital or post traumatic dysfunction of inferior oblique or CN 3 branch to inferior oblique
- Elevation deficient in adduction but need to distinguish from Brown Syndrome

IO Palsy

- Treatment
  - If torsion: weaken ipsilateral Superior oblique
  - If no torsion: recess contralateral superior rectus

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Brown Syndrome

- Abnormality of the superior oblique tendon
- Limitation of elevation in adduction

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Brown Syndrome

- Clinical Characteristics
  - Deficient elevation in adduction that improves in abduction
  - Hypotropia
  - Chin up head position and/or face turn away from affected eye
  - Forced ductions show restriction to elevation in adduction that is worse with retropulsion*
  - V pattern*
  - Superior oblique function normal*

*Helps distinguish from Inferior oblique palsy

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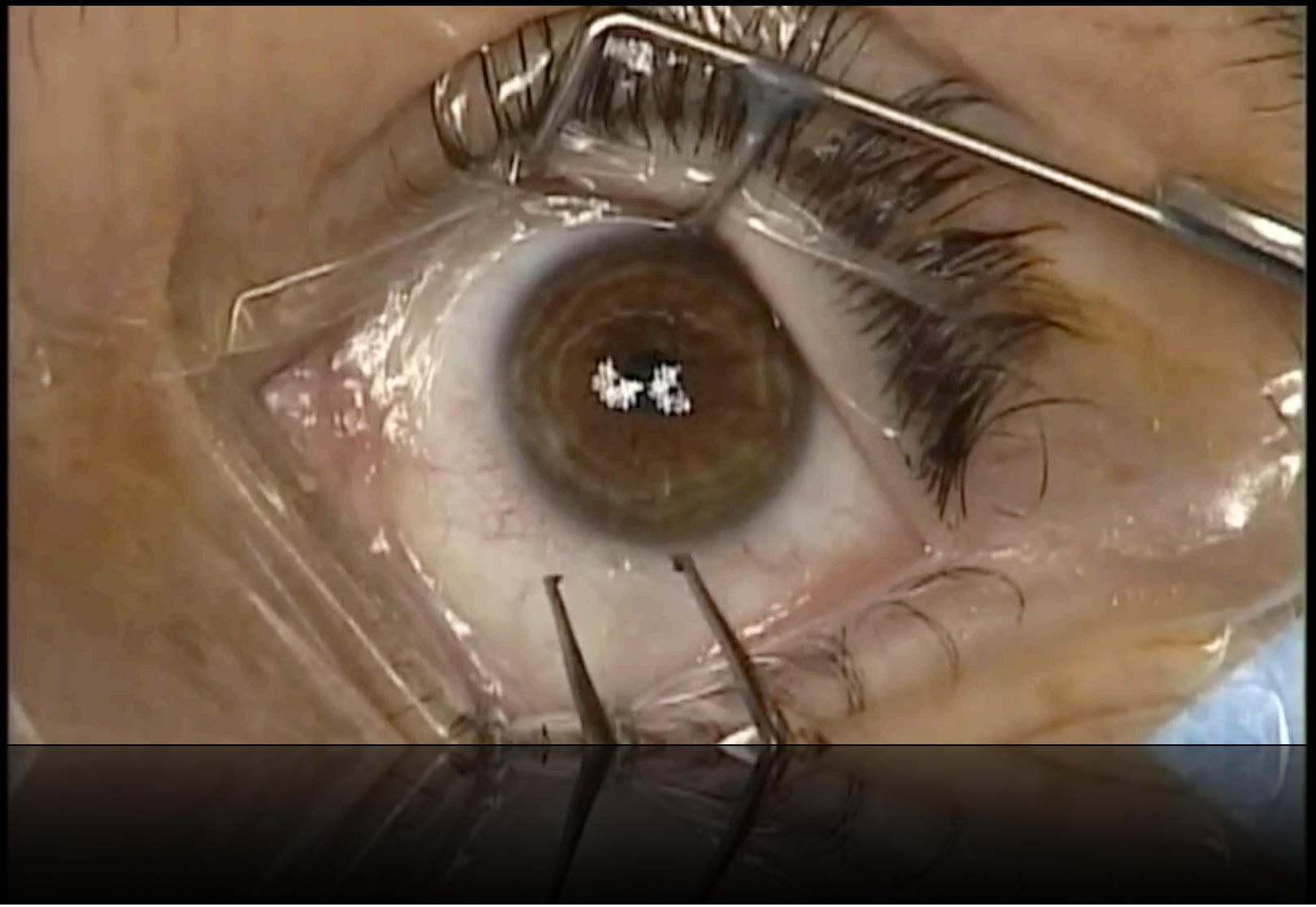
Forced Ductions



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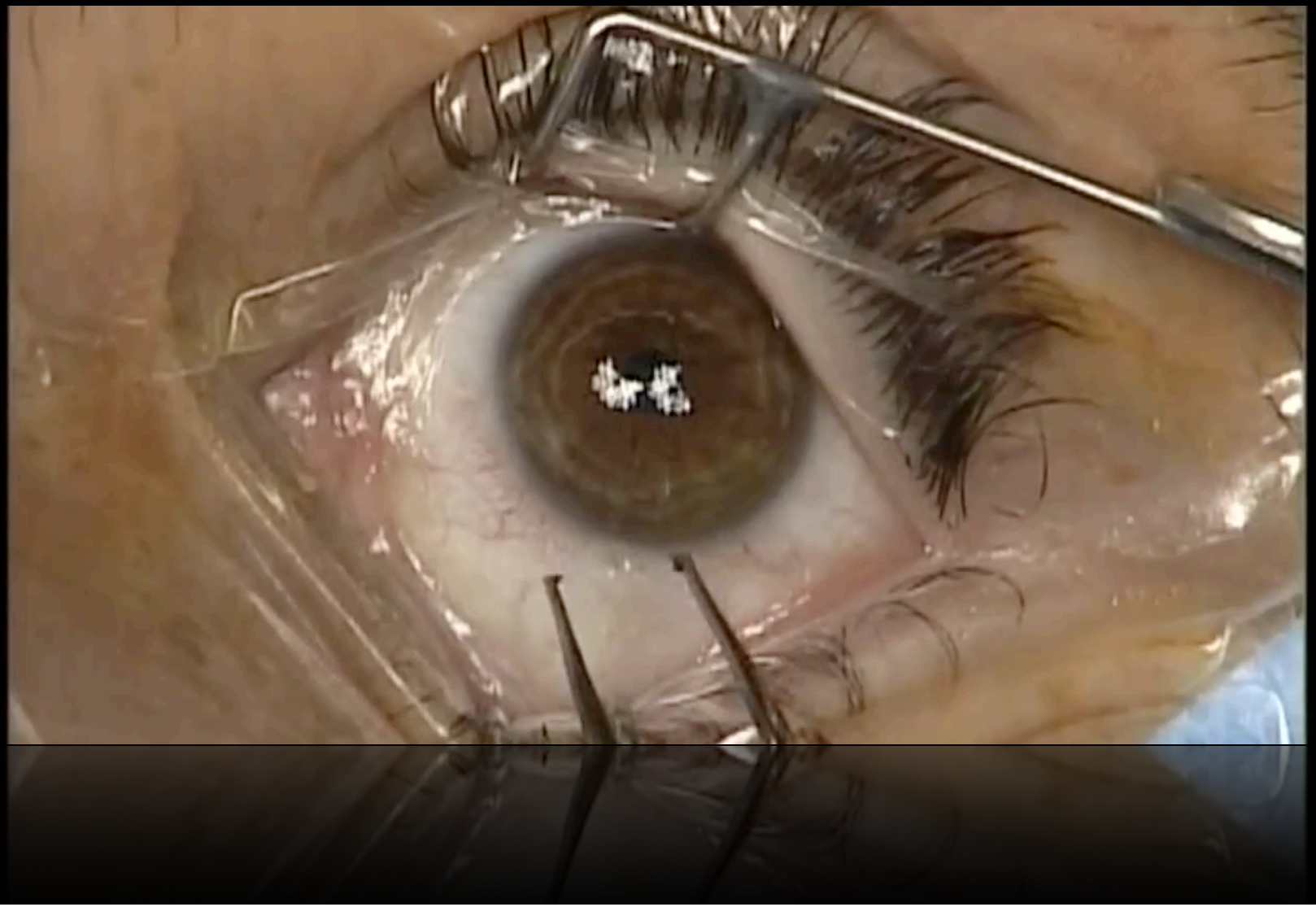
Forced Ductions



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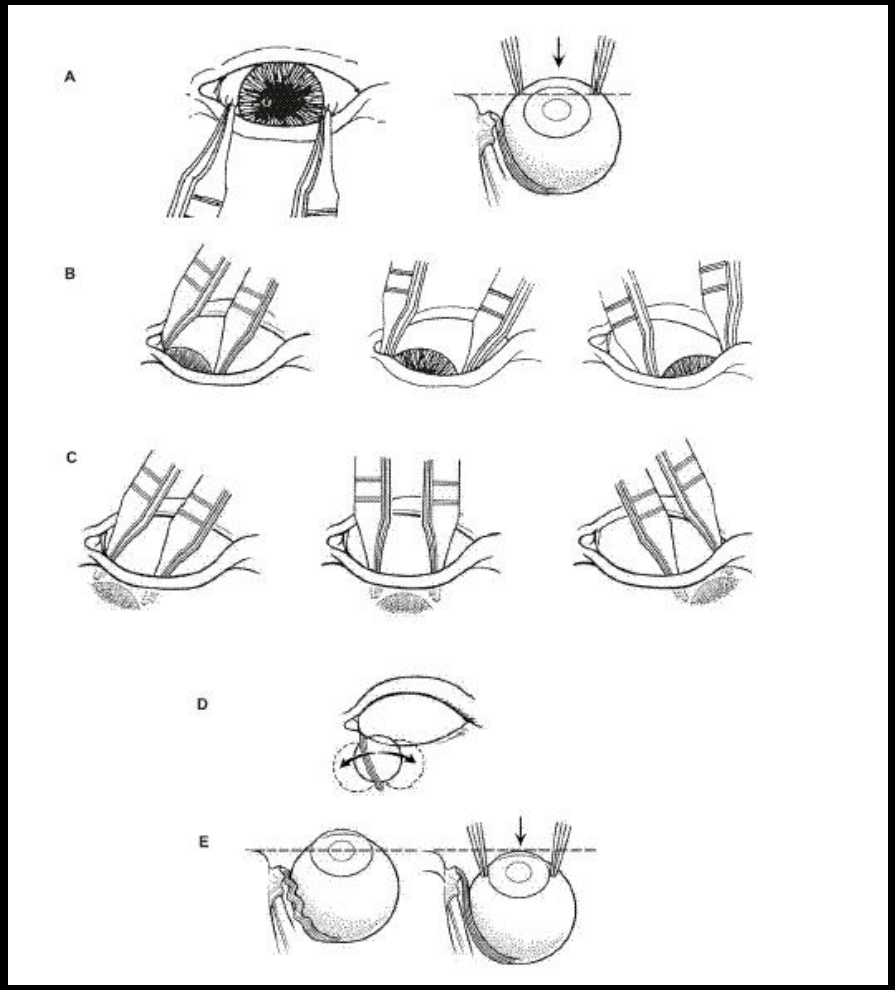
SO Traction Test



Surgical Management of Strabismus. Ch 5, 2005. Helveston

The superior oblique traction test (viewed from above the patient's head)

A. The eye is grasped at the 2 o'clock and 10 o'clock position (right eye from above)

B. The eye is pushed back into the orbit and is guided from nasal to temporal. As it goes over the normal superior oblique tendon, the eye 'pops' up.

C. With a lax or loose tendon the cornea disappears and remains hidden behind the upper lid as the eye is rotated.

D. The relative path of the globe as it passes over a normal tendon.

E. A lax superior oblique tendon allows the globe to be pushed backward into the orbit.

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Brown Syndrome

- Etiologies
  - Congenital tendon or trochlear abnormalities
  - Acquired
    - Trauma
    - Inflammatory
      - Sinusitis
      - Systemic inflammatory diseases: Rheumatoid arthritis

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Brown Syndrome

- Differential Diagnosis
  - **Isolated inferior oblique paresis**
  - Monocular Elevation Deficiency
    - Limited elevation and abduction and adduction
    - Ptosis or pseudoptosis
  - Congenital Fibrosis Syndrome
    - Restriction to elevation in abduction and adduction
    - Esotropia in limited upgaze more common
  - Blow-out Fracture
    - Limited elevation in adduction and abduction
    - Trauma, enophthalmos, infraorbital paresthesia, radiographic findings
  - Thyroid Eye Disease
    - Elevation limited in adduction and abduction (unless SO most affected- RARE)
    - Esotropia and typical clinical appearance
  - Fat Adherence Syndrome
    - Previous surgery history, Elevation limited more in Abduction

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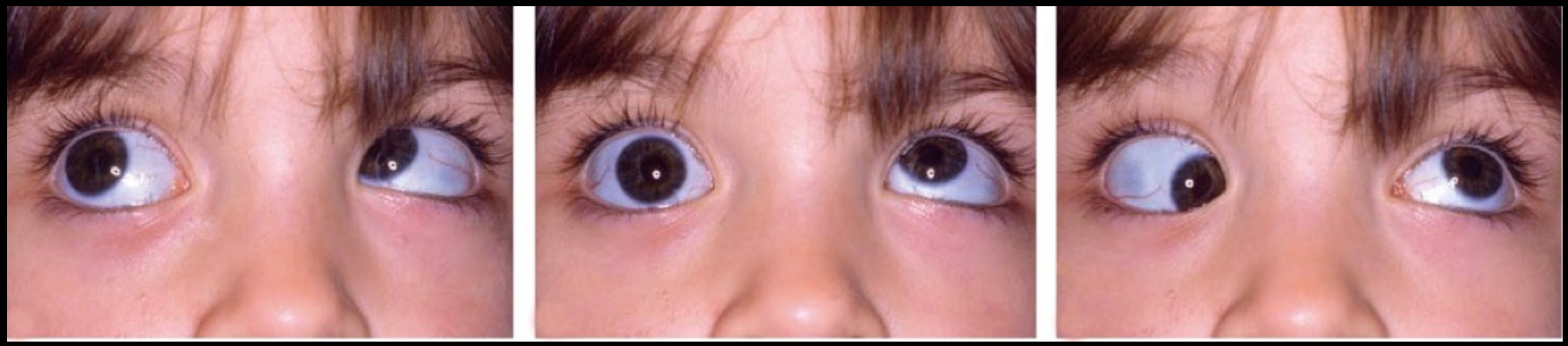
Brown Syndrome

- Treatment Goals
  - Improve Hypotropia in primary position
  - Improve chin up head position and face turn if present



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Brown Syndrome

- Treatment
  - Treat underlying inflammatory disease if present
    - Steroid injection into trochlear area
    - Oral non-steroidal anti-inflammatory agents
- U of Iowa Data suggests:
  - Most congenital cases remain stable

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Brown Syndrome

- Surgical Options
  - Superior Oblique tenotomy/tenectomy
    - Usually doesn't give SO palsy
    - Combined with IO recession
  - Superior Oblique tendon spacer
    - Silicone
    - Suture ("Chicken Suture")

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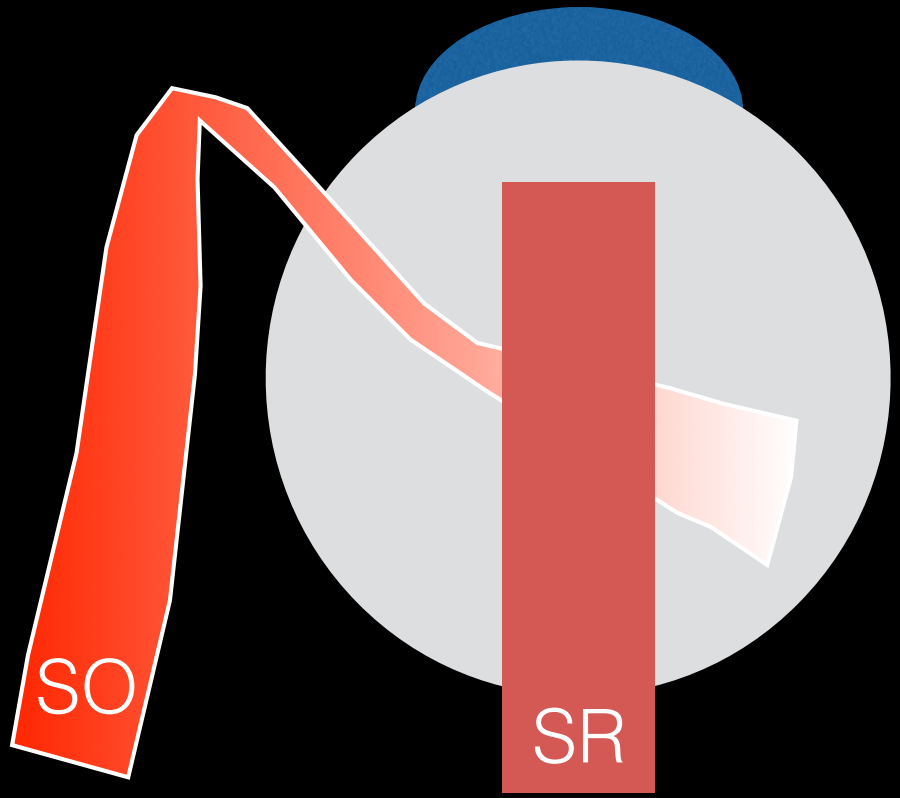
Superior Oblique Intra-sheath Tenotomy



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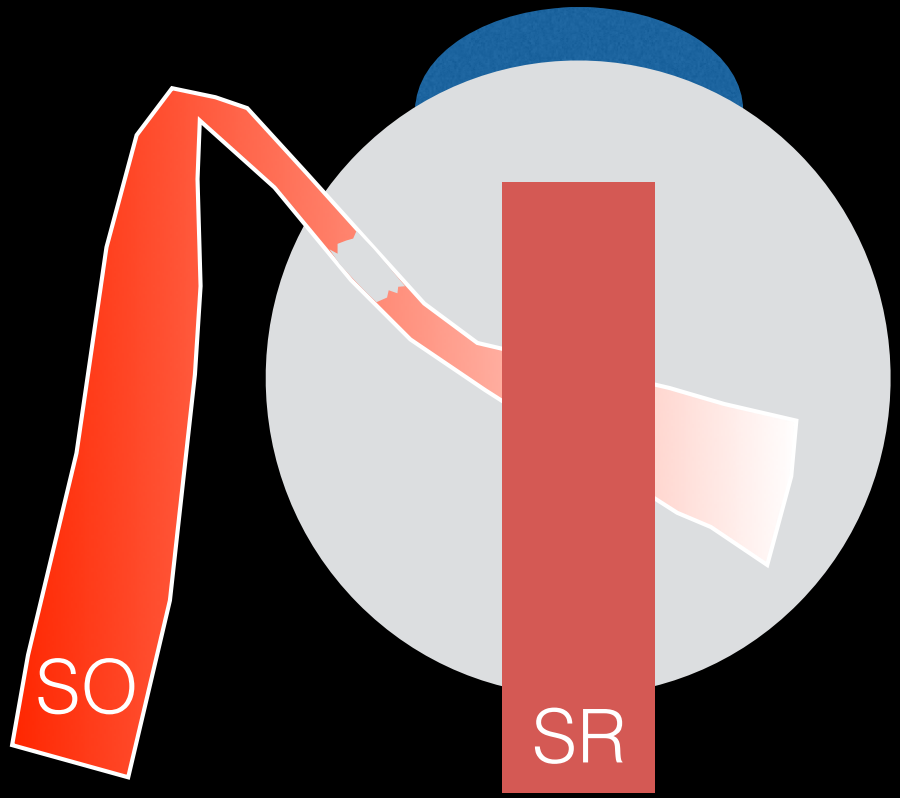
Superior Oblique Intra-sheath Tenotomy



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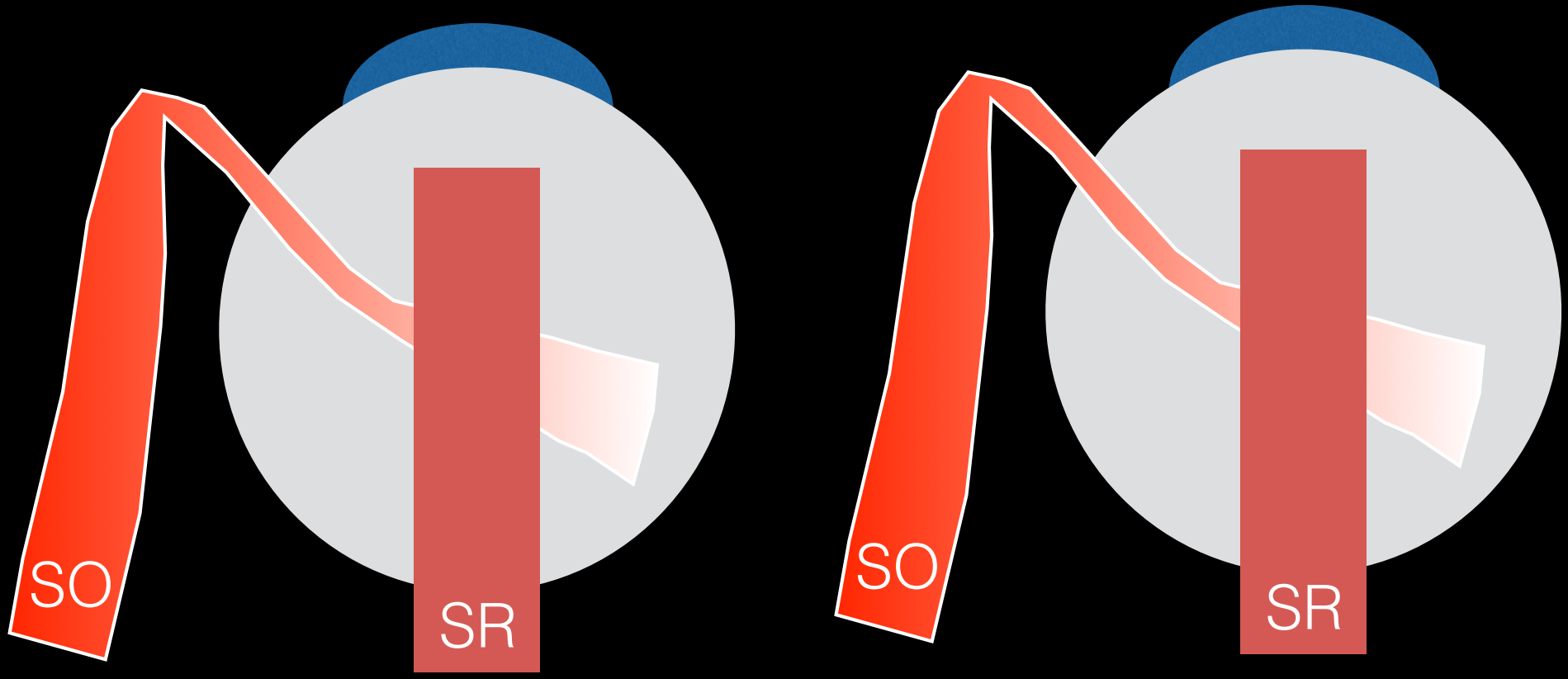
Superior Oblique "Guarded Tenotomy"



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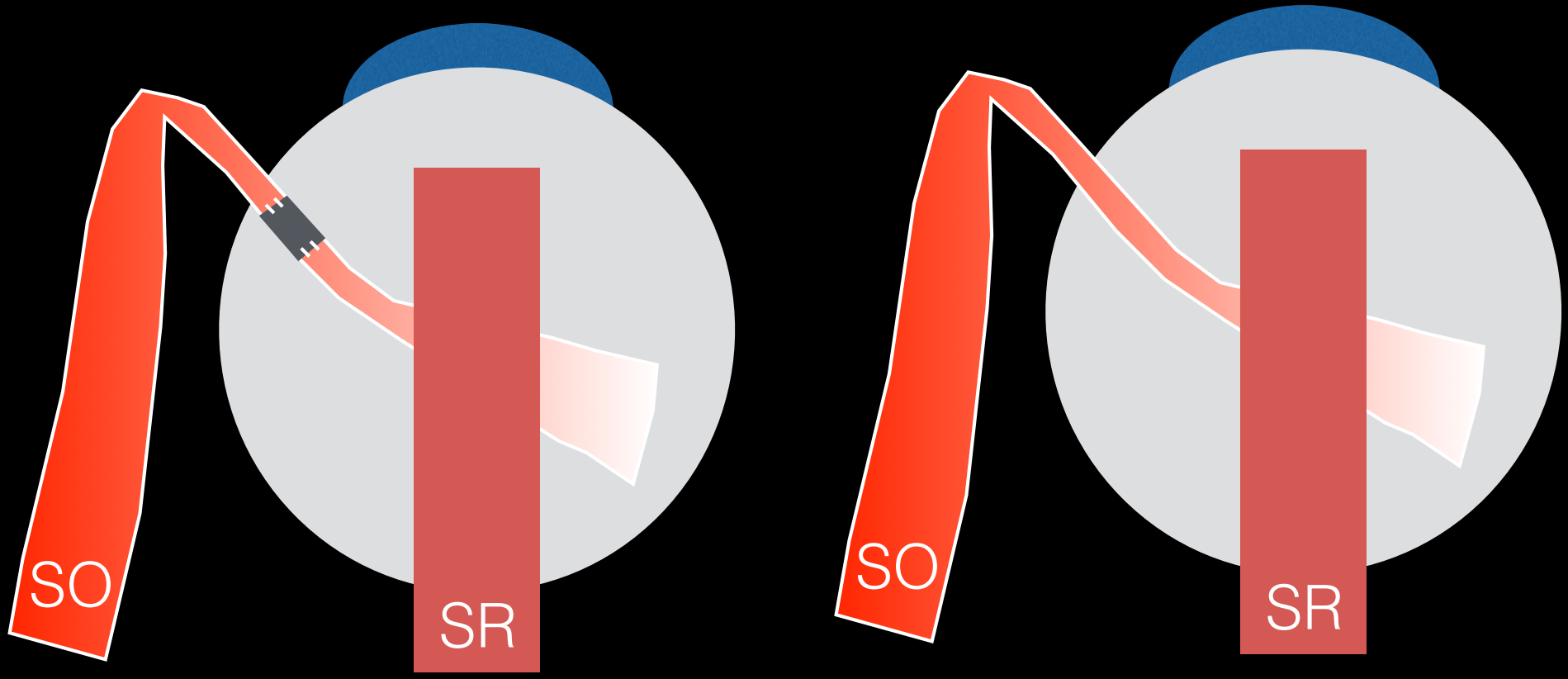
Superior Oblique "Guarded Tenotomy"



Silicone Spacer

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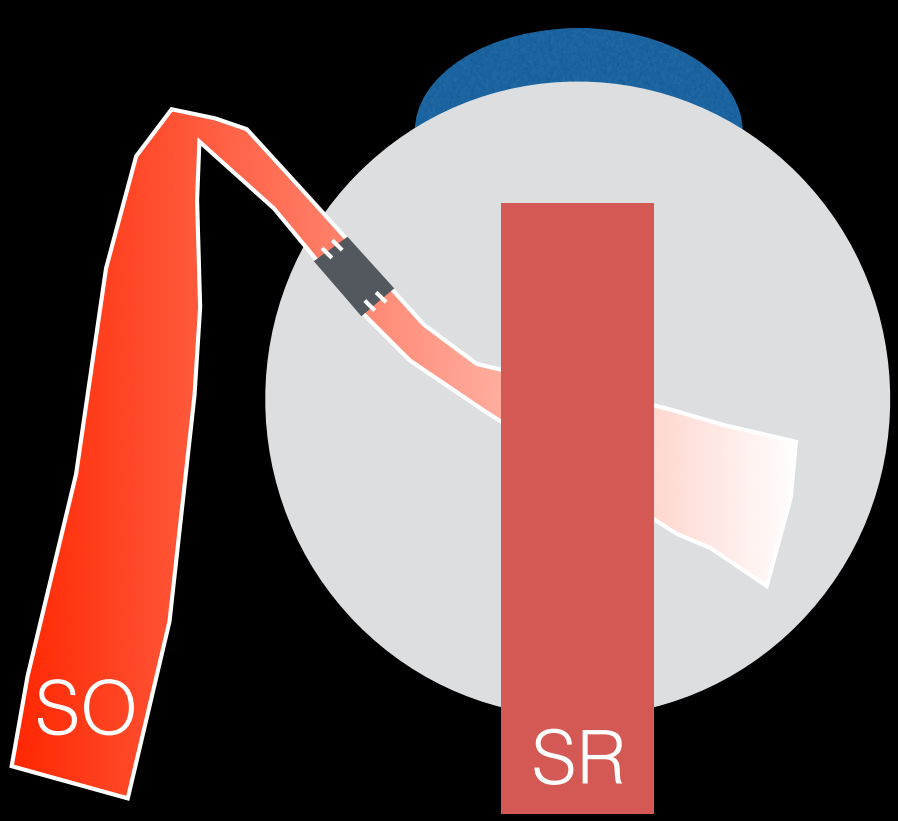
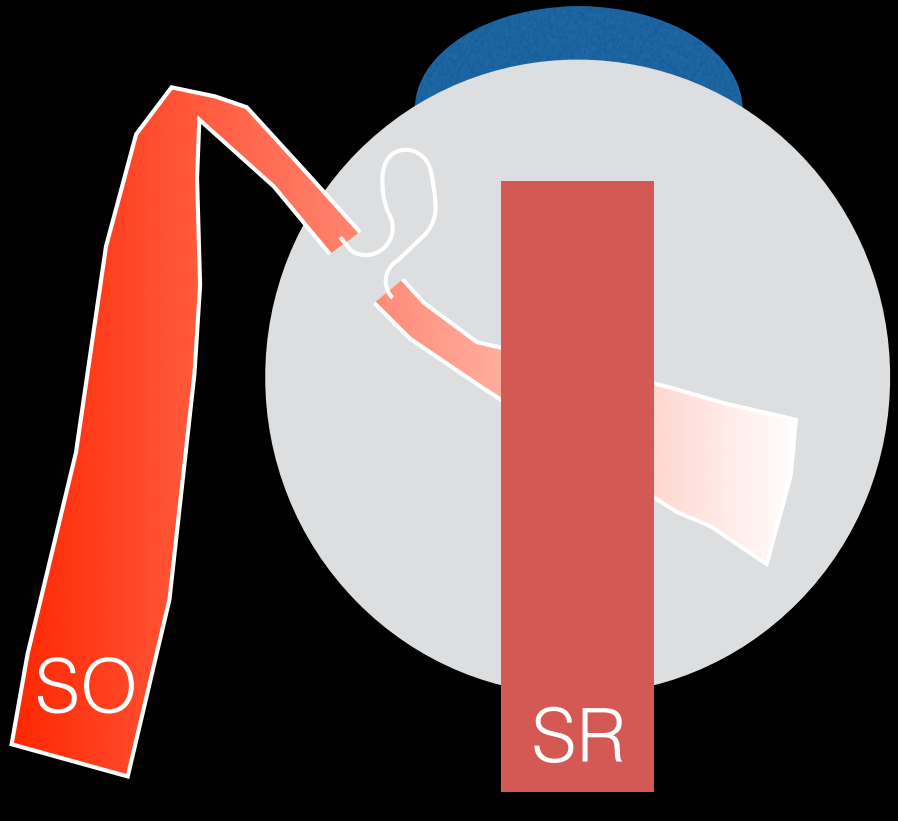
Superior Oblique "Guarded Tenotomy"



Silicone Spacer



Chicken Suture

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IO Palsy vs Brown Syndrome

	Inferior Oblique Palsy	Brown Syndrome

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IO Palsy vs Brown Syndrome

	Inferior Oblique Palsy	Brown Syndrome
Strabismus Pattern		

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IO Palsy vs Brown Syndrome

	Inferior Oblique Palsy	Brown Syndrome
Strabismus Pattern	A Pattern	

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IO Palsy vs Brown Syndrome

	Inferior Oblique Palsy	Brown Syndrome
Strabismus Pattern	A Pattern	V pattern

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IO Palsy vs Brown Syndrome

	Inferior Oblique Palsy	Brown Syndrome
Strabismus Pattern	A Pattern	V pattern
Superior oblique over-action		

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IO Palsy vs Brown Syndrome

	Inferior Oblique Palsy	Brown Syndrome
Strabismus Pattern	A Pattern	V pattern
Superior oblique over-action	+++	

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IO Palsy vs Brown Syndrome

	Inferior Oblique Palsy	Brown Syndrome
Strabismus Pattern	A Pattern	V pattern
Superior oblique over-action	+++	no

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IO Palsy vs Brown Syndrome

	Inferior Oblique Palsy	Brown Syndrome
Strabismus Pattern	A Pattern	V pattern
Superior oblique over-action	+++	no
Torsion		

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IO Palsy vs Brown Syndrome

	Inferior Oblique Palsy	Brown Syndrome
Strabismus Pattern	A Pattern	V pattern
Superior oblique over-action	+++	no
Torsion	Intorsion	

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IO Palsy vs Brown Syndrome

	Inferior Oblique Palsy	Brown Syndrome
Strabismus Pattern	A Pattern	V pattern
Superior oblique over-action	+++	no
Torsion	Intorsion	no

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IO Palsy vs Brown Syndrome

	Inferior Oblique Palsy	Brown Syndrome
Strabismus Pattern	A Pattern	V pattern
Superior oblique over-action	+++	no
Torsion	Intorsion	no
3 Step test		

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IO Palsy vs Brown Syndrome

	Inferior Oblique Palsy	Brown Syndrome
Strabismus Pattern	A Pattern	V pattern
Superior oblique over-action	+++	no
Torsion	Intorsion	no
3 Step test	Points to IO	

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IO Palsy vs Brown Syndrome

	Inferior Oblique Palsy	Brown Syndrome
Strabismus Pattern	A Pattern	V pattern
Superior oblique over-action	+++	no
Torsion	Intorsion	no
3 Step test	Points to IO	No change in side or head tilt

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IO Palsy vs Brown Syndrome

	Inferior Oblique Palsy	Brown Syndrome
Strabismus Pattern	A Pattern	V pattern
Superior oblique over-action	+++	no
Torsion	Intorsion	no
3 Step test	Points to IO	No change in side or head tilt
Forced Duction testing		

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IO Palsy vs Brown Syndrome

	Inferior Oblique Palsy	Brown Syndrome
Strabismus Pattern	A Pattern	V pattern
Superior oblique over-action	+++	no
Torsion	Intorsion	no
3 Step test	Points to IO	No change in side or head tilt
Forced Duction testing	Negative	

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IO Palsy vs Brown Syndrome

	Inferior Oblique Palsy	Brown Syndrome
Strabismus Pattern	A Pattern	V pattern
Superior oblique over-action	+++	no
Torsion	Intorsion	no
3 Step test	Points to IO	No change in side or head tilt
Forced Duction testing	Negative	Positive

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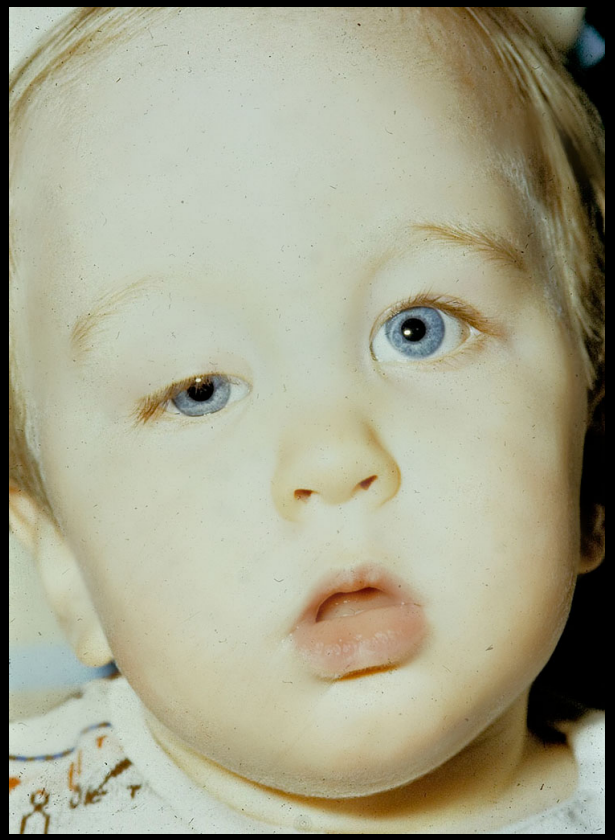
Monocular Elevation Deficiency (MED)

- a.k.a - old term “Double elevator palsy”
- Limitation of upward gaze
  - Supra-nuclear deficiency of elevation
- Hypotropia in adduction and abduction
- Pseudoptosis +/- True Ptosis



MED

- Chin up head position
- Amblyopia (especially if not using chin up)
- DVD may be present
- Identify ipsilateral inferior rectus tightness !
  - Asymmetry of Bells phenomenon
  - **Scott Sign**- Lower lid crease is more pronounced on attempted up gaze if inferior rectus is restricted
  - Forced Ductions

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Scott Sign

Lower eyelid fold with attempted supraduction

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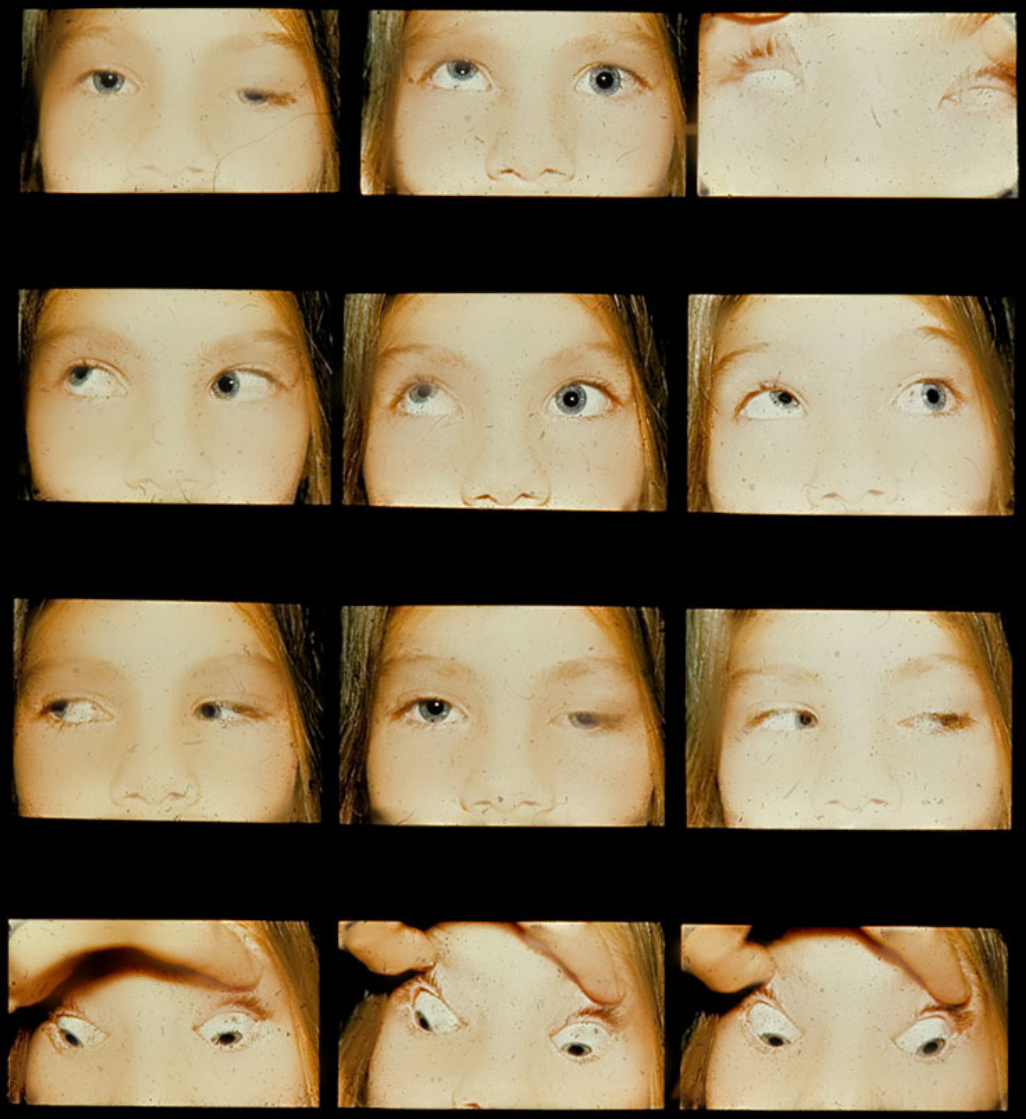
Bells Phenomenon



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MED- Types

1. Inferior Rectus Restriction
2. Elevation Weakness
3. Combination of 1 and 2

	Forced Ductions	Force Generations	Saccades of Superior Rectus
Type 1	+	Normal	Normal
Type 2	-	Reduced	Reduced
Type 3	+	Reduced	Reduced

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MED- Treatment

- Indications: large vertical with ptosis, abnormal head position

1. Inferior Rectus Restriction: Recess IR
2. Elevation Weakness: Transpose MR and LR up (Knapp)
3. Combination: IR recession and Knapp
    - Staged if hypotropia <40 Δ
    - Simultaneous if hypotropia ≥ 40 Δ

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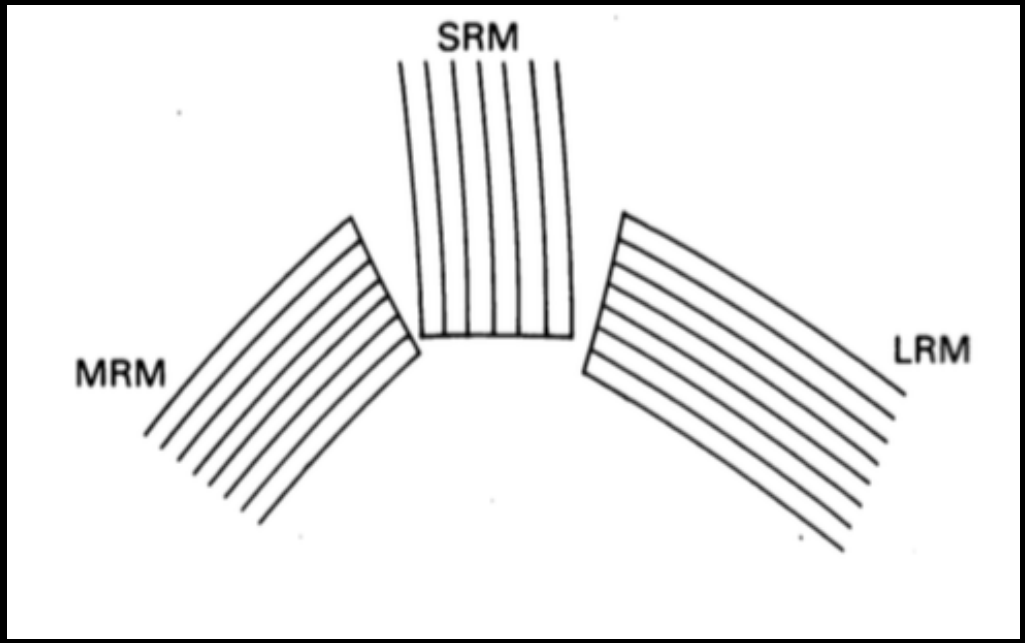
Knapp Procedure



Burke JP, Ruben JB, Scott WE. Br J Ophthalmol 1992;76:735