Evaluation and Management of the Superior Oblique Palsy

2020 Update and Clinical Discussion

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Poll Question #1
What is the most common cause for vertical diplopia?

1. Dissociated vertical deviation
2. Double elevator palsy
3. Skew deviation
4. Superior oblique palsy
5. Third nerve palsy
6. Thyroid ophthalmopathy
Superior Oblique - 4th Cranial Nerve “Palsies”

- Most common cause of vertical or “diagonal” or “oblique” diplopia
  - Combined vertical and horizontal

- Most common cause of strabismus related head tilts
Audience Question

• How to differentiate between skew deviation and SO palsy?
  – Egypt

Answer: SO palsies usually have incomitance although this may decrease with longstanding palsies. Skew deviations are typically a comitant hypertropia not isolatable to any one extraocular muscle or cranial nerve. Diagnosis of exclusion. Typical of brainstem, pre-nuclear vestibular injury.
These are Scary (difficult) Patients

However, if you follow a simple, systematic evaluation and treatment protocol, they actually become relatively straightforward.
Audience Questions

• What are the possible causes and diagnostics?
  – Philippines

• What causes SO palsy?
  – Nigeria
Superior Oblique “Palsy”: Etiology

• ¾ Congenital
  – Presenting in either childhood or adulthood
  – Tendon is lax on traction testing, opposite of Brown syndrome

Unilateral congenital SO palsy associated with tendon laxity
Superior Oblique “Palsy”: Etiology

- ¼ Acquired
  - Trauma
  - Vascular
  - Inflammatory
  - Neoplastic
  - Iatrogenic

Adults can be decompensated congenital or acquired as an adult.
Superior Oblique Actions

- Primary
  - Intorsion
- Secondary
  - Depression
- Tertiary
  - Abduction
Audience Questions

• Easy way to measure SO palsy?
  – Bangladesh

• Systematic examination for palsy in brief
  – Tanzania
Data needed for a typical SO palsy

Measure Torsion
Motility

SR
LR
IR
SO
MR
IO
+2

SR
LR
MR
SO
IR
Whiteboard Demonstration
Documenting Motility with Cybersight
OCULAR MOTILITY EXAMINATION

Date:  

□ Photos  □ OCT  □ VF  

□  

JUL 11 2016  

Signature  

OCULAR MOTILITY EXAMINATION (Page 1 of 1)  

Medical Record Copy  

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**IMPRESSON:**

- **VERSUS**
  - H H

**PLAN:**

- DMR
- Converg: Dist
- Converg: Near

**EUGENE AND MARILYN GLICK EYE INSTITUTE**

**INDIANA UNIVERSITY**

School of Medicine
### Alignment (Prism Diopters)

Abnormal (Alignment grid will appear when “Abnormal” is selected)

<table>
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- **Head Tilt Right**: H: O, V: 16LHT
- **Near with Correction**: H: O, V: O
- **Head Tilt Left**: H: O, V: 25LHT

### Torsion (Degrees): Double Maddox Rod

-1 Degrees
Audience Questions

• Is inferior oblique overaction (IOOA) accompanied with SO under-action?
  – Saudi Arabia

**Answer: No.** Particularly with congenital SO palsy, you may not see any SO under-action. However, it may be present and is more likely to be present with acquired SA palsies.
CN IV Palsy: Simple Step-by-Step Diagnosis

• Versions
  – Look for IO overaction (and SO under-action)
• Measurements
  – Three-Step Test
• Torsion (excyclo)
• “FAT scan”
Poll Question 2
Which of these do you have available in clinic?

1. DO NOT have prisms
2. HAVE only prisms to measure strabismus
3. Prisms and double Maddox rods (for torsion)
4. Prisms, double Maddox rods, and Hess screen
Audience Questions

• Any simple way to remember SO palsy in Hess chart?
  – India

• Evaluating unilateral SO palsy with Hess chart?
  – Nigeria
Hess Chart: To me, this is not simple
First: Observe Versions

We see a left head tilt, and right inferior oblique overaction.
Second: Measure strabismus and torsion
Audience Question: Any pearls to differentiate between IOOA and DVD?

- Lebanon

YES! ALT cover test in side-gaze. If DVD, will only see the eye deviate UP, never an opposite hypotropia.
Audience Question

• Please describe in simple terms the Bielschowsky head-tilt test
  – Canada
Bielschowsky head-tilt test
Bielschowsky head-tilt test

- When head tilts toward affected side, palsied SO needs to incyclotort eye.
- Because SO is palsied, incyclotorsion is impaired.
- SR is also an incyclotorter so it tries to compensate - but it is a primary elevator so it produces hypertropia while incyclotorting.
Three-Step Test
write down on a piece of paper

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Three-Step Test: Step 1

A right **HYPER-tropia** RHT (left hypo-tropia) could be either a weakness of depressors in RE or elevators in LE

Right hypertropia RHT=15 PD
Three Step Test: Step 2

Is the hypertropia worse in right or left gaze?
Three Step Test: Step 2

Is the hypertropia worse in right or left gaze?

Elevators working in left gaze
Three Step Test: Step 3

Is the hypertropia worse in right head tilt or left?
Three Step Test: Step 3

Is the hypertropia worse in right head tilt or left?

Intersection of all three steps is at the paretic muscle:
Right Superior Oblique palsy
Three Step Test: My piece of paper after circling the 3 steps

Right Eye
SR
IO
IR
SO

Left Eye
IO
SR
SO
IR

Intersection of all three steps is at the paretic muscle:
Right Superior Oblique palsy
Audience Question

• How accurate is three step test in long standing cases
  – India

Answer: Longstanding SO palsies can become comitant over time or restrictions may develop (ipsilateral SR contracture). There are other potential “perversions” of the three-step test (next slide)
Potential Perversions of 3-Step Test

- Vertical recti contracture
- Restrictive disease
- Paresis of > 1 muscle
- Skew deviation
- Previous surgery of vertical recti
- Myasthenia gravis
- DVD
Audience Question

• How to differ inferior oblique overaction from mild superior oblique paresis?
  – Pakistan

  Answer: They can look the same but SO paresis is more likely to have measurable excyclotorsion.
Torsion: Subjective Measurement

Double Maddox Rod
Torsion: Objective Measurement

- Fundus photos
  - Fovea normally sits at or just below the center of the optic nerve
Torsion: Objective Measurement

- Fundus photos: Fovea normally sits at or just below the center of the optic nerve
- On indirect ophthalmoscopy, this is reversed...
- Fovea is at or just above the center of the optic nerve

Photo from http://lvpmitra.com
Evaluation of Retinal Torsion
(Right Eye: Indirect Ophthalmoscope View)

Right Eye Excyclo-torted

Right Eye Normal
Bilateral Excyclotorsion

The Sensitivity of the Bielschowsky Head-Tilt Test in Diagnosing Acquired Bilateral Superior Oblique Paresis. Muthusamy B, Irsch K, Chang HY, Guyton DD in AJO 17(1)
Torsion Pearls

• Congenital palsy
  – May have little or no excyclotorsion

• Acquired palsy
  – Almost always has significant measurable excyclotorsion. 4-5 degrees or more

• Bilateral palsy
  – Spontaneous complaints of torsion
  – Measure >10 degrees of torsion on DMR.
Audience Question

• Investigations for determining the etiology of SO palsy?
  – India

• How to distinguish between congenital and acquired 4th nerve palsy and when to scan acquired 4th nerve palsies?
  – United Kingdom
Answer: congenital vs acquired

• Degree of torsion
  – More w acquired vs congenital

• Vertical fusional amplitudes
  – More w congenital > 3 PD

• “FAT Scan: Family (photo) Album Tomography”
  – Review older photographs or ID card for evidence of head tilt
Congenital or Acquired? Look at Facial Asymmetry

- Not specific for SO palsy
- Occurs with any longstanding torticollis
  - Superior oblique palsy
  - Congenital muscular torticollis
Facial Asymmetry

- Midface hypoplasia
- “Shallow” side on dependent (downward tilted) side of face
“FAT Scan”
Family Album Tomography

- Head tilts in old photographs
- Facial asymmetry
- Suggests a long-standing cause
- May negate the need for neurologic workup

FAT Scan not CAT Scan!
Audience Question

• When not to treat SO palsy?
  – Nepal

• Mild superior oblique palsy needs to be treated even without diplopia?
  – India

• What are the indications for surgery in children?
  – Sri Lanka

• How soon we should operate after diagnosis?
  – United Kingdom
Indications for surgery in children?

- If significant head tilt, want to prevent development of permanent facial asymmetry in children. Both soft tissue and bony changes.

Operate as soon as diagnosis is certain.
Audience Questions

• How do we help the patient with associated diplopia or if affecting occupation?
  – Argentina, India

Answer:

• Observation: If no symptoms or significant head tilt
• Prism: If mild diplopia or intermittent
• Surgery: If larger deviation, affecting daily life, or not prism candidate
Audience Question

• What is the limit for treatment with prisms?
  – Peru, Columbia

• In SO palsy with diplopia while reading how much prism we can give...and how?
  – India

**Answer:** Find subjectively (patient holds vertical prism bar) What is the minimum prism the patient likes? Can sometimes dispense and tolerate up to 8-10 PD vertical prism (variable)
Audience Question

- Can it be treated with botulinum toxin?
  - Columbia

**Answer**: Not ideal. Would need to inject antagonist inferior oblique without affecting either the lateral rectus or inferior rectus. Would also need to reinject every 3 months.
Audience Question

• Efficient surgical management of SO palsy
  – Egypt

• Which surgical technique do you prefer to treat superior oblique palsy?
  – Ecuador

• Management approach for unilateral SO palsy?
  – India
Unilateral Superior Oblique Palsy
Surgical Planning

1. **Magnitude** (PD) of primary position deviation (<15 PD versus >15 PD)
2. Oblique **Versions** (amount of IO overaction)
3. **Torsion** (unilateral vs bilateral)
4. Superior rectus **Contracture**
5. **Traction Test**: Superior oblique tendon laxity
Superior Rectus Contracture

- Long-standing, large hyper-deviations.
- Spread of comitance.
- Larger down-gaze deviation.
- **Contralateral** RSO over-action secondary to LSR restriction
- Need to recess SR

LSO palsy with LSR contracture
Traction Testing : S.O. Tendon Laxity

- Retropulse globe and do dynamic traction test
- Grade: -1 to -4
  - -1: minimal laxity
  - -2: definite laxity
  - -3: marked laxity
  - -4: ? tendon present
Step #1 - Grasp eye obliquely

Surgeon’s view at head of bed
Step #2- Rotate up, in, back

Surgeon’s view at head of bed
Step #3- Push until eye stops
Roll eye back and forth across tendon

Right tendon feels more lax than the left
Intraoperative finding confirms traction test

- Normal tendon
- Lax tendon
SO traction test in Brown syndrome
Traction test in SO with laxity
Superior Oblique Laxity Pearls

- Laxity variable, but almost exclusive to Congenital SOP
- Laxity **not expected in acquired** SOP
- IOOA usually marked when SO is lax
- If significantly lax, IO weakening alone will fail
- Always compare **relative** laxity between the two eyes
- Practice SO traction testing on normal eyes
Scary Decision

• Which muscles to operate on?
Choice of Muscle(s)

• Match fields of greatest deviation to muscles (Knapp)
• Modify by:
  – Magnitude of 1° position deviation
  – SO tendon laxity
  – SR contracture
If the deviation is < 15 PD

Single muscle surgery:

• If there is IO overaction, weaken the inferior oblique:
  – IO recession (IO overaction +1)
  – IO myectomy (IO overaction +2, +3, +4)

• If there is no IO over-action or excyclo:
  – Recess contralateral IR (helps incomitance in side-gaze)
  – Recess ipsilateral SR if contracted (less likely with small deviations)
Audience Question

• I have a question about inferior oblique muscle (IO) surgery. Tips regarding how to grab IO during surgical manipulation?
  – Pakistan
Inferior Oblique Surgery
Audience Question

• If the angle is greater than 15 PD do I need to touch 2 muscles?
  – Spain

Answer: Generally, yes. Choice of second muscle depends on... (next slide)
If the deviation is $> 15$ PD

Surgery on two or three muscles:

• **Weaken Inferior Oblique (10-15 PD)**

  Plus, typically one of the following

• Recess contralateral IR (3 PD/mm)
• Recess ipsilateral SR if contracted
• Tuck SO tendon if lax
Poll Question #3

When performing a Superior Oblique tendon tuck for Superior Oblique palsy, how do you determine how much tendon to tuck?

1. Always tuck 4-6mm of tendon
2. Tuck enough tendon so it feels tighter than the contralateral (normal) SO tendon
3. Tuck enough tendon so that both eyes feel similar on SO traction testing
Warnings!

• If a surgeon is uncertain, always err on the side of under-correcting patients...
  – Large fusional amplitudes are one directional!
  – Patients do not do well if over-corrected

• Do not tuck a S.O. tendon that is not lax
  – Iatrogenic Brown syndrome
  – The end point of tucking is symmetry between the two eyes on repeated traction testing
Superior Oblique Tuck
Tucked with a non-absorbable suture

5-0 Mersilene (braided polyester)
Scary Patient
Audience Question

• Diagnosing and managing bilateral SO palsy?
  – India

• What subjective complaints does the patient with torsional diplopia have? How do we measure torsion?
  – Turkey
Bilateral SO Palsy

- **Large excyclotorsion**
  - Generally >10 degrees
  - Measure with Double Maddox Rods
  - Complaints of torsion/tilting (door frames)
Bilateral SO Palsy

• Chin-down head posture
  – V-pattern esotropia
  – Horizontal diplopia on downgaze (reading)
Bilateral SO Palsy

- Small primary position deviation
  - Both SOs affected relatively equally
- Alternating hypertropia on head tilt and side gaze
  - LHT on left head tilt
  - RHT on right head tilt
Audience Question

• Management approach for unilateral versus bilateral Superior Oblique Palsy?
  – India

• Best way to manage esotropia in downgaze with extortion in bilateral superior oblique palsy?
  – India
Bilateral SO Palsy: Treatment

- Many options, all with common goal:
  - Collapse V-pattern (IR rec, MR ↓)
    - Reduce chin down posture
  - Nullify primary position hypertropia (asymmetric IR rec)
  - Reduce large degree of torsion (Harada-Ito, IR nasal transposition, SO tuck)

- I.R. recess
- M.R. downshift
- Harada-Ito
- I.R. nasal transposition
- S.O. tuck
Bilateral SO Palsy: Treatment

• Bilateral IO weakening is frequently inadequate
• May be more effective to weaken yoke muscles: inferior recti
  – Recess bilateral IR 5-6 mm
  – Collapses V-pattern
  – Can do asymmetrically to reduce primary position hyper. Ex: RIR 6 and LIR 4 if 1° position is 6 LHT
Audience Question

- Which cases do you opt for Harada Ito procedure?
  - India

**Answer**: typically, perform Superior Oblique Harada-Ito procedure in bilateral, acquired SO palsies with large amounts of symptomatic torsion (>10-15 degrees)
Harada-Ito Procedure

• Harada-Ito procedure for excyclotorsion
  – Anterior fibers of SO are primarily torsional

• Advancing the anterior ½ to 1/3 of the SO insertional fibers to the LR border strengthens incyclotorsion to treat torsional diplopia
Classic Harada-Ito
Fells modification of Harada-Ito
Enhances Incyclo-rotation of Globe
Outcomes of Harada-Ito Surgery for Acquired Torsional Diplopia

Y Bradfield, M Stuck, B Kushner, D Plager, D Neely, R Gagnon
Outcomes Harada-Ito: Results

• 26 patients
• Mean patient age 46 years (range, 13-89 years)
• Etiology of SO palsy
  – Head trauma: 11 (6 MVA, 5 others)
  – CNS tumor: 4
  – RD secondary high myopia: 2
  – CVA: 2
  – CC Fistula, AVM, silent sinus syndrome: 3
  – Unknown: 4
Harada-Ito: Surgical Technique

• **Suture:**
  - 3 surgeons used 6-0 Vicryl
  - 2 surgeons used 5-0 non-absorbable suture (Dacron or Mersilene)

• **Anterior 1/3 – 1/2 of SO tendon**

• **Sutured 7-8 mm posterior to LR insertion**
Outcomes Harada-Ito

• Mean **baseline torsion 11°** (range, 5-30)
• Harada-Ito Surgery (n=26)
  – 14 Bilateral
  – 12 Unilateral
• Mean torsional correction achieved was 10°
  – 12° for bilateral procedures
  – 8° for unilateral procedures  \( P=0.07 \)
Audience Question

• When there is hypertropia more than torsion in traumatic SOP, is it better to do tuck rather than Harada Ito?
  – India

Answer: Yes, in cases of asymmetric bilateral SO palsy with significant hypertropia in the primary position, SO tuck would produce more reduction of the HT as well as some torsional correction.
Superior Oblique Tuck Video
Cybersight Library: Videos: Strabismus

Surgery: Superior Oblique Tendon Tuck and Inferior Oblique Recession

This video demonstrates a superior oblique tendon tuck and an inferior oblique recession surgery in a 6-year-old with superior oblique paresis. Dr. Marmor explains all the steps during the surgery and answers the questions at the end.

Surgery location: on-board the Orbis Flying Eye Hospital in Chittagong, Bangladesh
Surgeon: Dr. Maury A. Marmor
Thank You!
Next lecture
Superior Oblique Overaction, Brown Syndrome, A-patterns

Orbis Cybersight
https://consult.cybersight.org