Inferior Oblique Anatomy

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11 December 2007

Summary
- Basic anatomy
- Anatomical variations
- Neurofibrovascular bundle of IO
- Imaging of IO

Basic Anatomy
- 37mm in length (shortest EOM).
- Originates from a small depression on the orbital plate of the maxilla, a little behind the orbital margin and just lateral to the orifice of the NLD.

Anatomy
- IO starts as a short, round tendon, passing backward and upward under the IR in between the 2 layers of the capsulopalpebral head.

Anatomy
- As soon as it touches the globe, IO makes a "dogleg" turn curving with the eyeball laterally and posteriorly to insert directly onto the globe with a 9.5mm insertion in the IT quadrant, 2mm above the inferior border of LR and 9.6mm from LR insertion.

Anatomy
- The posterior end of the insertion is 5mm from the optic nerve, and over the macula (2.2mm from fovea).
- No recognisable tendon at insertion.
Anatomy

- Nasal to the IR crossing, IO is engulfed in orbital fat, is oval in shape with a diameter of 4-6mm.
- Lateral to the crossing it flattens and widens to 8-10mm and is covered by Tenon's capsule.

Anatomy

- Between the Tenon's capsule penetration and insertion, IO muscle capsule contributes to the intermuscular septum, which provides interconnection between IR, LR and IO.

Anatomy

- The inferotemporal vortex vein exits from the sclera at the temporal border of IR, 12mm posterior to its insertion, then continues on a circuitous upward course on the inner surface of Tenon's capsule just posterior to IO before penetrating the muscle cone. Unless visualised at the time IO is hooked, the vein may be damaged.

Anatomy

- IO inclined posterolaterally at ~45° with AP plane, almost parallel with SO tendon
- The nerve and blood supply enter the IO in the undersurface of the "dogleg" turn, 15mm from the insertion, just lateral to IR.

Anatomical Variations

- 100 cadaver “virgin” orbits:
  - # of divisions at insertion
  - Variation in anatomy 10 and 12mm from insertion
  - Total width of muscle belly

Actions

- IO elevates the visual axis because it depresses the posterior aspect of the globe.
- Primary action, elevation, increases in adduction, and is nil in abduction. It is the only elevator in adduction.
- Subsidiary actions, abduction and extorsion, increase with abduction and decrease with adduction.
Anatomical Variations - Kraft

- 17 multiple insertions, ranging from 2 to 4
- 8 had divisions at surgical capture site. Among these 8:
  - 4 had dehiscences within the muscle that resulted in 2 distinct bellies at 10 and 12 mm positions, but the bellies rejoined at the insertion.
  - remaining 4 had bifid muscle bellies that inserted separately into the sclera.

Anatomical Variations - Kraft

- Muscle width at 10 mm:
  - 8.4 mm in 8 double bellies vs 7.7 in 92 other (not stat sig)
- Muscle width at 12 mm:
  - 7.8 mm vs 7.3 (not stat sig)

Anatomical Variations - Kraft

- These results are for “normal” patients
- The incidence of anatomical variations could be higher in those with IOOA - ?
- Double bellies have greater vertical action
- Failure to detect duplications at time of surgery → incomplete weakening and recurrence/persistence.

Anatomical Variations – Kraft 2

- JAAPOS 2001 – prospective survey over 7 years.
- Compared eyes with double vs single bellied IO muscles:
  - Gradings of pre-op IO & SO actions
  - Presence of fundus excyclotropia
  - A/V patterns
  - Presence and size of primary position hypertropias
  - Post-op IO action

Anatomical Variations – Kraft 2

- 27 of 247 (11%) eyes operated on had double bellied IO.
- Only fundus excyclotorsion incidence differed between groups – 48% with double bellies vs 27% with single bellies.
- The efficacy of weakening surgery in reducing IOOA was similar in both groups.
**Anatomical Variations – Kraft 2**

- **Bottom-line:**
  - About 10% of normals and IOOA have double bellied IO
  - If pt has fundus excyclotorsion – look hard for 2 bellies, but if no fundus exc → doesn’t rule out 2 bellies.
  - No pathognomonic signs that can predict 2 bellies.

**Neuro(fibro)vascular bundle of IO**

- David Stager, Texas, JAAPOS, 1997
- Cadaveric eyes and surgical specimens
- To investigate why IO anterior transposition often converts to IO to an “anti-elevator”

**Neuro(fibro)vascular bundle of IO**

- This study showed that the NFVB has a linear (not circuitous) course in the orbit.
- It is 27mm long and extends from the orbital apex to the midportion of IO just temporal to the lateral border of IR.
- The terminal 8mm of the nerve lies encased within surrounding fibrous tissue bands that attach posteriorly to IR muscle capsule and anteriorly to IO muscle caspule.
- These fibrous bands may represent a posterior modification of Lockwood’s ligament into a check ligament that binds the 2 muscles.

**Imaging of IO**

- Joseph Demer, Ophthalmology, 2003
- Aim: To study the size and contractility of the normal IO using high-res MRI and to evaluate abnormalities of SO and IO muscles in chronic SO palsy.
- Subjects: 13 pts with SO palsy, 17 orthotropic pts
- Methods: 2mm sagittal and coronal images repeated in multiple gaze directions.

**Results**

- MRI confirmed ipsilateral decrease in SO size and contractility in pts with chronic SO palsy.
- In all subjects, anterior movement and contractile thickening of IO was observed in supraduction, with posterior movement and relaxational thinning in infraduction.
Results

- But, in pts with chronic unilateral SO palsy, the IO cross-sectional area did not differ from either eye, nor from normal subjects.
- So despite these pts having IO “overaction”, their IO on MRI is not hypertrophied, nor exhibits supranormal contractility.
- “Overaction in adduction” due to a normal IO faced with a weak antagonist SO?