A and V patterns
Vertical transpositions or Oblique muscle surgery

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Prevalence Of A and V Patterns

- 15-25% of all strabismus

<table>
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<tr>
<th></th>
<th>V</th>
<th>A</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Esotropia</td>
<td>171 (41%)</td>
<td>105 (25%)</td>
<td>276 (65.5%)</td>
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<tr>
<td>Exotropia</td>
<td>97 (23%)</td>
<td>48 (11%)</td>
<td>145 (34.5%)</td>
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<tr>
<td>Total</td>
<td>268 (64%)</td>
<td>153 (36%)</td>
<td>421 (100%)</td>
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A PATTERN

- Relative convergence on up gaze and relative divergence on down gaze

- Minimum of 10-pd dioptres difference b/w upgaze and down gaze
V PATTERN

- Relative divergence on up gaze and relative convergence on down gaze
- Minimum of 15-pd dioptres difference b/w upgaze and down gaze
Aetiologic factors

- Oblique muscle dysfunction
- Horizontal rectus muscle dysfunction
- Vertical rectus muscle dysfunction
- Orbital factors
- The pulley concept

- Over- and under-action of the oblique muscles appears to be the most likely cause.
Neurological involvement and malformative/systemic syndromes were observed in 30.4% of the study group and in 19.8% of patients in the control group (P <0.001).

A-pattern showed a greater prevalence of neurological impairment, hydrocephalus and meningomyelocele.

V-pattern exhibited a greater prevalence of craniosynostosis and malformative syndromes.
Oblique muscles dysfunction

No

Vertical transpositions
(recessed or resected horizontal muscles).

Yes

Vertical transpositions (supraplacement or infraplacement)
(recessed or resected horizontal muscles)
oblique muscle weakening
V pattern exotropia with oblique dysfunction

Bilateral recession of overacting inferior oblique muscles is associated with a favorable prognosis,

Weakening the inferior oblique muscles corrects 15Δ to 25Δ of the V pattern between primary position and upgaze, depending on the severity of the overaction of the muscles.

Graded anterior transposition of overactive inferior oblique muscles.
Graded anterior transposition of the inferior oblique muscle for V-pattern strabismus

Full correction or undercorrection to <10(Δ) of V pattern was achieved in 82% of esotropia cases and 80% of exotropia cases.

Response to surgery was influenced by the severity of the preoperative inferior oblique muscle overaction and the extent of the preoperative V pattern.

V-pattern esotropia: a review; and a study of the outcome after bilateral recession of the inferior oblique muscle: a retrospective study of 78 consecutive patients
Jorge Alberto F Caldeira 1

In V-pattern esotropia cases of 15 pd or more the vast majority were in the range 15-35 pd. Overaction of both IO, underaction of both SO, and elevation in adduction OU constituted a triad of co-occurrent signs present in a significant number of patients.

A good outcome (collapse of the V pattern) was obtained with bilateral graded recession of the IO, but this surgery can create a vertical imbalance.
A pattern Esotropia with Oblique dysfunction

PBCT with glasses

- 65 BO
- 50 BO
- 25 BO

SUPERIOR OBLIQUE OVERACTION
The efficacy of superior oblique posterior tenectomy in the treatment of A-pattern exotropia without ocular intorsion: A retrospective study

Yan Wei, Ling-Yan Dong, Pei-quan Zhao & Xiao-li Kang

*BMC Ophthalmology* volume 20, Article number: 32 (Jan 2020)

The mean preoperative A-pattern deviation was 15 PD and the mean postoperative A-pattern deviation was 2.25 PD with a mean reduction of 12.75 PD.

Superior oblique posterior tenectomy surgery selectively improved the A-pattern and superior oblique overaction but not affect the primary position vertical deviation, as well as the ocular torsion.

Bilateral posterior tenectomy of the superior oblique muscle for the treatment of A-pattern strabismus JAAPOS 2014

Milan P Ranka 1, Grace T Liu 1, Julie N Nam 1, Marc J Lustig 1, Shirah R Schwartz 1, Lisabeth S Hall 1, Louis E Furlan 1, Emily J Ceisler 1, Mark A Steele 2

Of patients with a pattern deviation of <25(Δ), 87.9% had successful collapse of the pattern following 1 surgery, and 86.7% of patients who had a pattern of ≥25(Δ) had successful collapse.

A uniform dose of bilateral posterior 7/8 tenectomy surgery successfully collapses A-pattern deviations of all magnitudes.
No Oblique dysfunction: Vertical Transposition of the horizontal rectus muscle

- Medial rectus is transposed towards the apex of V and A
- Lateral rectus is transposed towards the base of V and A

Half-width tendon transpositions yield 15Δ to 20Δ change in the A or V pattern between upgaze and downgaze.

Sharma P et al concluded that a 5-mm shift was as effective as an 8-mm shift in monocular vertical displacement of horizontal rectus muscles in A and V patterns.

CASE 1


(BE) LR recession (7mm) with 5mm upshift with RE MR resection 5mm downshift 5.5 under GA
Post op 1 day case 1

Flick ET

8ET

10 ET

8ET

(N) 2ET

6ET
Controversy

Horizontal muscle transposition or oblique muscle weakening for the correction of patterns?

Oblique muscle weakening surgery and horizontal muscle offset are effective in the correction of V pattern when the amount of pattern is under 30Δ.

Should we touch the oblique muscle when mild overaction?

Pulley Heterotopy should be considered in DD of incomitant strabismus and oblique dysfunction.

**Introduction:** The description of connective tissue sleeves that function as pulleys for the rectus extraocular muscles (EOMs) suggests that abnormalities of EOM pulley position might provide a mechanical basis for some forms of incomitant strabismus. Pulleys determine the paths and thus the pulling directions of EOMs. **Methods:** High-resolution magnetic resonance images spanning the orbits were obtained in primary position, upgaze, and downgaze for each subject. Paths of the EOMs were measured with reference to the orbital center and permitted inference of pulley locations. **Results:** Data from 18 orbits of orthotopic subjects defined means and SDs of normal bilaterally, had bilateral superior mislocation of the medial rectus pulleys by greater than 2 mm. Computer simulations using the Orbit program (Eidactics, San Francisco) incorporating individually measured pulley positions reproduced the clinical patterns of incomitant strabismus in all cases without postulating abnormalities of oblique muscle innervation or contractility. **Conclusion:** Heterotopic EOM pulleys can cause patterns of incomitant strabismus that have been attributed to oblique muscle dysfunction. Even isolated mislocations of less than 2 mm, coupled with smaller mislocations of the other pulleys, can produce the clinical appearance of bilateral oblique dysfunction. Pulley heterotopy should be considered in the differential diagnosis of incomitant strabismus and oblique dysfunction. (J AAPOS 1998;2:17-25)
Are PULLEYS Important

- Recognition of these disorders is important to decide the surgery

- Strengthening or weakening the oblique muscles
- Transposition of EOM
- Direct pulley surgery
The Pulley concept – V pattern

Downward displacement of the lateral rectus pulleys and upward displacement of the medial rectus pulleys are associated with ‘V’ pattern

Coronal CT scan of the orbits in a patient of V esotropia shows Inferior displacement of both Lateral Rectus muscles.
The Pulley concept - A pattern

Upward displacement of the lateral rectus pulleys and downward displacement of the medial rectus pulleys are associated with ‘A’ pattern.

Coronal CT scan with an A-pattern esotropia.

Note bilateral superior displacement of the lateral rectus muscles and nasal displacement of the superior rectus muscles.
11 years
VA 6/12
No significant refractive error

PBCT – 30 XT with DVD 5 Prism OU

PBCT – 35 XT for D, DVD 5 PD OD, DVD 10 OS

35 XT for N

PBCT – 45 XT DVD 5 Prism OU
OU LR recession
8mm with SR
recession 6mm

PBCT – ortho
PBCT – 4 ET
PBCT – 4 XT

**Purpose:** To determine whether rectus extraocular muscle (EOM) sizes and pulley locations contribute to exotropia, we used magnetic resonance imaging (MRI) to measure these factors in normal control participants and in patients with concomitant and pattern exotropia.

**Design:** Prospective case-control study.

**Participants:** Nine patients with concomitant exotropia, 6 patients with pattern exotropia, and 21 orthotrophic normal control participants.

**Methods:** High-resolution surface-coil MRI scans were obtained in contiguous, quasicoronal planes. Rectus pulley locations were determined in oculocentric coordinates for central gaze, supraduction, and infraduction. Cross sections in 4 contiguous image planes were summed and multiplied by the 2-mm slice thickness to obtain horizontal rectus posterior partial volumes (PPVs).

**Main Outcome Measures:** Rectus pulley locations and horizontal rectus PPVs.

**Results:** Rectus pulleys were located differently in patients with A-pattern, versus V- and Y-pattern, exotropia. The lateral rectus (LR) pulleys were displaced significantly superiorly, the medial rectus (MR) pulleys were displaced inferiorly, and the inferior rectus pulleys were displaced laterally in A-pattern exotropia. However, the array of all rectus pulleys was excyclorotated in V- and Y-pattern exotropia. The PPV of the medial rectus muscle was statistically subnormal by approximately 29% in concomitant, but not pattern, exotropia (P < 0.05). The ratio of the PPV of the LR relative to the MR muscles in concomitant exotropia was significantly greater than in control participants and those with pattern exotropia (P < 0.05).

**Conclusions:** Abnormalities of EOMs and pulleys contribute differently in pattern versus concomitant exotropia. Abnormal rectus pulley locations derange EOM pulling directions that contribute to pattern exotropia, but in concomitant exotropia, pulley locations are normal, and relatively small medial rectus size reduces relative adducting force. *Ophthalmology* 2016;1–9 © 2016 by the American Academy of Ophthalmology.
Normal

A pattern

3 mm of superior displacement LR
2.5 mm of inferior shift of the MR and superior rectus (SR) muscles medially

V pattern

V pattern exotropia - array of all rectus muscles is excyclorotated bilaterally

Y pattern

LR muscles in both eyes are displaced inferiorly, and IR in the left eye is displaced nasally.
V pattern strabismus in patients with Craniosynostosis

Causes are excyclotorsion of globe, anomalous vectors of muscle action, shorter orbital floor

Despite clinical evident IO overaction – supracement of Lateral rectus muscles is essential
Methods:
**Quasi-coronal surface coil magnetic resonance imaging (MRI)** was performed during target-controlled fixation in 52 orbits of 26 patients (age, 23 ± 12 years) with CPH, and correlated with ocular motility. Pulley positions were determined from EOM area centroids in a normalized coordinate system.

Results:
LR pulley sag in V patterns was 4.4 ± 4.3 mm, with MR pulley 1.8 ± 2.0 mm sag. In A patterns there was 1.0 ± 3.9 mm LR and 3.6 ± 2.8 mm MR sag. There was marked orbital excyclorotation in V patterns with significant temporal shift of the superior and nasal shift of the inferior rectus,

Palpebral aperture slant, facial asymmetry and orbital bony deformities were associated with CPH.

Discussion: Thus incomitant strabismus in such cases may not be due to oblique muscle dysfunction and hence may not be counteracted by surgeries on the obliques.

Conclusion: Pattern strabismus in CPH is correlated with abnormal pulley locations of the horizontal rectus muscles.
Thank you
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