Intermittent Exotropia Treatment
The Changing Landscape

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Intermittent Exotropia (IXT)

What We Know
• Most common form of childhood-onset XT
• Normal alignment & sensory fusion sometimes
• Good stereoacuity at near (generally)
• Amblyopia is rare

What We Don’t Know
• Natural history
• Best form of treatment
Course Objectives

• Current best evidence for IXT treatment: PEDIG RCTs
  - Overminus lenses
  - Part-time patching
  - Surgery
• Current best evidence: Natural history of IXT
• Vision therapy: Treatment strategy (my clinical experience)
Best Evidence in Relation to Treatment of IXT in Childhood
Available literature consists mainly of retrospective case reviews, which are difficult to reliably interpret and analyze. The 1 RCT found unilateral surgery more effective than bilateral surgery for basic IXT. However, across all studies, measures of severity and thus criteria for intervention are poorly validated, and there appear to be no reliable natural history data. There is therefore a pressing need for improved measures of severity, a better understanding of natural history, and carefully planned RCTs of treatment to improve evidence base for management of this condition.
Randomized Trials for Treatment of IXT

- Monitor; watchful waiting
- Part-time patching
- Over-minus lens correction
- Prism
- Vision therapy
- Surgery
Outcome Measure for IXT Clinical Trials?

Control of IXT

% Time of Alignment
Ways of Assessing Control of IXT

- Patient and parental report
- Cover testing
  - Proportion of time XT is manifest
  - Speed of recovery
- PEDIG IXT control scale
Cover Testing: Clinical Tip

Test distance at far can make a difference
Use remote test distance

<table>
<thead>
<tr>
<th>Divergence Excess XT</th>
<th>3m vs. 6m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased angle 5-15Δ</td>
<td>64%</td>
</tr>
<tr>
<td>Surgery (yes/no)</td>
<td>32%</td>
</tr>
<tr>
<td>Surgical dose different</td>
<td>32%</td>
</tr>
</tbody>
</table>

Samantha: IAXT (50%) 14Δ at 3m; CAXT 25Δ at 50ft

Recovery
PEDIG IXT Control Scale

Observation for 30 seconds

- **5**: Constant XT
- **4**: XT >50% of time
- **3**: XT <50% of time
- **2**: > 5 seconds to recover
- **1**: 1-5 seconds to recover
- **0**: < 1 second to recover

No XT unless dissociated 10 sec; Worst of 3 consecutive 10-sec dissociations

Mohney BG, Holmes JM. Strabismus 2006;14(3):147–150
Control of XT: Start at Distance

Step 1: 30 sec observation before dissociation at distance

Spontaneously XT for 10 of 30 seconds (33% of 30 seconds)
**PEDIG IXT Control Scale**

- **Tropia Observed**
  - 5: Constant XT
  - 4: XT >50% of time
  - 3: XT <50% of time
  - 2: > 5 seconds to recover
  - 1: 1-5 seconds to recover
  - 0: < 1 second to recover

- **No XT Unless Dissociated**
  - 5: Constant XT
  - 4: XT >50% of time
  - 3: XT <50% of time
  - 2: > 5 seconds to recover
  - 1: 1-5 seconds to recover
  - 0: < 1 second to recover

*Mohney BG, Holmes JM. Strabismus 2006;14(3):147–150*
Control of XT: Near

Step 2: Near - 30 second observation before dissociation

No spontaneous tropia at near

Control score must be <3

(so....must dissociate at near)
Dissociative Testing: Occlude for 10 sec; uncover & observe recovery 3 Times; OD, OS, Worst eye

NOTE: If recovery >5 seconds for OD, control score = 2 and no further testing needed
PEDIG IXT Control Scale

**Tropia Observed**

- **Constant XT**
- **XT >50% of time**
- **XT <50% of time**

**No XT Unless Dissociated**

- **> 5 seconds to recover**
- **1-5 seconds to recover**
- **< 1 second to recover**

Mohney BG, Holmes JM. Strabismus 2006;14(3):147–150
Outcome Measure for IXT Clinical Trials

PEDIG IXT Control Scale

% Time of Alignment
Evidence in Relation to Treatment of Childhood IXT

*PEDIG RCT’s*
IXT RCT's

Part-time Patching
- RCT: Patching vs Observation
  - 3 to <11 years
  - 12 to 35 months

Overminus Lenses
- RCT: Over-minus vs Observation
  - 3 to <7 years

Surgical Procedure
- RCT: Bil LR Recession vs Unilateral Recess-Resect for Basic IXT
  - 3 to <11 years
Effectiveness of part-time patching in reducing risk of deterioration of IXT over 6 months?
IXT: Part-time Patching

• Reported benefits
  - Eliminates suppression
  - Reduces magnitude +/- or frequency
  - Changes character of deviation
• Commonly prescribed by peds ophthal
  - Varying dosages, duration, outcomes
  - Retrospective, small samples, no comparison group
Intermittent Exotropia-2 (IXT-2)

RCT Comparing Part-time Patching with Observation for Children with IXT

Study Objective

- Determine effectiveness of prescribed PT patching for reducing risk of deterioration of IXT over 6 months among children:
  - 3 to <11 years old
  - 12 to 35 months old
Major Eligibility Criteria

• Age: 3 to < 11 years; 12 months to 35 months
• Previously untreated IXT (any type)
  - IXT or CXT at distance; & IXT or XP at near
  - ≥ 10Δ at distance
  - ≥ 15Δ at distance +/or near
• Near stereoacuity of 400” (only older cohort)
• No amblyopia or amblyopia tx in last year
• Investigator / child / parent willing forgo all other IXT treatment until deterioration criteria met
Previously Untreated Children with IXT
Younger: 12 to 35 months
Older: 3 to <11 years

Observation
(SRx if needed)

Patching
3 hours / day

3-months

6-month
Primary Outcome

3-months

6-month
Primary Outcome
**Masked** assessment (*Retest ≥10 min IF deterioration*) of:
- Stereoacuity
- XT control (PEDIG office control score)
- Ocular alignment

* *1-month wash out; stop patching at 5 months
Primary Outcome: Deterioration by 6 Months

1. Constant XT ≥10Δ at Dist & Near*
2. Near stereopsis: drop ≥ 2 octaves from baseline*

*Masked examiner with retest

<table>
<thead>
<tr>
<th>Preschool Randot Stereoacuity</th>
<th>Baseline Stereo arc sec</th>
<th>Stereo at FU visit to meet deterioration*</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>200 or worse</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>400 or worse</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>400 or worse</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>800 or worse</td>
<td></td>
</tr>
<tr>
<td>400</td>
<td>Nil</td>
<td></td>
</tr>
</tbody>
</table>
Also Considered Deterioration

- If non-protocol tx started without meeting formal deterioration criteria
- Allowed exceptions:
  - Debilitating diplopia
  - Overwhelming social concern (parent/child)
  - Failure to keep up with stereo age-norms
PT Patching Results?
3 to <10 year olds
Deterioration by 6 Months Was Uncommon

- **Observation**
  - Deteriorated: 6%
  - Not Deteriorated: 94%

- **Patching**
  - Deteriorated: 0.6%
  - Not Deteriorated: 99.4%

- Difference in proportions = 5.4%
- Lower limit of 1-sided exact 95% CI = 2.0%; P = 0.003

### 3 to <10 Years

**Small Difference in Deterioration By 6 Months**

<table>
<thead>
<tr>
<th>Deterioration by 6 Months</th>
<th>Observation (N=165)</th>
<th>Patching (N=159)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number (%) Deteriorated</td>
<td>10 (6.0%)</td>
<td>1 (0.6%)</td>
</tr>
<tr>
<td>• Formal deterioration criteria met</td>
<td>7 (4.2%)</td>
<td>1 (0.6%)</td>
</tr>
<tr>
<td>Constant XT ≥10Δ D&amp;N</td>
<td>1 (0.6%)**</td>
<td>0</td>
</tr>
<tr>
<td>Stereo worsened ≥ 2 octaves</td>
<td>6 (3.6%)</td>
<td>1 (0.6%)</td>
</tr>
<tr>
<td>Both criteria</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>• Started treatment against protocol</td>
<td>3 (1.8%)</td>
<td>0</td>
</tr>
</tbody>
</table>

**Had 40 sec RDS on Randot Preschool; protocol-required UCT not performed**

• Difference in proportions = 5.4% ; Lower limit of 1-sided exact 95% CI = 2.0%; P = 0.003
3 to <10 Years
Only 1 Subject Developed Constant XT

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<th>Deterioration by 6 Months</th>
<th>Observation (N=165)</th>
<th>Patching (N=159)</th>
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*Had 40 sec RDS on Randot Preschool; protocol-required UCT not performed

• Difference in proportions = 5.4% ; Lower limit of 1-sided exact 95% CI = 2.0%; P = 0.003
Part-Time Patching
12 to 35 month olds
Results?
No Difference in Deterioration By 6 Months in 12 to 35-Month-Old Children

<table>
<thead>
<tr>
<th>Deterioration by 6 Months</th>
<th>Observation (N=87)</th>
<th>Patching (N=90)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL Number (%) Deteriorated</td>
<td>4 (4.6%)</td>
<td>2 (2.2%)</td>
</tr>
<tr>
<td>• Formal deterioration criteria met</td>
<td>2 (2.3%)</td>
<td>2 (2.2%)</td>
</tr>
<tr>
<td>Constant XT ≥10Δ D&amp;N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Started treatment against protocol</td>
<td>2 (2.3%)</td>
<td>0</td>
</tr>
</tbody>
</table>

Difference in proportions = 2.4%
1-sided exact 95% CI = -3.8% to +9.4%; P = 0.27

Mohney B et al. PEDIG. Ophthalmology 2015;122(8):1718-1725
Take Home Message

• Deterioration over 6 months uncommon
• 3 to <11 yrs: Observation or PT patching both reasonable management approaches
• 12 to 35 mos: Insufficient evidence to recommend PT patching

Overminus
Lens Therapy
for IXT
Overminus Lens Therapy for IXT

- Rx more minus (or less plus) than distance refraction
- Mechanism?
  - Magnitude reduced by stimulating A/C
  - A/C triggers reflex fusional vergence
  - May allow clear distance vision, facilitating fusion
    - Stimulation of accommodation by:
      - Excessive convergence required for fusion (convergence accommodation)?
      - Reliance on excessive AC to overcome XT?
Overminus Lens Tx: Cotter Clinical Impressions

- Patient profile
  - Age?
  - Accommodative function?
  - AC/A ratio?
- How much overminus?
  - Decrease in IXT magnitude?
  - Decrease in IXT frequency?
  - If results in eso at near?
Overminus Lens Therapy

• Length of treatment?
• Parental education – very important
• Myopia progression: no evidence of this yet
  - Retrospective chart reviews

<table>
<thead>
<tr>
<th>*Group</th>
<th>Initial RE</th>
<th>Change After 5 Y</th>
<th>Change After 10 Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (62)</td>
<td>0.00 ± 1.40</td>
<td>-1.40 ± 2.00</td>
<td>-2.41 ± 2.20</td>
</tr>
<tr>
<td>6-mo Tx (74)</td>
<td>0.00 ± 1.50</td>
<td>-1.52 ± 1.80</td>
<td>-2.34 ± 2.40</td>
</tr>
<tr>
<td>5-yr Tx (34)</td>
<td>-0.10 ± 1.50</td>
<td>-1.54 ± 1.90</td>
<td>-2.36 ± 2.10</td>
</tr>
</tbody>
</table>

Assess initial short-term response of IXT to overminus lenses
Intermittent Exotropia Study 3 (IXT3)

A Pilot Randomized Clinical Trial of Overminus Spectacle Therapy for Intermittent Exotropia

Study Objective

• Assess initial short-term response of IXT to overminus lenses
Major Eligibility Criteria

- Age: 3 to <7 years
- IXT
  - Distance control score ≥ 2 (mean of 3)
  - Near control score ≠ 5 (mean of 3)
  - ≥ 15Δ exo at distance by PACT
  - Near not exceed distance by >10 Δ (PACT)
- SE between +1.00 D and -6.00 D OD & OS
IXT-3 Study: 3 to < 7 Years

Enrollment

Randomization

Overminus Group
Spectacles with full CR plus 2.50D overminus

Observation Group
Non-overminus spectacles or no spectacles

2-week Phone Call from Site

8-Week Primary Outcome Exam (Masked Exam)

Control assessed 3 times throughout a single exam
Baseline XT Control at Distance

Percentage of Patients

Observation (N=31) Mean = 3.2
Overminus (N=27) Mean = 3.2

Control Score

- 0 to <1: N/A
- 1 to <2: N/A
- 2 to <3: 42% (Observation), 44% (Overminus)
- 3 to <4: 23% (Observation), 22% (Overminus)
- 4 to 5: 35% (Observation), 33% (Overminus)
Baseline XT Control at Near

Percentage of Patients

- **Observation (N=31) Mean = 1.5**
- **Overminus (N=27) Mean = 1.3**

### Distribution

- **0 to <1**
  - Observation: 35%
  - Overminus: 26%

- **1 to <2**
  - Observation: 26%
  - Overminus: 44%

- **2 to <3**
  - Observation: 20%
  - Overminus: 19%

- **3 to <4**
  - Observation: 10%
  - Overminus: 7%

- **4 to 5**
  - Observation: 6%
  - Overminus: 4%
Overminus Group Had Better Mean Distance Control at 8 Weeks

Difference = -0.80 (-1.49 to -0.11)
P = 0.01 for one-sided test

Overminus Lenses for 3 to <7 Year Old Children With IXT

Take Home Message

Improved distance control at 8 weeks

Larger & longer RCT needed to assess effectiveness of overminus lenses on and off treatment

Intermittent Exotropia Study 5 (IXT-5)

RCT of Overminus Spectacle Therapy for IXT

Currently Recruiting
Natural History of IXT in Children?
So What?
For Example: Surgery - Balance of Possibilities

- Improvement of social concerns
- Possibility of improving distance & retaining near stereoacuity

- Possibility of spontaneous improvement
- Surgical complications & high rate of reoperations
- Possibility of loss of stereoacuity through surgical overcorrection*

*21% overcorrection 6-mo post-surgery; Buck et al. BMC Ophthalmology 2012
IXT-2 Study Overview

Randomized

Observation: No Treatment

3-Months

6-Month Outcome for RCT

12, 18, 24, 30 month FU Visits

36 months: Natural History Outcome

Patching

Masked Examinations

- Ocular alignment
- Stereoacuity
- XT control

12, 18, 24, 30 month FU Visits

36 months - Study Completed
Natural History of IXT in Young Children

Objective

Deterioration of IXT Over 3-Year Period in Children with Untreated IXT Ages
- 12 to 35 Months Old
- 3 to 10 Years Old

PEDIG. Unpublished data
12 to 35 Month Olds Motor Deterioration by 3 Years?
Motor Deterioration Criteria

• Constant XT \( \geq 10\Delta \) (by SPCT) at Distance & Near
  - At masked exam by certified examiner; confirmed by a retest
  - Throughout exam and by at least 3 independent cover tests
  - Could deteriorate at any visit up to the 3-year visit
Primary Analysis: Kaplan-Meier Survival Analysis

Calculates cumulative probability of motor deterioration by 3 years

• Dichotomous outcome: deteriorated or not deteriorated
  - Once deteriorated, always deteriorated

• Subjects lost to follow up: contribute to analysis for time in study
  - If deteriorated before lost, counted when deterioration occurred
  - If not deteriorated before lost, “censored” at last study visit; credit for time not deteriorated

• Subjects who started treatment w/o meeting motor deterioration: “censored” at that visit
Results?

Motor Deterioration by 3 Years?
Baseline: Type of Exodeviation

- Basic: 64%
- Pseudo DE: 27%
- True DE: 5%
- High AC/A: 2%
- CI: 2%
Baseline: Character of Exodeviation

Distance Deviation Type:
- Constant XT: 91%
- IXT: 9%

Near Deviation Type:
- Exophoria: 71%
- Orthophoria: 22%
- IXT: 7%
Baseline: Distance XT Control Score (N=97)

Mean = 2.5 points
Baseline: Near XT Control Score (N=97)

Mean = 1.2 points

<table>
<thead>
<tr>
<th>Near Control Score</th>
<th>Percentage of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>No phoria</td>
<td>32%</td>
</tr>
<tr>
<td>0 phoria</td>
<td>31%</td>
</tr>
<tr>
<td>1</td>
<td>18%</td>
</tr>
<tr>
<td>2</td>
<td>12%</td>
</tr>
<tr>
<td>3</td>
<td>4%</td>
</tr>
<tr>
<td>4</td>
<td>0%</td>
</tr>
</tbody>
</table>

- No exo: 3%
- 0 phoria: 32%
Baseline: PACT at Distance (N=97)

Mean = \(27\Delta\)

**PACT at distance had to be \(\geq 10\Delta\) for eligibility.**

<table>
<thead>
<tr>
<th>Distance PACT Magnitude ((\Delta))</th>
<th>Percentage of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>1 to 9</td>
<td>0%</td>
</tr>
<tr>
<td>10 to 14</td>
<td>0%</td>
</tr>
<tr>
<td>16 to 18</td>
<td>9%</td>
</tr>
<tr>
<td>20 to 25</td>
<td>45%</td>
</tr>
<tr>
<td>30 to 35</td>
<td>40%</td>
</tr>
<tr>
<td>40 to 45</td>
<td>3%</td>
</tr>
<tr>
<td>(\geq 50)</td>
<td>2%</td>
</tr>
</tbody>
</table>
Baseline PACT at Near (N=97)

Mean = 18Δ
Motor Deterioration by 3 Years?
Probability of Motor Deterioration of 10% by 3 Years

PEDIG. Unpublished data
Untreated IXT in 12 to 35-Month-Olds

3-Year Natural History

• Motor deterioration was low (10%)
• Watchful waiting appears to be a reasonable treatment approach for this population
3 to 10 Year Olds
Motor or Stereo
Deterioration?
Probability of Motor or Stereo Deterioration by 3 Years

Mohney et al. & PEDIG. Unpublished data
<table>
<thead>
<tr>
<th>Deterioration by 3 Years</th>
<th>N</th>
<th>Cumulative Probability (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any reason (primary outcome)</td>
<td>25</td>
<td>15% (10% to 22%)</td>
</tr>
<tr>
<td>• Constant XT (D/N)</td>
<td>2*</td>
<td>1% (0% to 5%)</td>
</tr>
<tr>
<td>• Stereoacuity drop</td>
<td>11</td>
<td>7% (4% to 12%)</td>
</tr>
<tr>
<td>• Constant XT &amp; stereo drop</td>
<td>0</td>
<td>N/A</td>
</tr>
<tr>
<td>• Started treatment without meeting deterioration</td>
<td>12†</td>
<td>8% (4% to 13%)</td>
</tr>
</tbody>
</table>

*1 case with 40” stereo & constancy during stereo testing not verified & 1 case with 100” stereo (uncertain if verified)
†8 of 12 cases for protocol-approved exceptions (social concern, diplopia, or stereo norms)
Deterioration of stereo or progression to constant XT over 3 years is uncommon.

Mean control, stereo, and XT magnitude remain stable or slightly improve.

Observation alone is a reasonable approach for most children with IXT over a 3-year period.
Management of IXT in Children 1 to 10 Years of Age

In Conclusion...........Cotter....

• No strong support that PT patching is effective
• Watchful waiting (observation alone) is a reasonable approach, but if I want to intervene -
  • Overminus lenses - RCT support for 3 to < 7 years
  • Vision therapy - no RCT’s yet
Intermittent Exotropia Study 1 (IXT-1)

A Randomized Trial
Comparing Bilateral Lateral Rectus Recession versus Unilateral Recession-Resection for Basic Type IXT

PEDIG. Unpublished data
Study Objective

• Determine long term effectiveness of BLRc (bilateral lateral rectus recession) vs. R/R (unilateral lateral rectus recession with medial rectus resection) for treatment of basic-type and pseudo-DE type IXT
Table 2: Surgical Dose*

<table>
<thead>
<tr>
<th>Angle of Largest Deviation by PACT</th>
<th>Amount to Recess Each Lateral Rectus (LR)*</th>
<th>Amount to Resect Medial Rectus (MR)**</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 PD</td>
<td>4.0 mm</td>
<td>3.0 mm</td>
</tr>
<tr>
<td>18 PD</td>
<td>5.0 mm</td>
<td>4.0 mm</td>
</tr>
<tr>
<td>20 PD</td>
<td>5.0 mm</td>
<td>4.0 mm</td>
</tr>
<tr>
<td>25 PD</td>
<td>6.0 mm</td>
<td>5.0 mm</td>
</tr>
<tr>
<td>30 PD</td>
<td>7.0 mm</td>
<td>5.5 mm</td>
</tr>
<tr>
<td>35 PD</td>
<td>7.5 mm</td>
<td>6.0 mm</td>
</tr>
<tr>
<td>40 PD</td>
<td>8.0 mm</td>
<td>6.5 mm</td>
</tr>
<tr>
<td>45 PD</td>
<td>8.5 mm</td>
<td>6.5 mm</td>
</tr>
<tr>
<td>50 PD</td>
<td>9.0 mm</td>
<td>7.0 mm</td>
</tr>
</tbody>
</table>
Primary Outcome
Suboptimal Surgical Outcome BY 3 Years

• Suboptimal surgical outcome criteria (XT, constant ET, or stereo loss) met at ANY visit

OR

• Reoperation without meeting suboptimal surgical outcome criteria
Suboptimal Surgical Outcome
BY 3 Years (Primary Outcome)

Difference in cumulative probability of suboptimal surgical outcome by 3 yrs = 9% (95%CI = -6% to 23%)

PEDIG. Unpublished data
BLR Recession vs. Unilateral R&R for Basic-Type IXT

Clinical Take Home

• No difference in suboptimal surgical outcomes by 3 years

• Given there does not appear to be a clear advantage to either R/R or BLRc within first 3 post-op years, both techniques are reasonable surgical approaches

• Both groups had relatively high % with suboptimal surgical outcomes, although few patients had reoperations
Treatments for IXT

- Monitor; watchful waiting
  - Part-time patching
  - Over-minus lenses
- BI Prism
- Vision therapy
- Surgery

Non-surgical
How About Vision Therapy?
IXT Treatment Effectiveness

IXT treatment success using authors’ success criteria

- Patching ~37%
- Over-minus lenses ~28%
- Prism ~28%
- Vision therapy ~59%
- Surgery ~46%

Sequential Management

1. Optimum Initial Prescription
2. Improve Monocular Visual Function
3. Develop Sensory & Motor Fusion
4. Establish Binocular Vision in Free Space
Optimum Rx

Amblyopia Tx +/- or Equalize Monocular Skills

Intermittent XT (or Constant XT able to straighten eyes with Gross Convergence Therapy)*

CI

Basic / DE

Gross Convergence

Gross Convergence & Anti-suppression/Pathological Diplopia

Near: Increase Fusional Vergence Ability & Acc/Verg Facility

Near to Intermediate to Far (Except for CI)

Enhance Sensory Motor Fusion at all appropriate distances

Dismiss and Rx Maintenance HVT

*If NO, not IXT; train at >D
XT: Sequential Treatment Plan

Phase 1: Establish initial optical correction

• Lenses
  - Optical correction – Provide equally clear images
    ▪ Promotes accommodative accuracy
    ▪ Discourages suppression
    ▪ Promotes improved sensory fusion
  - Full myopia, anisometropia, astigmatism
  - Hyperopia?
    ▪ Generally cut +
    ▪ If moderate to high plus* (+5.00 OU and IAXT)

XT: Sequential Tx Plan

Phase 1: Establish initial optical correction
  • Consider overminus SRx
XT: Sequential Tx Plan

• Phase 1: Establish initial optical correction
  - Prism Therapy
    ▪ Horizontal: consider relieving prism if normal sensory fusion and can't do VT
    ▪ Vertical: only Rx for primary
XT: Sequential Tx Plan

• Phase 2: Improve monocular visual function
  - Amblyopia treatment: (if needed)
  - Accommodation: amplitude, facility, accuracy
IXT: Sequential Tx Plan

• Phase 3: Establish & improve normal sensorimotor fusion at orthoposition/free space
  - Gross convergence
  - Fusional vergence
    ▪ Convergence & divergence
    ▪ Smooth & step
    ▪ Vergence Facility
    ▪ Monitor position of eyes with AI’s if covariation
  - Diplopia awareness who suppress when XT
Optimum Rx

Amblyopia Tx +/or Equalize Monocular Skills

Intermittent XT (or Constant XT able to straighten eyes with Gross Convergence Therapy)*

CI

Basic / DE

Gross Convergence

Gross Convergence & Anti-suppression/Pathological Diplopia

Near: Increase Fusional Vergence Ability & Acc/Verg Facility

Near to Intermediate to Far (Except for CI)

Enhance Sensory Motor Fusion at all appropriate distances

Dismiss and Rx Maintenance HVT

*If NO, not IXT; train at >D
Gross Convergence

• Convergence surprise
• Pencil push-ups
• Brock string
• 3-dot card
Ultimate Goal: Voluntary Convergence
Smooth Fusional Vergence Training

• Adds accommodative control
• Importance of divergence ranges
Step/Jump Fusional Vergence Training
Vergence Facility Training
Move From Near to Intermediate to Far Distance
Monitor Eye Position with Afterimages
IF IXT with Co-Variation
Diplopia Awareness Therapy

• For patients who suppress when XT
• Train pathologic diplopia awareness when XT
• Feedback mechanism
• Timing of this aspect of therapy?*
• Procedures?
Optimum Rx

Amblyopia Tx +/- Equalize Monocular Skills

Intermittent XT (or Constant XT able to straighten eyes with Gross Convergence Therapy)*

CI

Basic / DE

Gross Convergence & Anti-suppression/Pathological Diplopia

Near: Increase Fusional Vergence Ability & Acc/Verg Facility

Near to Intermediate to Far (Except for CI)

Enhance Sensory Motor Fusion at all appropriate distances

Dismiss and Rx Maintenance HVT

*If NO, not IXT; train at >D
Diplopia Awareness: R/G Filters

- Red & green filters in a dark room looking at flashlight, penlight, candle
- Dissociated viewing to natural viewing
  - Illumination
  - Filters
  - Distance
Vertical Prism Addition & Removal
• Add dipl awareness training with suppression when XT manifests

Constant XT with gross convergence therapy

Constant XT with AC

Treat AC to establish normal sensory fusion at <D

Improve motor fusion around <D

Establish SM fusion in free space
Consider prism or surgery

Constant XT with Suppression

Anti-suppression at <D to establish normal sensory fusion at <D

Intermittent XT*

Fusional vergence training in free space
Objective-Angle Therapy
VT for XT: Important Considerations

• Typically, mostly free space activities
• ↑ smooth vergence & step/jump vergences
• Train divergence also!
• 3rd to 2nd to 1st degree fusion
• Near to intermediate to far distances
• Eliminate suppression both when eyes straight and when XT
• Constant XT: attempt motor therapy (gross convergence) at orthoposition first, if unsuccessful ………………
Thank You

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