Roger Trimble Memorial Lecture 2009:
Expanding the repertoire – New techniques for the strabismus surgeon

Teaching an old dog some new tricks

Lionel Kowal
Melbourne Australia
TRIBUTE TO ROGER TRIMBLE

• Great teacher
• I met him briefly @ UK meeting
My early training...

• The ONLY area in medicine where intellectual understanding of the problem was delegated to the paramedic [orthoptist]
• The surgeon was the technician who performed the orthoptists’ prescription
• Do 5mm recess / resect on all squints. Big effect on big squints, small effect on small ones
• All [real or apparent] 4ths : IO myotomy / myectomy
How far have we come?

Volume 13, Issue 1, Pages 1-3 (February 2009)

Strabismus surgery: How well do we do?

Michael X. Repka, MD

Received 2 January 2009; accepted 5 January 2009.
In the 1930s, Bielschowsky wrote: “in examining and treating motor anomalies, one never loses an uneasy feeling of incompetence until one has become thoroughly familiar with the physiologic fundamentals from which the signs and symptoms of those anomalies are to be derived.”
CALIFORNIAN INGENUITY:
DISCOVERING / REDISCOVERING FUNDAMENTALS & PUSHING BOUNDARIES

JOE DEMER  UCLA
HAS REDISCOVERED ANATOMY & PHYSIOLOGY
OF STRABISMUS
ALLOWS DEVPT OF NEW SURGICAL TECHNIQUES

ALAN SCOTT  SF
EXPLORED PHYSIOLOGY
PUSHED / CREATED NEW BOUNDARIES
BOTOX
ADJUSTABLE FADEN
PERIOSTEAL FIXATION
MUSCLE PROSTHESES

WITH HELP / COOPERATION OF JAMPOLSKY, ROSENBAUM, CLARK, MILLER, SKI, UCLA, .......
New surgical techniques that will become part of your repertoire

• 1. Medial rectus pulley suture
• 2. Adjustable Faden
• 3. Periosteal fixation
SCLERAL FADEN SUTURE

• Long history: Germany 50+ yrs
• Number of synonyms ≈ number of technique variations
• Frequently used in European and Latin strabismus
• Lower acceptance in Anglo-American strabismus
Using the scleral Faden...

- Compensate for incomitance
- No effect on primary position almost true
- MR: Only effect in Adduction.
- Commonest use: to augment effect of MR recess in convergence Xs
  - Can be used on MR without recess
  - Augment effect of SR recess in DVD
Faden procedure

• Posterior fixation suture
  – 12-14 mm posterior to insertion
  – Limits effect of muscle in its field of action with minimal effect in primary position
  – Pinning the rectus muscle to the sclera prevents the arc of muscle contact from unravelling. This shortens the moment arm and therefore the rotational force.
Scleral Faden procedure

Modification of Fig 17-9
Pediatric Ophthalmology & Strabismus.
KW Wright & P Spiegel
MECHANISM OF SCLERAL FADEN: NEW

Demer:
Scleral faden also creates restriction of movement through the muscle pulley, hence..

• **New intra-operative end point:** restriction of intra-operative duction

**SEMINAL PAPER** R A. Clark, J L. Demer Posterior fixation sutures: a revised mechanical explanation for the fadenoperation .... Am J Ophth 1999
MR passes through its pulley as RE aDducts

If we want to impair Adduction without affecting primary position...
SCLERAL SUTURE @ P

Primary gaze

Original MR insertion

Medial orbital wall

18 degrees ADd

P prevents normal MR movement through MR pulley - Adduction restricted by P
SCLERAL FADEN

• Many different techniques - all seem to work similarly

RARE COMPLICATIONS

• Perforation
• Scarring anterior to suture
  ..as if muscle is super-glued to sclera
THE NEW FADEN: PULLEY SUTURE  PS

• Technically more difficult than scleral Faden.
• The radiological & histological anatomy are well defined
• The surgical anatomy of the pulley is NOT well defined

From Clark &Demer
Pulley deflects paretic LR from straight-line course to apex of orbit

Radiological Anatomy
defined by Demer
manyIOVS 2008

‘Lateral inflection’ caused by Lateral Rectus having to go through its [orbital] pulley, a fixed & constant orbital structure
THE NEW FADEN: PULLEY SUTURE

• Create a restriction of movement of the muscle through the pulley by suturing muscle to the pulley itself
• Theoretically safer - no scleral suture
• Technically difficult
• Not titrateable (so far!)
• No long term results
P pulley suture

Primary gaze

MR insertion

Medial orbital wall

P = muscle sutured to its pulley.

This now restricts full abduction.

18 degrees ADd

PULLEY

P

A

B

MR

LR

P
Search ‘Pulley Suture’ on You Tube
Medial rectus pulley posterior fixation: a novel technique to augment recession

R A. Clark, R Ariyasu, J L. Demer  JAAPOS 2004

- 16 pts: standard Rs and/or Rc with MR PS

- 9 pts – recurrent ET with conv Xs
  5 – BMR re-Rc + PS
  4 – MR re-Rc + PS + ipsilateral LR Rs

Postop: D/N disparity 11Δ. (avg)
All pts: Dist ET ≤ 10 Δ. No pt overcorrected.
Medial rectus pulley posterior fixation for acquired ET with high AC/A

### 9 pts: standard BMR + Faden
- 2 – only scleral faden
- 7 – BMR + scleral faden

**Postoperatively**
- 6/9 – improved stereoacuity
- 8/9 – no longer needed bifocals

↓ D/N disparity av of 12Δ

### 13 pts: BMR ± pulley sutures
- 3 – only pulley suture
- 10 – BMR + pulley suture

**Postoperatively**
- 8/13 – improved stereoacuity
- 2/13 – no longer needed bifocals

↓ D/N disparity av of 14Δ

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R A. Clark, J L. Demer  Am J Ophthalmol 2004
Types of patients for PS

First 25       current >40

• 1. Very variable ET $n = 3$
• 2. Convergence Xs $n = 14$
• 3. Adding PS to previous BMR $n = 2$
• 4. Adding PS to BMR for anticipated poor glasses compliance $n = 4$
• 5. PS for face turn of LMLN $n = 1$
• 6. Conv Xs in sensory ET $n = 1$

...similar to a scleral Faden population
Very variable ET

• 3 patients
• 3 to 4 -fold range in angle variability
• 1 – PS only → Inadequate → BMR added as 2nd procedure
• 2 – PS and BMR

• All straight (17 months min FU)
When I have been using pulley sutures for convergence Xs

- ET 25\(\Delta\), ET‘ 35\(\Delta\): I use Parks’ BMR 5.
- Large experience – reliable. PS can’t compare.

- ET 15\(\Delta\), ET’40\(\Delta\). What dose BMR?
- Smaller international experience. Less agreement / less reliable.

- LK: D-N/2 = 27\(\Delta\) of surgery + pulley sutures
Convergence XS  n=14

• Mean age at surgery: 54.4 mo
• Gradient AC/A ratio: 8.6(5.3-16)
• D/N disparity: 20.6 Δ (14 - 35)
• All BMR with PS
Post-op  n=14

• D/N reduced to $2.2^\Delta (-5 \text{ to } 10)$
• FU  Mean 5.5 mo (1w to 20 mo)
• 11: angle $< 10^\Delta$
• 6 straight N&D
• 1 recurrent convergence XS ET
• No further Sx so far
PS to previous BMR for conv Xs

• 2 patients
• 1 Unilateral – inadequate
• 1 Bilateral – good result
Poor glasses compliance

- 4 patients (2 older)
- Avg refraction 3.4 D (2 to 4.5)
- Partially accom ET
- BMR with PS
- 3 straight D and N (without glasses)
- 1 - ET’ 10 Δ
Technical aspects

• Have only tried this on MR
• Failure to achieve intra-operative duction restriction with one PS: 5-10%
• ...2 PS: <5%
Pulley sutures: the current status and the future

CURRENT
• Has replaced scleral Faden for augmented effect in MR recess

FUTURE – many Qs
• How much intra-op restriction is needed for a particular post-op result?
• Long term results – does the PS fall apart after \( x \) years?..does it matter?
• Long term comparison of pulley vs scleral suture: clinical data and histology needed.
New surgical techniques that will become part of your repertoire

1. Medial rectus pulley suture

2. Adjustable Faden

3. Periosteal fixation
Mr AG

- 57 yr old keen surfer with troublesome vertical diplopia following L penetrating orbital injury

PHx:

- May 2008: left penetrating orbital injury (surfboard): upper and lower lid lacerations; presumed IR transection
  - Lid laceration repair, canalicular stent, orbital exploration (Geelong).
Mr AG

- Persistent post-operative diplopia
- Initial OMC review (11 days after injury):
  - Limited horizontal ductions L
  - Limited depression L
  - XT 30Δ BI with LH 6Δ
  - Clinical impression: LIR injury +/- inferior divisional palsy CN III
- MRI – EOM including L IR appear intact
Mr AG

- Horizontal diplopia resolved, persistent vertical diplopia
  - Relieved in primary position with 6PDΔL
  - Diplopia in downgaze:
    - difficulty reading, playing sport & surfing
- June 2009:
- LH 6Δin 1° 25Δin downgaze
- Poor L depression
Mr AG : 24/6/09: Adjustable Faden procedure

Objectives:
1. Correct $6\Delta$ vertical deviation (LH) in primary position.
   Could be achieved by recessing RIR by 2mm
2. Weaken RIR in its field of action

R IR: resect 3 mm + recess 5mm on adjustable 5/0 vicryl suture

Post op: no diplopia in primary postition; vertical diplopia beyond 20 degrees of downgaze. No adjustment required.
Recession: Starling length-tension curve
Recession: mechanical disadvantage
Combining recession and resection:
Combined adjustable rectus muscle resection-recession for incomitant strabismus

• N M Thacker, F G Velez, A L Rosenbaum. JAAPOS 2005

• 12 pts with incomitant strabismus: one or two rectus muscles resect-recess on adjustable suture
  – MR 7 patients
  – LR 5 patients
  – IR 2 patients
  – SR 1 patient

• Results
  – the amount of incomitance reduced from a preoperative mean of 12Δ to a post-operative mean of 3Δ
  – diplopia was eliminated in 11 of the 12 patients
Use of the combined recession and resection of a rectus muscle procedure in the management of incomitant strabismus


• 22 patients combined Rs-Rc procedure on rectus muscle/muscles on adjustables:
  – LR - 12 patients
  – IR - 7 patients
  – MR - 3 patients
  – SR - 3 patients

• Result: All but one patient had a measurable improvement in gaze incomitance
### INCOMITANT STRABISMUS

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- Need to fix the ‘6’
- Greater on down L gaze
- LIR Rc 2.5 will probably get the 6
- Need LIR Rc 3+ for 10, 4+ for 18
Recess inferior rectus

For Hypo, recession of IR from A → B will allow the eye to move to PP

MOVE INF RECTUS A → B

LEVER ARM O - A GENERATES MORE DOWNWARD TORQUE THAN O - B
INCOMITANT STRABISMUS

- LIR Rc 2.5 will probably get the 6
- Need LIR Rc 3+ for 10, 4+ for 18
- Rs 2.5 & Rc 5 : net Rc 2.5 in primary
- Rc 5 will have bigger effect on DG b/c posterior tangential contact of muscle insertion with circumference of globe

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Resect - Recess on Inferior rectus

If B-C is removed, moving muscle from A - C will have same effect on PP as moving original muscle from A-B.

At ‘C’, the IR now generates less rotational torque on downgaze [less than it did @ ‘B’]
Recess A-B same effect in PP on hypo as Resect B-C / Recess A-C

IR @ C generates less downward torque than IR @ B.

Same as A-B in PP
Less rotational torque
• 23 yo: head tilt L since early adolescence. Diplopia when tired.
• ROSV*: L of midline only.
• NPC 35 cm [main driver for Rx]
• Normal MRI
  − ROSV Range Of Single Vision

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#1

- Both sup obliques sl. Floppy, R = L
- RIR Rs 4, Rc 6.
- Adj: R gaze 15°. Further Rc → worse in primary

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BEFORE : ROSV to R 0°

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AFTER : ROSV to R 45°

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<td>LH1 FR -2 to +6 NPC 9cm</td>
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• 67 yo WCF
• 50+ yr history V diplopia, worse since recent cataract surgery
• Yrs ago: diplopia / click / single
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? SEQUELAE OLD L BROWN’S
#2

- RSR Rs 3, Rc 4  adj

Adjust using all of:
- 1. Maddox rod
- 2. Vertical fusion range
- 3. ROSV to R
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? SEQUELAE OLD L BROWN’S
• 57 yo WCM
• MBA @ 17
• V diplopia onset late 40’s
• Δs worked well for some yrs
#3

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R >> L SUP OBL PARESES
MRI: SMALLER RSO ON CORONALS
#3

- LIR  Rs 3, Rc 6.5

- Adj: ROSV  UG 15°, DG 15°

MADDOX ROD:

- PP 0, DG LH 8Δ, UG small RH

- 3w postop: ROSV DG 55°
#4 MEDIAL RECTUS

- Tried this for incomitant ET on medial rectus
- Not recommended: excellent early result quickly → incomitant consecutive XT
#5 LATERAL RECTUS

• Tried this on one LR
• Little / no effect
Total experience

• IR  x 5 : all good

• SR  x 2 : all good
12 pts with incomitant strabismus: one or two rectus muscles resect-recess on adjustables:

MR Rs-Rc – 7 patients
  LR Rs-Rc – 5 patients
  IR Rs-Rc – 2 patients
  SR Rs-Rc – 1 patient

Result:
- the amount of incomitance reduced from a mean of 12Δ (preop) to a mean of 3Δ (postop)
- diplopia was eliminated in 11 of the 12 patients
E Dawson, N Boyle, K Taherian, J P. Lee

Use of the combined recession and resection of a rectus muscle procedure in the management of incomitant strabismus (JAAPPOS 2007)

22 pts: combined Rs-Rc procedure on rectus muscle/muscles on adjustables:

- LR Rs-Rc - 12
- IR Rs-Rc - 7
- MR Rs-Rc - 3
- SR Rs-Rc - 3

Result: All but one patient had a measurable improvement in gaze incomitance
ADJUSTABLE FADEN

• LK: useful for incomitant vertical strabismus
• Literature : ..for MR & LR too
New surgical techniques that will become part of your repertoire

• 1. Medial rectus pulley suture
• 2. Adjustable Faden
• 3. Periosteal fixation
MODERN SURGERIES FOR 3RD NERVE PALSY

LIONEL KOWAL    MELBOURNE
CLAIDIA YAHALOM  ISRAEL
YAIR MORAD ISRAEL
ALAN SCOTT USA
ALAN MCNAB MELBOURNE
GUY BEN SIMON ISRAEL
3rd N palsy

- If MR completely ‘dead’ &
- If LR still attached to the globe [no matter how many times it has been weakened] *recurrent XT is inevitable* unless globe is tethered
TETHERING THE GLOBE

• Superior oblique to MR insertion
  Creates new verticals

• Bind MR insertion to anterior lacrimal crest [fascia lata, periosteal flap, ....]
  LR can’t stretch this tissue
If MR ‘dead’, make LR totally ineffective

• Will get centrally positioned globe with poor horizontal movement

• NO possibility of XT recurrence
How to make the LR totally ineffective

- Remove from globe & suture to periosteum  
  Scott, SKI, San Francisco

- Transpose LR to medial side of globe  
  Taylor, Melbourne. Presented @ ISA, 1988

Remove muscle
- Tonsil snare [Sinskey]
If muscle has already had multiple recessions:
- Anteriorly: Large anterior myectomy + miochol
- Remove via lateral orbitotomy
Lateral rectus muscle disinsertion and reattachment to the lateral orbital wall

• Morad Y, Kowal L, Scott AB
• Assaf Harofeh Medical Center, Israel
• Royal Victorian Eye and Ear Hospital, Australia
• Smith-Kettlewell Institute, CA, USA

• British Journal of Ophthalmology
  2005;89:983-985
LR → PERIOSTEUM

Hook the LR and suture as for recession

Tenotomise.

Expose the periosteal edge: a few vertical snips through Tenon’s then spread with scissors.

Feeling for the edge makes it easier.
LR → PERIOSTEUM

Suture under direct vision or by feel.
2 bites of your favorite non-absorbable suture
6/0 Mersilene S 29 [LK]
6/0 Prolene C1 needle [AS]
Dacron [YM]
Novafil [AR]

Close the Tenon’s defect with gut to isolate muscle from globe
LR → PERIOSTEUM

- Resect dead MR
- Leave slightly ET

<10^
One re-exploration [to take down sup obl transposition] :
lateral aspect of globe ‘clean’

No sign of any muscle
4 yo Fell from 3rd floor onto sidewalk [Morad]
Rectus Muscle Orbital Wall Fixation: A Reversible Profound Weakening Procedure

- Velez FG, Thacker N, Britt MT, Alcorn D, Foster RS, Rosenbaum AL J AAPOS 2004;8:473-480

... on the lateral rectus muscle in six subjects inc 3 cases of 3rd N palsy

Results: 4 of 6 patients aligned within 12Δ

No overcorrections.
Excise LR via lateral orbitotomy

• .. after multiple recessions and failed attempt @ periosteal suture
PERIOSTEAL MUSCLE SUTURE

• HIGHLY RECOMMENDED FOR TOTAL 3rds
• UNUSUAL TECHNIQUE THAT YOU WILL QUICKLY FIND COMFORTABLE
• Doing a little more to help more patients get a better result