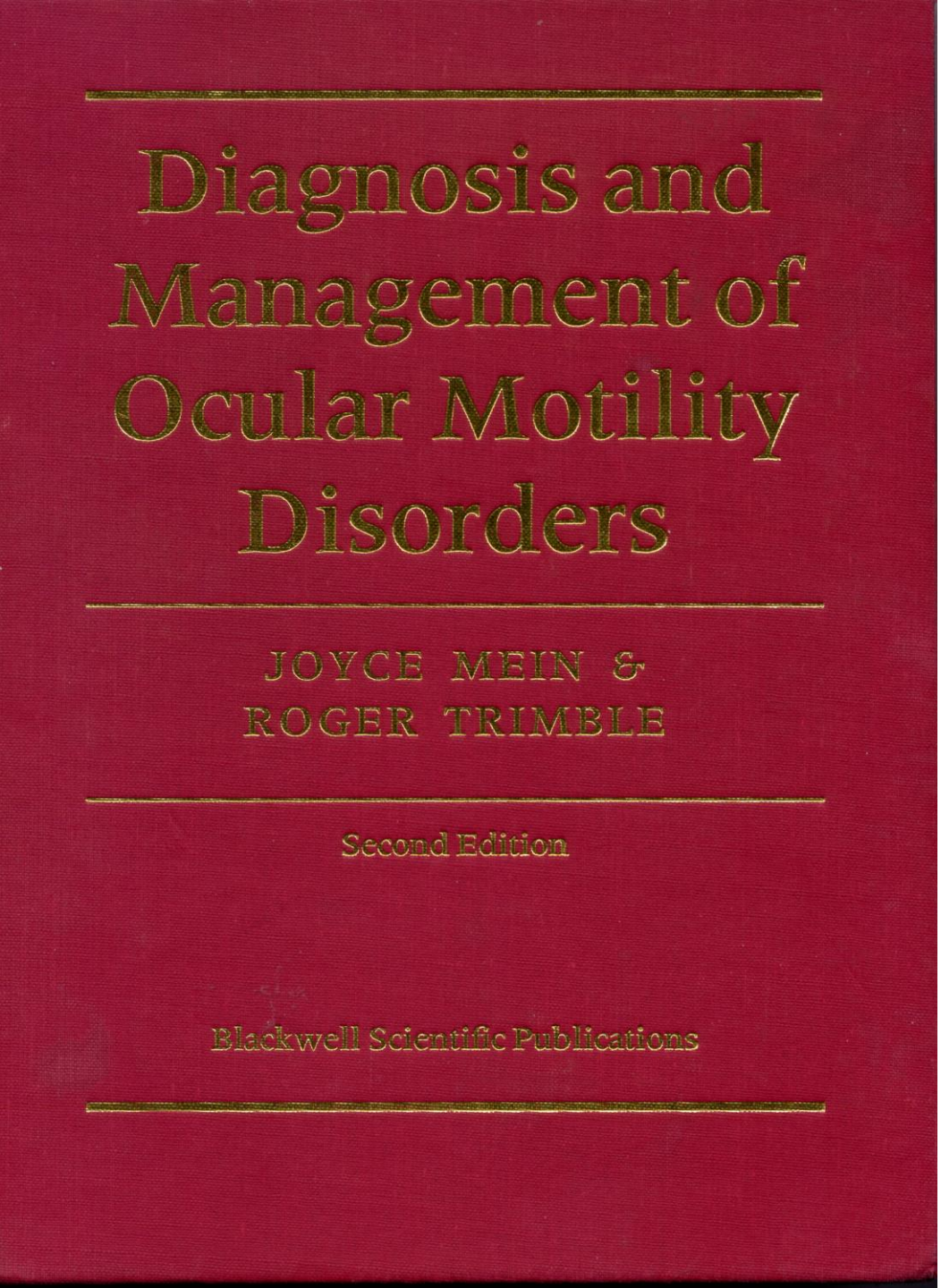
Roger Trimble Memorial Lecture 2009 :

Expanding the repertoire – New techniques for the strabismus surgeon

Teaching an old dog some new tricks

Lionel Kowal

Melbourne Australia



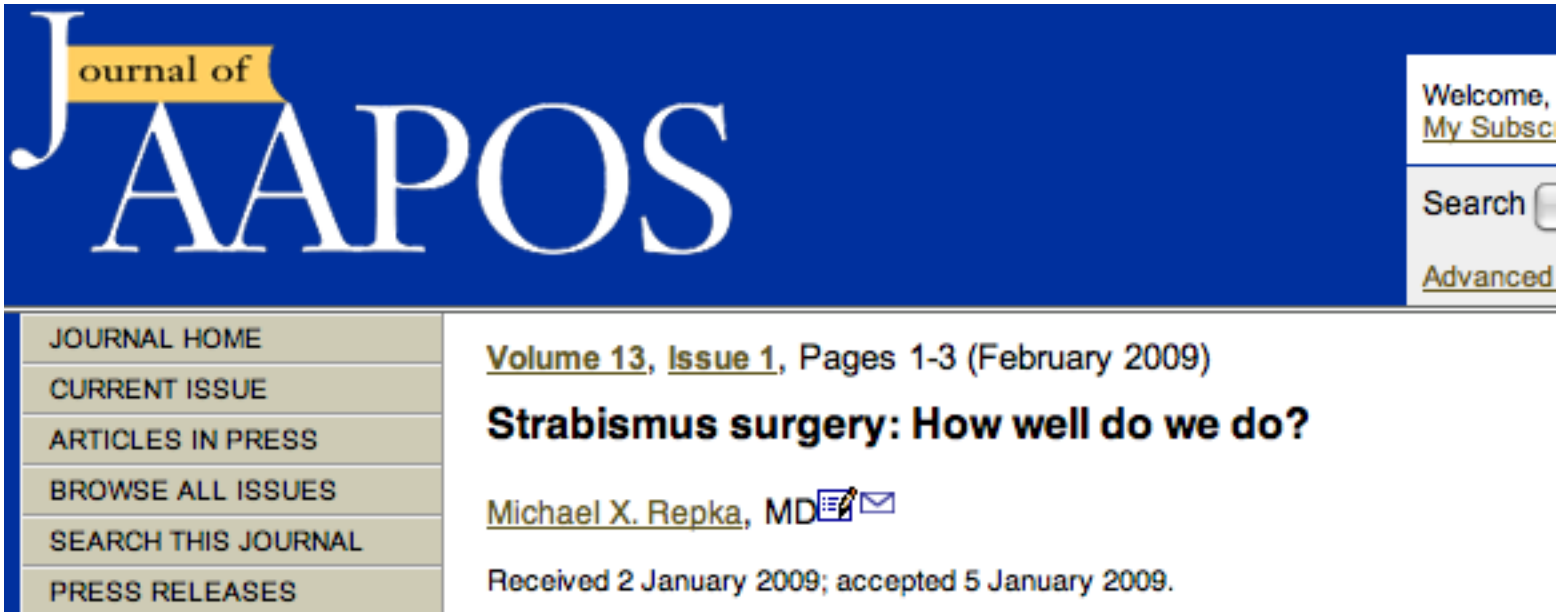
TRIBUTE TO ROGER TRIMBLE

- 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?



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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.

KNOW THE BASICS…..

- 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

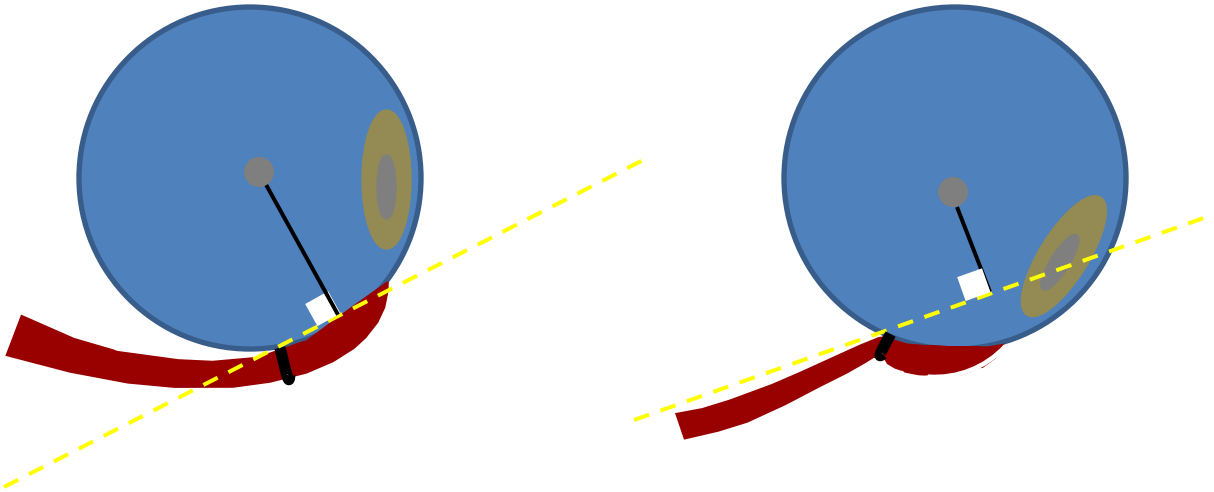
Using the scleral Faden…

- 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

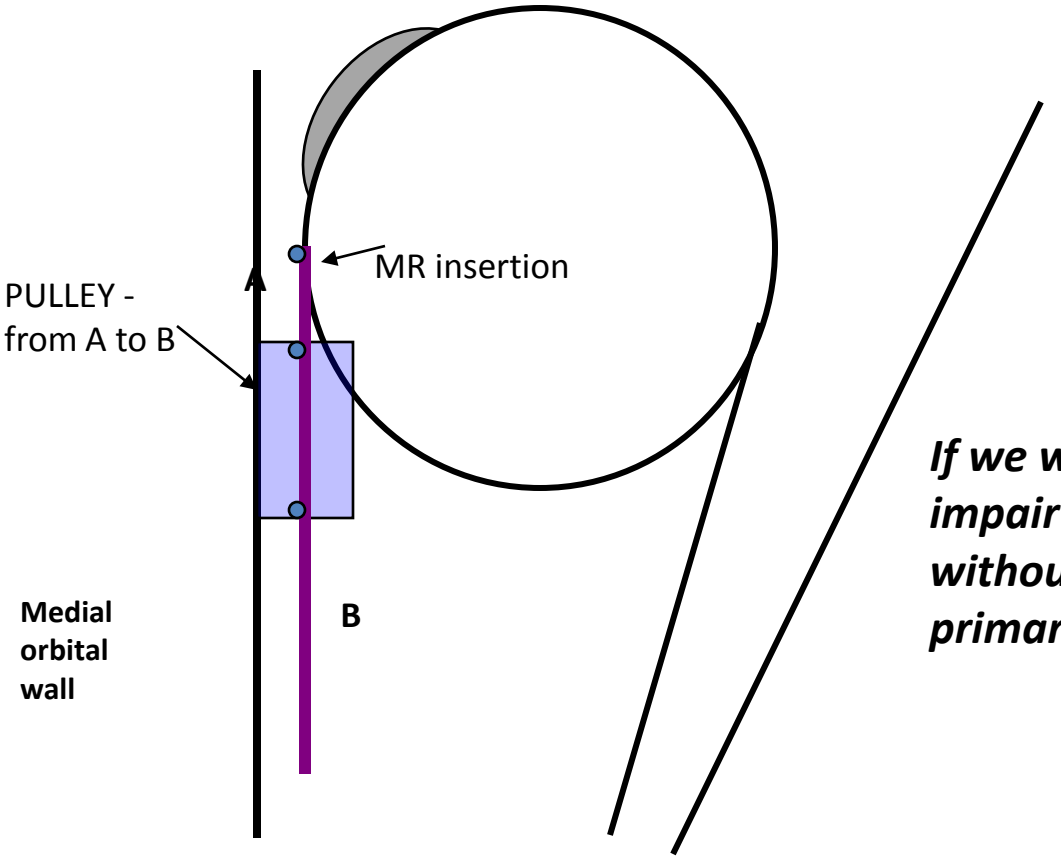
Demer:

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

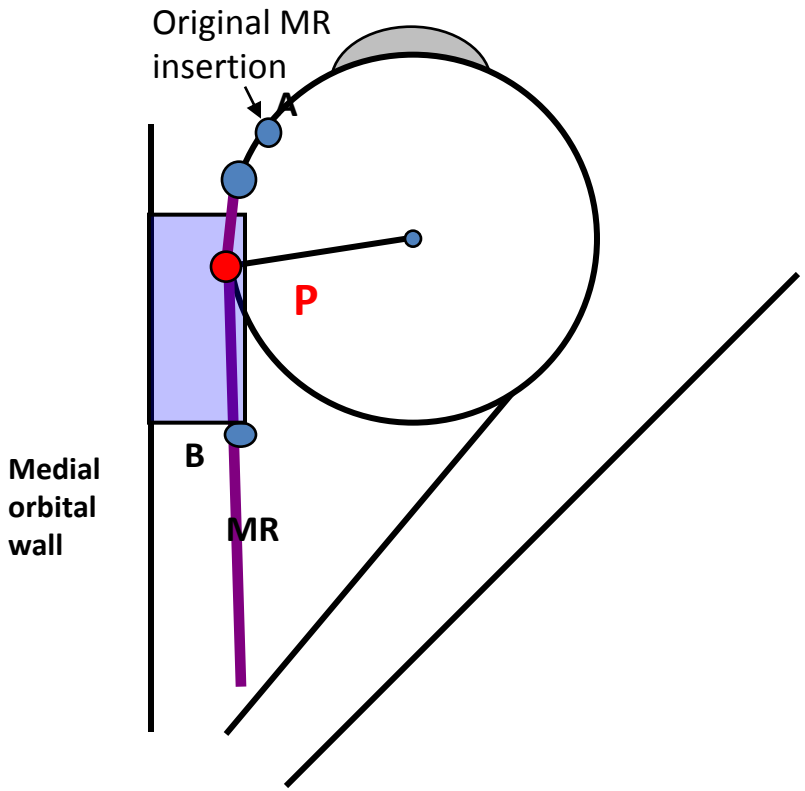
MR passes through its pulley as RE aDducts



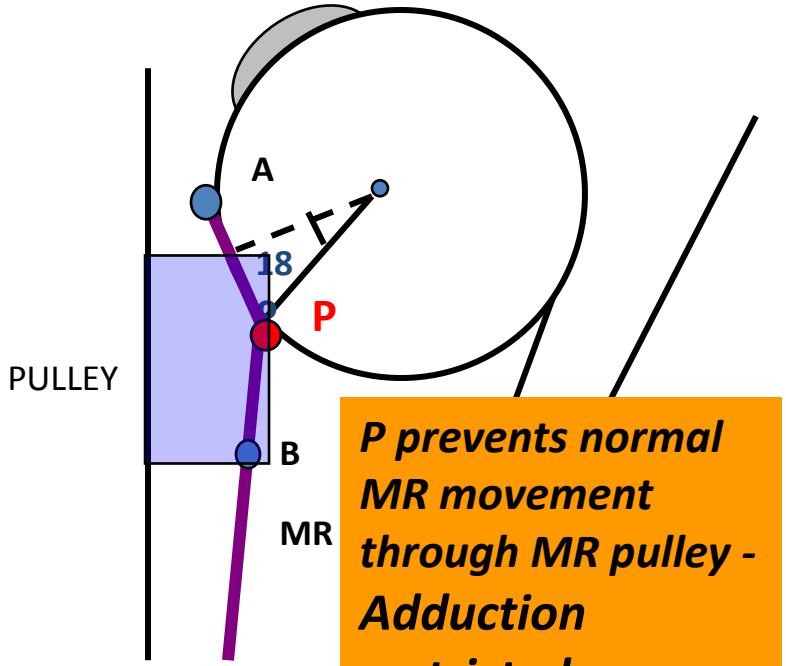
If we want to impair Adduction without affecting primary position…

SCLERAL SUTURE @ P

Primary gaze



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

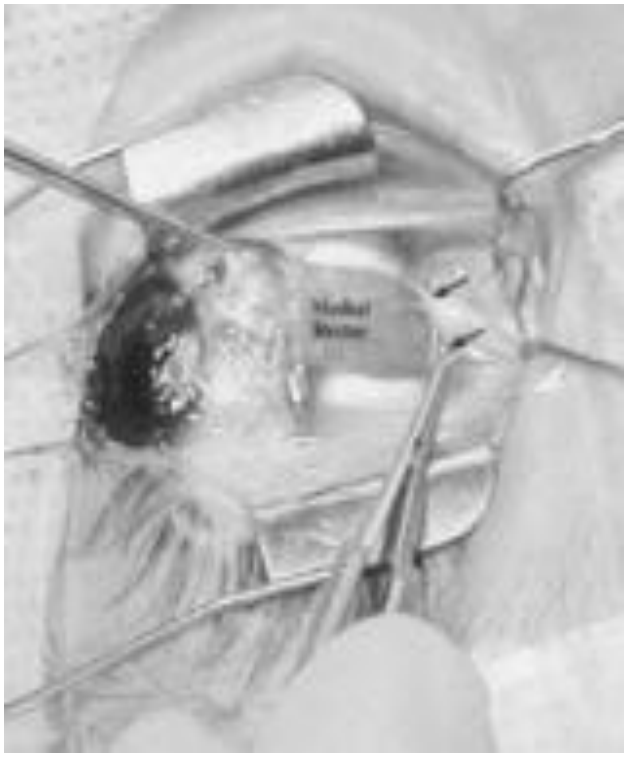
RARE COMPLICATIONS

- Perforation
- Scarring anterior to suture

..as if muscle is super- glued to sclera

THE NEW FADEN: PULLEY SUTURE PS

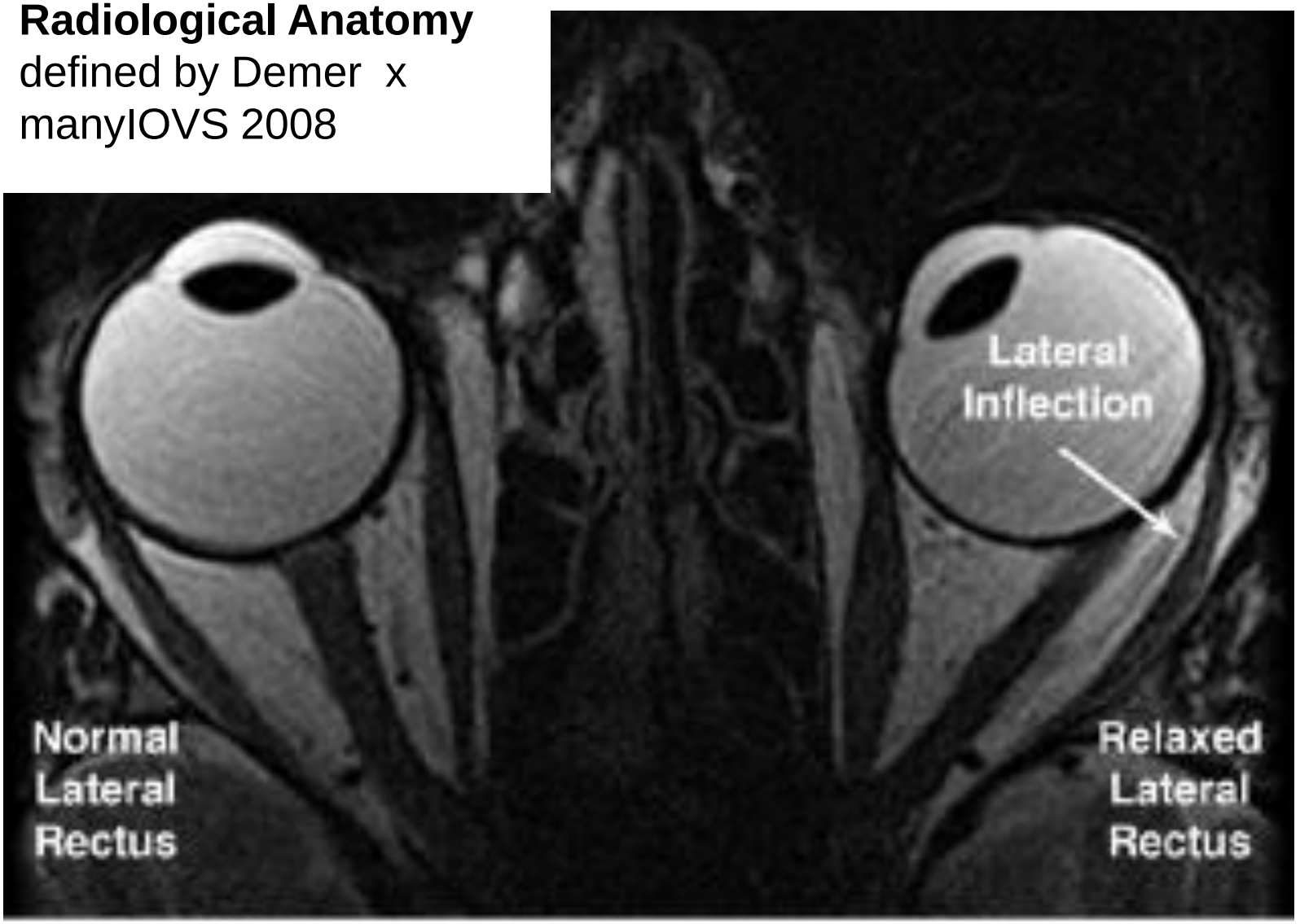
- Technically more difficult than scleral Faden.
- The radiological & histological anatomy are well defined
- **The surgical anatomy of the pulley is NOT well defined**



From Clark &Demer

Pulley deflects paretic LR from straight-line course to apex of orbit

Radiological Anatomy
defined by Demer x manyIOVS 2008



'Lateral inflection' caused by Lateral Rectus having to go through its [orbital] pulley, a fixed & constant orbital structure

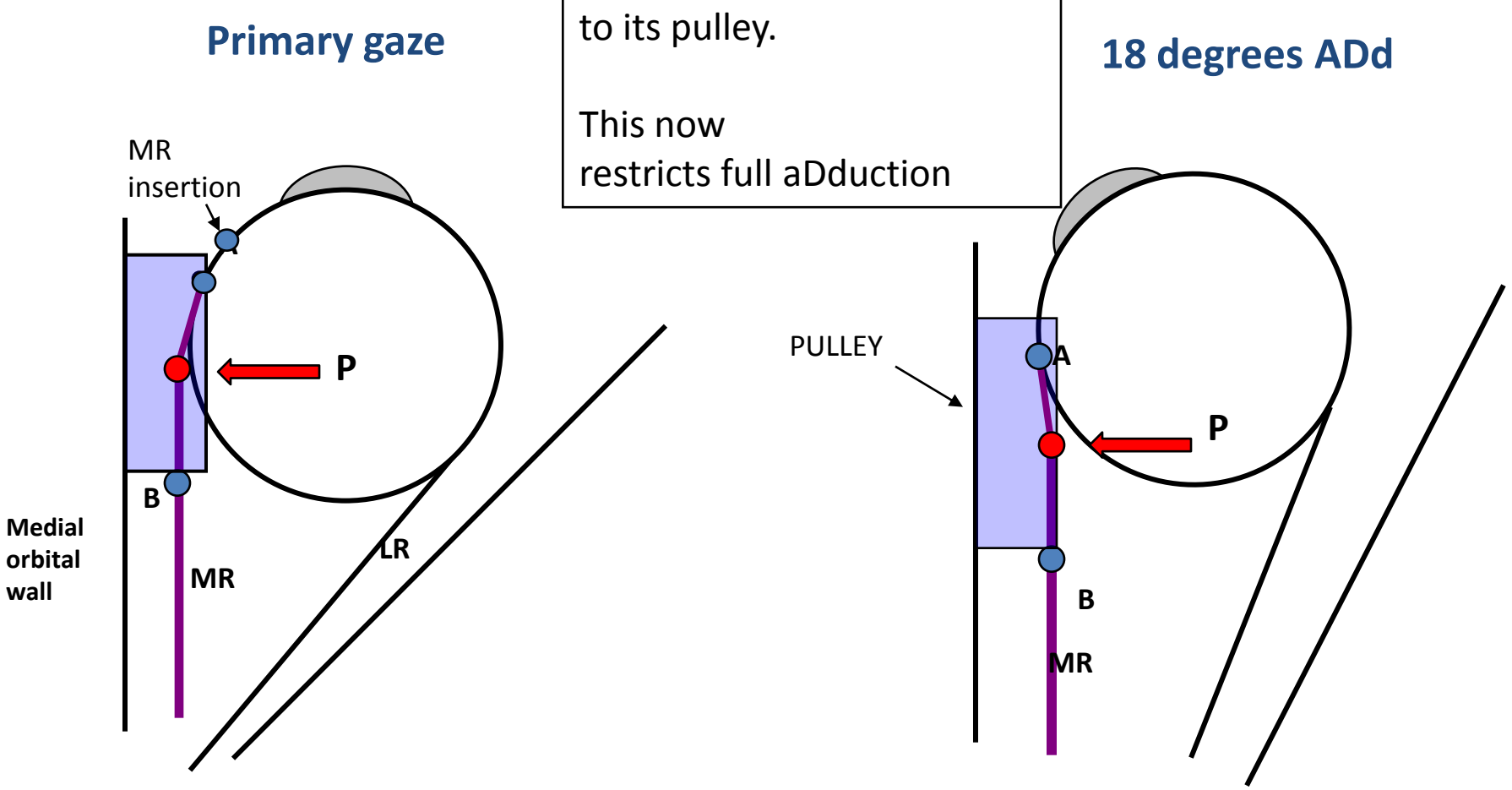
THE NEW FADEN: PULLEY SUTURE

- **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

Pulley suture

P = muscle sutured to its pulley.

This now restricts full aDduction



VIDEO

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 Rcwith MR PS

- 9 pts – recurrent ET with conv Xs

  5 – BMR re-Rc + PS

  4 – MR re-Rc + PS + ipsilateralLR 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 scleralfaden

7 – BMR + scleralfaden

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

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 25Δ, ET’ 35Δ: I use Parks’ BMR 5.
- Large experience – reliable. PS can’t compare.

- ET 15Δ, ET’40Δ. What dose BMR?
- Smaller international experience. Less agreement / less reliable.
- LK: D-N/2 = 27Δ 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 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 vsscleral 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

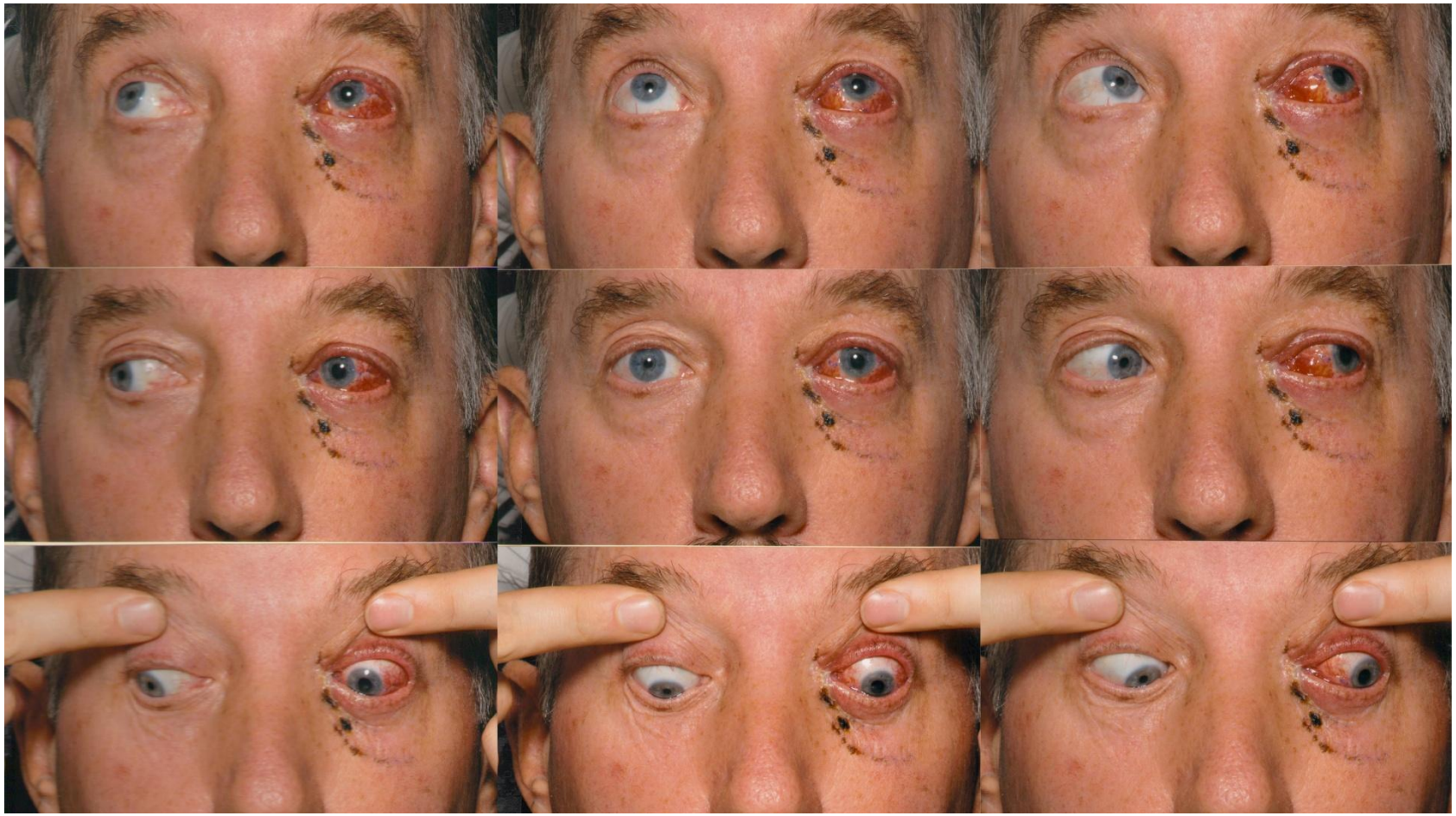
- 57 yr old keen surfer with troublesome vertical diplopia following L penetrating orbital injury

PHx:

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

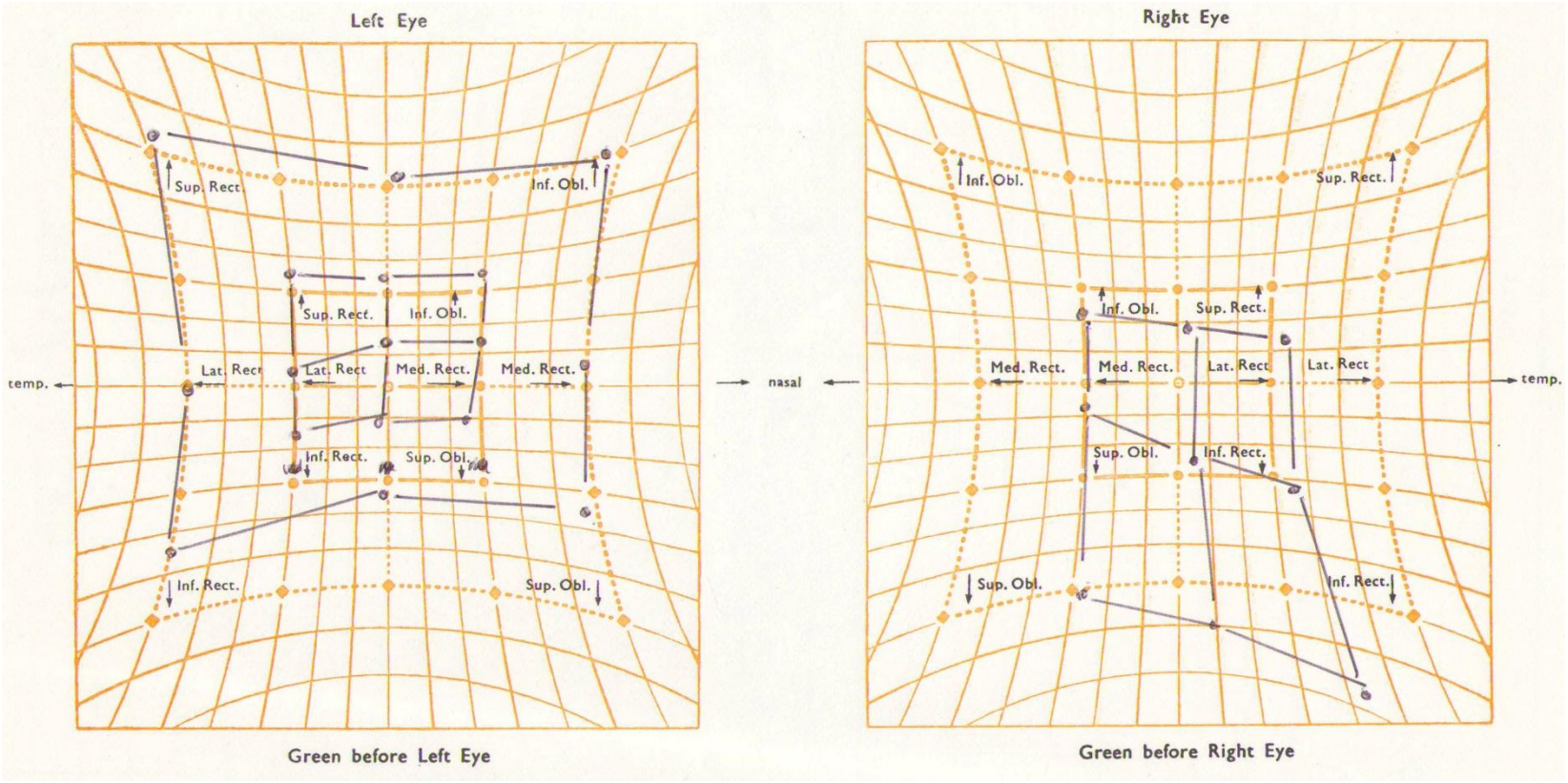
Mr AG

- 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^{o} 25Δin downgaze
- Poor L depression


Left Eye
Sup. Rect.
Inf. Obl.
Sup. Rect.
Inf. Obl.
temp.
Lat. Rect
Lat. Rect
Med. Rect.
Med. Rect.
Inf. Rect.
Sup. Obl.
Inf. Rect.
Sup. Obl.
Green before Left Eye
nasal
Right Eye
Inf. Obl.
Sup. Rect.
Inf. Obl.
Sup. Rect.
Med. Rect.
Med. Rect.
Lat. Rect
Lat. Rect
temp.
Sup. Obl.
Inf. Rect.
Sup. Obl.
Inf. Rect.
Green before Right Eye

Mr AG : 24/6/09: Adjustable Faden procedure

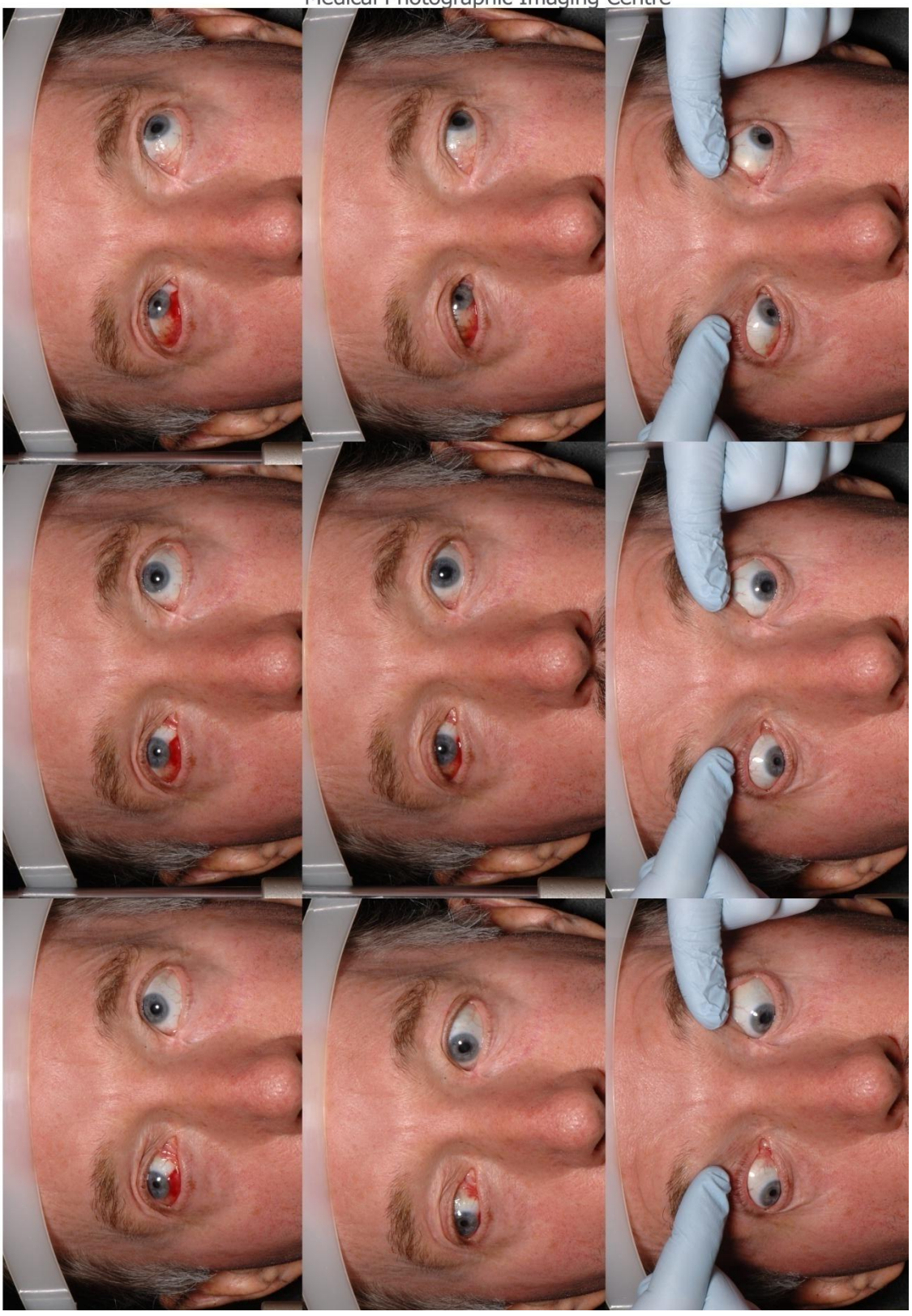
Objectives:

1. Correct 6Δvertical deviation (LH) in primary position.
   Could be achieved by recessing RIR by 2mm
2. Weaken RIR in its field of action

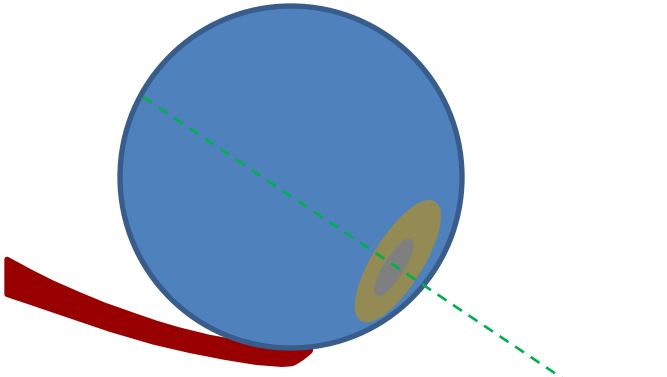
R IR: resect 3 mm + recess 5mm on adjustable 5/0 vicryl suture

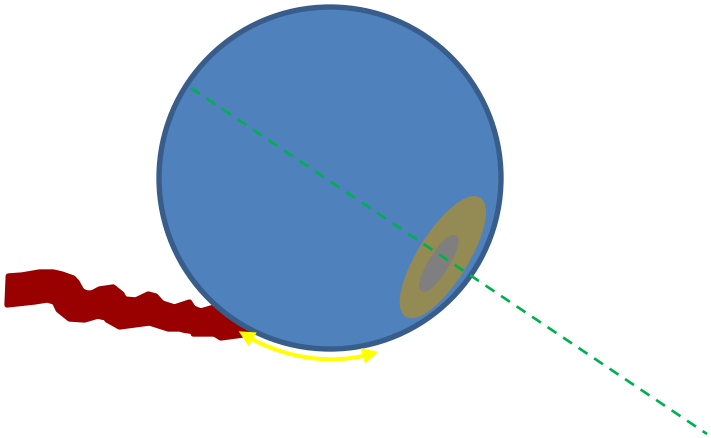
Post op: no diplopia in primary postition; vertical diplopia beyond 20 degrees of downgaze. No adjustment required.

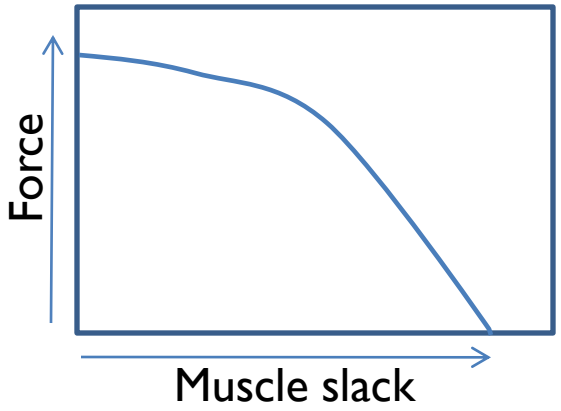
Medical Photographic Imaging Centre

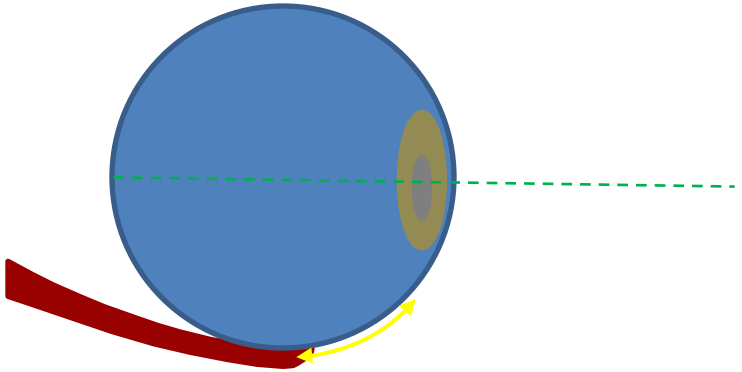


Recession:
Starling length-tension curve

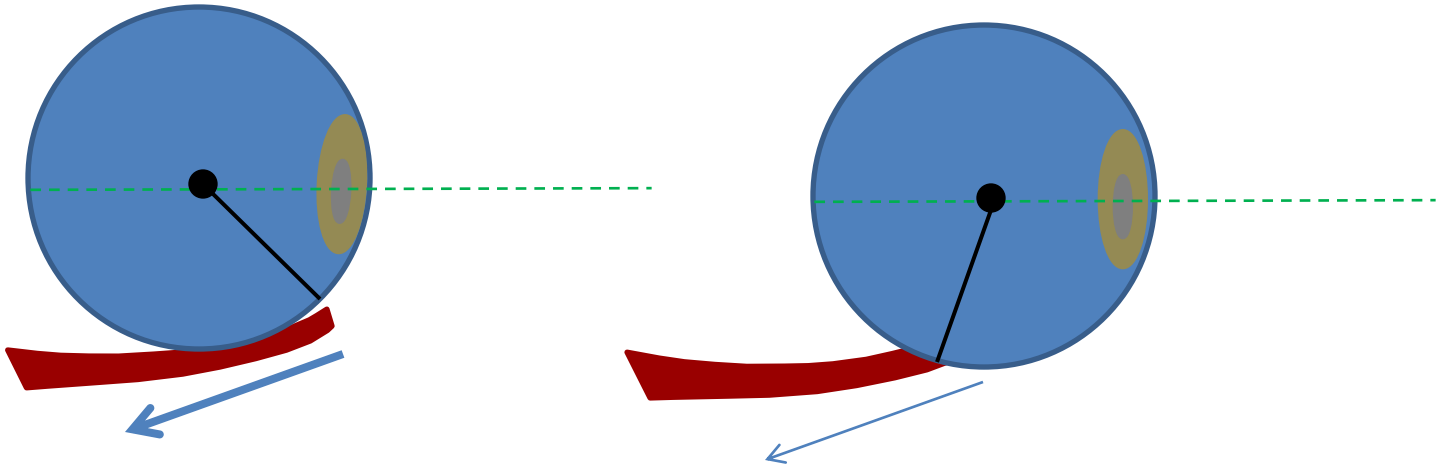




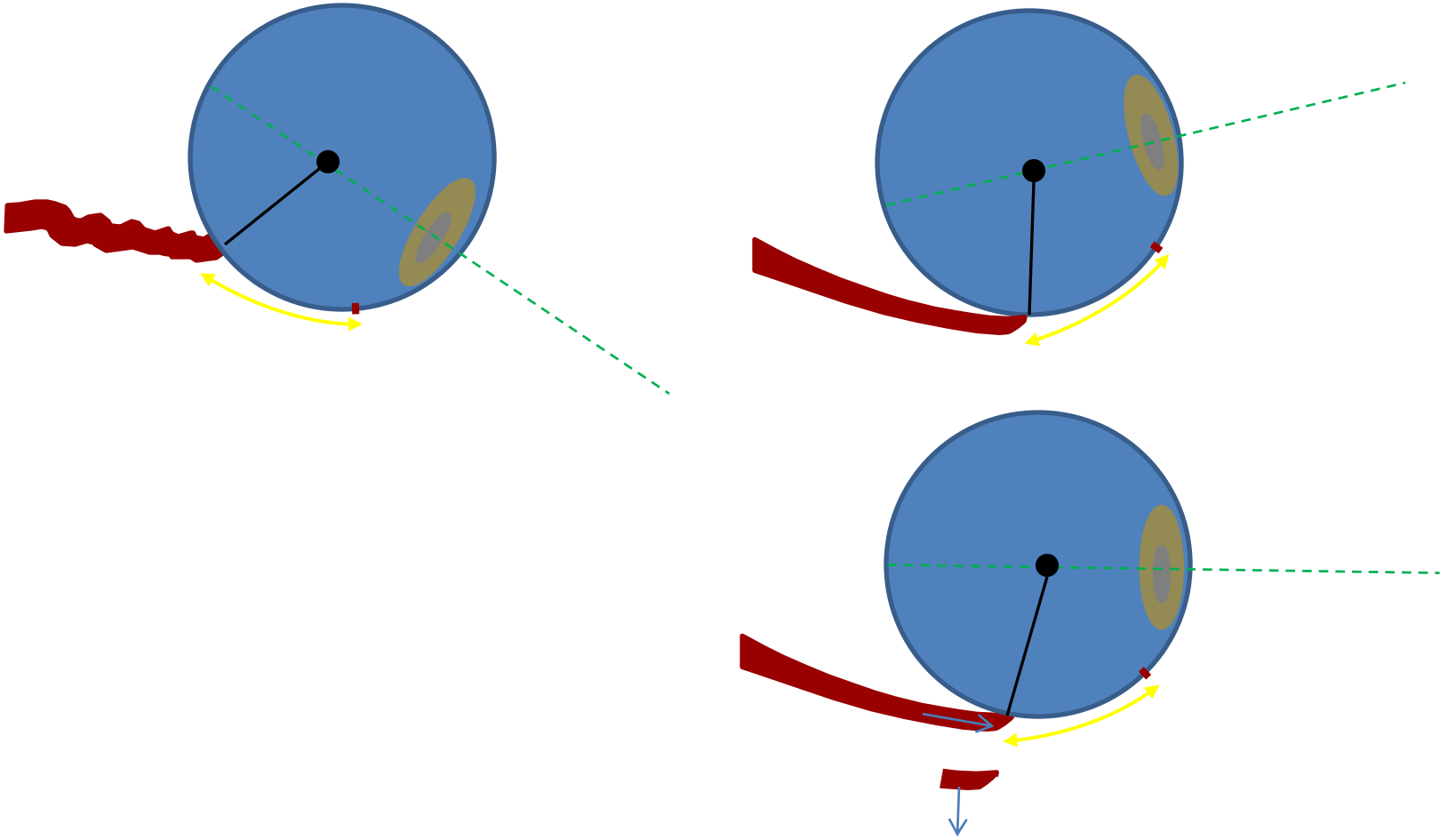




Recession: mechanical disadvantage



Combining recession and resection:



Combined adjustable rectus muscle resection-recession for incominant 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 incominant strabismus

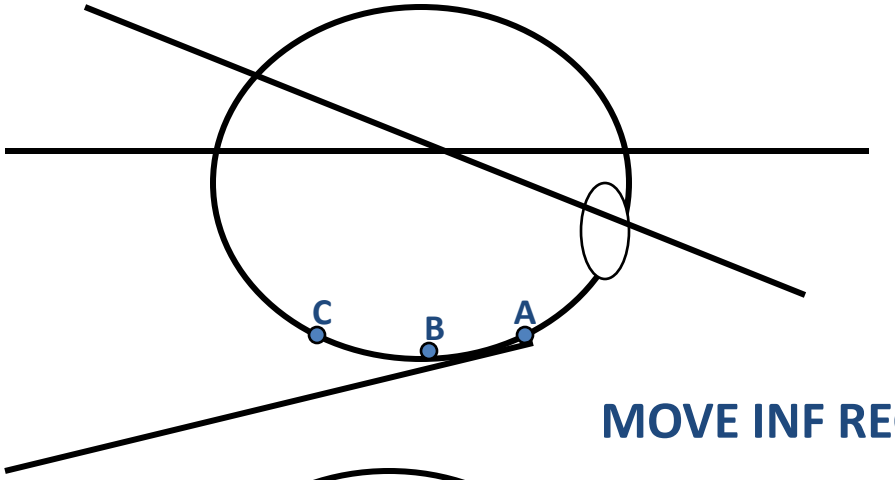
- E Dawson, N Boyle, K Taherian, J P. Lee. JAAPOS 2007.
- 22 patients combined Rs-Rc procedure on rectus muscle/muscles on adjustables :
  - LR - 12 patients
  - IR - 7 patients
  - MR- 3 patients
  - SR - 3 patients
- Result: All but one patient had a measurable improvement in gaze incomitance

INCOMITANT STRABISMUS

1	0	0
1	RH 6	10
1	10	18

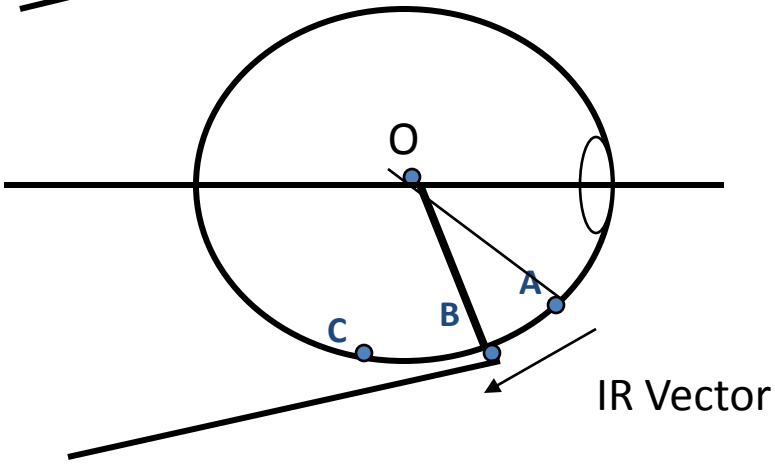
- Need to fix the ‘6’
- Greater on down L gaze
- LIR Rc 2.5 will probably get the 6
- Need LIR Rc 3+ for 10, 4+ for 18

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

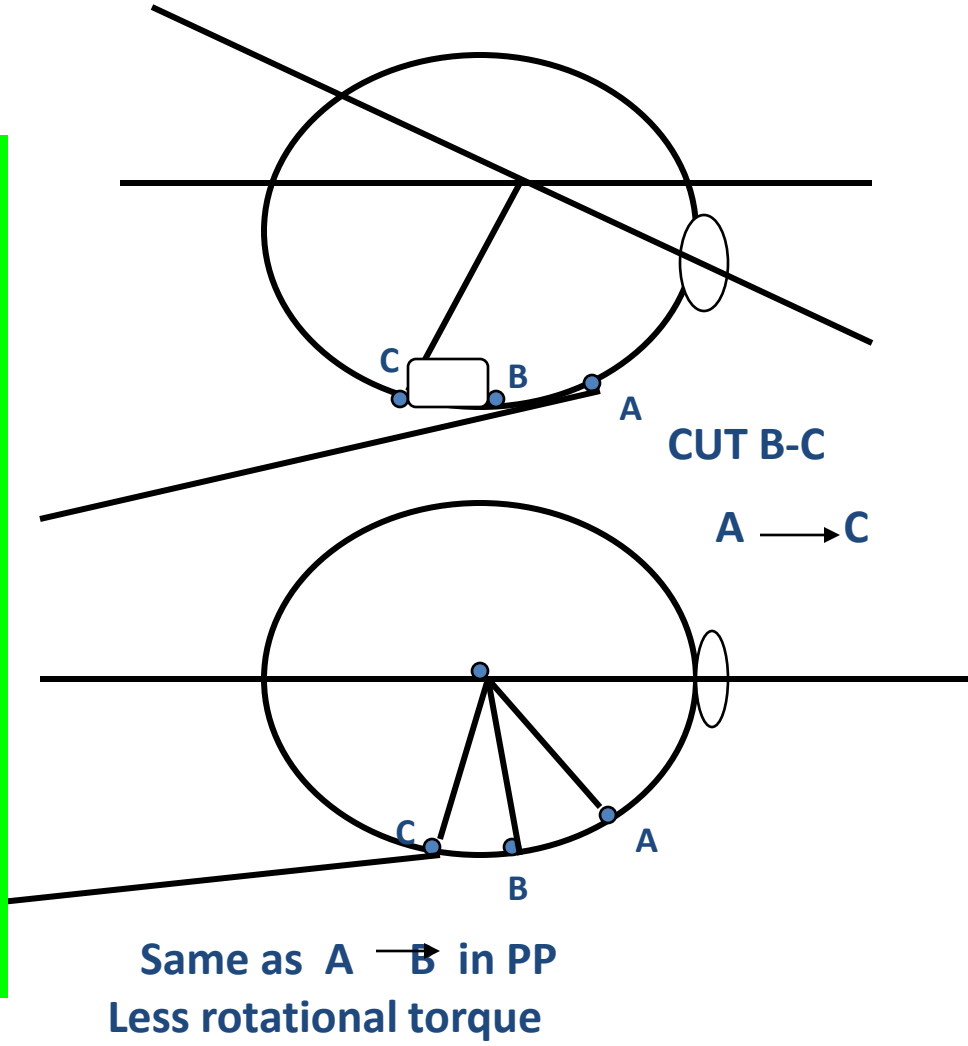
1	0	0
1	RH 6	10
1	10	18

- 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

Resect - Recess on Inferior rectus

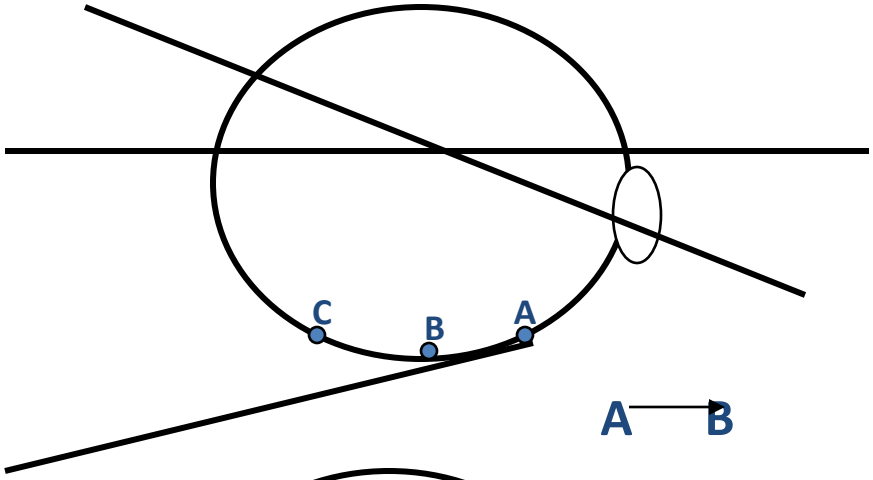
If B-C is removed, moving muscle from A - C will have same effect on PP as moving original muscle from A-B.

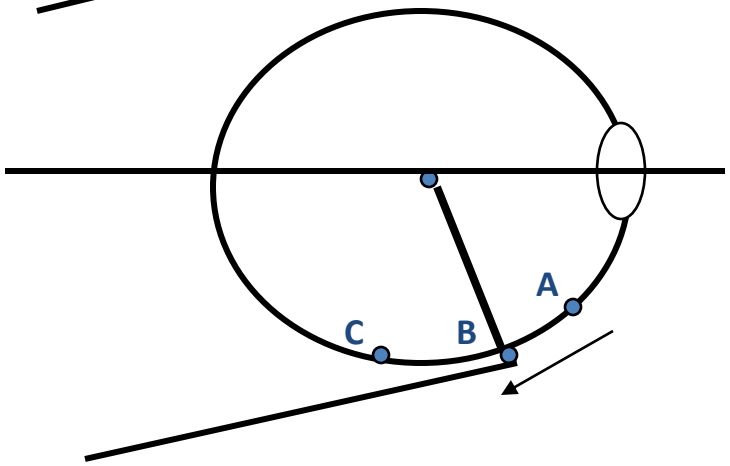
At ‘C’, the IR now generates less rotational torque on downgaze [less than it did @ ‘B’]

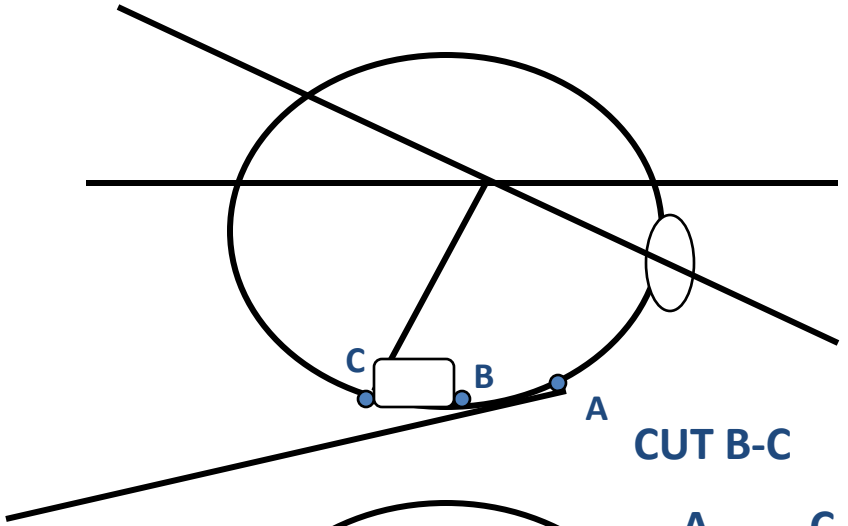


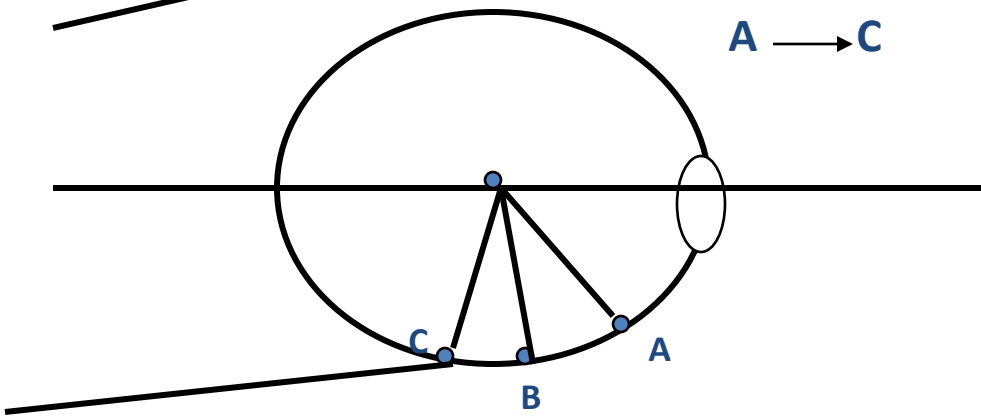
Recess A-B same effect in PP on hypo as Resect B-C / Recess A-C

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









Same as A B in PP
Less rotational torque

#1 45252

- 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

30		0
45	LH 5	4
50		6

#1

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

30		0
45	LH 5	4
50		6

#1

BEFORE : ROSV to R 0º

30		0
45	LH 5 NPC 35	4
50		6

AFTER : ROSV to R 45 º

35	LH1 FR -2 to +6 NPC 9cm	0

#2 42404

- 67 yo WCF
- 50+ yr history V diplopia, worse since recent cataract surgery
- Yrs ago: diplopia / click / single

#2

14		-3
11	RH 0	-4
0		0

? 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

#2 PRE**POST OP**

14		-3
11 **5**	RH 0 **0**	-4 **1**
0		0

? SEQUELAE OLD L BROWN'S

#3 45364

- 57 yo WCM
- MBA @ 17
- V diplopia onset late 40’s
- Δs worked well for some yrs

#3

-8		5
6	RH 10	10
3		16

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

#3

- LIR Rs 3, Rc 6.5

- Adj: ROSV UG 15º, DG 15º

MADDOX ROD:

- PP 0, DG LH 8Δ, UG small RH

- 3w postop: ROSV DG 55º

#4 MEDIAL RECTUS

- Tried this for incomitant ET on medial rectus
- Not recommended: excellent early result quickly $\rightarrow$ 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

BIBLIOGRAPHY

- N M. Thacker,F G. Velez, A L. **Rosenbaum.**

Combined adjustable rectus muscle resection-recession for incominant strabismus (JAAPOS 2005)

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

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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

<u>Remove muscle</u>

- 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

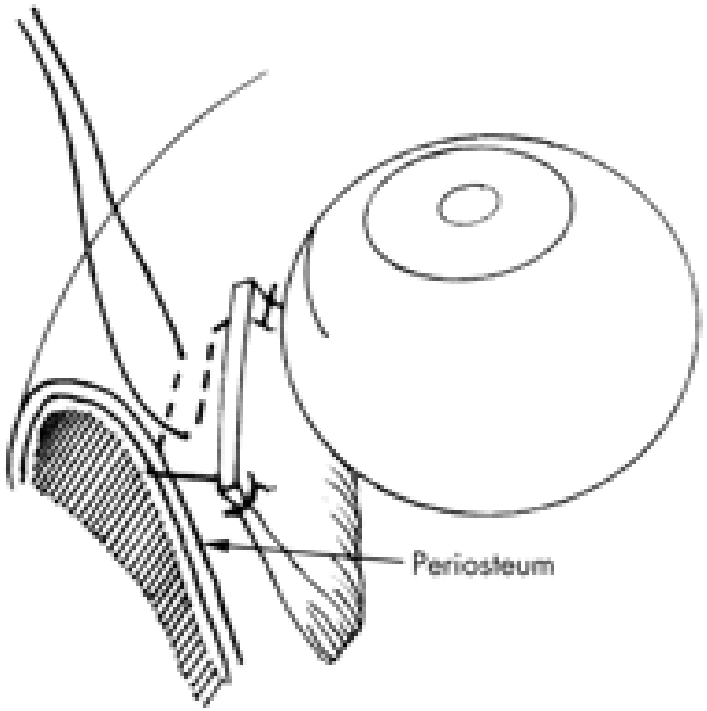
LR → PERIOSTEUM

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

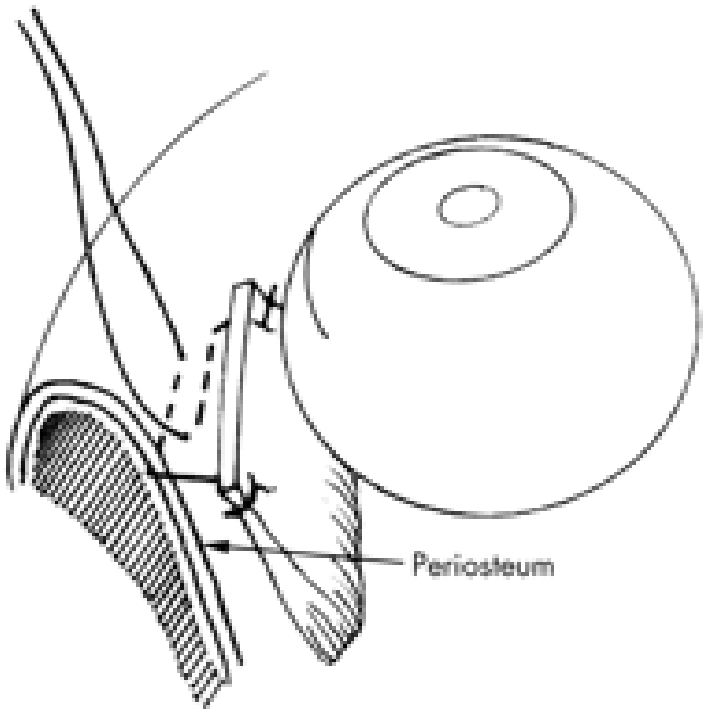
6/0 Mersilene S 29 [LK]

6/0 Prolene C1 needle [AS]

Dacron [YM]

Novafil [AR]

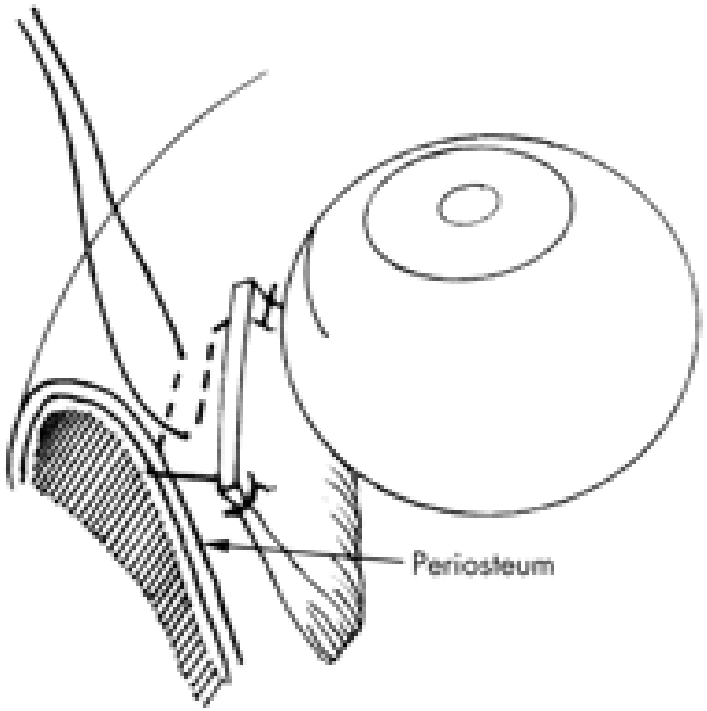
Close the Tenon's defect with gut to isolate muscle from globe



LR → PERIOSTEUM

- Resect dead MR
- Leave slightly ET

<10^

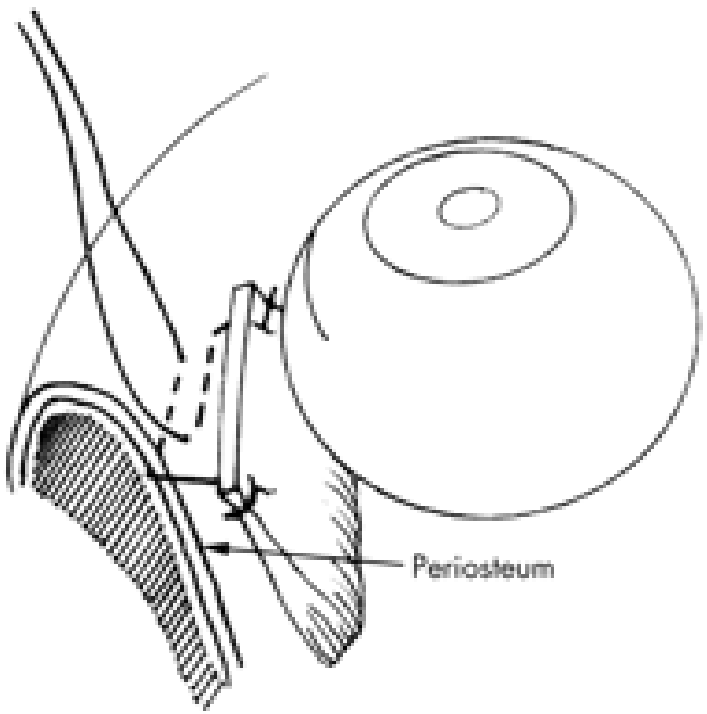


RE-EXPLORE

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

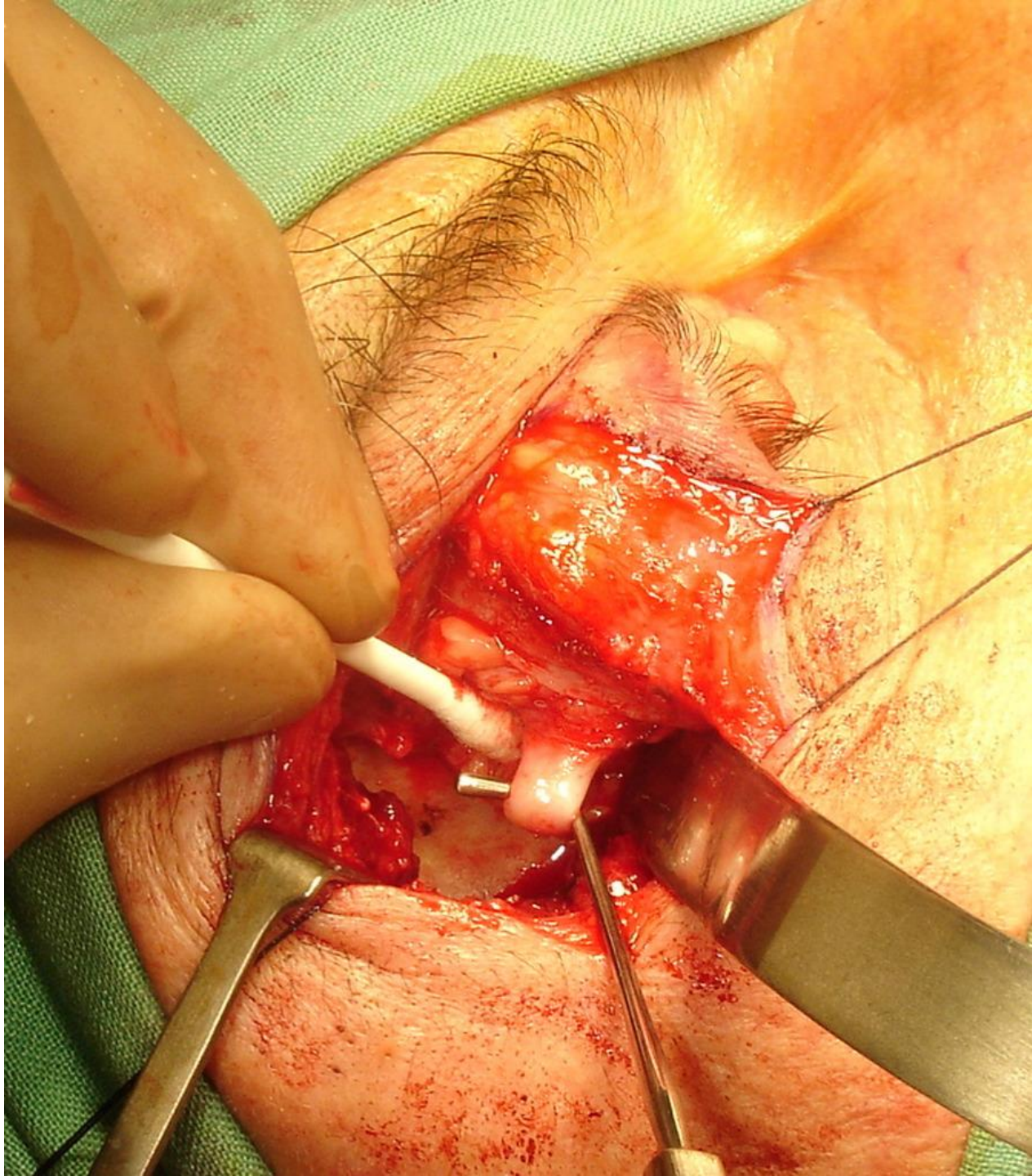
… on the lateral rectus muscle in six subjects inc 3 cases of 3rd N palsy

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