

Surgical Management of Mechanical Restriction of Eye Motility



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Mechanical Restriction of Eye Motility: Example No. 1

- Anomalous head posture (AHP) since birth:



**Intraop. forced duction:
Massive restriction
of adduction LE**

Mechanical Restriction of Eye Motility: ExampleNo.1

- After recession of lateral rectus muscle: Slight improvement
- Post.op. MRI: Strand inserting posteriorly



2nd operation and dissection of the strand: Passive motility unrestricted.

Mechanical Restriction of Eye Motility: Causes

- Post.op.: No further AHP



Diagnosis: Atavistic retractor of the globe

Mechanical Restriction of Eye Motility: Causes



Mechanical Restriction of Eye Motility: Example No. 2

- Acquired vertical diplopia, developing over weeks:



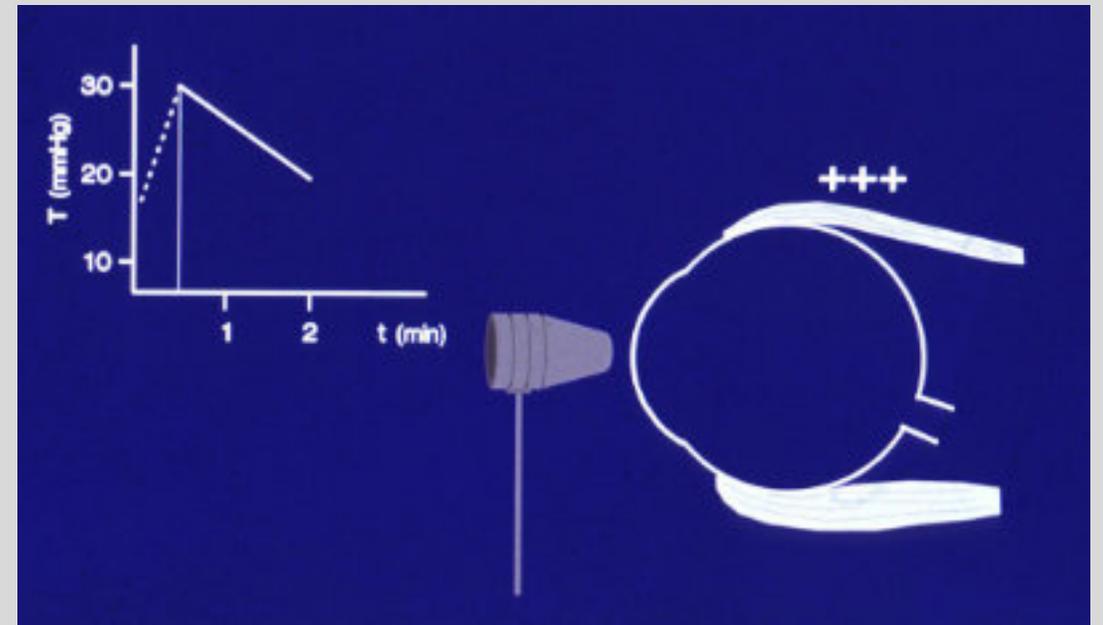
LE: Elevation deficit

MRI: „tumor“ of i.r.



Mechanical Restriction of Eye Motility: Example No. 2

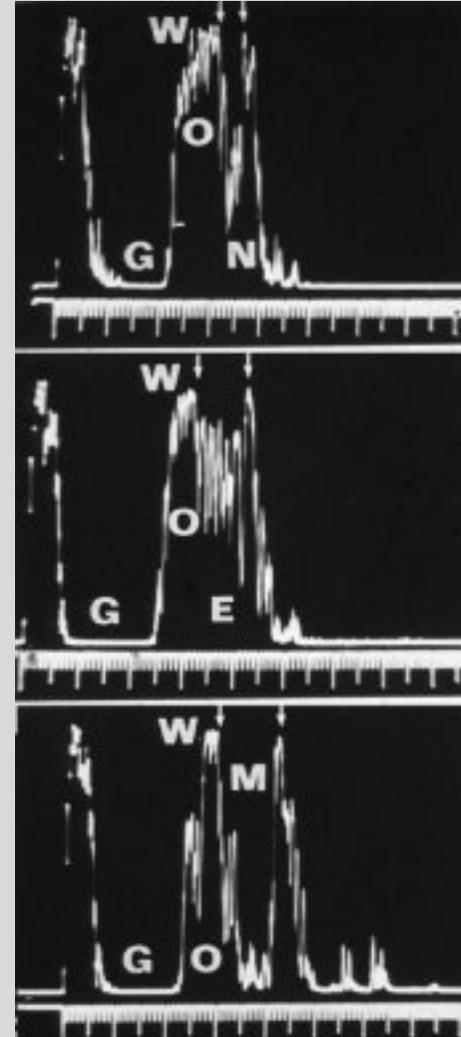
- Further diagnosis:
- History: Thyroidectomy 16 years ago
- Tonometry: Elevated IOP on up-gaze, indicating mechanical restriction



Mechanical Restriction of Eye Motility: Example No. 2

- Further diagnosis:
- History: Thyroidectomy 16 years ago
- Tonometry: Elevated IOP on up-gaze, indicating mechanical restriction
- Ultrasound: Typical intramuscular changes

Diagnosis: **Thyroid eye disease (TED)**



Mechanical Restriction of Eye Motility: Causes

- **Intramuscular :** e.g. fibrosis, lipomatosis
- **Extramuscular :** e.g. fibrous strands, connective tissue shrinkage, scars after operation,

Mechanical Restriction of Eye Motility: Clinical Entities

- **Congenital:** e.g. **C**ongenital **C**erebral **D**ysinnervation **D**isorders
Brown Syndrome
Atavistic retractor
- **Acquired:** e.g. **T**hyroid Eye Disease (TED)
Scars after trauma

Mechanical Restriction of Eye Motility: Clinical Entities and Causes

- **Congenital:** e.g. CFEOM
Brown Syndrome
Atavistic retractor
muscular (+ extram.)
extramuscular
extramuscular
- **Acquired:** e.g. Thyroid Eye Disease (TED)
Scars after trauma
muscular (+ extram.)
extramuscular

Mechanical Restriction of Eye Motility: Congenital **extramusclar**

- **Brown Syndrome: Clinical features**



Restricted elevation in adduction

Y-symptom

Mechanical restriction (forced duction)

DD. Strab. deorsoadductorius!

**SUPERIOR OBLIQUE POSTERIOR
TENECTOMY
in CONGENITAL BROWN'S
SYNDROME**

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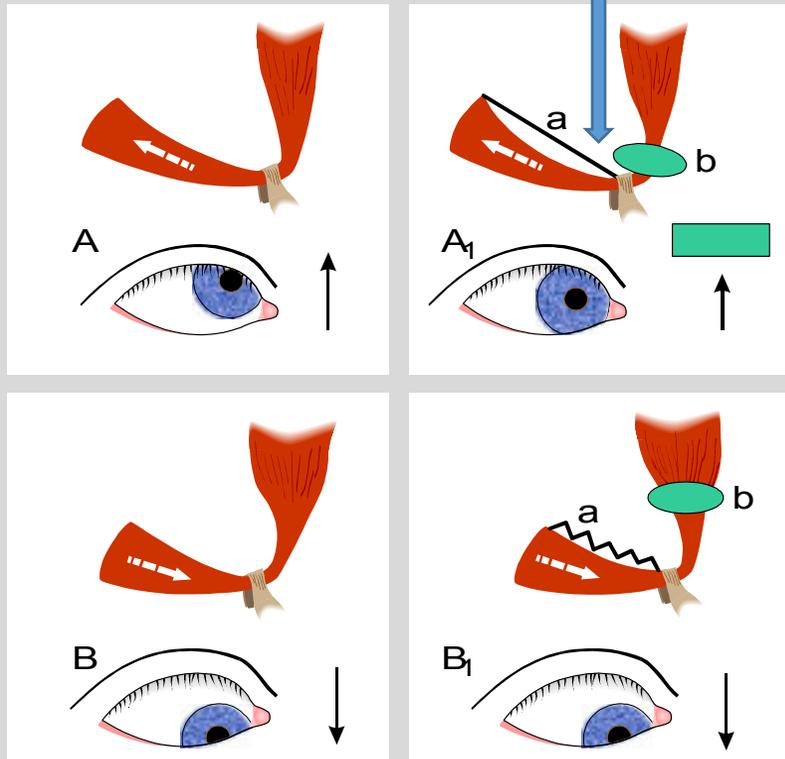
1-INFO SAN OPHTHALMOLOGY CLINIC, BUCHAREST, ROMANIA

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MUNICH, GERMANY**

ESA MUNICH -2008

Mechanical Restriction of Eye Motility: Congenital **extramusclar**

- Pathogenesis: Extramuscular strand!



(Mühlendyck 1996)



„...the fibrotic strand as cause for the congenital Brown's syndrome can be considered as an „atavistic“ superior oblique.

(Mühlendyck, 2013)

Mechanical Restriction of Eye Motility: Congenital **extramusclar**

- Surgical consequences:

Partial (posterior part) tendectomie* of the s.o. tendon

(Mühlendyck 1996)

***Better: Strandectomie**



Mechanical Restriction of Eye Motility: Congenital **intramusclar**

- **Congenital Fibrosis of the Extraocular Muscles (CFEOM):**

Primary total or partial aplasia of oculomotor nuclei or

defective sprouting of oculomotor nerves leads to

total or partial fibrosis of corresponding eye muscles

congenital cranial dysinnervation disorders

(CCDD)

Mechanical Restriction of Eye Motility: Congenital **intramusclar**

- Fibrosis of the extraocular muscles (CFEOM):

Table 1. A summary of the current CCDD classification

CRANIAL NERVE/NUCLEI	SYNDROME	GENETIC LOCUS	PHENOTYPE	GENE LOCATION	GENE
<i>Oculomotor</i>	<i>CFEOM</i>	<i>FEOM1</i>	<i>CFEOM1 (CFEOM3)</i>	<i>12p11.2-q12</i>	<i>KIF21A</i>
		<i>FEOM3</i>	<i>CFEOM3 (CFEOM1)</i>	<i>16q24.2-q24.3</i>	
		<i>FEOM4</i>	<i>CFEOM3</i>		
	<i>Congenital ptosis</i>	<i>PTOS1</i>	<i>PTOS1</i>	<i>1p32-p34.1</i>	
		<i>PTOS2</i>	<i>PTOS2</i>	<i>Xp24-27.1</i>	
<i>Oculomotor & trochlear</i>	<i>CFEOM2</i>	<i>FEOM2</i>	<i>CFEOM2</i>	<i>11q13.2</i>	<i>PHOX2A</i>

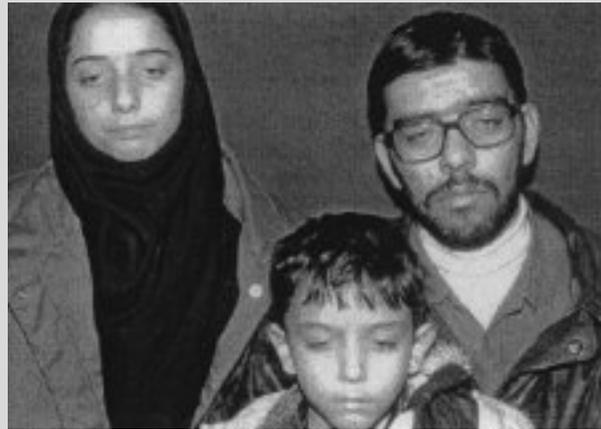
Mechanical Restriction of Eye Motility: Congenital **intramusclar**

- Phenotypes of CFEOM:

CFEOM1



CFEOM2



CFEOM3



From: Traboulsi, E.I.:Trans.Am.Ophthalmol.

Soc.2004;102:373-389

Mechanical Restriction of Eye Motility: Congenital **intramusclar**

- Motility in CFEOM:

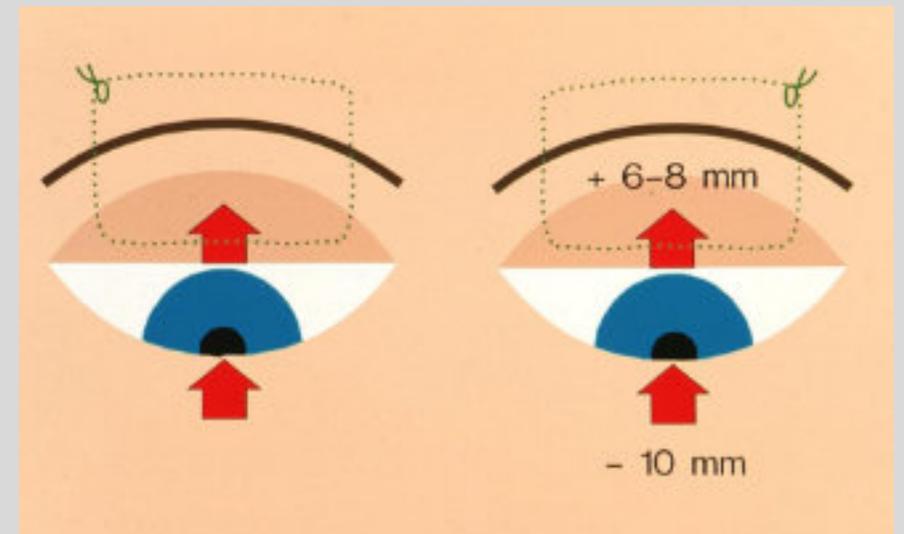


Paradoxical eye movements

Mechanical Restriction of Eye Motility: Congenital **intramuscular**

Congenital Fibrosis of the extraocular muscles (CFEOM): Surgery

- Early surgery (pseudoprogression, secondary changes of connective tissue)
- Large recessions (e.g. 8-10 mm of inf.rectus)
- Resections only in CFEOM1 or CFEOM2
- Ptosis surgery (frontalis suspension)



Mechanical Restriction of Eye Motility: Congenital **intramusclar**

- Early surgery (pseudoprogression, secondary changes of connective tissue)



Progression mimicked by changes of the eye position induced by growth of the globe within the cone of fibrotic eye muscles

Mechanical Restriction of Eye Motility: Congenital **intramusclar**

- Early surgery (pseudoprogression, secondary changes of connective tissue)
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Mechanical Restriction of Eye Motility: Congenital **intramusclar**

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Mechanical Restriction of Eye Motility: Congenital **intramusclar**

- Case: CFEOM2



CFEOM + Brown Syndrome

Mechanical Restriction of Eye Motility: Acquired **extramuscular**

- Possible causes:

- periocular inflammation (localized in acquired Brown Syndrome)
- localized scars (e.g. acquired posttraumatic Brown Syndrome)
- orbital floor fracture
- diffuse scars after trauma, detachment surgery

Mechanical Restriction of Eye Motility: Acquired **intramuscular**

- **Treatment:**

- **anti-inflammatory in non-traumatic Brown Syndrome**
- **surgery in orbital floor fracture**
- **counter paresis in cases with sufficient monocular excursion**
- **in diffuse scarring surgical improvement unlikely**

Mechanical Restriction of Eye Motility: Acquired **intramuscular**

• Thyroid Eye Disease (TED)

Classification of TED

(K.-P. Boergen, C.R. Pickardt, Med Welt 42: 72-76; 1991)

L Lid changes

E Exophthalmus

M Muscular changes

O Optic nerve involvement



0

absent

1

only visible on ultrasound/CT/MRI

2

pseudoparesis

3

pseudoparalysis

Mechanical Restriction of Eye Motility: Acquired **intramuscular**

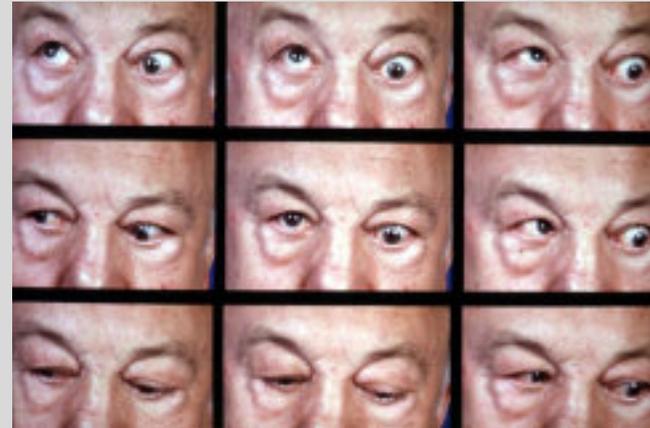
- **Thyroid Eye Disease (TED): Muscle changes**

Acute stage



Inflammation
↓
Conservative

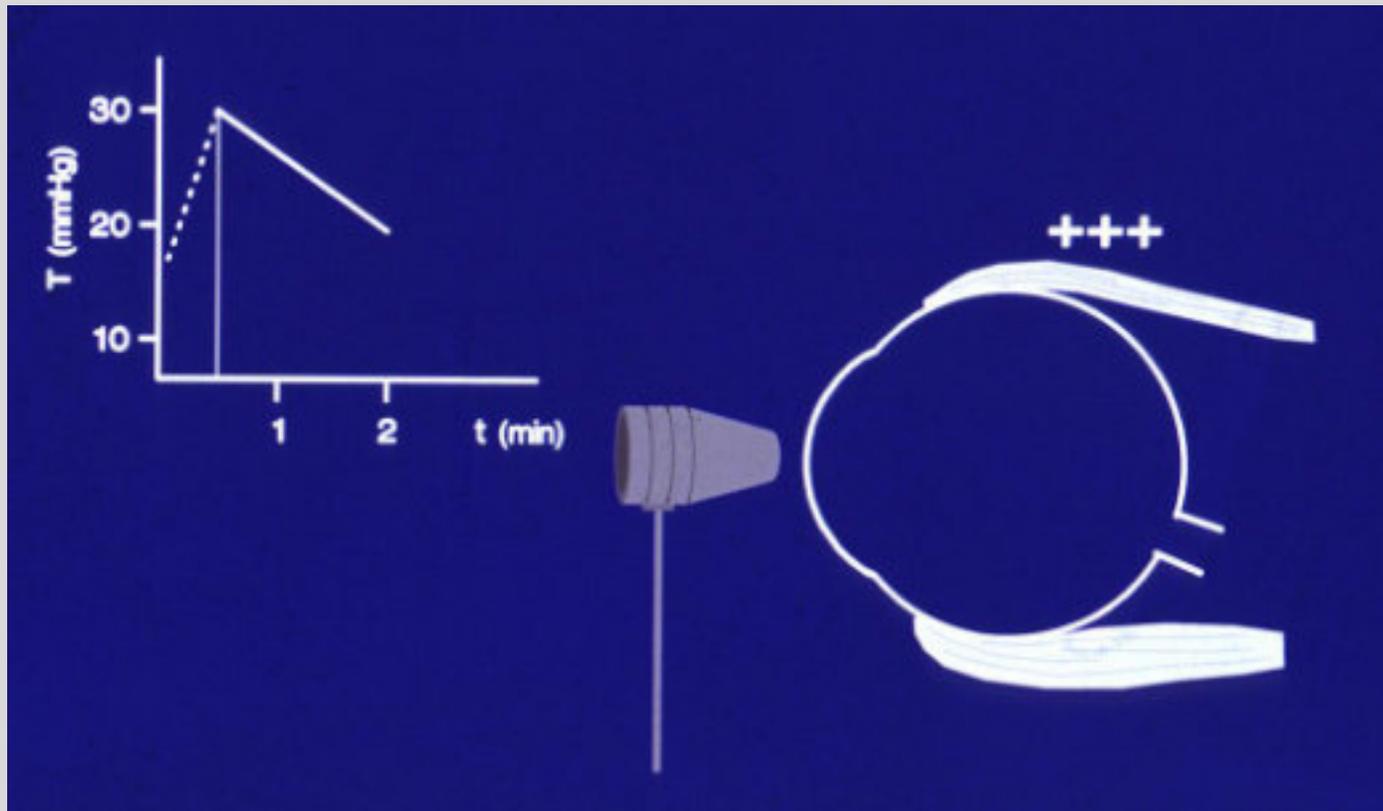
Chronic stage



Fibrosis/Lipomatosis
↓
Surgical

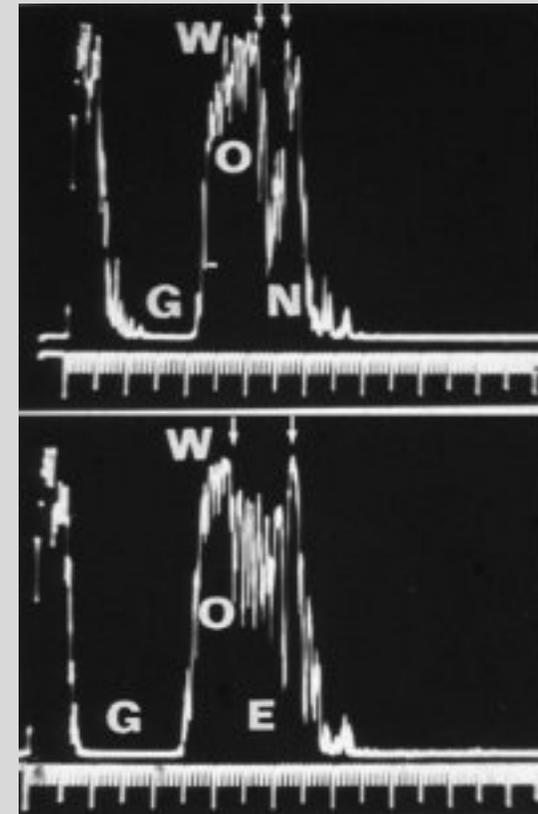
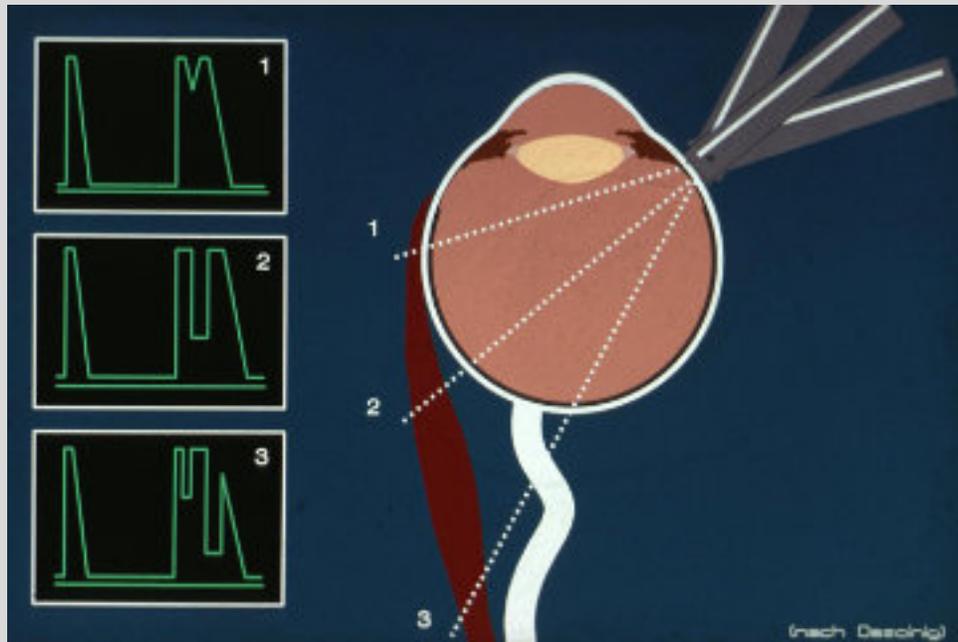
Mechanical Restriction of Eye Motility: Acquired **intramuscular**

- **Thyroid Eye Disease (TED): Muscle changes and IOP**



Mechanical Restriction of Eye Motility: Acquired **intramuscular**

- Thyroid Eye Disease (TED): Muscle changes and Ultrasound

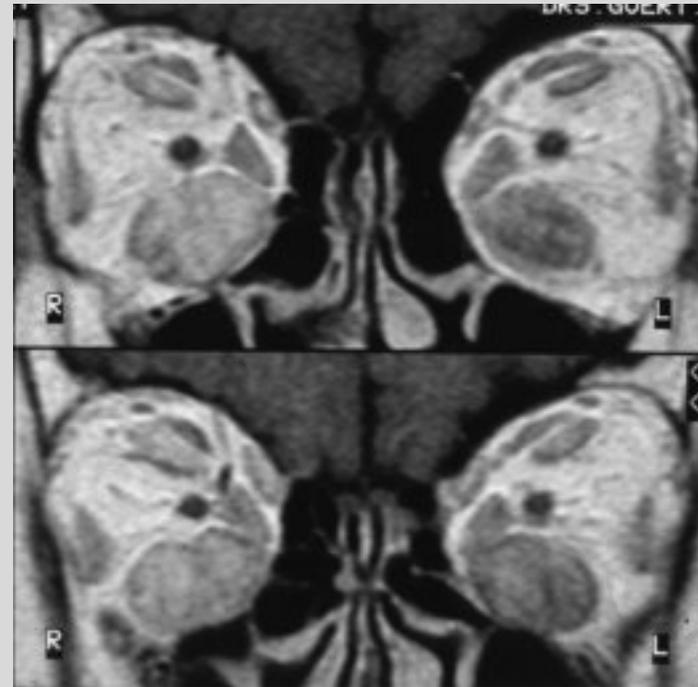
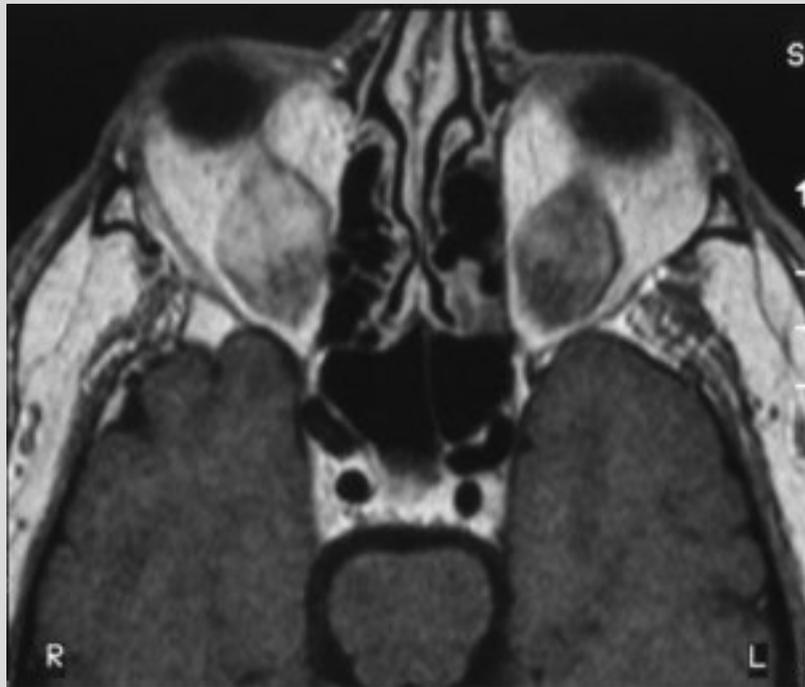


Normal

TED

Mechanical Restriction of Eye Motility: Acquired **intramuscular**

- **Thyroid Eye Disease (TED): Muscle changes and MRI**



Mechanical Restriction of Eye Motility: Acquired **intra**muscular

- Thyroid Eye Disease (TED): Sequence of surgical procedures

1. Decompression (if necessary)
2. **Eye muscle surgery**
3. Eye lid correction



Mechanical Restriction of Eye Motility: Acquired **intra**muscular

- Thyroid Eye Disease (TED): Sequence of surgical procedures

1. Decompression (if necessary)
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Mechanical Restriction of Eye Motility: Acquired **intra**muscular

- Thyroid Eye Disease (TED): Sequence of surgical procedures

1. Decompression (if necessary)
2. **Eye muscle surgery**
3. Eye lid correction



Mechanical Restriction of Eye Motility: Acquired **intra**muscular

- **Thyroid Eye Disease (TED): Timing of eye muscle surgery**
 1. **Stable endocrine situation for at least 6 months**
 2. **Stable motility for at least 6 month**
 3. **No decompression necessary or already performed**

Mechanical Restriction of Eye Motility: Acquired **intramuscular**

- Thyroid Eye Disease (TED): Sequence of muscles operated

Operate on the most involved muscle first !



Mechanical Restriction of Eye Motility: Acquired **intra**muscular

- **Thyroid Eye Disease (TED): Procedures and dosage:**
 1. **Recessions to release the mechanical restriction**
 2. **Careful resections only as second or third procedure**
 3. **Dosage difficult due to muscle changes**

Mechanical Restriction of Eye Motility: Acquired **intramuscular**

- **Thyroid Eye Disease (TED): Possibilities for dosage**
 1. **Preop. Dosage**
 2. **Intraop. Dosage, based on passive or **active** motility**
 3. **Postop. Dosage (adjustable sutures)**

Own approach:

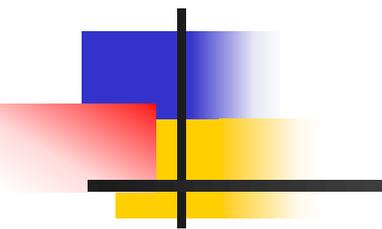
**Surgery under topical anesthesia with intact motility
under topical anesthesia**

Mechanical Restriction of Eye Motility: Acquired **intramuscular**

- **Thyroid Eye Disease (TED): Topical anesthesia in TED**

- Thorson et al. 1966: not in e.o.
- Harper 1978: applied to e.o.
- Boergen 1981, 1984: 3 (15) cases
- Fells 1983: 6 cases
- Diamond 1989: not in e.o.

Restrictive strabismus surgery using topical anesthesia



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POIANA BRAŞOV 2010

Mechanical Restriction of Eye Motility: Acquired **intramuscular**

- **Thyroid Eye Disease (TED): Surgery under topical anesthesia**
Preparation of patients

pre-op.: **mild analgetics**

intra-op.: **Oxybuprocainhydrochloride**
(Novesine[®] 0.4 %)

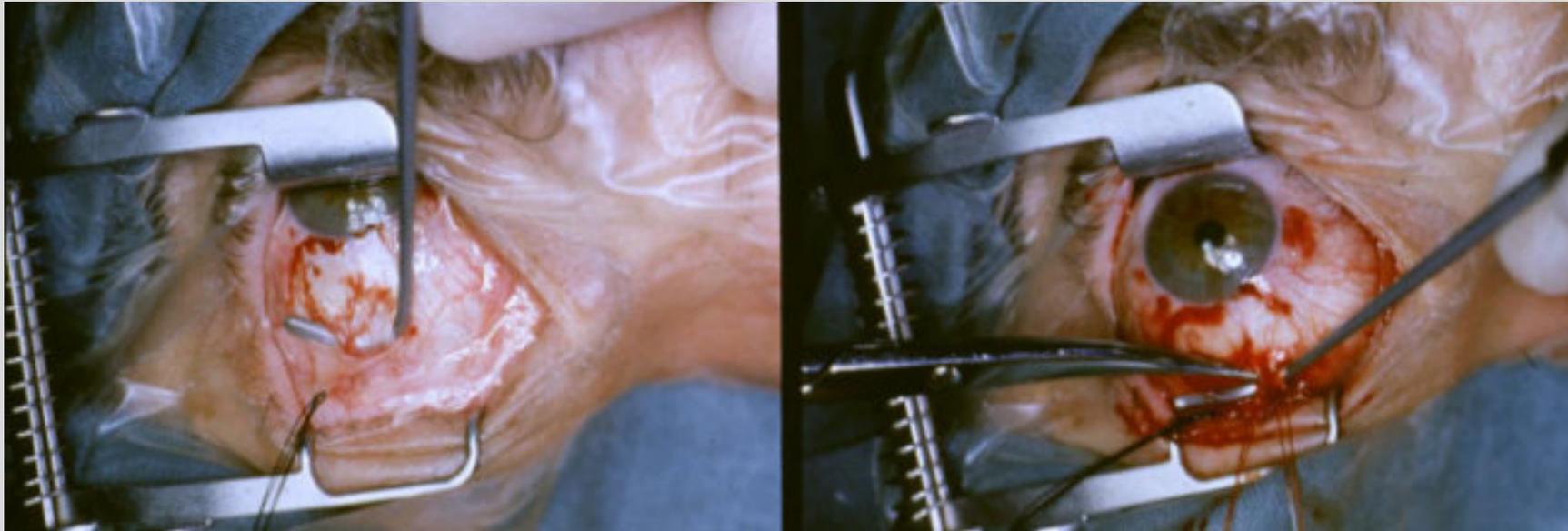
Mechanical Restriction of Eye Motility: Acquired **intramuscular**

- Thyroid Eye Disease (TED): Surgery under topical anesthesia
Active and passive motility



Mechanical Restriction of Eye Motility: Acquired **intramuscular**

- Thyroid Eye Disease (TED): Surgery under topical anesthesia
Hooking and detaching of the muscle



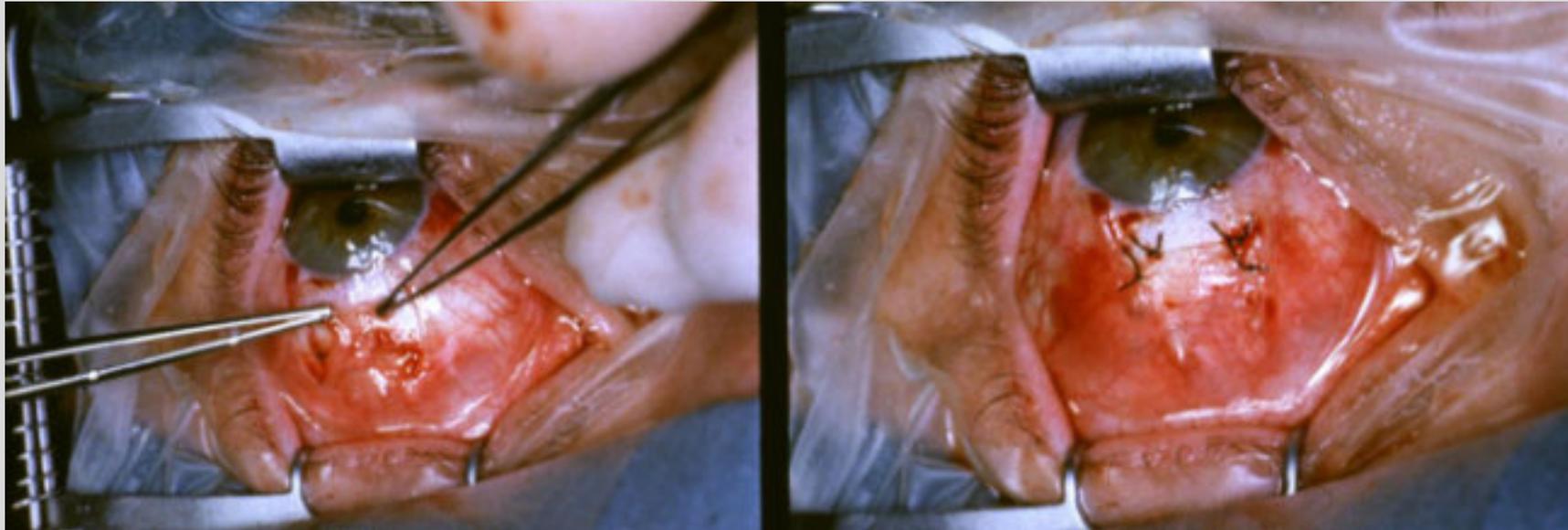
Mechanical Restriction of Eye Motility: Acquired **intramuscular**

- Thyroid Eye Disease (TED): Surgery under topical anesthesia
Recession according to the functional needs



Mechanical Restriction of Eye Motility: Acquired **intramuscular**

- Thyroid Eye Disease (TED): Surgery under topical anesthesia
Closure of conjunctiva without tension



Mechanical Restriction of Eye Motility: Acquired **intramuscular**

- Thyroid Eye Disease (TED): Surgery under topical anesthesia
Immediate postop.motility





Mechanical Restriction of Eye Motility: Acquired **intramuscular**

- **Thyroid Eye Disease (TED): Results**

Pat. A.F.,* 7.2.51

2x decompression



Mechanical Restriction of Eye Motility: Acquired **intramuscular**

- **Thyroid Eye Disease (TED): Results**

Recession of:

RE: Med. rect.: 4 mm

Inf. rect. : 5 mm

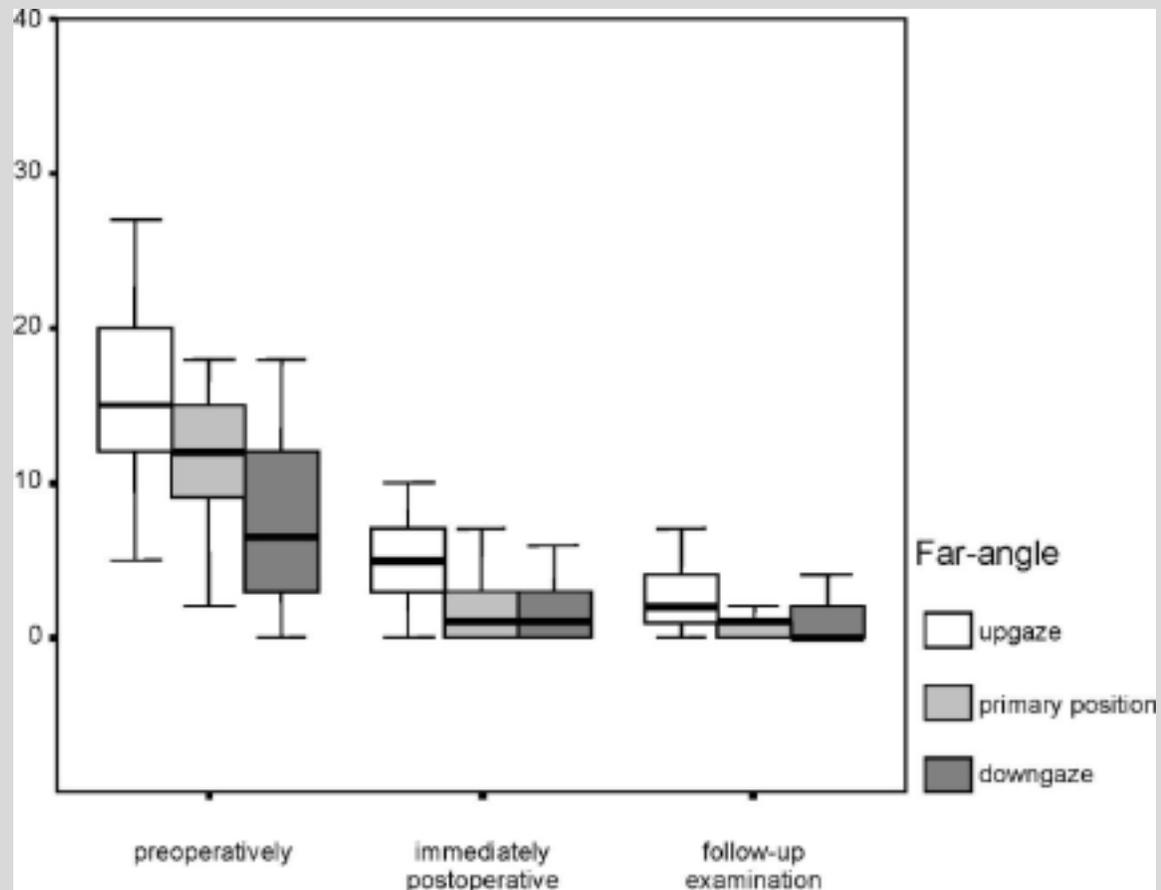
LE: Med.rect./Inf.rect.:

4/5 mm



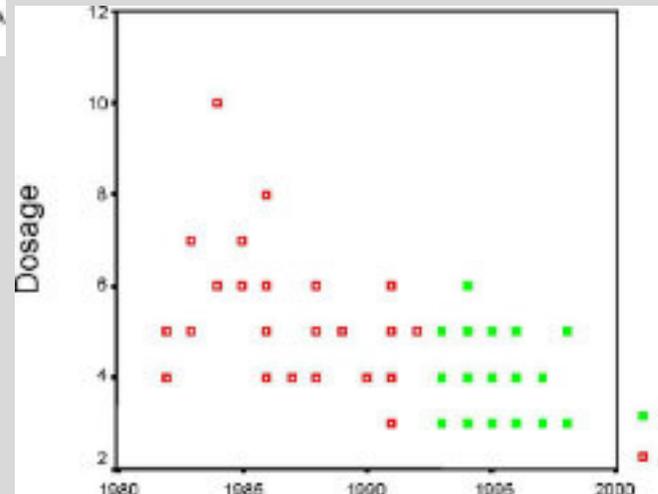
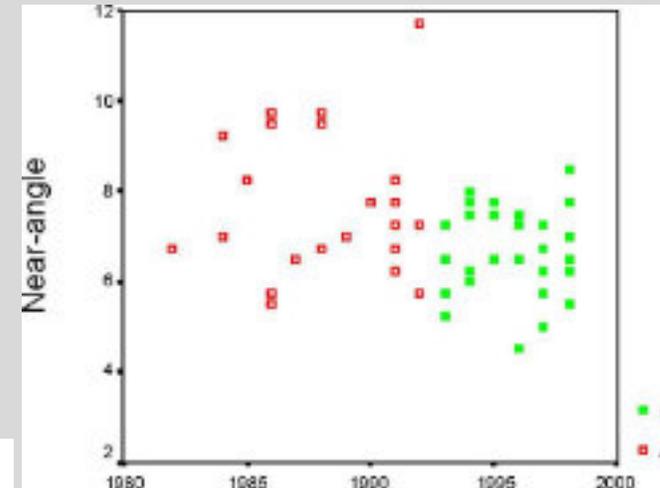
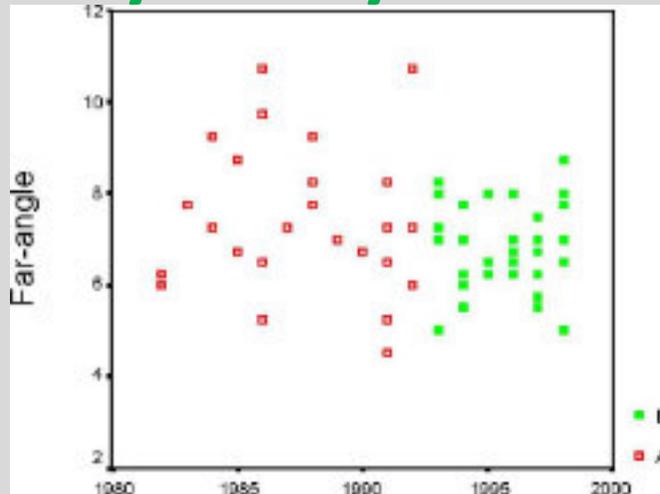
Mechanical Restriction of Eye Motility: Acquired **intra**muscular

- Thyroid Eye Disease (TED): Results (angle reduction)



Mechanical Restriction of Eye Motility: Acquired **intra**muscular

- Thyroid Eye Disease (TED): Learning curve



Mechanical Restriction of Eye Motility: Acquired **intramuscular**

• Thyroid Eye Disease (TED): Results (functional aspects)

- BSV around primary position: **94.6 %**
- BSV in 10° up-/ lateral and 20° down-gaze: **83.9 %**
- BSV in 20° in all directions of gaze : **75.0 %**
- BSV in 30° in all directions of gaze: **60.7 %**

Mechanical Restriction of Eye Motility: Acquired **intramuscular**

- **Thyroid Eye Disease (TED): Conclusions**

1. **Improvement of motility**
2. **Recess procedures preferred option**
3. **Most involved eye muscles recessed first**
4. **Intra-operative dosage under topical anesthesia**
5. **Extra-muscular tissue changes are limiting factor**

Mechanical Restriction of Eye Motility:

- **Diagnosis**

1. **Clinical entity and history**
2. **No obvious innervational pattern**
3. **Mechanical restriction demonstrated by:**
 - **Retraction phenomenon**
 - **Gaze dependend tonography**
 - **Forced duction test (active and passive)**
4. **Imaging (Ultrasound, MRI)**

Mechanical Restriction of Eye Motility:

- **Management:**

1. **Aim: Improvement of motility**
2. **Release restriction**
3. **Prefer recessions**
4. **Topical anesthesia**
5. **No surgery in marked scarring**

