



Tendon transfer options for trapezius paralysis : a biomechanical study

Department of Orthopedic Surgery, Department of Biomechanics
Mayo Clinic, Rochester, MN

Jean-David Werthel MD , Suenghwan Jo MD, Eric Wagner MD, Alex Hooke,
John W. Sperling MBA MD, Kai-Nan An, PhD, Bassem Elhassan MD
Department of Orthopedic Surgery, Mayo Clinic, Rochester, MN

New Light Upon Your Shoulder

ICSES 2016

The 13th International Congress of Shoulder and Elbow Surgery
May 18th (Wed) ~ 20th (Fri), 2016 / ICC JEJU, KOREA

Financial Disclosures

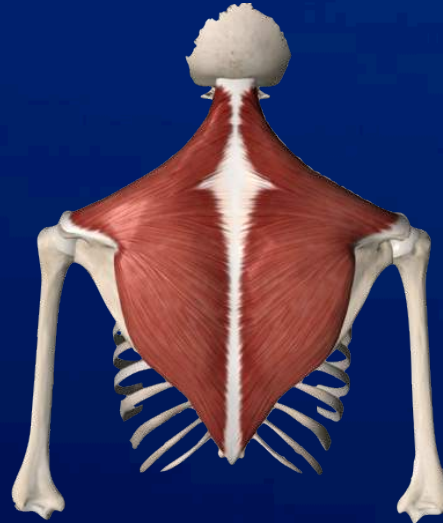
- Werthel
 - None
- Wagner
 - None
- Sperling
 - Royalties: Biomet
- An
 - None
- Elhassan
 - None

There was no external support for this project

Introduction – Role of the Trapezius

- 3/4 parts depending on descriptions:

- Anterior
- Superior
- Middle
- Inferior



- Upward rotation of the scapula +++
 - Enables full abduction
 - Preserves acromio-humeral distance (impingement)
 - Max efficiency: deltoid / rotator cuff

Introduction – Trapezius Paralysis

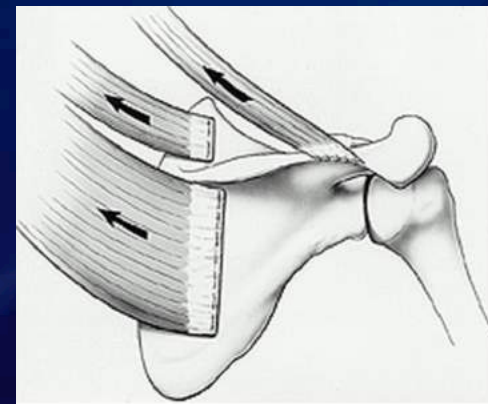
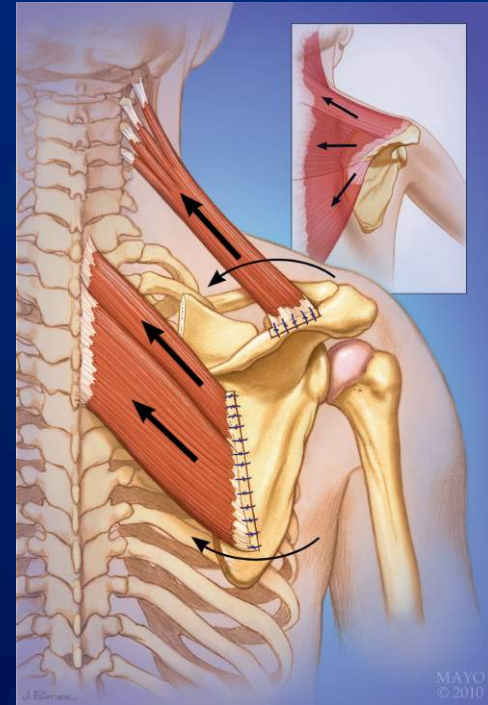
- Loss of function of the trapezius:
 - Shoulder drooping
 - Loss of abduction
 - Subacromial bursitis



Introduction – Trapezius Paralysis

- Surgical options in case of chronic paralysis?
 - Eden-Lange Transfer (LS, RM, Rm)
 - Modified Eden-Lange transfer
- Variable results
 - Abnormal ST motion?
 - Other transfer ?

Galano et al. Clin Orthop Relat Res (2008)



Purpose

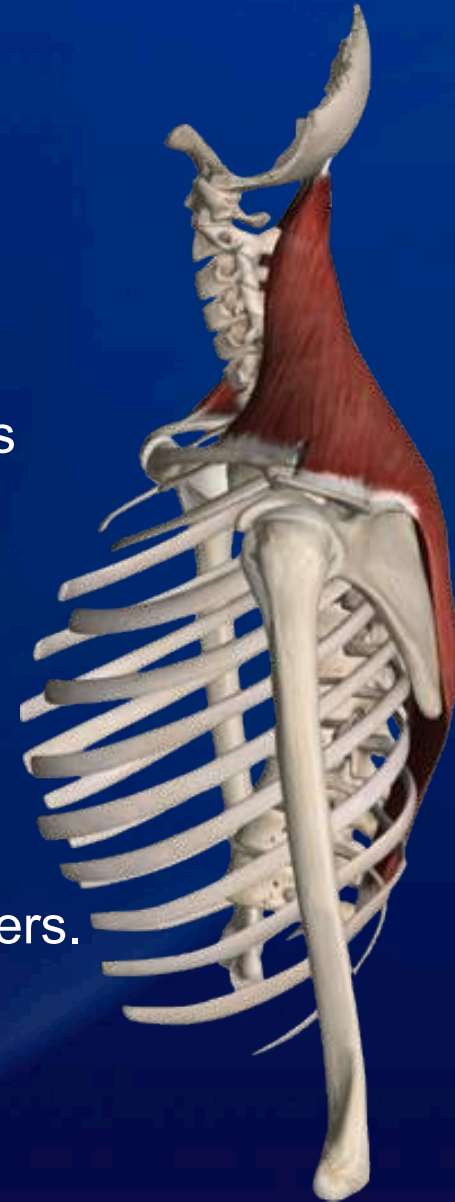
- To evaluate and compare the biomechanical effectiveness of LS, RM and Rm transfers when performed to different locations around the posterior scapula to try to restore the function of the paralyzed trapezius.

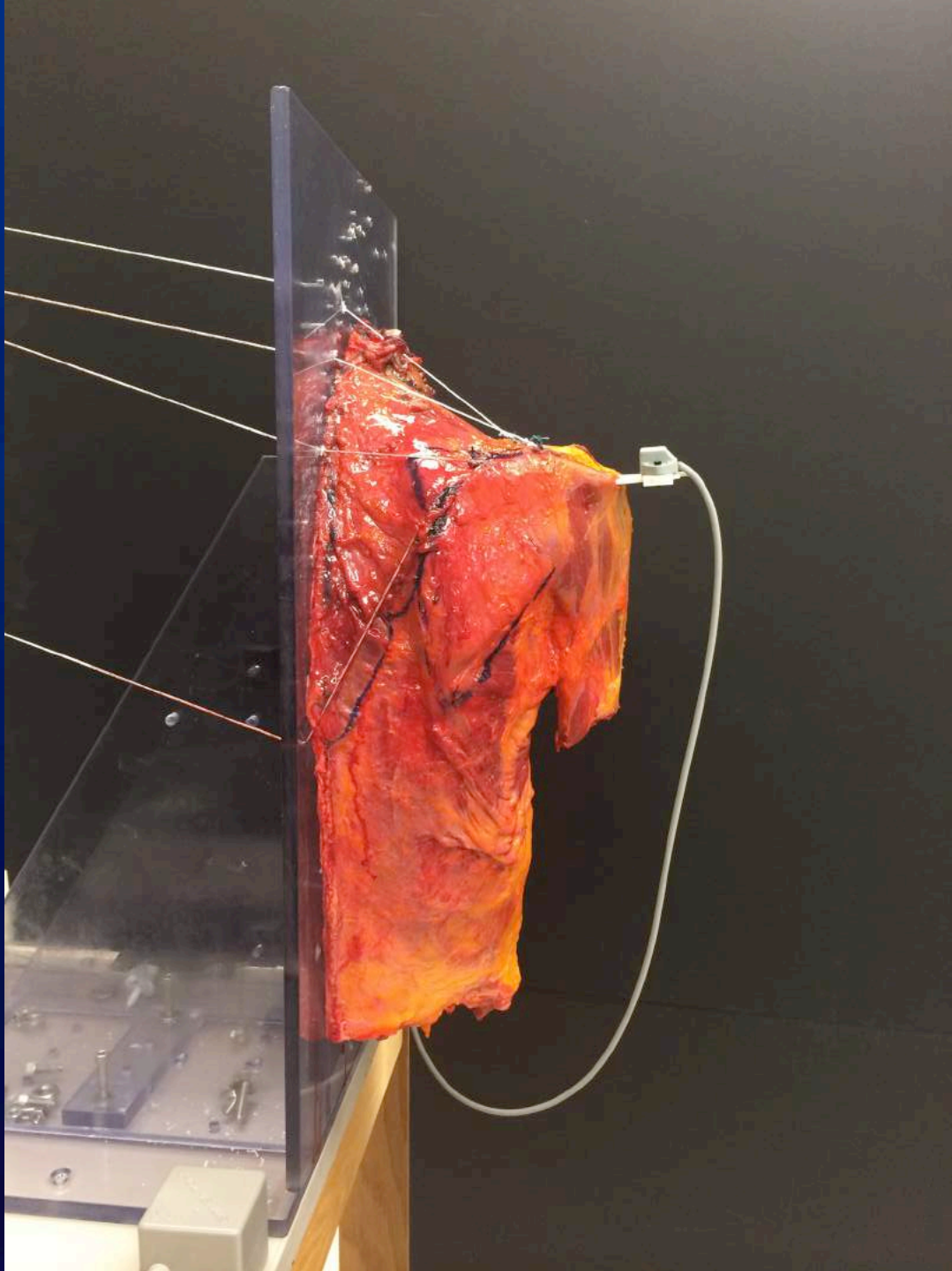
Materials and Methods

- *Cadaveric study*
 - 6 hemithoraces
 - 4 M, 2 F
 - Mean age: 86 yo (± 7.71)
 - Mean Height: 1.77 m (± 0.11)
 - Mean Weight: 75 kg (± 9.51)
 - Mean BMI: 27 (± 4.52)
- *Excluded if:*
 - Fluoroscopy / Abnormalities during dissection

Materials and Methods

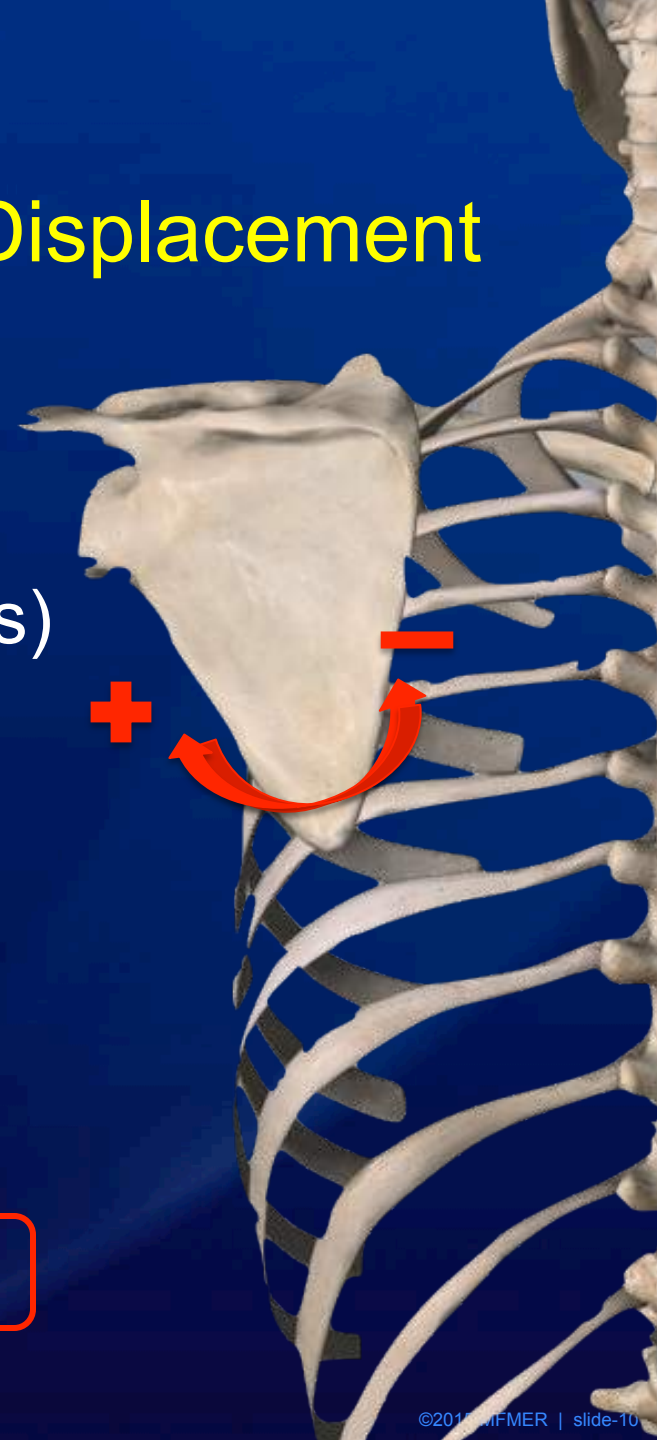
- *Preparation of the specimens*
- Origins and insertions of 7 different muscle body parts
 - *Trapezius (anterior, superior, middle, posterior)*
 - *Levator Scapulae,*
 - *Rhomboid Major,*
 - *Rhomboid Minor*
- Cords used to model lines of action of muscles/transfers.
- Mounted on custom-built apparatus





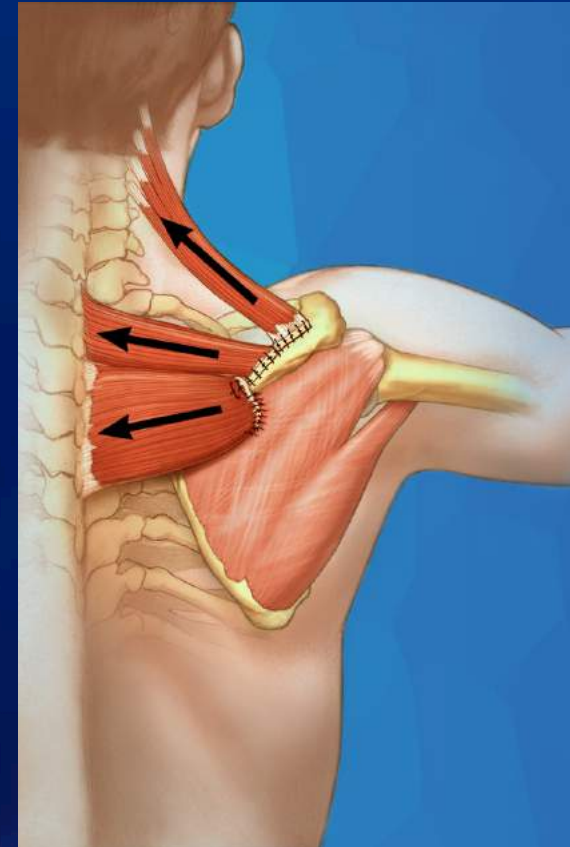
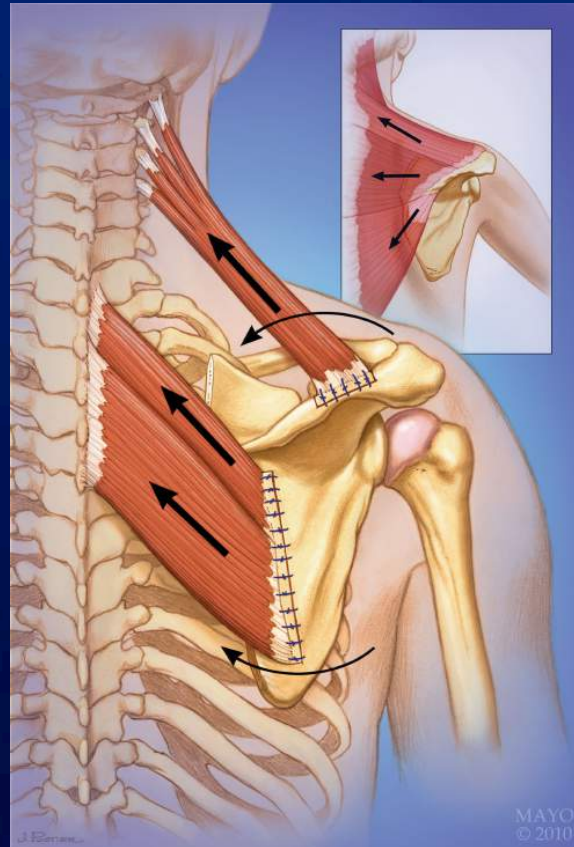
Materials and Methods – ST Displacement

- Sensors → kinematic data
- ST angles calculated (Euler angles)
 - Upwards rotation (+)
 - Downwards rotation (-)
- ↗ pressure to pneumatic actuator
- Each condition x3 :
 - Mean ST displacement angle



Materials and Methods– Conditions

- 3 conditions :
- Intact Muscles
- Eden-Lange transfer
- Modified triple transfer Elhassan B, J Shoulder Elbow Surg (2015)



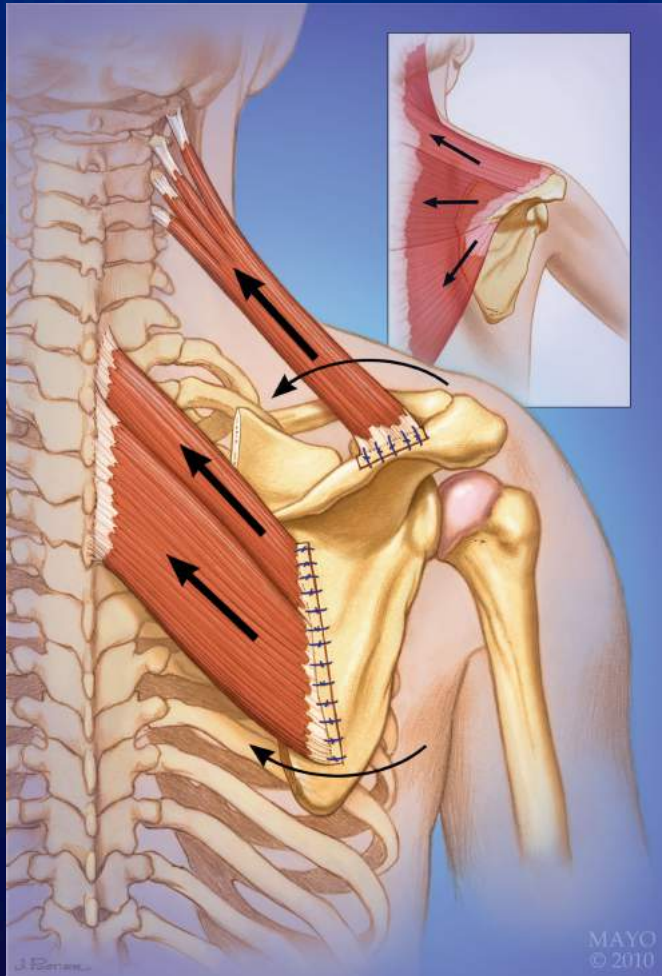
Results

Results– Intact



- Trapezius :
 - Upward rotation 27° (23° / 32°)
- LS:
 - Downward rotation : -6° (-4° / -7°)
- Rm + RM:
 - Downward rotation : -4° (-3° / -5°)
 - *Medial and superior displacement*
 - Upward rotation: 14° (12° / 15°)

Results– Eden Lange



Downward rotation
at the beginning of
motion+++

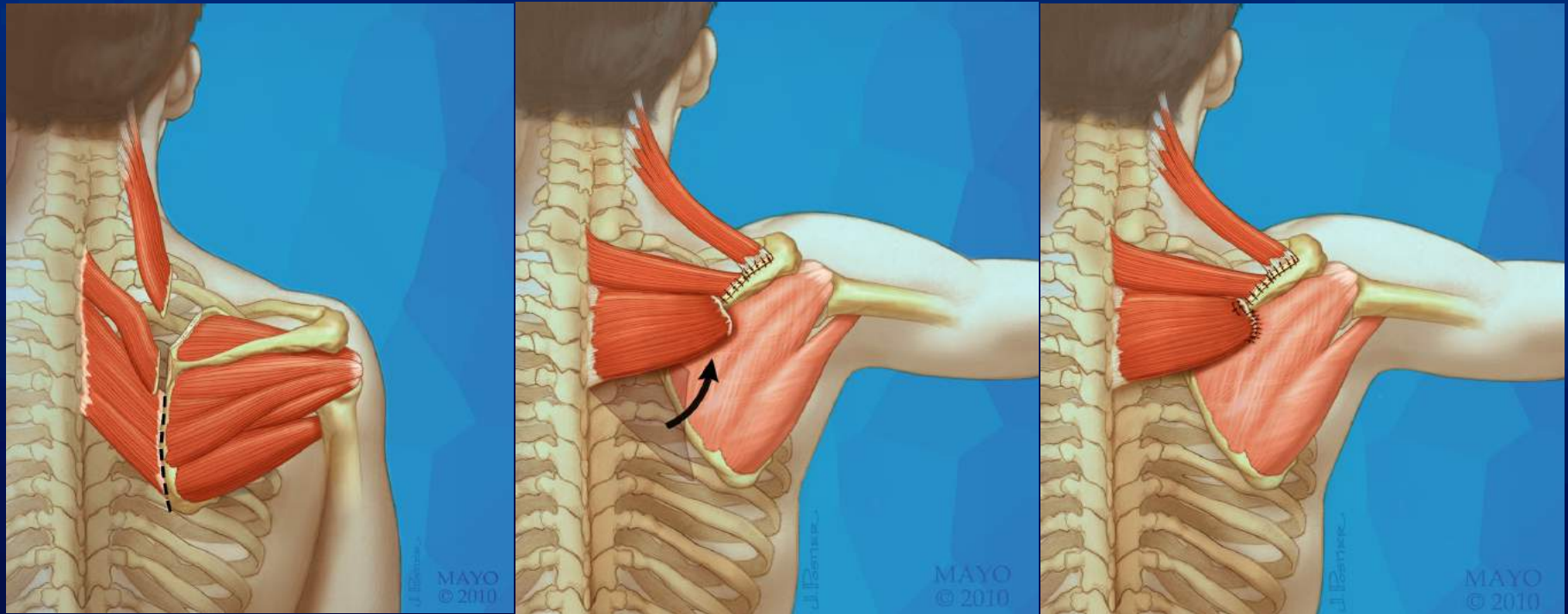
-7° (-3° / -14°)

Then translation
→ *Modif CoR*

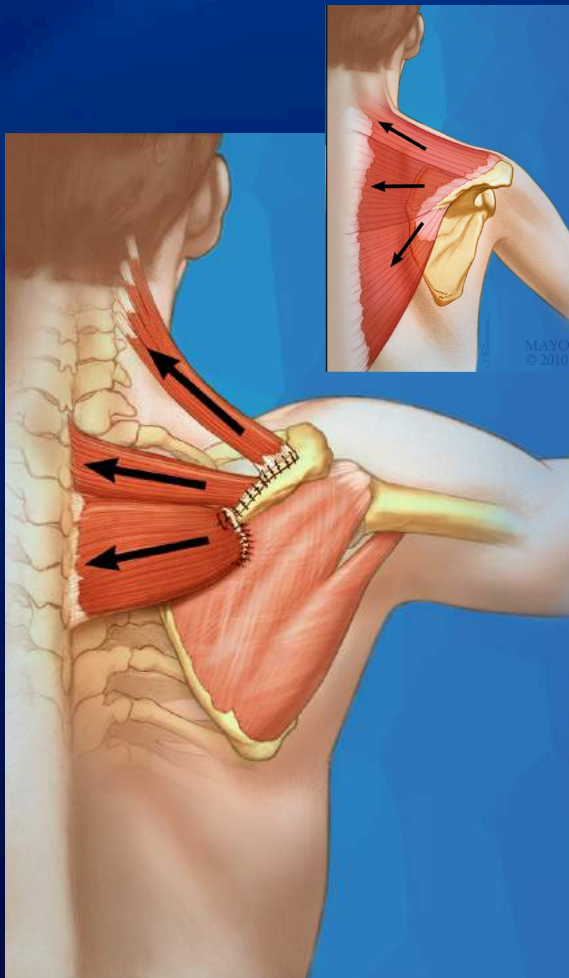
Upward rotation

Final displacement:
1° (-7° / 10°)

Results– Modified triple transfer

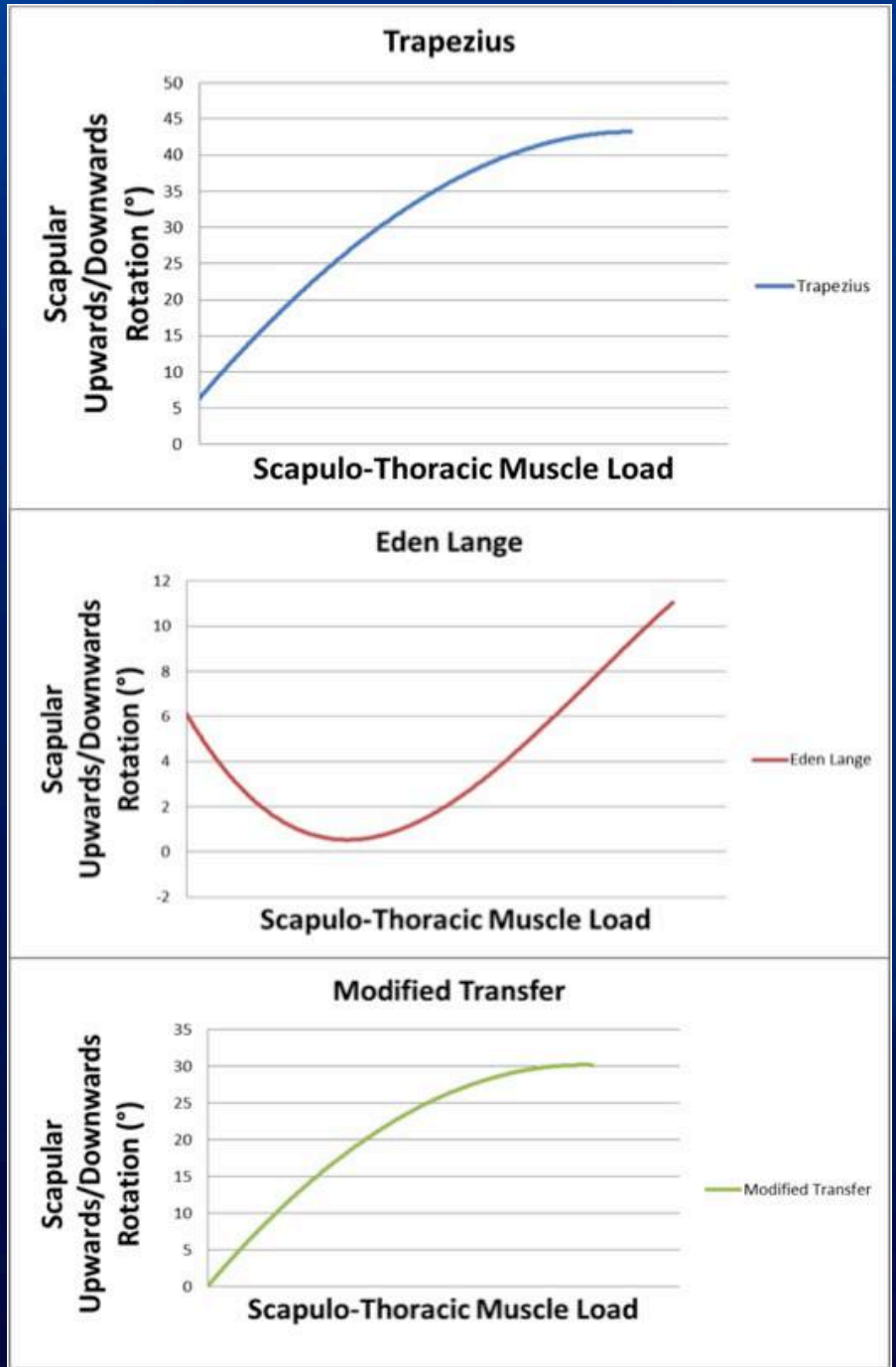
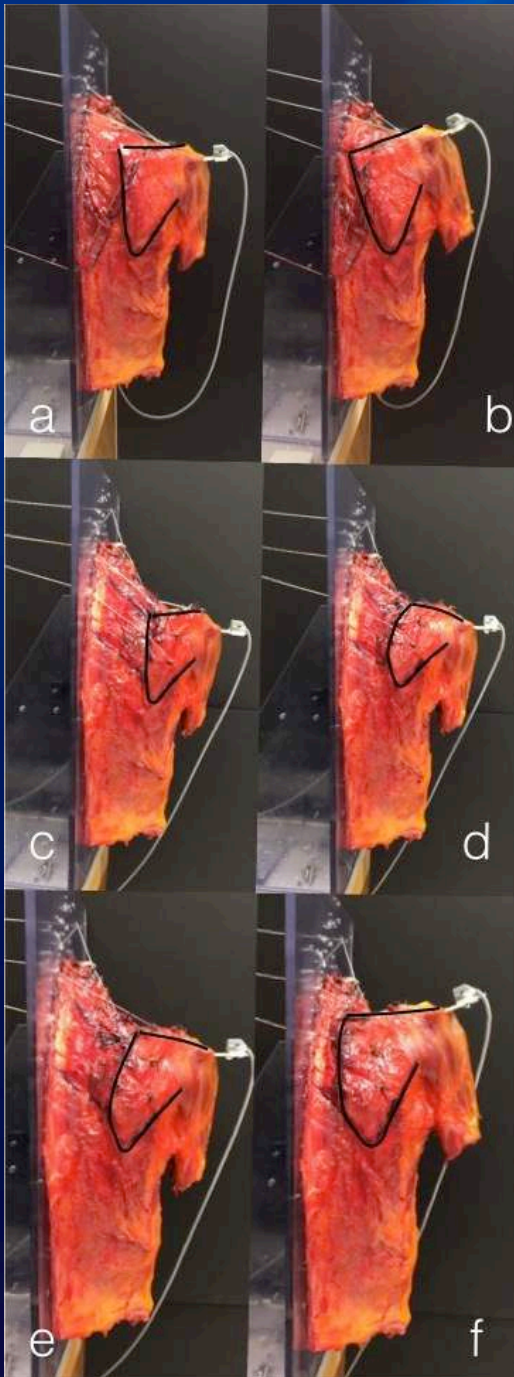


Results – Modified triple transfer



Upward rotation

Mean angle: 22°
(range, 13° - 30°)

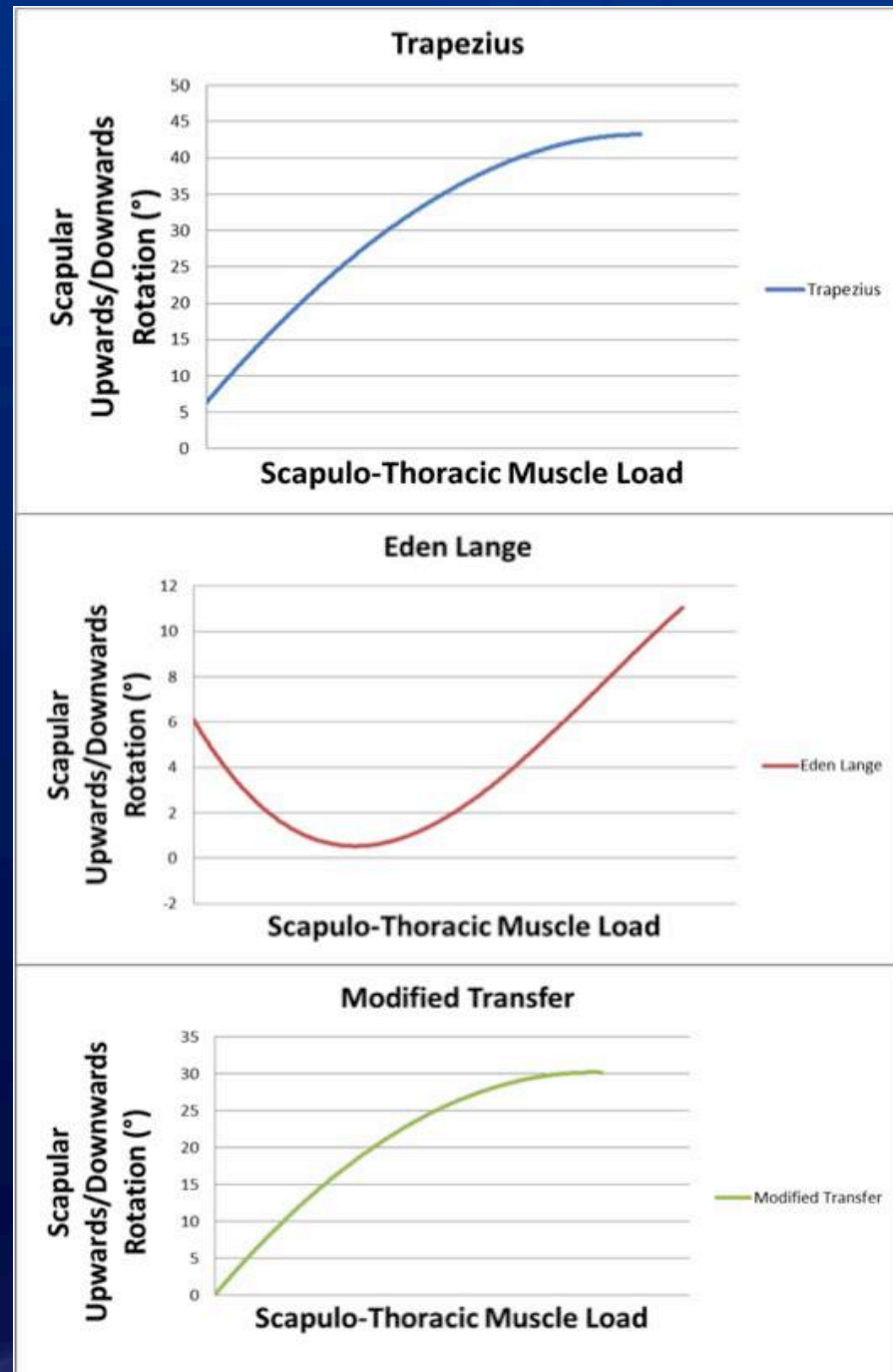


Discussion

- Main muscle → upward rotation of scapula / abduction : trapezius.
- LS and Rhomboids → downward rotation
- Eden-Lange transfer:
 - LS transferred on spine → upward rotation
 - Rhomboids transferred in infraspinatus fossa → downward rotation+++

Discussion

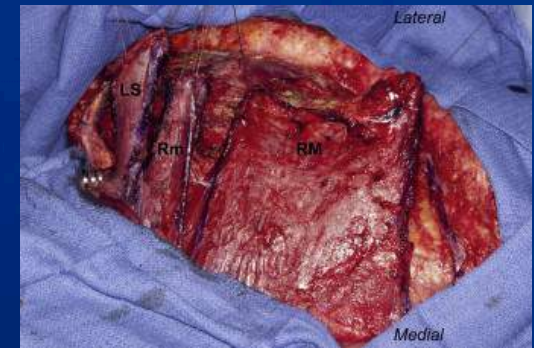
- Eden-Lange :
 - Beginning of movement of abduction
 - Downward rotation of the scapula
 - SSP and middle deltoid → poor position
 - Variability in clinical results?
- Modified transfer
 - Same kinematic profile as the trapezius



Limitations

- Simplified cadaveric model
 - 1 movement analyzed (upward/downward rotation)
 - Loads equally distributed among different muscle subregions (regardless of size/force-generating capacity)
 - Serratus anterior not loaded

Conclusion



- Eden-Lange transfer → contradictory ST movement when compared to trapezius
- Modified transfer → replicates ST motion of the trapezius.
 - → better clinical results?
 - Good results 22 patients, mean f/u 35 months

**Outcome of triple-tendon transfer,
an Eden-Lange variant, to reconstruct
trapezius paralysis**

Bassem T. Elhassan, MD*, Eric R. Wagner, MD



Thank You