Rehabilitation of Transversus Abdominis, Multifidus, and Pelvic Floor Muscles Using Real Time Ultrasound

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Muscle Assessment

1. Cognitive Activation   - Contract / Relax
   - Hold / Breathe
   - Hold Under Load

2. Automatic Activation  - Supine
   - ASLR / Isometric / Active Movement
   - Sitting / Standing tasks

3. Functional Activation - Functional tasks
   - Walking / Leg Press/
   Reformer
Transversus / Obliques
Transversus / Obliques

Evidence:

• *O’Sullivan et al (1997)* – TrA and MF retraining decreased back pain @ thirty months
• *O’Sullivan et al (1998)* – Isolated abdominal hollowing can alter automatic activation patterns of IO and RA in LBP patients
• *Hodges et al (2000)* – TrA activity preceded arm movements
• Hides et al (2001) – TrA retraining led to decreased LBP recurrence at 1 year from 84% to 30%
• *Richardson et al (2002)* – TrA decreased laxity of SIJ more than global contraction
Transversus / Obliques

Evidence Cont:

• *Ferreira et al (2004)* – TrA thickness with contraction is correlated to LBP
• *Kermode (2004)* – Co-contraction of TrA and IO led to a poor outcome in a pro soccer player
• *Hides et al (2007)* – TrA thickness inc. more than IO in simulated weight bearing in normals
• *Teyhen et al (2009)* - TrA and IO thickness inc. 24% and 11% in asymptomatics compared with 6% and 6% in LBP patients during ASLR
• *Hides et al (2010)* – Back pain patients show less change in abdominal CSA with hollowing than non-LBP
Transversus / Obliques

• (Saunders et al, 2004)
• At walking speeds TrA contraction was tonic
• As speed increases, TrA becomes phasic and is timed with heel strike
• Respiration is timed with heel strike
• Runners with back pain:
  - altered respiratory patterns
  - loss of timing of TrA with heel strike
  - Increase in tonic activation of obliques
Transversus / Obliques
Transversus / Obliques

Breathing:
• Hodges & Gandevia (2000)
• Diaphragm has a respiratory and stability function
Transversus / Obliques

Imaging:
- Linear Probe: 5-10 MHz
- Patient Supine in Crook Lying
- Just Above and Medial to Iliac crest
Transversus / Obliques

• Cognitive:
  - “Draw umbilicus towards spine without flattening your back or sucking in under your rib cage”
  - “Gently draw your stomach is as if putting on a tight pair of jeans”
  - “Bring your pelvic bones together”

• Automatic:
  - Foot Lift and Extend 1” off Bed
  - ASLR
  - Resisted KF / KE isometric contraction

• Functional:
  - Leg Press
  - Resisted Arm Movements
  - Pilates reformer

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Transversus / Obliques

a) Normal at rest
   - ratio of EO, IO and TrA maintained
b) Normal Contraction
   - has both fascial glide and increase in TrA thickness without IO and EO
c) Pre-contracted
   - little glide or thickness increase despite appearance of hypertrophied TrA relative to IO
Transversus / Obliques

d) En-block IO/TrA with poor slide
   - IO and TrA activate together with increase in thickness of both but poor fascial glide

e) IO dominant
   - very little TrA thickness increase or glide, initiates and dominates with IO

f) Loss of fascial tension (post partum) altering length tension curve
   - unable to develop fascial tension but muscle may increase in thickness. Alternatively the length tension curve may be so skewed that little change is noted.
Transversus / Oblique Muscles:

- **a) Normal at Rest**
- **b) Normal Contraction**
- **c) Pre-contracted**
- **d) En-block TrA and IO**
- **e) IO dominant**
- **f) Loss of fascial tension**

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Transversus / Obliques

Potential Pitfalls in measuring TrA thickness:
- Ceph / Caud location of transducer as muscle thickness varies considerably
- Transducer Pressure – 10mm of pressure will change thickness considerably

(Whittaker and Stokes, 2011)
Multifidus
Multifidus

Evidence:
- *Hides et al (1996)* – MF recovery after back pain is not spontaneous
- *Barker et al (2004)* – Psoas and MF atrophy ipsilateral to back pain
- *MacDonald et al (2006)* – Specific retraining of deep MF has scientific credibility
Multifidus

Evidence Cont:
• *Kiesel et al (2007)* – Muscle thickness changes on US correlated to EMG on prone arm raise task
• *Brenner et al (2007)* – US used to measure improvement in MF activation post manip that was maintained at 24 hours
• *Hides et al (2008)* – Atrophy in cricketer’s responded to specific MF retraining, and resulted in decreased pain
• *Fernandez-des-las-penas et al (2008)* – Chronic neck pain patients had dec. MF CSA C3-6 on US compared to controls
• *Gildea et al (2013)* – CSA of lumbar MF smaller in ballet dancers with back and hip pain, though not nec. Ipsilateral to symptoms.
Multifidus

- (Herbert et al, 2008) MF contraction improvement using RUSI biofeedback was retained better at 3-4 months with delayed variable feedback
- (Hides et al, 2011) Patients with a good TrA contraction 4.5x more likely to get a good MF contraction
Multifidus

Cross Sectional Imaging:
• Curvilinear Probe : 3.5 – 6 MHz
• Patient prone with pillow under stomach
• Perpendicular to Spinous Process
Multifidus

• Cognitive
  - “Imagine pushing your tailbone toward ceiling but without moving your spine”
  - “Just take the weight of your leg but don’t lift your leg”
  - “Imagine sucking your hip back into the socket without moving your spine”

• Automatic
  - Leg Lift (ipsi / contralat)
  - Contralateral arm lift prone in bilateral shoulder flexion
  - Seated posture correction “Lift your tailbone”

• Functional
  - Standing weight shift

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Multifidus

Longitudinal Imaging:
- Curvilinear Probe – 3.5 or 6MHz
- Patient prone with pillow under stomach
- Parallel to Spinous Process
- Angled slightly towards spine
Multifidus

Potential Pitfalls in measuring MF CSA
- Adjacent ES contraction may increase PA volume of MF  *(Whittaker and Stokes, 2011)*
Pathology

Spondylolisthesis:
- May appear as a “step” between vertebrae
- Cephalad vertebrae (L4) appears lower (anterolisthesis)
- NOT diagnostic but should raise suspicion
Pelvic Floor

**FIGURE 11.13** Muscles of the Pelvic Floor (female).

*bladder*

*pelvic floor*

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Pelvic Floor

Evidence:

- *Thompson et al (2003)* – Three patterns of levator plate movement noted on RTUS
- *Sherburn et al (2005)* – RTUS valid and reliable compared to vaginal palpation. For PF function
- *Thompson et al (2006)* – Women with SI showed global abdominal recruitment rather than preferential PF
- *Whittaker et al (2007)* – Excessive depression may indicate pelvic organ dysfunction or laxity
Pelvic Floor

Imaging (Transverse Plane):
• Curvilinear Probe – 2 MHz
• Patient Supine in Crook Lying, Perch Sitting or Standing
• Inferior to Umbilicus, Angled 50-70 degrees
• Point Probe Towards Pubic Symphysis
Pelvic Floor

• **Cognitive**
  - “Draw your perineum up”
  - “Draw your testicles up”
  - “Imagine stopping yourself from peeing”
  - “Imagine cutting off gas”

• **Automatic**
  - SLR

• **Functional**
  - Marching on the spot
  - Sit to Stand
Pelvic Floor

• Normal Elevation
  – Good PF contraction

• Excessive Elevation
  – Possible Pelvic Organ Dysfunction

• No Elevation
  – Isometric PF contraction against inc. IAP
  – No PF contraction

• Depression
  – Increase in IAP / Valsalva
  – Pelvic Organ Dysfunction

(Thompson et al, 2003)
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Pelvic Floor

Normal Levator Plate Elevation

No Levator Plate Elevation

Excessive Levator Plate Elevation

Levator Plate Depression

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Imaging (Sagittal Plane):
• Curvilinear Probe – 2 MHz
• Patient Supine in Crook Lying, Perch Sitting or Standing
• Just above Pubic Symphysis
• Angle probe slightly posteriorly
• NOTE:
  • Uterus above
  • Bladder Neck
  • Rectum posteriorly

Adapted from Whittaker et al, 2007
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Pelvic Floor

Sagittal Plane

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Pelvic Floor

Potential Pitfalls in measuring PF contraction
- A small change (as little as 10 deg) in transducer angle will significantly alter the depth of the PF
(Whittaker and Stokes, 2011)
Questions?