Mobility & Flexibility Considerations for Youth Training

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Overview

- Chronological and Biological Age
- Explore how the body should move
  - Identify limitations / weaknesses
  - Create solutions
- **Infancy**
- **Childhood**
- **Adolescence**
  - Chronological vs biological age
  - chronological age of 12 years of between 9 and 15 years”

Puberty: females 2 years advanced
Figure 5. Windows of Accelerated Adaptation to Training (Balyi and Way, 2005)

**Females**
- **Rate of Growth**
- **Developmental Age**
- **Chronological Age**
- **PHV**
- **Suppleness**
- **Skills**
- **Speed 1**
- **Speed 2**
- **Stamina**
- **Strength 1 & 2**

**Males**
- **Rate of Growth**
- **Developmental Age**
- **Chronological Age**
- **FHV**
- **Suppleness**
- **Skills**
- **Speed 1**
- **Speed 2**
- **Stamina**
- **Strength**

Physical, Mental - Cognitive, Emotional Development
NSCA Position Statement

(Blimkie et al. 2009)

• Of 1576 injuries (5-18 year olds)
  – football (19%)
  – basketball (15%)
  – soccer (2%)
  – resistance training (0.7%)
  – Lower back pain is the most common ailment in high school athletes using resistance training
Faigenbaum et al., (2011)

8-13 years
77.2% Accidental

23-30 years
27.5% Accidental
Quatman et al., (2009)
14-30 yrs
Butt Wink

- Noggin in neutral position
- Upright torso
- Knees tracking over (but not beyond) toes
- Crease of hips below parallel
- Feet shoulder
Lumbar spine: the most commonly injured area
(American Academy of Pediatrics 2001)
<table>
<thead>
<tr>
<th>Weak</th>
<th>Tight</th>
<th>Result</th>
<th>Common injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectus abdominus, Transverse, Obliques,</td>
<td>Rectus femoris, Iliopsoas, Erector spinae,</td>
<td>Anterior pelvic tilt, Increased lumbar lordosis,</td>
<td>Low back pain, Disc impingement,</td>
</tr>
<tr>
<td>Glutes Hamstrings</td>
<td>QL, TFL, Adductors</td>
<td>Hip flexion, Knee hyperextension</td>
<td>Knee pain, Hamstring strain</td>
</tr>
</tbody>
</table>

**Lower crossed syndrome**
<table>
<thead>
<tr>
<th>Weak</th>
<th>Tight</th>
<th>Result</th>
<th>Common injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longis capitus, Coli, Hyoid, Serratus anterior, Rhomboids, Trapezius: middle &amp; lower, Posterior rotator cuff</td>
<td>Pecs, Internal rotators, Upper traps, Levator scapulae, Sternocleidomastoid, Anterior scalenes, Suboccipitalus, Teres major, Anterior delts, Lats</td>
<td>Forward head, Depressed sternum, Anterior migration of shoulder girdle, Increased thoracic kyphosis, Internal rotation of humerus</td>
<td>Headaches, Rotator cuff impingement, Thoracic outlet syndrome</td>
</tr>
</tbody>
</table>

**Upper crossed syndrome**
Thomas Test

- Are they tight?
Are they working?

- Reciprocal inhibition
- Cook hook test
• ACL tear: most feared injury!
• Only 50-85% of athlete’s with ACL tears return to their previous sport
• Males: decreased flexibility after puberty
• Females: more joint laxity following the onset of puberty  Myer et al (2015)
Mobility or Flexibility
Anatomy of Stretching

- Joint capsule
  - 47%
- Muscle and fascia
  - 41% (myofascia)
- Tendons / ligaments
  - 10%
- Skin 2%
Ankle Mobility/Flexibility?

- Sitting straight leg calf stretch test
- Wall rock
- Stand 2-4” from wall
- Move constantly
- Multiplaner
- Build up to 15 reps
- One fist rule
Hips

- Can be both immobile and unstable
- Weak hips (glutes) permit internal rotation and valgus (adduction of the femur) induced knee pain
Hip Mobility

- Kneeling mobility
- Split squat (squat matrix)
- Develops hip mobility in three planes
T-Spine / shoulder Mobility

Horizontal Abduction w/ Thoracic Rotation

Internal External rotation
Anatomy of Stretching

- Joint capsule
  - 47%
- Muscle and fascia
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Rolfing technique
What about Chronic Stretching?
Muscle Architecture
So what’s happening?


Immobilization of right leg in mice.
**Sarcomerogenesis** over 14 days
Place the sarcomere back at optimal length

Chronic Stretch: *Tissue Adaptations*

- 10 min SS (30s) 5 days week for 6 weeks (Guissard & Duchateau 2004)
  - 31% increase dorsiflexion
  - 33% decrease in passive *stiffness*
  - *Most adaptation occurring over 2 weeks*
  - *No change in the unstretched leg*
- **No change in voluntary or elicited contractile force**
- Denervated animal models show changes in tissue properties (Taylor et al 1990)
- Daily SS for either three (Kubo et al., 2002) or six (Mahieu et al., 2007) weeks has shown no significant effect on active *stiffness*
Chronic Stretch: 
*Neurological Adaptations*

- 4 min daily SS (30 s) over 3 weeks increased plantarflexor ROM (20%)
  - **Decreased H-reflex** (Blazevich & Cannavan 2011)
- 10 min SS (30s) 5 days week for 6 weeks (Guissard & Duchateau 2004)
  - **Decreased H-reflex & T-reflex** after 4-6
- **Mechanical adaptations occurred before neural** (Guissard & Duchateau 2004)
Chronic Stretch

• Increased ROM
• Mechanical adaptations first
• Decreased passive stiffness
• Neurological occur about 3-4 weeks into stretching

• No decrease in force / strength
What about Acute Stretching?
Reduced muscle performance

• Research found reduction in performance!
  – Isometric
  – Concentric
  – Jumping
  – Sprinting
  – Running
  – Balance

• Revised guidelines by ACSM to exclude SS from warm-up (2006)

• Magnusson & Renstrom (2006): Review suggested that there is a strong body of evidence for impaired force production after acute stretch
Figure 1. Schematic diagram showing the measurements made to determine the distal displacement of the myotendinous junction (MTJ) and to estimate changes in tendon length during dorsiflexion and stretch of the whole gastrocnemius medialis muscle–tendon unit...

<table>
<thead>
<tr>
<th></th>
<th>End PROM</th>
<th>Pre-stretch</th>
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<tbody>
<tr>
<td>Ankle ROM (deg)</td>
<td>28.1 ± 2.3</td>
<td></td>
</tr>
<tr>
<td>MTU elongation (cm)</td>
<td>2.19 ± 0.14</td>
<td></td>
</tr>
<tr>
<td>MTJ elongation (cm)</td>
<td>1.04 ± 0.08</td>
<td></td>
</tr>
<tr>
<td>Tendon elongation (cm)</td>
<td>1.15 ± 0.09</td>
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ROM
- Muscle 47%
- Tendon 53%

Despite changes in muscle, **fascicle length did not change**

**Impact on force-length and Titin?**

Lack of change confirmed by others (Nakamura et al. 2011)

**Decrease in pennation angle**

**Changes in connective tissue**
KJÆR M Physiol Rev 2004;84:649-698
Physiological Reviews

A

Significant findings in the literature (%)

<30 s  30-45 s  60-120 s  >120 s

B

Mean reductions (%)

-12  -8  -4  0  4  8  12

Chaozzi et al. (18)
Chaozzi et al. (18)
Curry et al. (31)
Dalrymple et al. (32)
*Fletcher & Monte-Colombo (39)
González-Ravé et al. (42)
Haag et al. (44)
Knudson et al. (57)
Knudson & Noffal (58)
*Knudson & Noffal (58)
Little & Williams (62)
Little & Williams (62)
*Little & Williams (62)
Murphy et al. (75)
Ogura et al. (82)
Robbins & Scheuermann (87)
*Siatras et al. (95)
*Torres et al. (102)
Unick et al. (103)
*Winchester et al. (109)
Yamaguchi & Tshii (114)
Zakas et al. (121)
Zakas et al. (122)
Pooled Estimate (30-45 s)

<30 s stretch

30-45 s stretch

Mean Change (%)
Acute stretch findings

- Acute stretch not so bad!
- Voluntary force OK – minimal change (issue for elite sports)
- Electrophysiological measures OK
- No change in active *stiffness*

**Issues**
- Long stretch durations (10 - 60 min)
- Excessive number of stretch repetitions (45-s stretches for 20 min)
- Lack of warm-up
- Viscoelastic material
What if we don’t stretch?
Mechanotransduction

- Lateral force transmission
- Initiates gene expression, transcription, translation and protein synthesis to the extracellular matrix (Kjaer 2004)

- Up regulated IGF-1 & mRNA
  - after 4 days of immobilized rabbit
  - E-stim and contraction increased response (McCoy et al 1999)
What if we don’t stretch

- In muscle MAPK (mitogen-activated protein kinase) can be activated by muscle contraction and passive stretch
- This results in transcription factors, gene expression and protein synthesis
- Sarcomerogenesis?
  - Shown in cardiac cultured tissue
- Connective tissue more activated by passive stretch (tenocyte activation)
- Stretch counteracts disuse atrophy & collagen turnover in muscle and tendon
When and whom to stretch

• Needs analysis
• Specific ROM required for sporting movement
  – Jogging vs sprinting
• Influence of SSC (short vs. long perturbations)
• Mobilization or dynamic stretching (DS) can increase ROM
  – No evidence for force impairments after DS (Little & Williams 2006; Yamaguchi & Kojiro 2005; Fletcher & Jones 2004; McMillian et al 2006)
• If SS needed for psychological benefits keep stretches short (~8 s)
How should we move

• Active range of motion exercises without external load **FIRST**
• **Mobility before stability before movement** *(Gray Cook Philosophy)*
• Stiffness (tight muscles) might be **confused** for stability
• Stability: Ability to control segmental motion
  – Static: Isometric control (shoulders during deadlift)
  – Dynamic: Control of joint alignment during movement (hip control during deadlift)
in terms of progression, think (a) static to dynamic, (b) slow to fast, (c) simple to complex, d) unloaded to loaded
Conclusion

• Program prescription
• Five S’s of training
  – Speed
  – Skill
  – Suppleness
  – Strength
  – Stamina

Chronological age → Developmental age
Stretching after training

• Light stretching may help removal of waste products (although this could be done via cool-down procedure)
• Increased flexibility should be dedicated training session
• Possibility exists that stretching leads to muscle damage
• Exercise induced muscle damage & stretch induced muscle damage may increase recovery time
• Post exercise stretching does not appear to reduce DOMS (Herbert & Gabrial 2002; Herbert & de Noronha 2007)
Glenohumeral - Scapular Thoracic joints

- Glenohumeral joint needs mobility
- Scapular-thoracic joint needs stability
- Use wall slides to achieve both

http://www.youtube.com/watch?v=d6V2Exzb324

- Move glenohumeral joint in the presence of scapular stability
References


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