Chapter 6

Exercise Prescription for Flexibility and Low-Back Function

Flexibility FYI’s

- Temperature – increased temp. causes decreased stiffness. This can be environmental temp. or temp. increases with increased contraction. (we are less stiff at 2pm than in the am)
- Age - An older muscle has more inherent stiffness due to morphological changes in the muscle and collagen in connective tissues
- Intramuscular fluid – increase in intramuscular fluid will increase stiffness due to the splinting effect. This explains why Creatine Monohydrate tends to make muscles feel stiffer
- Injury – A muscle immobilized with a cast will have an increased stiffness over time (> 4wks)
- Physical Activity – Excessive training causes more crosslinking to occur between collagen fibers and this increases stiffness

Consequences of Poor Flexibility

- Increased risk of low back pain
- Increased risk of muscle or tendon injury
- Reduced ability to perform activities of daily living and tasks requiring high-intensity muscular exertion
- Reduced postural stability, increasing the risk of falling

Collagen

- Connective tissues in and around muscle are ‘passive’ or ‘non-contractile’
- Principle structure in tissues ‘collagen’
- Viscoelasticity – Made up of Viscous and Elastic properties
- Deformation/lengthening
Viscoelasticity tells us many practical things about stretching connective tissue

- Cycle loading – initial deformation occurs in the first stretch, after 4 there is little change in length (there is not benefit to stretching a muscle 10x in one session)
- It takes 12-18 seconds to reach stretch relaxation (no need to hold for longer than 20sec)
- Once elongated, length changes are no rapidly reversible due to viscous nature of tissue. Lasting changes come from remodelling of connective tissue. Stretching 1 every 4 hours was the most effective way to achieve elongation in a muscle
- ‘Creep’ – Ability of tissue to elongate over time when a constant load is applied. If we sustained a load the muscle would ‘creep’ a few degrees over time
- ‘Hysteresis’ – The amount of lengthening a tissue will maintain after a cycle of stretching and then relaxation. The range is maintained for some time after the load is removed (a temporary change in length following a stretch may start to regress after a few hours)

How a stretch happens: 3 Physical Properties of Viscoelastic Tissue

- ‘Creep’ – Ability of tissue to elongate over time when a constant load is applied. If we sustained a load the muscle would ‘creep’ a few degrees over time
- ‘Load Relaxation’ – Less force is required to maintain a tissue at a set length over time
- ‘Hysteresis’ – The amount of lengthening a tissue will maintain after a cycle of stretching and then relaxation. The range is maintained for some time after the load is removed (a temporary change in length following a stretch may start to regress after a few hours)

Neuromuscular Considerations

- Stretch reflex – Governed by Muscle Spindles. Lets feedback system know about muscle length and rate of length. When muscle is stretched MS triggers reflex contraction to limit the ability to stretch
- Reciprocal inhibition – MS responsible for RI. If a muscle contracts the opposite or antagonist muscle will relax to allow movement to occur without resistance.
- Autogenic inhibition – GTO receptor to provide information on increased tension in the muscle. This can come from contraction or a stretch. GTO connects with nerve cells in SC to inhibit or relax the muscle.
- ‘6 second rule’ The GTO will trigger if a stretch is sustained for > 6 sec or if the muscle contracts forcefully

PNF

- Muscle relaxation is fundamental to elongation of muscle tissue
- Uses proprioceptive abilities of GTO and MS to relax and inhibit the muscle to gain a more effective stretch
- Exists in a number forms; Contract relax, Hold relax, Contract relax and Antagonistic contraction
2 Types PNF

Passive Stretch – Hold Relax
“PUSH”
- Subject relaxes while trainer passively stretches muscle and hold 10 seconds
- Trainer instructs client to “PUSH” against resistance to produce isometric contraction of agonist 4-6 sec
- Limb is then re-stretched to a new position
- Passive stretch between isometric cont. 10 sec
- Repeat 3 times

Active Stretch – Contract Relax
“PULL”
- Trainer passively stretches muscle hold for 6-10 sec
- After isometric period instruct client to “PULL”
- This pull phase lasts 4-6 seconds
- At the end of this contraction the client relaxes and the trainer passively stretches the muscle
- Repeat 2-4 up to 3 times

PNF:
HAMSTRING
AND GLUTEAL
STRETCH

1. On back, leg on shoulder
2. Slowly stretch ham and glut by lowering leg to head until stretch
3. Apply light pressure to further stretch
4. Isometrically contract hamstrings and glut 5-10sec by trying to move leg down
5. Relax the ham and glut muscle and partner tries to stretch further for 5-10 sec using antagonists (iliopsoas and quads)

ACSM Recommendations for Building Flexibility

1. Warm-up aerobically prior (5-15 min)
2. Stretch 2-3 days/wk or following each aerobic workout
3. Hold position short of pain threshold 10-30 sec repeat 2-4x. Relax totally, let the muscles slowly go limp as tension of the stretched muscle slowly subsides
4. Target 60 seconds of total stretching time for each exercise
5. Positions: At least 8 specific stretches following a specific order for each muscle-tendon unit

Back/hips/hamstrings/legs/calves

- Calf rope stretch
- Lower back-hamstring rope stretch
- Groin stretch
- Spinal Twist
- Downward Dog
- Quad Stretch
The truth about Stretching!

- **Static** – Benefit is injury is minimal. This type of stretch is ideal to stretch connective tissue/non-contractile elements since it makes use of vascoelastic properties to cause elongation. Makes use of autogenic inhibition to trigger relaxation (6-sec rule)
- **Dynamic** – Muscle is taken through full ROM, slow and large amplitude movement. Opposing muscles are used to produce force. Done under control and not jerky.
- **Ballistic** – Done fast, rapid and through large ROM. Benefit is that it is sport specific to ballistic sports and allows integration of the ‘stretch reflex’.
- **Bouncing** – Similar to ballistic. Perform small oscillations at the end of range. The dangers of Ballistic and Bouncing = they can lead to muscle soreness cause by the rapid lengthening of the muscle. Initiates the stretch reflex and muscle tension but fails to provide adequate time for tissue to adapt to the stretch

Benefits of Flexibility

- Increased movement range
- Reduction in rate of functional decline
- Postural symmetry and joint alignment
- Stress reduction, reduced tension, and tissue relaxation
- Reduced risk of injury
- Relief of muscle pain
- Improved quality of life

Low Back Pain

- Anatomical and biomechanical aspects of the trunk and spine
- Stresses to the spine and how they produce symptoms related to LBP
- Core stability (CS) is the KEY!!!!
A Vertebral Motion Segment
(Functional Spinal Unit)


The Intervertebral Disc
As a Shock Absorber

- Both the spinal curves and the circumferentially enclosed nucleus pulposus help absorb compressive forces.
- If tears occur in the annulus fibrosis, the nuclear material could come in contact with pain receptors and nerve roots.

The Intervertebral Disc
As a Shock Absorber (continued)

Psoas and the Lumbar Curve

Tightness of the psoas can pull the low back off the table; however, by supporting the legs in flexion the low back can usually be flattened against the table. See the next slide for an illustration.

(continued)
Psoas and the Lumbar Curve (continued)

The Thoracolumbar Fascia Envelope and the Spinal Musculature

- This figure demonstrates why the lateral abdominal musculature is so critical to spine integrity.
- The aponeurosis of the transversus abdominis (and to a lesser extent that of the internal oblique) attaches to thoracolumbar fascia.

The Thoracolumbar Fascia Envelope and the Spinal Musculature (continued)

The Posterior and Lateral Abdominal Musculature

- The psoas can exert extreme compressive forces on the discs of the lumbar spine in certain abdominal exercises; it teams up with the iliacus in hip flexion (the two are often referred to as the iliopsoas).
- In recent years the quadratus lumborum has been found to play a critical role in enhancing core stability.
The Posterior and Lateral Abdominal Musculature (continued)


**Hip Flexor Stretch**

To stretch the hip flexors (e.g., psoas), it is important to keep pelvic posture neutral.

**I-T Band Stretch**

Note that most of the weight support is on the left leg (the right leg helps ensure stability). The stretch should be felt on the lateral surface of the left thigh.

**Stretch to Improve ROM of the Piriformis Muscle**
Cailliet Stretch

In a sit-and-reach stretch, it is recommended that each leg be stretched individually. Thus, the symmetry of hamstring length can be determined. If the hamstrings in one leg are in more of a shortened state than those of the other, stretching to achieve symmetry may be the first goal.

Step or Chair Stretch

Mad Cat Stretch

This is a good exercise to do as a warm-up before placing any stress on the spine.
Although these exercises can be used effectively to stretch the lumbar area, they are not recommended for people with disc problems.

Trunk Extension Exercise

This passive ROM exercise can be used to maintain extension ROM in the lumbar spine. (See figure 9.2 in the textbook for more information.)

The Quadruped Exercise

- This exercise emphasizes the low-back musculature; it also requires coordination.
- Keeping the spine in neutral is critical; the only movement that should occur is in the extremities.
- Initially, only one arm or leg is raised.
- In the figure on the next slide, the opposite arm and leg are raised; the spine is braced (splinted) throughout the activity.
The Quadruped Exercise (continued)

Second photo courtesy of Wendell Liemohn

Roman Chair

This exercise strengthens the lumbar erector spinae muscles; although often used in therapeutic programs, it would not be recommended for all.

Abdominal Curl

The crunch or curl emphasizes the rectus abdominis; the lateral abdominals are also used if done on a therapeutic ball.

Crunch: Diagonal Modifications

The exercise depicted emphasizes the development of the rectus abdominis. A diagonal or twisting movement can be added to place more emphasis on the oblique musculature.
Horizontal Isometric Side Bridge

This is an exercise for quadratus lumborum and transversus abdominis development. It is typically held isometrically for 30 to 60 sec.

Advanced Horizontal Isometric Side Bridge

This is a more difficult version of the side bridge exercise for quadratus lumborum and transversus abdominis development. It is also typically held isometrically for 30 to 60 sec.