Flexibility

Benefits of Flexibility and Stretching Exercises

- Joint health
- Reduction of low-back pain and injuries
- Additional potential benefits such as:
  - Reduction of DOMS
  - Pain relief
  - Athletic performance
  - Improved posture
  - Relaxation
- Flexibility and lifetime wellness

Types of Flexibility

- **Static flexibility**: ROM about a joint with no emphasis on speed.
- **Ballistic flexibility**: usually associated with bobbing or bouncing motion.
- **Dynamic (functional) flexibility**: ability to use ROM in the performance of a physical activity.

Muscle Response

- **Reciprocal innervation** is when an agonist muscle contracts, contraction of the opposing antagonist muscles is inhibited. So when I contract my hip flexors my hip extensors will relax.
- **Muscle spindles** are sensory nerve endings in muscle detect the change in length of the muscle and its rate of change. Force applied to a muscle stimulates the muscle spindles which activate protective reflexes resulting in contraction of that muscle.

Creating a Successful Program to Develop Flexibility

- **Types of stretching exercises**
  - static stretching
  - dynamic stretching
  - ballistic stretching
  - proprioceptive neuromuscular facilitation (PNF)
- Passive stretching (partner or gravity assisted)
- Active stretching

24 What Determines Flexibility?

- **Joint Structure and Surrounding Tissue**
  - Type of joint (hinge, ball and socket, etc.)
  - Joint capsule
  - Heredity
- **Muscle Elasticity and Length**
  - Collagen fibers provide structure and support
  - Elastin fibers are flexible and will stretch
  - Titin also contributes to flexibility
- **Nervous System Activity**
  - Stretch receptors control muscle length
  - If a muscle is stretched, receptors send a message to the spinal cord, which then sends a signal back to the muscle telling it to contract
  - A strong muscle contraction produces an opposite reflect that causes the muscle to relax
Benefits of Ballistic Stretching

- Increase chance of injury is always cited as a disadvantage of ballistic stretching and rarely are the benefits mentioned. These include:
  - Better development of dynamic flexibility.
  - Principle of specificity?
  - Ballistic stretching has been shown to be effective although more research is needed.
  - As ballistic stretching can be performed in unison during team warm-ups and this can help in promoting team camaraderie.
  - Ballistic stretching can be less boring than static stretching.

Ballistic Stretching

**Advantages**
- Development of dynamic flexibility
- Effectiveness
- Team camaraderie
- Interest

**Disadvantages**
- Inadequate tissue adaptation
- Soreness and injury
- Initiation of stretch reflex
- Inadequate neurological adaptation

Static Stretching

**Advantages**
- Historical preference
- Effective and optimal
- Less energy
- Less soreness

**Disadvantages**
- Boring?
- May overly dominate routine
- Principle of specificity?
- Increase change of injury by reducing amplitude of stretch reflex?

Proprioceptive Neuromuscular Facilitation
Proprioceptive Neuromuscular Facilitation

- Increased range of motion
- More motivation required
- Takes more time
- Increase pain and soreness and injury?

Basic Flexibility Program

- Intensity and duration (stretch to slight discomfort for ≥ 20 sec)
- Frequency (min 2-3 days a week)
- Evaluation (sit-and-reach test)
- All major muscles and joints should be targeted
- The ACSM recommends flexibility training a minimum 2 to 3 days per week holding each stretch for 20 to 40 seconds to mild discomfort; 3 to 4 repetitions per stretch.

Stretching

- Treat a stretching program with respect. Like strength training it does cause some disruption (damage) to the musculotendinous unit.

Flexibility Workouts

<table>
<thead>
<tr>
<th>Warm-up 5-10 minutes or following an endurance or strength training workout</th>
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<tbody>
<tr>
<td>Stretching exercises for major joints</td>
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</table>

Sample program

- **Exercise**
  - **Areas stretched**
  - Neck
  - Triceps, shoulders, chest
  - Shoulders, upper back
  - Upper back
  - Trunk muscles
  - Hip, front of thigh
  - Inner thigh, hip, calf
  - Iliotibial band
  - Trunk rotation
  - Back of thigh, lower back
  - Lower leg stretch
  - Calf, soleus, Achilles tendon

Type of activity: Stretching exercises that focus on major joints

- **Frequency:** 2–3 days per week or more
- **Intensity:** Stretch to the point of mild discomfort, not pain
- **Duration:** All stretches should be held for 10–30 seconds and performed at least 4 times

When you look at the muscle directory in ExRx.net in WebCT you will see that on the Exercise list when you click on a particular muscle there are also links to stretching exercises.


Common Orthopedic Inflexibilities

- Hamstrings Inflexibility
- Gluteus Maximum or Adductor Magnus Inflexibility
- Hip Flexor Inflexibility
- Shoulder Transverse Abduction/Extension Inflexibility
- Shoulder External Rotation Inflexibility
- Shoulder Internal Rotation Inflexibility
- Iliotibial Band Tightness
- Ankle and Foot Dorsiflexion Inflexibility
Contraindicated Stretches?
- Standing Hamstring Stretches
- Single or Double-Leg Inverted Hurdler’s Stretch
- Full Neck Circles
- Arches and Bridges (Back Hyperextension)
- Standing Torso Twist
- Gravity Inversion

Take home message
- Individuality may be a bigger issue than CV conditioning and muscle strength?
- Some may not need to do any
- Activities using full ROM may be good enough for some
- Assess needs of you sport if ROM is a factor (gymnastics, swimming, O-lifting, etc)
- Do not perform static stretches before ballistic activities
- Test for and be aware of definite inflexibilities

Core Conditioning and Back Care
You live with your back 24 hours a day
Be kind to it!

Low Back Pain (LBP)
- Lifetime prevalence of LBP is very high (80+%)
- Manual material handling is a major cause of work-related LBP & other musculoskeletal injuries.
- However, LBP is common in work environments where no lifting occurs, such as seated work.
- Work-related psychological stress and lifestyle factors may also increase LBP risk.
- Possibly only 33% of work-related LBP is due to lifting and bending tasks (Brown, 1973 & Magora, 1974)

Personal Risk Factors
- Physique / anthropometry / strength (static / dynamic endurance)
- Physical fitness / health history / spinal abnormalities / spinal mobility
- Age / gender
- Psychophysical factors / motivation
- Training and selection (experience)
Most flexion in these regions
Proper lumbar lordosis is crucial to reduce compressive and tensile forces in the lumbar spine.

Anatomy of the Core

- No one muscle is the most important muscle for stability - varies with movement pattern
- For athletes a conflict of stability and rhythmic contraction/relaxation of forced breathing exists

Abdominal Group
- In addition to stabilization each muscle group contributes to trunk movement
- Transverse abdominus ⇒ Forced expulsion
- Internal obliques ⇒ Lateral flexion, rotation to same side and flexion of trunk
- External obliques ⇒ Lateral flexion of trunk to same side, rotation to opposite side and flexion of trunk
- Rectus abdominus ⇒ Flexion of trunk

Back Muscles
- Erector Spinae ⇒ Trunk extension
- Multifidus ⇒ Lateral flexion, extension and hyperextension of the spine
  (Kader 2000 found multifidus atrophy in 80% of patients (n=78) with back pain – bilateral in most cases)
- Quadratus lumborum ⇒ Highly involved in lumbar spine stabilization - largely isometric
- Latissimus dorsi ⇒ Role as spine stabilizer enhanced by pulling to chest in lat pull down exercise
Buckling

- If the work done on the spine (energy applied) is greater than the work the muscles can do to stiffen the spine, then the spine will buckle.

Fishing Rod Analogy

- Lift with the legs not the back.
- Keep the back as straight and as upright as possible. Straight is more important than upright.
- Keep the load close to the body.
- If possible try not to lift heavy objects from the floor (unless you are a skilled weight lifter working out).
- Turn with your feet don’t twist.
- If its too heavy get help!!!!!
A good technique for very frequent lifting?

**Spinal Stability**

- As we will discuss in lab, back problems are often the result of incorrect recruitment patterns of the spinal muscles and/or muscle imbalances between the major groups.
- Poor proprioception has been implicated in delayed or disrupted patterns of muscle activity which may contribute to biomechanical vulnerability.

Muscles engaged (active) versus load carried by ligaments

- **Muscle Force**
- **Ligament Force**
- **Joint Shear**

Fully flexed spine inactivates back extensors, loads the posterior passive tissues and results in high shearing forces. Neutral spine posture...
Spinal Exercises / Core Strength

- Know the neutral spine position
  - Proper lordosis
  - Blood pressure cuff tests
- Check posture during lifting / work
  - Avoid trunk flexion
  - At full flexion spinal erector muscles are inactive

Core Exercises

- Curl Ups (rectus abdominus)
  - Feet anchored and leg raises
  - Press heel curl-up
- Horizontal Side Bridge (obliques and quadratus laborum)
  - Side sit-ups
- Back extension (erector spinae)
- Squats and other major lifts (deadlift, overhead squat)
- Labile Surfaces (Swiss ball, wobble board is whole body stability)

Role of Exercise in Preventing Back Pain

- We have already covered many exercises that will help maintain a healthy back.
- Good flexibility to allow for correct posture.
- Adequate muscle strength and a proper balance of this strength to support the spine.
- Good cardiovascular conditioning to help with everyday mobility (joints can also deteriorate with lack of movement).

Back Problems Helped by Exercise

- Disc degeneration
- Facet joint arthritis
- Osteoporosis of the spine
- Sacroiliac joint disorders
- Muscular strains or weakness
- Ligament sprains or inflammation
- Recovery phase of a fractured spine
- Weak back due to poor body maintenance

Back Problems Not Helped by Exercise

- T.B. of the spine
- Cancer of the spine
- Infections of the spine
- Acute phase of a fractured spine
- Acute disc - prolapsed or herniated disc
- Referred pain to the spine from other organs of the body
Lateral Musculature Test
- Test performed on both sides of the body
- Lying in full side bridge, legs extended, top foot in front
- Subject supported on one elbow and feet while lifting hips off the floor to create a straight line over their body length
- Uninvolved arm placed across the chest with hand on opposite shoulder
- Failure occurs when person loses the straight-back posture and hip returns to ground

Flexor Endurance Test
- Begins with person in a sit-up posture with the back resting against a jig angled at 60°
- Knees and hips flexed at 90°
- Arms folded across chest
- Hands on opposite shoulders
- Toes are secured by examiner or toe straps
- Test begins by pulling support back ten centimeters
- Failure occurs when subject falls back and touches jig

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Back Extensors Test
- Upper body cantilevered over the end of test bench - hands across chest
- Time to failure - drop from horizontal
- Data for these tests gathered from healthy men (n=92) and women (n=137) with a mean age of 21

Importance of Back Testing?
- Of all the factors tested such as extensor and flexor muscle lengths, hip flexor strength, size of lumbar lordosis, pelvic tilt, etc., *endurance of the back extensor muscles* had the highest association.

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Ratios Normalized to the Extensor Endurance Test
- Flexion/Ext. Ratio
- RSB/LSB Ratio
- RSB / Ext. Ratio
- LSB / Ext. Ratio

| Flexion/Ext. Ratio | 0.84  | 0.72  | 0.77  |
| RSB/LSB Ratio      | 0.96  | 0.96  | 0.96  |
| RSB / Ext. Ratio    | 0.58  | 0.40  | 0.48  |
| LSB / Ext. Ratio    | 0.61  | 0.42  | 0.50  |