

Health

Unit 2 of 4

The focus of Unit 2 will be on muscles, tendons, movement, the effect of gravity on your exercise, and the alternate definition of "strength".

Muscles

Here's the best way to avoid confusion in discussing exercise - distinguish the terms for muscles vs. movements vs. joints. For example, think about kicking a football. You sound like a pro when you can explain to someone that "*The quadriceps cause extension at the knee!*" In Unit 1, we talked about joints, and now muscles are making their entrance.

Unlike ligaments, muscles are made up of tissue that "contracts" (tenses, shortens). A muscle crosses a joint (where two bones come together). Your brain sends messages down your spinal cord then out along a nerve which sends small branches to the muscles. When the nerve endings "fire" like an electrical impulse, that's the nerve's way of delivering the message: Move It! That causes the fibers of the muscle to react and contract. So when the muscle contracts, it pulls on the bones it is attached to, causing that joint to move.

We've learned that a ligament stabilizes a joint and a muscle moves it.

1. Can a muscle help stabilize a joint? Can a ligament help move it? ("Yes" is the correct answer to only one of these!) Explain.

There is one part of many muscles that has a lot in common with ligaments. Tendons are thin bands that help attach some muscles to a bone. Some muscles narrow down into tendons. The wrists and fingers provide a close-up look at tendons -- you can see them on your own hand. Look at the back of your hand and pull your fingers back as much as you can. Appendix 1 shows what tendons look like under the skin.

2. Where can you feel or see a tendon at another joint?

3. Where is your biggest tendon? Hint: it helps you stand tip-toe. Do you know why it has the name it does?

Okay, now we have muscles, joints, tendons, and ligaments -- so let's start moving and we'll start with the wrist! When the muscles of the front of the wrist contract, they shorten, bending the wrist forward. To say it formally, the wrist flexes which is done by contraction of the flexors, and this motion is called flexion.

4. The extensors bend your wrist backward. What is this motion called?

5. What position is your wrist in when you are:

holding a tray full of glasses up over your head with one hand?
putting a spoon full of mashed potatoes into your mouth?

6. List two activities where your wrist is in flexion.

7. List two for extension.

We'll be using the terms contract, flex, and extend from now on, instead of shorten/tense, bend and straighten – so, it's worthwhile getting them "straight" in your mind. Knowing the correct terminology avoids confusion in setting up an exercise program and talking about specific movements. Here is some practice:

8. What are three joints of your arm between neck and hand? What position are all of them in when you hold your nose?

9. Extend the neck as far as it will go. What are you looking at?

10. Using all the correct terminology, write a sentence describing what happens to the elbow during a push-up.

11. Do you find it useful to know terminology when you design an exercise program? Why or why not?

Gravity

It is no surprise that the heavier the weight a muscle can lift, the stronger it is. But there are a number of other factors to complicate measuring muscle strength, such as:

- the number of repetitions
- the position of the joint or joints the muscle crosses
- whether an exercise is isometric (tightening without movement)
- whether a muscle is shortening or lengthening slowly
- positioning relative to gravity

Some of you serious exercisers wouldn't mind a whole course on all that. Others are saying, "Hey, I just want to know how many calories I get to eat after playing basketball!" So here's a compromise – Appendix 3 provides more information for those interested. For now, we'll all get detailed about a very important aspect of strength - gravity - and its effect on appearance, exercise, and rehabilitation.

Appearance:

This may not be the best word for this category, but it's the most apt to get your attention. Another way ligaments can be over-stretched is poor posture over time. An increased curve of the spine is a common result of aging from the weight of gravity on the head, back, and shoulders year after year. No wonder the ligaments and muscles get tired and stretched out and, let's face it, it's not as attractive as standing up straight.

The spine is not supposed to be completely straight; we would move like robots if it were.

12. Draw a line representing the head and spine with its natural curves.

Exercise:

Hold something in your hand that weighs about a pound or so. In standing, let your arm hang down, then lift up the weight by flexing/curling only your wrist. What you're doing is moving the object against gravity.

13. Hold the weight up as long as you can. What do you feel and where?

14. If you did that ten times in a row, repeating the program twice a day for two weeks, what changes to your body would you expect?

15. Where would you expect to see the changes?

Muscles that contract against gravity have to work, and if they push extra weight (an extra pound vs. just your arm, for example), they work harder. The harder they work (considering all those factors listed right under the intro to "Gravity"), the stronger they become.

To get specific, we'll focus on the knee. (See Appendix 2 – hamstrings & quads.) The muscles that flex the knee are the hamstrings (a group of three muscles). The hamstrings compose the back of the thigh, running from pelvis to tibia (the large bone of the calf).

When the hamstrings contract, they shorten, pulling on the tibia so the knee joint flexes, pulling the heel toward the butt.

The muscles that extend the knee are the quadriceps (a group of 4 muscles). The quadriceps is the big thigh muscle, running from pelvis to the front of the tibia. When it contracts, it extends the knee. The quadriceps end in a single big tendon; you can see it at the front of your knee and your knee cap sits right in it.

16. If you are lifting weights strapped to your ankles, which of these muscles would be moving the weight against gravity when you are lying on your stomach?

Probably the most common exercise to strengthen the quadriceps is in sitting, extending the knee with a weight attached to the ankle. What happens if the leg is then slowly lowered? Now the knee is bending and the muscle that bends the knee is the hamstrings - therefore the hamstrings are being strengthened too, right? NO!

17. Why not?

The most common mistake in figuring out which muscles are working is to forget about the influence of gravity. A joint that is holding up a weight against gravity is still working, no matter what direction it's going in. You can test it yourself: do a *very slow* deep knee bend, and pay attention to how your thigh muscles feel.

18. When are your quads working? When are the hams working?

The quadriceps straighten the knee and they work extra hard to push the knee straight when they have to lift the whole body up in standing. When you start to sit down, they don't *suddenly* stop working. Even though the knee is bending (a motion performed by the hamstrings), the hams don't have to work one single bit - gravity does it all for them.

19. When do the hamstrings work against gravity?

Rehabilitation:

Stroke. Heart attack. Arthritis. Spinal cord injury. Amputation. Head injury. There is a veritable unending list of injuries and illnesses that affect the ability to walk, stand, use the arms, and even lift the head.

20. Why can gravity make it harder for a person with a disability to stand and walk?

21. If someone is weak and has trouble standing, which muscle group would need to be strengthened? Why?

A wheelchair lets a person who can't walk be mobile. There are also a variety of assistive devices that make standing and walking possible for some.

- 22. What disability could be helped with the use of:
 crutches?
 a single cane?
 a back brace?

23. Think of another disability and the device that would help the patient.

Another Kind of "Strength"

The word STRENGTH can also mean something less visible than muscle bulk.

"We confide in our strength, without boasting of it; we respect that of others without fearing it."
 - Thomas Jefferson, 1793

"You gain strength, courage, and confidence by every experience in which you really stop and look fear in the face."
 - Anna Eleanor Roosevelt, 1960

"Their strength is to sit still..."
 - The Holy Bible, Isaiah

- 24. How would you define "strength" to include both meanings?
- 25. How can looking "fear in the face" help relax a person?
- 26. How can someone get stronger by sitting still?

Health Club

By now, maybe you've started working on your health program! Or maybe you're still gathering motivation....either way, try including more activities after reading about muscles and the effects of gravity. For instance, you could include more arm exercises (such as bicep flexion) or leg exercises (such as strengthening your quadriceps).

- 27. How has your exercise program been going so far?
- 28. What new exercises will you be incorporating into your program?

Remember: First names only & please let us know if your address changes

Appendices
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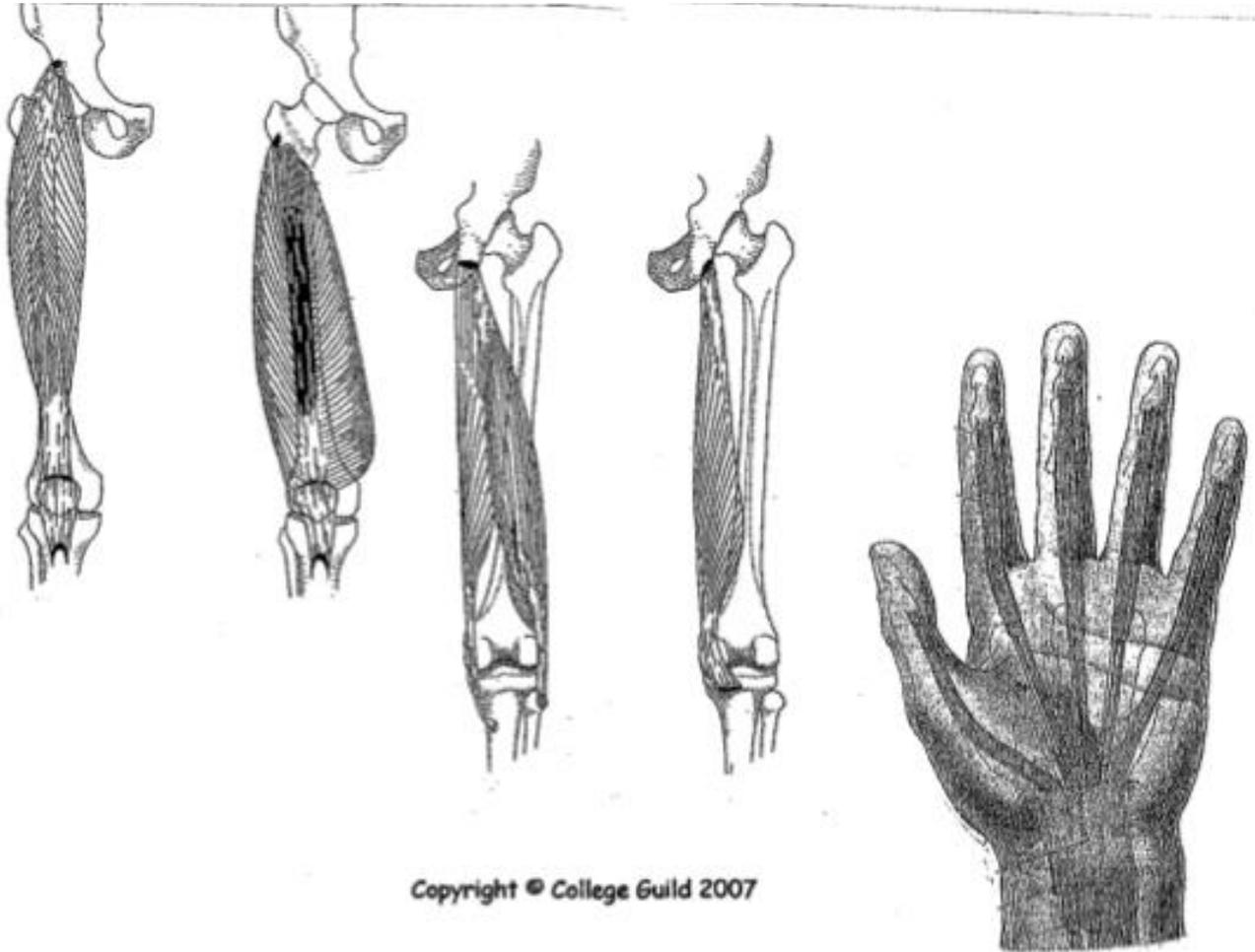
Appendix 1



By spreading your hands wide, or pulling your hand back, you should be able to see the tendons! It's more evident in some people...

Appendix 2

The quadriceps join to form one tendon at the front of the knee which contains the knee cap (patella). Two of the three hamstrings end in tendons, and they attach behind the knee joint. The muscles that flex and extend the fingers end in very long tendons beginning above the wrists.



Appendix 3: More on Muscles

Two-joint muscles

If a muscle crosses more than one joint, you have to think about the positions of all of them before working on exercising a particular muscle. Here's a demonstration that explains why:

Make a really tight fist. Look at the position of your wrist.

Here you are, strongly contracting the muscles that flex the fingers and the wrist. But your wrist is in extension. Here's another way to see the same thing.

Keep that hand fisted tight as you can while you flex your wrist as far as you can.

The strength of your tight grip decreases. The answer is simply that there's a limit to how far the muscles doing the opposite movement can stretch.

Shortening vs. lengthening contractions

Imagine you are holding a ten pound weight in your hand and slowly flex the elbow and hold while you count to five. Now SLOWLY extend your elbow, taking a full count of five to do it. Your biceps flex and your triceps extend the elbow.

When you extend, which muscle is being exercised?

If you answer triceps, you're wrong! The reason is, gravity and the key here is SLOWLY.

Why does extending a joint that is extended by the triceps strengthen the biceps?
(Go back and review the section on quadriceps and hamstrings to make sure it's clear.)

Other planes of movement

The hip moves in three different planes. You already know about flexion/extension. When you flex your hip, you get a closer look at the knee. Extension pushes your leg backwards. Now try this:

Stand with your feet pointing forward and hold on to something for balance.

Keeping your body facing forward, lift one leg (knee fully extended) straight out to the side, keeping that foot pointing forward and not leaning your body to the opposite side. How far does your leg "abduct" (move straight to the side)?

Measure this by pretending your body is a clock; your feet are 6 o'clock, your head 12 o'clock.

What number is your abducted leg at?

If you have full range of motion, your leg will be at 45 degrees, or about 7:30 on your clock. The opposite of abduction is "adduction" where your leg moves back in. Your hip also rotates.

Sit down with your feet dangling. Keep your knee and hip in the same position while you pull your foot inward so you are looking at the inside of your shoe.

That is "external rotation." The opposite is "internal rotation."

Which one are your hips in when you sit on the ground with your legs crossed?

Image Citations

<http://www.magic-tricks.ws/pics/backhandsubtlety6.jpg>

Daniels, Lucille, and Catherine Worthingham. *Muscle Testing: Techniques of Manual Examination*. Philadelphia: Saunders, 1986. Print

Feedback for Health Unit 1 assignments:

8. The hands need lots of joints because they perform so many intricate movements. They move the fingers, for example, to do everything from using chopsticks to cutting with scissors to playing a violin. And the feet? Their fine-tuning comes in allowing the body to walk, run, balance, tiptoe. Think of the different positions the bones of the foot are in when you walk -- from the time your heel hits the ground till your toes push off.

11-12. The joints of the arm are usually bent when brushing the teeth. If your elbow is straight, there is no way to get the brush to your mouth unless your neck is very long or you can hold the brush with your shoulder! So the first should be "easy" and second "impossible."

13. Walking upstairs is hard with knees bent because you can't push up completely to get your foot onto the next step. Going downstairs with knees straight is hard because your higher knee can't bend to lower you.

14-15. Here's an example: Gillian has arthritis and wants to swim at her local YMCA. To get out of the pool without straightening her knees, she can't use the ladder, but goes to the side, reaches behind and lifts herself back and up. Then she pushes herself sideways to a kneeling position where you can help her to her feet and hand her her crutches.

16-17. Problems besides pain when there is a sprain include instability and the risk that in the future, the joint will be more easily re-injured. Because of the instability, support (such as using crutches or elastic wrap) are smarter than toughing it out. The idea is for full healing to occur.

24. The other definition of exercise is carrying out an action/activity or acting on a belief.