

Open and closed kinetic chain exercises

Objectives :

By the end of this lecture the student will be able to:

1. Define kinetic chain
2. Describe open & closed chain exercises and their examples
3. Discuss the difference between open & closed chain exercises
4. Identify the advantages of closed chain exercises

Kinetic chain

- All of our bones and muscles are connected in a “chain” that is referred to as the kinetic chain of the body. All the movements we make are part of that kinetic chain.
- A kinetic chain is a chain of joints exercised together. For example the hip, knee, and ankle joints, when taken together, comprise the lower extremity kinetic chain.
- A recent idea in exercise and rehabilitation divides exercises into closed chain and open chain.

Open kinetic chain exercises (OKC) or open chain exercises :

- Open kinetic chain exercises are exercises that are performed where the hand or foot is free to move.
- These exercises are typically non-weight bearing, with the movement occurring at the elbow or knee joint.
- Open kinetic chain exercises utilize isometric, isotonic (concentric, or eccentric) muscle contractions.
- Limb motion is usually in a single plane. The distal segment of the limb (hand or foot) can move freely

- These types of exercises usually isolate a single muscle group and a single joint. For example, the one joint involved during a leg extension is the knee and the muscle group it isolates is the quadriceps.
- Open chain exercises can be done with or without added weight. But, when weight is added, it's usually placed at the distal (far away) portion of the limb, such as the ankle.
- Examples of open chain exercises include chest presses (fig. 1), biceps curls (fig. 2) , leg curls (fig. 3), and leg extensions (fig. 4), standing shoulder abduction with wrist weights(fig. 5) or straight leg raise with weights on the ankle (fig.6).



Fig.1: Chest presses



Fig.2: Biceps curls

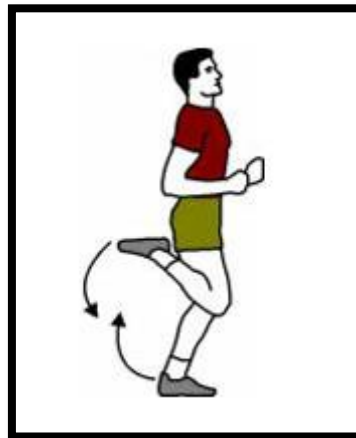


Fig.3: Leg curls



Fig.4: Leg extension



Fig. 5: Standing shoulder abduction with wrist weights

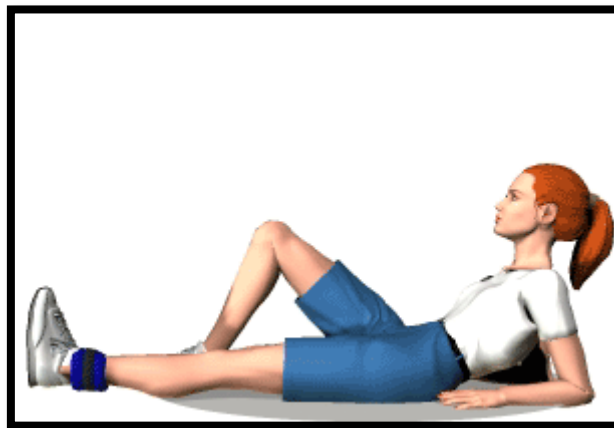


Fig. 6: Straight leg raise with weights on the ankle

Closed Kinetic Chain Exercises (CKCE):

- Closed kinetic chain exercises are physical exercises performed where the hand (for arm movement) or foot (for leg movement) is fixed and cannot move. The hand/foot remains in constant contact with the surface, usually the ground or the base of a machine. These exercises are typically weight bearing exercises.

- These types of exercises work multiple muscle groups and multiple joints at once. For example, the multiple joints involved in a squat are the knee, hip and ankle; and the multiple muscles groups are the quads, hamstrings, hip flexors, calves and glutei muscles.
- Closed chain exercises can be done with body weight alone or with added weight. When external weight is added, it is usually rested across the back of the shoulders or the front of the chest. This is safer than the distal placement of weight during open chain exercises.

Why are Closed Chain Exercises Preferred to Open Chain Exercises?

1. Closed chain exercises improve our “functional” fitness because they better mimic activities in our daily lives.
2. They’re also great for athletes because sports require multiple joint and muscle movements to happen at once. Very few movements in real life or in athletics isolate joints and muscles like open chain exercises do.
3. Closed chain exercises work many muscle groups at once. So they allow us to get more benefit in less time.
4. Closed chain exercises are safer for our joints. This is especially true for joints that are very vulnerable to stress and injury, such as the knee joint. The force involved in closed chain exercises is *compressive*. This type of force *stabilizes* our joints and helps strengthen them. In contrast, open chain exercises, like knee extensions and hamstring curls, produce *shear force*. This type of force *stresses* our joints and is more likely to cause injury. In the case of extensions and curls, the highest injury risk is to the ACL.

How does this affect your workouts?

If you already suffer from joint pain or a previous joint injury, you should try to avoid open chain exercises at that particular joint. For example, if you have injured knees, do squats (fig.7) and lunges (fig.8) (closed chain exercises) instead of leg extensions and leg curls (open chain exercises), if you have elbow pain or an injury, do push-ups (closed chain) instead of chest presses (open chain); if you have shoulder issues, try pull-ups; and so on.

With this information, we might be able to prevent problems from occurring in the first place. It gives us another reason why we should vary our exercise programs. We can do both open and closed chain exercises, but now that we know the difference between the two, we can choose what's best for us. For example, since our knee joint is the most vulnerable joint in our body, it would be best to limit the amount of open chain exercises we do for our lower body, especially when using heavy weight that is added to the distal part of our leg. Since the joints of our upper body aren't as prone to injury as the knee, they can handle equal amounts of open and closed chain exercises. But, we should vary between the two on a regular basis.

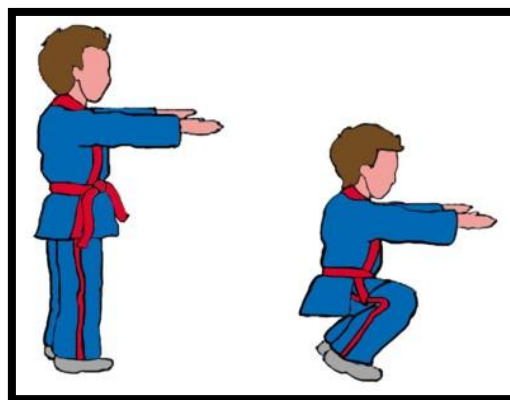


Fig. 7: Squats

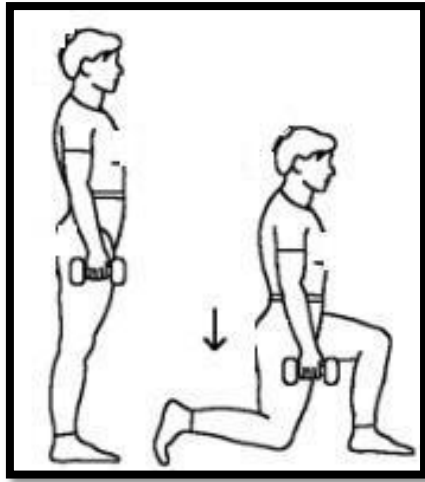


Fig. 8: Lunges

Advantages of Closed Chain Activities:

- Stimulation of proprioceptors
- Increased joint stability
- Decreased shear forces
- Enhanced dynamic stability
- It is also more functional

Closed Chain Exercise For Legs and Knees

Standing weight Shift: (fig.9) Stand with your feet shoulder width apart, weight equally distributed, and knees slightly flexed. Shift your bodyweight so that it is all on your right leg, although you keep both feet on the ground. Hold five seconds, then shift so your weight is transferred to your other leg and hold for five seconds. Shift back and forth, and continue for one or two minutes.

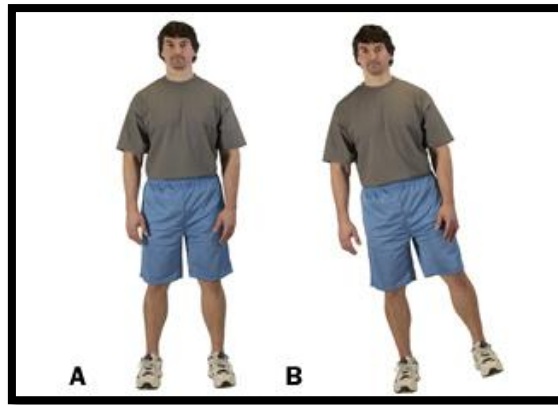


Fig. 9: Standing weight Shift

Quad Dips (mini squat) fig. 10: Stand with your feet shoulder width apart, using a door frame or counter top for balance, at first. Slowly flex your knees about 20 to 30 degrees and hold for 10 seconds. Then straighten up to full extension. As you flex and go into bent knee positions, be sure you keep your knees straight out in front over the top of your foot, and not allow your knee to bend inward toward your big toe. Start with a few reps and build up as much as you can tolerate.

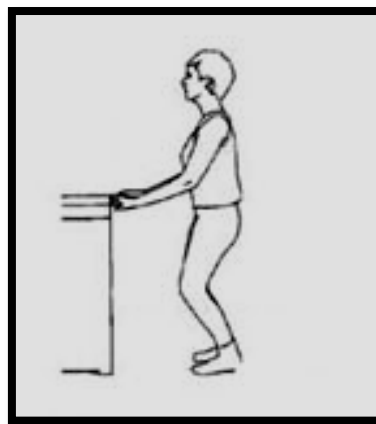


Fig. 10 : Quad dips

Wall Sits(wall slide exercise) fig. 11 : With your feet about 18 inches from a wall and under your shoulders, lean your back against the wall and slowly slide down the wall until your knees are about 45 degrees flexed. Hold as long as you can then return to your starting position.

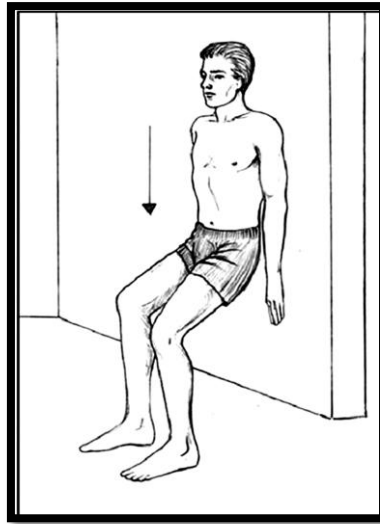


Fig. 11: Wall sit

One-Legged Quad Dips: Repeat the above quad dip exercise, but lift your stronger leg off the floor and perform the exercise with all your weight on the weaker leg. Initially you may need a hand hold to help your balance. Eventually, though, you should progress so that you develop better balance without help.

Lateral Step-Ups (fig. 12): Place a four to six inch block, or a phone book, on the floor, place your foot on the weaker side on the block and lift the toes on your stronger side so that you don't push off with them, then slowly step up on the block and then slowly step down, touching the ground with the heel of your stronger side first. You should do most of the work with your weaker leg, and repeat as you can tolerate and slowly build repetitions.



Fig. 12: lateral step up

Stork Stand: Stand on your weaker leg, holding the other leg in the air and your arms by your sides. Close your eyes and hold your balance as long as possible. Repeat several times.

Terminal Knee Extension fig.13: from standing use theraband or any elastic material around your knee .While the knee is flexed slightly , pull your knee back ward against the theraband

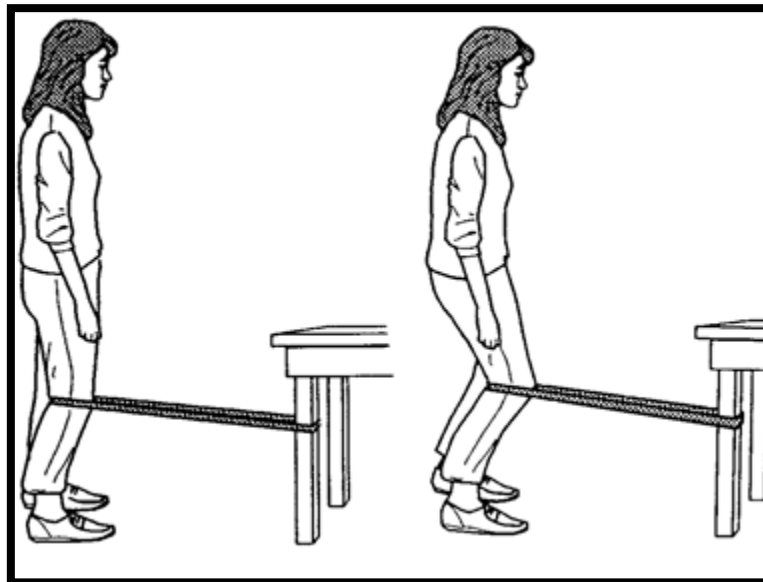


Fig.13: terminal knee extension

Together with squats and lunges, you should find this routine very helpful for building leg strength, and can aid your rehabilitation from a knee injury

Closed Chain Upper Body Exercises

A **push-up**, or **press-up**, is a common exercise performed in a prone position by lowering the body using the arms. Fig. 14

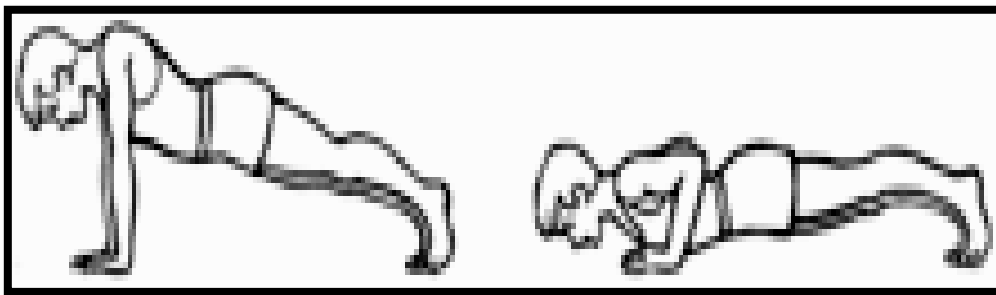


Fig. 14: push up exercise

The handstand push-up (press-up) fig.15: also called the **vertical push-up (press-up)** is a type of push-up exercise where the body is positioned in a handstand. For a true handstand, the exercise is performed free-standing, held in the air. To prepare the strength until one has built adequate balance, the feet are often placed against a wall, held by a partner, or secured in some other way from falling. Handstand pushups require significant strength, and also balance and control if performed free-standing.



Fig.15: handstand push up

A **pull-up** (fig.16) is an upper body pulling exercise where the body is suspended by the arms, gripping something, and pulled up with muscular effort. As this happens, the wrists remain in neutral (straight, neither flexed nor extended) position, the elbows flex and the shoulder adducts and/or extends to bring the elbows to or sometimes behind the torso (trunk).



Fig.16 : pull up