Open vs. Closed Kinetic Chain Exercises for Rehab

By Matthew Lane, DC, MS, CSCS, ART

When beginning any rehabilitation program, the goals and desired outcomes should be pre-determined by both doctor and patient. Once these goals have been assessed, the next phase in the development of a rehab or strengthening program should be the prescription of exercises that will allow the patient to progress and reach their full recovery potential. If prescribed accurately, the patient /athlete may even reach a level of health and performance beyond what they could achieve prior to injury.

Many chiropractors, physical therapists and occupational therapists choose to utilize closed kinetic chain exercises initially in a treatment plan, with the option of progressing to open kinetic chain exercises that allow a greater range of motion and degree of freedom in the desired joint or kinetic chain. There is currently some disagreement among professionals as to which form of exercise is more effective at improving a patient’s condition and which should be utilized in the progression of a treatment plan.

A closed kinetic chain exercise can be defined as an exercise performed with the hand (for arm movement) or foot (for leg movement) in a fixed position. 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 whereby the patient utilizes their own body-weight and/or external weight.

Closed-chain exercises have been shown to require graded, coordinated and sequential muscle activation to govern joint movements; co-contraction muscle activation to govern stability; and emphasis on proprioceptive feedback to initiate and control the muscle activation sequence. Thus, from a functional prospective, they are more beneficial in the rehabilitative process than open-chain exercises.²

Some believe that only closed-chain exercises should be used in any kind of physical development program because they reduce the risk of injury and allow for greater utilization of muscles surrounding the joint. However, others argue that open-chain exercises – which, unlike closed-chain exercises, allow for freedom of movement of the hand or foot, typically at the elbow or knee joint – are more optimal for developing athletic prowess and should be incorporated as soon as possible into a rehab program.
A study by Bakhtiary and Fatemi assessed the conservative treatment of patellar chondromalacia, the softening and breakdown of the cartilage that lines the underside of the knee. One recommended treatment for patellar chondromalacia is strengthening of the quadriceps muscle. The quadriceps can be trained via either a closed- or open-chain exercise. Bakhtiary and Fatemi examined the effectiveness of the open-chain straight-leg raise and the closed-chain semi-squat in 32 female university students with diagnosed patellar chondromalacia.

Q angle, maximal isometric voluntary contraction force of the quads, crepitation, thigh circumference and patellofemoral pain were assessed prior to and after a three-week rehab program. Results showed decreased Q angle, and crepitation, and an increase in strength of the quadriceps, in the closed-chain exercise group compared to the open-chain exercise group. Both groups showed a decrease in patellofemoral pain. This study may be perceived as significant, as the closed-chain exercises provided a decrease in Q angle and an increase in quad strength, which may prevent further knee complications and enhance stabilization.

Typically, most rehabilitation protocols begin with closed-chain exercises because of the belief that they not only enhance the body’s capability to produce stability, but also allow the muscles to provide the optimal amount of exertion around the joint and encourage proper centration. Functional joint centration, as defined by Dr. Pavel Kolar, implies maximum load-bearing or the best possible distribution of the load at the articular surfaces during each position in the course of a movement. This ensures the ideal path of instantaneous center of rotation during the movement. Centration results in balanced function of muscular activity at any moment of time during the movement. Many closed-chain rehab protocols are encouraged by dynamic neuromuscular stabilization (DNS) methods, according to Kolar, who is a leading physiotherapist and director of the rehabilitation department at University Hospital Motol in Prague.

That said, there is a necessity for open-chain exercises in certain sports, especially throwing events, when the goal is to advance the athletes or the general population patients to a greater degree of open-ended range of motion.

A greater degree of controversy exists when evaluating strengthening exercises for the shoulder joint. Most rehabilitation programs for the shoulder joint involve open-chain exercises, due to the fact that most athletic events that involve the shoulder are open kinetic chain activities such as throwing or serving. The rationale is for training and rehabilitation of the shoulder joint to approximate the actual event as much as possible to
make it more "functional." However, closed-chain exercises around the shoulder joint do encourage co-contraction force couples at the scapulothoracic and glenohumeral joints, which promotes proper centration and stability.\textsuperscript{2} This also forces the rotator cuff to confer concavity and compression, and a stable instantaneous center of rotation.\textsuperscript{2} Closed-chain exercises have also been shown to produce almost no translation, shear or distraction loads on the repaired tissues of the shoulder.\textsuperscript{2} Thus, the rehab process can begin earlier and with less demand on the recovering tissue around the shoulder joint.

Both closed kinetic chain and open kinetic chain exercises can play an important role in a rehabilitation program. Closed-chain exercises allow for faster program initiation with less stress on the surrounding tissue. This is desirable for any practitioner who understands the necessity of initiating active modalities as soon as the body can tolerate it. Open-chain exercises allow for a greater degree of range of motion and can be sport-specific based on the patient’s primary athletic activity. The decision of which type of exercise to prescribe should be well-thought-out and designed to allow for greater progression while maintaining safety and proper mechanical sense.

References


Dr. Matthew Lane, a graduate of Cleveland Chiropractic College - Kansas City, practices in Shawnee, Kan., at F.I.T. Muscle & Joint Clinic. Contact him with questions and comments regarding this article via e-mail: drlane -at- fitmjc.com.