Single Kinetic Exercise Vs Chain Kinetic Exercise - A new approach of kinetic chain exercises characterization

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Headline

In the field of training and rehabilitation, we use the terms of open and closed kinetic chain, to characterize an exercise we use and prescribe.

The concept of the kinetic chain, also known as a kinematic chain, is used to describe the human movement. The adapted term of "chain" suggests that we may have a number of rigid, overlapping segments in the body, connected by joints, producing levers and collectively created a mechanical system which propagates the muscle force and generate movement (1). During the activity, a movement at one joint, affects the movement at another joint, close and far from the first joint segment in a kinetic link. Based on this overall concept, movements and exercises use to be classified as open kinetic chain (OKC) or closed kinetic chain (CKC), with distinct advantages and weaknesses of each one (1,2).

The usual thesis, characterizes an exercise as an open kinetic chain (OKC), when the segment furthest away, known as the distal segment, from the body is free and not fixed to an object or stable surface. The distal segment for the kinematic chains of upper and lower limb, is typically the hand or the foot, respectively. Using a OKC exercise, we achieve an isolate muscle activation, improving strength and increasing range of motion. It is obvious, that we speak for a focused single joint movement, with the rest joint links of the chain, distally and centrally, not to be involved (3).

On the other side, closed kinetic chain (CKC) exercises are movements where the furthest segment, or distal aspect of a limb, is fixed to an object that is stationary, such as the ground or a solid surface. In this case, the completion of the required movement/drill, involves work from multiple joints and muscle groups in the body at once. As a training output, we can achieve an overall improving on balance, stability, and strength. A CKC exercise offers functional stimulation, because requires muscles activation that is both coordinated and sequential to create the ideal joint movement (3,4).

Aim of the paper

Based on these, the question often arises, is how we could objectively characterize an exercise during its execution, following the concepts of open and closed kinetic chain.

Discussion

In the examples below (Fig.1 & 2), we have the execution of the exercises, Dumbbell flies (DF) and Dumbbell bench (DB), respectively. Based on the common approach so far, both will be characterized as open kinetic chain exercises.

Observing both cases, if we calculate their kinematic manifestation, combined with their kinetic (dynamic) activation, we have two different approaches. DF is performed through the movement exclusively of the shoulder joint and through the activation of the synergistic muscles that strictly perform the pattern of horizontal adduction (upper and lower pectoralis major, anterior deltoid and biceps brachii short head, muscles) (Fig .1). On the other hand, DB is performed through the sequential movement of the shoulder and elbow joints and through the sequential activation of synergists and antagonist muscles (pectoralis major, anterior deltoid and triceps brachii) (Fig .2).

In any case, the motor system must generate movements that are adaptive and that accomplish those two exercises, through the activation of the specific muscles. In order to coordinate the signals to many muscle groups, the motor system determines the necessary forces and coordination at each joint involved, in order to produce the final, smooth motion of the arm (5). This coordination is supported by the proprioceptors located at the joints and muscle-tendon units, which inform the motor control, of the length of muscles and the forces being applied to them. Eventually, it uses this information to calculate joint position and other variables necessary to make the appropriate movement, while constantly produces postural adjustments in order to compensate for changes in the body's center of mass during the execution. In parallel to the use of proprioception to sense the position of the body before a movement, the motor system uses the sensory feedback in order to perform the movement accurately (5).

It is clear, therefore, that in the two cases of our exercises, there is a different approach in relation to the execution and completion of each one, based on the number of joints involved and the activity identity of the muscles involved (flexors-extensors), during the execution. The most complex (multi joint) exercise DB, requires during the execution, the antagonistic muscles to exert opposing forces on the elbow and shoulder joints and distinct temporal patterns of their activation drive different motor outputs according to exercise (5,6). Additionally, the execution of the exercise require joints be stabilized rather than rotated, necessitating the simultaneous contraction of relevant antagonist muscles (6). These antagonist alternations and co-contractions involve different patterns of spinal circuit engagement, and motor cortex has been implicated in each, through sensory feedback from the working muscles, who activate spinal circuits that inhibit the motor neurons of antagonist (7,8). In the case of the monoarticular

DF exercise, the execution conditions require only joint stabilization through the cocontraction of antagonist muscles and unilateral activation of synergistic muscle groups (horizontal adductors), thus, lower corticospinal processing (9,10).

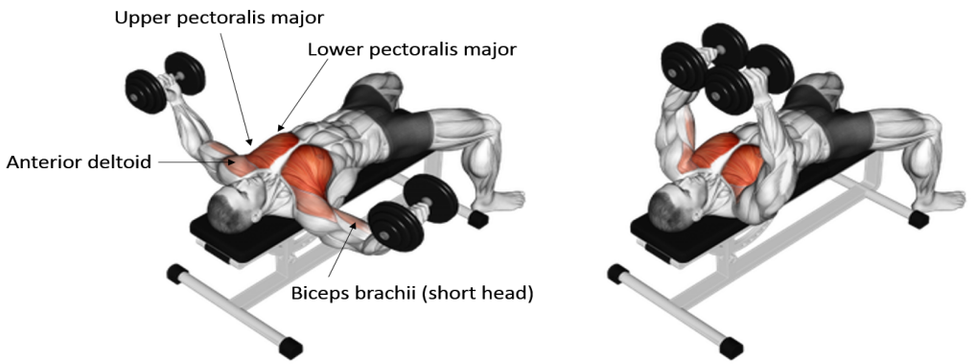

Fig. 1. **Dumbbell Flies**

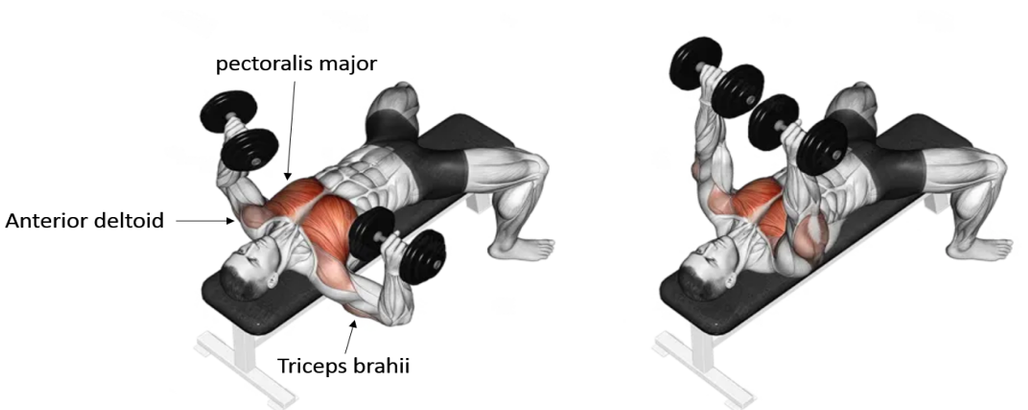

Fig. 2. **Dumbbell Bench**

Practical applications

Concerning the above, we propose to characterize the strengthening exercises, based on the number of joints involved during execution, characterizing as Single Kinetic Exercise (SKE) the one you perform through the mobilization of a single joint and Chain Kinetic Exercise (CKE), the one you perform through the mobilization of at least two joints. Included in this distinction are all the other characteristics and effects of open and closed kinetic chain exercises, as they are known so far.

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