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Accentuating Muscular Development Through Active Insufficiency and Passive Tension

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MANY ATHLETES AND PHYSIQUE competitors attempt to isolate their muscles during training. The reasons for doing so include improving muscular symmetry, correcting strength imbalances, and/or rehabilitating an existing injury. It is important to realize, though, that strict muscular isolation is, for all practical purposes, impossible under loaded conditions; there simply is no way to fully activate a muscle without involving other synergists in the activity.

Fortunately, there are several techniques that provide the ability to target individual muscles or even emphasize specific parts of a muscle. For instance, you can use single-joint movements rather than compound movements during training. This reduces the involvement of supporting and stabilizer muscles, focusing more on the prime mover. Changing the angle of a movement (e.g., incline presses versus flat presses) is another way to accentuate muscular development. This works by placing a muscle in a position to directly oppose gravity. In certain cases, simply varying hand spacing can allow a muscle to contract more in line with certain muscle fibers as opposed to others (e.g., performing wide grip lat pulldowns versus close grip lat pulldowns).

While these techniques can certainly be effective, there are 2 strategies that often are overlooked: passive tension and active insufficiency. Active insufficiency refers to the condition where a 2-joint muscle is shortened at 1 joint while a muscular contraction is initiated by the other joint. Because of the weak contractile force of a muscle when its attachments are close together, the muscle is at its lowest point on the length–tension curve and therefore its capacity to produce force is diminished. Conversely, passive tension is achieved when a 2-joint muscle is elongated at 1 joint while producing motion or force at the other joint (5). This produces a favorable length–tension relationship and therefore maximizes the capacity of a muscle to produce force. As an analogy, think of a slingshot; you can propel an object a lot further when the rubber band is taut than when it is slackened.

The following are some of the major muscle groups where these techniques can be applied.

Calves

The triceps surae (gastrocnemius and soleus) are the primary plantar flexors of the ankle joint and make up the bulk of the muscular mass in the calf region. The gastrocnemius originates at the distal femur and fuses with the Achilles tendon to insert at the calcaneus; thus, it crosses both the knee and ankle joints. The soleus, on the other hand, has its origin at the tibia and its insertion at the calcaneus, making it a single-joint muscle.

Because the gastroc crosses the knee joint, it is stretched when the leg is straightened. Accordingly, any calf exercise performed in the straight-legged position (such as donkey calf raises, standing calf raises, etc.) will produce passive tension in the gastroc and thereby increase its force production (6). Conversely, when the legs are bent, the gastroc becomes slack and loses a substantial amount of its ability to produce force. So any calf exercise per-

formed with the knees flexed at a 90° angle (i.e., seated calf raises) will render the gastroc actively insufficient and the majority of the work will be performed by the soleus (1).

Hamstrings

The hamstring muscles (semitendinosis, semimembranosus, and long head of the biceps femoris) cross both the knee and hip joints (the short head of the biceps femoris only crosses the knee and therefore is actually not part of the hamstring complex). The muscle complex has 2 distinct functions: to extend the hip and to flex the knee. It therefore follows that, by flexing at the hip during leg curl movements, passive tension is created. Accordingly, by using a lying leg curl machine with an angled surface (in the prone position, the body is bent at the hip) or assuming a position of forward flexion during the performance of standing leg curls, you will maximize hamstring involvement. On the other hand, in the performance of hip extension movements (such as stiff-legged deadlifts and good mornings), passive tension is applied to the hamstrings by eliminating any bend at the knee. While a slight degree of knee flexion can be beneficial in reducing patellar forces, optimal hamstring activity is achieved by keeping the legs as straight as possible without locking out the joint.

Biceps

Along with the brachialis and brachioradialis, the biceps brachii are the primary flexors of the elbow joint. As the name implies, the biceps has 2 distinct heads. The short head attaches at the coracoid process on the anterior part of the scapula while the long head attaches at the supraglenoid tubercle of the scapula. The fibers associated with both heads mesh together to form the bicipital tendon, which in turn inserts on the radius.

Because the long head of the biceps crosses over the glenohumeral joint, it assists in both flexion and abduction of the shoulder (3). The short head, with its attachment on the anterior scapula, does not significantly contribute to these actions. With this in mind, the long head can be passively tensed by bringing the shoulder into a position of hyperextension (as in an incline curl). This permits the long head to exert maximal force and carry out a greater portion of the workload during elbow flexion. On the other hand, by placing the shoulder into flexion, the long head becomes actively insufficient, allowing the short head to play a more dominant role (4). The short head can also be stressed by abducting the shoulder and performing loaded elbow flexion (as in a high cable curl performed in a cable crossover apparatus).

Triceps

The triceps brachii are the primary extensors of the elbow joint. As the name implies, the triceps complex has 3 distinct heads. The lateral and medial heads attach proximally on the humerus, making them pure elbow extensors (they are single-joint muscles). The long head, on the other hand, attaches proximally at the scapula just inferior to the head of the humerus, and therefore it crosses the shoulder joint. The 3 heads join and form a common tendon that attaches to the ulna.

Because the long head of the triceps crosses the shoulder joint, passive tension is created when the shoulder is held in a flexed position (i.e., the arm is raised and the elbow points toward the ceiling). Since the long head crosses the shoulder joint, it becomes stretched in shoulder flexion and therefore can exert more force than the other 2 heads (2). Conversely, the medial and lateral heads are more active during movements where the shoulder is extended (i.e., held at the sides). This renders the long head less active, which in turn allows the remaining heads to accomplish a greater amount of work. When the upper arms are slightly hyperextended (brought behind the torso), the effect is even more pronounced and even better isolation is achieved. Thus, an exercise such as the triceps kickback will allow for maximal involvement of the lateral and medial heads.

Conclusion

In sum, active insufficiency and passive tension are powerful strength training techniques. When implemented in the appropriate manner, they can help selectively target various muscles and thereby optimize muscular development. Applying these concepts to achieve a given result is where the science of exercise truly becomes an art! ▲

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