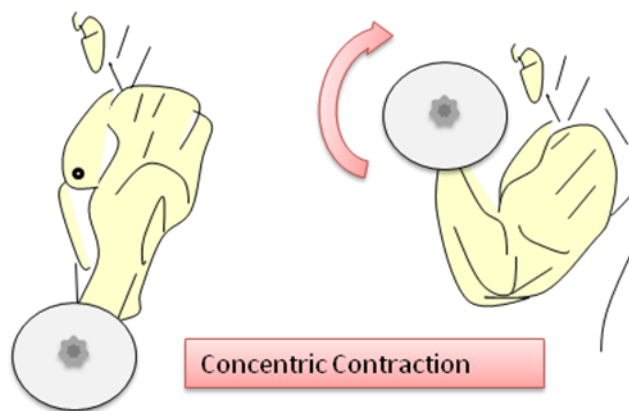


# Acute Training Variables, Muscle Growth, Strength, and Power – Muscle Action

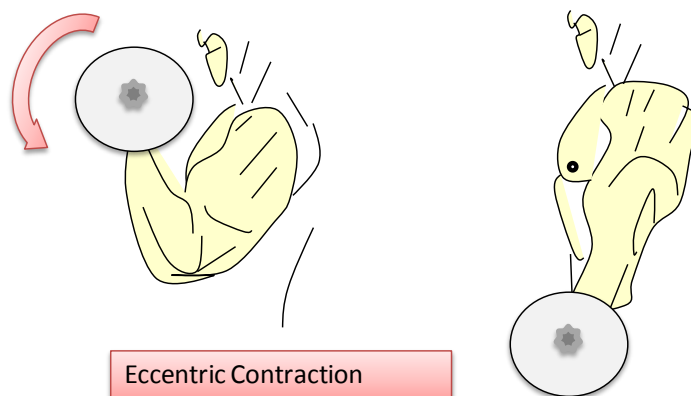
Researched and Composed by Jacob Malachi Wilson\*, M.S., PhD. Candidate, C.S.C.S.

## Muscle Action

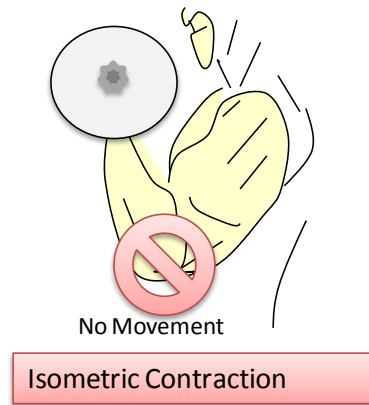
Muscle action refers to the type of contraction elicited and can be generally divided into concentric, eccentric, and isometric contractions.



**Figure 1.0A** In a concentric contraction the individuals lifts the weight, and in the process shortens the muscle



**Figure 1.0B** In an eccentric contraction the individuals lowers the weight, and in the process lengthens the muscle



**Figure 1.0C** In an isometric contraction the individual holds the weight in one place, contracts, but does not move the muscle. For example: squeezing at the top portion of a biceps curl.

The following paragraphs will analyze the effects of each contraction in terms of hypertrophy, strength, and power.

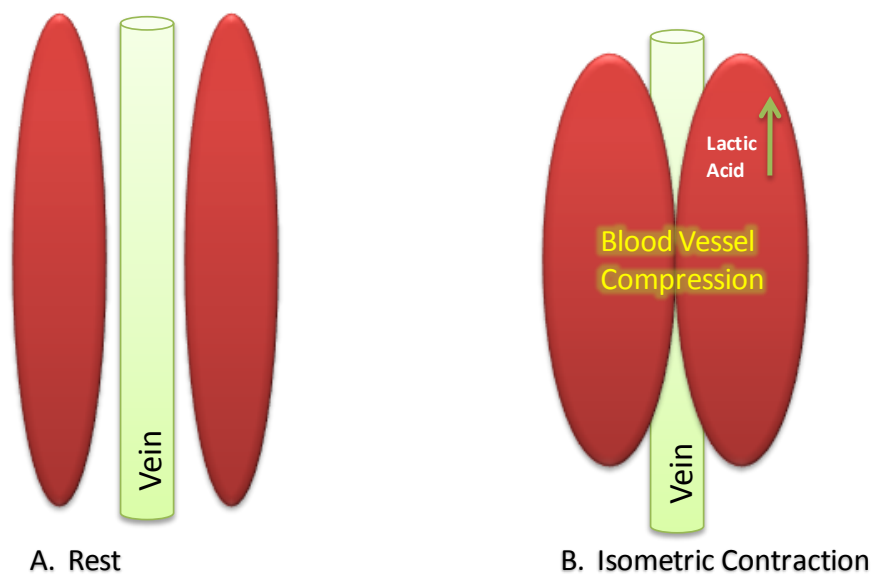
### Concentric vs. Eccentric contractions

Concentric contractions occur when you shorten a muscle such as during the up phase on a squat, while eccentric actions occur on the lowering phase of a movement when the muscle is lengthening. Studies are very clear, eccentric contractions produce more strength and muscle growth than concentric contractions<sup>1</sup>. Eccentric contractions basically change the local environment to favor muscle growth over concentric contractions. For example, studies show that eccentric contractions produce more mechanogrowth factor<sup>1</sup>, raise protein synthesis to a greater extent<sup>2</sup>, lower protein degradation<sup>3</sup>, and increase the machinery (ribosomal proteins) responsible for protein synthesis to a greater extent than concentric contractions<sup>3</sup>. Further bodybuilding is dependent on actually remodeling muscle tissue, and evidence suggests that eccentric contractions actually trigger the remodeling process, possibly due to their greater ability to induce muscle fiber damage<sup>4, 5</sup>. However, most exercise programs include both lowering and shortening contractions, and so eccentric contractions are generally emphasized as much as concentric contractions. The data presented in this article however provides support for the use of incorporating forced

negatives following a set as a means to increase muscle growth. It also demonstrates why people who fling weights around using momentum, and who allow gravity to take the weight down instead of resisting the weight generally experience poor gains in muscle size and strength.

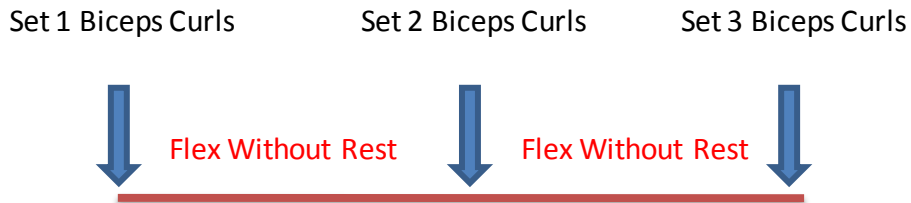
## Isometric contractions

Isometric actions occur when an individual contracts without actually shortening the muscle. Gripping a weight and flexing in a muscle in a stationary position are examples of isometrics. Isometric contractions by themselves do very little for muscle growth, and generally only cause increases in strength or power at the angle used<sup>6</sup>. However isometric contractions are effective at occluding blood flow. Recently my colleagues Layne Norton, Gabriel Wilson and I wrote an article for Ironman Magazine on blood flow occlusion, in which you wrap a muscle group with a compression band in order to shut down blood flow to the muscle.



**Figure 2.0** Effects of isometric contraction on blood vessel compression.

Lowered blood flow decreases oxygen in the muscle, crippling its ability to clear lactic acid (a byproduct of muscle contraction). Lactic acid is a powerful stimulator of GH<sup>7</sup>, and therefore studies using blood occlusion demonstrate large increases in both GH, and muscle growth<sup>8-11</sup>. Isometrics completely occlude blood flow at around 65 % of maximal contraction (moderately hard contraction)<sup>12</sup>.



**Figure 3.0** Example of an isometric, hypertrophy oriented protocol.

Thus, following an intense exercise set, instead of allowing muscles to relax, a bodybuilder might flex and hold the muscles they trained, preventing lactic acid from being cleared, and raising the growth hormone response. For example: standing barbell curls super-setted with static flexing of the arms, followed immediately without rest by another set of barbell curls.

**Table 1.0 Take Home Messages for Muscle Action's Effects on Hypertrophy, Strength, and Power.**

- ❖ **Generally a combination of both concentric and eccentric contractions, as in a normal upward and downward lift is recommended. However, because eccentric contractions appear to promote greater muscle growth, protein synthesis, and skeletal muscle remodeling it is recommended that eccentric only training be incorporated into an individual's routine. This can be used at the end of a set, or as an eccentric only set using greater than average loads.**
- ❖ **Isometric contractions should not be used to increase overall strength or muscle size by themselves. However, if you flex (a form of isometric contraction) between normal weight lifting sets you will occlude blood flow to the target muscle, thereby lowering the oxygen availability in that muscle and trapping lactic acid in the area. Increased acidity is a powerful stimulator of protein synthesis and hormones and thus can serve as an effective stimulus for muscle growth.**

## References

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