**Weight Training Causes Muscle Damage and Inflammation**

Of all types of exercise, weight lifting generally requires the greatest amount of recovery time, which is the period of time you need after lifting weights for the body to fully recover its strength and to be ready for another bout of lifting. This article will touch on what happens when weight training causes muscle damage and inflammation.

**Weight training typically causes muscle damage**

Lifting weights differs from other types of exercise in that it typically causes muscle damage. I say “typically” because just moving a few weights around, as so many do, won’t damage muscles. But an intense set of repetitions with a heavy weight, done to muscular failure, does cause damage.

It’s often categorically stated that muscles only grow via damage like that inflicted by weight training, but that doesn’t appear to be true. Weight training affects muscles in a number of ways, for instance by activating the molecular machinery for growth, notably mTOR.

Damage does seem to be necessary to activate muscle satellite cells, which are muscle precursor (stem) cells, necessary for adding new muscle cells.[1. Kadi, Fawzi, et al. “The effects of heavy resistance training and detraining on satellite cells in human skeletal muscles.” *The Journal of physiology* 558.3 (2004): 1005-1012.] After 30 and 90 days of resistance training, the number of satellite cells in muscle fibers is greatly increased.

Damage, as to be expected, makes a muscle weaker until the damage is repaired.
Creatine kinase (CK), an enzyme marker of muscle damage, increases in the bloodstream in the days after a bout of resistance training, due to leakage of the enzyme from damaged cells.[2. Howatson, Glyn, et al. “Exercise-induced muscle damage is reduced in resistance-trained males by branched chain amino acids: a randomized, double-blind, placebo controlled study.” Journal of the International Society of Sports Nutrition 9.1 (2012): 1.] Check out the graph below, which shows an increase in CK, greatest at 24 hours post-training, and subsiding until it returns to normal in about 4 days.

Side note: when someone has a heart attack, the heart muscle is damaged, and a blood test for CK can be used to determine whether the heart has been damaged, i.e. whether a heart attack has been taken place.

Muscle soreness increases after training, reaching a peak at 48 hours. See chart below.
This is “delayed onset muscle soreness” or DOMS. I refer to the day that comes two days after my workout as DOMS Day.

When muscle is damaged, it also becomes weaker, and this lasts several days. See below.

Muscles don’t return to normal until about 4 days after hard training.

**Why do I feel like crap the day after a workout?**

Weight training also acutely increases inflammation, which is a necessary aspect of muscle growth. Cytokines, small messenger molecules, increase inflammation and can be measured after resistance training.[3. Trenerry, Marissa K., et al. “STAT3 signaling is activated in human skeletal muscle

The chart below shows the increase in gene expression of cytokines following a bout of resistance training.

![Graph A](chart_a.png)  ![Graph B](chart_b.png)  ![Graph C](chart_c.png)  ![Graph D](chart_d.png)

Inflammatory cytokines are important in what is known as “sickness behavior”. When you’re sick, your body tells you to rest, and you feel fatigued and depressed. In clinical depression, much the same thing happens. Inflammatory cytokines are behind both sickness behavior and depression. [4. Maes, Michael, et al. “Depression and sickness behavior are Janus-faced responses to shared inflammatory pathways.” *BMC medicine* 10.1 (2012): 1.]

Now you know why you can feel so awful in the days following a hard workout. Inflammatory cytokines increase, giving rise to sickness behavior and depressed mood. In addition, muscles are weaker.

**Can you speed recovery?**

You can do a few things to speed recovery.

As can be seen in the graphs above, branched-chain amino acids (BCAAs) increase strength and decrease CK and muscle soreness in the days after exercise. In the study, participants took 10 grams of BCAAs, twice a day, which is a fairly hefty amount.  

Whey protein contains a large fraction of BCAAs, about 25%. Or you could [supplement with BCAAs](http://www.example.com/).

Unfortunately, inflammation is a necessary process to muscle growth, and dampening it may negate some of the muscle growth you want from weight training.

Non-steroidal anti-inflammatory drugs (NSAIDs), such as aspirin and...

This is probably the same effect seen in the effect of cold exposure after training, in which immersion in cold water strongly inhibited measures of muscle growth. Cold water immersion lowers levels of inflammation, and this in turn inhibits muscle growth.

So, beyond providing muscles what they need to grow, namely protein, whey, and/or BCAAs, if you want the benefits of weight training, you may just have to suffer through the recovery period.

**Conclusion**

Weight training causes muscle damage and inflammation, and these require several days of recovery.

These processes are intrinsic to muscle growth.

Whey protein and BCAAs can speed recovery, but lowering inflammation interferes with muscle growth.

**PS:** For more, read my book, Muscle Up.

**PPS:** Check out my Supplements Buying Guide for Men.