

MACHINE VERSUS FREE WEIGHTS

Jeffrey M. McBride, PhD, CSCS



This paper was presented as part of the NSCA Hot Topic Series.

All information contained herein is copyright© of the NSCA.

www.nasca-lift.org

INTRODUCTION

A common question among recreational weight trainers is whether to use machine or free-weight exercises. The term “machines” usually refers to resistance training devices that have cables, pin loaded weight stacks or fixed lever arms. Free-weights encompass dumbbells and plates that are typically loaded on to the end of a barbell. Free-weight exercises are performed usually on utility benches or squat racks. The most obvious difference between the two is that free weight lifting better simulates real-life movement patterns. For example, lifting a suitcase or bag of groceries is basically the same as lifting a dumbbell or barbell from the floor of a weight room. This has a desirable effect in that free weights mimic what is called “free-form.” Meaning, lifting a free weight requires the same type of forces and muscle activity that is common to everyday activities and athletic endeavors as well. Machine exercises are less like real life activities in that they supply resistance in a more controlled and coordinated fashion. However, the benefit is that technique becomes less of concern because most the motions are “guided” for the lifter. The lifter simply pushes or pulls the weight and the machine determines the direction the weight will go. Machines also offer the benefit in terms of user friendliness. They typically have pin-loaded weight stacks, comfortable seats and are easy exercises to perform with little or no professional instruction. Let’s examine a couple of issues and challenges facing both free weight and machine exercises.

MUSCLE HYPERTROPHY

The term “muscle hypertrophy” refers to the process by which your muscles grow and get stronger and is commonly one of the most desired effects of lifting weights. In essence, muscles grow in response to the degree of loading placed upon them. So, in reality, it doesn’t really matter how the loading is placed on the muscle just as long as it is sufficient to stimulate the muscle to be active. If muscle hypertrophy is your only concern it probably doesn’t make a big difference if you use machines or free weights to achieve this goal⁷. The important factor is to provide sufficient overload to the muscle by lifting heavy weights. Bodybuilders, for example, typically use a wide variety of machine and free weight exercises to get bigger muscles. They use many different exercises to make sure every muscle in their body is being stimulated to grow. However, there is still one drawback to using a machine exercise as opposed to a free weight exercise to stimulate muscle growth. As mentioned



earlier, free weights involve free-form which requires you to use more muscles for a given exercise. For example squatting with a barbell requires you to balance the weight on your back, to balance yourself (so you don't fall over) and thus requires a lot more muscle activation than a machine exercises⁵. Improvement in bone mineral density has also been shown to be greater with free weight training⁶. These studies indicate that there might be some additional benefits in using free weight exercises over machines.

NERVOUS SYSTEM

Most people don't realize that your strength level is not just determined by how big you muscles are, but also by your nervous system. Your nerves adapt to resistance training just like your muscles do. Their structure and function change to allow you to lift more weight⁸. Due to free-form involved with training with free weights it is likely that the stimulus to the nervous system is greater than with machines⁶. There are some studies that indicate that strength gain due to free weight training is more beneficial to the performance of daily tasks or athletic activities as well^{2,3,4}. However, there is a balance between how much free-form you want to have. For example, performing a free weight squat allows for increased muscle activation and force production, but, if you squat while standing on a wobble board or balance disk your force production and muscle activity actually goes down¹. Free weights appear to be a nice compromise between creating free-form, yet still allowing for maximal muscle activity and force production which is absolutely necessary for increasing muscle strength by properly stimulating the nervous system.

PRACTICAL CONCERNS

Beyond whether free weights versus machines are better for increasing your muscle strength, there are also some other practical concerns as well. For example, free weights tend to be less costly and take up a lot less space than machines do. In addition, machines have limitations in terms of how they fit each person. If you are very tall or very short you may not fit very well into a machine that is designed for someone of a more average body size. Many new machine exercise devices can cost thousands of dollars in comparison to the relatively meager expense of a barbell and some weight plates. However, as mentioned earlier machines can be easier to use and usually require a lot less professional assistance to get started. You don't have to worry about loading and unloading weight plates or moving bars and dumbbells. This is probably the most significant reason for machine exercise



devices. They tend to be easier to use and don't often times require a spotter or assistant to help perform the exercise. It is important to remember, however, that injury and improper form can occur with the use of either free weight or machine exercises. So it is always important to receive proper instruction from strength and conditioning specialist whenever starting a weight training program. One of the final concerns in using free weights or machines is the cost and effort in maintaining the equipment. Free weights tend to require a lot less maintenance. Machines often have many moving parts, including cables, straps, pulleys, etc. If machines are not cared for properly it can potentially result in injury to the user. Frayed cables or broken pulleys are a recipe for disaster in the weight room.

CONCLUSION

One may conclude, therefore, that the greatest benefit of machine exercises is their ease-of-use, but remember that for increasing muscle strength for general fitness and quality of life, free weights most likely have the advantage. If you have access to both there is no reason that a combination of using both free weights and machines cannot be implemented. Some exercises might be more easily performed on a machine versus a free weight device, so there is no reason why a machine exercise cannot be used in certain situations. One of the most important parts of resistance training is to actually do it consistently and make sure that you are using progressive overload. Don't just go to the gym and put on a light weight and breeze through your workout. Challenge yourself by lifting heavier and heavier weights each time. This is the only way to increase muscle strength and have it contribute to your quality of life or athletic performance.



REFERENCES

1. Behm, D.G., Anderson, K., Curnew, R.S. (2002) Muscle force and activation under stable and unstable conditions. *Journal of Strength and Conditioning Research*, 16(3), 416-422.
2. Brill, P.A., Matthews, M., Mason, J., Davis, D., Mustafa, T., Macera, C. (1998) Improving functional performance through a group-based free weight strength training program in residents of two assisted living communities. *Physical and Occupational Therapy in Geriatrics*, 15(3), 57-69.
3. Jensen, C.R. (1963) Effects of five training combinations of swimming and weight training on the swimming of the front crawl. *Research Quarterly*, 34, 471-477.
4. Lachowetz, T., Evon, J., Pastiglione J. (1998) The effect of an upper body strength program on intercollegiate baseball throwing velocity. *Strength and Conditioning Research*, 12(2), 116-119.
5. McCaw, S.T., Friday, J.J. (1994) A comparison of muscle activity between a free weight and machine bench press. *Journal of Strength & Conditioning Research*, 8(4), 259-264.
6. Maddalozzo, G.F., Snow, C.M. (2000) Effects of two resistance training protocols on insulin-like growth factors, muscle strength, and bone mass in older adults. *Calcified Tissue International*, 66(6), 399-404.
7. Pipes, T.V. (1978) Variable resistance versus constant resistance strength training in adult males. *European Journal of Applied Physiology*, 39, 27-35.
8. Sale, D.G. (1988) Neural adaptation to resistance exercise. *Medicine and Science in Sports and Exercise*, 20(Supplement 5), 135-145.