Maximizing Bicep Muscle Hypertrophy

Ronak Sharma

York University

December 23, 2022

Abstract

Background: Effective hypertrophy-oriented weightlifting produces mechanical tension and we are yet to find maximum efficiency for hypertrophy. Methods: I studied eight humans with various genders and experience in weightlifting, using an EMG machine on each person to test peak muscle contraction and average contraction within the biceps through various exercises (including resistance training) helps in finding the most efficient exercises for hypertrophy in the biceps. Putting the eight people through a constant routine of a HI-RT allowed a constant and fair reading throughout the many workouts, also understanding the maximum weight they can handle since everyone has a different limiting strength in weightlifting and considering pre-exhaustion which is important when testing. Result: *YET TO BE DETERMINED*. Conclusion: *YET TO BE DETERMINED*

Keywords: Hypertrophy, limiting strength, pre-exhaustion, genders, experience, resistance, single set.

Introduction

Strength training and resistance training are commonly used for hypertrophy and achieving certain fitness goals, when looking for these goals it's important to be as efficient as possible to achieve desired results faster and through this research, with the help of an EMG

machine, we can determine the most effective exercises for muscle building in the biceps. Strength training includes a lot of benefits, such as an increase in lean body mass, an increase in metabolic rate, a decrease in risk of injury, and an increase in bone density [1]. Using resistance training (resistance bands) is proven to provide similar results in strength gain compared to using conventional devices [2]. Hypertrophy with the use of resistance bands has not been researched frequently and with this research, we can determine if it can compete with weight training (free weights and machines). Hypertrophy takes place when muscle protein synthesis exceeds muscle protein breakdown which ends up resulting in a positive net protein balance in cumulative periods [3]. Understanding how hypertrophy works, we can conclude that hypertrophy is achievable through resistance training and strength training. There are many variables to be considered when measuring the muscle contraction of the eight people. It is important to understand gender, pre-exhaustion, experience with exercising, strength limit, and amount of sleep. With these variables contributing to the potential contrast in results between each subject, keeping variables such as pre-exhaustion, and amount of sleep constant within every person is important, rest of the variables are something that we are incapable of changing which is why these certain factors are kept in mind when performing every test. We are still in search to find an optimal strategy to maximize our neuromuscular performance [4], this prevents us from ideal measuring under a certain amount of sets and reps, considering this limiting factor, we performed a singular set with eight reps as our main goal is to find peak muscle contraction over various exercises to optimize the choice of workouts rather than searching for an ideal strategy. Finding exercises that mostly have a primary focus on the biceps allows bodybuilders or people looking to achieve certain fitness goals to understand optimal exercises to achieve their goals faster.

Methods

Understanding EMG Readings

The EMG signal is a signal that measures electrical currents generated in muscles during contraction, which represent neuromuscular activities; the machine reads nerve cells which are known as motor neurons. The EMG signal also gains noise while traveling through different tissues, hence why it reads nothing when the muscle is at rest [5]. Surface electromyography amplitude depends on the muscle activation and is typically used to infer the strength of neural drive received by muscles (the machine uses motor neurons) [6]. Using the amplitude given by the machine, we can produce an amplitude over time graph which helps us study contractions for each exercise and also understand the peak contraction for each exercise.

Building The EMG Machine

The material needed for building an EMG machine was a muscle sensor board, EMG cable, disposable surface electrode, Arduino UNO REV3, two 9V batteries, and female to male wires. For the machine to function two kinds of connections are required, the muscle sensor board to the Arduino and the Arduino to any PC or laptop where you are capable of coding the board. Once the code has been finished you can set up the EMG machine onto your bicep and run the program, this will provide an analog voltage which can be changed to a serial plotter.

```
void setup()
{
  Serial.begin(9600);
}

void loop()
{
  float sensorValue = analogRead(A1);
  float millivolt = (sensorValue/1023)*5;

  Serial.print("Sensor Value: ");
  Serial.println(sensorValue);

  Serial.print("Voltage: ");
  Serial.print(millivolt*1000);
  Serial.println(" mV");
  Serial.println("");
  delay(1);
}
```

Discussion

Understanding Activation

High activation during an exercise does not always directly lead to increase in muscle mass. Three important components to muscle growth are eccentric stress, progressive overload, and intensity, out of these three only two of them are significant to this research. In a research performed by Sanmy and Cleiton they tried to prove why resistance training to failure might differently affect muscle adaptations in different populations, the reason for this was because training till failure was still not researched enough to be considered necessary [7]. The meta-analysis for hypertrophy suggests that training till failure or not the increase in similar muscle size can be attained but it's important to consider that the upper limit of the 95%CI in the analysis was 0.55 which is in the range of a large effect [8]. Even if training till failure has not been proven to be significantly better than training without failure the wide 95%CI must be researched in the future to fully understand the benefits of training till failure [8]. There is an exception when training till failure, for experienced resistance-trained participants training till failure had significant effect on muscle hypertrophy, when an individual has reached their genetic ceiling for muscular adaptations, a greater intensity is required to get further gains [8]. When looking at muscle building progressive overload is important, when you manipulate the volume of resistance exercise over several weeks you can influence metabolic and hormonal responses, morphological/architectural changes, and neural adaptations which may alter one's muscle hypertrophy and strength [9]. While progressive overload is known to provide benefits when it comes to muscle building and muscle strength, few exercises are difficult and or take time to progressive overload. When looking at tricep kickbacks the muscle activation is certainly high since this workout isolates the tricep but when building muscle this would not be considered

as the best exercise considering it is difficult to progressive overload since there is minimal leverage when performing this exercise, this also provides no meaningful stretch to the tricep, and because of this high muscle activation does not always directly lead to muscle growth. Eccentric exercises are also known to help with muscle hypertrophy, for beginners eccentric strength training increased muscle mass during the first four weeks [10]. For trained athletes, junior alpine skiers increased their leg muscle mass by 1.9% when replacing one-third of the weekly leg press exercises by eccentric cycle ergometer training for a total duration of six weeks [10]. During this research it was important to understand these three factors in deciding which workouts are the best for muscle hypertrophy. Intensity, progressive overload, and eccentric exercises all play a key role to muscle building which is why high muscle activation does not always result in muscle growth as there are plenty of variables to understand.

Previous Measurement

To attain a percentage on the muscle activation throughout the various exercises, calculating the maximum voluntary contraction (MVC) is important. Using manual resistance on the bicep while measuring allows us to get a reading on the EMG machine which gives us an understanding of the MVC. Without calculating the MVC we are left with a reading for only the exercises performed without having a reference point to compare, having MVC and a reading from the EMG machine allows us to come up with a percentage of the muscle activation for each person being tested.

Training Application

When testing for HI-RT or LI-RT eccentric movement and understanding of potential progressive overloading will determine an exercise's effectiveness. For HI-RT we kept an adequate number of repetitions (8-12) and we implemented normal rest intervals (1-2 minutes),

as well as multiple sets (3-6), this is ideal for hypertrophy. It is proven that a higher RT volume (28-30 sets/muscle/week) is associated with greater increases in hypertrophy [3]. LI-RT is not necessary for this research since the goal is to find the best exercises for muscle hypertrophy and not strength training. A slower tempo of movement during the eccentric phase increases the time under tension which may contribute to greater muscle hypertrophy [3].

Limitations

This research has a few limitations such as nutrition, inaccurate EMG readings, and participants ' performance. When conducting the test the participants' nutrition was not taken into account, factors like protein intake play a factor in one's strength and muscle mass and is well-documented [11]. EMG readings at times are not going to be accurate, factors like sound may manipulate the readings shown as well as the placement of the patches can be inserted onto an area with hair which results in not being extremely accurate. Participants may get tired mid set and not effectively perform the exercise with correct form which is something that we can not control and is natural, hence why it was important for us to do multiple sets.

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