Effects of Vibration Devices on Increasing Muscle Motor Learning

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I. ABSTRACT

For the first few weeks of training, an athlete is able to improve their record on weight training through muscle learning, rather than growth. When athletic improvement is seen, it is rather the muscle fibers learning how to execute a motion more efficiently and effectively, spending less energy or stress on completing a motion. Such is called "muscle learning", rather than muscle growth. With that, some propose that the use of muscle vibration technology will increase muscle learning by increasing neural feedback from the activated muscle group to the brain, essentially helping the body understand what muscles are exactly being activated through a pin-pointed vibration feedback system. In this research, 5 subjects ranging from normal adults to healthy athletes were put under a schedule of data collection, in which they would undergo a week of a regular set of exercises as well as another week of the same exercises with the proper use of muscle vibration devices, or Pulse Devices. With each data collection, the weight of each exercise was not changed as the number of repetitions stood as the only changing variable. In conclusion, the experiment deemed that there was a statistical correlation between increased muscle learning and vibration feedback, as subjects on average had an increase of 11.829742% muscle learning through the use of Pulse Devices. While many factors such as diet and placebo stand as potential factors hindering the dataset, this study was able to observe and conclude the initial hypothesis.

II. METHOD

The basis of this experiment lies in recording increased muscle learning through weight training. The experiment will follow a 3-week schedule. Data will be collected at the beginning and end of each week, specifically with the first and second week. The second week will serve as a cool-down period for data accuracy. On Sunday, the subject will go through the set of exercises and record their personal best. On Saturday, the subject will go through the set of exercises and record their personal best to observe for any improvements. During the week, on assigned days (Monday, Wednesday, and Friday) the subjects will go through their routine exercises at 70% capacity of their maximum performance. During the first week, the subjects will go through their exercise plan without the use of a pulse device – this will serve as the control for the experiment. During the third week, the subjects will go through their exercises with the proper use of a pulse device, both for measurement as well as training throughout the entire week.

Sun -record personal best	Mon -observe personal best -routine exercise (without pulse device)	Wed -observe personal best -routine exercise (without pulse device)	Fri -observe personal best -routine exercise (without pulse device)	Sat -record personal best
Sun -rest period	Mon -rest period	Wed -rest period	Fri -rest period	Sat -rest period
Sun -record personal best	Mon -observe personal best -routine exercise (with pulse device)	Wed -observe personal best -routine exercise (with pulse device)	Fri -observe personal best -routine exercise (with pulse device)	Sat -record personal best

III. PARTICIPANTS

The participants of this experiment are as follows. Participants were chosen from a pool of willing participants ranging from athletes, common workers, students, and bodybuilders. Throughout the experiment, the subjects were advised to keep a consistent meal plan that did not change significantly from week to week.

Subject 1:
A high school student, male.
Age around 17 - 20.
No prior experience with weight training or daily exercise.

Subject 2:
A high school student, male.
Age around 17 - 20.
An athlete experienced with weight training, cardiovascular fitness, as well as a dietary schedule of a regulated athlete.

Subject 3:
An adult, male.

Age around 20-25.
A previous athlete experienced with weight training and cardiovascular fitness.

Subject 4:
An adult, male.
Age around 20-25.
A fitness enthusiast experienced with weight training and cardiovascular fitness works out at least 3 days out of the week.

Subject 5:
An adult, male.
Age around 20-25.
A regular individual who does not participate in daily exercise.

IV. EXPERIMENTAL DESIGN

The experiment will revolve around a set exercise plan, with the vibration device measuring motor learning and muscle growth in the general locomotive areas. For recording the personal best and daily routine exercises, the subject will go through these exercises.

General Area	Specific Muscle Group	Exercise Name
Shoulders	Front Delt	Lateral Front Raise
Arms	Bicep	Curls
Chest	Chest	Bench Presses
Back	Traps	Shrugs
Legs	Quad	Squats with Weights
Back Arms	Triceps	Pushdowns

Exercise	Picture

Lateral Front Raise:	
Curls:	
Bench Presses:	
Shrugs:	

Squats with weights:	
Pushdowns:	

For the third week of the experiment, the vibration device or "PULSE" device will be placed on each according to muscle to the exercise. Below is the chart that shows the exercise along with the device placed on the subjects.

Exercise	Pulse Device Placement

Lateral Front Raise: (Front Delt)	
Curls: (Bicep)	
Pushups: (Chest)	
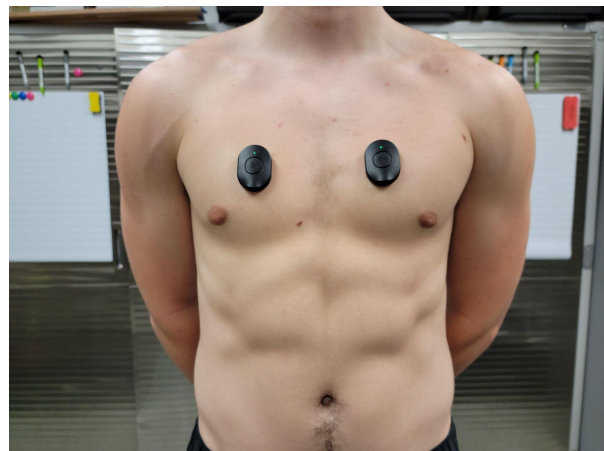
Shrugs: (Traps)	
Squats with weights: (Quad)	
Pushdowns: (Triceps)	

V. MEASUREMENTS / CALCULATIONS

As mentioned previously, the measurement of muscle learning will primarily rely on the "reps" of each exercise. For the sake of data consistency, the weight of each

corresponding exercise will be independent from change, while the number of reps will change according to the personal best of each subject.

One rep indicates a full contraction as well as relaxation of the corresponding muscle group, meaning a full tension and release of each weight during the exercise. The weights (lbs) indicate how much weight is distributed to both or one of the left or right muscle groups. In the case of single-sided weight distribution, the exercises are as follows: Lateral Front Raise, Curls, and Shrugs. In the case of double-sided weight distribution, the exercises are as follows: Bench Presses. Squats with Weights, Pushdowns.

VI. DATA ANALYSIS

Subject 1 (Week 1 - Control)

	Lateral Front Raise	Curls	Bench Presses	Shrugs	Squats with Weights	Pushdowns
Week 1 (Sun / Start)	11 Reps 15 lbs	15 Reps 20 lbs	15 Reps 70 lbs	19 Reps 20 lbs	25 Reps 20 lbs	28 Reps 35 lbs
Week 1 (Sat / End)	15 Reps 15 lbs	26 Reps 20 lbs	15 Reps 70 lbs	22 Reps 20 lbs	27 Reps 20 lbs	32 Reps 35 lbs
% Increase in Reps	11 → 15 36.3636%	15 → 26 73.3333%	15 → 15 0%	19 → 22 15.7895%	25 → 27 8%	28 → 32 14.2857%

% Increase in Reps Mean = 24.62868%

Subject 1 (Week3 - With Pulse Device)

	Lateral Front Raise	Curls	Bench Presses	Shrugs	Squats with Weights	Pushdowns
Week 3 (Sun / Start)	12 Reps 15 lbs	14 Reps 20 lbs	11 Reps 70 lbs	21 Reps 20 lbs	24 Reps 20 lbs	25 Reps 35 lbs
Week 3	17 Reps	28 Reps	16 Reps	21 Reps	31 Reps	28 Reps

(Sat / End)	15 lbs	20 lbs	70 lbs	20 lbs	20 lbs	35 lbs
% Increase in Reps	12 → 17 41.6667%	14 → 28 100%	11 → 16 45.4545%	21 → 21 0%	24 → 31 29.1667%	25 → 28 12%

% Increase in Reps Mean = 38.04798%

Subject 2 (Week 1 - Control)

	Lateral Front Raise	Curls	Bench Presses	Shrugs	Squats with Weights	Pushdowns
Week 1 (Sun / Start)	13 Reps 10 lbs	12 Reps 10 lbs	21 Reps 65 lbs	7 Reps 10 lbs	8 Reps 10 lbs	11 Reps 25 lbs
Week 1 (Sat / End)	12 Reps 10 lbs	17 Reps 10 lbs	22 Reps 65 lbs	8 Reps 10 lbs	17 Reps 10 lbs	13 Reps 25 lbs
% Increase in Reps	13 → 12 -7.69231%	12 → 17 41.6667%	21 → 22 4.7619%	7 → 8 14.2857%	8 → 17 112.5%	11 → 13 18.1818%

% Increase in Reps Mean = 30.61729%

Subject 2 (Week 3 - With Pulse Device)

	Lateral Front Raise	Curls	Bench Presses	Shrugs	Squats with Weights	Pushdowns
Week 3 (Sun / Start)	15 Reps 10 lbs	12 Reps 10 lbs	22 Reps 65 lbs	8 Reps 10 lbs	10 Reps 10 lbs	12 Reps 25 lbs
Week 3 (Sat / End)	18 Reps 10 lbs	20 Reps 10 lbs	25 Reps 65 lbs	10 Reps 10 lbs	9 Reps 10 lbs	24 Reps 25 lbs
% Increase in Reps	15 → 18 20%	12 → 20 66.6667%	22 → 25 13.6364%	8 → 10 25%	10 → 9 -10%	12 → 24 100%

% Increase in Reps Mean = 35.88385%

Subject 3 (Week 1 - Control)

	Lateral Front Raise	Curls	Bench Presses	Shrugs	Squats with Weights	Pushdowns
Week 1 (Sun / Start)	15 Reps 25 lbs	20 Reps 30 lbs	14 Reps 80 lbs	20 Reps 20 lbs	30 Reps 25 lbs	30 Reps 30 lbs
Week 1 (Sat / End)	16 Reps 25 lbs	22 Reps 30 lbs	15 Reps 80 lbs	20 Reps 20 lbs	30 Reps 25 lbs	33 Reps 30 lbs
% Increase in Reps	15 → 16 6.66667%	20 → 22 10%	14 → 15 7.14286%	20 → 20 0%	30 → 30 0%	30 → 33 10%

% Increase in Reps Mean = 5.63492%

Subject 3 (Week 3 - With Pulse Device)

	Lateral Front Raise	Curls	Bench Presses	Shrugs	Squats with Weights	Pushdowns
Week 3 (Sun / Start)	14 Reps 25 lbs	22 Reps 30 lbs	16 Reps 80 lbs	21 Reps 20 lbs	25 Reps 25 lbs	30 Reps 30 lbs
Week 3 (Sat / End)	18 Reps 25 lbs	26 Reps 30 lbs	18 Reps 80 lbs	27 Reps 20 lbs	26 Reps 25 lbs	32 Reps 30 lbs
% Increase in Reps	14 → 18 28.5714%	22 → 26 18.1818%	16 → 18 12.5%	21 → 27 28.5714%	25 → 26 4%	30 → 32 6.66667%

% Increase in Reps Mean = 16.41521%

Subject 4 (Week 1 - Control)

	Lateral Front Raise	Curls	Bench Presses	Shrugs	Squats with Weights	Pushdowns
Week 1 (Sun / Start)	32 Reps 30 lbs	20 Reps 45 lbs	10 Reps 135 lbs	21 Reps 25 lbs	33 Reps 25lbs	36 Reps 50 lbs
Week 1 (Sat / End)	35 Reps 30 lbs	20 Reps 45 lbs	8 Reps 135 lbs	25 Reps 25 lbs	40 Reps 25lbs	42 Reps 50 lbs
% Increase in Reps	32 → 35 9.375%	20 → 20 0%	10 → 8 -20%	21 → 25 19.0476%	33 → 40 21.2121%	36 → 42 16.6667%

% Increase in Reps Mean = 7.7169%

Subject 4 (Week 3 - With Pulse Device)

	Lateral Front Raise	Curls	Bench Presses	Shrugs	Squats with Weights	Pushdowns
Week 3 (Sun / Start)	34 Reps 30 lbs	20 Reps 45 lbs	18 Reps 135 lbs	24 Reps 25 lbs	37 Reps 25lbs	34 Reps 50 lbs
Week 3 (Sat / End)	38 Reps 30 lbs	17 Reps 45 lbs	24 Reps 135 lbs	38 Reps 25 lbs	44 Reps 25lbs	47 Reps 50 lbs
% Increase in Reps	34 → 38 11.7647%	20 → 17 -15%	18 → 24 33.3333%	24 → 38 58.3333%	37 → 44 18.9189%	34 → 47 38.2353%

% Increase in Reps Mean = 24.26425%

Subject 5 (Week 1 - Control)

	Lateral Front Raise	Curls	Bench Presses	Shrugs	Squats with Weights	Pushdowns
Week 1	11 Reps	17 Reps	14 Reps	15 Reps	8 Reps	22 Reps

(Sun / Start)	15 lbs	15 lbs	45 lbs	10 lbs	15 lbs	20 lbs
Week 1 (Sat / End)	18 Reps 15 lbs	25 Reps 15 lbs	20 Reps 45 lbs	16 Reps 10 lbs	10 Reps 15 lbs	30 Reps 20 lbs
% Increase in Reps	11 → 18 63.6364%	17 → 25 47.0588%	14 → 20 42.8571%	15 → 16 6.66667%	8 → 10 25%	22 → 30 36.3636%

% Increase in Reps Mean = 36.93042%

Subject 5 (Week 3 - With Pulse Device)

	Lateral Front Raise	Curls	Bench Presses	Shrugs	Squats with Weights	Pushdowns
Week 3 (Sun / Start)	14 Reps 15 lbs	20 Reps 15 lbs	15 Reps 45 lbs	13 Reps 10 lbs	10 Reps 15 lbs	24 Reps 20 lbs
Week 3 (Sat / End)	19 Reps 15 lbs	24 Reps 15 lbs	26 Reps 45 lbs	20 Reps 10 lbs	20 Reps 15 lbs	27 Reps 20 lbs
% Increase in Reps	14 → 19 35.7143%	20 → 25 25%	15 → 26 73.3333%	13 → 20 53.8462%	10 → 20 100%	24 → 27 12.5%

% Increase in Reps Mean = 50.06563%

VII. RESULTS

From the collected data, the mean % increase in repetitions in each subject shows an increase in muscle learning through the use of muscle vibration technologies. Subject 1 had a controlled increase of 24.62868% with an experimental increase of 38.04798%, a net gain of 13.4193%. Subject 2 had a controlled increase of 30.61729% with an experimental increase of 35.88385%, a net gain of 5.26656%. Subject 3 had a controlled increase of 5.63492% with an experimental increase of 16.41521%, a net

gain of 10.78029%. Subject 4 had a controlled increase of 7.7169% with an experimental increase of 24.26425%, a net gain of 16.54735%. Subject 5 had a controlled increase of 36.93042% with an experimental increase of 50.06563%, a net gain of 13.13521%. Therefore, each subject showed that the use of the Pulse Device had increased their repetition gain compared to the control without them. The total mean of all net gains % throughout the 5 subjects totaled 11.829742%, showing that the use of muscle vibration devices ultimately increased muscle learning.

VIII. DISCUSSION

Though many factors such as diet, lifestyle, personal condition, as well as exercise affect one's muscle growth, muscle learning can be used as a more quantitative data of change. While the vibration effect may certainly help with muscle learning, many other external factors may have affected the data as well.

While diet, controlled for consistency, was not measured specifically to fit a target range, it is also possible that subjects may have been affected by the placebo effect. To mitigate such errors, a more specific trial with a pre-set meal plan as well as a machine that emits sound may serve as improvements to a more accurate data set.

IX. ACKNOWLEDGEMENTS