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Effect of Imaginary Resisted Exercise on Handgrip Strength in Young Adults: An Experimental Study

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Abstract

Objective: Does exercise with imaginary resistance (not actual physical resistance) improve muscle strength?**Methods:** An experimental study.**Participants:** Normal healthy individuals without any musculoskeletal pathology of upper limb.**Intervention:** A 6 week (5 days/week) intervention was given. This included handgrip exercise with imaginary resistance by observing in VR Box. 5 different type of resistance were imagined by participants by observing their own video in VR box. Which was shoot while participant were asked to do 10-10 repetitions with same 5 resistive objects on day one only to make them familiar with kind of resistance which they have to imagine. Every imaginary resistance exercise had 10 repetitions. Every session had 4 sets of same exercise. Post data was collected after 6 weeks.**Outcome measures:** Handgrip strength in lb by using hydraulic hand dynamometer.**Results:** Grip strength of Dominated Hands was calculated in pounds [lb] for all the 30 subjects with the help of hydraulic hand held dynamometer. Confidence interval (CI) was considered to be 95% and level of significance (p-value) was considered less than 0.05. Three trials were taken out of which highest reading was taken in to consideration and the mean value of Pre and Post hand grip strength were 57.8 lb and 69.5 lb simultaneously. 2 tailed student Pair t-test was used to compare pre and post data. 0.001p-value was found. Statistics showed significant improvement in handgrip strength while comparing pre and post data.**Conclusion:** Imaginary resisted exercise is effective in improving strength.**Keywords:** Experimental study; Handgrip strength; Imaginary resistance; Virtual Reality (VR) box; Hydraulic hand dynamometer; Video recording

Introduction

Muscular strength is key components to physical fitness. A specific level of muscular fitness is needed to perform activities of daily living and to maintain functional independence. Adequate levels of muscular fitness lessen the chance of musculoskeletal pathologies and injuries. For sports specific performance muscle strength is require as per the need of the sport. Muscular strength also requires preventing injuries. There are many manual and mechanical techniques and methods to improve muscle strength. Like isometric exercises [1], manual resisted exercise [2], isotonic strength training [3] etc.

"Imagination creates reality" by Richard Wagner. There are lots of things world knows today. Thanks to advancement of medical science. But there are still many mysteries which need to unfold. The relation of human imagination to thinking and action has been of interest to scholars at least since the time of the early Greek philosophers [4,5]. Today, these questions are of no less important to the study of imagination. Indeed, since the 1950s, the experimental study of imagination has become a broad field of study in its own right [6].

Motor imagery is the imagined movement of the body while keeping the muscles motionless, sometimes considered to be a conscious use of unconscious preparation for an actual movement [7]. There are numerous studies outlining the similarities between motor execution (actual performance of the movement) and motor imagery (imagination of doing movement) [8-11].

Imagination is the faculty or action of forming new ideas or images or concepts of external objects not present to the senses [12]. Imagination meaning an ability to form picture in the mind [13] Imagination: the act or power of forming mental images of what is not actually present. Remarkably, imagination not only has the potential to develop the meaning of an experience and deepen understanding, by multiplying

and expanding the perspectives from which a phenomenon can be considered, but it also allows anticipating the outcome of an action without truly performing it via a “simulation” process. So, imagination is mental power underlying visionary and creative thought [14].

The operations of the human brain are very powerful. Human mind and its many functions, is one of the most influential operations of the brain. The brain is unable to distinguish between the mind’s imagination and reality. Whatever mind believes is real, brain then truly perceives and processes as real [15]. Few example of response of imagination which person experiences in day to day life: When something scary happens in dream sudden Heart Rate and Respiratory Rate increases, Imagination of meeting with loved ones results in happiness and makes person delightful and bring a smile to the face, Imagination of eating a slice of very sour lemon can bring a grimace to face Or imagination of eating favorite food which can fill mouth with saliva. Even though these all are clearly illusions, in that moment brain completely believes them as real. In accordance with the information perceived by the brain, physiological response appears in real. These responses show the power of imagination of brain.

Motor imagery and imaginary resisted exercise both are different. Motor imagery is the imagined movement in which muscles does not move [7]. When in this study imaginary resisted exercise is used, in which muscle movement occurs but with imagination of resistance force.

Distinguishably this study is designed to check the efficiency of imaginary resisted exercise on muscle strength, which is different than manual and mechanical resistance.

Imaginary resistance is not a physical resistance, like manual and mechanical. But it is a stimulatory resistance created by mind through imagination.

Previous study [16] shows that imagination of doing muscle activity causes significant motor activation of the brain. Human brain is so powerful that it gives response of imagination as real [15]. Brain gives response of imagination in physiological form, as like that activity took place in real. Few example of response of brain to imagination are, Imagination of eating a slice of very sour lemon can bring a grimace to face, Imagination of eating favorite food which can fill mouth with saliva, Imagination of meeting with loved ones results in happiness and makes person delightful and bring a smile to the face, Imagination of scary things sudden causes increase in heart rate and respiratory rate. These all are clearly illusions, but brain completely believes them as real and gives response accordingly. So need of this study is to know that, can strength of skeletal muscles gain just through imagination of resistance without using any kind of resistive devices.

The research questions was, Does exercise with imaginary resistance (not actual physical resistance) improve muscle strength?

Research Methodology

Design

A total of 30 subjects were included in the study according to selection criteria. Consent form and pre data was collected on day 1.6 week (5 days/week) intervention was given. Post data was collected after 6 weeks.

Participants, Therapists and Centres

A total of 42 normal healthy individual participants without any musculoskeletal pathology of upper limb were approached for the study. Consent form was taken from all 42 subjects. 41 subjects were assessed for pre data. 1 subject did not participate for pre assessment. Amongst 41 subjects, 2 subjects did not participated in intervention program. From remaining 39 subjects, 9 left during intervention program. 30 subjects completed full intervention program. So they were assessed for post data. Intervention was given by JunedBolatarat RK University Campus hostel (**Figures 1-6**).



Figure 1: VR Box.



Figure 2: Cell phone.



Figure 3: Intervention (upper view).



Figure 6: Assessment (side view).



Figure 4: Intervention (side view).



Figure 5: Assessment (upper view).

Intervention

Handgrip exercise with imagination of resistance in hand by getting feedback in VR Box was given as an intervention. Stretching at beginning and at end of the session. 6 week (5days per week) intervention was given. This included handgrip exercise with imaginary resistance by observing in VR Box. 5 different type of resistance (**Table 1**) were imagined by participants by observing their own video in VR box. Which was shoot while participant were asked to do 10-10 repetitions with same 5 resistive objects on day one only to make them familiar with kind of resistance which they have to imagine. Every imaginary resistance exercise had 10 repetitions. Every session had 4 sets of same exercise [17]. Post data was collected after 6 weeks.

Table 1: Resistance imagined by participant in each set.

S.No	Content	Reps
1	Imagination of squeezing a Sponge ball	10 reps
2	Imagination of Finger Exerciser	10 reps
3	Imagination of Theraband	10 reps
4	Imagination of pressing Rubber ball	10 reps
5	Imagination of pressing Hard object	10 reps

Outcome measures

Handgrip strength in lbs measured by using hydraulic hand dynamometer [18]. Procedure of handgrip strength measurement: The participants were asked to seat with back supported. Hip joint as well as knee joint was kept in 90flexion and feet were placed in contact with ground. Shoulder was in adducted position with elbow in of 90 flexion. Forearm was kept in midprone position and wrist was kept in 30 extension. Thumb was kept around one side of the handle and the four fingers were kept around the other side of the handle.

Therapist's hands (without touching) were kept at lower end of dynamometer to prevent fall. Participants were asked to press as much as hard they can (by keeping other body part relax) for three seconds with command of "press, hard, harder

and relax." Same was repeated three times. Two minutes of rest was given between every repetition. Best of three was taken as final reading [19].

Data analysis

The value for the results were captured and stored in the MS Excel. All the Descriptive information including the Graphs and intra group comparison of Pre and Post Data was done using MS Excel itself. And test of normality and other data were analyzed by SPSS version 21. Normal distribution of data was checked using histograms, Shapiro Wilk test and Q-Q plots. Confidence interval (CI) was considered to be 95% and

level of significance (p-value) was considered less than 0.05. 2 tailed student Pair t Test was used to compare pre and post data. Normal distribution of data was checked using histograms, Shapiro Wilk test and Q-Q plots. Confidence interval (CI) was considered to be 95% and level of significance (p-value) was considered less than 0.05.

Results and Discussion

Intra group comparison was done for pre and post data. Result found is described in **Table 2**.

Table 2: Comparison of dominant hand grip strength between pre and post value of grip strength among boys and girls.

N		Mean	Std. Deviation	T
Boys Pre Grip Strength	15	68.3 lb	8.8	p=0.000 vhs
Post Grip Strength	15	85.9 lb	12.4	
Girls Pre Grip Strength	15	47.4 lb	16.2	p=0.005 hs
Post Grip Strength	15	53.0 lb	7.1	
B&G both Pre Grip Strength	30	57.8 lb	13.6	p=0.000 vhs
Post Grip Strength	30	69.5 lb	19.4	

Research question

Does exercise with imaginary resistance (not actual physical resistance) improve muscle strength? Yes, it does.

Previous research shows that the motor imagery (imagination of doing any activity) tasks causes significant levels of brain activation. The two concepts which are used interchangeably is Imagery and imagination. Literature also indicated the Imagination is the capacity which is very well developed in the Human being. So it is quite obvious that human can easily imagine the event which occur in the past as a picture or material and also anticipate the future even.

In the present study there is an increase in the muscle strength of the dominant Hand just by imagination with the help of VR Box that means it is possible that the person can increase its strength just by imagine the movement which is resistive in nature. In normal conventional way this increment in the strength required strength training which is repetitive in nature and person will hold some sort of Load or effort in his/or her arm which can raise the level of difficulty but going by this present study the only mechanism which enhance the movement is the imagination and repetition.

According to Hasan et al. and Brooks, resistive muscle contractions were same as the imagined contractions during training. This is clearly in the line of the present study but in the past study they just told the subject to imagine the movement other than doing it.

For enhancement of the imagination power in the present study the VR Box is used which can be used by the help of any smart phone and the video for the resistive Exercise were used

and the protocol of this exercise is constructed only for this study keeping in mind to enhance the grip Strength. Use of this VR Box includes virtual reality games, app, 3D videos, 360 immersive 3d videos etc. Stryla and Banas used these virtual reality techniques in the patients of ischemic stroke and they found that improvement in the paretic upper limb and in the upper limb without paresis in the speed of performing functional tasks as well as in hand grip strength while using these virtual reality techniques and in the present study itself the strength of the Hand Grip is increased by doing the imaginary resistance exercises.

Previous research shows that the motor imagery (imagination of doing any activity) tasks causes significant levels of brain activation this brain activation may lead to excitability of motor neuron which helps in improving the muscle strength.

Conclusion, Limitations and Future Prospects

This study was done with purpose to analyze the effect of imaginary resisted exercise on handgrip strength. In the study handgrip strength (in lbs) measurement by using hydraulic hand dynamometer was taken as an outcome. The result shows improvement in the strength. From statistics the null hypothesis is rejected and alternative hypothesis is proven.

There was some limitation of the present study that only one outcome measure was used this is only because of the long intervention time and it would be ideal if we can see the effect of these resistive imaginative techniques on hand eye

coordination and dexterity so in future we can also do the study with the more outcome measures.

Future studies is also needed in the area of comparative study if we can compare the conventional training with the imaginative techniques to see if the imaginative training can match the conventional training programme.

This type of increase is very fruitful and these enhancements in the strength just by imagination will be a very important concept in the stroke or SCI rehabilitation programme as the cases of paraparesis or hemiparesis would be the beneficiary and we should see in this aspect in the future.

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