

Upper Body Muscular Activation on Plyometric Push-Up in Normal Individuals

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Abstract:-

Background: The push-up is widely accepted by means of examining and enhancing the strength and endurance of upper trunk by simple technique. It is an effective upper body exercise where the fitness is achieved by using of the body's own weight. They promote the strength, balance, stability in upper body by developing several key muscles. Electromyography (EMG) is a clinical technique that involves recording of the electrical activity generated in a muscle for diagnostic purpose. EMG used to examine the neural activation of muscles which are essential for mechanical movement and strength gains.

Objective: To find the upper body muscular activation on plyometric push-up in normal individuals.

Methodology: The study design was quasi experimental and the study type is pre and post-test type .30 men were selected with age group of 17-22 years with minimum training experience in gym and normal BMI (18.50-24.99). Individuals with any major upper extremity or back injuries in last one year, recent surgeries, any deformity in upper & lower limb, chest wall deformity, any medical illness were excluded from the study. Push-up training was given for 4 weeks.

Outcome Measures: Electromyography (EMG).

Results: There is significant ($p < 0.05$) improvement in plyometric push-up for upper body muscular activation.

Conclusion: The study concludes that the significant effect on upper body muscular activation on plyometric push-up in normal individuals.

Keywords: Plyometric push-up, Resistance exercise, Electromyography.

I. INTRODUCTION

The plyometric push ups training is also known as stretch-shortening drills or stretch strengthening drills due to high velocity eccentric to concentric muscle loading reflexive reaction and functional movement patterns¹. The plyometric training is defined as high velocity resistance training characterized by a rapid, resisted eccentric [lengthening] contraction during the muscle elongation, immediately followed by a rapid reversal of movement with a resisted concentric [shortening] contraction of same muscle¹. This exercise is used to strengthen the muscles such as pectorals major, deltoid or shoulder muscle scapular and rotator cuff, triceps located on the base of the upper arm and serratus anterior muscle that helps in maintaining strength and stability

balance². The muscular activity is measured by the EMG device. The EMG device is used by assessing the neural activation of muscles necessary for the production of mechanical movement and strength gain. The purpose of this study was assessing the upper body muscular activity in normal individuals on plyometric push ups. The plyometric push ups is widely accepted means of assessing and improving the upper body strength and power by simple technique and that do not require any expensive equipment³. The plyometric push exercise are commonly performed by different age group people to develop the endurance and strengthen their muscles. These push ups increases the pectoral, triceps and brachii muscle activity and decreases the elbow stress. The various types of push ups exercise have an impact on changing the muscular activation patterns⁴. The resistance exercise is used to enhance three elements of muscle performance of power, endurance to develop strength and power for the upper body where the plyometric push ups is one of the best exercise. There are types of exercise performed using the body's own weight to have an effective measure to build fitness foundation⁵. Adaptation occurs while performing rotator movement of arm during ascending and descending push ups. This maximizes the strength and power in the arms, shoulder, chest and back abdominal while decreasing the joint strain⁹. The push ups is has an effect on the endurance, power and strength of muscles. The muscular ability to perform recurrent contraction against resistance is termed as endurance. The maximum effect of push ups exercise is obtained as it is a closed kinematic chain exercise by load the body weight source of resistance⁶. The muscle power is the capability of the muscle to exert high force during contracting at a higher speed and push ups is evaluated by the upper body strength, it is demonstrated to increase the upper body power and endurance. The push ups increases trunk stability and thereby would benefit the sports performance by providing an increased production in the upper and lower extremities⁹. These exercises that which lead to the production of high EMG amplitude for the specific skeletal muscle are expected to strengthen it and there is greater adaptation to strength over time. The EMG device was recorded for muscles such as pectorals major, serratus anterior, posterior deltoid and triceps brachii muscle^{7,8,10}

Aim of the Study

To find out the effect of upper body muscular activation on plyometric push- up in normal individuals.

Need for the Study

Muscular activation has been documented using various types of Push ups in previous studies. Studies investigating the Muscular Activation using Electromyographic studies for Plyometric Push ups are Limited. Hence this study is needed.

II. METHODOLOGY

STUDY DESIGN: QUASI-EXPERIMENTAL

STUDT TYPE: PRE AND POST TYPE

SAMPLING METHOD: SIMPLE RANDOM SAMPLING

SAMPLE SIZE: 30 SAMPLES

STUDY DURATION: 4 WEEKS

STUDY SETTING: SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

INCLUSION CRITERIA

AGE: 17-22 years. Normal healthy males

BMI (18.50-24.99) WHO Classification. Minimal Gym trained persons

EXCLUSION CRITERIA

Any major upper extremity or back injuries with in last one year Recent surgeries

Any medical illness

Any deformities in upper & lower limb Chest wall deformities

Procedure

Thirty healthy men were selected on based of inclusion and exclusion criteria. The procedure was clearly explained to all subjects and informed consent was obtained from all the participations. They were allocated to plyometric push-ups. The plyometric push-ups intervention covered 12 training session at a frequency of 3 sessions per week. At the beginning and after 4 weeks of training, the muscle activity was recorded. The EMG device recorded the amplitude of muscle activity of pectoralis major , serratus anterior ,

posterior deltoid and triceps muscles by using the surface electrode. The electrodes positioning of the triceps muscle was on the midpoint between the posterior aspect of acromion and olecranon process. For pectoralis major, the electrode was positioned at the midpoint between the sternal notch and axillary fold. For serratus anterior electrode was positioned just anterior to the latissimus dorsi muscle at the level of inferior to tip of the scapula. For posterior deltoid, electrode was positioned to angle of oblique to deltoid tuberosity. The electrode used in this study is the disposable surface electrode of Audio Evoked Potential [AEP] electrode. They three electrode used were green, red and black, where the green electrode was placed on the muscle bulk , red and black electrodes were placed on either sides of the green electrode. The push –ups training was given for 3 days a week for 4 weeks. A single session consists of 3 sets with each set having 10 repetitions. Before the starting of push-up general warm up exercise was given for 5-10 minutes. The warm up exercises consist of stretching exercise of upper and lower extremities. The exercise protocol consist of first week trained was normal push –up, second week trained with drop push –up and fourth week of training with clap push- ups. Drop Push-up: The subject perform a prone push up from knees or feet with hand on platform positioned a shoulder width apart drop the both hands and the chest to the floor controlling descend of the trunk (eccentric phase) (FIGURE 3) quickly perform another push-up (concentric phase) and return both hands to platforms (FIGURE 4). Clap Push-up: The subject while on the floor, have to perform a forceful prone

push-up from knee or feet: clap hands elbow to flex [eccentric phase] quickly perform another push-up [concentric phase].(figure 5)

Outcome Measures

Electromyography (EMG)

III. STATISTICAL ANALYSIS

This study was to find out the upper body muscular activation on plyometric push-up in normal individuals using EMG and the outcomes were assessed and tabulated. The data analysis was done by using paired sample test of statistical package for social science IBM (SPSS) version 20.0 software.

TABLE – I
PRE –TEST AND POST-TEST OF MUSCLE ACTIVITY OF (RIGHT SIDE)

MUSCLES	N	TESTS	MEAN	SD	t value	Sig
PECTORALIS MAJOR	30	PRE-TEST	290.4517	62.7939	-8.803	0.000
		POST-TEST	318.6707	68.51350		
SERRATUS ANTERIOR	30	PRE-TEST	245.4150	38.24449	-12.819	0.000
		POST-TEST	265.1007	40.96105		

TRICEPS	30	PRE-TEST	326.8790	55.82802	-11.478	0.000
		POST-TEST	375.2050	58.70432		
POSTERIOR DELTOID	30	PRE-TEST	280.1600	41.40227	-6.526	0.000
		POST-TEST	311.9770	41.31833		

There is a statistically sig ($P < 0.05$) increased. Table I shows the mean values of pre-test and post-test values of muscle activity of right side. The muscle activity of pectoralis major on pre-test was 290.4517 and on post-test was 318.67,

Serratus Anterior on pre-test was 245.41 and on post-test was 265.10, Triceps on pre-test was 326.87 and on post-test was 375.20 and Posterior Deltoid on pre-test was 280.16 and on post-test was 311.97.

GRAPH - I
PRE -TEST AND POST-TEST OF MUSCLE ACTIVITY OF (RIGHT SIDE)

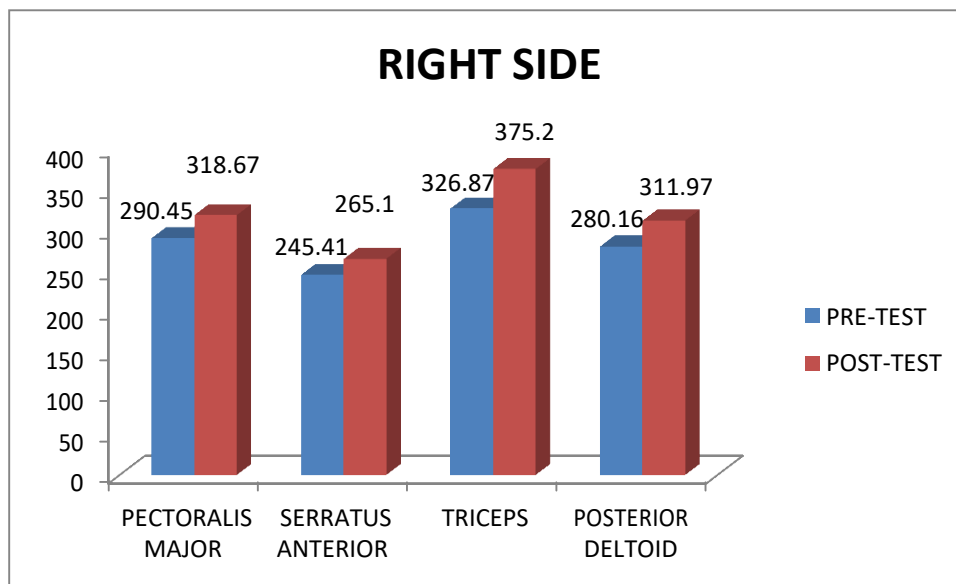


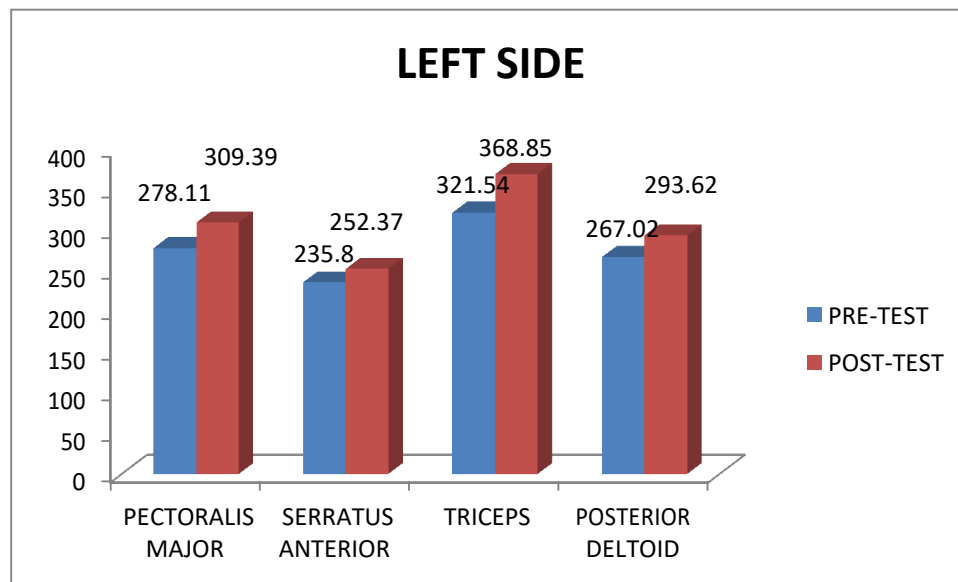
TABLE II
PRE -TEST AND POST-TEST OF MUSCLE ACTIVITY OF (LEFT SIDE)

MUSCLES	N	TESTS	MEAN	SD	t value	Sig
PECTORALIS MAJOR	30	PRE-TEST	278.1157	62.75174	-12.734	0.000
		POST-TEST	309.3967	70.78848		
SERRATUS ANTERIOR	30	PRE-TEST	235.8090	24.51296	-16.383	0.000
		POST-TEST	252.3783	26.04356		
TRICEPS	30	PRE-TEST	321.5470	51.14280	-11.105	0.000
		POST-TEST	368.8567	52.07945		
POSTERIOR DELTOID	30	PRE-TEST	267.0237	36.75015	-14.656	0.000
		POST-TEST	293.6273	41.67230		

There is a statistically sig ($P < 0.05$) increased. Table II shows the mean values of pre-test and post-test values of muscle activity of left side. The muscle activity of pectoralis major on pre-test was 278.1157 and on post-test was 309.3967, Serratus

Anterior on pre-test was 235.8090 and on post-test was 252.3783, Triceps on pre-test was 321.5470 and on post-test was 368.8567 and Posterior Deltoid on pre-test was 267.0237 and on post-test was 293.6273

GRAPH – II
PRE –TEST AND POST-TEST OF MUSCLE ACTIVITY OF (LEFT SIDE)



IV. RESULTS

Tables and graphs shows that there is a significant difference between the pre and post-test in improving upper body muscular activation among subject treated with plyometric push-up exercise for a period of 4 weeks 3 days per week which denotes significant improvement of muscle activity and improvement in upper body power , endurance and strength. Table I and Graph I shows the mean values of pre-test and post-test values of muscle activity of right side. The muscle activity of pectoralis major on pre-test was 290.4517 and on post-test was 318.67, Serratus Anterior on pre-test was 245.41 and on post-test was 265.10, Triceps on pre-test was 326.87 and on post-test was 311.97. Table II and Graph II shows the mean values of pre-test and post-test values of muscle activity of left side. The muscle activity of pectoralis major on pre-test was 278.1157 and on post-test was 309.3967, Serratus Anterior on pre-test was 235.8090 and on post-test was 252.3783, Triceps on pre-test was 321.5470 and on post-test was 368.8567 and Posterior Deltoid on pre-test was 267.0237 and on post-test was 293.6273

V. DISCUSSION

The purpose of this study was analysing the upper body muscular activation on plyometric push up in normal individuals by using EMG device. The result of present study was a significant improvement in outcome measure of muscle activity ($p < 0.000$). This study was performed in 30 male students with minimum trained experience in gym. Their muscle activity was improved after training by using EMG device. This study mainly considered four muscles of each side of upper body - pectoralis major, serratus anterior, Triceps and posterior deltoid .The muscle activity was improved in right side than left side and major improvement

was observed in triceps muscle and pectoralis major when compared to serratus anterior and posterior deltoid muscle. Tal Amasay et al (2016) Concluded that approximately men performed more push-up than women, where men performed in a 33 repetitions and women were performed 30 push-ups on average. Sumiaki Maeo et al (2014) reported that better activation of muscles of upper limbs and anterior trunk was achieved by sling-based push-up exercise when compared with the ground-based push-up exercise. The plyometric push-up produced a greater improvement in upper body muscle activation. Joaquin Calatayud et al (2014) Concluded that the push-up was performed in improvement of muscle recruitment of pectoralis major muscle where the suspended version of the exercise delivered on supplementary advantage. The plyometric push-up was performed in major improvement of pectoralis major, serratus anterior , triceps and posterior deltoid. Salvi Shah (2011) concluded that plyometric push up was increased the power, endurance and strength more than dynamic push-up. These push up was increase the power and strength so it was increased the muscle activity in upper body. The plyometric push-up is known to increase the amount of muscle fiber recruitment, enhance the velocities of muscle contraction and over all explosiveness movement which could be implemented in training and sports performance Plyometric push-up may facilitate better contraction of muscle along with increased impulses of powerful force outputs and ability to enhance the rate of muscle contraction. The plyometric push-up was enhanced of upper body muscle recruitment, mainly focussed on the triceps, serratus anterior, posterior deltoid and pectoralis major muscles. The plyometric push-up was increase the muscle recruitment and faster muscle contraction both them ability to enhance the forceful pressing capacity. The forceful pressing capacity is such as a bench press, barbell press.

The plyometric push up was create the stresses and forceful capacity, velocities and impulse. The plyometric push up was preparing the proper absorption and transfusion of impulse and metabolic system so it is protect the connective tissue , muscle , bone and joint injury.The plyometric push up was promote the high level forceful capacity and improving the muscle power and endurance so these was produce the high level energy of capacity to kicking , punching, throwing and bench pressing.

VI. CONCLUSION

This study concluded the plyometric push-up training has improved the upper body muscular activation among normal individuals. So there is a significant effect of upper body muscular activation on plyometric push-up in normal individuals.

VII. LIMITATIONS

- Sample size was small.
- Training duration was less.
- Only male subject was selected.

VIII. RECOMMENDATIONS

- Future studies can be done involving different age groups.
- Further studies can be done by comparing both genders.
- Large sample size and training period can be increased

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