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Comparative Study on Effect of Full Squat and Half Squat over Isometric Strength of Quadriceps Muscle

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Abstract – The study was conducted to see the effect of full squat training and half squat training over the isometric strength of quadriceps muscle and to see which squatting technique is better to develop maximal isometric strength of quadriceps muscles. Purposive sampling was used and pretest-posttest design was used. For this study 10 male participants 5 for full squat training and 5 for half squat training treatment, aging from 18 to 25 year were selected from the weight lifting match practice of L.N.I.P.E, Gwalior were selected. To check the effect of four week training program within the pretest and posttest of full squat Paired-t test was used and same was conducted for half squat and to check the effect of training program between both the groups Independent-t test was used by the means of SPSS software package. The level of significance was set at 0.05. To study the effect of the training program on athletes more precisely the muscular electric activity of the quadriceps muscle was also taken in consideration. The RMS value (Root Mean Square) was taken in account for statistical test of muscle electric activity. The comparison of muscle electric activity of both the groups was tested by Independent-t test by the means of SPSS software package. The level of significance was set at 0.05. Collegiate athletes (n = 10) completed four study visits, Pre-test and post-test and data collection of muscular electric activity. The collection of pre-test and post-test data was done by the standardized David F200 Quadriceps Extension machine. After the pre-test all the 10 subjects which were divided in two groups of 5 subjects in each group full squat and half squat were given training for 6 weeks on alternate days to provide 48 hours for recovery and growth process. In between the training process EMG (electro mayography) data of quadriceps muscles of both the groups was collected. After the 48 hours of completion of training program post-test was conducted and data was collected, researcher gathered the actual data of both the groups. On the day of Post-test, participants were informed the timing in advance to come in Bio-mechanical lab. However, there was significant increment in their score. So the conclusion was carried out that if we provide the full squat and half squat training to the athletes regularly, then it will bring 100% positive effect on the isometric strength of quadriceps muscles of the athlete and increase their performance and will definitely enhance their result. So the one Hypotheses out of three was rejected, but it may be concluded that squatting whether it is full squat or half will bring positive increment if isometric strength of quadriceps muscles.

Key Words: Squatting, Half Squat, Full Squat, Isometric Strength, David Machine, EMG.

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INTRODUCTION

Squatting is a posture where the weight of the body is on the feet (as with standing) but the knees and hips are bent. In contrast sitting involves taking the weight of the body, at least in part, on the buttocks against the ground or a horizontal object such as a chair seat. The angle between the legs when squatting can vary from zero to widely splayed out, flexibility permitting. Another variable may be the degree of forward tilt of the upper body from the hips. A half squat or partial squat (also known as standing, half, semi, parallel, intermediate, shallow, incomplete or monkey squat etc.) is an intermediate stage between standing and full squatting, that is, standing but with the knees and hips bent. (In contrast, stooping involves bending at the waist rather than just the knees and hips). Full squat posture reduces the amount of hip and knee flexion and ankle dorsiflexion needed to reach full depth. While from a biomechanical perspective this variation enables the lifter to complete the exercise with higher loads because range of motion is reduced, it may not be the safest variation on articulating joint surfaces for beginning exercisers who have no desire for improving their 1RM. Isometric strength exercises

are contractions of a particular muscle or group of muscles. During isometric exercises, the muscle doesn't noticeably change length and the affected joint doesn't move. Isometric exercises help maintain strength. They can also build strength. Isometric exercises may be helpful to someone who has an injury, which could make movement painful. The David machine solution includes joint-specific devices with optimized biomechanical properties for spine, hip & knee and shoulder joints. The devices use correct joint and axis alignment, scientifically proven loading curves and target area isolation enabled by effective fixations. This allows for a remarkably gentle motion to the joints yet provides the highest possible neuromuscular training effect. All training parameters are quantified and fine-tuned for each individual. Besides basic physiological and biomechanical studies, kinesiological EMG is established as an evaluation tool for applied research, physiotherapy/rehabilitation, sports training and interactions of the human body to industrial products and work conditions. The important role of EMG is the objective evaluation of the neuromuscular activation within any activity. Unlike the other areas, EMG is a without a serious competitive method within its class. The important starting point is the proper selection and combination of methods that can address a certain topic. Starting from a problem you observe with your subjects or patients or the desire to achieve a better understanding of the physiological conditions within any activity, you formulate expectations or hypothesis on that particular topic. Usually it is easy to convert assumptions to categories of questions. In the next step you need to decide which biomechanical method can best detect the processes related to your questions. The selection of a correct biomechanical sensor or class is very important. EMG cannot answer how strong (in Newton) a muscle is, and the other way around, force measures cannot answer if a muscle fires correctly. Finally, within each category of biomechanical sensors, several sub-classes of analysis questions can be answered.

METHODS:

Ten subjects have been spotted out by the scholar for the six weeks of training schedule. All the subject have given their consent to be the part of this study. They were briefed about the training program. Their pre training score ware obtained through David F200 leg extension machine. The pre training scores of full squat group are shown in Table no.1 and pre training scores of half squat group are shown in Table no.2.

TABEL- 1, PRE-TEST DATA OF FULL SQUAT GROUP

S.NO.	SUBJECT	PRE-TEST
1	A	175Nm
2	B	347Nm
3	C	336Nm
4	D	116Nm
5	E	473Nm

TABEL- 2, PRE-TEST DATA OF HALF SQUAT GROUP

S.NO.	SUBJECT	PRE-TEST
1	A	250Nm
2	B	419Nm
3	C	468Nm
4	D	280Nm
5	E	301Nm

Later on the subjects were imparted training through the full squat and half squat training method. The training was provided on every alternate day to the respected group with the 48 hour of recovery before next session and increment of 10 kg wad made on every athlete in fourth session of training respectively. For three days of each week all the subjects underwent training through above mentioned yogic practices. The whole training schedule is given below in table. No.3:-

TABLE-3

Training plan

Name of exercise.	Training days.	Recovery days.	Total no. of set in a day.	Total no. of repetition in one set.	Duration of performing one set.	Duration of rest after each set.
Full squat	Monday, Wednesday and Friday.	Tuesday, Thursday and Saturday.	4	8 to 12	20 second to 30 second	2 minutes
Half squat	Tuesday, Thursday and Saturday.	Monday, Wednesday and Friday	4	8 to 12	20 second to 30 second	2 minutes

After six weeks of training the post-test data of both the groups was collected through David F200 leg extension machine. The scores of post-test are shown in Table no.4 and Table no.5.

TABLE-4 POST-TEST DATA OF FULL SQUAT GROUP

S.NO.	SUBJECT	POST-TEST
1	A	320Nm
2	B	506Nm
3	C	496Nm
4	D	366Nm
5	E	596Nm

TABLE-5 POST-TEST DATA OF HALF SQUAT GROUP

S.NO.	SUBJECT	POST-TEST
1	A	271Nm
2	B	442Nm
3	C	493Nm
4	D	308Nm
5	E	322Nm

In order to find out the effects of full squat and half squat over isometric strength of quadriceps muscle, the data was analyzed by using "Descriptive Statistics and Paired t-test" at 0.05 level of significance.

RESULTS:

For the chosen training program for developing isometric strength of quadriceps muscles, the data were subjected to Descriptive statistics and Paired t-test and to find the which squatting technique is better to develop maximal isometric strength of quadriceps muscles the post-test data of both the groups were subject of Descriptive statistics and Independent-t test

The data was subjected to Descriptive Statistics to find out the mean difference of pre-test and post-test scores within the group and mean difference of post-test scores between the groups. The Descriptive statistics are shown in Table No.6, 8 and 10.

EFFECT OF FULL SQUAT OVER ISOMETRIC STRENGTH OF QUAQDRICEP MUSCLE

TABLE-6 DESCRIPTIVE STATISTICS

S.NO.	TEST	MEAN	N	Std. Deviation
1	Pre-test	289.4000	5	143.48624
2	Post-test	451.4000	5	104.11436

Table 6 shows the mean and standard deviation of pre-test and post-test of 5 male subjects' isometric strength of quadriceps muscle after the full squat training for 1 month. The mean along with SD of pre-test and post-test are 289.4^{+}-143 and 451.4^{+}-104 respectively.

TABLE-7 PAIRED SAMPLES TEST

S.NO.	TEST	N	t	Sig
1	Pre-Post	5	-6.506	.003

Table 7 shows the t value and P value of pre-test and post- test of 5 male subjects' isometric strength of quadriceps muscle after the full squat training for 1 month. The calculated t-value was -6.506 and P-value was .003.

Hence, the P<0.05 clearly indicated the significant effect of full squat over the isometric strength of quadriceps muscles

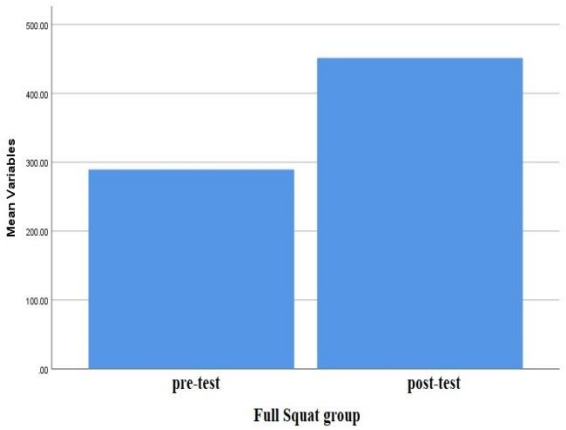

FIGURE 1: Effect of full squat over isometric strength of quadriceps muscle

EFFECT OF HALF SQUAT OVER ISOMETRIC STRENGTH OF QUAQDRICEP MUSCLE

TABLE-8 DESCRIPTIVE STATISTICS

S.NO.	TEST	MEAN	N	STD. DEVIATION
1	Pre-test	343.6000	5	94.57960
2	Post-test	367.2000	5	95.16144

Table 8 shows the mean and standard deviation of pre-test and post-test of 5 male subjects' isometric strength of quadriceps muscle after the half squat training for 1 month. The mean along with SD of pre-test and post-test are 343.6^{+}-94 and 367.2^{+}-95 respectively

TABLE-9 PAIRED SAMPLES TEST

S.NO.	TEST	N	t	Sig
1	Pre-Post	5	-17.789	.000

Table 9 shows the t value and P value of pre-test and post- test of 5 male subjects' isometric strength of quadriceps muscle after the half squat training for

1 month. The calculated t-value was -17.789 P-value was .000.

Hence, the P<0.05 clearly indicated the significant effect of half squat over the isometric strength of quadriceps muscles.

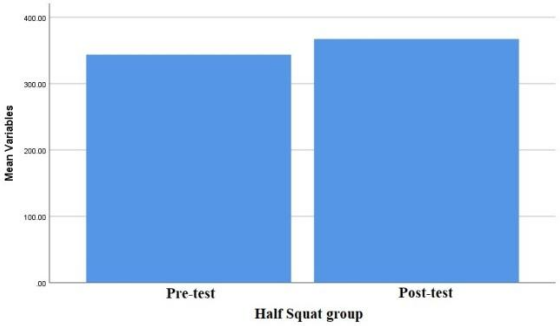

FIGURE 2: Effect of half squat over isometric strength of quadriceps muscle.

COMPARISON BETWEEN EFFECT OF FULL AND HALF SQUAT OVER ISOMETRIC STRENGTH OF QUAQDRICEP MUSCLE

TABLE-10 DESCRIPTIVE STATISTICS

S.NO.	TEST	MEAN	N	Std. Deviation
1	Post-test Full squat	451.4000	5	104.11436
2	Post-test Half squat	367.2000	5	95.16144

Table 10 shows the mean and standard deviation of post-test of 5 male subjects' isometric strength of quadriceps muscle after the full squat training and half squat training for 1 month. The mean along with SD of full squat and half squat post-test are 415.4^{+}-104 and 367.2^{+}-95. Calculated mean of full squat is higher than calculated mean of half squat which indicated that full squat has better effect on isometric strength of quadriceps muscles than half squat.

TABLE-11 INDEPENDENT SAMPLES TEST

S.NO.	TEST	N	t	df	Sig
1	Post-test half and full squat	10	1.335	8	.219

Table 11 shows the t value, df value and P value of post- test of 10 male subjects' isometric strength of quadriceps muscle after the full squat and half squat training for 1 month. The calculated t-value was 1.334, df-value was 8 and P-value was .219.

Hence, the P>0.05 clearly indicated no significant difference between effect of full squat and half squat over the isometric strength of quadriceps muscles.

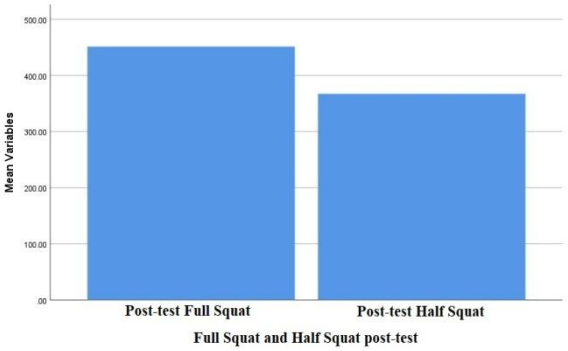

FIGURE 3: Comparison between effect of full squat and half squat over isometric strength of quadriceps muscles.

To study the effect of the training program on athletes more precisely the muscular electric activity of the quadriceps muscle was also taken in consideration. The RMS value (Root Mean Square) was taken in account for Descriptive statistics and independent t-test.

The data was subjected to Descriptive Statistics to find out the mean difference of the muscular electric activity of the quadriceps muscle between the groups. The Descriptive statistics are shown in Table No.12.

COMPARISON BETWEEN ELECTRIC ACTIVITY OF QUADRICEP MUSCLE DURING FULL SQUAT AND HALF SQUAT TRAINING

TABLE-12 DESCRIPTIVE STATISTICS

S.NO.	GROUP	N	MEAN	Std. Deviation
1	Full Squat	5	2469.4200	36.11602
2	Half Squat	5	1102.5700	77.91366

Table 12 shows the mean and standard deviation of quadriceps muscles electric activity of 10 male subjects' during half squat and full squat training for 1 month. The mean along with SD electric activity of quadriceps muscles are 2469.42^{+}-36 and 1102.57^{+}-77 respectively.

TABLE-13 INDEPENDENT SAMPLES TEST

S.NO.	GROUP	N	t	df	Sig
1	Full Squat and Half Squat	10	35.590	8	.000

Table 13 shows the t value, df value and P value of quadriceps muscles electric activity of 10 male subjects' during half squat and full squat training for 1 month. The calculated t-value was 35.590, df-value was 8 and P-value was .000.

Hence, the P<0.05 clearly indicated the significant difference between the electric activity of quadriceps

muscles during full squat and half squat training respectively.

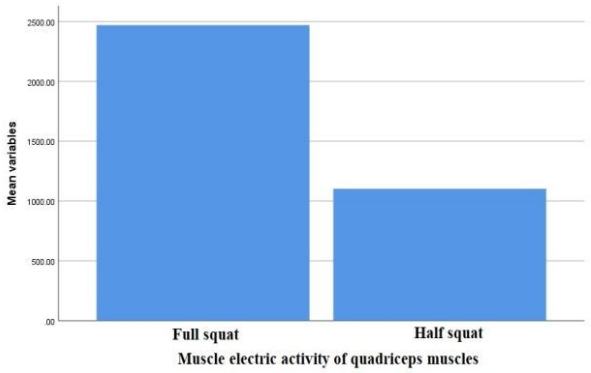

FIGURE 3: Comparison between muscles electric activity of quadriceps muscles during full squat and half squat training.

DISCUSSION:

The purpose of study was to compare effect of full and half squat over isometric strength of quadriceps muscle. The digital photography was used as a technique for finding out the kinematic variables. A standard motor driven camera i.e., canon-77 D EOS was used to obtain photo sequence. The score of pre and post data of isometric strength of quadriceps muscle of both the groups (half squat and full squat) were compared to find the significant difference after the treatment given which was collected through DAVID F 200 machine. The score of muscle electric activity data of quadriceps muscle for both the groups (half and full squat) were compared to find the significant difference during the skill performed by the subjects and was recorded through Free EMG. Selected muscles were Rectus Femoris, Vastus Medialis and Vastus Lateralis. The result have exhibited that the obtained calculated P-value was less than selected level of significance (0.05) which stated significant effect of full squat and half squat over isometric strength of quadriceps muscle and same was in scenario of muscle electric activity of quadriceps muscle during full squat and half squat training. The calculated P-value was higher than selected level of significance in case of comparison between effect of full squat and half squat which clearly indicated no significant difference between effect of full squat half squat over the isometric strength of quadriceps muscles. This insignificant finding may also be attributed to small number of subjects for data collection for the study.

CONCLUSIONS:

Based on the analysis and within the limitations of present study, following were the conclusions drawn:

1. All the selected variables showed the significant effect of full squat and half squat over the isometric strength of quadriceps muscle.
2. The post-test after training of 1 month showed no significant difference between effects of full squat and half squat over the isometric strength of quadriceps muscles.
3. Selected EMG variables showed the significant difference between the electric activity of quadriceps muscles during full squat and half squat training respectively.

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