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A Study to Find Out EMG Activity of the Vastus Medialis Oblique Muscle in Functional Positions in Patients with Osteoarthritis of Knee: An Observational Study

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ABSTRACT

Background: Osteoarthritis is a chronic degenerative disorder primarily affecting the articular cartilage of synovial joints, with eventual bony remodeling and overgrowth at the marginal of the joints. Electromyography is used to evaluate the scope of neuromuscular disease or trauma, and kinesiological electromyography is used to study muscle function. The Vastus Medialis Oblique is the most important quadriceps muscle and arguably the most responsible muscle for knee stability.
Aim: To check the EMG activity of vastusmedialis muscle in different functional position in patients with OA knee.
Method: Total 30 subjects (7) male and (22) female were taken in this study.EMG activity of VMO was recorded in different eleven (11) functional positions (In Supine, Side lying, Sitting, Standing).
Outcome Measure: EMG activity-Amplitude.
Statistical Analysis: The differences between the vastus medialis oblique muscle was assessed by using nonparametric Friedman test.
Results: The EMG activity of VMO muscle was recorded with the mean of the all eleven positions. Extremely significant difference was found in supine positions, sitting and side lying positions (p=0.000) in standing positions that difference were (p=0.019).
Conclusion: These finding suggest that there was extremely significant difference among all exercises. In supine positions SLR with ER was found highest mean (114.07).In high sitting knee extension exercise found greater mean (172.4) so high sitting knee extension exercise produced the highest VMO activation among all the exercises. In standing positions squatting position was found highest mean (128.07).

Key Words: OA knee, VMO muscle, EMG

INTRODUCTION

Globally, OA is the eighth leading cause of disability (Mathers CD et al 2003) with the joint most frequently associated with disability being the knee (Felson DT et al 1987).[1]

Epidemiological profile of this disease in India is not clear but it is estimated that osteoarthritis (OA) is the second most common rheumatological problem and is most frequent joint disease with prevalence of 22% to 39% in India (Chopra A et al 2001). Prevalence of OA in India is reported to be in the range of 17 to 60.6% (Sharma MK et al 2007).[1]

Knee osteoarthritis prevalence increase with age.[2] (Dinesh Bhatia et al 2013) the study reveals that the prevalence of OA between the age of 30 to 65 years.[1]

Electromyography is used to evaluate the scope of neuromuscular disease or trauma, and kinesiological electromyography is used to study muscle function.[4] As an examination procedure,

clinical EMG involves the detection and recording of electrical potentials from skeletal muscle fibers.[4] EMG is the recording of the electrical activity of muscle and in essence, the study of motor unit activity.[4] EMG used to analyse the motor recruitment of the muscle.[4]

The VMO, which is short for "VastusMedialis Oblique." [5]This is the most important quadriceps muscle and arguably the most responsible muscle for knee stability.[5] Function of the vastusmedialis oblique is to prevents the lateral displacement of the patella.[6] The VMO arise from the tendon of the adductor magnus.[7]

It is unclear what is suitable and safe movement of the exercise can improve VMO muscle strength. However, based on a review of literature, there is still discrepancy as to which exercise best target the vastusmedialis oblique. Continued research should be done to further investigate commonly used quadriceps exercised in an effort to reach a higher standard of care for patients with OA knee.[7]

NEED OF THE STUDY

Usually in clinical practice widely use last 15 degree knee extension exercise and high sitting knee extension exercise for strengthening of VMO but there may be more effect of other exercise for VMO strengthening. There are few studies that show the EMG activity of the VMO muscle. No research, as yet has investigated the activation of the VMO muscle during different functional position. As some of the exercise from this study causes isometric contraction of VMO which may be pain free. Which can be substantially useful in VMO activation.

So purpose of the study is to find best exercise for VMO strengthening.

AIM AND OBJECTIVES

AIM

- To find out the EMG activity of vastusmedialis oblique muscle in functional position in patients with OA knee.

OBJECTIVES

- To find out the EMG activity of vastusmedialis oblique muscle in supine position.
- To find out the EMG activity of vastusmedialis oblique muscle in side lying position.
- To find out the EMG activity of vastusmedialis oblique muscle in sitting position.
- To find out the EMG activity of vastusmedialis oblique muscle in standing position.

HYPOTHESIS

NULL HYPOTHESIS

There is no significant difference of EMG activity of vastusmedialis oblique muscle in functional positions in patients with OA knee.

ALTERNATIVE HYPOTHESIS

There is significant difference of EMG activity of vastusmedialis oblique muscle in functional positions in patients with OA knee.

Methodology

Study Design: Cross-sectional observational study

Sampling Technique: Convenient sampling

Study Setting: Shree k.k. sheth physiotherapy college, Rajkot

Sample Size: 30 subjects

Source Of Data: Subjects was collected from OPD in and around physiotherapy centers.

Study Population: OA knee

Selection criteria

INCLUSION CRITERIA

- Age :- 30-60 year
- Gender :- male and female
- Patients diagnosed with primary osteoarthritis.
- Stages 2 and 3 osteoarthritis of knee on radiographs finding. (The Kellgren and Lawrence system)

- Patients with unilateral or bilateral OA knee.
- BMI:- 18-30 kg/m^2
- Criteria for OA knee ACR(American college of rheumatology)

EXCLUSION CRITERIA

- History of trauma around knee, hip, ankle, foot
- Any neurological condition
- Osteomyelitis
- Any other musculoskeletal disorders
- Un cooperative patient

Materials used in study

- RMS EMG PK M-II (model no. 7.5.10)
- Surface electrodes
- Electrode gel
- Weight cuff (2.5 kg)
- Ball
- Cotton
- Spirit
- Micropore
- Inch tape
- Pen
- Consent form

Method of data collection

30 participants (females and males), aged 30 to 60 years old were recruited and written consent was taken from subjects, who fulfilled the inclusion and exclusion criteria. Activity of the vastusmedialis muscle was checked in different eleven functional positions. The EMG signals were acquired and analyzed using the RMS EMG PK M-II software.EMG amplitude taken as a outcome measure.

DIFFERENT FUNCTIONAL POSITIONS:-

Supine position.

VMO placement

Side lying position

Sitting position

Standing position

STATISTICAL ANALYSIS

All Statistical analysis was done by software SPSS 20.0 version. Means and Standard Deviation (SD) were calculated as a measure of central tendency and measure of dispersion respectively. Descriptive statistics of the participants and assessed variables were calculated and Shapiro-Wilk test was used to determine normal distribution with the 95% confidence interval of mean.

Non-parametric Friedman test was used as the variables did not followed normal distribution and Friedman test used because there were eleven variable and one group so it was used to determine whether significant difference of EMG amplitude exist among eleven positions or not.

RESULTS

Non-parametric Friedman test in supine position

Descriptive Statistics						Ranks	Df.	Asymp. sig.
Sr.No	N	Mean	Std. Deviation	Minimum	Maximum	Mean Rank		
supineposition1	30	114.07	54.260	43	296	3.70		
supineposition2	30	58.77	26.045	13	124	2.05		
supineposition3	30	47.97	20.574	19	98	1.70	3	.000
supineposition4	30	76.37	56.255	26	270	2.55		

INTERPRETATION: The above table shows mean and std. deviation of the variables and non-parametric Friedman test which shows there was very highly significant different (p=0.00) among supine positions.

Descriptive statistics in sidelying position

Descriptive Statistics						Rank	Df.	Asymp.sig
Sr.No.	N	Mean	Std. Deviation	Minimum	Maximum	Mean Rank		
sidelyingposition1	30	40.07	16.663	18	90	2.25	1	.000

INTERPRETATION: The above table shows mean and std. deviation of the variables and non-parametric Friedman test which shows there was very highly significant different (p=0.00) among side lying positions.

Non-parametric friedman test in sitting positions

Descriptive Statistics						Ranks		
Sr.No.	N	Mean	Std. Deviation	Minimum	Maximum	Mean Rank	Df.	Asymp. sig.
sittingposition1	30	108.20	61.014	45	290	2.03		
sittingposition2	30	172.40	91.238	78	524	2.9	2	0.00
sittingposition3	30	43.73	16.280	16	80	1.07		

INTERPRETATION: The above table shows mean and std. deviation of the variables and non-parametric Friedman test which shows there was very highly significant different (p=0.00) among sitting positions.

Non-parametric friedman test in standing positions

Descriptive Statistics						Rank	Df.	Asymp. Sig.
	N	Mean	Std. Deviation	Minimum	Maximum	Mean Rank		
standingposition1	30	111.43	66.618	38	352	1.67	2	0.019
standingposition2	30	123.37	55.155	38	279	1.95		
standingposition3	30	128.07	49.884	54	322	2.38		

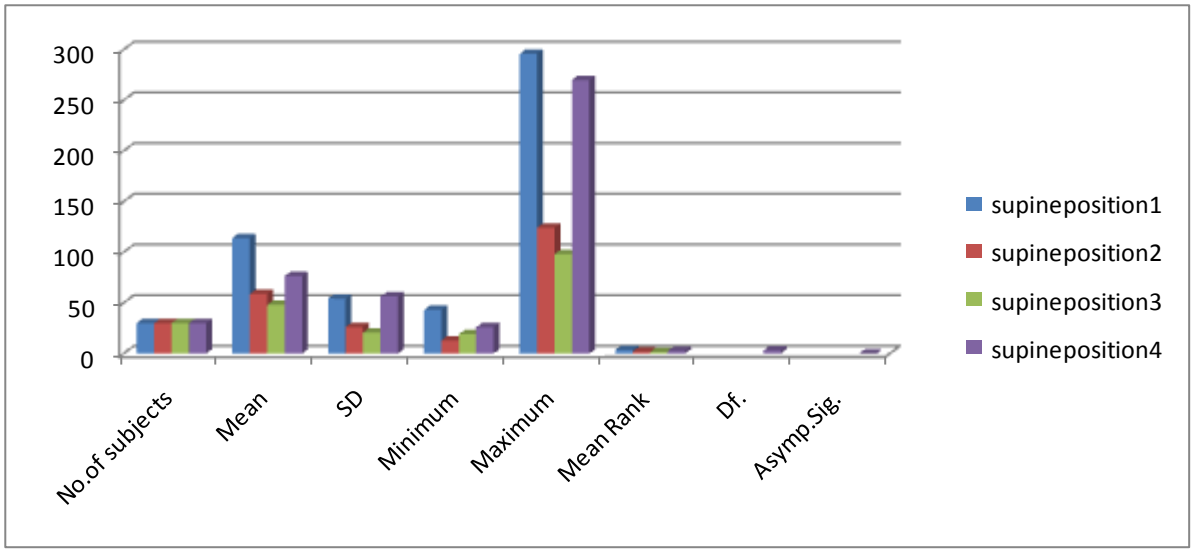
INTERPRETATION: The above table shows mean and std. deviation of the variables and non-parametric Friedman test which shows there was highly significant different (p=0.019)among standing positions.

Non-parametric friedman test in all positions.

Sr.No.	Descriptive statistics					Rank	Df.	Asymp.Sig.
	N	Mean	Std. Deviation	Minimum	Maximum	Mean Rank		
supineposition1	30	114.07	54.26	43	296	7.65	10	.000
supineposition2	30	58.77	26.045	13	124	3.93		
supineposition3	30	47.97	20.574	19	98	3.05		
supineposition4	30	76.37	56.255	26	270	5.12		
sidelyingposition1	30	40.07	16.663	18	90	2.25		
sittingposition1	30	108.2	61.014	45	290	7.13		
sittingposition2	30	172.4	91.238	78	524	9.87		
sittingposition3	30	43.73	16.28	16	80	2.75		
standingposition1	30	111.43	66.618	38	352	7.48		
standingposition2	30	123.37	55.155	38	279	8.07		
standingposition3	30	128.07	49.884	54	322	8.7		

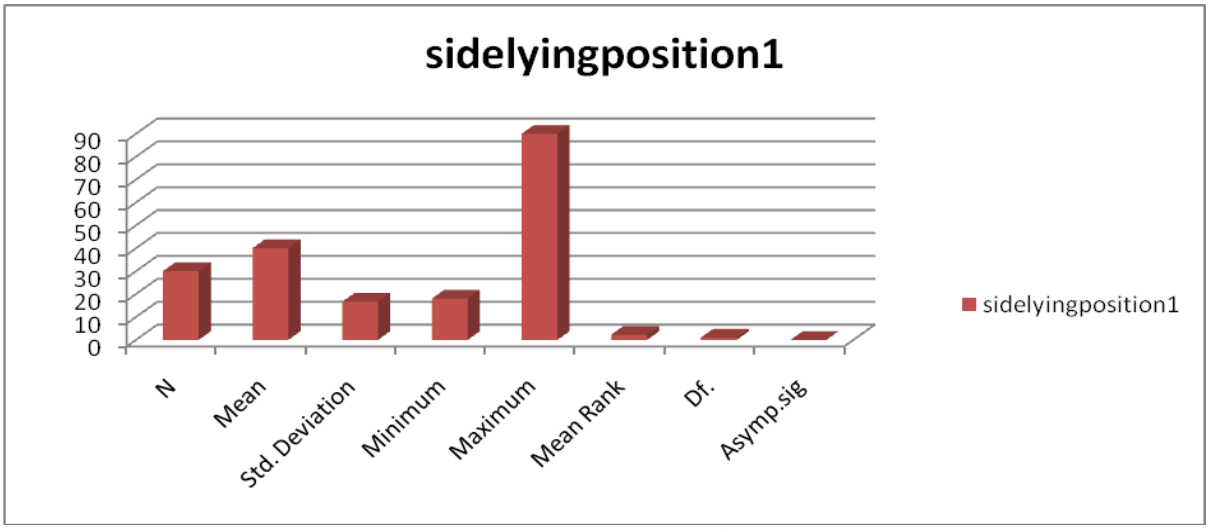
INTERPRETATION: The above table shows mean and std. deviation of the variables and non-parametric Friedman test which shows there was highly significant different (p=0.00) among all positions.

GRAPHS

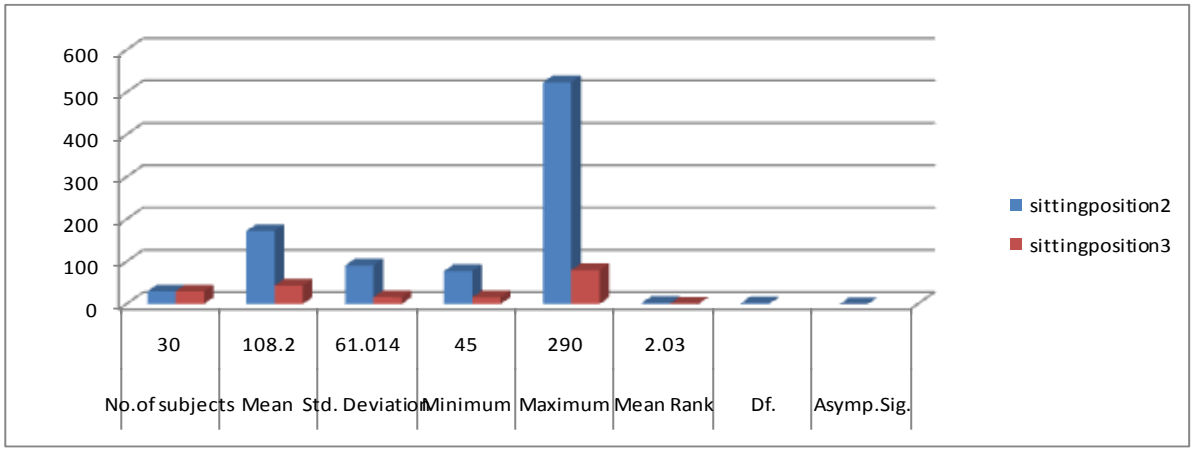


Graph 1: Non- parametric Friedman test graph for supine positions

INTERPRETATION: The above graph shows there was very highly significant difference (p=0.00) in supine position.

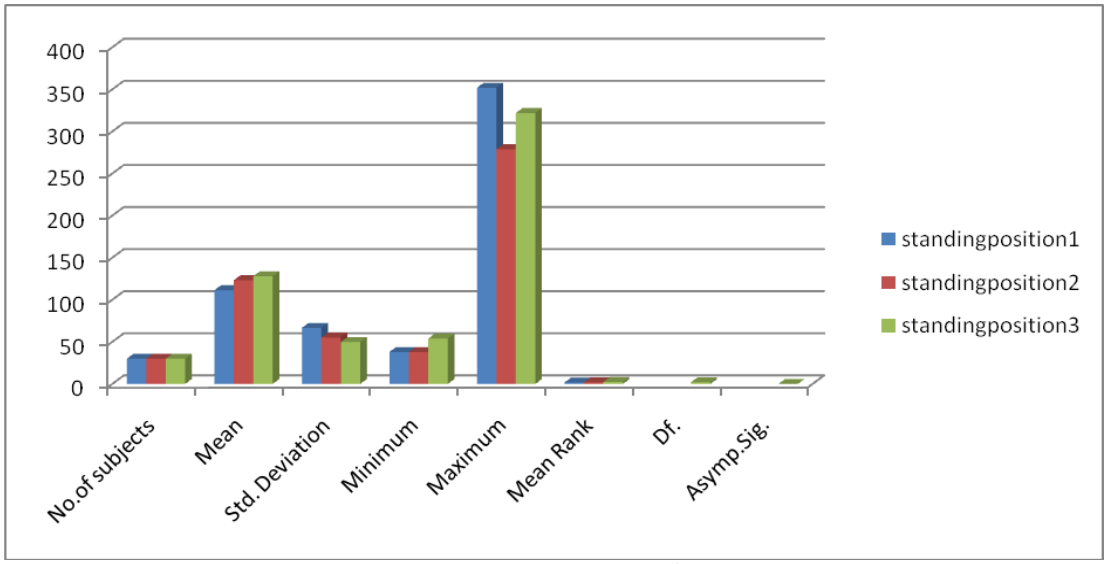


Graph 2: Non-parametric Friedman test graph for side lying positions



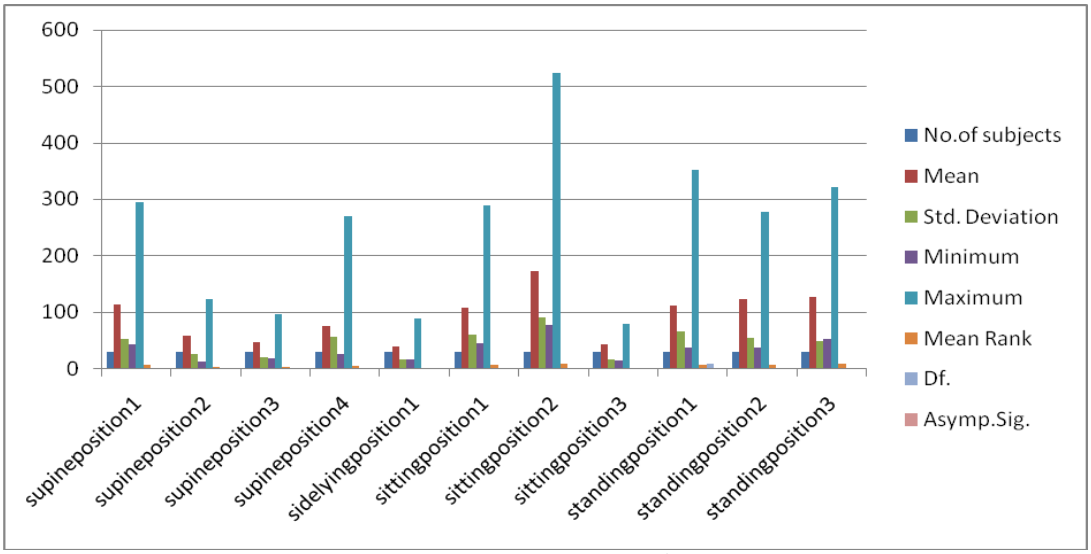
Graph 3: Non-parametric Friedman test graph for sitting positions

INTERPRETATION: The above graph shows there was very highly significant difference (p=0.00) in sitting position.



Graph 4: Non-parametric Friedman test graph for standing positions

INTERPRETATION: The above graph shows there was highly significant difference (p=0.09) in standing position.



Graph 5: Non-parametric test Friedman for all positions

INTERPRETATION: The above graph shows there was highly significant difference (p=0.09) in standing position.

DISCUSSION

The results of the present study support the alternative hypothesis which shows the significant difference between EMG activities of VMO among all the eleven exercises. Depending upon this finding this study cannot concluded based on this number alone that one of this exercise is better than the others for preferentially recruiting the VMO. All the exercises did have a ratio close to the 0.000 which suggested that there were highly significant difference among all the exercises.

In supine exercise among all the four exercise SLR with external rotation gives better recruitment than other three exercise.

Roush et al, conducted a study in support of SLR with ER for rehabilitation of anterior knee pain, finding improved patient outcome and cost effectiveness.[8]

This current study also support these review.

Researchers have hypothesized that there will be an increase in VMO activity with external rotation of the hip because of the VMO's muscular fibers originating from the adductor magnus muscle. Based on this thinking, when the hip is placed in an externally rotated position and flexed using the adductors, the VMO would be stimulated, therefore causing an increase in EMG activity.[8]

In sitting exercises among all the three exercises high sitting knee extension were found to generate more overall activation than the other exercises.

In last 15 degree knee extension moment arm decreases therefore more tension is needed to perform the movement.[8]

Hertel et al; conducted a study in support of knee extension exercise in weight bearing alone is gives greater surface EMG activity than knee extension with hip adduction or abduction.[9]

In standing exercises among all the three exercises squatting exercise gives better EMG outcome than lunges exercise.

Isotonic squatting exercise may lead to increased VMO activity because the VMO must be more active in the dynamic stabilization of the patella during knee movement.[9]

Current study checked isometric VMO exercises (hip adduction) (ball squeeze) used to found which isometric hip adductor exercise recruited more muscle fibers and result shows that standing with ball squeeze recruited more muscle fiber. Isometric exercise may be more appropriate during early rehabilitation where retraining of the VMO is critical to restoring normal

pattelofemoral mechanics.[9]

Such weakness can have a significant impact functionally because many activities of daily living (ADLs) require adequate quadriceps strength. Therefore, these results provide additional knowledge to assist clinicians in the development of exercise progression, especially in the early portions of rehabilitation following osteoarthritis.

Limitations

- The study was conducted on patient with age group 30-60 years, those with Kellgren-Lawrence radiographic grade 2 to 3, thus limiting the generalization of these results to other patient category.
- Weight distribution was different in all positions supine, side lying, sitting and standing.
- In regards to the use of surface EMG to measure muscle activity; the possibility of cross talk between muscles exists. Needle EMG can use for accurate result.

Further Recommendations

Relationship between the EMG onset activity of VMO and VLO muscles during the testing positions should be taken into consideration.

- Future research includes considering the effect of Q angle on the recruitment patterns of the VMO.
- Modification in the exercises in the rehabilitation protocol in a more general population including wider range of ages, body types and activity levels.

CONCLUSION

In supine positions SLR with ER was found highest mean (114.07). In high sitting knee extension exercise found greater mean (172.4) so high sitting knee extension exercise produced the highest VMO activation among all the exercises. In standing positions squatting position was found highest mean (128.07).

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