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Original Article

A COMPARATIVE STUDY OF THE AMPLITUDE AND FREQUENCY OF EMG ON THE EFFECT OF MUSCLES IN SELECTED YOGA TRAINED SUBJECTS AND IN SUBJECTS EXCLUSIVELY PERFORMING ABDOMINAL CRUNCHES

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ABSTRACT

Background: Electromyography refers to recording of action potentials of muscle fibers firing singly or in groups near the needle electrode in a muscle. Yoga and yoga-related training have often been touted as providing good muscle stretching and relaxation, as well as being beneficial for overall stress management. As life style changes have caused numerous cardiac and metabolic disorders which have increased the mortality and morbidity rate, this study will highlight the implications of these exercises and also identify the electrical activity of these abdominal and truncal muscles with regard to frequency and amplitude and make us to understand the physiological concepts and provide advice on the benefits of these exercises. Our aim was to perform comparative study of the amplitude and frequency of EMG on the effect of muscles in selected yoga trained subjects and in subjects exclusively performing abdominal crunches. **Methods:** The present study was carried out with the prior approval of Human Ethical Committee of Meenakshi University. The participants of this study were first year students of Meenakshi Medical College (n=20). Electrical activity of these abdominal and truncal muscles with regard to frequency and amplitude were tested. **Results**: Abdominal muscle are essential for the purpose of this study was to determine and compare the rectus abdominus and external oblique while the subjects performed various abdominal exercise intended to target to specific muscle sites. With respect to the rectus abdominus, and external oblique, no significant differences were found ($P > 0.05$). However, there was a trend toward somewhat higher EMG amplitudes in the left rectus abdominus compared with the rectus abdominus breathing exercise. **Conclusions**: In conclusion by use of abdominal crunch appears to be effective in recruiting the abdominal muscles and also safe in not excessively activating the unwanted hip flexor muscles. Our findings suggested that little difference be detected in the EMG activity of different rectus abdominus portions. However, our results illustrate the unconformity between the usual practice and scientific based observations and highlight the greater importance of exercise intensity to activate both muscle portions.

Keywords: *Abdominal exercise, Myoelectric activity, Rectus abdominus, External oblique.*

INTRODUCTION

Electromyography refers to recording of action potentials of muscle fibers firing singly or in groups near the needle electrode in a muscle. The muscle action potential when recorded by a needle appears triphasic as the action potential approaches, crosses and leaves the recording electrode. Recording from an area incapable of propagating the impulse, therefore, results in a large positivity with a low and long negativity. The distance of recording electrode from the muscle fibers determines the rise time and fall of muscle action potential [1,2].

Basis of triphasic shape of normal motor unit potential on needle recording; the positive, negative and positive deflections of Motor unit potential (MUP) are attributed to impulse approaching (a), crossing (b) and leaving (c) the recording electrode respectively. The normal muscle fibers are under neural control. The rate and pattern of firing of the muscle fibers of a motor unit, therefore, depends on the stimuli approaching through the nerve [3]. The denervated muscle fibers on the other hand have unstable membrane potential and fire spontaneously (without stimulation), individually (single fiber) and regularly. Before describing the normal and abnormal EMG signals, a brief description of different EMG needle electrodes would be appropriate [4,5].

Motor unit potential (MUP) represents the sum of the muscle action potentials supplied by an anterior horn cell. The muscle fibers discharge in near synchrony adjacent to the needle electrode. The MUP therefore has a higher amplitude and longer duration than action potential produced by a single muscle fiber [6].

MATERIALS AND METHODS

Twenty healthy young adults (Age group 18 – 20 years) without recent history of prolonged pain or injury in hips or spine were volunteered to the study. All individuals signed an informed consent before participation in the study.

Exercise: The EMG responses were analyzed during the performance of abdominal exercises. All exercises were performed on the floor in a flat surface.

Electromyography: Disposable surface electrodes were placed over both portions of rectus abdominus and external oblique muscle three centimeter superior and inferior to umbilicus and three centimeter to the right side. Before the electrode placement skin was cleaned with alcohol. These procedures followed the recommendations of Cram and Kasman.(1998). The EMG signal was collected with ME3000 electro myography (RMS POLYRITE) sampled at 1000 Hz and filtered with pass band of 10-500 Hz [7-10].

Data collection: Data was collected in one single session. After the anthropometric data, skin was prepared and the electrodes fixed. Each individual performed five consecutive repetitions in each exercise with a frequency of one repetition each three second. Between exercises was observed ten minutes rest interval. Exercises were executed in a random order.

Rectus Abdominus Crunches , Rectus Abdominus Breathing exercises, External Oblique abdominal, External Oblique breathing exercises

Data analysis: The EMG signals from the first and last repetition of each exercise were excluded and the mean RMS signal from the other three repetitions was used as an indicative of EMG response to that exercise and individual. The signal was normalized to each muscle from the exercise with highest EMG intensity.

Statistical analysis: A Two way repeated measures ANOVA was used to each portion of the muscle with exercise. SPSS version 18.0 for Windows (SPSS Inc., Chicago, IL, USA) software package was used to analyze the data of various parameters. The t-test statistical significance was set at $P \leq 0.05$. Values were expressed as Mean ± Standard Deviation.

RESULTS

Fig: 1 Subject performing abdominal exercises

Abdominal muscle are essential for the purpose of this study was to determine and compare the rectus abdominus and external oblique while the subjects performed various abdominal exercise intended to target to specific muscle sites. No significant differences were found both the rectus abdominus and external oblique however, there was a trend toward somewhat higher EMG amplitudes in the left rectus abdominus compared with the rectus abdominus breathing exercise.

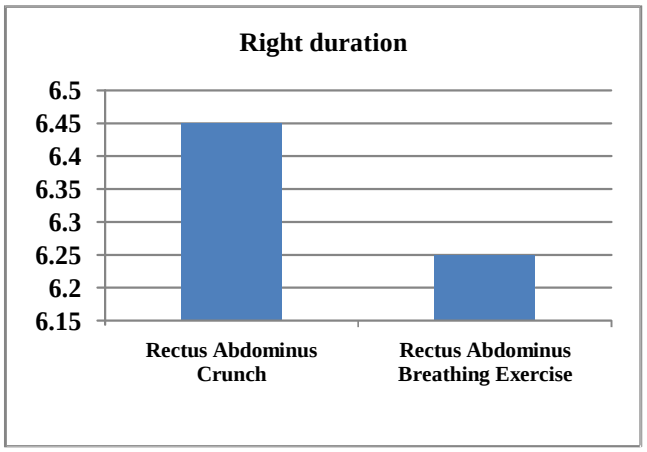

Fig2: Comparison of duration of EMG in between the right side of Rectus Abdominus Crunch and Rectus Abdominus breathing exercise

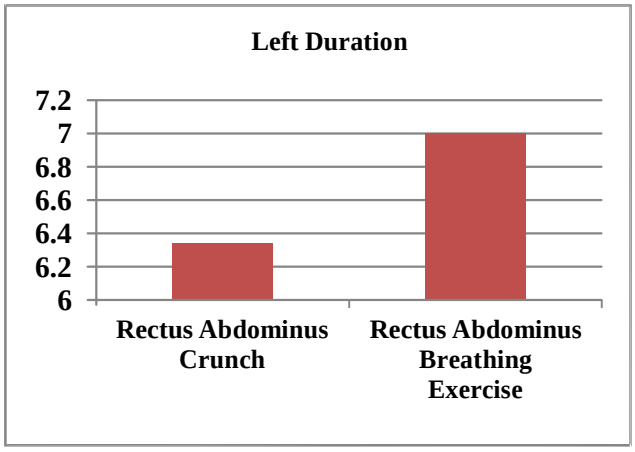

Fig3: Comparison of duration of EMG in between the left side of Rectus Abdominus Crunch and Rectus Abdominus breathing exercise

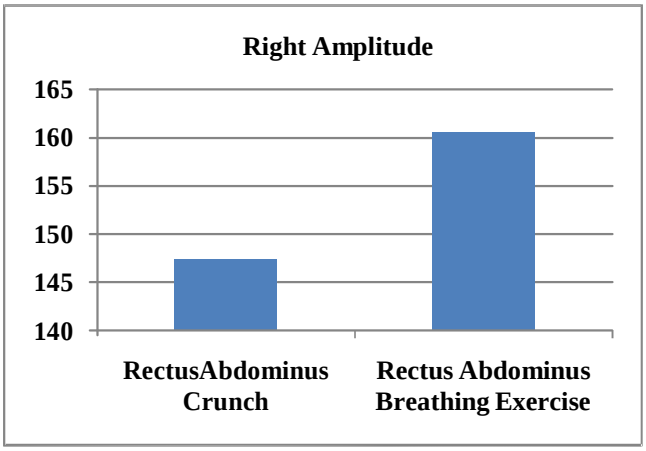

Fig 4: Comparison of amplitude of EMG in between the right side of Rectus Abdominus Crunch and Rectus Abdominus breathing exercise

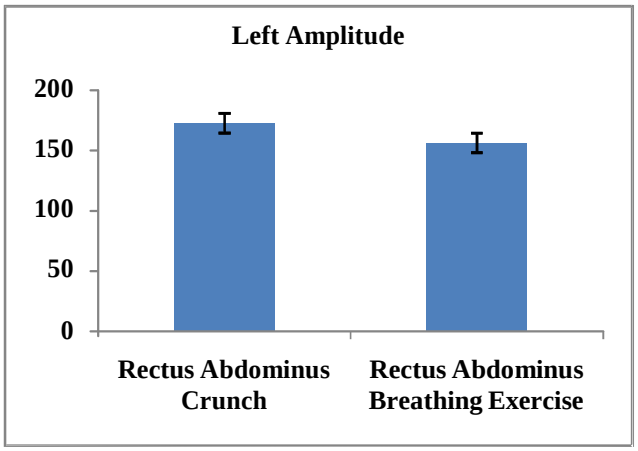

Fig 5: Comparison of amplitude of EMG in between the Left side of Rectus Abdominus Crunch and Rectus Abdominus breathing exercise

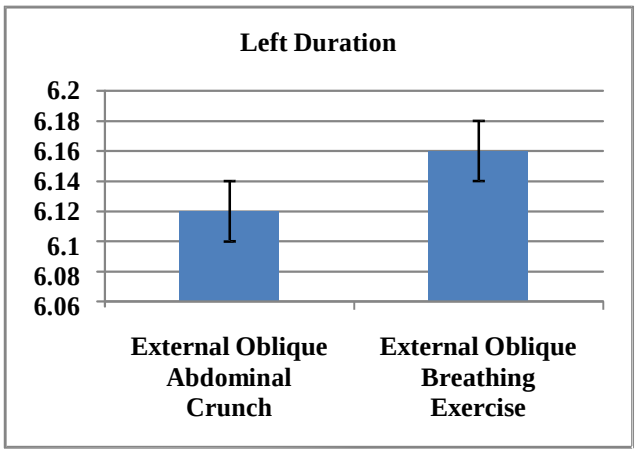

Fig 6: Comparison of duration of EMG in between the right side of External Oblique and External Oblique Breathing Exercise

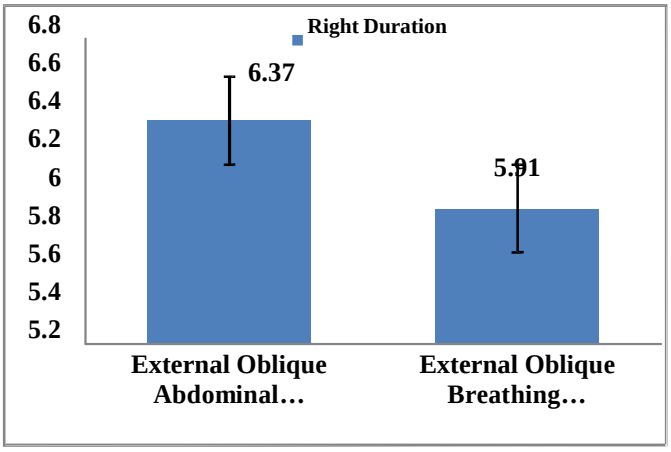

Fig 7: Comparison of duration of EMG in between the left side of External Oblique and External Oblique Breathing Exercise

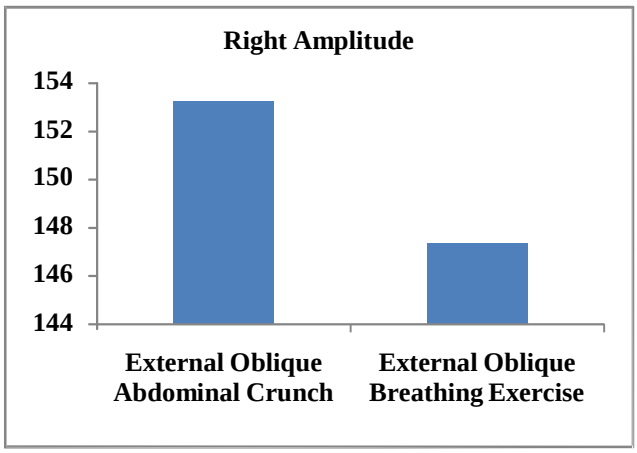

Fig 8: Comparison of amplitude of EMG in between the Right side of External Oblique and External Oblique Breathing Exercise

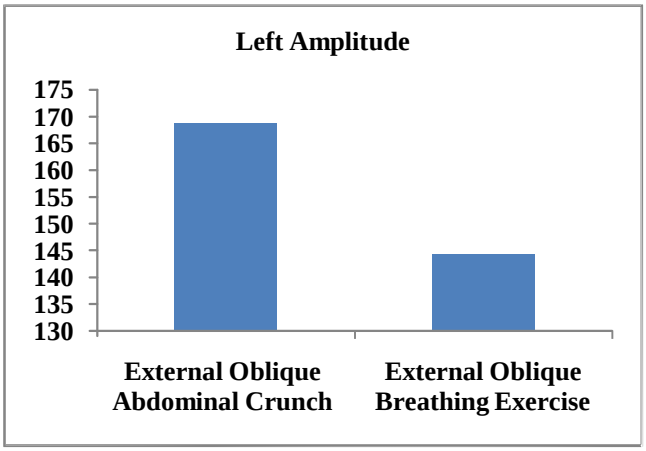

Fig 9: Comparison of amplitude of EMG in between the Left side of External Oblique and External Oblique Breathing Exercise

DISCUSSION

There are different ways to perform an exercise should change the pattern of activation of the specific musculature evolved [11,12]. However, it is important to highlight that in the event of a single muscle is not possible to contract one portion of rectus abdominus which contracts the other one –

Significant differences were found in both the amplitude of the action potentials of external oblique and rectus abdominus which is due to exercises performed. The differences due to exercise reflect the differences inherent in the movement themselves. The rectus abdominus muscle is recruited primarily to create trunk flexion. Abdominal exercise has shown to produce reasonable levels of activity in the rectus abdominus muscle while minimizing the resultant spine load [13].

In this study, the comparison between right and left side of duration of rectus abdominus and rectus abdominus breathing exercise as well as the external oblique and external oblique breathing exercise did not show any significant differences but the amplitude of the left rectus abdominus, rectus abdominus breathing exercise, external oblique breathing exercise, showed significant differences,

this was supported study done by Lapier et al [14,15]. In resting position, the participants were lying supine on the couch with the hands under the lower back effort to maintain a consistent level on spinal flexion, as this helps in the muscle length controlling, electrode placing, sub cutaneous tissue bulging and posture. The knee's were bent 90 belong exercises are develop the abdominal musculature should involve minimal contributions of the hip flexors. The knee bent position also help in preventing hyper extension and decreasing the stress on low back. Gilleard and brown found that external oblique to be more active than the rectus abdominus, whereas, in this study, the external oblique has slightly higher amplitudes, though once again[16-19], the differences between external oblique and external oblique breathing exercise of the EMG duration were not significant.

CONCLUSION

In conclusion by use of abdominal crunch appears to be effective in recruiting the abdominal muscles and also safe in not excessively activating the unwanted hip flexor muscles. Our findings suggest that little difference be detected in the EMG activity of different rectus abdominus portions. However, our results illustrate the unconformity between the usual practice and scientific based observations and highlight the greater importance of exercise intensity to activate both muscle portions.

Conflict of Interest: Nil

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