

225 - COMPARATIVE ANALYSIS OF RECTUS ABDOMINAL MUSCLE MYOELECTRIC ACTIVATION IN THE COLUMN FLEXION ON STABLE AND NON STABLE SURFACES- A PILOT SUTDY

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INTRODUCTION

Due to increasing of physical activities in public places (gyms, spas, clubs and similar) scientific research of physical exercises becomes preponderant on these places, so these exercises become more safe and efficient (FERREIRA AND NAJAR, 2005).

Physical exercises are designed to create muscular overload aiming to increase neuromuscular systems performance, however one of the highest challenges who physical activities professionals and health professionals face is the selection of which exercises will isolate determined muscular group or muscle to be trained (STERNLICHT AND RUGG, 2003).

Exercises to the abdominal zone follow this tendency of study, where scientists try to analyze through surface electromyography mainly, the influence that factors as position changes of upper and lower members (Workman et al, 2008; Lehman and McGill, 2001; Willett et al, 2001; Whiting et al, 1999; Sarti et al, 1996; Piering et al, 1993) as equipments and positions variations (Lizardo et al, 2009; Duncan, 2008; Youdas et al, 2008; Sternlicht et al, 2007; Avedisian et al, 2005; Clark, Holt and Sinyard, 2003; Lizardo et al, 2007; Sternlicht and Rugg, 2003; Vera-Garcia, Grenier and McGill, 2000) can generate in the activation of different muscles which compose the abdominal zone (MONFORT-PAÑEGO ETAL, 2009).

According to the surfaces variation, the exercises to the abdominal zone have been prescribed in the instability by the belief that these exercises will provide a great challenge to trunk muscles, increasing the necessary muscular request to maintenance the spine stability (MCGILL et al, 2000).

Searching scientific evidences, authors have been researching through surface electromyography, which surface (stable or labile), the execution of the exercises to abdominal zone requires higher or lower activities of determine muscle or muscles from this zone (DUNCAN, 2008; STERNLICHT et al, 2007; LIZARDO et al 2007; PETROFSKY et al, 2007; LEHMAN et al, 2005^a; LEHMAN et al, 2005^b; CLARK, HOLT AND SINYARD, 2003; VERA-GARCIA, GRENIER AND MCGILL, 2000).

To this comparison between the surfaces the most used exercise was the partial spine flexion until the scapular lose contact with the surface (partial abdominal), because this abdominal is considered closer to the ideal position for maximum utilization of the abdominal zone (Petrofsky et al, 2003), although there is no knowledge about studies which measure degrees of this ideal angulation

Results disagreement about exercises for abdominal zone may be related to the fact of studies analysis have been made only considering time of contraction, what may favor activities in labile surfaces since this surface require more time of contraction to stabilize the trunk. Maximum muscular peak contraction analysis of a muscle or muscle group is pointed by various authors as an important aspect in the analysis of specific exercise efficiency (Zatsiorky & Kraemer, 2008). According to this the aim of the study is to analyze through comparative electromyography the spine flexion exercise on the floor and on the 75cm Swiss ball using peak contraction, so it is important to know the rectus abdominal activity in both surfaces so that professionals of this area can elaborate safer and more efficient trainings to the abdominal zone muscles.

METHODS

5 healthy volunteers have participated on this study. Medium age was 27 years (± 2) weight 79,4Kg ($\pm 2,1$) height 184cm ($\pm 0,4$) and body fat percentage 10,3% ($\pm 1,2$) with at least 6 months of strength exercises practice and volunteers who realize abdominal exercises at least twice a week. All participants of this study have been explained about the tests that would be applied and signed a consent term. Chronic lumbar pain, lumbar rectification or marked concavity individuals and individuals with abdominal or lumbar surgeries were excluded to the study (Vera-Garcia, Grenier, McGill, 2000; Lehman et al 2005). High body fat percentage individuals were also excluded from the tests because this factor may interfere on the muscular activity measurement (STERNLICHT et al, 2007).

After the anamnesis, volunteers were submit to an anthropometric evaluation -waist-hip using metric tape (sanny medical) and being measured the waist perimetry on the smaller diameter of the trunk and the hip perimetry on the higher diameter of the hip (trochanter), mass index characterized as the relation between weight and the height and Pollock 7 folds protocol to sample characterization. Welmy scales (110 model) and Cescorf skinfold (Brasil) were also used in this study (Fernandes Filho, 2003).

After the anthropometric evaluation, all volunteers were submit to skin preparation (removal and cleansing) on the electrodes place fixation. Then 2 bipolar electrodes AE1010 – VRA0 were implanted 2cm besides the umbilical scar (Clark, Holt, Sinyard, 2003). After that the volunteers were positioned to exercise execution on the floor, performing the spine flexion movement until 30° and 3 minutes later (Simão et al. 2006) on the Swiss Ball performing also 30° spine flexion (Campos, 2002). All volunteers have been already practice the abdominal in both surfaces so exercise adaptation set was not performed before the tests. The volunteers performed the exercise during 40 seconds in both surfaces accounting 10 repetitions. Each phase of the movement was executed in 2 seconds (Clark; Holt; Sinyard, 2003). Movement amplitude was limited in spine flexion 30° and goniometer (sanny) was used and placed using the last rib as referential point because the partial abdominal is considered closer to the ideal position to abdominal muscles maximum utilization (PETROFSKY ETAL, 2003).

Nowadays 75cm diameter Swiss Ball is very used in gyms and to the movement execution it was standardized volunteers with 180° on the hip and 90° on the knees flexion measured by a goniometer. All volunteers realized the spine flexion until the sternum touch a stem with 30° inclination and returned to the initial position without spine hyperextension.

The abdominal exercise on the floor was realized with the volunteers positioned with 100° knee flexion and 40° hip flexion. 30° inclination stem was placed after the last rib and the volunteer realized the concentric phase until touch the sternum on the stem and then the volunteer returned to the initial position.

Lynx – EMG 1000 software Bioinspector and bipolar electrodes AE 1010 – VRA0 were used in the tests. Although electromyography is considered the main way to analyze muscular contractions interferences may occur.

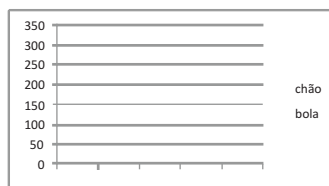
RESULTS

The obtained data by the anthropometric evaluation are represented on the following table.

Weight	Height	IMC	RCQ	%Fat	Dobra abdominal
79,4	1,84	23,45	0,81	10,3	15

According to this table we can observe that the IMC medium is under the mortality risk values. Waist- hip ratio is also under the values of the development of coronary diseases and body fat can be considered excellent according to the volunteers age medium (FERNANDES FILHO, 2003).

The achieved values by the exercise on the floor and on the ball are represented on the graphic bellow.



The graphic demonstrate that the 10 muscular contractions medium of each individual show higher peaks on the exercise in labile surfaces.

The medium values obtained from the general medium between the surfaces were analyzed trough test T for dependent samples and the results showed that the abdominal in labile surfaces presents significant statistic difference when compared with the abdominal exercise on stable surfaces. Shapiro- Wilk test was also realized to verify the sample normality and this test confirmed the sample normality.

ndependent Samples (Spreadsheet1)											
ables were treated as independent samples											
	Mean	Mean	t-value	df	p	Valid N	Valid N	Std.Dev.	Std.Dev.	F-ratio	p
Instável	160,5520	314,0660	-68,6615	8	0,000000	5	5	2,832529	4,119585	2,115233	0,485950

DISCUSSION

Abdominal exercises execution in labile surfaces presents conflicting data on the literature. Studies comparing upper and lower portions of rectus abdominal muscle didn't showed significant differences between portions (Clark; Holt; Sinyard, 2003; Lehman; McGill, 2001), however if stable surfaces data were compared with labile surfaces some authors demonstrate higher activity on rectus abdominal muscle on the labile surface (Petrofsky et al, 2007; Clark; Holt; Sinyard, 2003; Mc Gill et al, 2000) and others didn't found significant differences between the surfaces (LIZARDO ETAL, 2007; HILDENBRAND; NOBLE, 2004).

Obtained data on the present study corroborate with the results in other studies cited before which demonstrate a higher activity to the labile surface. This increase on the rectus abdominal activity on the Swiss ball could be explained due to the muscles increased request to stabilize the spine and the body as the probability decrease to fall from de labile surface (VERA-GARCIA, GRENIER, MCGILL, 2000).

Muscular activity increase on the swiss ball when it was compared to the floor found in this study can also be explained by the volunteers position on the swiss ball because when the individual places de ball closer to the scapular inferior level there is a decrease on the muscular activity however when the ball is placed near to lumbar part, as it happened on this study, there is an increase on the muscular abdominal zone activation. This increase could occur due to a higher effort to flex the spine and require higher trunk stabilization (STERNLICHT ETAL, 2007).

Another important factor is most of the studies analyze the time of contraction instead of contraction peak that may benefit labile surface activities by the need to keep more time in contraction to stabilize the trunk. Maximum muscular peak contraction analysis of a simple muscle or muscular group is an important aspect to specific exercise efficiency (Zatsiorky & Kraemer, 2008). According to this perspective (Salerno; Guimarães; Fernandes, 2007) found higher peaks of activity of rectus abdominal when it was compared the stable with the labile surface however the difference was not significative and the ball was placed near the scapular.

CONCLUSION

According to the used methodology and the analysis of the results of this study we can conclude that for the analyzed sample significant statistic differences were demonstrate between the labile surface when it was compared with stable surface.

There were limitations in this study. The electrodes placing only in rectus abdominal muscle may interfere in the obtained results since stabilizers and antagonists muscles were not monitored by the electrodes placing difficulty.

New studies with a better control of the described variables are suggested and other studies relating the size and ball position because we believe that the hip joint position influences on exercise biomechanics, so that professionals who work with programs prescription can elaborate more efficient exercises with real knowledge of each surface effects.

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COMPARATIVE ANALYSIS OF RECTUS ABDOMINAL MUSCLE MYOELECTRIC ACTIVATION IN THE COLUMN FLEXION ON STABLE AND NON STABLE SURFACES- A PILOT SUTDY

Nowadays physical exercises in labile surfaces have been preconized by the belief that this kind of exercises will provide an increase on trunk muscle activity and other benefits therefore scientific studies are controversial about this subject, and consequently there are doubts about the achieved results. According to this the aim of the study was to analyze through comparative electromyography the abdominal exercise in stable and labile surfaces using contraction peak. 5 healthy volunteers have participated on this pilot research and every volunteer realized an anamnesis and after that and anthropometric evaluation to sample characterization. After the anthropometric evaluation all volunteers were submit to skin preparation and then 2 bipolar electrodes were implanted on each surface of rectus abdominal muscle to EMG analysis. The volunteers realized the exercise during 40seconds in both surfaces accounting 10 repetitions. A 30° trunk curl angle was limited on the concentric phase to exercise execution. The medium values of the obtained data of exercise execution in both surfaces were compared through test T for dependent sample and the results demonstrate that the abdominal exercise in labile surface showed significant statistic difference when compared to the exercise in stable surface with value of $p=0,000000$. According to this the abdominal exercise in labile surfaces seems to be more efficient when peak contraction is considered, a important factor to a strength training prescription.

KEY WORDS: abdominal exercises, stable surfaces, labile surfaces, electromyography

ANALYSE COMPARATIVE DE L'ACTIVATION MIOELÉTRICA DU MUSCULE RETO DU ABDÔMEN SUR LA FLEXION DE LA COLONNE SUR SURFACE STABLEE ET NON STABLES - UN PILOT DE ETUDY

Récemment, il a été suggéré des exercices dans un environnement instable par la conviction que ces exercices fournira une activité accrue des muscles du tronc, et d'autres avantages, mais ces études scientifiques sont controversée et donc, les résultats pose de doutes. Dans cette perspective, l'objectif de cette étude était d'analyser, en utilisant l'électromyographie comparative, les exercices abdominaux sur une surface stable et aussi sur une surface instable passant par le pic de la contraction du muscle. Cinq volontaires, actif et sain, ont participé des études. Chaq'un a été soumi a une entrevue et puis à une évaluation anthropométrique pour les caractériser. Après l'évaluation anthropométriques, les participants ont été soumi a la préparation de la peau et ,puis, ont été déployé deux électrodes bipolaires, une sur chaque surface du muscle reto de l'abdomen pour l'analyse sur l'EMG. Ensuite, les volontaires ont réalisés des mouvement sur une surface stable et une outre instable, respectivement, pendant 40 seconde pour 10 répétitions. La flexion de la colonne vertébrale a été limité à un angle de 30 ° dans la phase concentrique des exercices. Les valeurs moyennes des données obtenues dans les jeux d'exercices sur les zones stables et instables ont été comparées en utilisant le test T for dependent sample et les résultats ont montré que l'exercice abdominale

dans un équilibre instable présente une différence statistiquement significative par rapport l'exercice abdominale sur une surface stable avec une valeur $p = 0.000000$. Ainsi, l'exercice abdominale effectuée dans une surface instable semble être plus efficace quand elle prend en compte le pic de la contraction musculaire, ce qui est un facteur déterminant pour la préparation de la musculature.

MOTS-CLÉS: gymnastique abdominale, surface instable, surface stable, lectromyographie

ANÁLISIS COMPARATIVO DE ACTIVACIÓN RECTO DEL ABDOMEN MYOELÉCTRICAS FLEXIÓN EN LA COLUMNA EN SUPERFÍCIE ESTABLE Y NO ESTABLE - UN ESTUDIO PILOTO

Recientemente se ha sugerido a los ejercicios en una superficie inestable por la creencia de que estos ejercicios proporcionarán una mayor actividad de los músculos del tronco, y otros beneficios, pero los estudios científicos son controvertidos en esta materia y, por tanto, sin duda, de los resultados. En vista de esto, el objetivo de este estudio fue analizar mediante electromiografía el ejercicio abdominal comparativo sobre superficies estable y inestable a través del pico de la contracción muscular. Los participantes se pusieron a 5 voluntarios, activa y saludable, donde cada sujeto realizó una entrevista y una evaluación antropométrica para caracterizar la muestra. Después los participantes se sometieron antropométricas preparación de la piel y pronto se desplegó dos electrodos bipolares, uno en cada superficie del músculo recto abdominal para el análisis de la EMG. Entonces los voluntarios realizaban el movimiento en las superficies estables e inestables, respectivamente, durante 40 segundos ejecutándose 10 repeticiones del movimiento. Se limitaba a un ángulo de 30° de flexión de la columna en la fase concéntrica de los ejercicios. Los valores medios de los datos obtenidos en las obras de los ejercicios en las zonas estables e inestables fueron comparadas usando la prueba de t para muestras dependientes y los resultados mostraron que el ejercicio abdominal en un estado inestable presenta una diferencia estadísticamente significativa en comparación con el ejercicio abdominal en una superficie estable con un valor $p = 0,000000$. Así, el ejercicio abdominal que se hace en la rama inestable parece ser más eficaz cuando se toma en cuenta el pico de la contracción muscular, que es un factor determinante para el desarrollo del entrenamiento de fuerza.

PALABRAS CLAVE: ejercicio abdominal, inestable, la electromiografía superficie estable

ANÁLISE COMPARATIVA DA ATIVAÇÃO MIOELÉTRICA DO MÚSCULO RETO ABDOMINAL NA FLEXÃO DA COLUNA EM SUPERFÍCIE ESTÁVEL E NÃO-ESTÁVEL- UM ESTUDO PILOTO

Recentemente tem se preconizado a realização de exercícios em superfícies instáveis pela crença de que esses exercícios proporcionarão aumento na atividade dos músculos do tronco, além de outros benefícios, porém os estudos científicos são controversos sobre esse assunto e, conseqüentemente, existem dúvidas dos resultados alcançados. Em vista disto, o objetivo do presente estudo foi analisar através da eletromiografia comparativa o exercício abdominal em superfície estável e em superfície instável através do pico de contração. Participaram da pesquisa piloto 5 voluntários, ativos e saudáveis, onde cada voluntário realizou uma anamnese e posteriormente uma avaliação antropométrica para caracterização da amostra. Após a avaliação antropométrica os participantes foram submetidos à preparação da pele e logo em seguida foram implantados dois eletrodos bipolares, um em cada superfície do músculo reto abdominal para análise no EMG. Em seguida os voluntários realizaram o movimento em superfícies estável e instável respectivamente, durante 40s contabilizando 10 repetições. Foi limitado um ângulo de 30° de flexão da coluna na fase concêntrica para realização do exercício. Os valores médios dos dados obtidos nas execuções dos exercícios nas superfícies estável e instável foram comparados através do teste T for dependent sample e os resultados demonstraram que o exercício abdominal em superfície instável apresenta diferença estatística significativa quando comparado com o exercício abdominal em superfície estável com valor $p= 0,000000$. Assim, o exercício abdominal realizado em superfície instável parece ser mais eficiente quando se leva em consideração o pico de contração muscular, o que é um fator determinante para elaboração de um treino de força.

PALAVRAS-CHAVE: exercício abdominal, superfície instável, superfície estável, eletromiografia

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