48 - ACUTE EFFECT OF FLEXIBILIZING BY PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION ON STRENGTH ENDURANCE

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INTRODUCTION.

The influence of flexibility in strength has been the object of studies by a number of authors[1,8,10,17,18,19,20,21,27]. The view that the decrease in strength does not occur after flexibility training is still defended by experts on the subject[12,14,15,24,26].

A few hypotheses have been raised in order to explain such decreases in strength promoted by the application of flexibility exercises. One of the reasons could be the altered relation of length-tension which may alter the mechanical properties of the muscle[5]. Another reason is that the stretching of the muscle induced adjustments may be of a peripheral origin showing an action in the receptor (muscle spindles, Golgi tendon organs) or of a central origin influencing the neural transmission [13]. Yet, studies indicate that the central nervous system may act through inhibitory mechanisms, causing a decrease in strength[1,25], where it is affected more by muscle inhibition than by changes in elasticity [1]. Another important factor is the reduction in strength transmission of muscle to bones involved in the movement, due to an increase in compliance of tendon-muscle properties [4,16,18,19].

However, the importance of flexibility and its preponderant role in motor betterment and improvement in mechanical efficiency of the individual is not discussed.

A few investigators[8,11,17,18,24,25,26,28] have given emphasis to the study of the influence of flexibility in maximum strength, not taking into consideration that training of maximum strength forms the smallest portion of periodized training. The variation in volume of training and intensity (periodization) is extremely important in order to improve strength[33] gain. Therefore, it is also necessary to investigate the influence of flexibility in strength endurance.

The Proprioceptive Neuromuscular Facilitation (PNF) flexibility method used to increase joint amplitude, observed in joint mobility (through the sustentation-relaxation, slow reversion and relaxation-contraction), and muscular elasticity (through repeated contractions)[6], is one of the most recommended methods used to reach the increase in joint amplitude[7,22,31,32]. That is the reason why this method was chosen for the execution of the current study, which aims at assessing the acute effect of flexing by PNF on strength endurance in young adults.

MATERIALS AND METHODS.

The sample was made up of 18 subjects of the male gender, with an average age of 23,11 ± 5, 2; physically active and with a minimum of six months practice. They were randomly split up into two groups; Experimental Group (EG n=10) and Control Group (CG n=08). After the subjects were briefed on the research procedures, they signed a form of free consent and answered the PAR-Q questionnaire, where the results were all negative.

The study was approved by the UFAC - Federal University of Acre Research Ethics Committee -, protocol nº 23107.008386/2007-90.

Experimental procedure:

The selected exercise for the strength test was the bench press. The groups executed the 1RM test, followed by the EG test. The EG was submitted by the PNF method (Scientific Stretching for Sport - 3S) applied on the pectoral muscular grouping, following protocol. The appraised subject was placed in a standing position, with his knees semi flexed, feet parallel, torso erect and with a horizontal extension of his arm, mobilizing the corporal segment until its maximum amplitude limit, followed by a maximum isometric contraction, during eight seconds. After the contractions, the appraised subject forced the segment beyond the original limit during the relaxation of his musculature. The procedure is executed three times[6].

The 1 RM bench press test:

In order to reduce execution errors, a few precautions were taken: The subjects were instructed regarding the execution procedure of the test, with emphasis on the execution technique of the exercise, following these stages: The subject is positioned on the bench press, with knees flexed, lower limbs parallel and feet propped up. The positioning of the hands on the bar for each subject was standardized at a 90° angle between his arm and forearm. The horizontal flexing of shoulders and complete extension of elbows was carried out in the eccentric phase. All of the tests were carried out at night before the execution of the 1RM test and the subjects carried out a warm up of 15 repetitions at 50% of the strength level they were used to during their training session. [30] The weights used in the study were previously checked using a calibrated scale. All of the volunteers were totally familiar with the 1RM tests.

Maximum repetition test:

75% of the maximum load reached was calculated for the tests of each appraised subject after the execution of the 1RM test. The groups then executed the maximum number of repetitions possible with the predicted load (Pre-test). The groups were given a 10 minute interval after the repetitions. This time interval is necessary so that immediate sources of energy are re established for the execution of a high intensity exercise, thus allowing for a satisfactory recovery in order for the subjects to execute the highest number of repetitions[29]. After the interval, the EG was submitted to flexibilizing (PNF) followed by a new test of maximum repetitions (Post-test). The CG executed the maximum repetitions only after the interval (Post-test). A new 10 minute rest interval was given to the groups. The groups then executed a new maximum repetition test (Post10min).

The descriptive statistic (mean and mean-deviation) was used to describe the sample. The Levene test was used to check the homogeneity of the sample. The variance analysis (ONE WAY ANOVA) and the Post Hoc Scheffé test were used for comparison between groups.

RESULTS.

The objective of the study was to verify the influence of the Proprioceptive Neuromuscular Facilitation method in strength endurance. The group descriptive analysis results are described in table 1.

Table 1: Nº of maximum repetitions executed with a weight of 75% TPM1RM.

	Groups	N	Average	Median	Mean Deviation	Mean Error	Variation Coefficient
RM-Pre	GE	10	10,60	10,5	,966	,306	9,11%
	GC	8	12,25	12,5	1,282	,453	10,46%
RM-Post	GE	10	9,00	9,0	,943	,298	10,48%
	GC	8	11,63	11,5	1,061	,375	9,12%
RM-Post 10min	GE	10	8,80	9,0	1,033	,327	11,74%
	GC	8	10,88	11,0	,835	,295	7,67%

The ANOVA Table 2 resulted in p<0,05, showing a significant difference between at least one of the groups in relation to the others. Table 2. Anova between and within groups:

		Sum of Squares	Df	Mean Square	F	Sig.
RM-Pre	Between Groups	12,100	1	12,100	9,729	,007
	Within Groups	19,900	16	1,244		
RM-Post	Between Groups	30,625	1	30,625	30,866	,0004
	Within Groups	15,875	16	,992		
RM-Post 10min	Between Groups	19,136	1	19,136	21,152	,0003
	Within Groups	14,475	16	,905		

In order to check which group differs significantly from the others, the Post Hoc Sheffé test was used as it was considered to be more conservative (VINCENT, 1999), table 3.

Table 3: Post Hoc Scheffé, for the Dependent Variables.

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
GE Pre-test	GE Post-test	1,600(*)	,458	,047	,01	3,19
	GE Post10min.	1,800(*)	,458	,017	,21	3,39
GC Pre-test	GC Post-test	,625	,512	,911	-1,15	2,40
	GC Post10min.	1,375	,512	,226	-,40	3,15

DISCUSSION.

The result found in the study, indicates that strength endurance exercises are significantly affected (p=0, 0001<0, 05) by previous PNF exercises (%=16, 98%). Possible alterations of peripheral origin with action on the receptors, muscle spindles and Golgi tendon organs, or of central origin influencing the neural transmission[13], can have influenced the loss of strength endurance in the experimental group. However, wear and tare itself caused by the first series of exercises, lead to the decrease in strength endurance (%=13, 6%), observed in the post-test of the control group. Nevertheless, this decrease was not significant, as in the experimental group, showing that the PNF exercise was responsible for the decrease in strength endurance which took place in the EG.

Lattari[17] also noted a reduction in maximum strength levels in a study carried out with 20 subjects of the male gender. In the experiment, the subjects were submitted to a 1RM test; after the test, 90% of the maximum load was calculated for each subject and they were then directed to carry out the maximum number of repetitions possible. After the first series, they were divided into two groups; one group carried out passive flexibility exercises, and the other did not; followed by a new series of maximum repetitions. The loss of maximum strength was observed in both groups, however only significantly in the experimental group that carried out the passive flexibility exercise. The results of our research indicate the same tendency in relation to exercises with a higher number of repetitions. In our experiment, the repetition average of the groups was of 10, 4 ±1,6 indicating that flexibility exercises also influence this type of strength.

When the PNF is executed as a warm up, it may also influence the loss of strength[2]. According to Church [2] these exercises should not be used before a training session which requires power, such as high jumps and sprints. Loss of power was observed in his study during the vertical jump when it was executed after a routine of PNF exercises.

Upon comparing this study, Simão[28] did not note any change in strength in two warm up protocols for the 1RM test; the specific warm up and the PNF method. He attributed these results to the probable hypothesis that the warm up was carried out in only one session before the test. Thus, possible plastic modifications did not take place in the elastic components of soft tissue as well as muscular fascia, which lead to more permanent modifications in their length. Corroborating this argument, Young and Elliot[27] obtained the same results in power and strength exercises where the PNF did not negatively affect performance in long jump and in the voluntary maximum contraction.

Nevertheless, recent studies[8,10,17,20] checked the influence of flexibility in strength[20] In a study carried out with sixteen athletics athletes (11 men, 5 women) Nelson noted a significant reduction in performance in 20m sprints in athletes who carried out passive flexibility, coming to the conclusion that this type of previous exercise could interfere negatively in the performance of short duration exercises. Eurico[8] noted that a routine of static flexibilizing carried out before maximum strength exercises, causes a significant decrease in production of maximum strength. Fowles [10] verified the decrease in maximum force in young adults (6 men and 4 women), with 30min of passive flexibility exercises. (13 extensions of 135s each from the ankle flexors), A similar control group participated in the research without carrying out the extension. Isometric strength measures (maximum voluntary contraction), and electromyography, were used before, immediately after and at 5, 15, 30, 45, and 60 min after tests. A decrease in maximum voluntary contraction in the post-test was noted (28%) and at 5 (21%), 15 (13%), 30 (12%), 45 (10%), and 60 (9%) min after the flexibility exercise (P<0.05). This data indicates that prolonged flexibility from an only muscle decreases voluntary strength up to 1hr after flexibility exercises. This result was due to impaired activation and deficit of contractile force in the first phase and deficit of contractile force throughout the entire period. Similar results were found in our work, as a decrease in strength endurance even with a 10 minute interval given to the groups before the execution of the third series of exercises and only the group which carried out flexibility exercises (PNF), presented a significant reduction in strength endurance.

Marek[18] notes that the risk benefit relation should be observed whilst using the PNF technique before exercise. A significant reduction in torque peak, strength and electromyography (EMG) in the knee extension isokinetic exercise was noted in his study, but he classified the effect as being slight, according to the size attributed to these changes induced by stretching. Our findings also point in this general direction, due to the decrease of repetitions in the post-test of the experimental group, which although significant, were slight. What should also be observed is the cost benefit relation, concerning flexibility, for its preponderant role in the motor capacity of man and his performance [23].

CONCLUSIONS.

Based on the results of the study, we can conclude that strength endurance may be affected by prioperceptive neuromuscular facilitation exercises executed before training. This loss in strength was also significant after a 10 minute interval

between the series.

These results show that the inclusion of PNF exercises is not recommended before a competition. In relation to training, besides the influence of PNF in strength endurance, one aspect should be considered by the athletes and coaches; the cost benefit relation concerning flexibility, as it presents a motor improvement and a mechanical efficiency, although still contested, decreasing the risk of injury, expressivity and corporal conscience, which are factors that contribute to the increase in sports performance.

For new researches, we suggest that the appraised subjects be submitted to a flexibility test, in order to check for the correlation existence between the degree of flexibility and loss of strength.

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ACUTE EFFECT OF FLEXIBILIZING BY PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION ON STRENGTH ENDURANCE

ABSTRACT:

Objective: The objective of this study is to verify the acute effect on the decrease of muscular force endurance after the execution of Proprioceptive Neuromuscular Facilitation exercises (PNF). Methodology: 20 men, 23,1±5,2 of age who underwent 14 weeks of training participated in the study. The 1RM was used to verify the maximum load in the bench press exercise where a value of 75% was calculated after the exercise. After the test, the subjects were divided into two groups: Experimental Group (EG) and Control Group (CG). The EG executed the maximum number of repetitions with 75% of the maximum load obtained in the 1RM test and the PNF exercise was executed after an interval of 10min, followed by a new series with the same load and a new interval of 10min was given before the third trial. The CG executed the same procedure, except for the execution of the PNF exercise. Results: A mean of 10,6±0,9 repetitions in the first series, 9,0±0,9 in the second series and 8,8±1,0 in the third series was observed in the EG, showing a significant difference (p=0,0001<0,05). The (CG) reached a mean of 12,5±1,2 repetitions in the first series, 11,6±1,0 in the second series and 10,8±0,8 in the third series, showing no significant difference (p=0,0574>0,05); Conclusion: when the PNF exercises are executed before strength training, this causes a decrease in strength endurance.

KEY-WORDS: Proprioceptive Neuromuscular Facilitation; Strength Endurance and Acute Effect.

EFFET AIGU DE FLEXIBILITÉ PAR FACILITATION NEUROMUSCULAIRE PROPRIOCEPTIVE SUR RÉSISTANCE DE FORCE.

RÉSUMÉ:

Objectif : L'étude il a eu comme objectif, vérifier l'effet aigu dans la diminution de la résistance de force musculaire après la réalisation d'exercices de FNP. Méthodologie : 20 hommes avec âge de 23,1±5,2 années ont participé de l'étude. Tous avec description de plus de 14 semaines de formation. Les sujets ont été informés sur les procédures de la recherche et ont signé le terme d'approbation ait exempté éclairci, approuvée par le Comité d'Éthique dans Recherche de l'Université Fédérale de l'Acre - UFAC. A été utilisé l'essai de 1RM pour la vérification du chargement maximum dans l'exercice de supino droit et ultérieurement calculée 75% de la valeur obtenue. Après l'essai les sujets ont été divisés dans deux groupes : Groupe expérimental (GE) et groupe contrôle (GC). Le GE a réalisé le maximum de répétition avec 75% du chargement maximum obtenu dans l'essai de 1RM, après un intervalle de 10min a été réalisé l'exercice de FNP, ensuite nouvelle série avec le même chargement a été réalisée, un nouvel intervalle de 10min a été donnée avant troisième tentative. Le GC a réalisé la même procédure excepté la réalisation de l'exercice de FNP. Résultats : A été vérifiée dans le GE une moyenne de 10,6±0,9 répétitions dans première série, dans seconde 9,0±0,9, et dans troisième 8,8±1,0 en montrant différence significative (p=0,0001<0,05). (GC) il a atteint une moyenne de 12,5±1,2 répétitions dans la première série, dans la seconde série 11,6±1,0 répétitions et dans la troisième 10,8±0,8 en n'ayant pas de différence significative (p=0,0574>0,05) ; Conclusion : les exercices de FNP quand réalisés avant la formation de force provoquent de la diminution de la résistance de force.

MOTS-CLES : Facilitation Neuromuscularire Proprioceptive ; Résistance de Force et effet aigu.

EFECTO AGUDO DEL FLEXIONAMENTO EN LA FACILITACIÓN NEUROMUSCULARES PROPIOCEPTIVA ACERCA DE LA RESISTENCIA DE LA FUERZA

RESUMEN:

Objetivo: El estudio tuvo como objetivo verificar el efecto agudo en la disminución de la resistencia de fuerza muscular después de la realización de ejercicios de FNP. Metodología: Veinte hombres con edad entre 23,1±5,2 años participaron del estudio. Todos ellos habían practicado más de 14 semanas de entrenamiento. Las personas fueran informadas de los procedimientos de la investigación, además de eso, ellas firmaron un documento permitiéndonos realizar la investigación. El documento fuera aprobado por el Comité Asesor de Ética de la *Universidad Federal do Acre-UFAC*. Fuera utilizado el teste de *1RM* para la verificación de la cantidad máxima de ejercicios de supino erecto y posteriormente calculado 75% del valor obtenido. Después del teste los sujetos fueron divididos en dos grupos: *Grupo Experimental (GE)* y *Grupo Controle (GC)*. El GE realizó el máximo número de repetición con 75% de la carga máxima obtenida en el teste de *1RM*. Después de una pausa de diez minutos fuera realizado el ejercicio de FNP enseguida nueva secuencia con la misma carga fuera realizada un nuevo intervalo de diez minutos fuera dado antes de la tercera tentativa. El *GC* realizó el mismo procedimiento excepto la realización del ejercicio de FNP. Resultados: Fuera verificado en el GE una média de 10,6±0,9 repeticiones en el primér grupo de la enseñanza fundamental en la segunda 9,0±0,9; y en la tercera repeticiones y en la tercera 10,8±0,8, no existiendo distinción significativa (p=0,0574>0,05); Conclusión: el ejercicio de FNP, cuando realizados antes del entrenamiento de fuerza, provoca disminución de la resistencia de fuerza. PALABRAS-CLAVE: Facilitación Neuromuscular Propioceptiva; Resistencia de Fuerzas de Efecto Agudo.

EFEITO AGUDO DO FLEXIONAMENTO POR FACILITAÇÃO NEUROMUSCULAR PROPRIOCEPTIVA SOBRE A RESISTÊNCIA DE FORçA

RESUMO:

Objetivo: O estudo teve como objetivo, verificar o efeito agudo na diminuição da resistência de força muscular após a realização de exercícios de FNP. Metodologia: 20 homens com idade de 23,1±5,2 anos participaram do estudo. Todos com histórico de mais de 14 semanas de treinamento. Os sujeitos foram informados sobre os procedimentos da pesquisa e assinaram o termo de consentimento livre esclarecido, aprovada pelo Comitê de Ética em Pesquisa da Universidade Federal do Acre -UFAC. Foi utilizado o teste de 1RM para a verificação da carga máxima no exercício de supino reto e posteriormente calculado 75% do valor obtido. Após o teste os sujeitos foram divididos em dois grupos: Grupo experimental (GE) e grupo controle (GC). O GE realizou o máximo número de repetição com 75% da carga máxima obtida no teste de 1RM, após um intervalo de 10min foi realizado o exercício de FNP, em seguida nova série com a mesma carga foi realizada, um novo intervalo de 10min foi dado antes da terceira tentativa. O GC realizou o mesmo procedimento exceto a realização do exercício de FNP.. Resultados: Foi verificado no GE uma média de 10,6±0,9 repetições na primeira série, na segunda 9,0±0,9, e na terceira 8,8±1,0 mostrando diferença significativa (p=0,0001<0,05). O (GC) atingiu uma média de 12,5±1,2 repetições na primeira série, na segunda série 11,6±1,0 repetições e na terceira 10,8±0,8 não havendo diferença significativa (p=0,0574>0,05); Conclusão: os exercícios de FNP quando realizados antes do treinamento de força provoca diminuição da resistência de força.

PALAVRAS-CHAVE: Facilitação Neuromuscular Proprioceptiva; Resistência de Força e efeito agudo.