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ELECTROMYOGRAPHIC ANALYSIS OF THREE SETS OF BENCH PRESS AND LYING DOWN TRICEPS EXTENSION EXERCISES

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INTRODUCTION

Strength training is increasingly being used either for athletes preparation for all sports or to improve health and life quality and for aesthetics purposes. Among the exercises for upper limbs, bench press and lying down triceps extension are most common, the latter, however, little studied. The purpose of this study was to analyze the electromyographic (EMG) activity of five shoulder muscles on the bench press and lying down triceps extension exercises over three sets.

METHODS

Nine male subjects were selected for this study, with body mass and height of 83,8 ± 5,3 kg and 1,77 ± 0,04 m without upper limbs injury history and with at least 24 months of experience in strength training.

The EMG activity was recorded with the equipment EMG 1000 (Lynx, São Paulo, Brazil). The analyzed muscles was pectoralis major, sternal (PMs) and clavicular (PMc) head, anterior (AD) and medial deltoid (MD) and triceps brachii long head (TBL) on the bench press and lying down triceps extension exercises.

The electrodes were placed 1 cm away from the motor point of each muscle, parallel to the fibers, and fixed by adhesive tape to avoid motion over the skin. A ground electrode was attached over bone at the clavicle. The motor point as a reference for electrode placement allowed better EMG signal reproducibility across days (41). Motor point localization was performed by the use of an electric pulse generator OMNI PULSI-901 (QUARK, Piracicaba, Brazil).

For measuring the test load, a 8RM test was used. During the 8RM tests, each subject had a maximum of 3 attempts on each exercise with 5-minute intervals between attempts. If the subject did not accomplish 8RM in the first attempt, the weight was adjusted by 1 to 2 kg before the next attempt. After the 8RM load in a specific exercise was determined, an interval no shorter than 20 minutes was allowed before the 8RM determination of the next exercise. The signal was normalized using maximal voluntary isometric activation (MCIV), cut each two seconds of overlap of 50% and the higher RMS was used. The MCIV test has duration of ten seconds and was realized in a separated day with previous warm up of subjects. The EMG analysis was done using three set of eight repetitions for each exercise with a rest interval of two minutes. Data were collected in two different days, one day to perform each exercise and one week between these days. Half of subjects performed first the data collects with bench press and the others performed lying down triceps extension.

Data analysis was realized using Matlab 2009b (Mathworks, USA) software. The descriptive analysis consisted of calculating the mean and the standard derivation. Data normality was verified for a Kolmogorov-Smirnov test and equal variance for Levene test. A split-split-plot variance analyses was performed to assess differences between exercises, sets and muscles respectively. When necessary the Student-Newman-Keuls (SNK) post-hoc was used. The level of significance was set at $p<0.05$.

RESULTS AND DISCUSSION

Analyzing the EMG activity of three sets of each exercise for the five muscles selected, it was found that bench press (71,5%) had higher activation than lying down triceps press (47,7%). However, were not found significant differences between all the sets of each exercise, which reveal the lack of influence of fatigue during the exercises sets.

When comparing exercises (TABLE 1), for bench press the PMs (99,18%) and PMc (86,92%) were the muscles with greater activity, same results found in TREBS (4), BARNETT (1), McCAW & FRIDAY (3), ELLIOTT et al. (2). To lying down triceps extension exercise, TBL (80,69%) and PMs (62,18%) were the muscles with higher EMG activity. Comparing both exercises, bench press showed greater activity than lying down triceps extension to all muscles, except for TBL, muscle that were found no significant differences between exercises. This differences can be associated to the fact of bench press be a multiarticular exercise with neuromuscular control demands more complex.

In bench press exercise, PMs acts as primary agonist to glenohumeral horizontal abduction, PMc as secondary agnonist, AD and MD as synergists and TBL as primary agonist to elbow extension. Otherwise, TBL is the primary agonist in lying down triceps extension and PMs, PMc, AD

and MD acts as synergists of shoulder joint. From the results obtained, it can be concluded that bench press has greater activity than lying down triceps extension in the shoulder horizontal abduction agonist and in all synergists. However, lying down triceps extension has no muscle that has greater activity than bench press and only TBL didn't show statistical significant differences.

This way, it's possible to verify that bench press is an exercise more complete than lying down triceps extension for both agonists and synergists muscles. Unlike the bench press, there are no studies investigating the EMG pattern in lying down triceps extension, what shows the lack of studies about monoarticular triceps exercises.

	Bench press	Lying Down Tr. Extension
PMs	99.18	62.13
PMc	86.92	40.77
AD	76.31	34.33
MD	37.69	20.96
TBL	75.43	80.70

Table 1 - RMS value (% MCIV) of the analyzed exercises – mean between the sets

CONCLUSIONS

It can be concludes that both analyzed exercises are being used in a proper manner in training programs: bench press is used for chest training and lying down triceps extension for triceps. On the other hand, it was verified that there were no differences between the TBL activity in both exercises, what suggests that when bench press is performed in a training program, TBL will be trained in an equivalent manner to doing lying down triceps extension. Though, it's essential to consider the importance of variation of stimulus in a training program.

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