CORRELATION BETWEEN CLINICAL AND LABORATORIAL MEASUREMENT OF HAMSTRING FLEXIBILITY

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Maximal joint range of motion (ROM) represents the muscular flexibility level. However, different methods are used to measure the ROM at clinic and laboratory. So, the aim of this study was correlate a clinical and a laboratorial measurement of hamstring flexibility. The flexibility of both lower limbs of thirty-six young and healthy subjects was assessed by two apparatus: modified knee extension test (clinical measure) and Flexmachine (laboratorial measure). The results showed a moderate positive and significant correlation (r=0.693; p<0.001) and a common variance of 48% between the maximal ROM measured by these tests. It suggests that clinical and laboratorial tests are independent in nature. Further studies are necessary to correlate the maximal ROM clinically measured and others physiological and biomechanical variables.

KEYWORDS: Joint range of motion, flexibility measurement, electromyography, correlation, hamstring, stretching.

INTRODUCTION: Muscle flexibility is generally measured by the joint range of motion (ROM) and the maximal value of ROM represents the individual flexibility level (McHugh et al., 1998). Several clinical and laboratorial tests are used to measure the ROM. Quantitative criteria, such as onset of EMG activity are commonly used at laboratorial tests (Magalhães et al., 2007). This procedure enable estimate maximal passive ROM of the muscle tendon unit (MTU). However, the use of electromyography is not a common tool at clinical practice, what difficult the measurement of maximal passive ROM without the influence of muscle contraction.

Many authors perform clinical tests to estimate hamstring flexibility by knee extension ROM (Baltaci et al., 2003; Chagas et al., 2008; Roberts & Wilson, 1999). At these tests, ROM is usually registered by a goniometer and a subjective criterion is used to indicate maximal ROM, for example, highest passive resistance perceived by an examiner. Correlational research would provide insights into the relative importance of different tests for clinical practice and training control. We hypothesized that maximal ROM measures obtained at clinical and laboratorial test are independent. The purpose of this study was to correlate a clinical and a laboratorial measurement of knee extension ROM, which represents hamstring flexibility.

METHOD: Eighteen male and eighteen female volunteer to this study (mean ± SD; age: 24.2 ± 3.2 years; mass: 67.2 ± 13.0 Kg; height: 169.8 ± 7.9 cm), all free of any pathology in lower limbs, lower back or pelvis. Knee extension ROM was measured by two tests: Modified Knee Extension Test (MKET) (Chagas et al., 2008) and Flexmachine (Magalhães et al., 2007). Three measures were obtained at each test and the mean values were considered for both lower limbs. The intraclass correlation coefficient for MKET was 0,94 (Bergamini et al., 2005) and 0.92 for Flexmachine (Peixoto et al., 2007).

On the MKET, the subjects were positioned laid in supine on an adapted litter with a central cylinder and fixers on knee and hip to avoid compensatory movements. The volunteer's knee and hip were flexed at 90°, which was considered as 0° of knee extension ROM (figure 1). Next, the examiner extended the knee until achieve the highest passive resistance, which was determined by subjective perception. The ROM were recorded in this position by a flexometer (Leighton, Lafayette Instrument), and was defined as the maximal ROM (ROM_MKET).

Figure 1. Modified Knee Extension Test.

On the Flexmachine, an isokinetic machine composed by two chairs connected to a mechanical arm moved by a motor (SEW Eurodrive, Brazil), subjects were positioned at seated position with the hip flexed 45° from horizontal plane (figure 2). The center of subject´s knee was aligned with the axis of rotation of mechanical arm, which angle was continuously measured by a potentiometer fixed on this axis. Once triggered, the mechanical arm extended the knee joint passively (5º/s) until maximal stretch tolerance was achieved. For the measure, the 0° of knee extension ROM initiate at the vertical line from the ground. Electrical muscle activity was detected by Ag/AgCl surface electrodes (Midi-Trace® 2000 Foam, Canada) placed between the semitendineous and semimebranous muscles. The passive ROM (ROM_EMG) was obtained on the onset of the electromyogram signal (i.e. a raise bigger than two standard deviations of baseline mean) of the hamstring muscles during the test. The potentiometer values were acquired using analogical/digital convertor (Data Translation, DT BNC Box USB 9800 Series) and converted to angle by the software DASYLab 9.0 (Dasytech Laboratories, 32 bits). The Pearson product moment correlation coefficient was used to correlate the variables ROM_MKET and ROM_EMG and significance level of 95% was adopted.

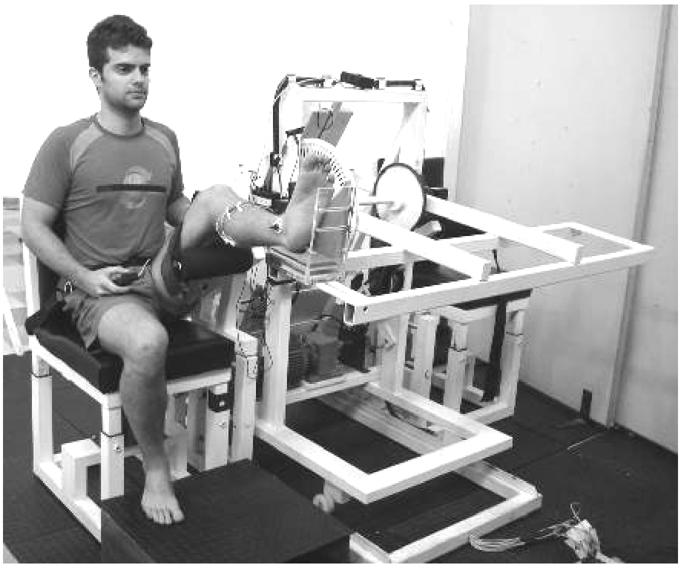

Figure 2. Flexmachine.

RESULTS: The descriptive data of ROM_MKET and ROM_EMG are present in table 1.

Table 1. Descriptive data of ROM_MKET and ROM_EMG.

	Mean	Standard deviation	Minimum	Maximum
ROM_MKET (º)	68.9	15.7	36	91
ROM_EMG (º)	93.2	20.2	51	132

There were a moderate positive and statistically significant correlation between the ROM_MKET and ROM_EMG (n=72; r=0.693; p<0.001). The coefficient of determination (R^2 x 100) was 48%. The results are presented in the figure 3.

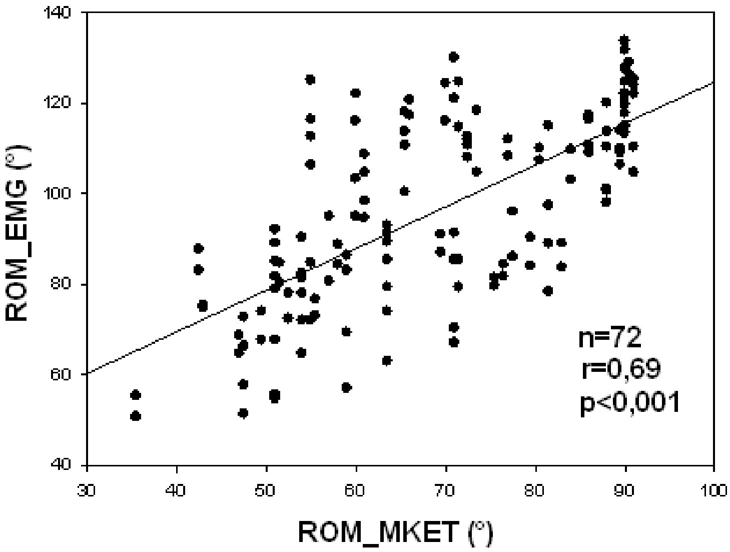

Figure 3. Scatter plot of ROM_MKET and ROM_EMG

DISCUSSION: The results demonstrate that knee extension ROM measured by MKET has moderate correlation with those obtained by Flexmachine. The coefficient of determination indicates that 48% of the variance in ROM_MEKT can be accounted for by knowing the variance in ROM_EMG. The others 52% reflect the proportion of variance that is not explained by the relationship between ROM_MKET and ROM_EMG. This outcome shows the use of ROM_MEKT as a possible predictor will result in a reasonable estimate of ROM_EMG, but not thoroughly accurate. This finding confirms previous report that found low relationship between clinical and laboratorial measures.

Blackburn *et al.* (2004) encountered a low correlation (r=0.36) between maximal ROM and passive stiffness. In this study, the maximal ROM was measured by very similar clinical test used in the present study and the passive stiffness was calculated using data obtained in laboratorial test. This indicate that the isolated measurement of maximal ROM in clinical tests not provide information about important characteristics of MTU during stretching. The shared common variance of only 48% shows that clinical and laboratorial tests are independent in nature. It suggests that differing physiological and biomechanical factors contribute to maximal ROM.

Further correlational approach could evaluate the relationship between other variables of flexibility, like passive torque, passive stiffness and work absorption, and maximal ROM obtained by clinical test. Other studies also are needed to evaluate the possible influence of the criteria used for determine maximal ROM, such as subjective criteria of the subject or of the examiner.

CONCLUSION: There is a moderate and significant correlation between the clinical (MKET) and the laboratorial (Flexmachine) measurement of knee extension ROM, however low common variance between both tests was found.

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