

EFFECT OF TRAINING MACHINE'S MECHANISM ON THE MUSCULAR PERFORMANCE

¹ Georges Dalleau, ¹ Bertrand Baron, ¹ Bruno Bonazzi, ¹ Pierre Leroyer, ¹ Thomas Verstraete and ¹ Chantal Verkindt

¹ CURAPS - DIMPS, Université de la Réunion, Le Tampon, France

email: georges.dalleau@univ-reunion.fr

INTRODUCTION

Monitoring the force and power production of the athletes during resistance training is critical to adapt the training programs to the sport performance requirement [1]. Mainly, isokinetic dynamometers allow investigations on muscular strength but these ergometers are still difficult to handle in training context.

Furthermore, during resistance training, athletes rather use isoinertial machines that involve different mechanisms to apply one resistance. One of used popular system is a cam link to adapt the resistance to the human torque capacity [2]. Nonetheless, little attention was paid to monitor the muscular performance with such apparatus.

The purpose of the study was to test the effect of the machine's mechanism (cam vs pulley) on muscular performance.

METHODS

A cam equipped knee extensor machine (Leg extension FIT22, Panatta, Italy) was instrumented with sensors to assess the angular velocity of the lever and the torque and power produced during a full knee extension. A semi-circular pulley was added to impose a constant resistance arm in contrast with that of a cam (figure 1).

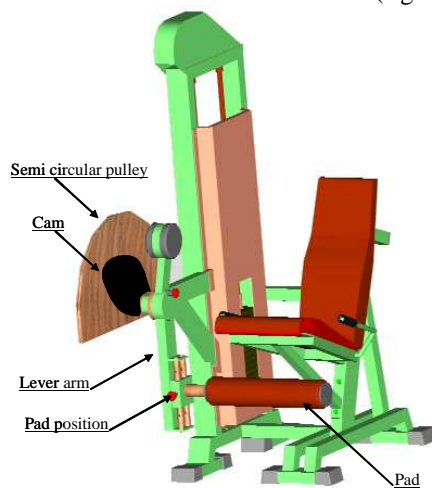


Figure 1: Leg extensor machine equipped with mechanical sensors.

Fourteen adults participated to this study. Their mean age was 24 yr (SD 2), their mean body mass 71.64 kg (SD 7.27) and their mean height 1.76 m (SD 0.05). All of them were familiar with resistance training.

The subjects were tested during two sessions separated by at least 3 rest days. Each session was conducted in specific link condition (cam vs pulley). After a warm-up consisting of several knee extensions at different loads, each subject

performed a full knee extension at his maximal velocity for different load varying from 40kg to 80kg by steps of 5kg. Two trials per load were performed with a rest period of at least 2 minutes or until complete recovery. For each lifted load, mean velocity, mean torque and mean power were calculated during the concentric contraction of the knee extensors.

The reliability of the measurements was tested by calculating the intraclass correlation (ICC) between the two trials using ANOVA with repeated measures. The mean differences of torque, velocity and power between the two conditions of pattern of resistance were tested with paired t-tests at each given load.

RESULTS AND DISCUSSION

The equipment setting was designed to measure the muscular performance of the individuals with very high reliability (ICC range: 0.836 – 0.999).

Subjects developed lower torque with the cam than with the pulley (99 N.m at 40kg to 200 N.m at 80kg with the cam vs 121 N.m at 40kg to 237 N.m at 80 kg with the pulley; $p < 0.001$). At the beginning of the movement, the constraint on the patellofemoral joint is higher with the pulley than with the cam, because the subject developed high quadriceps force with his bent knees [3]. The pulley equipped machine seems to favour the developing muscular force over the range of knee extension.

Knee extension velocity ranged from 2.58 $\text{rad}\cdot\text{s}^{-1}$ to 1.71 $\text{rad}\cdot\text{s}^{-1}$ with the cam and from 2.25 $\text{rad}\cdot\text{s}^{-1}$ to 1.55 $\text{rad}\cdot\text{s}^{-1}$ with the pulley ($P < 0.001$). The cam equipped machine still addresses the training of the contraction velocity.

No differences were obtained concerning the power at each load between the two conditions. Power values ranged from 224 to 351W in cam condition and from 228 to 349W in pulley condition.

CONCLUSIONS

The pulley condition facilitated force production while the cam condition facilitated velocity. However, the cam condition seems to limit damage to anatomical structures mainly at the beginning of knee extension. Thereby, the influence of the machine's mechanism on muscular performance has to be known to optimize resistance training.

REFERENCES

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