METHOD OF EVALUATION OF POWERABSORPTION PROPERTIES OF A BIOMECHANICAL SYSTEM " LOCOMOTORIUM - SPORTS FOOTWEAR - ARTIFICIAL COVER "

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INTRODUCTION

It’s known, that the mechanical performances of materials of artificial covers (AC) and soles of sports footwear (SF) influence powerabsorption properties (PP) of a biomechanical system " locomotorium (L)-SF-AC "(McMahon & Greene 1979, Nigg 1986). This problem practically is not explored for movements which begin with a shock forefoot landing though just in such movements the spring property of the lower finiteness and especially foot is revealed at maximum. A new method based on methods of electromechanical analogies (Strett 1955) and damping oscillations for an evaluation of PP of the above mentioned biosystem was developed (Dychko 1995).

REVIEW AND THEORY

It’s known the given biosystem can be simulated by a mechanical oscillatory model with lumped parameters in the process of a forefoot landing (Zatciorsky 1981). Such model represents a mass M on a spring with a stiffness factor K and a damper with factor of damping R parallel to spring. The performance estimating a degree of accumulation and dispersion of energy of an elastic strain during operation of a system is necessary for the more full description of such model. We can solve this problem using a method of electromechanical analogies. The main point of the method is in the following: in a number of cases the concurrence of the mathematical equations circumscribing oscillations in a mechanical model and oscillations of a current in an electrical circuit allows to consider a sequential electrical circuit instead of the examined mechanical system. In the first system of electromechanical analogies the mass is an inductance, damper - active resistance, and spring - electrical capacitor. The most important characteristic circumscribing powerabsorption properties of electrical oscillatory circuits is the Q-factor (Atabekov 1969). The Q-factor numerically is equal to the maximum energy accumulated in an circuit divided by the energy dispersed for period of resonance oscillations in the same circuit. Proceeding from the given definition we offer to use “an equivalent biomechanical Q-factor” (EBQ) for an evaluation of PP of a biomechanical system "L-SF-AC". The EBQ is determined with use of a method of damping oscillations. The examinee jumps off from an elevation on a force platform, landing on a force platform on forefoot with preservation of a pose of landing. The signal from a platform arrives on computer where is treated under the special software (Dychko 1995).

PROCEDURES

One examinee - man (28 years, 186 cm, 82 kg) without traumas of knee and ankle joints participates in the experiment. The drop-jumps were executed from heights 15, 20, 25 and 30 cm, till 3 attempts at each height. It was used the SF with a forward part of a sole made of rubber (R) + EVA, R + polyurethane (PU), PVC. The force platform made in Russia, had the following characteristics: total relative error of a measurement of a vertical component force of a response of a support - no more + \- 1.5 %, own frequency - not less than 300 Hz. Aluminum was used as a material of a cover. So the hardness of the material of a cover is much greater than hardness of materials of a forward part of a sole of researched footwear. The outcomes of experiment are represented in table 1.

H, cm	Barefoot	PVC	R+PU	R+EVA
10	1.08	1.69	1.56	1.22
15	1.18	1.61	1.37	1.37
20	1.39	1.42	1.47	1.56
25	1.20	1.31	1.45	1.64

Table 1: Changes of biomechanical Q-factor researched biosystem depending on a material of a sole and height of a drop-jump.

RESULTS AND DISCUSSION

The minimum figures of EBQ were registered for barefoot drop-jumps on all heights. The figures EBQ of the biosystem "L-SF-AC" for a sole R + EVA were increasing during the process of making the heights of drop-jumps greater. For SF with a sole PVC the inverse relation was registered. The maximum figures were registered at smaller heights of drop-jumps. EBQ decreases with growth of heights. For SF with a sole R + PU the EBQ is changed in a range 1.37 - 1.53.

The outcomes of experiment show that the method worked out by us allows objectively to evaluate PP of a biomechanical system "L-SF-AC" in acyclic movements which start in shock forefoot landing. EBQ which is calculated using the method of damping oscillations is offered for a quantitative evaluation of PP. The recuperative ability of a researched biosystem is improved on covers with hardness much greater of hardness of soles of SF in comparison with movements executed barefoot.

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