PROGRAMMED STRENGTH TRAINING USING A COMPUTERIZED ISOTONIC STAND

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INTRODUCTION

One of the very important tasks of the theory and practice of modern training is searching for new methods, in order to improve the efficiency of the training process. Nowadays muscle strength seems to be the most significant factor which influences performance in different kinds of sport and weigth training is used in order to increase strength, speed or power (Fleck and Kraemer 1987, Mc Dougall et al.1991, Pauletto 1991, Baechle 1994). Different weight machines - sometimes technically very complicated - have been used in strength training for many years (Perrin 1993). Machines are popular, not only because they make strength training more attractive, but because of the possibility to precisely regulate and control the training load (Ariel et al.1990, Baechle and Groves 1992). Basic information exists which allows for the design of an optimal weight training program.

The aim of this paper is to present computer-controlled strength training using a special stand for muscle strength training and diagnostics.

THE STAND

The stand (locally made), shown on figure 1 consists of three main sub-assembles: mechanical part (steel bedplate, bar with replaceable holders, bench for exercises), hydraulic resistance module and electronic part (valve controller, A/C converter, PC). The main element of the stand is an electrically controlled hydraulic weight, which brakes the movement of a bar. The resistance is controlled by a computer system and it remains consistent troughout the full range of motion (isotonic resistance). Using an advanced computer and A/D converter allows a high level of regulation (on-line) to be obtained. The stand is operated by a computer 486 DX 4/120/8 or higher (e.g. Pentium 90). All the information about the user, performed exercises, parameters of training volume (work) and intensity (power) are stored in the computer's memory and can be visualized at any time. The stand enables the performance of many various single- or multijoint exercises, as popular as, for example, squats, bench press, pulls, seated press, biceps curl, bent over row, etc. or any exercise defined by the user. The basic technical data of the stand is as follows: range of forces: 0 - 2500 N, range of bar movement: 1.6 rad, accuracy of force measurement: ±5%, dimension: 680x400x1300 mm and weight: 150 kg.

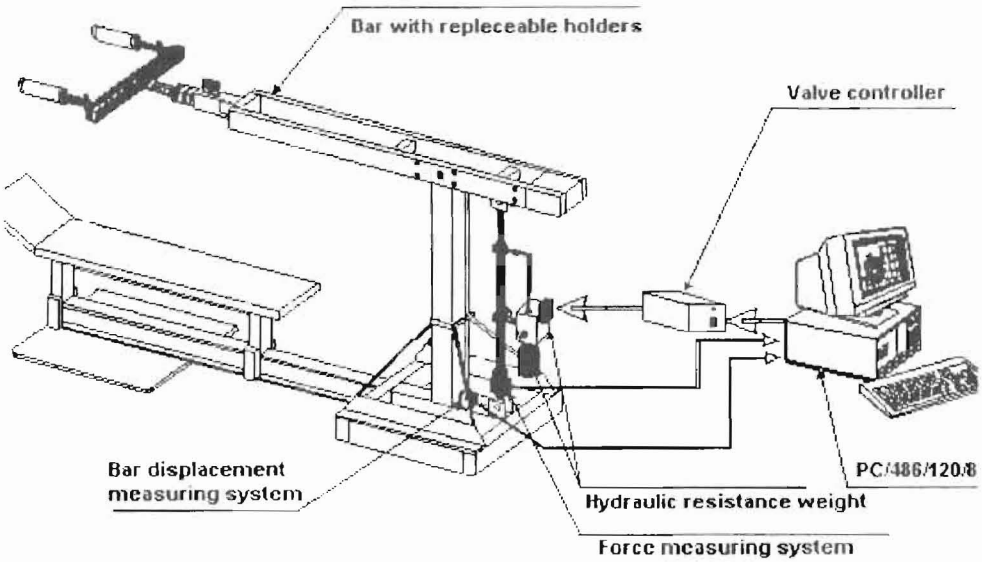

Fig.1. Computer-controlled isotonic stand for strength training and diagnostic

THE PROGRAM

Apart from force stabilization and registration of the basic parameters of movement the computer-controlled training program includes three basic strength training methods:

1. Repeated effort method. This is the most popular method used during training in different sports by both, beginners and advanced athletes. However, it develops strength endurance and leads to hypertrophy (Baechle 1994, Zatsiorsky 1995). The amount of resistance in this method is of 50% to 80% RM, number of sets 4-8 and number of repetitions 10-20. The basic training program includes 12 weeks with a steady frequency of 3 times per week.

2. Maximal effort method. This method can be used by high performance athletes only, because load (intensity) is very high: 90%-100% RM, 1-5 sets and 1-3 reps. Two versions of this method are used in the computer program (Kemp 1989): narrow pyramid approach (5 sets: 90% RM/3 reps, 95% /2, 100%/1, 95%/2, 90%/3) and maximal concentric contractions (5 sets: 100% RM/1 rep). The basic program includes 10 weeks (5 for each version) three times per week.

3. Speed-strength method. All the exercises performed according to the rules of this method have to be done with maximal velocity of movement (Eliasz 1993). The load is rather low and almost stable in the training (40%-45%RM, 4-8 sets, 8-12 reps). Programmed training includes 10 weeks (30 training units). Rest periods between sets, depending on its number, are of 60 to 90s.

Besides these methods the user can exercise according to his (or her) individual program. There are four main indices describing training loads, which can be controlled: resistance (%RM), number of series, number of reps and rest periods. The initial value of resistance is established during the special trials, refers to the diagnostic of maximal velocity of movement and of maximal force developed by user (1RM when ω=0.2 rad/s). Both tests are also

performed during these phases of the training, when the resistance should be changed - thus they compose an important element of testing and evaluation of the training progress. Programmed strength training can be appropriate for beginners or high performance athletes of any sport- the value of initial resistance and a different system of controlling its progress are accomplished automatically according to the chosen option.

CONCLUSION

The computer program enables registration of several important parameters of the workout: mechanical power, velocity of the bar, work per rep(s), set(s) and unit(s). During the special trials the speed-strength abilities of the user are continually assessed and, according to achieved results, the training loads are changed automatically. The equipment can be used under field or laboratory conditions, because it is not noisy (if compared to free weights) and not too large. The stand is safer to train with than free weights, especially for those who have limited experience in the weight room - so, spotting is not necessary. Results of the exercise displayed on the monitor during work are a very good motivational factor for users. Apart from these it is possible to use the stand under laboratory conditions for complex estimation (biochemistry, physiology, biomechanics) of an athlete during strength exercises. The computer-controlled strength training program is especially useful in the case of injuries and rehabilitation (Kannus 1994), because of the precise measurement of several parameters characterizing the movement.

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