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The influence of elbow joint angle on different phases of relaxation from maximal voluntary contraction

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The purpose of the study was to find whether the early and late phases of relaxation from maximal voluntary contraction depend on the elbow joint angle and whether the influence of joint angle on relaxation depends on which optimal angle (Ao or Ao(MVC)) was considered as a reference value. Ao(MVC) was the optimal elbow joint angle at which elbow flexor muscles can produce maximum voluntary force and Ao was the optimal angle at which the fastest rates and shortest time of relaxation occur. Twenty-two young, physical education male students were tested four times. The first and second sessions were done to establish optimal angles (Ao, Ao(MVC)). The third and fourth sessions were done to measure the relaxation indices at an optimal angle, as well as at the angles that were smaller (As=optimal-30°) and larger (Al=optimal+50°). All testing sessions consisted of four trials of 2 or 3-s MVC at each angle. To assess the speed of relaxation, the following relaxation indices were measured: early, late and latest relaxation rate (ERR, LRR, and LstRR, respectively; %F/5ms), maximal rate of relaxation (MRR; %F/5ms), and half relaxation time (1/2Rt; ms). The BIODYNA dynamometer was used to measure torque versus time curve for right elbow flexor muscles. The maximum voluntary force was produced at the angle Ao(MVC)=89.4±8.0°. The end force (EF) had the best score at 89.2°±8.4°. The optimal angles (Ao) for relaxation indices were ERR=90.9°±8.2°; LRR=88.3°±8.8°; LstRR=89.5°±9.8°; MRR=90.3°±7.5°; and 1/2Rt=87.9°±8.5°. The differences were not statistically significant. Although the Ao and Ao(MVC) were similar, most subjects had values for Ao that were 5°-10° smaller or larger than Ao(MVC). Moreover, a small difference between MVC at Ao and Ao(MVC) (1.1%) was accompanied by much bigger differences for relaxation indices. At Ao: ERR, LRR, and MRR were 10% to 12% higher, LstRR-25% higher and 1/2Rt 10% shorter compared to the values at Ao(MVC). The optimal elbow joint angle at which elbow flexor muscles produced maximum voluntary force (Ao(MVC)) did not always coincide with the angle at which relaxation indices had the best results (Ao). Nevertheless, unlike the relaxation of single muscle following electrostimulation, the indices of early and late relaxation of elbow flexor muscles during voluntary contraction were not affected by joint angle in young active men independent of whether As and Al were compared to Ao or As and Al to Ao(MVC).

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