

NEW MODEL OF ANGLE SPECIFIC STRENGTH TRAINING PROTOCOL

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It has been shown (Rainoldi *et al.*, 2000; Aljure *et al.*, 1968) that muscle contractile properties depend on muscle length. The main objective of our research was to monitor angle-dependent muscle activation and to model specific strength training protocol on the basis of measured results. For this purpose a new non-invasive and selective measuring method was used. This method is tensiomyography (TMG) which is based on the principle of muscle contraction: when the muscle contracts its belly enlarges and muscle belly enlargement is measured with a displacement sensor (Valenčič, 1990).

Angle dependent contractile properties of quadriceps femoris (m. vastus lateralis, m. vastus medialis and m. rectus femoris) in 6 top level ski jumpers (aged 23 ± 2.3 , mean \pm SE) were measured using TMG. Muscle contraction was electrically elicited, bipolar supramaximal stimulation was used. During the measurements each subject was sitting in a measuring chair with the hip joint fixed at 110° and both cruses fixed to the measuring chair. Measurements were performed at different knee joint angles, ranging from $120^\circ - 180^\circ$. With respect to the jump-off technique, same muscles on both legs were measured simultaneously. In order to evaluate measurement results, two TMG based parameters were taken into account: muscle belly displacement (Dm) and contraction time (Tc) for being related to muscle activation and structure (Dahmane *et al.*, 2001), respectively.

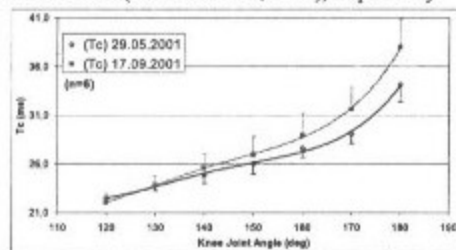


Figure 1. Changes in activation size of left and right quadriceps femoris at the beginning and at the end of preparation period.

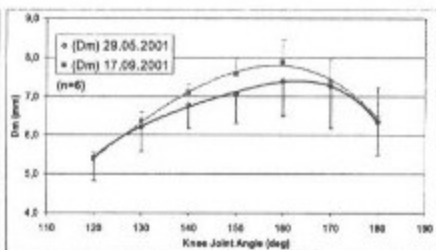


Figure 2. Changes in activation pattern of left and right quadriceps femoris at the beginning and at the end of preparation period.

In Figure 1 the difference in activation between the beginning of preparation period (May) and before competition period (September) is demonstrated. On the basis of pre-season stage measurements specific training protocol had been suggested in order to increase type II muscle fibres activation within range of smaller angles. If compared with type I fibres, type II fibres feature shorter contraction times and exert greater force. Figure 2 indicates that at smaller angles the majority of activated muscle fibres was of type II. Results presented in Figure 1 and 2 indicate the increase of type II fibre activation at smaller angles as a result of specific strength training protocol. The main goal of this training protocol was to achieve selective hypertrophy of type II muscle fibres – more power with less or same body weight.

The above-described measurements enable us to determine whether the angle at which maximal muscle activation occurs is inside or near the optimal range. For ski jumpers these angles range from 70° to 140° . From these results we conclude that the TMG method enables determination of knee joint angles at which the type II fibres can be selectively developed. This method can help us to increase specificity of the strength training protocol.

REFERENCES

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