

# An electromyographic and kinematic study of the function of selected shoulder muscles involved in the throwing of the discus

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## **Abstract**

The knowledge of the actions of the shoulder muscles during the phases of a discus throw is necessary for the design of the strength training program of throwers. The upper-limb equilibrium angle (equilibrium between centripetal, gravitational and shoulder reaction forces) computed with a model of upper-limb rotation around a vertical axis was compared with the actual angle of the upper-limb to discuss the action of the abductor and adductor muscles [biceps brachii (BB), anterior (DA) and middle (DM) deltoid, pectoralis major (PM), latissimus dorsi (LD), trapezius superior (TS)] studied by electromyography in seven elite throwers. Simultaneously, 3D kinematic video data were obtained with markers on the discus, wrist, elbow and shoulder. The active muscles during the last phase (PM, BB, DA) were inactive during the first phases in contrast with DM active during Preparation and the beginning of Entry but silent during Delivery. Equilibrium angle was higher than the actual upperlimb angle during Entry, Airborne and most of Delivery. Shoulder abduction was probably due to inertia and limited by LD. The function of DM was not abduction but coaptation. The highest EMG activities were observed during Delivery for the muscles which produced the highest power compatible with the optimal trajectory.

**Keywords:** Discus throwin; EMG; Kinematics; Modelling; Throwing technique