THE CONTRIBUTION OF LOWER TORSO, UPPER TORSO AND UPPER LIMBS SEGMENTAL MOTION TO HAMMER HEAD VELOCITY DURING ACCELERATION PHASE

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INTRODUCTION: In hammer throw event, the distance of the hammer throw is mainly determined by hammer head resultant velocity at release. During turn phase, hammer head resultant velocity is increased gradually with four turns and is increased during double support phase. The purpose of this study was to investigate the contribution of the motions in the lower torso, upper torso, upper limbs and hammer segment to the hammer head tangential velocity during double support phase.

METHODS: Six male hammer throwers with records in official competitions of 65.9～77.6m participated. Hammer throw with four turn technique was recorded by two high speed cameras (250Hz). The hammer head and 23 points of the body were digitized and coordinate data were three-dimensionally reconstructed using a DLT method. The coordinate data were smoothed with a Butterworth digital filter at optimum cut-off frequencies (6.0~8.25Hz) determined by a residual error method. Hammer head velocities were resolved into several components, namely the velocity caused by the segmental rotation at lower torso, upper torso, upper limbs and hammer head segment. The velocity of each component were calculated as the vector cross-products between the respective relative segmental angular velocity vector and the respective relative displacement vector from each joint to center of hammer head, by means of a mathematical model suggested by Springings et al (1994).

RESULTS AND DISCUSSION: Figure1 shows the averaged tangential velocities obtained from each motion component on all subjects. In each double support phase, the tangential velocity obtained from lower torso rotation（LTV）, upper torso rotation（UTV）, upper limbs rotation（ULV）contributed to hammer head tangential velocity mainly. Furthermore, at the beginning of the double support phase, UTV was increased. Although ULV reached the peak in middle of double support phase, Finally, LTV reached the primary component of hammer head tangential velocity during last half of double support phase. Because ULV was considered as a passive motion caused by the upper torso motion, these results suggested that lower torso rotation and upper torso rotation play KEY roles to accelerate hammer head. It was inferred from these results that technique of lower limbs motion that caused torso rotation and torsion were the critical factor of successful acceleration of hammer head.

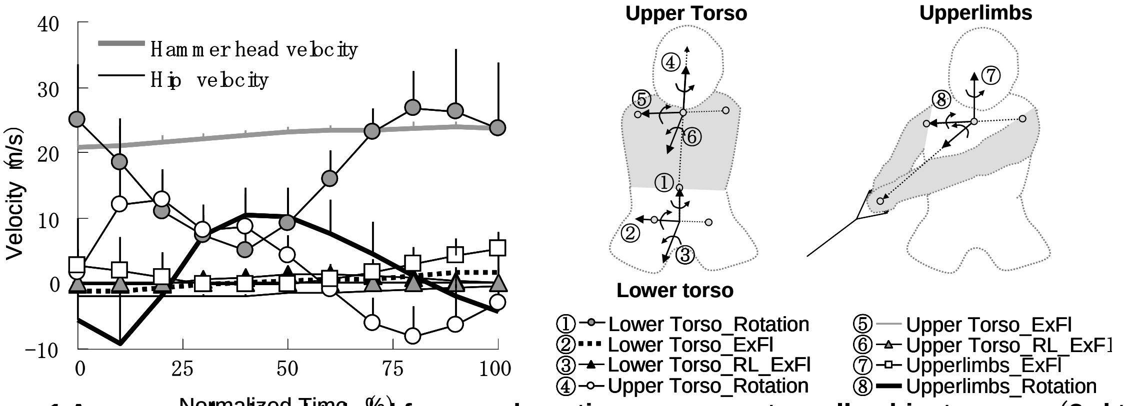

Figure1 Average Velocity obtained from each motion component on all subjects （3rd turn）.

REFERENCE: Springings et al. (1994): A three-dimensional kinematic method for determining the effectiveness of arm segment rotations in producing racket-head speed. J .Biomechanics. 41 :23-37