

## **Three-dimensional joint dynamics and energy expenditure during the execution of a judo throwing technique (Morote Seoï Nage).**

Blais L, Trilles F, Lacouture P.

Equipe Mécanique des Gestes Sportifs, Laboratoire de Mécanique des Solides, Université de Poitiers, Poitiers, France.

A new method for analysing judo throwing techniques is proposed. Beyond a solely descriptive analysis of the kinematic parameters, we determined the main active joints and segments in the execution of a judo throwing technique. This was achieved by calculating three-dimensional joint dynamics parameters. The environment of the judoka was manipulated by using a judo-specific ergometer to replace his partner. The ergometer was used together with two force sensors coupled with two force platforms, and six synchronized infrared cameras. Sixteen French athletes competing in senior national events participated in this study and executed the throwing technique Morote Seoï Nage ten times, using the Mayeur ergometer loaded with 20 kg. This load was chosen to cover variations in the athletes and represents the effective mass they have to displace during the movement. Our main aims were to evaluate the forces and moments at the main joints in three dimensions during Morote Seoï Nage, and determine the energy expenditure of the athletes during the movement. Contrary to the teaching of some judo coaches and experts, our results show that the main driving moments are generated by the lower limbs [mean 24% ( $s = 4$ ) of the total moments at the knees and 29% ( $s = 3$ ) at the hips] and the trunk (mean 28%,  $s = 3$ ) and not the upper limbs. Moreover, our results show that most energy expenditure (mean 880 J,  $s = 160$ ) occurs during the Tsukuri phase, when the Tori (the person who throws) is positioned under the Uke (the person who is thrown).