Effect of the wear of skates on performance in vertical jump
M. Haguenauer, P. Legreneur, K.M. Monteil
Centre de Recherche et d’Innovation sur le Sport, Université Claude Bernard - Lyon 1
27-29, Bd du 11 Novembre 1918, 69 622 Villeurbanne Cedex, France
Tel: (33)(0)4.72.43.10.91. Fax: (33)(0)4.72.44.80.27.
Email : marianne.haguenauer@univ-lyon1.fr

Introduction
Jumping is the result of the conversion of angular motion of body segments around joints to vertical motion of the center of gravity of the body (van Ingen Schenau et al., 1987). However, in figure skating, the range of motion of the ankle joint is strongly constrained by the skate boot. As it is well known in the literature, plantar flexion plays a major role on the vertical jump performance. Indeed, many researches have demonstrated that body segments contribute in a proximo-distal sequence to the projection of the body (Gregoire et al., 1984; Bobbert and van Ingen Schenau, 1988). Bobbert (1988) has shown that this sequential order of the extension of the hip and knee joints and the plantar flexion of the ankle joints delays the influence of the anatomical and geometrical constraints (van Ingen Schenau, 1989) to the very end of the push-off. Luhtanen and Komi (1978) reported a contribution of 22% of plantar flexion to take-off velocity which is related to performance. Therefore the purpose of this study was to quantify the influence of the restriction of ankle extension on jumping coordination.

Methods
Ten national level skaters performed a vertical jump from a squatting position at a knee angle of 90° (SJ) on an AMTI platform. This jump had to be successively realized in three conditions: barefoot (BF), lifting a 1.5kg weight attached on each lower limb representing the skates’ mass (LW) and wearing skates (SK). The acquisition rate of the platform was set at 1000Hz. Data were acquired and processed using “Biosoft” software in order to obtain vertical ground reaction force (GRF) values. Maximal value of GRF was determined from the individual curves. Instantaneous peak positive power was calculated from the GRF and the velocity instantaneous value of the CG. This latter was calculated by numerical integration of acceleration. The maximum height reached by skaters during the flight (Hmax) was calculated from the takeoff velocity using standard equations for projectile motion. Mean curves of GRF were calculated after synchronization of individual curves on the instant that the toes or the tip of the blade lost contact with the force platform. GRF values were expressed as a percentage of the system’s weight. Wilcoxon signed-rank test was used for statistical analysis. A significance level of 0.05 was chosen.

Results & Discussion
Maximal heights attained by the CG of the body during the flight were 0.295 m, 0.28m and 0.246 m for the BF, LW and SK conditions respectively. Compared to the BF and LW conditions, wearing skates significantly decreased the performance by 16.79% and 12.11% respectively (Fig. 1). Adding a mass on distal limbs decreased the performance by 5.3% (p<0.05). These results pointed out that the skates' mass and the restriction of plantar flexion appeared to be two determining variables of the figure skaters' SJ performance. The mass of the skates accounted for 4.7% in the decrease in performance whereas wearing skates accounted for 11.5%.

Figure 1: Mean and standard deviation of SJ Hmax for the three conditions
Peak GRF generated were 1315.15N, 1322.83N and 1374.84N for the BF, LW and SK conditions respectively.

Times to reach the peak force and the duration of impulse were shorter in the BF (t=68%) than in LW (t=76.8%) and SK (t=73%) conditions (p<0.05) but no difference was obtained between the LW and SK (Fig. 2). No significant difference of peak force could be shown between the different conditions.

![Figure 2](image.png)

**Figure 2:** Mean vertical SJ ground reaction force (GRF) for three conditions.

A positive strong correlation (r≥0.82) was found between H_max and positive peak power for all conditions. As shown in a previous study, the limited mobilisation of the ankle joint seemed to influence the performance by decreasing external power of the skaters (van Ingen Schenau et al., 1985).

A further kinematic analysis will complete this study by quantifying the contribution of each lower limb joint to determine the coordination induced by wearing skates.

**References**


