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WHOLE BODY VIBRATIONS EXPOSURE IN ROLLER SKIING

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Introduction

Most of elite Nordic athletes around the world use roller skiing during the off-season for specific physical training simulating winter cross-country skiing (XC). Although specific roller skiing tracks with smooth tarmac have been constructed in many countries, these athletes are exposed to high mechanical vibrations transmitted by the wheels then to the skis since they train most of the time on public roughness roads. Prolonged vibration exposure in sport activity increases the risk of joint injury or muscular pain [1] and could explain the tibial compartment syndrome reported in many Nordic athletes (Skiing French Federation, unpublished data). According to these observations, it would be interesting to reduce the vibratory dose by choosing the most appropriate macadam and roller skis for practice. The aim of this study was to measure the vibration exposure of several commercialized roller skis in actual conditions.

Methods

Six pairs of roller skis have been tested three times on a 30-m slight downhill (mean slope of 2°) with a rough macadam at a mean speed of 13.9 ± 0.5 km.h^{-1}. The shaft of skis were built in aluminum or with ski composite materials. One pair was also equipped with a damping system against vibrations. Three different polyurethane wheels hardness levels have been evaluated: soft, medium and hard. All the tests were performed by the same subject (1.80 m, 68 kg) with the same XC shoes and adopting an aerodynamic position for gliding (Figure 1).

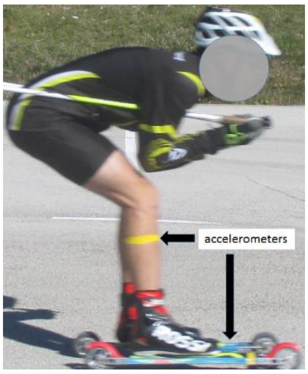

Figure 1: Accelerometers' placement during the tests

The vibrations were measured by two tri-axial accelerometers at 1350 Hz (Hikob Fox, Hikob, Villeurbanne, France) fixed to the shaft (front of the right binding, NNN system, Rottefella, Austria) and to the right shinbone. The transmissibility was computed as the ratio between the root mean square (RMS) of longitudinal acceleration measured at the shinbone (output) and the RMS of normal acceleration at the shaft (input) during 5 s.

Results

The road vibrations were strongly reduced at the shinbone for all the tested skis (Figure 2). The transmissibility decreased by 14-18% when soft wheels are used compared to hard wheels. The transmissibility was less diminished (2-5%) with the use of ski composite materials compared to aluminum shafts with same wheels. For all trials and roller skis, the mean RMS were 54.6 ± 3.6 m.s^{-2} (range: 51.1-59.9) at the shaft and 6.4 ± 1.5 m.s^{-2} (range: 5.3-7.6) at the shinbone.

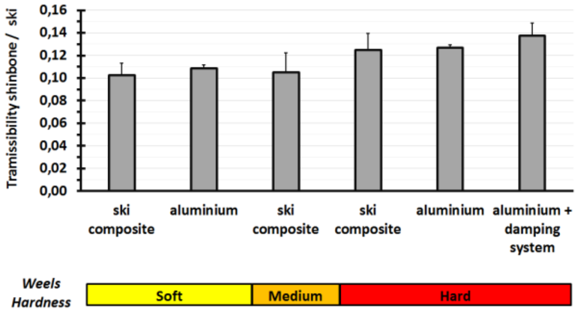

Figure 1: Transmissibility of accelerations between the shaft and the shinbone for the six roller skis tested.

Discussion

This preliminary study seems to indicate that the transmissibility of accelerations during roller skiing can be reduced by choosing skis that are an assembly of ski composite shaft and soft polyurethane wheels. The addition of specific damping system does not appear benefit for decreasing mechanical vibrations. Nevertheless, these recommendations should be confirmed by testing other ski techniques (skating and classic) on different macadam roughness.

References

1. Tarabani et al, Ergonomics, 58:1143-1150, 2015.

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