



**HAL**  
open science

## Whole body vibrations exposure in roller skiing

Sebastien Duc, Frédéric Puel, William Bertucci

► **To cite this version:**

Sebastien Duc, Frédéric Puel, William Bertucci. Whole body vibrations exposure in roller skiing. 22nd Congress of the European Society of Biomechanics, Jul 2016, Lyon, France. hal-03124463

**HAL Id: hal-03124463**

**<https://hal.univ-reims.fr/hal-03124463>**

Submitted on 28 Jan 2021

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/345940075>

# Whole body vibrations exposure in roller skiing

Conference Paper · July 2016

CITATIONS

0

READS

7

4 authors:



**Sébastien Duc**

Université de Reims Champagne-Ardenne

71 PUBLICATIONS 512 CITATIONS

[SEE PROFILE](#)



**Frédéric Puel**

Université de Reims Champagne-Ardenne

37 PUBLICATIONS 58 CITATIONS

[SEE PROFILE](#)



**William Bertucci**

University of Champagne-Ardenne (France)

162 PUBLICATIONS 1,217 CITATIONS

[SEE PROFILE](#)



**Nicolas Coulmy**

French Ski Federation, France, Annecy

24 PUBLICATIONS 192 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Treatment methods for bone fractures [View project](#)



Proposition de thèse CircaPerf [View project](#)

# WHOLE BODY VIBRATIONS EXPOSURE IN ROLLER SKIING

Sébastien Duc (1), Frédéric Puel (1), William Bertucci (1), Nicolas Coulmy (2)

1. GRESPI (EA 4696) / UFR STAPS, University of Reims Champagne Ardennes, France

2. Sport & Sciences Department, Skiing French Federation, Annecy, France

## 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  $2^\circ$ ) with a rough macadam at a mean speed of  $13.9 \pm 0.5 \text{ km}\cdot\text{h}^{-1}$ . 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).

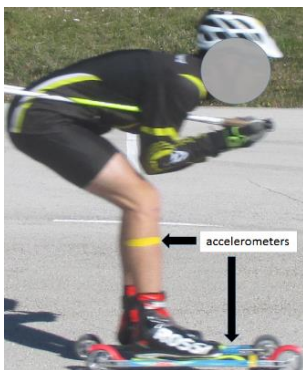


Figure 1: Accelerometers' placement during the tests

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  $54.6 \pm 3.6 \text{ m}\cdot\text{s}^{-2}$  (range: 51.1-59.9) at the shaft and  $6.4 \pm 1.5 \text{ m}\cdot\text{s}^{-2}$  (range: 5.3-7.6) at the shinbone.

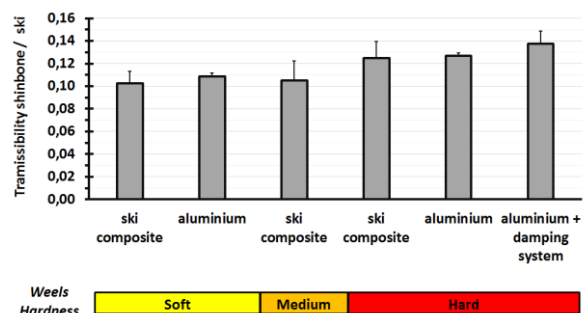


Figure 1: Transmissibility of accelerations between the shaft and the shinbone for the six roller skis tested.

## 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.

## Acknowledgements

We thank Mr Nicolas Jean-Prost (Intersport, Les Rousses, France) for ski supplies and his help in the experiments.

