

PLANTAR PRESSURE DISTRIBUTION MEASURED DURING ALPINE SKI TURNS

Dany Lafontaine_{1,2}, **Mario Lamontagne**_{1,2}, **Binta Diallo**_{1,2}, **Daniel Dupuis**₃,
School of Human Kinetics₁, Department of Cellular and Molecular Medicine₂ and
Biomechanics of Hockey Research Laboratory₃, University of Ottawa, Ottawa, Canada.

Introduction: Previous research on skiing has focused on the forces and pressures involved in skiing in laboratory and/or static situations¹. Following recent developments in biomechanical instrumentation, research on alpine skiing can now be performed on-hill^{2,3,4}. The focus of the on-site research done to this point has been aimed towards ski racers. However, most recreational skiers do not race. Therefore it seems of greater value to measure the distribution of underfoot pressures of high level ski instructors, performing a variety of turns.

Methods: Full-time ski instructors (CSIA level IV) consented to serve as subjects for this study. Their ski boots were instrumented with pressure sensitive insoles linked to the PEDAR mobile system (Novel GmbH, Munich). The subjects performed four different types of turns on a groomed run (Short Radius, Dynamic Parallel, Giant Slalom and Basic Parallel). Markers on the snow surface controlled the turn radii, set according to the guidelines of FIS and CSIA. While the subjects skied, the PEDAR mobile system recorded data at a rate of 50 Hz, while saving it to its memory card. A mobile video (60Hz) recording of every trial was made and synchronized with the PEDAR data to facilitate analysis.

Results: Results from this study indicated that the pressures under the feet were quite high, reaching up to 45 N/cm². These peak pressures were recorded on the medial side of the heel, as well as under the first metatarsal. The centre of pressure (cop) travelled from under the head of the first metatarsal down to the medial part of the longitudinal arch as the skiers progressed through the SR, DP and BP turns. During GS turns however, the cop migrated from the head of the first metatarsal back towards the medial side of the heel. Force-time histories revealed peak forces of up to 2127 N during GS turns.

Discussion/Conclusions: It is quite likely that the equipment used by the subjects (skis, boots, custom footbeds) influenced the pressure values. Technical adjustments made by the skiers may also have had an influence on the measurements. An interesting tendency is observed however, the centre of pressure tends to move from the medial part of the forefoot, back towards the middle of the longitudinal arch. Further research in this field should include more subjects of varying ability levels and standardization of skiing equipment.

References:

1. Hall, B.L., *Dynamic Displacement and Pressure Distribution in Alpine Ski Boots*, Microform Publications, College of Human Development and Performance, University of Oregon, 1991.
2. Müller, E., *Analysis of the biomechanical characteristics of different swinging techniques in alpine skiing*, J. of Sports Sciences, 1994, 12, 261-278.
3. Schaff, P., Senner, V. and Kaiser, F., *Pressure distribution measurement for the alpine skier-from the biomechanical high tech measurement to its application as Swingbeep-feedback system*, in Müller et al., Skiing and Science, London, E & FN Spon, 1997, 159-172.
4. van Bergen, B., *Different possibilities of measuring forces transmission between ski and binding*, in Müller et al., Skiing and Science, London, E & FN Spon, 1997, 189-199.

Acknowledgement: This research project has been partially funded by the Laboratory for Research on the Biomechanics of Hockey and Le Gap ski school. We would like to thank all the instructors from Le Gap ski school for their participation.