



SKIING

Trauma & Safety

FIFTEENTH VOLUME

EDITORS:

Robert Johnson,
Jasper E. Shealy, and
M. Georg Ahlbäumer

STP 1464



INTERNATIONAL
Standards Worldwide®

STP 1464

Skiing Trauma and Safety: Fifteenth Volume

*Robert J. Johnson, Jasper E. Shealy, and
M. Georg Ahlbäumer, editors*

ASTM Stock Number: STP1464



ASTM International
100 Barr Harbor Drive
PO Box C700
West Conshohocken, PA 19428-2959

Printed in the U.S.A.

ISBN: 0-8031-3490-8
ISSN: 1050-7582

Copyright © 2005 AMERICAN SOCIETY FOR TESTING AND MATERIALS INTERNATIONAL, West Conshohocken, PA. All rights reserved. This material may not be reproduced or copied, in whole or in part, in any printed, mechanical, electronic, film, or other distribution and storage media, without the written consent of the publisher.

Photocopy Rights

Authorization to photocopy items for internal, personal, or educational classroom use, or the internal, personal, or educational classroom use of specific clients, is granted by the American Society for Testing and Materials International (ASTM) provided that the appropriate fee is paid to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923; Tel: 978-750-8400; online: <http://www.copyright.com/>.

Peer Review Policy

Each paper published in this volume was evaluated by two peer reviewers and at least one editor. The authors addressed all of the reviewers' comments to the satisfaction of both the technical editor(s) and the ASTM International Committee on Publications.

To make technical information available as quickly as possible, the peer-reviewed papers in this publication were prepared "camera-ready" as submitted by the authors.

The quality of the papers in this publication reflects not only the obvious efforts of the authors and the technical editor(s), but also the work of the peer reviewers. In keeping with long-standing publication practices, ASTM International maintains the anonymity of the peer reviewers. The ASTM International Committee on Publications acknowledges with appreciation their dedication and contribution of time and effort on behalf of ASTM International.

Foreword

This publication *Skiing Trauma and Safety: Fifteenth Volume*, contains papers presented at the symposium of the same name held in St. Moritz/Pontresina, Switzerland, on 27 April – 2 May 2003, sponsored by the ASTM International Committee F27 on Snow Skiing. The symposium chairman was Dr. Robert Johnson, University of Vermont, and the co-chairmen were Dr. Jasper E. Shealy, Consultant, Rochester, NY, and Dr. M. Georg Ahlbäumer, Clinic Gut, St. Moritz, Switzerland.

Contents

OVERVIEW	vii
Using Signal Detection Theory as a Model to Evaluate Release/Retention Criteria in Alpine Skiing— J. E. SHEALY, C. F. ETTLINGER, AND R. J. JOHNSON	1
Methods for Improving the Efficiency of Alpine Ski Equipment Rental Operations— C. F. ETTLINGER, J. SHEALY, AND R. J. JOHNSON	13
Contrast Enhancing Filters in Ski Sports— B. LINGELBACH AND G. JENDRUSCH	23
Injury Rates and Injury Types in Alpine Skiing, Telemarking, and Snowboarding— A. EKELAND, S. SULHEIM, AND A. RØDVEN	31
Winter Sports in an Indoor Facility—Accident and Injury Trends— S. RICHTER, G. JENDRUSCH, H. HENKE, H. G. HERMICHEN, AND H. HECK	40
Skiboard Injuries—A Three-Year Comparison with Alpine Skiing— M. LANGRAN	49
How Fast Do Winter Sports Participants Travel on Alpine Slopes?— J. E. SHEALY, C. F. ETTLINGER, AND R. J. JOHNSON	59
An Attempt to Predict a Risk of Some of the Knee Region Ski Injuries by Means of Computer Simulations— K. KIETLINSKI AND C. RZYMKOWSKI	67

Overview

The eight articles published in this book were among the 73 papers that were presented at the 15th International Conference on Skiing Trauma and Safety of the International Society of Skiing Safety, which was held in St. Moritz/Pontresina, Switzerland, from April 27, to May 2, 2003. The International Society of Skiing Safety was founded as a result of the 1st World Congress on Skiing Safety that was held in Riksgränsen, Sweden, in 1974. The organization of the Society was instigated under the enlightened leadership of Ejnar Eriksson, MD, of the Karolinska Hospital in Stockholm, Sweden. The second meeting of the society occurred in 1977 in the Sierra Nevada of Spain and has been held biennially ever since. The subsequent meetings occurred in Queenstown, New Zealand in 1979, Bormio, Italy in 1981, Keystone, Colorado, USA in 1983, Naeba, Japan in 1985, Chamonix, France in 1987, Riksgränsen, Sweden for a second time in 1989, Thredbo, Australia in 1991, Zell am Zee, Austria in 1993, Voss, Norway in 1995, Whistler/Blackcomb, British Columbia, Canada in 1997, Breuil Cervinia, Italy in 1999, Queenstown, New Zealand in 2001, St. Moritz/Pontresina, Switzerland in 2003, and Arai, Niigata, Japan in 2005. Planning is now for the 17th meeting of the ISSS to be held in May, 2007, in Aviemore, Scotland under the direction of Dr. Mike Langran.

The primary purpose of the Ski Trauma and Ski Safety Congress is to bring together a wide variety of individuals interested in all aspect of snow sports safety. These meetings have served as a format for the presentation of a multitude of subjects concerning snow sports including the means to prevent injury and improve various aspects of the sport and the treatment of injuries. A major accomplishment of each of these meetings has been the publication of the presentations given during the congresses. Since 1983, with the cooperation of the American Society for Testing Materials (ASTM International) Committee F27, we have published a book containing papers given at the congresses. These publications have continued to be the primary source of information for all of those interested in winter sports safety. Following the 1999, 2001 and 2003 meetings, abstracts of the papers presented at the Congress were published in *Knee Surgery, Sports Traumatology and Arthroscopy*.

Attendees of the symposia of skiing trauma and safety have included representatives of the skiing industry such as binding, boot and ski manufacturers, engineers from industry, universities and technical institutions, skiing professionals such as ski instructors and patrolmen, physicians, lawyers, ski area managers and participants in recreational and professional skiing and riding activities. Interchange of ideas, comments, and critiques are encouraged in formal discussion of the papers. Many of the individuals who attend these meetings are involved in the ASTM International Standards process or those of other national and international standards organizations and are members of the International Society of Skiing Safety but all interested individuals are encouraged to participate.

All authors who present papers at the meetings were encouraged to submit their papers in a manuscript form to be considered for publication in a Special Technical Publication (STP) and now the *Journal of ASTM International (JAI)*, which results from the peer review and editorial processes of the ASTM International. We believe that his ongoing effort has produced the standard for the world in the assemblage of a relevant body of literature dealing with safety in winter sports as well as the prevention and treatment of injuries sustained by participants in these activities. The fundamental goal of both the International Society of Skiing Safety and the American Society for Testing

Materials International Committee F27 on Snow Skiing is to improve the sport of skiing and associated activities by reducing the risk of injury and producing better and more enjoyable means of participating in all these winter snow sports activities.

Summary of Papers

Shealy and co-authors utilized signal detection theory to evaluate the effectiveness of current release value recommendations for alpine ski bindings. Overall, they found no improvement in system performance for the past 15 seasons. They reported that ski boot binding systems work better for females than males. Their data supports the recent 15% reduction in release values suggested for children under age 10, and for skiers older than 50, but found no support for recommending changes for adolescents (10–16 years), or both males and females between age 17–49.

Methods for improving the efficiency of alpine ski equipment rental operations were reported by Ettlinger and colleagues. Modern alpine rental boot/binding combinations are more predictable and reliable than those of the recent past. However, inspection, maintenance and dispatch procedures now in use do not take full advantage of these capabilities. They suggested procedures that can minimize time-consuming correction procedures which improve the release retention performance of equipment dispatched to rental skiers.

Lindelbach and Jendrusch provided insight into the means of choosing an appropriate contrast-enhancing filter to allow better recognition of irregularities in the snow surface by moving skiers. They measured the spectra of snow under various conditions and provided physiologic evidence of the efficacy of a new kind of filter.

In a case control study of alpine skiing, telemarking and snowboarding, Ekeland et al. reported variations in the injury rates observed for these three disciplines. The injury incidence for snowboarders was over twice that of alpine skiers and telemarkers. Wrist injuries were over six times more likely for snowboarders than for alpine skiers or telemarkers. Snowboarders sustained more fractures than those in the other disciplines, but alpine skiers sustained the highest rate of knee injuries. The percentage of knee injuries among females was twice that of males in alpine skiing and snowboarding.

Richter et al. evaluated the injuries which occurred in a one-year study of an indoor, artificial slope in Neuss, Germany. While the majority of participants were alpine skiers, the majority of injuries occurred to snowboarders. The “funpark” or terrain park appeared to be related to a significant portion of the injuries sustained by snowboarders.

A three-year study of skiboarding injuries in comparison to those sustained by classic alpine skiers was presented by Langran. Skiboarders sustained a higher overall injury risk than alpine skiers and highest fracture rate of any snow sport. The lower leg fracture rate was also very high and the author felt it was most likely explained by the presence of non-release bindings on skiboards.

Shealy et al. used a calibrated radar speed gun to determine the velocity of alpine skiers and snowboarders on “blue square” (more difficult) ski trails at three ski areas widely dispersed in the United States. Skiers were unaware that their speed was being observed. The average speed for alpine skiers (44.5 km/h) was significantly higher than that of snowboarders (38.9 km/h). Poor visibility decreased speed while helmet use was associated with a significant increase in speed compared to non-helmeted participants.

Kietlinski and Rzymkowski presented a means of predicting some of the risk of sustaining a knee injury in alpine skiing by computer simulations. They modeled a two-skier impact and the “boot induced” injury mechanisms. A multi-body skier with flexible elements and a finite element model of the knee were developed. The solutions obtained showed a high risk of sustaining an anterior cruciate ligament injury, but there appeared to be little risk of sustaining injuries to the medial or lateral collateral ligaments.

Concluding Statements

The inter-relationship between the International Society of Skiing Safety and the American Society for Testing and Materials International has resulted in a unique method for providing a forum for the discussion of problems of winter sports safety and the publication of a state-of-the-art book such as this Special Technical Publication. When it was initially organized, the goal of the ISSS was to primarily address the problems of alpine and Nordic skiing safety, but through the years the scope has changed to include freestyle skiing, snowboarding, skiboarding and other hybrid activities that occur on the slopes of the world's mountains. The goal remains to identify the risks and the means of reducing risks in these activities. We encourage all who are interested in these snow sports to join us in the future as we seek to improve their quality and safety.

Robert J. Johnson, MD
University of Vermont
Burlington, Vermont, USA
Symposium Chairman and Editor

Jasper E. Shealy, PhD
Rochester Institute of Technology
Rochester, New York, USA
Symposium Co-chairman and Editor

Georg Ahlbäumer, MD
Klinik Gut St. Moritz
St. Moritz, Switzerland
Program Chairman & Editor



ISBN: 0-8031-3490-8
STOCK #: STP1464