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Head Injury Biomechanics

Volume III – Mitigation

Jeffrey A. Pike
Dedication

To Debbie and the “kids,” Stacy, Adam, Blair, and Emily,
and
to the memory of my parents and sister, Herbert, May, and Anne Pike,
and
to the memory of Professor Voigt Hodgson.
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Preface

An earlier SAE International compendium (Biomechanics of Impact Injury and Injury Tolerances of the Head-Neck Complex, PT-43, edited by Stanley H. Backaitis) provided a collection of papers from the early 1960s through 1991 and so this compendium focuses on the early 1990s up to the present (2011). This collection also includes several of the earlier papers to help put current research into a historical perspective. The “Blunt Head Trauma” chapter ties together anatomy, injury mechanisms, and a number of related topics regarding current research as well as introduces some of the concepts likely to be utilized in the future. It takes an interdisciplinary approach and draws upon transportation, sports, falls, and military applications of the basic principles.

This compendium is divided into three volumes: The Skull (Volume I); The Brain (Volume II); and Mitigation (Volume III). Volume I contains publications primarily related to head impact and the resulting injury to the “outside” of the head, namely the skin, bones of the skull, and sensory organs. Volume II includes publications relating to injury of the head’s contents, primarily the brain, its surrounding membranes, and its blood supply. The causes of the injuries include head impact with an external environment (e.g., vehicle interior) and abrupt head movement without head impact. Volume III applies protective strategies to various injury scenarios (e.g., passenger vehicles, football players, blast injuries) or to a particular demographic group (e.g., children, seniors).

Each volume includes: 1) reprints of approximately a dozen previously-published technical papers, plus an SAE paper providing a detailed discussion of the anatomy of the head; 2) a table of more than 250 references arranged by topic, (e.g., transportation mode or sport); and 3) a new chapter that ties together various aspects of anatomy, injury, and injury mechanisms. The resultant insight regarding head injury should be applicable to a broad range of applications, including transportation, falls, sports, and blast-related injury and the reprinted papers, in conjunction with the bibliography and chapter, should offer useful insights, not only with regard to the past and present, but as this ever-changing field continues to evolve, regarding future applications as well.
Acknowledgments

First and foremost, it is my pleasure to acknowledge the role of the Advisory Panel. Once again, I have been very fortunate to have been assisted by a truly outstanding panel — how can you go wrong with a group that includes several PhDs, two physician engineers, two neurosurgeons, and a knight? Their help with paper selection and material review was invaluable. Each member of the panel is truly a world-renowned authority and I thank each of them for their willingness to participate and for sharing their time and expertise.

The Advisory Panel members all have “day jobs” in which capacity they help save lives and reduce injuries. Ultimately, injury biomechanics is not about papers and books, but about reducing morbidity and mortality from biomechanical trauma. I hope this volume will help others to continue these efforts.

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I would also like to thank the many authors whose publications are included, either as reprints or in the bibliography. Acknowledgement is given to the following organizations for permission to include full-text papers: International Research Conference on the Biomechanics of Impact (IRCOBI); Association for the Advancement of Automotive Medicine (AAAM); National Highway Traffic Safety Administration (NHTSA). Many of the authors graciously provided review copies of their papers and were very generous with their time. Ultimately, this volume was the result of a number of diverse selection criteria, and some very fine papers could not be included.
The dedication page of this book includes head injury researcher, Prof. Voigt Hodgson. He somehow managed to balance directing a research laboratory, teaching and serving as a role model and on a personal note, was a gracious host who always provided a generous supply of the world's best donuts.

Finally, this is my fifth volume for SAE International — the first three as author and then two as editor. Perhaps the best acknowledgment that I can give to Martha Swiss and the crew at SAE is to mention that there may be a sixth (call it a “sixth sense”).

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