

# Preface

Biomechanics is an exciting and fascinating specialty with the goal of better understanding the musculoskeletal system to enable the development of methods to prevent problems or to improve treatment of patients.

Biomechanics has increasingly become an interdisciplinary field where engineers, physicists, computer scientists, biologists, and material scientists work together to support physicians, sports scientists, ergonomists, and physiotherapists and many other professionals.

This book *Fundamentals of Biomechanics* summarizes the basics of mechanics, both static and dynamics including kinematics and kinetics. The book introduces vectors and moments, applying them with many simple examples, which are essential to determine quantitatively or at least estimate loads acting during different situations or exercises on bones and joints. Joints and bones are mostly stabilized by their associated ligaments and muscles and therefore such calculations also require knowledge of the complex anatomy. Creativity is also needed to simplify these often complicated scenarios to reduce the parameters for the free body diagrams that can be used to develop the equations that can be solved. This book presents the concepts and explains in detail examples for the elbow, the shoulder, the spinal column, the neck, the lumbar spine, the hip and the knee, as well as the ankle joint. The reader however should also be aware that results from such calculations should be validated with available in vivo studies because muscle forces are often not known and the simplifications may be too strong.

The book also explains stress and strain relations, which can cause the failure of structures. The differences between the mechanical properties of hard and soft biological tissues are presented. The beauty of biomechanics is that mechanics can be applied to biological tissues to explain healing or degenerative processes. This knowledge is important to better understand what happens on the cellular level of these tissues and to explain remodeling processes in these structures. In order to move deeper into biological applications other books may also

be recommended; some of these can be found in the suggested readings following specific chapters. This book may also serve as reference when notations or definitions or units are not clear.

One of the most important unique features that should be emphasized is the fact that each chapter contains exercise problems and detailed solutions that help to practice the concepts via many examples. Therefore this book should not only be recommended to students but also to professors who teach biomechanics. People from other disciplines like “normal” engineers or physicists are often asked to teach biomechanics for example to physiotherapists. For these professionals, this book may serve as a valuable source for their own preparation.

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Fundamentals of Biomechanics

Equilibrium, Motion, and Deformation

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