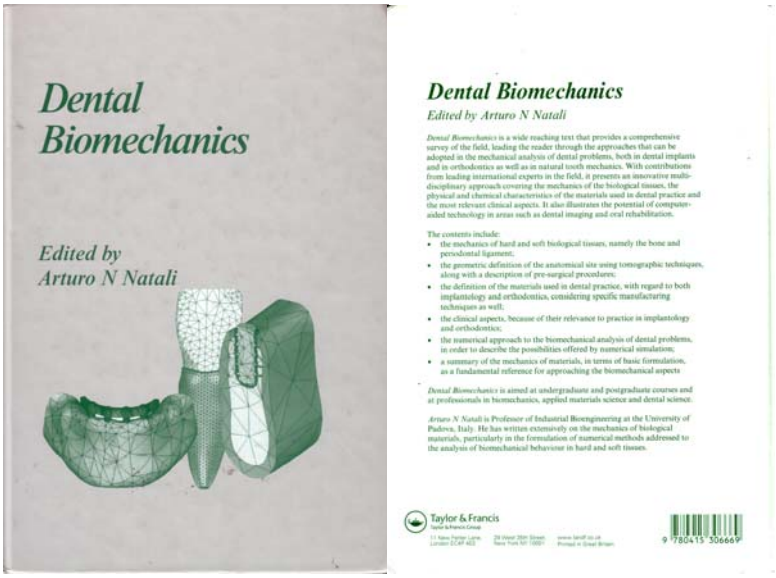
Natali, A. Ed. 2003. Dental Biomechanics. – New York, Taylor & Francis

Book review by B.L. Beatty



As someone focused on the function and wear of dentitions and with the general interest of vertebrate palaeontologists as a whole in mind, I was initially anticipating to find the text, 'Dental biomechanics', to be completely composed of chapters I would find useful for my specific purposes. For various reasons, probably largely due to the dual meaning in science of the term 'dental', I was slightly disappointed. To me and many others, 'dental' refers to teeth specifically – but to most, especially the medical community, the authors of this book, and to its apparent target audience, 'dental' in the title refers to dental medicine and surgery (orthodontics). Still, as I hope this revue will elucidate, much of vital importance to the vertebrate functional morphologists can be learned from this text. This can be seen especially from some of the chapters (see chapter 2 below) that deal with concerns often neglected due to our usual oversimplified views on how tissues interact.

Ironically, despite the heavy use of materials engineering mathematics, the chapter introducing the mechanics of materials (by Natali *et al*.) is the last chapter, and the first one covers the mechanics of bone (by Natali *et al*.). Throughout the book, it seems as if the order of the chapters is partly arbitrary. For this reason, I will briefly review each of the chapter categories I can identify in an order that I would suggest reading them, then follow it with some general comments.

Chapter 12, 'Mechanics of materials', by Natali *et al*. is a concise, but detailed and heavily mathematical account of the concepts underlying our understanding of the mechanics of materials. While an intimidating chapter (perhaps why it is placed last), Natali *et al*. do a fine job of introducing the important details of the subject without excessive wordy explanation. I would not suggest this to anyone in need of an introduction to materials science who has no engineering background, but it is still a useful chapter to have in this text, especially if it were used as a textbook in an advanced dental bioengineering course.

Two chapters, chapter 1 ('Mechanics of bone tissue' by Natali *et al*.) and chapter 2 ('Mechanics of periodontal ligament' by Nishihira *et al*.) are good chapters to read along with chapter 12. Chapter 1 thoroughly covers the most recent models of phenomenological and mechanistic models of bone mechanics, which is something of a rarity and definitely worth reading for anyone doing bone mechanics work. Chapter 2 is in itself a rarity, not just as a similarly thorough review of the models used to understand the periodontal ligament (henceforth abbreviated as 'PDL'), but also for its presentation of innovative new experimental data on the mechanics of the PDL. For these two chapters alone, this book should be looked into by anyone doing work on feeding mechanics in modern or fossil mammals.

In addition to the mechanics chapters, there are several chapters on medical imaging and its uses in biomechanics and clinical use that could serve the palaeontological and anthropological communities well to read. Chapter 3 ('Computer tomography for virtual models in dental imaging' by Natali & Viola) is a clear review of the basis behind much of the CT imaging seen not just in dentistry, but now commonplace in palaeontology and physical anthropology. As most readers of this chapter are not likely interested in knowing all the details of how CT works, it appears to have been thoughtfully written to be as concise as possible without sacrificing the details necessary to fully understand what the data from a CT scan really is. Chapter 11 ('Numerical approach to dental biomechanics' by Natali & Pavan) is by far one of the most fascinating and

thought-provoking of the chapters in this book. Its description of finite element analysis (henceforth abbreviated as 'FEA') of the mechanics of alveolar bone, the PDL, and dental implants, though directed at orthodontics, serves to illustrate the importance of soft tissues and the dynamics of bone biology in FEA. Many modern studies in palaeontological uses of FEA neglect soft tissue mechanics and treat structures, especially the PDL, as static and homogenous, which it clearly is not.

Lastly, and least appropriate for the usual readers of PalArch, there are a handful of chapters concerning the clinical aspects of biomechancis research for orthodontics, especially implantology. Though as an instructor in a medical school I found the clinical aspects fascinating as a source of knowledge to pass on to my students, I cannot say much about the utility of them in vertebrate palaeontology. Chapter 4 ('Computer-aided, pre-surgical analysis for oral rehabilitation' by Van Oosterwyck *et al*.), chapter 9 ('Clinical procedures for dental implants' by Vogel *et al*.), and chapter 10 ('Clinical procedures in orthodontics' by Garattini & Meazzini) give detailed accounts of clinical procedures in orthodontic imaging and implantology. Possibly more useful to those generally interested in prosthetics and materials mechanics are chapters 5 ('Materials in dental implantology' by Fernandez *et al*), 6 ('Dental devices in titanium-based materials via casting rout' by Bonollo *et al*.), 7 ('Testing the reliability of dental implant devices' by Soncini *et al*.), and 8 ('On the mechanics of superelastic orthodontic appliances' by Auricchio *et al*.). In my opinion, it may be good for us palaeontologists to get a dose of materials science, so make sure to scan these chapters.

Though the English editing leaves something to be desired at times, Natali delivers a book appropriate as a textbook for researchers and graduate students in biomedical engineering or biomechanics that is concise and full of necessary background and mathematics lacking in most of other texts of this kind. The only truly unfortunate detail is the order of the chapters: it does not make much sense and no justification is presented in Natali's preface. For vertebrate palaeontologists and palaeoanthropologists actively engaged in feeding biomechanics work, this book is certainly a must have, if anything, as a resource for understanding the finer details of the technical aspects of this work. As for the biomechanics of dentition itself, I guess that will be up to me and some others to do.

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