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HEAD, JAWS, AND MUSCLES - ANATOMICAL, FUNCTIONAL,  
AND DEVELOPMENTAL DIVERSITY IN CHORDATE EVOLUTION

Janine M. Ziermann, Raúl E. Díaz Jr., Rui Diogo (eds.). 2019 Fascinating Life Sciences Series. Springer Nature Switzerland AG

The editors and the other thirteen authors of this book are recognized experts in their field. They frequently publish outstanding research in the most prestigious journals worldwide, related to the themes developed here. The topics addressed in this book are among the most fascinating of the Vertebrate Comparative Morphology and Evo-Devo disciplines, such as the origin and evolution of heads, jaws and their muscles in all main clades of vertebrates. These appealing issues are developed in eleven chapters: The first one devoted to the musculature of the *Ciona intestinalis* and the amphioxus, considering, among other issues, the recent findings in the context of the new head hypothesis and the origins of the jaw and other head muscles in vertebrates. This chapter also presents the new discoveries on the cardiopharyngeal field, which account for the origin of the strong links between the heart and the branchiomic muscles. The second chapter is about the early vertebrates and the emergence of jaws, with a consideration of the serial hypothesis or the gill arch theory; some interesting molecular data are discussed in the context of old and hot debates such as the origin of the jaws. In this context, contrasting hypotheses such as the serial one and the mandibular confinement hypothesis are compared and analyzed, always considering empirical evidence coming from the vertebrate taxa. This chapter also addresses other interesting topics such as the organization of teeth and dentition in early vertebrates, and presents advances on the origin of the braincase. These two first chapters show an engaging continuity.

Chapter three is about the cranium, cephalic muscles and homology in cyclostomes, with remarks on the development of the chondrocranium and the evolution of jaws. As cyclostomes constitute the sister clade of extant jawed vertebrates, comparison of their shared traits could help to unveil those present in their last common ancestor (LCA). Chapter four is a detailed account of the evolution

of Chondrichthyes, including a fascinating report on the development of their sense organs. Chapter five is devoted to the actinopterygians and the sixth to sarcopterygians; both chapters include an overview of the groups composing these two big clades, with descriptions of the cranial skeletal and myological structures. Chapter six deals with sarcopterygians, presenting remarks on very charismatic taxa such as *Neoceratodus*, “the most enduring vertebrate of the planet” or *Latimeria*, “the Lazarus taxon”, written in an easy-to-read style; the chapter includes a glossary and suggested further readings to each of the fish addressed group, including the other sarcopterygian, the ancestral tetrapods.

Chapter seven is about the diversity of the head, jaws and cephalic muscles in amphibians, addressing topics such as heterochrony and evo-devo issues. Reading of this chapter brings immediately to mind the truly amazing events that conform salamanders and frogs development in bones and muscles, along with the diversity in, for example, cranial morphology between the amphibian taxa. The chapter includes analyses about the homology and evolution of several anatomical structures such as the branchiohyoideus, depressores branchiales and cucullaris muscles, very useful to people seeking for the correct use of myological terms. Subheadings devoted to Evo-Devo and Heterochrony are also a general synthesis of the points previously addressed. Chapter eight is about the evolution, diversity and development of the craniocervical system in turtles. This section shows with accuracy the elusive issues related to the phylogeny and evolution of turtles by addressing their cranial and jaw musculature. The authors highlight the ongoing controversy on the evolution of the turtle skull to then address the importance of the turtle's neck. They relate the neck with feeding and mobility, underlining its unique ability to retract it and the head inside the shell, and including an interesting report on the functional anatomy of jaw muscles and feeding.

Chapter nine presents an integrative view of cranial anatomy, development and diversification of lepidosaurs. Details about the skull development of several lizard species are given, and it is inevitable to remember classic works in relation to this theme (for example the work of Gavin de Beer). The authors include a thorough analysis of the adductor mandibulae muscles development, with a special consideration of the levator anguli oris homology. Interestingly, the main role of tendinous structures in the attachment of muscles to bones is also analyzed, an aspect rarely considered in this type of work. A survey on the cranial nerves in lepidosarurians is also included. Chapter ten is about the skull and head muscles of archosaurs, with a detailed account of the muscle homologies among them, that address, for example, the orbito-temporal and auricular musculature. Chapter eleven discusses the origin and evolution of the mammalian head muscles. As in the other chapters, the review of the pertinent literature is impressive and very useful. Although several issues of this chapter seem to deal with very specific aspects of muscles homologies, synthesis of controversial muscle identification and consideration of their development make its reading unavoidable. The synthesis of the discussions about, for example, the origin, development and evolution of the pharyngeal muscles and on the cucullaris derivatives in mammals are ineludible. Interestingly, the chapter relates diverse morphological trends in primates with ecological aspects such as habitat use, an unexpected ecomorphological approach of Dr. Diogo.

It is striking that the nomenclature of the muscles addressed in this book is not unified, despite the proposal of Diogo and Abdala (2010), Daza et al. (2011), and Diogo et al. (2018). This fact makes it even more necessary to deepen the efforts to reach a unified nomenclature for the muscles of

vertebrates. Most sections include conclusions, concluding remarks or future directions for researches, which synthetize the general perspective posited in the chapter, along with the controversial issues that still remain. All book parts are remarkably exhaustive and profound. They are also engaging, especially because all of them include iconic aspects of past and recent controversial topics. The sections capture the reader's attention allowing a smooth reading. Thus, the clear sound scientific data and the expertise of the authors make this book surprisingly amusing, considering that many complex scientific issues are considered here. As this book comfortably rides between popularization and science, it is appropriate not only for scientist working in the field, but also for graduate and postgraduate students seeking to improve basic knowledge on the issues.

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