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The usage of 3D methodology is becoming more commonplace in palaeontology, allowing researchers to study taxa in unprecedented detail. However, the effectiveness and fidelity of conventional radiographic approaches is determined by the nature of preservation. Highly flattened remains, such as those of the Thalattosauriformes from Monte San Giorgio (Middle Triassic, Switzerland/Italy), render most traditional means inadequate. Thalattosauriformes are a group of secondarily aquatic reptiles from the Triassic. This enigmatic clade is characterized by high morphological disparity, particularly in their body sizes, rostral shapes and dentition types prompting questions about their functional ecology. They have remained poorly understood due to a historic dearth of material and their difficult preservation. Here we use an integrative imaging approach, combining traditional high-resolution CT scanning and angled radiography (CL), to solve the problem of low-resolution output when scanning large, flattened specimens. We created the first 3D cranial reconstruction of *Askeptosaurus italicus* using segmentation, re-positioning, and retrodeformation. Subsequently, using extant myological analogues and preserved osteological indicators the musculature was reconstructed on the cranium, providing a more realistic portrayal of muscle function and force output than traditional 2D approaches. This new approach also offers detailed morphological information for thalattosaur phylogenetics and provides 3D data to be used in quantitative shape analyses and biomechanical studies, which in turn helps to elucidate dietary specializations that produced the remarkable cranial shapes of Thalattosauriformes.

Title: 44-1: Armed to the teeth: Adaptive functionality of shark denticles from material and mechanical perspectives

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Skin denticles are a distinguishing characteristic of cartilaginous fishes and represent their oldest fossil remains (~455 mya.) By covering the body in an aligned arrangement, denticles modulate turbulence and hydrodynamic drag for locomotion, surface interactions, and even respiration. Although denticles exhibit consistent composition (mostly hydroxyapatite and collagen), a great variation has evolved at other organizational levels, particularly denticle size, shape and arrangement, along the body, between sexes, and among species. Here we demonstrate remarkable denticle modifications in the filter-feeding basking shark, both on the throat and skin. In the throat, rows of flexible gill rakers filter zooplankton when the mouth is open. We show these to be exceptionally elongate denticles that, through their comparatively thin enameloid

layer, hollow interior and arcuate form, appear to deform by inflow of water to control filtration. In contrast, basking shark skin denticles are more typical of elasmobranchs, albeit squat and robust. Their arrangement, however, is unusual, with randomly-oriented denticles clumped together to form 'paver blocks', separated by unscaled folds that allow great expansion of the head skin during feeding. The function of the disarrayed denticles is unclear, but starkly contrasts the streamlined 'scale armors' of other sharks. The heavily modified denticles of basking sharks demonstrate how mineralized biomaterials can evolve novel functions via adaptive alterations at multiple size scales and we discuss their implications from ecological perspectives.

Title: 14-2: Keeping clean: a study of self-grooming kinematics in small sized mammals.

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Ever since mammals had fur, they needed to clean themselves. Motor activities related to body care protect the animal against ectoparasites and maintain the insulating function of the fur. We aim to find out the similarities and differences in grooming movements by interspecific comparison across a variety of small-bodied mammals. Specific questions that we tackled are: What are the main targets? What are the main "tools", i.e. hind paws, forepaws or teeth? We analyzed the spatial and temporal structure of grooming sequences based on video recordings in short-tailed opossums, hedgehogs, rabbits, and rodents. Main targets across all species are the sensory organs of the head, especially the ears and vibrissae, and the anogenital region. Scratching with the hind paws, which evolved long before the origin of mammals, is ubiquitous, even in the spiny hedgehog. Differences across the species are related to social behaviour and to ecological aspects. Furthermore, specific locomotor adaptations affect the kinematics of grooming movements. In particular, shoulder mobility as well as the rotational capabilities of the forepaws or the ankle may represent constraints that must be circumvented by other kinematic solutions. Furthermore, there is evidence for the common origin of the ways mammals groom themselves which could have had a driving effect on the evolution of such mammalian-specific characters like the flexible lumbar spine or the atlanto-axial joint.

Title: 19-1: Evolutionary changes of the mammlian skull and their influence on feeding efficiency

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The origin of mammals is a vital transition in vertebrate evolution, accompanied by fundamental tranformations of features for feeding (teeth and jaw) and sensory reception of high-frequency sound. Pivotal was the decoupling of the chewing mechanism from the hearing function