MOLAR OCCLUSION WITH AN ANTERIORLY DIRECTED COMPONENT IN THE POWER STROKE IS UNIQUE TO THERIAN MAMMALS AND MAY HAVE INFLUENCED EARLY THERIAN DIETARY DIVERSIFICATION

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Unlike most vertebrates, mammals have a precise dental occlusion, a lower jaw composed of one bone, and middle ear ossicles derived from ancestral jaw bones. Non-mammalian synapsids and early mammals underwent complex evolutionary changes in both feeding and hearing adaptations, which were crucial for the radiation of extant mammals. To investigate functional transitions in the chewing mechanisms of synapsids, we compiled jaw movement directions during postcanine occlusion based on primary literature for a sample of 133 synapsid genera. Occlusal complexity generally increases in more recently evolved synapsid clades, but occlusal movements among non-therian synapsids are limited to orthal-dominated shearing processes with some taxa that developed posteriorly directed (i.e., palinal) chewing movements. Therian mammals in comparison are the only synapsids that include lineages which exhibit transverse occlusal movements with a significant anterior component. An anterior directed jaw movement during occlusion necessitates anteriorly directed muscle force vectors. We posit that such a change in direction of muscle force vectors is preserved in the mammalian fossil record by the appearance of the cladotherian (i.e., therians and close relatives) angular process that shifts the orientation of superficial masseter and medial pterygoid muscles. The evolutionary change in jaw morphology was followed by the development of the lower molar talonid basin, which facilitates additional occlusal contacts during extended transverse movements. In earlier synapsids anterior movement might have been absent because of the middle ear elements were still attached to the lower jaw, prohibiting a more posterior insertion of jaw musculature. Thus, a complex shift in the entire masticatory apparatus of early cladotherians, involving transformations of the jaw corpus and muscles, molar shape, and detachment of the middle ear elements permitted the evolution of novel masticatory movements. This evolutionary transition starting with the earliest cladotherians may have been a critical prerequisite for the dietary diversification of therians.