



# Microwear structures and surface analysis on isolated theropod teeth from the Upper Jurassic Andrés fossil site, Pombal, Portugal

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## LETHAIA



The analysis of wear surfaces on teeth has been applied to infer diet, feeding mechanisms, climatic conditions, and habitat in various groups of extinct organisms. Recently, analyses of microwear surfaces have been used to study dinosaur feeding strategies in theropods, demonstrating that different groups may have resorted to similar feeding mechanisms. Here, we present the characterization of wear surfaces and patterns of striations in isolated teeth from Late Jurassic theropods collected at the Andrés fossil site at Pombal, Portugal, based on electron microscopy images. Different morphologies of wear surfaces were identified in the studied sample of isolated teeth. Various origins for these wear surfaces are proposed based on comparisons with dental wear patterns described in other fossil records. Among the identified patterns, the most common may be related to contact between opposing rows of teeth or between the tooth and food, corresponding to wear facets and spalled surfaces, respectively. A particularly pronounced wear surface identified in the sample suggests tooth fracture followed by subsequent wear. Furthermore, correlations between the identified wear surfaces and microstructures with specific habits and feeding mechanisms are explored and tested using Finite Element Analysis. The analysis of these structures holds great potential to enhance our understanding of the palaeoecology of theropod dinosaurs, particularly in inferring dietary strategies. □ *Lusitanian Basin, Coelurosauria, Allosaurus, wear patterns, Finite Element Analysis, feeding behaviour*

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Over the past two decades, various types of tooth wear surface analyses at different scales have been applied to primates and other mammals to infer diet, chewing mechanisms, feeding strategies and food abrasiveness, as well as habitat and climatic conditions (e.g. Rivals & Deniaux 2003; Scott *et al.* 2005; Ungar *et al.* 2007; Schulz *et al.* 2013; Withnell & Ungar 2014; Schulz-Kornas & Winkler 2023). Concerning dinosaur dentition, studies of microwear patterns have primarily focused on herbivorous taxa (e.g. Ösi *et al.* 2014; Skutschas *et al.* 2021; Sakaki *et al.* 2022; Kubo *et al.* 2023). Wear surfaces and microstructures in theropod teeth have been studied by some authors (Farlow & Brinkman 1994; Schubert & Ungar 2005; Candeiro *et al.* 2017) and mentioned by others

(Molnar 1998; Ösi *et al.* 2010; Williamson & Brusatte 2014). More recently, Winkler *et al.* (2022) published the first application of dental microwear texture analysis to study theropod feeding ecology, and Torices *et al.* (2018) combined tooth microwear and finite element analyses to demonstrate that different coelurosaurian theropods employed similar puncture-and-pull feeding mechanisms, while differences in denticle morphology may be related to diverse predation strategies.

Recently, several authors have recognized two different types of surfaces related to feeding on theropod tooth crowns: 1) surfaces resulting from repeated tooth-to-tooth contact, which correspond to wear facets; and 2) surfaces formed by interactions