Soft dentin results in unique, naturally bendable teeth in scraping catfish

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The teeth of vertebrates are used for biting, grasping, crushing, cutting and chewing, actions in which teeth experience mainly compressive forces acting mostly downward. Teeth are wonderfully adapted for this, with an ordered microstructure of hydroxyapatite crystals and organic components of the enamel(oid) and the dentine tissues contributing to the compressive, but also shear and tensile strengths, directing forces and preventing cracks. Some vertebrates, however, use their teeth for scraping or filtering, with teeth experiencing strong sideward forces, and some scraping suckermouth catfishes (Loricariidae) appear to have flexible teeth. Considering the mineralised nature of tooth tissues, the notion of flexible teeth seems paradoxal, though. We confirmed and quantified the extreme bending performance of single teeth (up to 180°), and show that reorganizations of the tooth (micro)structure and local hypomineralisation of the dentine are adaptations allowing flexibility and preventing breaking. In the dentine of the flexible zone, tubuli are absent, mineral elements are locally near-absent, and collagen is mostly longitudinally oriented. Tooth shape and internal structure appear to be optimised for bending in one direction, probably naturally occurring numerously during scraping feeding, but teeth can bend in the opposite direction as well. Not all Loricariidae possess flexible teeth, with the trait perhaps having evolved more than once. In view of the often unexpected mechanical properties of mineralised biological materials and the interesting process of actively biomediated dentine formation and mineralisation, the flexible tooth appears to be the finest illustration hitherto known.