Paleodontology key from the past to the future: Indian perspective *

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"It is not the strongest of the species that survives, nor the most intelligent but the one most responsive to change" – Charles Darwin

Paleodontology is a rich field with a long and fascinating past and an even more promising future. Teeth are the strongest components of the human body that are resistant to physical, chemical and biological deterioration, taphonomic damage, and traumatic insults (1). Teeth are also peculiar in nature that show individualistic characteristics such as seasonal migration, contamination exposure, radiation or pathological findings, cultural changes and the age of death (2). Decoding the forensic bioarchaeological information contained in the dried bones and teeth seems to be a challenge for field experts. However, as the

paleoanthropologist Kristin Krueger says, teeth are little pieces of a puzzle that could help you to see a broader picture of someone's life.

With a combination of visual examination, metric and microscopic analysis and carbon-14 dating, paleontologists can uncover hidden findings. Dental anthropologists are focused in unlocking facts from specimens of modern and fossil teeth. Studying dental fossils shows the chronology of knowledge, growth and culture.

India is one of the most interesting places in the world and a major venue for fossil exploration due to its vast and large geographical coverage (3). India has been inhabited by diverse populations for more than 5000 years, due to its complex demographic distribution, its vast plains and hilly regions. The first fossil reported was the 9 Million Years old Pliopithecoid ape located in Himachal Pradesh, India (4). Two infant lower molar teeth of the ape-like creature Krishnapithecus (Pliopithecoid family) were roughly 8-9 mm in length. Deciduous teeth have also been reported from the Chalcolithic site of Inamgaon (1400-700 B.C.), a prehistoric agricultural village on the Deccan Plateau in western India (5), revealed that their teeth are larger than the deciduous teeth of modern peoples of European descent but smaller than the deciduous teeth of modern Australian aborigines. A 13 million years old dental fossil of ape was found in Uttarkhand, India, on September 9, 2020 (6). It shone out in the pile of dirt and was instantly recognized as a primate tooth. Later, the molar tooth was photographed, CT scanned, and compared to extinct ape teeth, and found to belong to the previously unknown genus and species Kapi ramnagarensis. However, there seems to be a deficit of access for Indian experts to many such areas, which could be one of the challenges. Moreover, the absence of legal protections to fossil remains also allows landowners to arbitrarily shut down access to sites.

The field of palaeontology has seen some revolution in recent years, such as digital scanning, simulation and study, with the introduction of emerging innovations (7). Paleodontological findings can also be found at the forefront of forensic and dental anthropological research as a result of the application of these techniques. Also, digital repositories and tools can be used for the universal exchange and distribution of 3D resource material, offering a possible solution to the problems of access to rare fossil dental materials. With the use of 3D scanners, the physical object can be transferred to a virtual one, and with a 3D printer, the virtual object can be replicated as a replicate model (8). This provides a tremendous opportunity for areas such as palaeontology, archaeology and forensics by supplying a prototype bone, teeth and artefact replicas. These technologies can also be useful in many areas, such as fossil maintenance and restoration, excavation preparation and revitalization of artefacts. It also allows the museum to enhance the collection of data contributing to an improved scope and comprehensive study of the dental fossils. Improvements in scanning and data processing techniques would allow even more of the human past to be read from the fossil record, and with even better precision (7,8). These 3D paleodontological archives will provide tools for paleontological studies and provide retrospective evidence for fossil remains. Thus, e-paleodontological repositories created for archeological and forensic study can be used for education and research activities. While 3D technology has its benefits, the biggest limitation is the difficulty of using these high-tech imaging technologies in less developed countries. However, 3D technology-backed paleodontology is a future for the recovery of dental fossil riches. New techniques allow dental fossils to be represented in three dimensions in unparalleled precision. The latter allows paleodontologists to obtain valuable insights into their anatomy, growth and preservation. The way ahead is to make our footing stronger through adequate research and the right understanding of the evolving technology.

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