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Occurrence of three-rooted permanent mandibular molar and its possible link with archaic human - an overview*

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Abstract

Occurrence of 3-rooted mandibular molar varies from one geographical and ethnic group to other. Its prevalence is very high in Asian and Asian-derived populations, particularly Aleuts and Eskimos. The recently revealed individual from Xiahe, China—recognized as Denisovan shows a 3-rooted lower permanent molar, giving a direct morphological link between archaic and recent Asian Homo sapiens population. This area of study is useful in archaeology, palaeontology, physical anthropology and forensic pathology/ dentistry. Its application is also important in clinical dentistry.

Keywords: Mandibular molar; Homo sapiens; Denisovans

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Glossary

Denisovan: The Denisovans or Denisova hominins are an extinct species or subspecies of archaic human that ranged across Asia during the Lower and Middle Palaeolithic. Denisovans are known from few remains, and, consequently, most of what is known about them comes from DNA evidence. The first Denisovan individual was identified in 2010 based on mitochondrial DNA (mtDNA) extracted from a juvenile female finger bone from the Siberian Denisova Cave.

Introgression: Also known as introgressive hybridization, in genetics is the transfer of genetic material from one species into the gene pool of another by the repeated backcrossing of an interspecific hybrid with one of its parent species.

Gene flow: Also known as gene migration or geneflow and allele flow is the transfer of genetic material from one population to another.

EPAS1 gene: (Endothelial PAS domain-containing protein 1) the EPAS1 gene encodes one subunit of a transcription factor involved in the induction of genes regulated by oxygen, and which is induced as oxygen concentration falls (hypoxia).

H. erectus: Homo erectus belongs to the genus Homo, and was also the earliest in the human lineage. Unlike other early hominins, H.erectus had distinct characteristics which meant it was similar to modern humans.

Introduction

Typically, the mandibular first molar of modern human (Homo sapiens) presents with 2 well-defined roots: a mesial root with two canals and a distal root with one or two canals. Wide variations of root and canal configuration of the mandibular first molars have been reported in the literature (1). Occurrence of the third root on mandibular permanent teeth is one of the interesting, important phenomena. It is important because careful study of radiographs obtained at different angles is needed before initiating endodontic treatment to increase the chance of detection of such anatomical variations and reduce the risk of missing a canal [Figure 1].

Presence of third root on mandibular molar is interesting anatomical variation as its prevalence is having wide variations in different ethnic groups. Paleoanthropologist also find its genetic link with extinct hominid - Denisovans.

Even though mandibular permanent molars are normally 2-rooted in the genus Homo, root number differs from one to three or even more (2). When it occurs in modern humans, the third root typically seen on the lower first molar (referred to as a 3RM1) may also appear on the mandibular second and third molars (3) [Figure 2]. The 3- rooted permanent mandibular molar, being called radix entomolaris by Bolk, may occur on one side of jaw or on both sides (4).

Prevalent scientific and bioarchaeological research accept the infrequency of the 3-rooted permanent mandibular molar external to Asia and the New World. In Asian people, the regularity of the three-root permanent mandibular molar may surpass 40% (Aleut, Neolithic China). However, in non-Asian populations, the frequency ranges from 0 to 3.4%. The rarity of the 3- rooted permanent mandibular molar in non-Asian H. sapiens is small enough to be elucidated by mutation only (5). The high frequencies of 3-rooted permanent mandibular molar in northeast Asians and Native Americans is a crucial trait connecting Native American origins to Asia (6).

The recently revealed individual from Xiahe, China—recognized as Denisovan by paleoproteomics shows a 3-rooted lower permanent molar, giving a direct morphological link between archaic and recent Asian Homo sapiens populations (7). This individual is dated to 1,60,000 years ago. The third root seen towards tongue is an extra root in the middle of mesial and distal roots.

Furthermore, till a 3-rooted permanent mandibular molar is discovered in more archaic hominins, it should be recognised as a morphological feature that was transmitted to H. sapiens by gene flow with Denisovans. Gene flow between H. sapiens and Denisovans has been recognized, with a mutation (at EPAS1 gene) associated to high-altitude acclimatisation shared by a Siberian Denisovan and modern Tibetans (8). Significantly, Nepal also displays one of the peak incidences (25%) of 3- rooted permanent mandibular molar in East Asia. Alike the high-altitude associated mutation, which is preserved due to favourable choice, the preservation of 3-rooted permanent mandibular molar at great regularity in Asia may be related to selection for molar retention in populations with substantial chewing capacity (9).

The 3-rooted permanent mandibular molar is an Asian-derived uniqueness that we may conclusively corelate to Denisovans. Therefore, we now have accurate proof that gene flow between archaic groups and H. sapiens

Figure 1. Radix Entomolaris i.e., three-rooted permanent mandibular molar, here, with four canals. (Picture and case courtesy: Dr. Kreena Patel, Specialist in Endodontics at Brigstock Dental and Oaktree Dental Practice, UK).

instigated in the transmission of distinguishable morphological structures. There have been a number of Asian H. sapiens fossils designated lately that point to admixture with archaic humans as a clarification for the existence of primitive traits, e.g., Dushan caves and Tianyuan caves (10, 11). If the 3- rooted permanent mandibular molar was relocated from archaic humans to H. sapiens, other traits may have been as well. Definitely, the occurrence of "archaic features" in current Asians that were once used to recommend continuousness from Pleistocene Asian H. erectus may also have been gained by introgression from Denisovans (12).

Whatsoever the reason, we claim that the 3-rooted permanent mandibular molar anomaly is an illustration of a morphological character in modern humans which may be positively linked to this archaic intermixture.

Declaration of interest

None

Authors' contributions

The authors contributed in the following way:

Dr. Resham AV: Data acquisition and interpretation, literature search and manuscript preparation as well as editing.

Dr. Vivek Pakhmode: Data acquisition, definition of intellectual content, literature search, and manuscript preparation.

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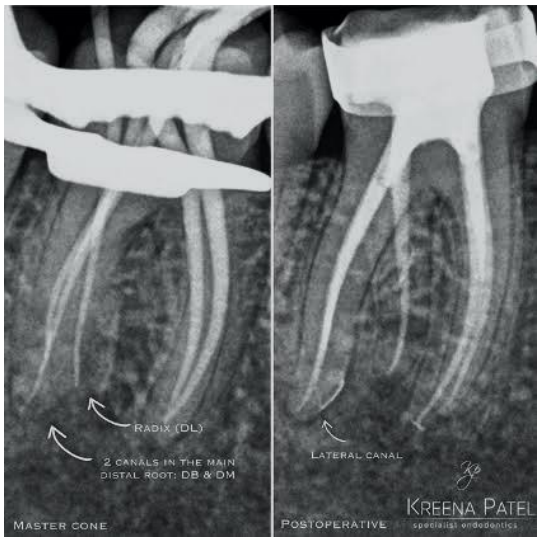

Figure 2. Radiographic image showing presence of three-rooted mandibular molar with five canals, undergoing root canal treatment. (Picture and case courtesy: Dr. Kreena Patel, Specialist in Endodontics at Brigstock Dental and Oaktree Dental Practice, UK).

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