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Longstanding dental pathology in Neandertals from El Sidrón (Asturias, Spain) with a probable familial basis

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ABSTRACT

Two Neandertal specimens from El Sidrón, northern Spain, show evidence of retained left mandibular deciduous canines. These individuals share the same mitochondrial (mtDNA) haplotype, indicating they are maternally related and suggesting a potential heritable basis for these dental anomalies. Radiographs and medical CT scans provide evidence of further, more extensive dental pathology in one of these specimens. An anomalous deciduous canine crown morphology that developed before birth subsequently suffered a fracture of the crown exposing the pulp sometime after eruption into functional occlusion. This led to death of the tooth, periapical granuloma formation and arrested deciduous canine root growth at an estimated age of 2.5 years. At some point the underlying permanent canine tooth became horizontally displaced and came to lie low in the trabecular bone of the mandibular corpus. A dentigerous cyst then developed around the crown. Anterior growth displacement of the mandible continued around the stationary permanent canine, leaving it posteriorly positioned in the mandibular corpus by the end of the growth period beneath the third permanent molar roots, which, in turn, suggests a largely horizontal growth vector. Subsequent longstanding repeated infections of the expanding cyst cavity are evidenced by bouts of bone deposition and resorption of the boundary walls of the cyst cavity. This resulted in the establishment of two permanent bony drainage sinuses, one through the buccal plate of the alveolar bone anteriorly, immediately beneath the infected deciduous canine root, and the other through the buccal plate anterior to the mesial root of the first permanent molar. It is probable that this complicated temporal sequence of dental pathologies had an initial heritable trigger that progressed in an unusually complex way in one of these individuals. During life, this individual may have been largely unaware of this ongoing pathology.

Introduction

Previously, Prieto and Abenza (1999a,b), Prieto (2005), and López-Valverde et al. (2012) have described multiple dental pathologies in an adult Neandertal hemi-mandible (Adult 2; SDR-007/008) from El Sidrón, northern Spain (Fortea et al., 2003). Adult 2 represents one of 13 individuals preserved in the sample from El Sidrón (Rosas et al., 2006, 2012). The mandible is preserved from the left ramus to the mesial aspect of fractured right canine socket, but is missing the posterior border, condyle and coronoid process of the left ascending ramus. López-Valverde et al. (2012) noted several dental abnormalities including a retained left deciduous canine with an anomalous crown morphology, a radiolucent periapical area beneath the mesial root of the left first permanent molar and an unerupted left permanent canine lying low in the mandibular body beneath the second and third molar roots.

Dental pathology in fossil hominins is comparatively rare and this specimen offers an exceptional opportunity to study a number of untreated disease processes that may have accumulated and

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progressed in parallel over the lifetime of the individual. Judged by the completed M3 root apexes and the minimal occlusal wear on the left M3, this individual was a young adult at the time of death but some of these dental pathologies must have arisen before birth and others were acquired or developed gradually over many years.

New medical CT images of the specimen allow us to put together a more comprehensive picture of the dental pathology present in this mandible. It is also now possible to piece together a better chronological history of how these pathologies may have developed over the lifetime of the individual. Moreover, there is now genetic evidence about the familial relationships between some specimens at El Sidrón. Particularly in this respect, an adolescent individual, Adolescent 3, represented only by isolated teeth and a small fragment of mandible, shares the same mtDNA haplotype as the Adult 2 hemi-mandible described here (Lalueza-Fox et al., 2011). This individual also shows evidence of shared dental pathology with the Adult 2 hemi-mandible.

Individual 2 from El Sidrón preserves most of the lower dentition and a complete maxilla has been associated with this individual. It retains, even post-fossilization, severe dental calculus deposits, with the maxillary left premolars and molars either partially or totally covered. There is also an asymmetry in the degree of occlusal wear between the right maxillary dentition, which is more advanced (more evident in the canine), and the left one. Regarding the pattern of para-masticatory dental wear, and despite Adult 2 having a large number of instrumental striations indicating a right-handed preference (Estalrrich and Rosas, 2013), some striations on the anterior teeth are nevertheless distinctive of left-handedness, suggesting some degree of interchangeable hand-use in this individual. This observation may be of relevance in trying to interpret whether or not any occlusal wear asymmetry might derive from one or other of the dental pathologies described in this paper.

Materials/methods

Lateral radiographs, periapical radiographs and medical CT scans (slice thickness 0.625 mm, pixel size 0.344 mm) were made of the Adult 2 Neandertal hemi-mandible, and of the mandibular fragment of the adolescent specimen, and reconstructed in Amira 4 (VSG). Besides these, conventional radiographs were also taken. Additional observations and measurements were made directly on the specimens.

Description of the specimens

The dental pathology of Adult 2; mandible SDR-007-008 Both permanent central incisors are missing from the Adult 2 mandible, lost post-mortem, but both lateral incisors are present (although the left lateral incisor is now removed from the specimen). The permanent left canine is unerupted (Fig. 1) and lies horizontally low in the mandibular corpus. Its incisal tip lies in line with the mesial root apex of the M2 ~15 mm below the alveolar bone margin and ~20 mm above the lower border of the mandible (Fig. 2). The canine root apex lies ~3 mm distal to the distal M3 root apex and protrudes through a fenestration (7 × 10 mm) in the lingual cortical plate of the submandibular fossa, well beneath the mylohyoid line. The canine lies immediately lingual to the inferior alveolar nerve bundle (Fig. 2) but the external contours of the mandibular bone are normal both lingually and buccally. CT scans show that the pulp chamber and pulp canal of the unerupted canine are small and reduced, suggesting an older rather than a younger tooth that has continued to form secondary dentine for some time despite being unerupted and non-functional.

A retained deciduous canine is positioned between the left lateral incisor and the P3 (Fig. 3). The deciduous canine crown is abnormal in its morphology but its root appears normal. The surface enamel immediately above the cervix also appears normal but this part of the crown is somewhat peg-shaped and surmounted occlusally by an additional cap of enamel. The cap expands as a dilatation from a clear constriction where it joins the true crown to form a flat worn surface that was in occlusion with the distopalatal aspect of the upper left canine. Occlusally the crown is ~3 mm wide mesiodistally and has contact facets for the lateral incisor mesially and the P3 distally. It appears to have been tightly integrated into the dental arch and in functional occlusion.

The overall appearance is of a peg-shaped deciduous tooth crown joined head-to-head at a mid-crown constriction with an upper portion set at 90° to the long axis of the main root canal and pulp chamber of the tooth (Fig. 3). On the buccal aspect of the abnormal enamel extension, there is a circular 'crater-like' feature comprising a fractured enamel rim and dentine core with an exposed central pulp horn in its base. A part of the bulbous upper crown extension appears to have fractured off here, leaving an exposed portion of its pulp horn in direct communication with the main pulp chamber and root canal. On CT scans, a continuous rim of enamel surrounds a central dentine core that has fractured through on the buccal aspect at a point where the two pulp horns meet at an isthmus (Fig. 3). The retained deciduous tooth root appears normal and measures ~10 mm long. At the cervix, the root is 3 mm mesiodistally by 4 mm buccolingually in transverse cross-section. However, the root has a wide-open apex and a wide pulp canal consistent with incomplete root formation.

The premolar crowns show no signs of any pre-mortem pathology such as caries, crown fractures or discolouration. Enamel wear facets buccally are only just through to dentine on the P4. The M1 crown shows no signs of any pre-mortem pathology and has only small islands of dentine wear exposed over the buccal cusps. The M2 shows a few enamel wear facets on the cusp tips. On the M3, there are only minimal enamel wear facets. Neither M2 nor M3 shows any evidence of pre-mortem crown pathology, although there are heavy deposits of supragingival calculus on the lingual aspects of M1 and M2 with some evidence of early lingual crestal bone resorption in this position (López-Valverde et al., 2012). On the CT images there are several obvious post-mortem shrinkage fractures through the premolar and molar crowns and roots (Fig. 2).

The bony pathology of Adult 2 Anteriorly, a large buccal sinus (~10 mm by 8 mm) emerges from an extensive bony cavity beneath the roots of the left lateral incisor and deciduous canine (Fig. 1). The alveolar margin of the buccal plate at the top of the sinus opening may have been intact at death since there is fresh fractured trabecular bone mesial to the deciduous canine root. At the buccal opening of the sinus, two bony cavities appear to have coalesced into one. Beneath the incomplete deciduous canine root apex there is a rounded eroded bony cavity typical of a periapical granuloma. Rising up lingually and inferiorly from the floor of the main bony cavity is a separate funnel-shaped sinus that opens low down beneath the lateral incisor root apex to merge with the cavity beneath the deciduous canine root (Fig. 1).

A large mental foramen, typical of Neandertals, opens midway between the mesial and distal M1 roots. This lies 20 mm below the margin of the buccal alveolar bone and 10 mm below the distal M1 root apex. Two small vascular foramina open anterior to the mental foramen, one beneath the mesial M1 root and one higher up beneath the P4 root apex (Fig. 1).

A large buccal sinus with well-established smooth rolled bony margins has exposed the apical two-thirds of the mesiobuccal M1 root (Fig. 1). Some of the crestal alveolar bone from the superior margin of the sinus may have been lost post-mortem, giving the