



Human palaeontology and prehistory (Palaeopathology)

A case of an osteolytic lesion on an Italian Neanderthal jaw

Lésion ostéolytique sur une mandibule néandertalienne provenant de la péninsule italique

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ABSTRACT

This article describes an osteolytic odontogenetic lesion found on the mandible of a Neanderthal from the Middle Paleolithic site of Riparo Mezzena near the city of Verona (Italy). A pathology was revealed through X-ray and computerized-tomodensitometric examinations. This lesion was compared to present and sub-contemporary populations and indicates that it may have been of infectious origin, resulting from a bacterial invasion of the root canal of a coronal pulp exposure. The bacterial contamination may have resulted either from a traumatic fracture, a cavity, or extensive wear on the tooth.

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R É S U M É

Cet article présente une lésion ostéolytique odontogène observée sur la mandibule d'un fossile Néandertalien provenant du site Paléolithique moyen de Riparo Mezzena, près de la ville de Vérone en Italie. Cette pathologie a été mise en évidence par des examens radiologiques et tomodynamométriques. Par comparaison avec une lésion d'aspect similaire chez un patient actuel, l'étiologie de cette pathologie semble être d'ordre infectieux. Elle serait, sans doute, due à une invasion bactérienne de la cavité pulpaire à partir de la surface occlusale, par suite de la cassure accidentelle de la dent, ou d'une carie, ou encore d'une très forte abrasion.

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1. Introduction

One of the main challenges presented by the study of human fossils is in reconstructing their living conditions and behavior through detailed analysis of the elements represented by prehistoric fossils, above all the skeleton and teeth. In this article we examine a Neanderthal mandible from an extinct human fossil group that was present in Europe between 150,000 and 30,000 years ago. We provide evidence for an osteolytic lesion in a mandible, revealed during a systematic computerized-tomography scan of the mandible from the Neanderthal of Mezzena.

2. Material and methods

The site of Riparo Mezzena in northern Italy is located at 250 meters a.s.l, along a Middle Eocene limestone cliff on the northern side of the Avesa Valley, next to the city of Verona. The site, named after its discoverer, Franco Mezzena, was excavated by the Natural History Museum of Verona in the summer of 1957 under the direction of F. Zorzi and A. Pasa. During these excavations a series of layers of variable thickness were exposed, ranging between 1.5 and 1.7 meters, and at least three anthropogenic layers were identified (top-bottom: layers I, II and III). All the human remains (probably two individuals) were found in layer Ib. Results from the pedological, sedimentological and palynological analyses suggest the presence of a cold, continental climate associated with layer III, followed by a wet interval corresponding to the limestone surface between layers III and II. Layers I and II were marked by a continental climate, characterized by dry and cold phases (in correspondence with loess sediments) as well as humid phases (corresponding to concretions) (Bartolomei et al., 1980). All of these elements suggest that the Mezzena site was inhabited during a Late Mousterian phase.

The lithic industry has recently been the topic of a new study aiming to understand the interaction between humans and their environment (Giunti and Longo, 2010; Longo and Giunti, 2007; Longo et al., 2011; Thun Hohenstein et al., 2011). It has been linked to human groups that frequented the site at different times, using it as a residential site, although for relatively brief periods. The Levallois technology is documented both by recurrent centripetal and by the preferential methods. Predetermined blanks are of medium-small dimensions. Scrapers are numerous, with quite a few Charentian elements. Mousterian points are also present. Raw materials consist primarily of flint originating from the formations of Maiolica (Scaglia Variegata and Eocene Limestone), which are located 5–15 km from the site (Longo and Giunti, 2007, 2010).

2.1. The human remains and the dental pathology of the mandible

The majority of human remains from Mezzena were found within level I. The human fossils include an incomplete mandible and 14 bone fragments, three of which belong to the post-cranial skeleton. From a morphological point of view, the thickness of the cranial fragments is

remarkable. In view of their state of preservation and of the thickness of the bones, these fossil remains may have belonged to a single adult individual, although it is not possible to relate them to each other. The fragmentary state of the material allows only a limited anatomical study. However, among these pieces, fragments of the frontal bones suggest a very flat frontal bone similar to that observed on European Mousterian Neanderthals and, in particular, among the Italian Neanderthals (Condemi, 1992, 2001). Because the anatomy of this mandible has already been published in detail (Giunti et al., 2008), it is of interest here to note only its similarity to European Mousterian Neanderthals due to its robustness, the morphology of its symphyseal region, the inferior margin of the mandible and the external and interior face of the mandibular body (particularly in the position of the *linea mylohyoidea*) (Condemi, 2001).

In view of all the morphological features, the human remains of Mezzena are assigned to Neanderthals and confirm the prior diagnosis (Corrain, 1968). The Neanderthal status for this fossil has also been confirmed by paleogenetic analysis. Indeed, three of the smallest fragments, which exhibit no diagnostic traits, were used for the DNA extraction. The mtDNA revealed the typical Neanderthal sequence (Krings et al., 1997) including also a variation that suggests that this individual Neanderthal (known as MLS, sample IGVR9) belonged to a Mediterranean geographical variant (Caramelli et al., 2006; Lalueza-Fox et al., 2006). In addition, two genes from the cranial fragments of Mezzena have been analyzed and have contributed very important results. The MCR1 nuclear gene on the Mezzena cranial fragments (MLS, sample IGVR9) indicate that this Neanderthal individual had red hair pigmentation (Lalueza-Fox et al., 2007). The other gene analyzed is the microcephaline gene, *mcph1*, which contributed to the debate concerning the origin of the haplogroup D in modern humans (Lari et al., 2010). In view of all of its morphological and paleogenetic features, the Mousterian human remains of Mezzena are clearly Neanderthals. At present, the fossils of Mezzena are the only genetically typed Neanderthals from the Italian peninsula.

The incomplete mandible of Mezzena in which a pathology has been found is represented by a complete symphyseal region and a section of the mandibular corpus. The two rami and the left side of the mandibular corpus are broken. However, the symphyseal region is complete. On its right side, the corpus of the mandible is conserved up to the level of the second molar.

No teeth remain in the mandible. (Fig. 1). The loss of the left incisors, canines and first premolars, as well as of the right central incisors and of the right mandibular posterior section, after the canine to the first molar, is *ante-mortem*. Indeed, the alveolar bone is in formation in these zones. The loss of the right lateral incisor is estimated to have occurred after death, because the alveolus is empty and has a homogeneous shape. Nevertheless, it is not possible to determine chronologically the loss of the right canine: there are no signs of healing on the bone but its alveolar walls display remodeling of the bone.

Extensive destruction and pathological remodeling of the bone in the vicinity of the right premolar and molar

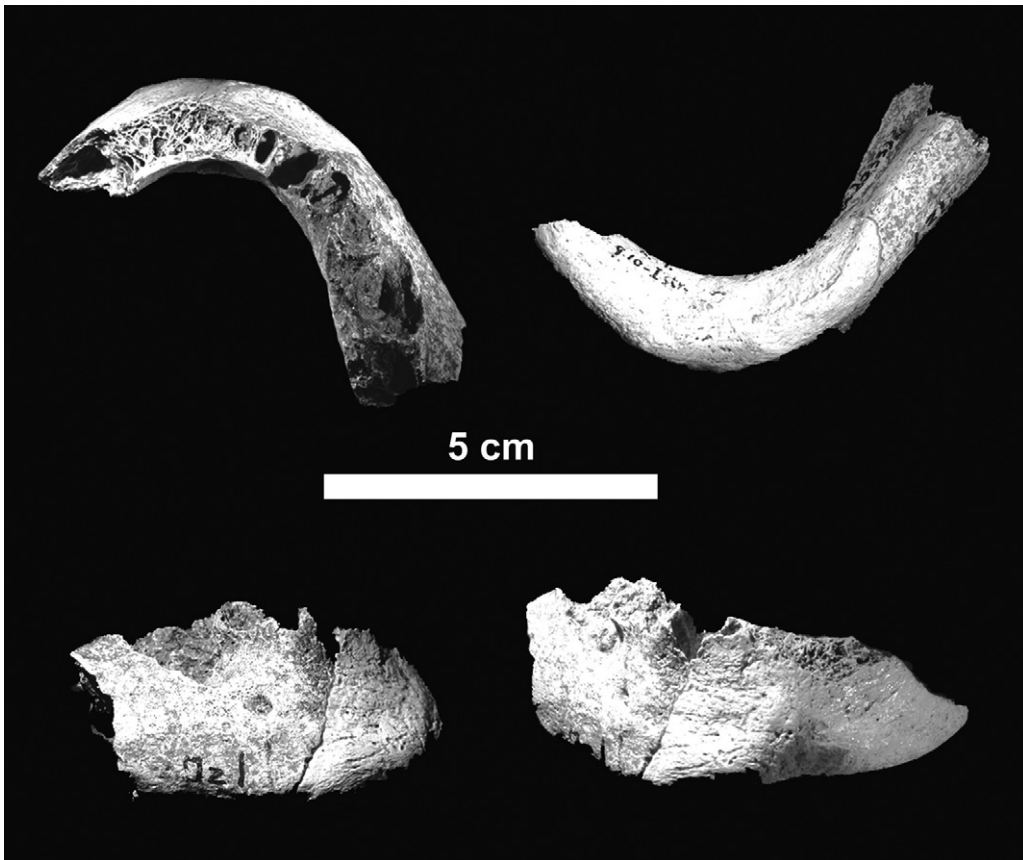


Fig. 1. The Mezzena Mandible; top left: superior view; top right: inferior view; bottom left: lateral view; bottom right: frontal view.

Fig. 1. La mandibule de Riparo Mezzena; en haut à gauche : vue supérieure ; en haut à droite : vue inférieure ; en bas à gauche : vue latérale ; en bas à droite : vue frontale.

teeth were revealed through X-ray and computerized-tomodensitometric examinations. X-ray analysis reveals a radiologically clear image, located on the lower edge of the mandible. In lateral view, it extends from the first right premolar to the first right molar and is composed of three parts: two individualized lobes in the half lower horizontal segment, a mesial lobe, situated in the area of the first right premolar, and a more distal one, extending from the second premolar to the first right molar and 1 vertical “trajectory” extending from the alveolus of the second right premolar to the junction of the two lobes previously described, situated in the middle of the rising body on a vertical axis. The residual apex of the second right premolar may also be distinguished in the alveolus. Its position can be associated with an eviction in process (see supplementary on line material, Figs. S2 and S3). In frontal section, the volume of the lesion is in the half lingual mandibular corpus without any contact with the cortical bone. The anterior limit of the mesial lobe is situated lingually and apically at the level of the mental foramen, but without any contact with it (see supplementary on line material, Fig. S4).

3. Results

This type of osteolytic lesion in the Neanderthal mandible of Mezzena corresponds to a benign bone tumor

of dental origin (Langsjoen et al., 1998) or to an abscess. Benign cysts and tumors of the mandible are most often odontogenic, meaning that they originate from tissue related to the teeth. The osteolytic lesion developed from the second right premolar, as shown from the corresponding residual tooth apex and the direction of its intra-osseous trajectory. Moreover, the high position of the apex, probably undergoing eviction, and the bone apposition between this radicular debris and the lesion seem to illustrate a healing process. An interesting parallel may be established with a lesion found on a present-day patient, also situated in the middle of the mandibular corpus, mesio-distally between the distal face of the right second premolar and the mesial face of the second mandibular molar. It presents identical characteristics in terms of form and size: an oval shape measuring $8 \times 8.5 \times 9.5$ mm. A 3D-model (software MIMICS 10.01[®]) of this lesion allows us to evaluate its volume: 687 mm^3 . Its surgical removal confirmed these data (see supplementary on line material, Fig. S5). From an etiological point of view, this lesion, without clinical signs, was an accidental discovery. The anamnesis and clinical examination revealed the origin of this pathology: a chronic intra-osseous bacterial infiltration developed from a cavity and the fracture of the second right mandibular premolar, leading to this peri-apical lesion. The analogies observed between a lesion

described on a current patient and the Neanderthal fossil of Mezzena support the hypothesis of a similar etiopathogenesis and positive diagnosis: an irritated periapical lesion with endodontic origin. In the Mezzena Neanderthal fossil, the neo-apposition of the healing bone around the lesion and the position of the radicular debris in eviction attest the fact that this pathology occurred a long time before death and was not its cause. The presence of multiple dental loss *ante-mortem* leads to the conclusion that, over the course of its life, the Mezzena Neanderthal suffered from several acute dental pathologies similar to the present-day patient.

4. Discussion

The Mezzena jaw belongs to the Neanderthals that inhabited a vast geographical area during the Middle and Late Pleistocene, extending from all over Europe to the Middle East, western Asia and southern Siberia. The Mezzena mandible presents an odontogenic osteolytic lesion that led to extensive destruction and pathological bone remodeling in the vicinity of the right premolars and first molar teeth. This lesion is evidenced by the fistulian intra-osseous path and is certainly the result of an infection developed in the premolar.

Regarding the cause of this pathology, we note that the residual root fragment is situated close to the alveolar rim and is probably in the process of eviction. This observation makes it possible to exclude the hypothesis of bacterial proliferation around the dental root originating from a periodontal trauma, which would have been illustrated in the X-ray image by a “glove finger-shape” osseous loss. Thus, the bacterial invasion that induced this osteolytic lesion was probably exclusively of endodontal origin. This hypothesis is corroborated by the complete exposure of the tooth pulp to bacteria due to absence of the tooth crown.

Because a great number of teeth are absent and were missing *ante-mortem* on the Neanderthal Mezzena mandible (see supplementary online material Figs. 2 and 3), it may be that other teeth underwent a similar process. It is clear that this extensive tooth loss had consequences for the quality of life of the Mezzena Neanderthal. It is nonetheless difficult to determine whether this individual required conspecific care for its survival, as has been claimed for fossils with a similar pathology (Lebel et al., 2001) or not (De Gusta, 2002).

It is interesting to note that the Mezzena mandible shows an oral pathology that is frequently observed among both Neanderthals and hunter-gatherer human populations (Tropel, 2004; Webb, 1995). Indeed, the Italian Neanderthals from Grotta Guattari lost all their maxillary teeth *ante-mortem*. Abscesses are also known among Neanderthal fossils such as Forbes' Quarry (Gibraltar) (Iberian peninsula) and Arcy-sur-Cure 9, La Chapelle-aux-Saints 1 and La Ferrassie 1 (France). The Neanderthal of La Chapelle-aux-Saints (France) shows a marked pathological dental condition on its maxilla and mandible (Tappen, 1985). On the mandible only the anterior teeth were present at the time of death and this fossil displays extensive destruction and pathological remodeling of bone similar to that observed in the Mezzena example (Tappen, 1985).

At present, there is no clear etiological diagnosis for the causes of the pulp exposure in the Mezzena mandible. This exposure may have resulted from a traumatic fracture, from a cavity, or from extensive wear on the tooth. All these causes are documented in Neanderthals.

Indeed, traumatic breaks have been observed on fossil teeth and are found on at least two French Neanderthals: Arcy 9 and La Quina 5. For a long time, no cavities were recognized in Pleistocene populations and it is only during the last two decades that cavities have been observed in Neanderthals. Thus, two cavities have been described on two Neanderthal teeth from the same French site (Baud'Aubiesier) (Lebel and Trinkaus, 2000; Trinkaus et al., 2002) and from a Spanish site of Sima de las Palomas and Banyoles (Walker et al., 2011). This may be supplemented by the cavity found in the Levantine Neanderthal from Kebara (Tillier, 1991). In human fossils the only case of polycavities that has been discovered is in the Zambian fossil of Kabwe (Carter, 1928). For this reason, we cannot exclude the possibility that the pathology of the Mezzena specimen was due to a cavity, although we recognize that multiple extensive abrasions are more frequent among Pleistocene humans and, in particular, among Neanderthals. For example, among European Neanderthals they can be found in La Ferrassie 1, Baud'Aubiesier, L'Hortus (France), Banyolas 1 and Gibraltar 1 (Iberian peninsula), as well as among Levantine and eastern Neanderthals (Amud 1 in Israel; Shanidar 1, 3, 4 and 5 in Iraq).

In view of the extensive wear found in particular on Neanderthal teeth and, more generally, on those of hunter-gatherer populations, it would be tempting to support the hypothesis that the loss of the premolar crown on the mandible of Mezzena was most probably caused by dental abrasion.

5. Conclusions

The mandible of a Neanderthal from the Middle Paleolithic site of the Riparo Mezzena presents an osteolytic odontogenetic lesion. This pathology was revealed through X-ray and computerized-tomodensitometric examinations. Similar lesions have been observed among present and sub-contemporary populations and indicate that the lesion of the Mezzena specimen may have been of infectious origin, resulting from a bacterial invasion of the root canal due to coronal pulp exposure. There is no clear etiological diagnosis concerning the causes of the pulp exposition in the Mezzena mandible. Available data known for Pleistocene fossils and, in particular, for Neanderthals, indicate that the etiology of the pulp exposure in the Mezzena Neanderthal mandible may have been due to breakage of the tooth, to a cavity, or to extensive wear.

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Appendix A. Supplementary data

The four figures, Figs. S2 to S5, are supplied as supplementary material with the electronic version of this article, doi:10.1016/j.crpv.2011.08.004.

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