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A Neanderthal Lower Incisor from Cova del Gegant (Sitges, Barcelona, Spain)

Incisivo Inferior Neandertal de la Cova del Gegant (Sitges, Barcelona, España)

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Resumen

La Cova del Gegant está localizada en el término municipal de Sitges (Barcelona, España). La cavidad está desarrollada dentro de una diaclasa en un pequeño sistema kárstico que contiene material paleontológico y arqueológico del Pleistoceno Superior (Daura, *et al*., 2005). El yacimiento fue excavado por primera vez en 1954 y posteriormente en la década de los '70 (Viñas, 1972; Viñas & Villalta, 1975) y '80 (Martínez *et al.*, 1985; Mora, 1988; Martínez *et al.*, 1990). Finalmente desde el 2007 el GRQ ha reiniciado los trabajos arqueológicos (Daura, 2008; Daura *et al.*, 2010). En la primera campaña se recuperó una mandíbula humana que fue objeto de un minucioso análisis y publicada recientemente (Daura *et al*., 2005), esta mandíbula pertenecería a un individuo de la especie Homo neanderthalensis. En este trabajo describimos por primera vez un diente humano que fue recuperado en los trabajos arqueológicos de los años setenta e identificado como tal durante una revisión reciente del material en el año 2010.

El resto es un Incisivo Inferior Lateral Permanente. Su preservación es bastante buena, se conserva la totalidad de la corona, aunque la raíz está rota en su tercio apical. Este hecho hace muy difícil determinar si el diente ya estaba completamente formado o no. En la corona se aprecia un ligero desgaste oclusal inclinado hacia distal, pero sin exposición de dentina, además de una faceta mesial de contacto. La superficie Bucal es curvada y posee una fractura longitudinal en el esmalte. La superficie lingual muestra una forma de pala muy ligera con un ligero tubérculo lingual. La corona está cubierta por unas pequeñas manchas de concreción sedimentaria.

El análisis métrico muestra que este diente es lo suficientemente grande como para pertenecer a la especie neandertal tanto de manera absoluta como relativa (Diámetro Bucolingual=7.71mm; Diámetro Mesiodistal=7.30mm). Para probar esto se realiza una aproximación gráfica y un análisis discriminante. Este último se realiza para tener la probabilidad de asignación a una especie particular.

La asociación de este diente con la mandíbula recuperada previamente es muy difícil debido a la aparente diferencia de edad entre ambos elementos anatómicos. Uno representaría a un adulto (la mandíbula) y el otro representaría a un subadulto de entre 8 y 10 años.

Abstract

Cova del Gegant is located near the city of Sitges (Barcelona, Spain). The cave is a small karst system which contains Upper Pleistocene archaeological and paleontological material (Daura *et al*., 2005). The site was first excavated in 1954 and then in 1972 and 1974- (Viñas, 1972; Viñas & Villalta, 1975) and in 1985 and 1989 (Martínez *et al.*, 1985; Mora, 1988; Martínez *et al.*, 1990). Finally, in 2007, Grup de Recerca del Quaternari has restarted the archaeological research at Cova del Gegant (Daura, 2008; Daura *et al.*, 2010). A human mandible was recovered during the first field season in 1954 and was recently published by Daura *et al.* (2005). In the present study, we describe a new human tooth (left I_2) that appeared, like the mandible, in a revision of the faunal material recovered from the site in 1974-1975. The specimen preserves the entire crown and the cervical two thirds of the root (Figure 1). The lack of

the root apex makes it difficult to determine if the tooth was fully developed at the time of death. However, CT analysis reveals a pulp cavity that could be still open, suggesting root formation was incomplete. The specimen shows only slight dental wear corresponding to stage 2 of Molnar (1971 en Hillson, 1996). Morphologically, the crown shows slight shovelling and a lingual tubercle and appears similar to Neandertal incisors. Standard crown measurements (buccolingual diameter=7.7 mm; mesiodistal diameter= 7.3 mm) (Figure 2) suggest a fairly large tooth, particularly in the BL dimension, again resembling Neandertals in this regard. Discriminant analysis classified the Gegant incisor as Neandertal with a 99.8% posterior probability (Table 2). Association of this tooth with the previously described mandible is considered unlikely given the different ages at death estimated for each. Thus, there appear to be two individuals preserved in the sediments of the Gegant cave, one adult and one subadult (around 8-10 years old).

1. Introduction

The Cova del Gegant site is located in Punta de les Coves (Sitges), some 40 km south of the city of Barcelona. The cave opens directly onto the Mediterranean Sea and it is situated in the seaward edge of Garraf Massif, a low-relief mountain chain composed of Jurassic and Cretaceous limestone and dolomite and one of the most important karstic systems of NE Iberia.

A Neandertal tooth has been recently identified among the faunal remains recovered during the 1974-75 field season. This specimen was not identified until 2010 during a revision of this Pleistocene faunal collection by M. Sanz and J. Daura. The tooth is preserved in Museu de Geologia de Barcelona, as a part of Villalta collection (Gómez-Alba, 1997; Daura & Sanz, 2009). The tooth was found in a storage tray with other isolated, mainly carnivore, dental remains and is labelled with the museum reference V-2028. It was recovered in the GL1 area of the site, the same sediments that yielded the Neandertal mandible (Viñas & Villalta, 1975; Daura *et al.*, 2005; Arsuaga *et al.*, 2011). Although several paleontological and archaeological studies from this collection were developed (Viñas & Villalta, 1975; Estévez, 1978; Alcalde, 1986; López-García *et al.*, 2008; Sánchez, 2005) it was not recognized until 2010. In the present study, we analyze this tooth in order to assess its taxonomic affinities and whether it represents the same individual as the mandible that was published in 2005 (Daura *et al.,* 2005, Arsuaga *et al.,* 2011).

2. Material and methods

The tooth represents a lower left lateral permanent incisor (I_2) (Fig. 1) that preserves the entire crown, but is missing approximately the apical third of the root (preserved total length 26.7 mm, being coronal length 10.8 mm). The root tip appears to have been broken post-mortem, making it difficult to determine whether it had completed its formation at the time of death.

A bivariate scatterplot of buccolingual (BL) and mesiodistal (MD) dimensions and a discriminant analysis were generated to assess taxonomic affinities. The tooth from Gegant was compared with samples of modern humans, Neanderthals and *Homo heidelbergensis* specimens (Table I).

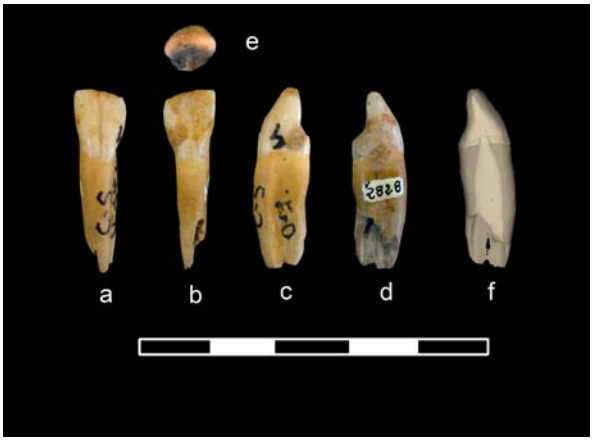

Figure 1. Incisor from the "La Cova del Gegant" in buccal (a), lingual (b), distal (c), mesial (d), and occlusal (e) views as well as a virtual reconstruction (f) in distal view to observe the shape of the pulp cavity. Scale = 5 cm.

- Incisivo de la Cova del Gegant. a)Vista bucal, b) Lingual, c) Distal, d) Mesial, e) Oclusal, f) Reconstrucción virtual en vista distal para observar la forma de la cámara pulpar. Escala 5 cm.

A Computer tomography scanner (CT scan) was performed in order to aid in assessing the developmental stage of the tooth. CT image data were captured with a YXLON Compact (YXLON International X-Ray GmbH**,** Hamburg, Germany) industrial multi-slice computed-tomography scanner, housed at the Universidad de Burgos, Spain. The specimen was aligned along the long axis of the tooth with the crown upwards to obtain cross-sectional slices. Scanning parameters included a scanner energy of 160 kV and 4 mA. Slice thickness was collimated to 0.5 mm, inter-slice spacing was 0.2 mm, and field of view 5.24 mm, reconstruction interval of 0.5 mm. Slices were obtained as a 1024 x 1024 matrix of 32 bit float format with a final pixel size of 0.051 mm and transferred for processing using the commercially available software package Mimics v.10.0 (Materialise, Inc., Belgium).

Table I: Comparative samples used in the present study
- Muestras de comparación usadas en este estudio

Sample	Author	Taxon
CAN med	BERMÚDEZ DE CASTRO, 1986	Modern humans
Mussau Island	KIRCH *et al.*., 1989	Modern humans
Recent Spanish	**Original data N=15	Modern humans
Skühl	MCCOWN & KEITH, 1939 in DAY, 1965	Early Modern humans
Ehringsdorf	DE LUMLEY, 1973	*H. heidelbergensis*
Mauer D	BERMÚDEZ DE CASTRO, 1986	*H. heidelbergensis*
Sima de los Huesos	BERMÚDEZ DE CASTRO, 1986	*H. heidelbergensis*
Arcy-sur –Cure	LEROI-GOURHAN (1958); BAILEY & HUBLIN (2006)	*H. neanderthalensis*
Circé	SERGI AND ASCENZI, 1955	*H. neanderthalensis*
Combe Grenal	GARRALDA AND VANDERMEERSH, 2000	*H. neanderthalensis*
Cova Negra	ARSUAGA *et al.* (2007)	*H. neanderthalensis*
Genay	DE LUMLEY (1973)	*H. neanderthalensis*
Kebara	TILLIER (1991)	*H. neanderthalensis*
Krapina	WOLPOFF (1976)	*H. neanderthalensis*
Le Moustier	BILSBOROUGH & THOMPSON (2005)	*H. neanderthalensis*
Shanidar	TRINKAUS (1983)	*H. neanderthalensis*
Sidron	**Original data N=3	*H. neanderthalensis*
Sima de las Palomas	JMBC[a]	*H. neanderthalensis*
Sipka	JMBC[a]	*H. neanderthalensis*
Spy	DE LUMLEY (1973)	*H. neanderthalensis*
Subalyuk	PAP ET AL. (1996)	*H. neanderthalensis*
Tabún	MCCOWN & KEITH, 1939 in DAY, 1965	*H. neanderthalensis*
Valdegoba	QUAM *et al.* (2000)	*H. neanderthalensis*
Vindija	WOLPOFF (1981)	*H. neanderthalensis*

**Original specimens measured by the authors.
**Especimenes originales medidos por los autores
[a] Data provided by J. M. Bermúdez de Castro.
[a] Datos obtenidos gracias a la aportación de J.M. Bermúdez de Castro

3. Results

The specimen shows no sign of pathology. The lingual surface shows very slight shovelling (ASUDAS grade 1), with slight development of the mesial and distal marginal ridges, and a slight lingual tubercle. The buccal surface of the crown is vertically convex. The root shows moderate mesial and marked distal grooves that become wider towards the root apex, although only a single pulp chamber is present. The tooth shows slight distally sloping occlusal attrition without exposure of the dentine, corresponding to wear stage 1 of Molnar (1971), and a small mesial contact facet is present. The buccal surface is curved with a longitudinal crack running from the cervix to the incisal margin. The lingual surface is covered by small spots of sedimentary concretion (Fig. 1). Unfortunately, due to the poor preservation of the enamel surface at the microscopic level, nothing can be said about handedness or diet.

3.1. *Metrical analyses*

Because it is well known that anterior teeth in neandertals are absolute and relatively bigger than in modern humans (Trinkaus, 1983), the size of the anterior teeth can aid in assessing the taxonomic affinities of a human tooth within a European Pleistocene context. We have measured the BL (7.7 mm) and MD (7.3 mm) crown diameters for comparison with living and fossil human taxa (Table I for comparative samples, and Table II for basic statistics).

Its position in the scatterplot (Fig. 2) shows that the Gegant tooth falls well inside the range of variation of *H. neanderthalensis* and *H. heidelbergensis*. Discriminant analysis of these same two variables considering only Neandertals and modern humans (due to the upper Pleistocene age of the Gegant specimen) classifies the Gegant tooth as a Neandertal with a 99.8% posterior probability (Table III for discriminant function and matrix).

Table II: Basic statistics of dental diameters in *H. sapiens* and *H. neanderthalensis populations* and The Cova del Gegant incisor ones. Measurements in mm.
- Estadísticos básicos para los diámetros dentales de las poblaciones de *H. sapiens* y *H. neanderthalensis* y valores del Incisivo de la Cova del Gegant. Medidas en mm.

		Valid N	Mean	Minimum	Maximum	Std.Dev.
H. sapiens	DIAM. MD	18	5,6	4.9	6.2	0.41
	DIAM BL	18	6.1	5.4	7	0.42
H. neanderthalensis	DIAM. MD	44	6.6	5	7.5	0.62
	DIAM BL	44	7.8	6.8	9	0.51
El Gegant	DIAM. MD	1	7.31			
	DIAM BL	1	7.71			

Tabla III. Matriz y función de clasificación para el análisis discriminante realizado.
- Clasification matrix and function for the discriminant analysis

Clasification function	G_1:1	G_2:2	
DIAM. MD	9.1351	9.3	
DIAM BL	20.7336	27.892	
Constant	-90.0964	-139.993	
Clasification matrix	**Percent**	**G_1:1**	**G_2:2**
G_1:1	94.44444	17	1
G_2:2	97.72727	1	43
Total	96.77419	18	44

4. Discussion and conclusions

One of the most important items in this work, it is not only to know who the human we are studing is, but also to know how old he/she was and if there is some pathological sign that could tell us which is the death cause. It is known that neandertals have a different development that modern humans (faster development), that means that with the same erupted teeth, neandertals are younger than modern humans. So, sometimes, age at death is giving following modern human patterns which it is not very accurate. But, although a lot of investigations have been done with molars and development (Dean *et al*., 1986 and Tompkings, 1996, as some pioneers examples), nothing is done with incisors.

Due to this fact, in the present study, we are going to make reference to modern human pattern, although we know that we are in some kind of error always giving more age to our specimen, and that someday we will have to change the age.

In this sense, and considering the slight incisal wear we suggest that this tooth belonged to a subadult individual. We follow Bermúdez de Castro *et al.,* 2003 protocol which they have used for *Homo antecessor*. If lower incisors begin to wear at 7.0 and 7.5 years, for I_1 and I_2 respectively, then this little wear can tell us that the individual was at least 8 and around 10 years old. Elsemore, CT images (Figura 1f) show a thinning in the cement in the preserved distal portion of the root that suggests the pulp cavity was still open and root formation was incomplete. Relying on this, the estimated age at death would fall between 8-10 years following modern human standards (Schour & Massler, 1941 in Hillson, 1996). In a macroscopic analysis this tooth is very similar in development and wear to that of Le Moustier 1 who is around 10 years old (with corrected methods). So although we are conscient to be making some mistake, it does not look to be very important.

Taking into account that in this same site (Cova del Gegant) appeared an adult mandible (Arsuaga *et al.,* 2007) with all the alveolus completely developed, in this paper we present a younger second individual.

So the present study has described a human tooth from Gegant cave and assessed its taxonomic affinities. The specimen represents a Neandertal individual, that cannot be associated with the previously described mandible from the site. The Gegant mandible represents an adult individual with M_2 and (probably) M_3 erupted at the time of death. If the root apex in Gegant incisor is not fully formed, and considering its slight wear and mesial contact facet, this suggests the tooth belongs to a second individual from the site, who was younger at the time of death, perhaps around 10 years old.

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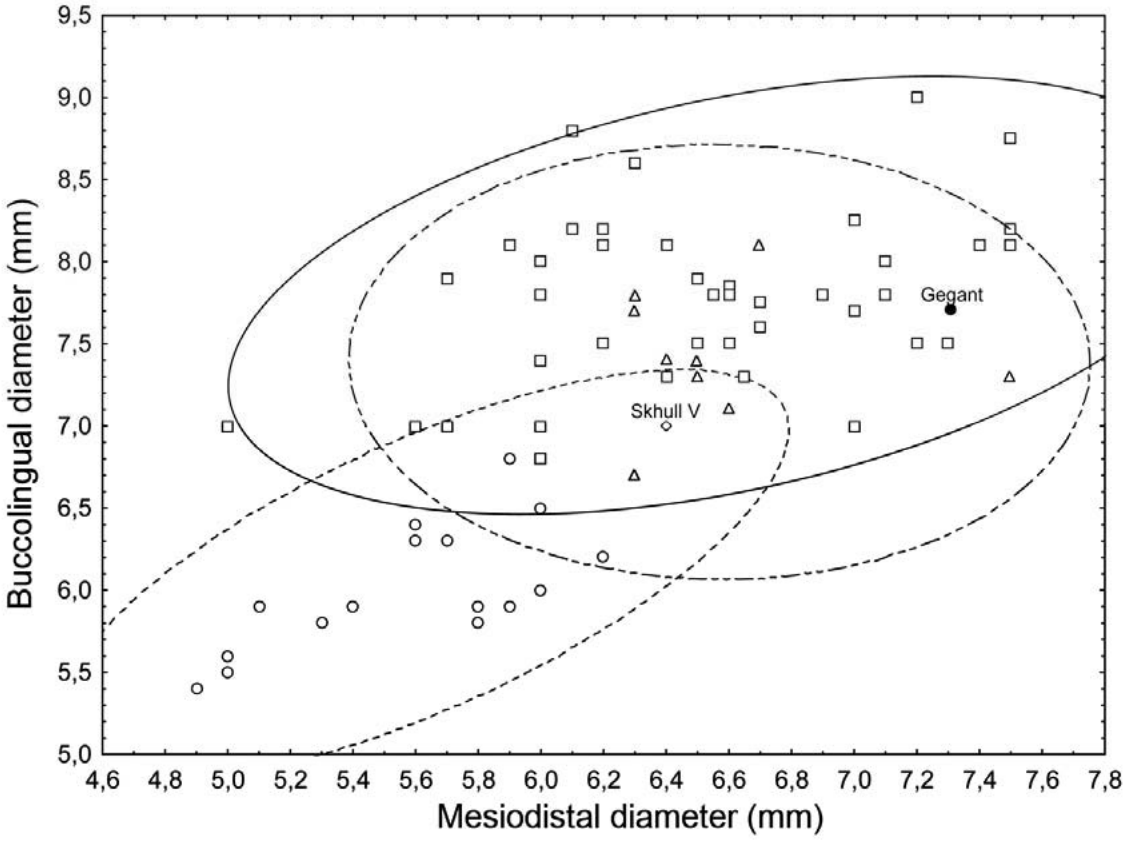

Figure 2. Bivariate scatterplot of the mesiodistal and buccolingual diameters in *H. neanderthalensis* (open squares), *H. heidelbergensis* (open triangles), recent *H. sapiens* (open circles), Pleistocene *H. sapiens* (open diamond) and Gegant (solid circle) and 95% equiprobability ellipses for *H. neanderthalensis* (continuous line), *H. heidelbergensis* (discontinuous line), and recent *H. sapiens* (dotted line).

- Gráfico de dispersión de los diámetros de los dientes en las muestras del estudio (MDD: diámetro mesio-distal, BLD: diámetro buco-lingual). *H. neanderthalensis (*cuadrados vacíos*)*, *H. heidelbergensis (*triangulos vacios*)*, humano moderno (círculos vacíos). *H.sapiens Pleistocenos (*rombos vacíos*). Gegant,* círculo macizo. Elipses al 95% of equiprobabilidad: Línea contínua: *Homo neanderthalensis*, Línea discontinua *H.heidelbergensis*, línea de puntos Humanos modernos.

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