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The Morphological description of the Dental Remains from the Early Paleolithic site of Dmanisi (Georgia)

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Abstract

The early Paleolithic site of Dmanisi was discovered in 1983, situated in the environs of the medieval town of Dmanisi, placed on the promontory formed by the confluence of the Mashavera and Pinezauri rivers (Gabunia *et.al.*, 2000). The main objective of the study was to perform the morphological description of the complete inventory of Dmanisi hominin dental remains, as it had never been done before. This would help to characterize morphologically dentition of the Dmanisi hominins and make a general comparison with other hominin dentitions to deepen the knowledge of their taxonomic and phylogenetic status. Analyses showed that Dmanisi hominins are morphologically closer to the African Plio-Pleistocene hominids than to the other representatives out of Africa and they share both traits - primitive and derived ones, but the primitive features are in majority. These hominin fossils represent the first evidence of human presence out of Africa, yielding an age of 1.77 m.a. (Gabunia and Vekua, 1995).

Keywords: Paleolithic, Hominin, Teeth, Dmanisi.

Introduction

The early Paleolithic site of Dmanisi was discovered in 1983, near the deserted medieval town of Dmanisi. In the lowest stratigraphical levels are found hominin skulls and mandibles together with postcranial remains, yielding an age of 1.77 m.a. ($^{40}Ar/^{39}Ar$), and representing the first evidence of human presence out of Africa (Gabunia and Vekua, 1995; Lordkipanidze *et al.*, 2006).

The main objective of the study was to perform the morphological description of the complete inventory of Dmanisi hominin dental remains, as it had never been done before.

This would help to characterize morphologically dentition of the Dmanisi hominins and make a general comparison with other hominin dentitions to deepen the knowledge of their taxonomic and phylogenetic status.

Methods

The method of our study was the visual observation. The first steps for the observation of the teeth were done by Hrdlička (1920) describing the main traits of the incisors, later in the middle of the 20th century Dahlberg (1971) developed the scale for describing Carabelli's cusp and Protostylid. Definitely this was not enough for the dental morphological studies, so the Dental Anthropology Department of Arizona State University (ASUDAS – Arizona State University Dental Anthropology System) developed the 23 rank-scaled reference plaques for the full description of the 36 dental and root traits, which is fully defined and illustrated in Turner *et al.* (1991).

In 2006 some more description of dental traits were added by Martinón-Torres and also was completed the plaques of ASUDAS itself because the modern human anatomy doesn't show us the severe forms of different dental traits

that are often met in the past populations like Neanderthals or Heidelbergensis.

The methods that we used to study the teeth were odontoscopy (visual studies and morphological description) – that contains definition of the generation (deciduous or permanent), class, side and norms (vestibular, lingual, distal, mesial and occlusal) of the teeth.

In each of these norms must be described several characteristics, like: structural forms – form of the surface of the crown, forms of the cusps of the occlusal surface, curving of the roots; Number of the morphological formations; Number of the particularity of the structure; Disposition of the dental formations; Disposition of the structures in the correspondence of between each other; Sizes and levels of development of the morphological structures (e.g. Carabelly Cusp). In each of the norms was emphasized the position of the cement-enamel boarder and described the relief of the occlusal surface (Dmitrienko *et al.,* 2000).

We also use the odontometrical studies measuring the height of the tooth, vestibule-lingual size (diameter) of the crown and mesio-distal size (diameter) of the crown. In our case we used the measurement of the mesiodistal (MD) and buccolingual (BL) dimensions taken to the nearest 0.1mm by J.M. Bermúdez de Castro following the techniques of Flechier, Lefêvre and Verdéne. The materials of our study are the dentition of the hominin remains from Dmanisi site (Tab. 1).

Results and Discussion

Among Dmanisi fossils, D211 mandible exhibits some primitive traits typical of early Homo (Gabunia *et al*., 2001), like a long and narrow dental arcade of **U**-shape (Fig. 1).

Regarding the dental evidence, the derived traits of this mandible are the molar size reduction form M1 to M3 and P4 talonid reduction, resulting in the derived P3>P4 size sequence (Rosas and Bermúdez de Castro, 1998).

According to Gabunia (Gabunia *et al.,* 2001), also, the protolstylid complex is removed.

According to the analysis, the Dmanisi hominins are morphologically closer to the African Plio-Pleistocene hominins in concordance with Martinón-Torres results (Martinón-Torre, 2006).

This fact would be supported by the remarkably smaller size of the UI2 when compared to the UI1, which is considered a primitive trait typical of Australopithecines (Aiello and Dean, 1999).

Interestingly, in European species, like *Homo neanderthalensis*, upper incisors tend to increase their size (Wolpoff, 1971) and also develop "mass-additive" traits (Irish, 1997) like dental tubercles and strong shovel shape in very high frequencies. In addition, the UI2 develops the "classical shovel shape" (Martinón-Torres, 2006), typical of Plio-Pleistocene hominins (Fig 2).

The huge canines, with the very well developed essential lobe and highly distinguished distal and mesial marginal ridges forming a free apex on the distal edge of the occlusal surface are characteristic of primitive species like those from the genus Australopithecus and *H. habilis* (Tobias, 1991), one more prove of the Dmanisi hominins early origin. It is also interesting to emphasize the development of a strong cingulum (Fig. 1) in the buccal surface of canines and premolars of Dmanisi hominins, a primitive trait that only will be lost in the last stages of human

	D211md	**D2600**md	**D2735**md	**D2282**mx	**D2700**mx	**Isolated teeth belonging to D2700 and D2735**
RI1	+	+	-	-	-	URI1 D2736
LI1	+	+	-	-	-	
RI2	+	+	-	-	-	LRI2 D2854
LI2	+	+	-	-	-	ULI2 D2677 / LLI2 D3698
RC	+	+	-	-	-	URC D2732 / LRC D2678
LC	+	+	-	-	-	LLC 2723
RP3	+	+	+	-	-	URP3 D3672
LP3	+	+	+	-	-	
RP4	+	-	+	+	+	
LP4	+	-	+	-	+	
RM1	+	+	+	+	+	
LM1	+	-	+	+	-	ULM1 2710
RM2	+	+	+	-	+	
LM2	+	+	+	+	+	
RM3	+	+	Just the follicle stitch	Just the follicle stitch	-	URM3 D2711
LM3	+	+	Not erupted	Just the follicle stitch	+	

Tab. 1. List of Dmanisi Dental remains. Underlined letters show the definition of the jaws (upper or lower), letters without underline define the side of the tooth and the class (left or right, incisor, canine, premolar or molar); md – mandible; mx – maxilla.

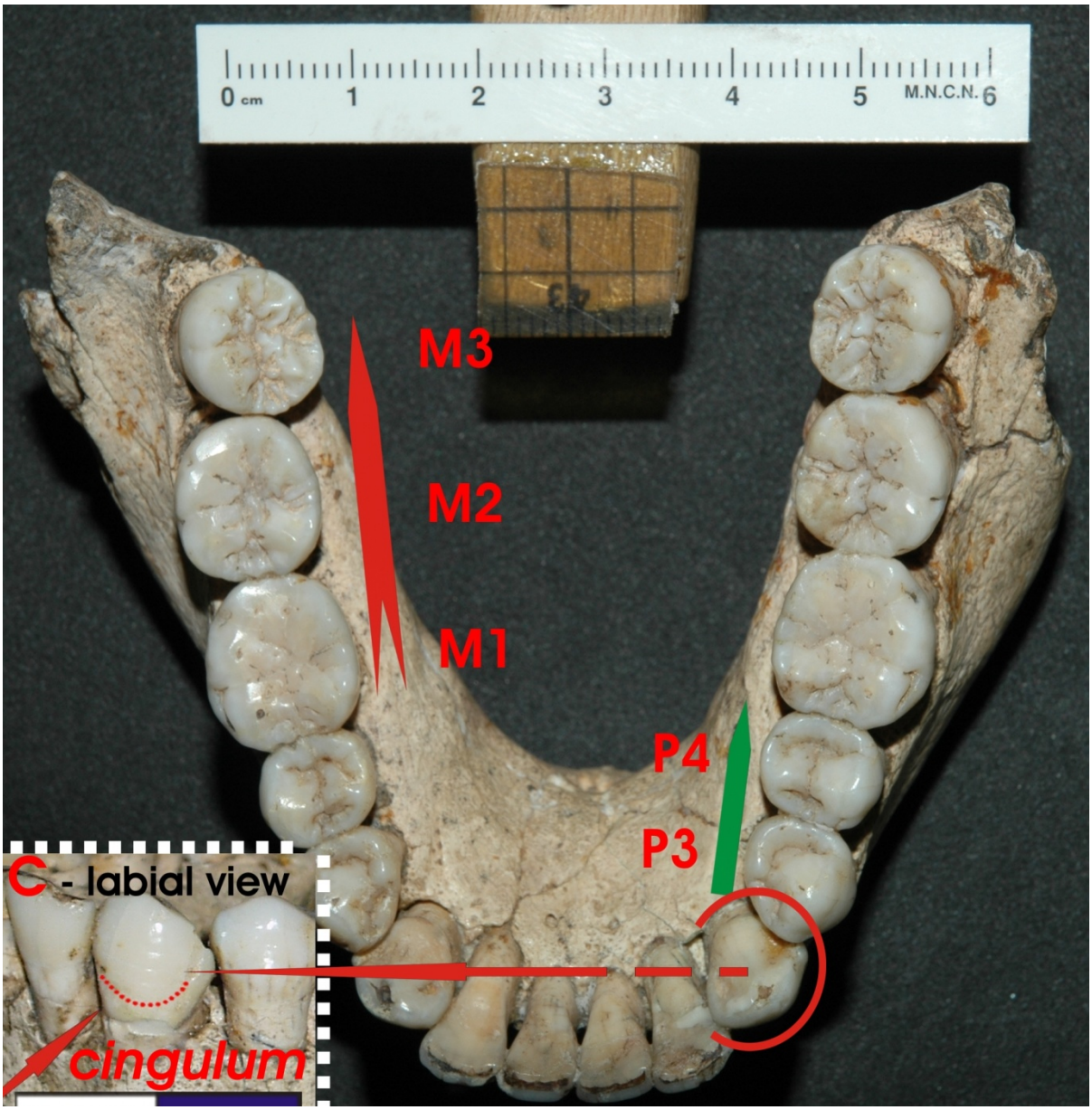

Fig. 1. Mandible D211. M1>M3 size reduction. Premolar talonid reduction. Cingulum on the Canine.

Fig. 2. The "classical shovel-shape" Upper Left I2 – D2677.

evolution, in *H. neanderthalensis* and *H. sapiens* species. Posterior teeth also present primitive features: strongly assymetrical premolars with wide occlusal polygon, additional lingual cusps (Martinón-Torres *et al.*, 2006), and the bifurcated buccal essential ridges of the upper premolars. It is surprising to find in these hominins a size reduction from M1 to M3 (M1>M2>M3), considered a derived trait in genus Homo (Bermúdez de Castro and Nicolás, 1997) (Table 2). As we can see, the M1>M2 sequence is a trait that already appears in some Middle Pleistocene hominins although it is infrequent (OH-22, Rabat, Atapuerca-SH and Asian H. erectus from Zhoukoudian) (Rosas and Bermúdez de Castro, 1998).

M3 reduction is also a trait that appears very early in the hominin fossil record in some specimens such as OH-16, KNM-ER 806, KNM-ER 730 and KNM-ER 730 (Rosas and Bermúdez

Features	*Dmanisi Hominids*
Shovel-shaped upper incisors: 0-presence; 1-absence	0
Relative BL dimensions of the mandibular incisors and canines: 0-broad 1-narrow	0 and 1
Absolute MD dimension of the mandibular canines: 0-long 1-shortened	0
Cingulum in mandibular canines and premolars: 0-presence 1-absence	0
Crown shape of the mandibular P3: 0-strongly asymmetrical 1-symmetrical or moderately symmetrical	0
Relative BL dimension of the mandibular P3: 0-broad 1-narrow	1
Talonid of the mandibular P3: 0-well developed 1-small or absent	0
Mandibular premolar root morphology: 1 – 2R:MB+D; 2 – 2R:M+D; 3 – 2R:MB+DL; 4 – 2T; 5 – 1T; 6 – 1R.	1(D2600) and 6 (D211, D2735).
Mandibular P3/P4 size sequencefor the crown area: 0 – P4>P3; 1 – P4<P3; 2 – P4=P3.	0 (D2735)and 1 (D211)
Mandibular M1/M2 size sequence for the crown area: 0 – M1<M2; 1 – M1>=M2.	1
Mandibular M1/M3 size sequence for the crown area: 0 – M1<M3; 1 – M1>=M3.	1
Maxillary M1/M2 size sequence for the crown area: 0 – M1<M2; 1 – M1>M2.	0 (D2700)and 1(D2282)
Hypoconulid in the mandibular M1 and M2: 0 – present and well developed; 1 – reduced in size and/or incidentally absent; 2 – frequently absent in M2 and less so in M1.	0
Relative BL dimensionof the mandibular M1: 0 – relatively broad; 1 – relatively narrow.	0
Taurodontism: 0 – presence; aurodontism or radicular taurodontism; 2 – absence.	2

Tab. 2. State of some dental features in the Dmanisi Hominids, described by Margvelashvili, on the basis of Bermúdez de Castro & Nicolás 1999.

de Castro, 1998) (Table 3) and several individuals assigned to *Homo erectus* and *Homo antecessor* (Martinón-Torres, 2006). Dmanisi hominins would represent the earliest evidence of molar reduction in all the hominin fossil record. Still, their molars express accessory cusps, profuse enamel crenulations and a mid-trigonid crest that are in concordance with their primitive origin.

	Modern humans % range	**Early Homo *N* %**		**Dmanisi *N* %**	
M1 Hypoconulid	54,0-100,0	11	100,0%	3	100,0%
C6	0,0-65,0	11	0,0%	3	?-wear degree
C7	0,0-34,6	11	27,3%	3	75,0% - 25% -? Wear degree
M2 Hypoconulid	0,0-62,0	6	100,0%	3	100,0%
C6	0,0-47,0	6	25,0%	3	?-wear degree
C7	0,0-29,7	6	50,0%	3	75,0% - 25% -? Wear degree
M3 Hypoconulid	15,6-84,4	9	100,0%	2	100,0% - 25% -? Wear degree
C6	0,0-50,0	9	35,0%	2	50,0%25% -? Wear degree
C7	0,0-7,0	9	22,0%	2	50,0%25% -? Wear degree

Tab. 3. Indices (in %) of Hypoconulid, C6 and C7 (Bermúdez de Castro, 1992).

The protostylid is also more frequent in early hominid species like those from the genus Australopithecus than in later Homo species. It is important to emphasize that despite the decrescent molar series, Dmanisi hominins do not present the reduction of cusp number or simplified posterior teeth that is characteristic of *H. sapiens* and hominins from the *H. heidelbergensis/neanderthalensis* lineage (Bermúdez de Castro and Nicolás, 1995; Martinón-Torres, 2006; Martinón-Torres *et al.,* 2006) (Tables 2 and 3). Dental roots have an important function of supporting the tooth crown. Paranthropus and Australopithecus show high incidence of two distinct mesial and distal roots with a buccal and a lingual interradicular process each (Robinson, 1956; Sperber, 1974; Wood *et al*., 1988; Bermúdez de Castro *et al.,* 1999).

Modern humans are basically single-rooted with some variants possibilities (Scott and Turner, 1997).

In this context, is worthy to mention the impressive feature of the D2600 specimen, which shows double-rooted lower P3, characteristic of Paranthropus and *H. rudolfensis* specimens (Table 4**).** This root morphology is very "molarized" with a very divergent and early bifurcation in the cervical third (Fig. 3). The large sized canines, P3 with a talonid and oblique orientation of the principal axis, two clearly individualized roots from the neck (mesial and distal root) distinguish D2600 from the rest of the hominins (Gabunia *et al*., 2002).

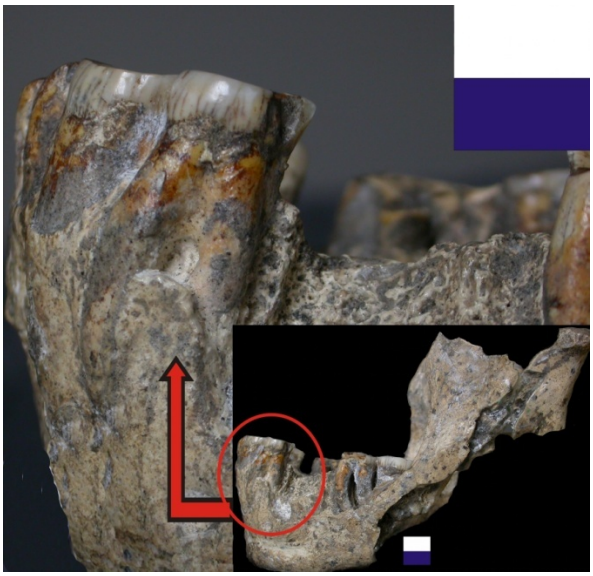

Fig.3: Mandible D2600 with double-rooted Left P3.

Conclusion

Dmanisi hominins share both traits - primitive and derived ones, but the primitive features are in majority, so that we can conclude that morphologically they are closer to the African Plio-Pleistocene species than any other representatives form Eurasia.

Specimen		1R	1T	2T	2R:	2R: MB+D	2R: M+D
A. afarensis	P3		*			*	
	P4						+
A. africanus	P3			*		*	
	P4					+	
P. robustus	P3			*			*
	P4					+	+
P. boisei	P3					*	*
	P4						+
H. rudolfensis	P3			*		*	*
	P4						+
H. habilis s.s.	P3	*	*			*	
	P4	+	+				+
H. ergaster	P3	*		*		*	
	P4	+					+
TD6 H1	P3				*		
	P4				+		
H. heidelberg.	P3	*	*				
	P4	+					
H. erectus	P3	*	*	*			
	P4	+	+				
D2600	P3			*			*
	P4						

Tab. 4. Premolar root form in hominids By J.M. Bermúdez de Castro, A Rosas and M.E. Nicolás, 1999 (D2600 added by Margvelashvili).
* - indicates presence of the marked roots on P3
+- indicated presence of the marked roots on P4
1T (single Tomes' root); 1R (singe root); 1T category includes the specimens with at least one groove or cleft on the mesiolingual surface, which does not lead to bifurcation (or is restricted to the periapical region). The root of these teeth has two components with independent pulp canals. The 1T is considered to be an intermediate stage between Tomes' root (2T) and single root. ; 2T (Tome's root) (Bermúdez de Castro,Rosas & Nicolás, 1999).

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