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ARTICLE / *ARTICLE*

The presacral spine of the La Ferrassie 1 Neandertal: a revised inventory

La colonne vertébrale présacrée du Néandertalien La Ferrassie 1 : un nouvel inventaire

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Abstract This contribution provides a detailed inventory and description of the presacral vertebrae attributed to the La Ferrassie 1 Neandertal, including substantial photographic documentation. Several errors in the reconstruction of these vertebrae have been noted. Furthermore, one of the thoracic vertebrae probably belonged to the La Ferrassie 2 female individual. In light of these results, caution is recommended in future analyses of the La Ferrassie 1 vertebral column.

Keywords Vertebrae · Cervical · Thoracic · Lumbar · *Homo neanderthalensis* · La Ferrassie 1 · La Ferrassie 2 · Anatomical determination

Résumé Cette étude inventorie et décrit de façon détaillée les vertèbres présacrées attribuées au Néandertalien La Ferrassie 1. Elle inclut aussi une importante documentation photographique. Nous mettons en évidence quelques erreurs dans la reconstruction de ces vertèbres. De plus, l'une des vertèbres thoraciques appartenait probablement à l'individu féminin La Ferrassie 2. À la lumière de ces résultats, nous recommandons la prudence lors d'analyses futures de la colonne vertébrale de La Ferrassie 1.

Mots clés Vertèbres · Cervicale · Thoracique · Lombaire · *Homo neanderthalensis* · La Ferrassie 1 · La Ferrassie 2 · Détermination anatomique

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Introduction

The study of the vertebral column and thorax in fossil hominins is hampered by various difficulties. First, these elements are fragile and therefore the fossil record is less abundant compared to other anatomical regions. Second, both vertebrae and ribs are metameric elements, i.e., they are seriated and repeated, which makes determining their precise anatomical position difficult. Third, many skeletal collections have been obtained from dissection rooms and tend to be of older individuals, which makes it difficult to amass reasonably sized comparative samples comprising measurements from complete, pathology-free bones. All these difficulties have resulted in less research on these anatomical elements and a vision of vertebrae and ribs as being less informative. This is reflected in the published monographs in which these elements are restricted to marginal chapters with just inventories or a very basic metric description, which is in stark contrast to the efforts devoted to other postcranial regions, such as long bones.

The Neandertals present a special case as there is a relatively abundant record of vertebrae and ribs compared to other fossil hominins, in part due to their mortuary practices (see [1] for a review) which has allowed the recovery of relatively well-preserved skeletons. In fact, the 1856 Feldhofer individual preserved five ribs [2] and the first Neandertal vertebrae were found in Spy in 1886 [3]. However, the study of the Neandertal spine and thorax have been the subject of debate as to whether or not there are significant differences between this species and modern humans. In the case of the spine, the view has changed since M. Boule [4] proposed that Neandertals were primitive and possessed a less curved spine based on his study of La Chapelle-aux-Saints. The view that prevailed during the second half of the 20th century proposed that the Neandertal spine is similar to that of modern humans, at the robust end of the range of modern variation [5,6].

The reassessment of key Neandertal specimens, starting with Kebara 2, is providing evidence of significant

differences between Neandertals and modern humans in both the morphology of the vertebrae and the posture of the spine. In fact, Neandertals had less lumbar lordosis but, contrary to Boule's vision, this is a derived feature present in the Neandertal lineage [7–12]. There is, however, a need to review and re-study the Neandertal individuals which were first recovered some time ago. In fact, the reassessment of the postcranial axial skeleton in some Neandertal individuals has resulted in the detection of errors in reconstruction and/or anatomical determination [13–16, see 17 for an example in other fossil hominins]. This re-evaluation is providing more accurate inventories which are a necessary preliminary step before attempting metric or paleopathological studies.

Objectives

A recent reassessment of the postcranium of La Ferrassie 1 (LF1) has resulted in: 1) the detection of wrongly refitted vertebral specimens; and 2) the identification of one element belonging to La Ferrassie 2. Thus the main objective of this article is to thoroughly re-evaluate the presacral vertebral remains of LF1, present an up-to-date inventory and provide photographic documentation for all the presacral vertebral elements.

Materials and methods

For a more in-depth review of the site of La Ferrassie and the discovery of LF1, see [18–21] and the references therein. LF1 is a nearly complete skeleton that preserves all anatomical regions. It has been determined to be male based on its greater sciatic notch and to have died when he was between 40 and 55 years [18–20]. All the vertebral elements curated in boxes numbered 37 and 38 at the Muséum national d'Histoire naturelle (MNHN, Paris, France) have been studied (Figs. 1 and 2). These two boxes include all the presacral vertebrae attributed to LF1, as well as his first coccygeal vertebra. These two boxes contain 30 large vertebral fragments, which were studied by Heim [18]. There are another 20 smaller fragments, most of them unidentifiable, that are not considered here. Some of the presacral specimens have been labelled with a number indicating their position within the presacral column, in which "1" would indicate the 1st cervical vertebra (C1) and "24" would indicate the 24th presacral vertebra (i.e., the fifth lumbar – L5).

Due to the errors in the anatomical determination of LF1's vertebrae and the fact that not all the vertebral specimens were labelled, the most important fragments curated in boxes numbered 37 and 38 have been "virtually labelled", using a system independent of the anatomical determination of the individual

Fig. 1 Box 37. The letters after the "#" to the top left of each fossil correspond to the (new) "virtual" labelling system. The numbers to the lower right correspond to the physical (traditional) label. This box holds all the cervical and some of the thoracic vertebrae / *Boîte n° 37. Les lettres qui suivent le « # » en haut à gauche de chaque fossile représentent l'étiquetage « virtuel ». Les numéros en bas à droite représentent l'étiquette physique. Cette boîte conserve toutes les vertèbres cervicales et une partie des vertèbres thoraciques*

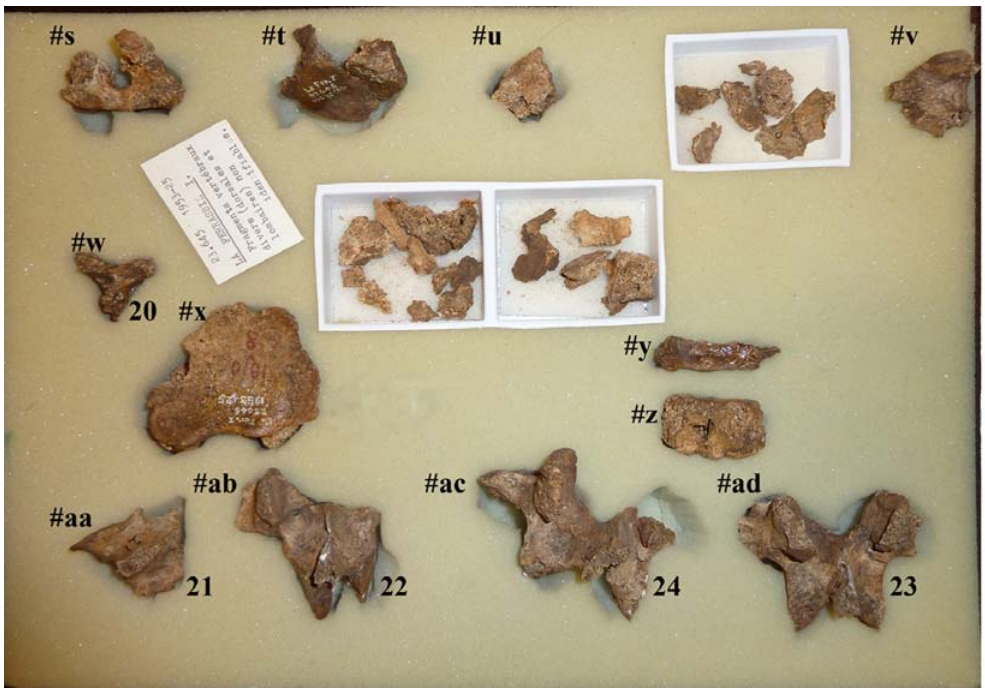

Fig. 2 Box 38. The letters after the "#" to the top left of each fossil correspond to the (new) "virtual" labelling system. The numbers to the lower right correspond to the physical (traditional) label. This box holds some of the thoracic, all the lumbar and the first coccygeal vertebra / *Boîte n° 38. Les lettres qui suivent le « # » en haut à gauche de chaque fossile représentent l'étiquetage « virtuel ». Cette boîte conserve une partie des vertèbres thoraciques, toutes les vertèbres lombaires et la première vertèbre coccygienne*

vertebrae. This virtual labelling has been achieved using a letter from #a to #ad following the order in the boxes. For example, the third cervical of La Ferrassie 1 has a "3" labelled on the cranial surface of the vertebral body, and due to its position, it has been virtually labelled with a "#d" in the box. It should be noted that the most complete vertebrae are composed of different fragments. In fact, in certain cases the relative position of the different fragments that compose each of the fossils is affected by taphonomic distortion or by incorrect reconstruction. In some instances, each of these fragments will be referred to by adding a number to the general letter of the specimen. For example, the vertebra "virtually" labelled as "#t" is composed of two fragments (#t1 and #t2) that do not belong to the same vertebra (see below).

Some of these vertebrae have been reconstructed using one or more chemical products. In some cases this was glue, but wax/plaster has also been used to reconstruct missing parts. The MNHN does not keep a record of the exact chemical product used for the reconstruction. Additionally, some of the vertebrae have also suffered from the moulding process performed to obtain replicas, which has filled some of the exposed trabeculae with silicone.

Anatomical determination

First, the most diagnostic presacral vertebrae (C1, C2, C7, T12 and L5) have been identified [22]. The relative seriation has relied on modern complete skeletons, a high quality cast of the vertebral column of the Neandertal Kebara 2 (also curated at the MNHN), and osteometric measurements taken from the original skeleton of Kebara 2 and from modern collections curated at the Cleveland Museum Natural History (Cleveland, USA) and the University of Iowa (Iowa City, USA). Regarding the presacral spine, it is assumed that LF1 had 7 cervicals, 12 thoracic and 5 lumbars, which is the modal number of vertebrae in modern humans and is the number of vertebrae present in the most complete Neandertal spine (Kebara 2) [6].

Previous and present inventories of the presacral vertebral remains of La Ferrassie 1

Heim [17] provided a first inventory in which he described the presence of all the 7 cervicals, 11 or 12 thoracics and 5 lumbars. He provided measurements of the ventral height of the vertebral body in the C3–T3 segment and the orientation of the spinous process in the C3–T1 segment. He also described the fragmented sacrum, in which four sacral vertebrae (S1–S4) are recognized. A more recent assessment of the bilateral periostitis present in this individual also provided information about the spine. It was reported to include

Table 1 Complete inventory of the vertebral remains curated in boxes 37 and 38 at the MNHN and attributed to La Ferrassie 1, including the anatomical preservation of all the fragments / *Inventaire complet des restes vertébraux conservés dans les boîtes 37 et 38 au MNHN et attribués à La Ferrassie 1, y compris la préservation anatomique de tous les fragments.*

Virtual label	Physical label	Anatomical position (Heim, 1976)	Current anatomical position	Individual	Vertebral body/ Anterior arch	Pedicle		Transverse process		Upper articular facet		Lower articular facet		Lamina		Spinous process/ Posterior arch
						Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	
#a		C1	C1	LF1	C				C	C	C	C	C	-	-	P
#b	2	C2	C2	LF1	C*	-	-			P	P	C	C	P	C	C
#d	3	C3	C3	LF1	C	C	P			C	C	C	C	C	C	C
#c	4	C4	C4	LF1	C	C	P			C	C	C	C	C	C	C
#e	5	C5	C5	LF1	C	P	C			C	C	C	C	C	C	C
#f	6	C6	C6	LF1	P	C	C			C	C	C	C	C	C	C
#g	7	C7	C7	LF1	P		P			P	C	C	C	C	C	C
#h	8	T1	T1	LF1	P	C	C			C	C	C	C	C	C	C
#i	9	T2	T2	LF1	P	P	C	C	P	C	C	C	C	C	C	C
#j	10	T3	T3	LF1	P	P	P	C			C	C		P	P	P
#k1	11	T4	T4?	LF1	P											
#k2	11	T4	T5–T11	LF1			C				C					
#k3+k4 +k5	11	T4	T4?	LF1					P				C		C	C
#l	12	T5	T1–T4	LF2				P				C	C	C	C	
#p	13	T6	T9?	LF1									C	P	C	P
#m			T5–T8	LF1	P											
#q	14	T7	T5–T8	LF1	P					C		C	C	C	C	C
#z			T7–T8?	LF1	P											
#s1			T9	LF1	P											
#s2			T	LF1?		P				C						
#o	15	T8	T10?	LF1											P	P
#u			T10? (or T11)	LF1	P		P									
#n	17		T11?	LF1									P		P	C
#r	#19	T12	T12	LF1	P	P							P		C	P
#t1			T12?	LF1	P											
#t2			L1?	LF1	P											
#w	#20	L1	L1	LF1										C	C	P

(Suite page suivante)

Table 1 *(suite)*

Virtual label	Physical label	Anatomical position (Heim, 1976)	Current anatomical position	Individual	Vertebral body/ Anterior arch	Pedicle		Transverse process		Upper articular facet		Lower articular facet		Lamina		Spinous process/ Posterior arch
						Right	Left	Right	Left	Right	Left	Right	Left	Right	Left	
#x		L2/L3	L3?	LF1	C											
#aa	#21	L2	L2	LF1								C	C	C	C	P
#ab	#22	L3	L3	LF1			P		P		C	C	C	C	C	P
#ad	#23	L4	L4	LF1		P	P	P	P	C	C	C	C	C	C	P
#v			L5	LF1	P	R		P		P						
#ac	#24	L5	L5	LF1			P		P	P	C	C	C	C	C	P

*Dens also virtually complete; C, Complete or nearly complete; P, Partial.

"23 or 24 pre-sacral vertebrae with damage to the thoracic and lumbar segments, four pieces of the sacrum, the first coccygeal vertebra" [20]: 986).

Table 1 summarizes the anatomical identification of all the vertebral specimens attributed to LF1. All the cervical vertebrae (C1–C7) are represented in LF1, as well as all the lumbar vertebrae (L1–L5), four out of five sacral vertebrae (S1–S4) and the first coccygeal vertebra (note that the sacrum is not described in this contribution), as noted in previous inventories. Discrepancies with previous inventories are related only to the thoracic segment. Based on the vertebral bodies present, there are 10 thoracic vertebrae represented: T1–T4, T12 and another five elements between T5 and T11. Based on the neural arches, nine thoracics are represented: T1–T4, T10–T12 and another two between T5 and T9. The smaller-sized vertebral fragments that are present in the two boxes have not been taken into consideration.

The discrepancies between Heim's [18] inventory and this new inventory are based upon two facts:

- One of the neural arch fragments (#l, 12) previously assigned to LF1 likely belonged to La Ferrassie 2 (see below).
- One of the vertebral bodies (#t), identified as an additional vertebra, is actually composed of two fragments (#t1 and #t2) that probably belonged to vertebrae already represented by other fragments (see below).

In addition to #t, another case (#k) has been found in which the vertebra is composed of different fragments that do not belong to the same vertebra. In fact, two more similar cases in the ribs of LF1 were also detected. There are other cases of vertebrae in which, either due to taphonomic distortion or to the reconstruction process, the fragments do not fit one another perfectly (see below for a detailed account).

Anatomical descriptions

Descriptions and photographic documentation of the most important individual fragments curated in these two boxes are provided. Descriptions followed the order assigned in the "virtual labelling".

BOX 37

#a: First cervical (C1). Fig. 3.

The atlas is virtually complete: it only lacks the right transverse process and the posterior tubercle of the posterior arc. This vertebra is formed of five fragments. The two fragments that form the posterior arc have been put together using some unknown material (wax?; see Fig. 3). The fragment that represents the right half of the posterior arc is not correctly reconstructed as it is slightly displaced to the right

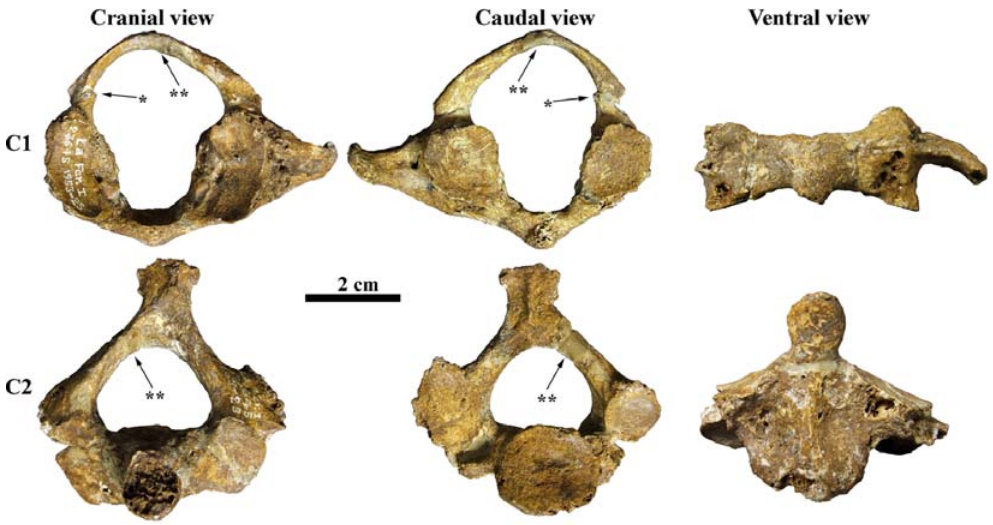

Fig. 3 Cranial, caudal and ventral views of the upper cervical spine of the La Ferrassie 1 Neandertal: atlas (C1) and axis (C2). Arrows marked * indicate wrongly reconstructed fragments (either due to taphonomic distortion or the reconstruction performed at the beginning of the 20th century). Arrows marked ** indicate parts filled with an unknown filler (wax/clay/plaster) / *Vertèbres cervicales supérieures du Néandertalien La Ferrassie 1 : atlas (C1) et axis (C2) en vues crâniale, caudale et ventrale. Les flèches accompagnées d'un * représentent les fragments mal reconstruits (soit en raison de la distorsion taphonomique ou de la reconstruction réalisée au début du xxe siècle). Les flèches accompagnées de ** représentent les parties remplies d'une matière inconnue (cire / argile / plâtre)*

side (see Fig. 3). It shows slight erosion to the cranial aspect of the transverse process, to the lateral sides of the upper articular facets and to the ventral end of the lower right articular facet. While both the anterior arch and the lateral masses look quite robust, the posterior arch is of small size.

The preserved transverse process shows a very small transverse foramen. The smallness of this foramen was attributed by Heim [18] to an exostosis (abnormal bone growth). While the cranial aspect of this transverse process is slightly eroded, the caudal aspect is not and there is no trace of abnormal bone growth. In our view, this anomaly is a congenital defect (Gómez-Olivencia et al., manuscript in preparation). This vertebra also displays slight osteophytosis in the margins of the articular facets.

#b (2): Second cervical (C2). Fig. 3.

The axis is virtually complete as it only lacks the transverse processes and the cranial end of the odontoid process. The right upper articular facet is incomplete and part of the right lamina has been reconstructed (see Fig. 3). This vertebra is formed of four fragments that perfectly fit together. The ventral edges of the upper articular facets and of the caudal surface of the vertebral body are slightly eroded and the trabecular bone is exposed.

The lower left articular facet is hypertrophic; the original surface has been completely remodelled, showing a secondary porosity and well-developed marginal osteophytes (i.e., degenerative hypertrophy) due to osteoarthritis. The remaining articular facets show mild marginal osteophytes.

#c (4): Fourth cervical (C4). Fig. 4.

Virtually complete vertebra that only lacks the transverse processes. The right half of the ventral surface of the vertebral body is crushed and the left pedicle reconstructed. This vertebra is composed of four fragments. Most of them perfectly fit together, but there is slight error in the reconstruction between the fragment that represents the right half of the neural arc and the spinous process (see arrow in Fig. 4). It shows erosion on the uncinate process, on the ventral end of the upper left articular facet and on the lateral sides of the spinous process.

The articular pillars are asymmetric and the right side is taller than the left side. All the articular facets show osteophytes, especially those of the right side. In cranial view, the spinous process is twisted to the right.

#d (3): Third cervical (C3). Fig. 4.

C3 is virtually complete and only lacks the transverse processes, and the right half of the tip of the spinous process. This vertebra is composed of five fragments, and the left pedicle and the lower right articular facet have been partially reconstructed (see arrows in Fig. 4). It shows erosion of the ventral edges of both surfaces of the vertebral body, exposing the trabecular bone.

The unciform joints are deformed and asymmetric, the left one being more developed than the right. The upper left articular facet shows porosity and significant osteophytic growth on its edges, consistent with that present in the axis. The remaining articular facets also show osteophytic growth

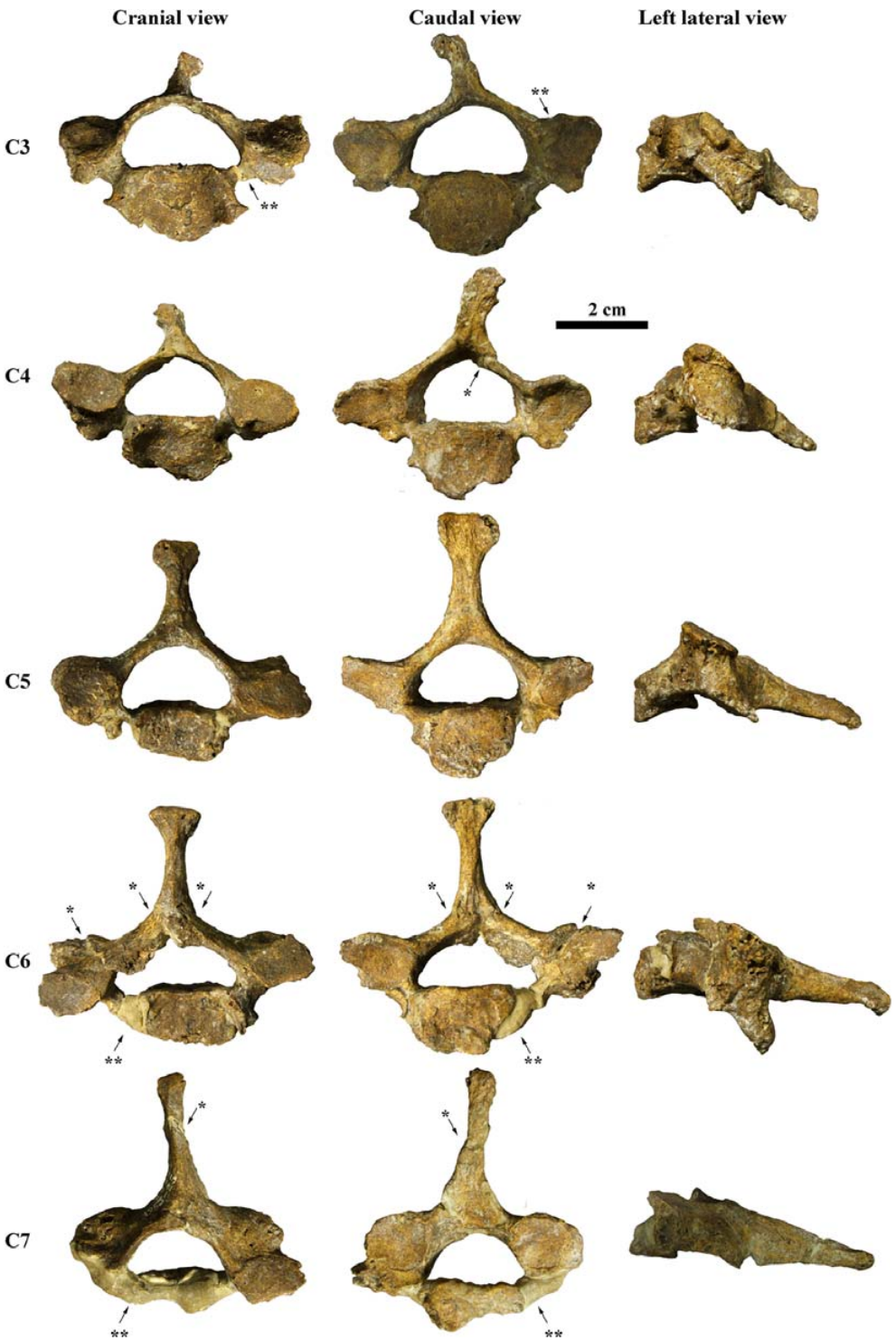

Fig. 4 Cranial, caudal and left lateral views of the lower cervical spine of the La Ferrassie 1 Neandertal: C3 to C7. Arrows marked * indicate wrongly reconstructed fragments (either due to taphonomic distortion or the reconstruction performed at the beginning of the 20th century). Arrows marked ** indicate parts filled with an unknown filler (wax/clay/plaster) / *Vertèbres cervicales inférieures du Néandertalien La Ferrassie 1 : C3 à C7 en vues crâniale, caudale et latérale gauche. Les flèches accompagnées d'un * représentent les fragments mal reconstruits (soit en raison de la distorsion taphonomique ou de la reconstruction réalisée au début du xxe siècle). Les flèches accompagnées de ** représentent les parties remplies d'une matière inconnue (cire / argile / plâtre)*

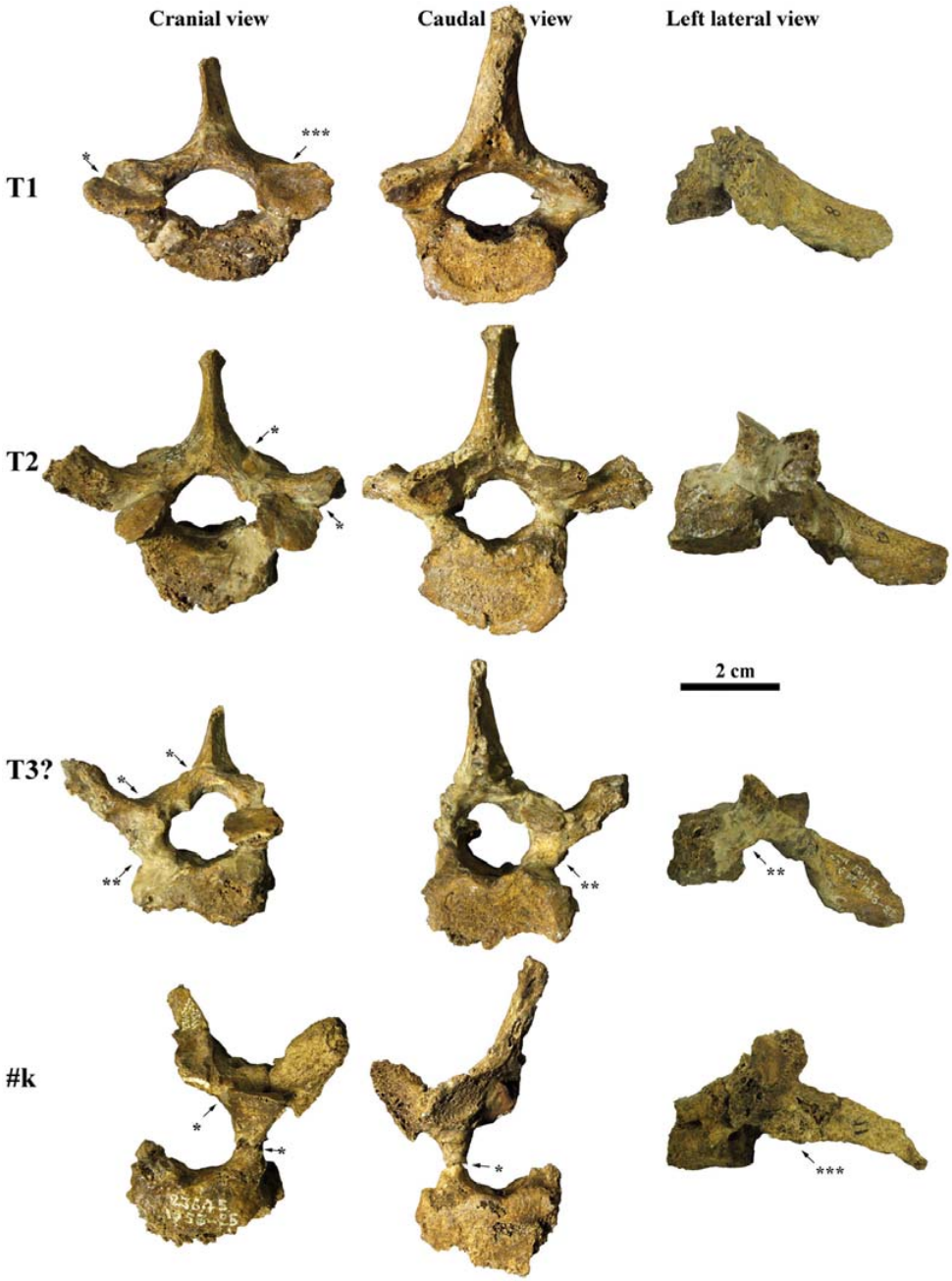

Fig. 5 Cranial, caudal and left lateral views of the uppermost thoracic vertebrae of the La Ferrassie 1 Neandertal: T1 to T3? Arrows marked * indicate wrongly reconstructed fragments (either due to taphonomic distortion or the reconstruction performed at the beginning of the 20th century). Arrows marked ** indicate parts filled with an unknown filler (wax/clay/plaster). The arrow marked *** indicates pathological lesions: the enlarged upper facets of the T1 that extends onto the root of the transverse processes (see text) and the extremely modified lower left articular facet of #k / *Vertèbres thoraciques supérieures du Néandertalien La Ferrassie 1 : T1 à T3 ?, en vues crâniale, caudale et latérale gauche. Les flèches accompagnées d'un * représentent les fragments mal reconstruits (soit en raison de la distorsion taphonomique ou de la reconstruction réalisée au début du xxe siècle). Les flèches accompagnées de ** représentent les parties remplies d'une matière inconnue (cire / argile / plâtre). Les flèches accompagnées de *** représentent des lésions pathologiques : les facettes supérieures élargies de T1 qui s'étendent sur la racine des apophyses transverses (voir texte) et la très importante modification de la facette articulaire gauche de #k*

Table 2 Raw dimensions (in mm) of the lamina and spinous process for La Ferrassie, Kebara 2 and descriptive statistics (mean and standard deviation) of a modern male comparative sample / *Dimensions brutes (en mm) de la lame et de l'apophyse épineuse de La Ferrassie 1, Kebara 2 et statistiques descriptives (moyenne et écart-type) d'un échantillon de comparaison d'hommes modernes.*

Anatomical position (moderns and Kebara 2)	Label (La Ferrassie)*	Lamina: cranio-caudal diameter			Lamina: thickness		Spinous process: maximum length (M13)			
		Moderns** (mean ± SD)	Kebara 2 (right/left)	La Ferrassie (right/left)	Moderns* (mean ± SD)	Kebara 2 (right/left)	La Ferrassie (right/left)	Moderns* (mean ± SD)	Kebara 2	La Ferrassie
T1	#h (8)	16.6 ± 1.4	16.5/–	18.0/16.9	6.0 ± 1.0	6.9/5.7	5.5/6.3	37.5 ± 2.7		
T2	#i (9)	16.8 ± 1.4	–/16.8	18.2/–	5.9 ± 0.9	5.2/–	4.2/–	39.0 ± 2.9	39.3	(39.0)
T3	#j (10)	16.6 ± 1.4	17.7/15.5		5.9 ± 0.7	–/5.9	4.9/4.6	40.4 ± 3.2	37.8	
T4	#k (11)	17.9 ± 1.2	–/17.4	–/19.5	6.1 ± 1.3	–/5.7	–/5.9	42.9 ± 4.5	41.0	43.0
T5	#l (12)	19.4 ± 1.7	19.5/18.9	13.5/–	5.8 ± 0.8	5.9/5.8	4.9/–	48.0 ± 4.8	(42.5)	
T6	#p (13)	20.8 ± 1.8		–/18.8	5.8 ± 0.8	–/6.9		50.2 ± 4.6	42.5	
T7	#q (14)	21.4 ± 1.7		19.9/18.3	6.0 ± 0.9		6.7/7.5	49.6 ± 4.4		(41.5)
T8		21.1 ± 1.6	–/19.3		6.1 ± 0.9	6.7/–		46.5 ± 3.5		
T9		20.7 ± 1.5	20.5/19.5		6.3 ± 1.0	7.2/–		42.5 ± 3.3	38.8	

Values between parentheses are estimated.

*We have organized the vertebrae from La Ferrassie according to Heim's (1976) anatomical position. All these vertebrae were attributed to La Ferrassie 1 by Heim (1976);

**Modern Euroamerican males ($n = 28$). Note the shorter spinous processes of Kebara 2 in the middle thoracic vertebrae.

The extremely low values of #l (12) indicated in bold type suggest that this vertebra belonged to the female Neandertal La Ferrassie 2.

Table 3 Descriptive statistics (mean ± standard deviation and range) of the lamina variables in a modern female* comparative sample / *Statistiques descriptives (moyenne ± écart-type et plage de variation) des variables de la lame dans un échantillon de comparaison de femmes modernes**.

Anatomical position	Lamina: cranio-caudal diameter	Lamina: thickness
T1	15.0 ± 1.3 (12.5–17.9)	5.3 ± 0.8 (3.3–6.9)
T2	15.2 ± 1.5 (11.7–17.7)	5.3 ± 0.7 (3.3–7.1)
T3	15.6 ± 1.4 (13.0–18.4)	5.4 ± 0.8 (3.3–6.6)
T4	16.6 ± 1.4 (13.9–19.5)	5.5 ± 0.9 (3.5–7.4)
T5	18.0 ± 1.8 (15.5–21.4)	5.6 ± 1.1 (4.0–7.4)
T6	19.4 ± 1.8 (16.0–22.6)	5.4 ± 0.8 (3.7–7.4)
T7	19.7 ± 1.8 (15.9–24.3)	5.5 ± 0.8 (3.8–6.8)
T8	19.6 ± 1.6 (15.8–22.1)	5.6 ± 0.8 (3.8–7.2)
T9	19.4 ± 1.3 (16.1–22.0)	5.8 ± 0.8 (3.7–7.3)

*Modern Euroamerican females (n = 32).

Fig. 6 Dorsal (left) and ventral (right) views of #l (12). Arrows marked * indicate wrongly reconstructed fragments (either due to taphonomic distortion or the reconstruction performed at the beginning of the 20th century). Arrows marked ** indicate parts filled with an unknown filler (wax/clay/plaster). This small-sized specimen probably belonged to the La Ferrassie 2 Neandertal (see text and Tables 2 and 3) / *Vues dorsale (à gauche) et ventrale (à droite) de #l (12). Les flèches accompagnées d'un * représentent les fragments mal reconstruits (soit en raison de la distorsion taphonomique ou de la reconstruction réalisée au début du xxe siècle). Les flèches accompagnées de ** représentent les parties remplies d'une matière inconnue (cire / argile / plâtre). Cet ossement de petites dimensions appartenait probablement au Néandertalien La Ferrassie 2 (se référer au texte et aux Tableaux 2 et 3)*

on their edges, but there is no remodelling to their surface. In cranial view, the spinous process is twisted to the left side and, in dorsal view, it is rotated anticlockwise.

#e (5): Fifth cervical (C5). Fig. 4.

Virtually complete vertebra that only lacks the transverse processes. The right half of the ventral surface of the vertebral body is crushed. This vertebra is composed of four fragments that perfectly fit together. It has a long spinous process.

The vertebral body shows osteophytes and so do the articular facets, especially the upper right one, whose orientation has changed to more dorsal due to pathological remodelling. This makes the right articular pillar slightly smaller cranio-caudally than its left side counterpart. From the dorsal view, the tip of the spinous process is slightly rotated anticlockwise.

#f (6): Sixth cervical (C6). Fig. 4.

Virtually complete vertebra that only lacks the transverse processes. It is fragmented into six pieces that have suffered taphonomic distortion in a dorso-ventral (DV) direction (see Fig. 4). Thus, the medio-lateral (ML) dimensions of the vertebra between the lateral edges of lateral masses are exaggerated, and the DV dimension of the vertebra is smaller than what it should be. This ML exaggeration has resulted in the separation of the vertebral body from its right pedicle. This separation and the fact that the right side of the vertebral body is eroded have led to the reconstruction of this part of the vertebra using an unknown filler (see Fig. 4). The edge of the left unciform process, the edges of the lower articular facets and the caudal aspect of the tip of the spinous process show slight erosion that exposes the trabecular bone.

The edges of the articular facets show osteophytes. The articular pillars are asymmetric, the left side being slightly larger cranio-caudally.

#g (7): Seventh cervical (C7). Fig. 4.

This vertebra is incomplete: it preserves the dorso-caudal third of the vertebral body and the neural arc. This specimen is composed of five fragments and some unknown filler has been used in order to refit the vertebral body to the neural arch, especially on the right side, reconstructing the right pedicle. Due to this reconstruction it is difficult to know if the position of the vertebral body is correct with respect to the remainder of the vertebra. The dorsal-most fragment of the spinous process is also misaligned in relation to its ventral-most part. It shows erosion of the lateral surfaces of the tip of its spinous process. The spinous process of this vertebra looks long and gracile, as it does not display the dorsal medio-lateral enlargement present in C5 and C6.

The articular facets show osteophytes on their margins. Regardless of the slight misalignment of the dorsal-most fragment of the spinous process, it is clear that in cranial view the spinous process is twisted to the right. The lower articular facets are concave, especially on the right side, due to remodelling of the facet and changes in the C7–T1 articulation (see below).

#h (8): First thoracic vertebra (T1). Fig. 5.

Partially preserved vertebra that lacks the ventral half of the vertebral body, the transverse processes and the tip of the spinous process. It shows erosion of the dorsal edge of the caudal surface of the vertebral body. It is formed of six fragments, most of which perfectly fit together although there is

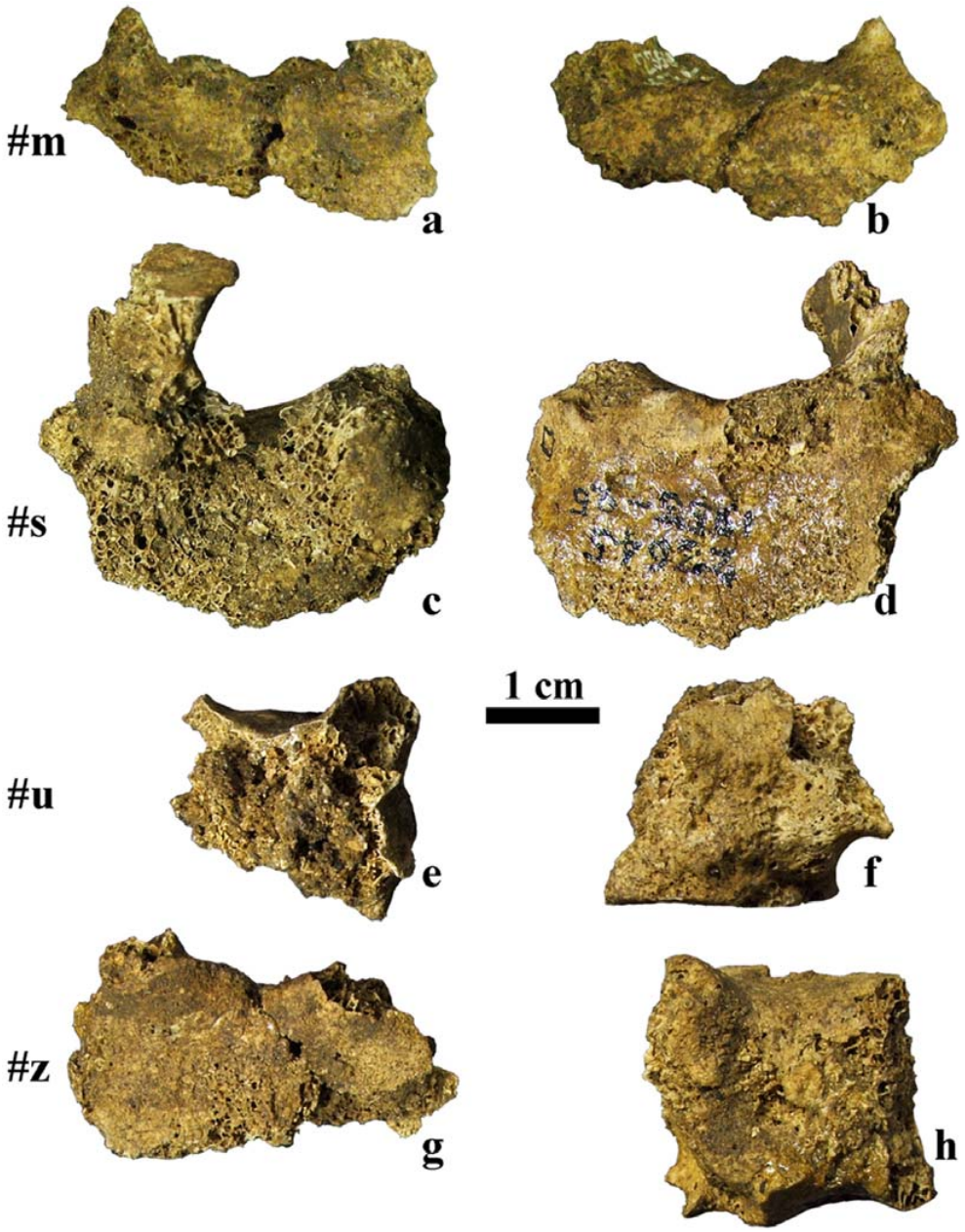

Fig. 7 Thoracic vertebral bodies of La Ferrassie 1. Cranial (a) and caudal (b) views of #m. Cranial (c) and caudal (d) views of #s. Cranial (e) and left lateral (f) views of #u. Cranial (g) and right lateral (h) views of #z / *Corps vertébraux thoraciques de La Ferrassie 1. #m en vues crâniale (a) et caudale (b). #s en vues crâniale (c) et caudale (d). #u en vues crâniale (e) et latérale gauche (f). #z en vues crâniale (g) et latérale droite (h)*

a small error in the reconstruction of the two fragments that rejoin at the upper right articular facet (see Fig. 5). The caudal aspect of the spinous process shows a well-developed crest for the insertion of the interspinous ligament.

T1 shows osteophytes on the edges of the articular facets. The upper articular facets extend over the roots of the transverse processes (see Fig. 5). Normally, T1s show an abrupt step from the articular facet to the root of the transverse process. In this case, the articular facet continues over this step, rendering it less abrupt and leaving the facet with a concave morphology. In cranial view, the spinous process is slightly twisted to the right and in dorsal view, it is slightly rotated clockwise.

#i (9): Second thoracic vertebra (T2). Fig. 5.

Nearly complete vertebra that only lacks the craniventral edge of the spinous process and shows erosion of the tips of the transverse processes and the spinous process. It is formed by four fragments, most of which refit perfectly, but the fragment that represents the upper left articular facet

Fig. 8 Dorsal views of #n (17) (left) and #o (15) (right) / *Vues dorsales de #n (17) (gauche) et #o (15) (droite)*

and the fragment that represents the left lamina+lower left articular facet+left transverse process are not completely aligned with the other vertebrae. The caudal aspect of the spinous process shows a well-developed crest for the insertion of the interspinous ligament.

The vertebra has osteophytes on the lateral edges of the caudal surface of the vertebral body, the edges of the articular facets and the right costal facet. In cranial view, the spinous process is slightly twisted to the right and in dorsal view, it is slightly rotated clockwise.

#j (10): Third (?) thoracic vertebra (T3?). Fig. 5.

This vertebra is composed of six different fragments and a considerable amount of filler has been used in order to reconstruct it. All of these fragments show erosion to the most protruding parts.

- #j1 – dorsal half of a thoracic vertebral body
- #j2 – left pedicle and left upper articular facet
- #j3 – cranial fragment of the union of the laminae
- #j4 – spinous process
- #j5 – lower left articular facet
- #j6 – right pedicle and left transverse process

The fragments #j1 and #j2 certainly belong to the same vertebra due to anatomical congruence. The fragments #j3, #j4, #j5 and #j6 also all belong to the same vertebra due to anatomical congruence. All the fragments may belong to a single vertebra but this is uncertain due to the degree of reconstruction. There are some errors in the anatomical reconstruction. The most noticeable are: 1) the position of the spinous process relative to fragment #j3: the fragment of the spinous process is rotated clockwise; and 2) the lower right articular facet is positioned more cranially than it should.

The shaft of the distal-most part of the spinous process is not straight cranio-caudally, but it appears slightly curved with the concavity to the right side (forming a very open "c" shape).

#k (11): Thoracic vertebra. Fig. 5.

This vertebra is composed of five fragments:

- #k1 – dorsal half of a thoracic vertebral body that partially preserves the left pedicle, the insertion of the right pedicle and the left demifacets for the articulation of the ribs. It shows erosion to the caudal part and there is some glue where the right pedicle would go, suggesting that there was something glued there before.
- #k2 – left pedicle and left upper articular facet. It shows erosion to the cranial and lateral ends of the articular facets.
- #k3 – complete but eroded left transverse process.
- #k4 – left lamina and lower left articular facet. The dorsal surface of the lamina is eroded, exposing the trabeculae. The articular facet is porous and shows an additional articulation on its lateral end and perpendicular to its orientation, probably due to the contact with the vertebra below.
- #k5 – spinous process. The dorsal end of the tip of the spinous process is eroded. This fragment has not been correctly refitted with #k4 and is slightly rotated in an anticlockwise direction.

The fragments #k4 and #k5 belong to the same vertebra, and #k3 probably belongs to the same vertebra. The #k2 fragment does not fit either with #k1 or with #k3+#k4 +#k5. Thus the anatomical determination has to be performed separately for these three fragments.

- #k1 (vertebral body): T4?
- #k2 (left pedicle and upper articular facet): thoracic (T5–T11 by exclusion)
- #k3+#k4+#k5 (left transverse process, lamina, lower articular facet and spinous process): T4?. The length of the spinous process is consistent with this determination but does not preclude the possibility that it belonged to a more caudally located vertebra. In fact, the length of the spinous processes of the T4–T6 vertebrae of Kebara 2 is similar to this specimen.

#l (12): Thoracic vertebra. Fig. 6.

This fragment represents a fragmentary neural arch which is composed of three fragments:

- #l1 – lower articular facet
- #l2 – laminae and lower right articular facet
- #l3 – right transverse process
- #l2 and #l3 perfectly fit together but #l1 does not, as some filler has been used for the reconstruction. However, this does not preclude the possibility that all these fragments belong to the same vertebra.

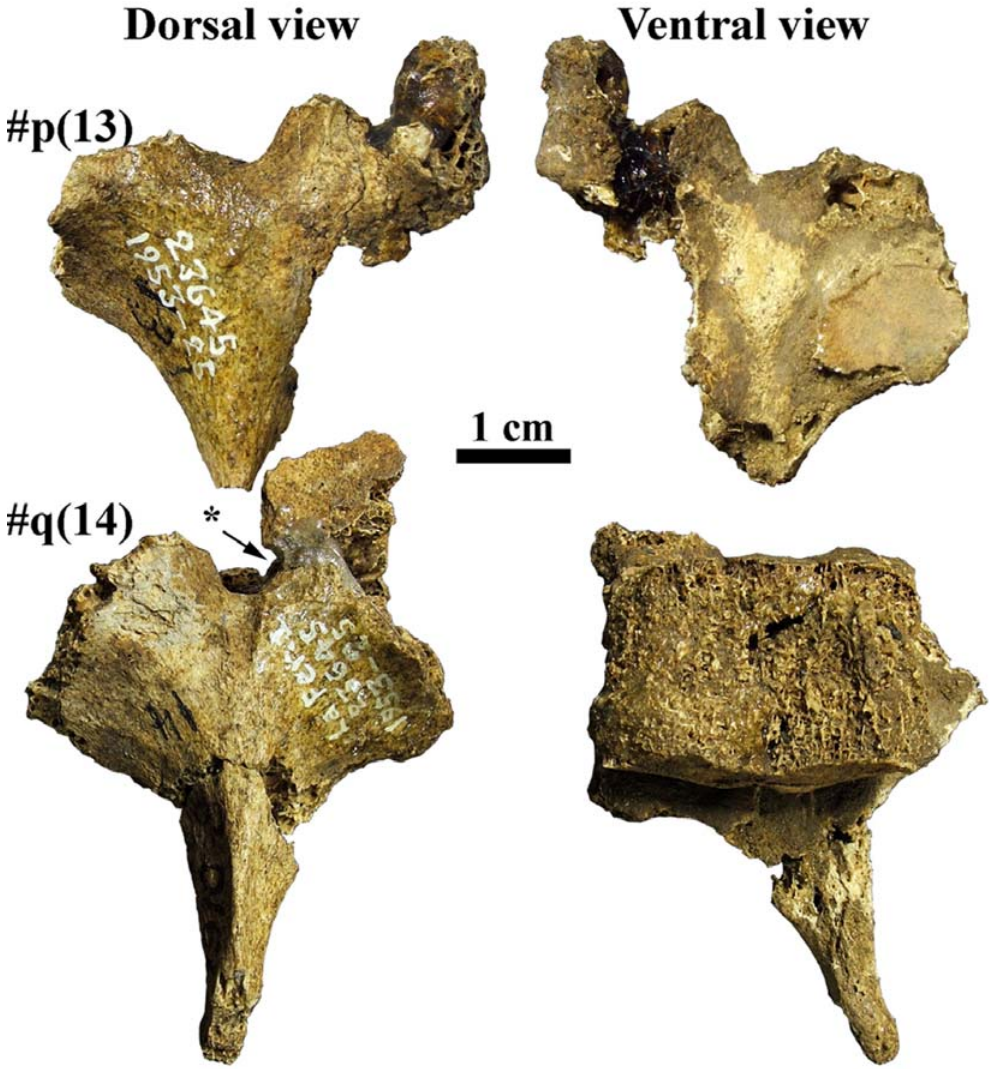

Fig. 9 Dorsal and ventral views of #p (13) and #q (14). Arrows marked * indicate wrongly reconstructed fragments (either due to taphonomic distortion or the reconstruction performed at the beginning of the 20th century) / *Vues dorsale et ventrale de #p (13) et #q (14). Les flèches accompagnées d'un * représentent les fragments mal reconstruits (soit en raison de la distorsion taphonomique ou de la reconstruction réalisée au début du xxe siècle)*

The cranio-caudal diameter of the right lamina is very small compared to the rest of LF1 vertebrae (see Table 2), and thus it is unlikely that it belongs with the LF1 thoracic series. This vertebra does not show the porosity present in the articular facets of immature individuals such as La Ferrassie 6 and thus it is very likely that this fragment belonged to the only other adult skeleton from the site, the La Ferrassie 2 female individual. Based on a simple comparison of the size of the lamina with a modern female comparative sample, this vertebra would likely belong to the T1–T4 segment (see Table 3, Fig. 6).

#m: Thoracic vertebra. Fig. 7.

This specimen is composed of two fragments that perfectly fit together. It represents the dorsal third of a vertebral body which preserves the location of the pedicles, both upper demifacets, but only the lower right demifacet. There is some sediment adhered at the nutrient foramen of the dorsal face of the vertebral body. The vertebra displays osteophytes (of about 1–1.5 mm) on the dorsal end of both cranial and caudal surfaces. This vertebra's anatomical position is uncertain due to its fragmentary nature, and thus it is assigned to T5–T8 by exclusion (Fig. 7).

#n (17): Eleventh (?) thoracic vertebra (Fig. 8)

Fragmentary spinous process that preserves a fragment of the lower left articular facet. Morphologically is similar to Kebara 2's T11, but due to the small size of this fragment, caution is warranted in determining the anatomical position of this vertebra (Fig. 8).

#o (15): Tenth (?) thoracic vertebra. Fig. 8.

Fragment of neural arch that preserves the root of the spinous process. Morphologically it resembles a lower thoracic

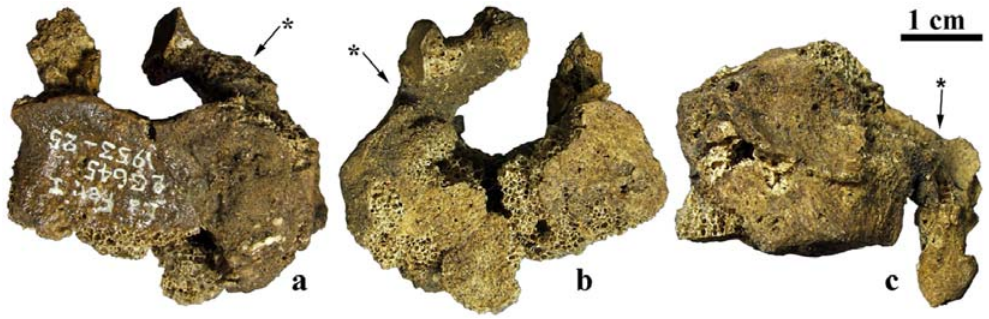

Fig. 10 Cranial (a), caudal (b) and left lateral (c) views of the 12th vertebra of La Ferrassie 1 (#r, 19). Arrows marked * indicate wrongly reconstructed fragments (either due to taphonomic distortion or the reconstruction performed at the beginning of the 20th century). Note also the sediment present at the caudal aspect of the left pedicle (see b) / *La 12^{e} vertèbre de La Ferrassie 1 (#r, 19) en vues crâniale (a), caudale (b) et latérale gauche (c). Les flèches accompagnées d'un * représentent les fragments mal reconstruits (soit en raison de la distorsion taphonomique ou de la reconstruction réalisée au début du xxe siècle). Notez également le sédiment présent dans la partie caudale du pédicule gauche (voir b)*

Table 4 Raw dimensions (in mm) of the dorsal cranio-caudal diameter (height) of the vertebral body* for La Ferrassie 1, Kebara 2 and descriptive statistics (mean and standard deviation) of a modern male comparative sample** / *Dimensions brutes (en mm) du diamètre cranio-caudale dorsal (hauteur)* du corps vertébral de La Ferrassie 1, Kebara 2 et statistiques descriptives (moyenne et écart-type) d'un échantillon de comparaison d'hommes modernes***.

Anatomical position	Vertebral body: dorsal cranio-caudal diameter (height)	Kebara 2	La Ferrassie 1
T1	16.9 ± 0.8 (15.4–18.8)	15.7	16.3 (#h)
T2	17.8 ± 1.1 (16.0–20.5)	17.9	18.5 (#i)
T3	18.3 ± 1.2 (15.0–20.8)	18.2	19.7 (#j)
T4	19.1 ± 1.1 (17.0–21.2)	19.5	20.9 (#k)
T5	19.7 ± 1.1 (17.2–21.6)	20.7	
T6	20.4 ± 1.2 (17.5–23.0)	(20.5)	
T7	21.0 ± 1.1 (18.8–23.0)	20.1	
T8	21.5 ± 1.0 (19.2–23.3)	20.1	
T9	21.9 ± 1.1 (19.7–24.7)		21.1 (#s)
T10	23.2 ± 1.1 (21.2–26.6)	22.1	
T5–T8			21.2 (#m)
T5–T8			19.3 (#q)
T7–T8?			18.9 (#z)

*M2 according to [23]; **Modern Euroamerican females (n = 32).

(T10, with a range of T9–T11), and the antero-posterior thickness of the base of the spinous process (11.0 mm – measured perpendicular to the dorsal surface) is similar to that of Kebara 2's T10 (10.6 mm), and well above Kebara T9 (9.2 mm). However, due to the small size of this fragment, caution is warranted in assigning its anatomical position.

#p (13): Ninth (?) thoracic vertebra (Fig. 9)

This specimen is composed of two fragments that fit together. The largest fragment is composed of the laminae, the lower left articular process and a fragment of the spinous process. The smallest fragment, slightly crushed and broken into small pieces on the dorsal surface, preserves the cranial end of the lower right articular facet. It shows erosion to the lateral end of the lower left articular facet. This fragment is more caudally located than #q and by morphological comparison with Kebara 2 it could be a T9 or, less probably, a T8 (Fig. 9).

#q (14): Thoracic vertebra. Fig. 9.

This specimen is composed of six fragments grouped into three regions.

- #q1+#q2+#q3 – the first three fragments perfectly fit one another and form the dorsal end (ca. 25%) of a thoracic vertebral body
- #q4 – fragmentary right pedicle and upper right articular facets that shows erosion to its cranial end
- #q5+#q6 – laminae, lower articular facets (#q5) and spinous process (#q6). There is erosion of the caudal ends of the lower articular facets and to the tip of the spinous process, and some osseous matter has been lost in the breakage point between #q5 and #q6.

This vertebra is crushed antero-posteriorly so the vertebral foramen has been reduced to a minimum expression. By exclusion this vertebra is assigned to a T5–T8 (see Tables 2 and 4).

#r (19): Twelfth thoracic vertebra. Fig. 10.

This vertebra preserves the dorsal 60% of the vertebral body, the right pedicle, the caudal end of the left pedicle, the left lamina, the lower left articular process and the root

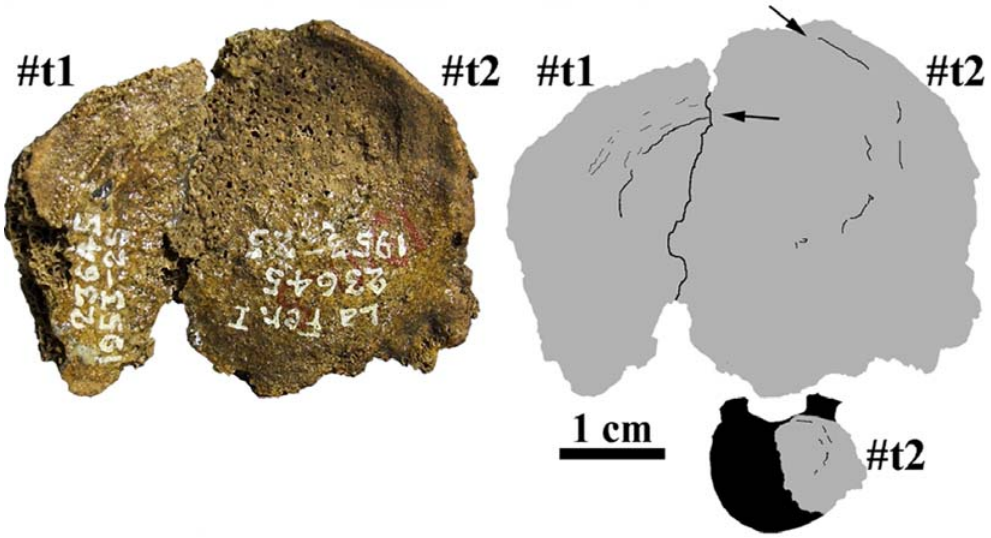

Fig. 11 Caudal aspect of the #t vertebra. This specimen is the result of the incorrect reassembly of two fragments of different vertebrae. The annular epiphyses do not match one another (see arrows on the right). #t1 could be a fragment of the T12 while #t2 represents the right half of a lumbar, probably L1. The drawing at bottom right shows the part of the vertebra which #t2 represents in caudal view / *Aspect caudal de la vertèbre #t. Cette vertèbre est le résultat du mauvais remontage de deux fragments de vertèbres différentes. Les épiphyses annulaires ne correspondent pas les unes avec les autres (voir les flèches sur la droite). #t1 pourrait être un fragment de la T12 tandis que #t2 représente la moitié droite d'une lombaire, sans doute L1. Le dessin en bas à droite représente la partie de la vertèbre #t2 en vue caudale*

of the spinous process. This vertebra is composed of seven fragments. The vertebral body is divided into two main fragments, the left of which is further divided into three fragments, two of which are slightly crushed cranially. The right pedicle is in two fragments. Finally, the left half of the neural arch is slightly crushed ventrally into the vertebral body (see arrows in Fig. 10). The crushing of some of the fragments into others is likely related to taphonomic processes. There is also some sediment adhered to the cranial surface of the vertebral body.

On the left side of the vertebral body there is a complete and isolated facet for the articulation with the head of the 12th rib. On the right side, most of the facet has been eroded and the trabecular bone is exposed, except for the cranial-most part in which it is clear that this articular facet communicates with the cranial surface of the vertebral body (i.e., it is not an isolated articular facet).

This vertebra is a T12 based on the presence of large articular facets on the lateral of the vertebral body for the articulation with the rib, an overall morphology similar to Kebara 2's T12 and the fact that the preserved lower articular facet is sagittally oriented, and thus it is the diaphragmatic vertebra which is normally located at the T12 level.

The left articular facet for the ribs shows an osteophyte at its caudal end. Mild osteophytosis can be found at the dorsal end of the caudal surface of the vertebral body and at the lower left articular facet.

BOX 38

#s: Thoracic vertebra. Fig. 7.

This specimen is composed of two fragments and it is not possible to be completely sure whether these two fragments belong to the same vertebra.

- #s1 – a fragment of vertebral body of a thoracic vertebra that preserves the caudal surface of the vertebral body, the demifacets for the articulation of the ribs and the caudal end of the right pedicle. The size and morphology of the vertebral body suggest that this vertebra belonged to a T9.
- #s2 – the right pedicle and upper articular facets.

#t: Thoracic vertebra. Fig. 11.

This specimen is composed of two fragments (#t1 and #t2) glued together that clearly do not belong to the same vertebra, based on the lack of continuation between the annular epiphyses of #t1 and #t2 (see arrows in Fig. 11). These two fragments have been described separately:

- #t1 – fragment of vertebral body that preserves a small portion of the caudal surface. It shows a marked annular epiphysis that resembles that of #r (T12). The size of this specimen and the incompleteness of the T12 makes it possible that these are part of the same vertebra, but due to the lack of diagnostic features it is cautiously attributed to a lower thoracic (less probably a lumbar).

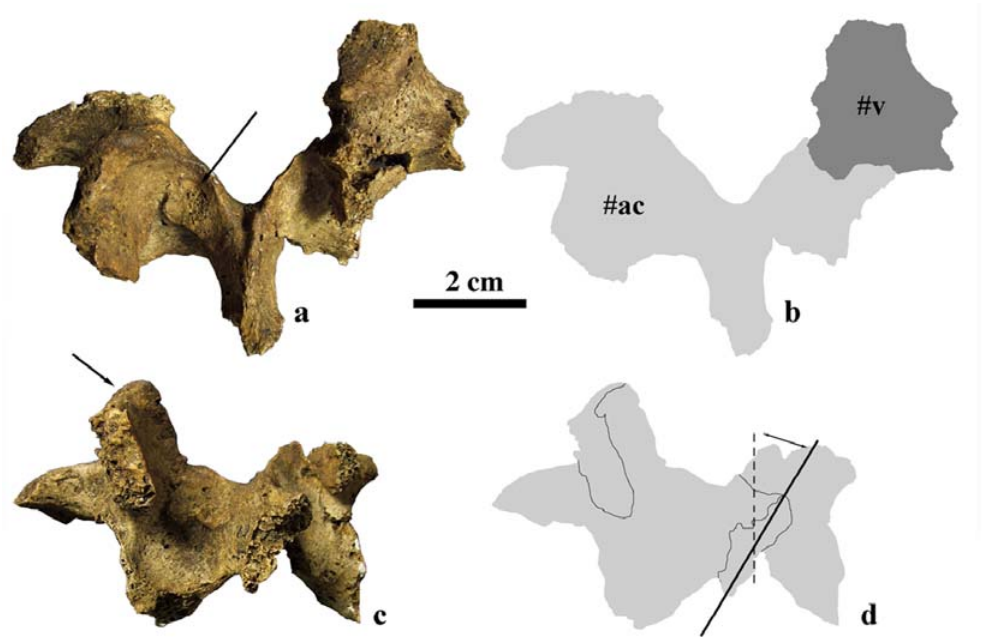

Fig. 12 Fifth lumbar (L5) of La Ferrassie 1. Cranial (a) representation with the fragments making up this vertebra illustrated in (b). The arrow in (a) represents the remodelling due to the contact point between the lower left articular facet of L4 and the lamina of L5. Dorsal view of #ac (c), in which the clockwise rotation of the spinous process can be seen. Note that in (c) and (d), the photograph is not completely perpendicular to the spinous process and thus the actual rotation (~20–25°) is less than that represented in (d) (~30°). The arrow in (c) represents the remodelling of the upper left articular facet resulting from contact with the pedicle of L4 / *Cinquième lombaire (L5) de La Ferrassie 1. Vue crâniale de la vertèbre (a) et représentation avec les fragments qui composent cette vertèbre (b). Vue dorsale d'ac # (c) dans laquelle il est possible de noter la rotation dans le sens horaire de l'apophyse épineuse. Notez que pour c et d, la photographie n'est pas complètement perpendiculaire à l'apophyse épineuse et donc la rotation réelle (~ 20–25°) est inférieure à celle qui est représentée en d (~ 30°). La flèche dans (a) représente le remodelage dû au point de contact entre la facette articulaire inférieure gauche de la L4 et la lame de la L5. La flèche dans (c) représente le remodelage de la facette articulaire supérieure gauche dû au contact avec le pédicule de la L4*

- #t2 – fragment of vertebral body, probably a lumbar based on its large size and the fact that it cannot be the T12. It preserves the right half of the caudal surface of the body (34.5 mm × 25.5 mm), the caudal part of where the pedicle would go and a small fragment of the cranial surface. The lateral end displays a large osteophyte of ca. 3 mm along ca. 10 mm of the edge of the vertebral body. It is cranial to #x but probably not immediately superior, which suggests that this is an L1 and thus #x is an L3.

#u: Thoracic vertebra. Fig. 7.

Fragment of a vertebral body that preserves a portion of the caudal surface (27.4 mm × 14.7 mm) below the left pedicle, and a portion of the upper left facet for the rib. The absence of a lower demifacet and the position of this facet suggest that this specimen could be a T10 (less probably a T11, but definitely not a T9).

#v: Fifth lumbar vertebra (Fig. 12)

Fragment that represents a portion of the cranial aspect of the vertebra (15.6 mm × 11.1 mm), the right pedicle with the root of the transverse process and a fragment of the upper right articular facet. This fragment was once glued to the remainder of the L5 (#ac) (Fig. 12).

#w (20): First (?) lumbar vertebra. Fig. 13.

Fragment of a neural arc of a lumbar vertebra that preserves the laminae and most of the spinous process. The cranial edges of the laminae are not preserved. By exclusion it would be an L1.

#x: Third (?) lumbar vertebra. Fig. 13.

Nearly complete lumbar vertebral body that partially preserves the pedicles. It has lost most of the ventral and left lateral surface of the body. It has not been possible to surely associate this vertebra with any of the lumbar neural arches (#w, #aa, #ab, #ac and #ad). The morphology of the pedicles suggests that it cannot be an L4 or L5, and the overall size rules out L1. It is more likely to be an L3 rather than an L2, also using exclusion criteria (see #t above).

This specimen shows extensive remodelling and osteophytosis of the right lateral and ventral edge of the cranial surface of the vertebral body. On the right lateral edge, the annular epiphysis has vanished due to remodelling which has left a

Fig. 13 Lumbar vertebrae of La Ferrassie 1. Dorsal view (a) of the first lumbar vertebra #w (20). Dorsal view (b) of the second lumbar vertebra #aa(21). Dorsal (c) and ventral (d) views of the third lumbar vertebra #ab(22). Dorsal (e) and cranial (f) views of the fourth lumbar vertebra. Cranial (g) and caudal (h) views of the vertebral body of the third (?) lumbar vertebra. The arrows in (c) and (d) indicate degenerative hypertrophy of the lower left articular facet. Arrows in (g) and (h) indicate osteophytic growth / *Les vertèbres lombaires de La Ferrassie 1. Vue dorsale (a) de la première vertèbre lombaire w# (20). Vue dorsale (b) de la deuxième vertèbre lombaire aa # (21). Vues dorsale (c) et ventrale (d) de la troisième vertèbre lombaire ab # (22). Vues dorsale (e) et crâniale (f) de la quatrième vertèbre lombaire. Vues crâniale (g) et caudale (h) du corps vertébral de la troisième (?) vertèbre lombaire. Les flèches dans (c) et (d) indiquent une hypertrophie dégénérative de la facette articulaire inférieure gauche. Les flèches dans (g) et (h) indiquent une croissance ostéophytique*

Fig. 14 Ventral, cranial and dorsal views of #y (coccyx) of La Ferrassie 1 compared to a cast of the coccyx of Kebara 2 / *Vues ventrale, crâniale et dorsale #y (coccyx) de La Ferrassie 1 comparé au moulage du coccyx de Kebara 2*

groove that generally follows the edge of the vertebral body (ca. 16.9 mm × 2.5 mm), followed laterally by osteophytes with a maximum lateral extension from the groove of 6.1 mm (see arrow in Fig. 13h). The orientation of this large osteophyte is lateral and slightly cranial to its edge.

#y: First coccygeal vertebra. Fig. 14.

Fragment of the first coccygeal vertebra. It preserves the dorsal two thirds (66%) of the cranial surface of the articulation, and most of the dorsal surface. It shows erosion to the right *cornus* which exposes the trabecular bone.

#z. Seventh or eighth (?) thoracic vertebra. Fig. 7.

This specimen is composed of two fragments that perfectly fit together. It represents the dorsal third of a thoracic vertebral body that preserves both demifacets from the right side and the insertion for the right pedicle. Its anatomical determination is uncertain, being probably more caudal than #m and more cranial than #s, thus it could be a T7–T8. It displays osteophytes to the dorsal edge of the caudal surface of the body of 1–1.5 mm in length (Fig. 14).

#ab (21): Second lumbar vertebra (L2). Fig. 13.

Fragment of a lumbar neural arch that preserves the laminae, the lower left articular facet, the cranial half of the lower right articular facet and the root of the spinous process. It shows erosion of the ventral edge of the lower left articular facet, displays osteophytes of moderate size (2.0 mm) on the dorsal edge of the lower left articular facet.

#ac (22): Third lumbar vertebra (L3). Fig. 13.

Fragmentary neural arch of a lumbar vertebra that preserves the upper left articular facet, the root of the left transverse process, the laminae, the lower articular facets and a fragment of the spinous process. This specimen is composed of four fragments that perfectly fit together.

The lower articular facets display osteophytes which are more marked on the left side. In fact, the lower left facet is larger than its right side counterpart. The medial edge of the lower left articular facet shows an extra articular facet due to contact with the root of the spinous process of the L4.

#ad (24): Fifth lumbar vertebra (L5). Fig. 12.

Fairly complete neural arch of the fifth lumbar vertebra composed of three fragments that perfectly fit together and that once were also glued to #v. This specimen is composed of the left pedicle, a fragment of the left transverse process, the upper left articular facet, a fragment of the upper right articular facet, the lower articular facets and a fragment of

the spinous process. It shows erosion of the caudal-most tip of the lower left articular facet.

The upper left articular facet seems to be enlarged (degenerative hypertrophy) and its cranial tip shows remodelling because of contact with the L4. The dorsal aspect of the lamina shows remodelling because of contact with the lower left articular facet of the L4. Similar to the L4, the lower left articular facet is enlarged in the dorso-ventral direction when compared to its right side counterpart. The left side is cranio-caudally smaller than the right side and also shows remodelling to the caudal tip due to contact with the sacrum. The caudal surface of the left transverse process shows an articular surface due to the contact with the sacrum. Finally, the spinous process is twisted to the right and rotated in a clockwise direction. If this spinous process is put vertically, in its presumed anatomical position, the left side of the vertebral column would be shortened. Thus, there would be scoliotic curvature to the left (the concavity towards the left lateral side) just above in the lumbosacral junction.

#ae (23). Fourth lumbar vertebra (L4). Fig. 13.

Fairly complete neural arch of a lumbar vertebra composed of four fragments that perfectly fit together. It preserves the pedicles (partially), the roots of the transverse processes, the articular facets and a fragment of the spinous process. It shows mild erosion on the cranial- and dorsal-most edges of the upper articular facets, and it lacks a bone chip between the spinous process and the rest of the neural arch, at the margin of the join between these two fragments.

The upper left articular facet is larger than its right counterpart, both cranio-caudally and dorso-ventrally. The upper right articular facet also shows some remodelling to the cranial quarter of the facet. The lower left articular facet is extremely remodelled, being larger than its right counterpart, through cranial, caudal and dorsal hypertrophy of the articular facet. It also shows a new articulation on the caudal edge of the apophysis due to contact with the dorsal aspect of the left lamina of the L5.

Discussion and summary

La Ferrassie 1 was found in 1909 and was part of the comparative material used by M. Boule [4] in his famous monograph on the La Chapelle-aux-Saints Neandertal. The material from La Ferrassie did not receive descriptive treatment until the work of J.-L. Heim in the late 1970s and early 1980s. In Heim's monograph [18,19] the vertebrae (and ribs) of the adult skeletons LF1 and LF2 have a minor role, with short chapters that include just basic inventories and only a few measurements in the case of the vertebrae. Despite the fact that this is one of the most complete Neandertal vertebral columns found to date, no analytical study of it has been performed. The updated inventory presented here provides a new account of this historical specimen, upon which further metric and paleopathological studies can be performed in the future.

In this study, errors in the reconstruction of some vertebrae have been detected and a vertebra that most likely belonged to another individual from the site of La Ferrassie has been found. The misattribution of elements to individuals is, unfortunately, not unknown in the La Ferrassie assemblage. Maureille [23] discovered that the humerus and femur that were the only remains that represented La Ferrassie 4 individual actually belonged to Le Moustier 2. According to Maureille, these two bones were sent by Peyrony to Boule for an age diagnosis. Thus, it was likely that they were commingled afterwards with the immature bones from La Ferrassie.

In summary, the spine of LF1 is represented by 7 cervicals, 10 thoracic, 5 lumbars and a coccygeal vertebra. Due to a small number of errors in anatomical determination, incorrect reconstructions, the presence of a vertebra likely belonging to La Ferrassie 2 and the fragmentary status of some of these remains, a note of caution regarding the previous anatomical determination on the thoracic segment of LF1 is warranted. Future studies should take these problems into consideration.

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