# Chapter 10

# THE JUVENILE NEANDERTAL MANDIBLE FROM SCLADINA (SCLA 4A-1 & SCLA 4A-9)

Michel TOUSSAINT

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## 1. Introduction

Mandibles are among the most frequently studied bones within the corpus of hominin fossils. These studies mainly concern patterns of growth and development as well as phylogenetic relationships. Regarding Neandertals, one of the limitations in these studies is the relatively small number of available immature mandibles in each age group and at every stage of their evolution, at least from MIS 8 — and from MIS 12 or even 13 for the first appearance of some Neandertal features — to MIS 3. In addition, most of the known specimens are incomplete or at worst very fragmentary. As a result (Mann & Vandermeersch, 1997), fossils originating from sites all over Europe and the Near-East must be used in order to have a graduated series of Neandertal specimens from infancy to adulthood, which may unfortunately introduce bias that complicates the decoding of the influence of other features. Furthermore, it has to be considered that the determination of the age of Neandertal fossils can vary depending on the methods used as most of them are conventional methods of anthropology originally designed for modern populations applied to Neandertals, sometimes with some random corrections. Newer determinations, like on Scla 4A-1 & 9, are sometimes based on the most recent histological techniques. Another problem that can be encountered is the difficulty of taking into account differences related to sexual dimorphism, which is very difficult to evaluate on fossils and particularly on isolated specimens not associated with innominate bones, as is the case for Scla 4A-1 & 9.

Despite such challenges, the Scla 4A-1 & 9 hemimandibles (Figure 1), the two parts of the Scladina I-4A specimen, are of great interest.

The first quality of the specimen is that it is one of the most well-preserved Eurasian Neandertal juvenile mandibles and by far the most complete from the Meuse Basin. In fact, although about 25% of the entire Neandertal remains are immature individuals (Tillier, 1995; Mann & Vandermeersch, 1997), most of them are more or less fragmentary, which further accentuates the interest of this mandible.

A second essential interest of the specimen is its biological age since immature fossil bones, notably mandibles and maxillae, are uncommon in the European Neandertal age group represented on Scladina I-4A (Minugh-Purvis, 1988).

Finally, a third major interest of the mandible is its antiquity which likely corresponds to MIS 5 b-a — or less probably to the very beginning of MIS 4 — a period in which Neandertal fossils are rare in northwestern Europe. In this regard, most of the Belgian Neandertals belong to MIS 3, i.e. Spy, Couvin, Walou and Goyet. In fact, at the scale of the Belgian Meuse Basin, six complete and partial mandibles have been found since the beginning of palaeoanthropological research, at the end of the third decade of the 19th century

**Figure 1:** Scladina mandible (Scla4A-1 & 9) without the refitted teeth found isolated in the cave sediments (photograph Joël Éloy, AWEM).


Figure 2: Scla 4A-1 right hemimandible: a. superior view; b. inferior view (photographs Joël Éloy, AWEM).

(Toussaint, 2001; Toussaint et al., 2011). Four of these belong to adults, i.e. the famous La Naulette specimen (Dupont, 1866; Leguebe & Toussaint, 1988), two from Spy (Fraipont & Lohest, 1887; Thoma, 1975) and one from Goyet (Rougier et al., 2009). The two remaining mandibles belong to children: the partial Spy VI (Crevecoeur et al., 2010) and Scladina I-4A (Toussaint et al., 1998). This information also means that one or more mandibles, nearly complete or fragmented, have been found in half of the Mosan Neandertal fossil sites. It is also of importance to note that by adding the teeth of Engis (Tillier, 1983[a]), Couvin (Toussaint et al., 2010) and Walou (Toussaint, 2011), as well as the maxillary molar, now lost, found at Fonds de Forêt (Twiesselmann, 1961), all regional Mosan Neandertal sites have yielded mandibular remains. At Fonds de Forêt however, it is not possible to be certain that the lost molar is really from the same taxon as the partial femur found on this site.

The Scla 4A-1 & 9 mandible examined here was never before completely analysed and only briefly described in preliminary papers (especially Toussaint et al., 1998).

## 2. Discovery and preservation

The Scla 4A-1 & 9 mandible was found in two major pieces, with, in addition, a set of teeth discovered separately and found scattered in the sediments of different layers of Sedimentary Complex 4A (see Chapter 5). Altogether, the different bones and teeth belonging to the mandible were found in an elliptical area of about 13 m in length and 5 m wide. They were discovered in the stratigraphical units 4A-CHE and 4A-POC, at least in secondary position.

The largest portion of the mandible, referred to as Scla 4A-1 (Figure 2), was found on July 16, 1993 in Square D29. Although not immediately authenticated as a Neandertal in the field (Bonjean et al., 2009), its position was precisely recorded in situ as is the case for thousands of bones found in Scladina Cave. The fossil consists of the biggest part of a right hemimandible including the ramus and much of the corpus of which the anterior part, that is to say the area before the middle of the socket of the canine, is missing. Four permanent teeth are present, i.e. the completely erupted $M_1$, the nearly erupted $M_2$, the germ of $M_3$, partially visible in occlusal view in its already open socket, as well as the unerupted $P_4$, which had to be studied using X-rays and micro-CT. The bone is dense. No indications of pathology are present. A small splinter belonging to the upper part of the anterior border of the right ramus was detached during the excavation process and was latter refitted. This right hemimandible is fossilized. Its surface is slightly polished; but, this may have been accentuated by the wax used in moulding the fossil. The main colours are grey and pale yellow. Small and thin cracks, mainly parallel to the longitudinal axis of the body, are present (beginning of stage 1 of Behrensmeyer, 1978). No manganese coating was present. No rodent or carnivore marks were observed. The anterior break corresponds to that of Scla 4A-9: vertical in its two upper thirds, then slightly distally oblique. The gonion is eroded. The internal part of the condyle is eroded while the external one is partially missing.

The second portion of the mandible, Scla 4A-9 (Figure 3), was found 3 years after the first part, on July 12, 1996 in Square C28, at a horizontal distance of about 1 m from Scla 4A-1. The fossil, immediately identified as human, is represented by the anterior part of the right corpus (missing on Scla 4A-1), the symphysis and the left corpus. The left ramus is missing. Three permanent left teeth are present, i.e. the completely erupted $M_1$, the nearly erupted $M_2$, and the unerupted $P_4$. The fossil exhibits numerous thin cracks, mainly horizontal but also vertical. Manganese coats both sides, generally as small stains, but sometimes fused; in most cases, a manganese coating covers the cracks. Excavation damage, i.e. marks


Figure 3: Scla 4A-9 left hemimandible: a. superior view; b. inferior view (photographs Joël Éloy, AWEM).

of an metal scraper used by the excavator, is also present, mainly on the inner face. Scla 4A-9 is not as heavy as 4A-1. The color is different from the other side of the mandible: its main colours are dull yellow orange and light yellow orange.

Both Scla 4A-1 and 4A-9 can be perfectly refitted. The mandible, taken as a whole, is nearly undistorted and fairly well preserved. The right part (Scla 4A-1) articulates with the maxillary fragment Scla 4A-2. Some isolated teeth were refitted on both parts of the mandible (see Chapter 13).

## 3. Age and sex

Initially estimated at around 10-11 years using conventional methods (Otte et al., 1993; Toussaint et al., 1998), the subject's age has been determined more precisely to 8 years thanks to a histological study (Smith et al., 2007; see also Chapter 8). The sex of an isolated fossil mandible, especially one belonging to a juvenile, is virtually impossible to determine with certainty. In the case of Scladina I-4A, however, various features of the teeth and the mandible might suggest a female (see Chapter 9).

## 4. Mandibular morphology

### 4. 1. Symphyseal region

#### 4.1.1. Decription

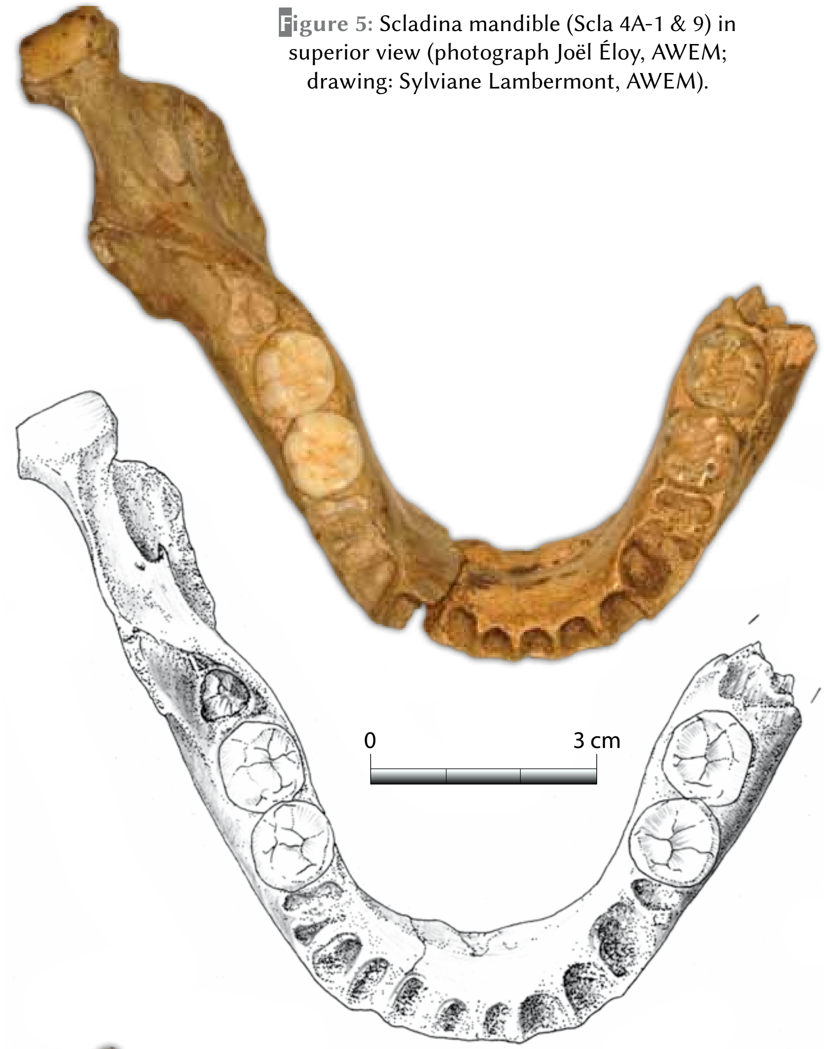
##### 4.1.1.1. Anterior face

Viewed from the side with the fossil resting on its base, the anterior profile of the symphyseal region (Scla 4A-9) leans slightly backward (Figure 4). In fact, when the mandible lies on its inferior border, its anterior face is entirely hidden in superior view (Figure 5). By contrast, this face is perceptible in modern juveniles due to a prominent mental protuberance.

The anterior face of the symphyseal region (Figure 6) only shows a very slight depression which could suggest the presence of a faint *incurvatio mandibulae anterior*. The Scla 4A-9 *mentum osseum* rank is only 2 according to Dobson & Trinkaus' (2002) terminology. The outline of a non-projecting *tuber symphyseos*, or symphyseal


Figure 4: Scladina mandible (Scla 4A-1 & 9) viewed from the right side showing the receding symphyseal region (photograph Joël Éloy, AWEM; drawing Sylviane Lambermont, AWEM).

Figure 5: Scladina mandible (Scla 4A-1 & 9) in superior view (photograph Joël Éloy, AWEM; drawing: Sylviane Lambermont, AWEM).



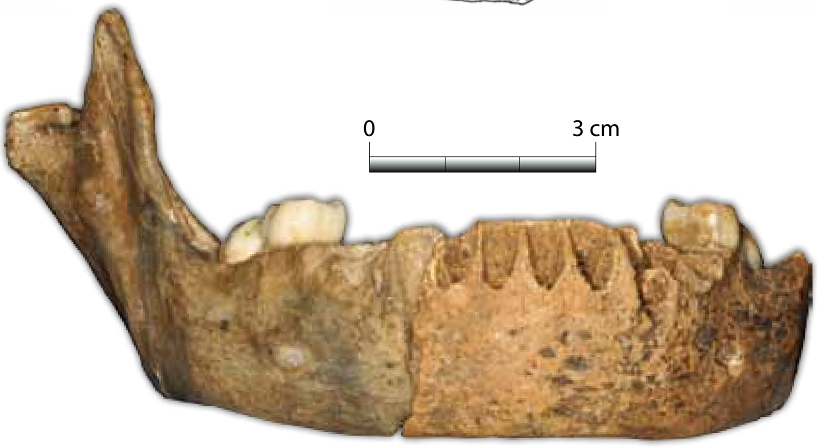




Figure 6: Scladina mandible (Scla 4A-1 & 9), anterior face of the symphyseal region (photograph Joël Éloy, AWEM).

tubercle, can be observed along the midline approximately a third of the way up from the base; but, the specimen lacks the lateral tubercles (*tubercula lateralia*) and, therefore, there is no clearly defined modern human-like protruding mentum osseum or "chin". Between both anterior walls of the central incisors, on Scla 4A-9, is a faint vertical ridge which corresponds to the symphysis.

#### 4.1.1.2. Posterior surface of the symphysis

The superior third of the posterior surface (Figure 7) of the Scla 4A-9 symphysis recedes obliquely backwards, producing a relatively well expressed alveolar plane (*planum alveolare*). This inclined area is delineated superiorly by the alveolar posterior border of the sockets of the incisives and canines and inferiorly by the superior transverse torus (Figures 8 & 9). This thickening (*torus transverses superior* or *margo terminalis*) extends laterally to about the level of the $P_3$, then becomes indistinguishable. Both the *planum* and the torus are vertically divided by a thin groove which is the remnant of the fusion of both hemimandibles (*crista interincisiva interna*). The *planum* itself is slightly concave, which could correspond to very weak *fossae subincisivae internae.*

In the upper part of the *planum* is one vascular foramen on each side of the sagittal suture. The left one has a diameter of around 0.75 mm and is at 4 mm from the suture and at around 3 mm below the alveolar border. The right one is slightly below, at around 3.5 mm from the alveolar border, and at 4.7 mm from the suture; its diameter is about 0.5 mm.

The well marked genioglossal fossa (*fossula supraspinata*) is overhung by and just below the superior transverse torus. This fossa opens slightly below the mid-level of the mandible and is transversally oval. Its depth is 1.4 mm. A genial canal (*foramen supraspinosum*) is present at the deepest part of the fossa. One small adjacent foramen is present in both lateral parts of the fossa, 5 mm from the genial canal and around 1 mm below the level of its centre.

The genioglossal fossa is bounded below by the inferior transverse torus (*torus transverses inferior* of Holl), which is a thickening of the posterior part of the base of the mandible. In inferior view, the inferior transverse torus appears to be less developed in its postero-central part, a few millimeters on each side of the vertical axis of the symphysis. Laterally, the torus bulges forming two excrescences, the 'transverse rolls' ("éminences arrondies", parts of the "bourrelet transversal" of Piveteau, 1963: 302), and extends, although increasingly less marked, to the level of the $P_3$–$P_4$ septum.

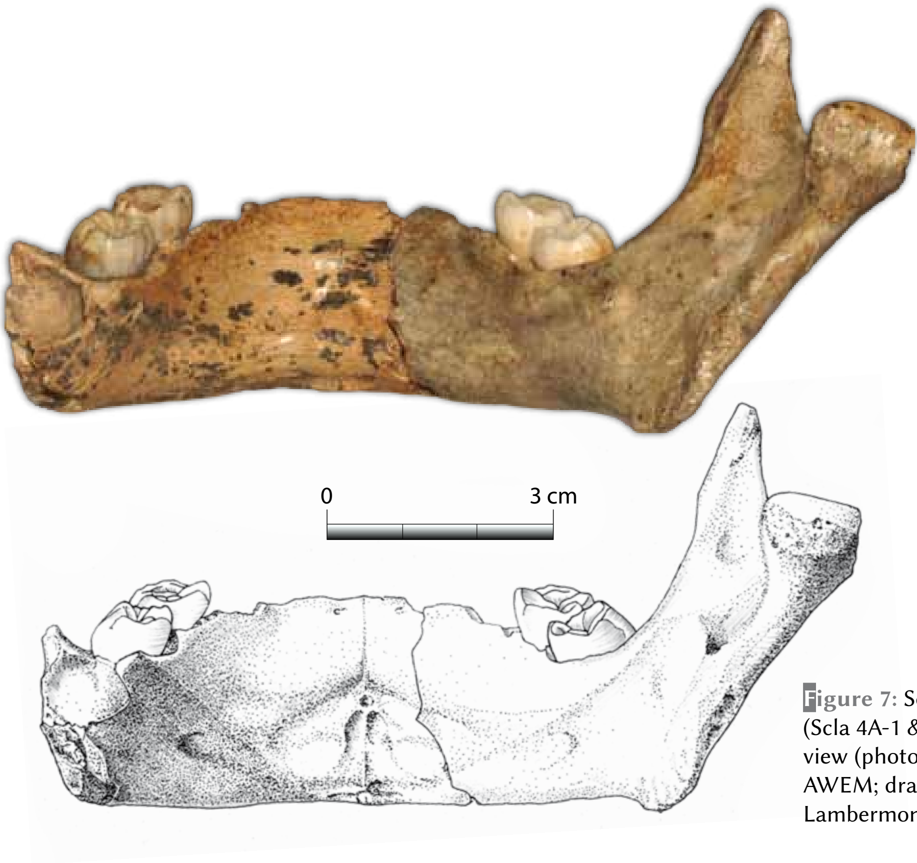



**Figure 7:** Scladina mandible (Scla 4A-1 & 9), posterior view (photograph Joël Éloy, AWEM; drawing Sylviane Lambermont, AWEM).

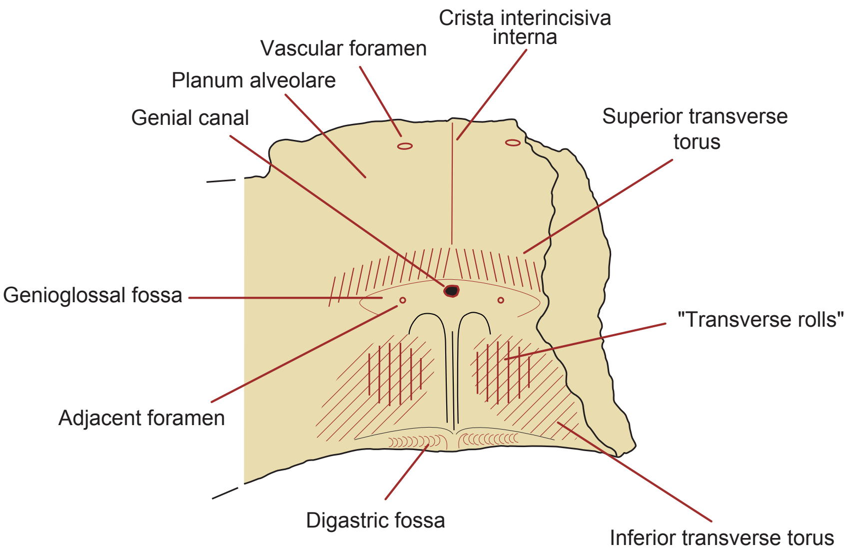



**Figure 8:** Scladina hemimandible (Scla 4A-9), posterior surface of the symphysis (graphics Sylviane Lambermont, AWEM).

The lower part of the genioglossal fossa is vertically divided by three parallel sagittal ridges which join just below the genial canal: a sagittal one, and two lateral curved ones. These three crests are the mental spine (*spina mentalis* of Weidenreich, 1936: 45). The two small vertical areas between the three crests are slightly depressed. The two lateral spines end at the superior inner part of the excrescences ("bourrelets transversaux") while the central mental spine goes down between the excrescences and continues between the digastric fossae as a series of very fine accessory crests which form the interdigastric spine.

#### 4.1.1.3. Alveolar border

In the occlusal view, the alveoli of the incisors and, to a lesser extent, of the canines, as well as the teeth themselves, tend to be placed in a

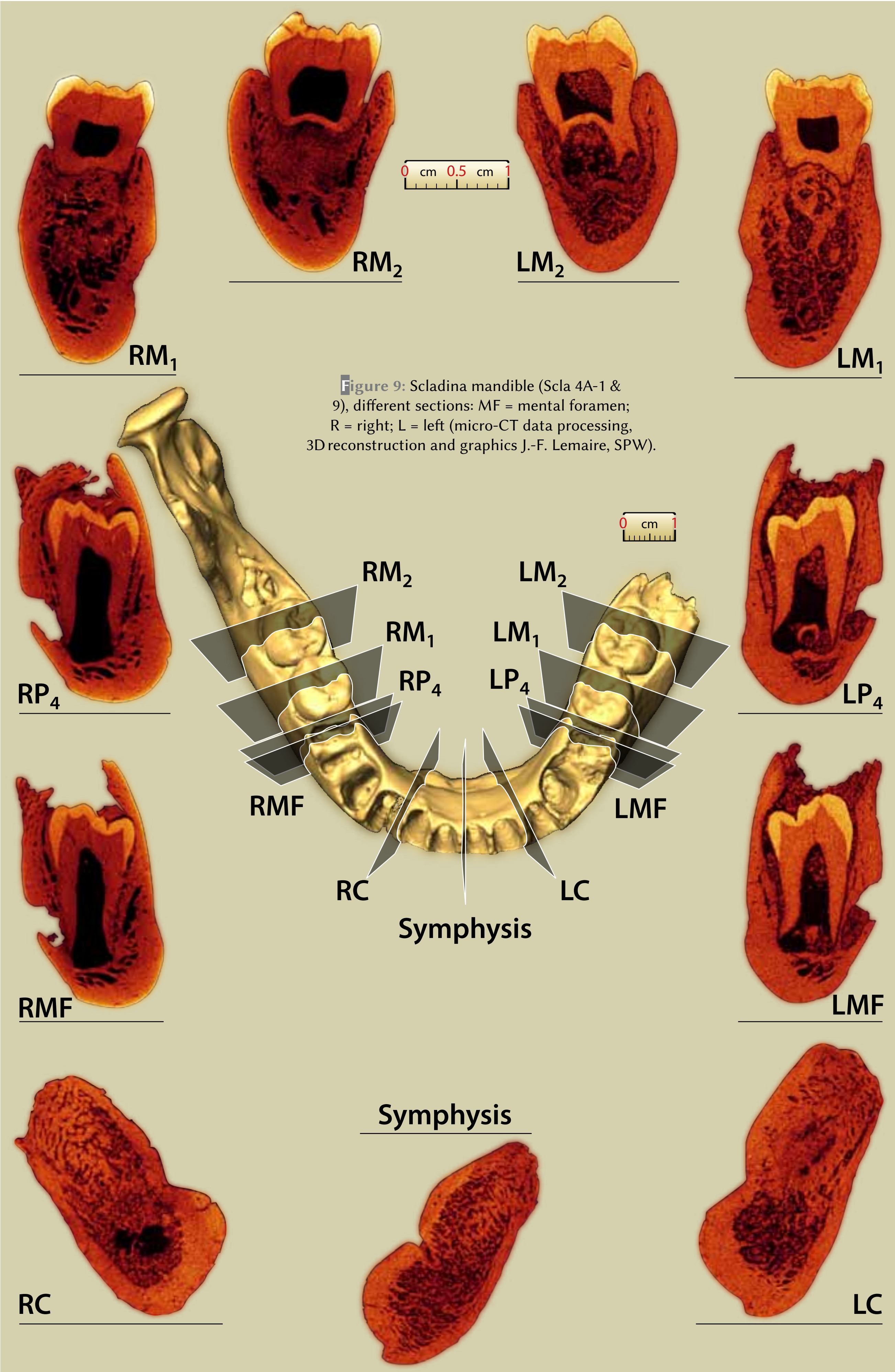



**Figure 9:** Scladina mandible (Scla 4A-1 & 9), different sections: MF = mental foramen; R = right; L = left (micro-CT data processing, 3D reconstruction and graphics J.-F. Lemaire, SPW).

frontal alignment, although slightly arched from side to side. In other words, the main axis of the central incisors is antero-posterior, the axis of the lateral incisors is nearly antero-posteriorly orientated while that of the canines is slightly laterally turned.

In superior view, the width of the central incisor alveolus is 4.7 mm and that of the lateral ones 5.5 mm. The antero-posterior diameters of these teeth cannot be measured precisely as the anterior walls of the upper part of the corresponding sockets are strongly eroded. Nevertheless, the sockets of the lateral incisors are slightly longer than those of the central ones. The mesiodistal diameter of the left canine socket is around 6.8 mm.

#### 4.1.1.4. Inferior border

On the inferior part of the symphyseal region, the digastric fossae, attachment sites for the digastric muscles, are well marked (Figure 10). They face inferiorly and slightly downwards, are oval in shape, and are separated from each other by the interdigastric spine, an extension of the mental spine. The dimensions of the digastric fossae are around 14.5 mm × around 7.5 mm on both sides.

On the basal symphysis, there is a slight arch corresponding to a very weak *incisura submentalis*. As already pointed out, conspicuous arches are usually associated with developed anterior marginal tubercles (Rosas, 1995: 552; Quam et al., 2001: 397; Daura et al., 2005: 63). The fact that the *incisura submentalis* appears to be weakly expressed correlates well with the weakness of the corresponding anterior marginal tubercles.

### 4.1.2. Taxonomy

Some important features observed on the symphysis of the mandible (Scla 4A-9) are archaic/plesiomorphic as on the other immature Neandertal mandibles (Tillier, 1983[b]: 143; Tillier, 1991: 109):

— on the anterior face, the absence of a modern chin with all its components (Rak et al., 2002);
— on the posterior face of the symphysis, a distinct *planum alveolare* (Tillier, 1979; Hublin & Tillier, 1981; Rightmire, 1990; Quam et al.,

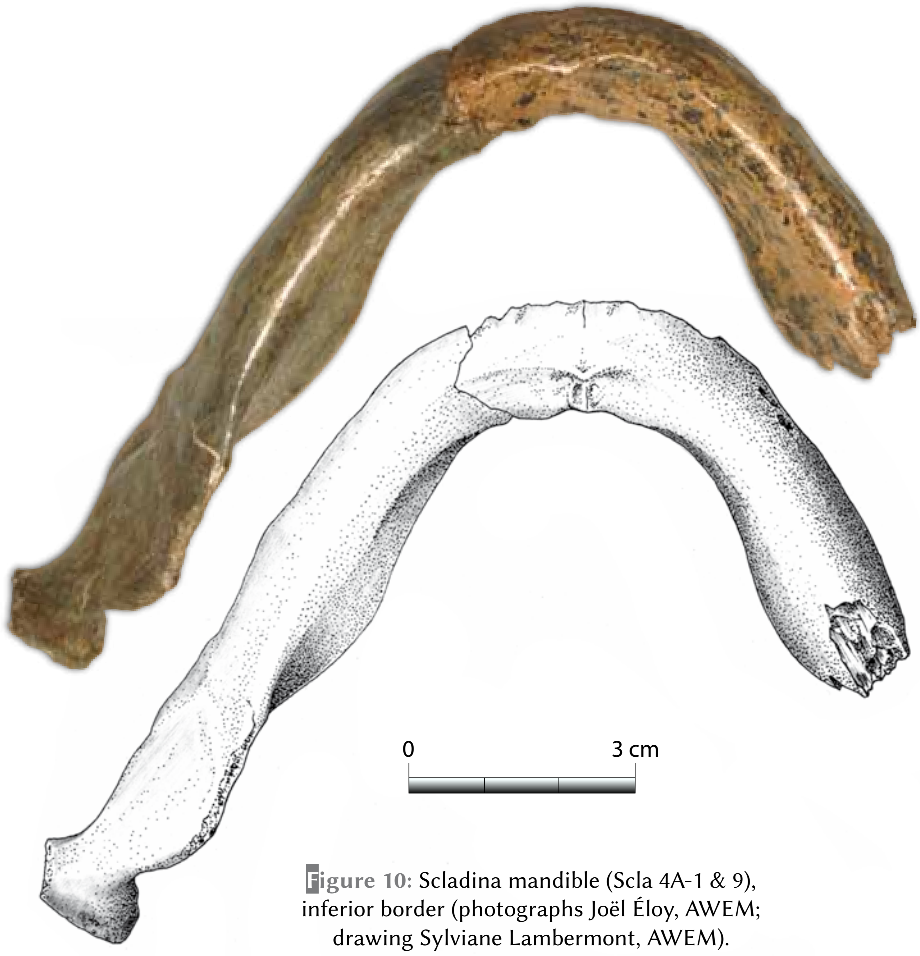



**Figure 10:** Scladina mandible (Scla 4A-1 & 9), inferior border (photographs Joël Éloy, AWEM; drawing Sylviane Lambermont, AWEM).

2001: 400, 429; DAURA et al., 2005: 62), a superior transverse torus (HUBLIN & TILLIER, 1981) and a genioglossal fossa (*fossula supraspinata*; TILLIER, 1979; HUBLIN & TILLIER, 1981; TILLIER, 1986: 214);

— on the inferior border, a nearly inferior orientation of the digastric fossae (TILLIER, 1984; RIGHTMIRE, 1990; HEIM & GRANAT, 1995; DAURA et al., 2005), whereas modern humans usually have more posteriorly-facing fossae.

Frontal alignment of the anterior alveoli and teeth is common, but not constant, among Neandertals, including juveniles (VANDERMEERSCH, 1981: 152; TILLIER, 1986: 209, 213; 1991: 110). However, the morphologically modern immature Qafzeh 11 mandible in a Mousterian context (TILLIER, 2002; DAURA et al., 2005) shows a frontal alignment. So, the taxonomic inferences which could be drawn on this feature are likely not really founded and this feature cannot be considered as derived (HEIM & GRANAT, 1995: 85).

## 4.2. Mandibular body

### 4.2.1. Height and thickness

The height of the mandibular body (or lateral corpus or horizontal ramus) decreases and is progressively thickened from the front to the rear. This characteristic is often seen as modern (VANDERMEERSCH, 1981: 147–148), but the analysis of a modern collection (Place Saint-Lambert in Liège; personal observation) suggests that it has little taxonomic value in juveniles as all combinations of these two measurements are present.

### 4.2.2. Description

#### 4.2.2.1. External aspect

On both sides, the lateral prominence (*protuberantia lateralis*) is at the level of $M_2$, but has only vague outlines (Figures 11-13). Other reliefs are very poorly expressed and difficult to individualize as the outer face is smooth. The weakly discernible superior lateral torus (*torus lateralis superior*, WEIDENREICH, 1936: 24, or *torus marginalis superior*, ROSAS, 1995), the upper anterior branch of the lateral prominence, makes its way towards the upper part of the mental foramen. Above the lateral prominence and the superior lateral torus is the extramolar sulcus (*sulcus extramolaris*, KEITER, 1935; WEINDENREICH, 1936: 24). Below the superior lateral torus, the *sulcus intertoralis* (WEIDENREICH, 1936: 24) is not really present, just as a very shallow depression barely palpable below and behind the foramina, especially on the left side (Scla 4A-9). The weak marginal rim (*torus marginalis inferior*; WEIDENREICH, 1936: 24) blends into the inferior border of the corpus.

The anterior marginal tubercle (*tuberculum marginale anterius*) is only weakly expressed; on the right side (Scla 4A-1), it is along the external edge of the basal border, at the level of $P_4$, below the posterior part of the biggest mental foramen and below the bridge of bone between both foramina.

The left mental foramen (Scla 4A-9; Figure 14a) is located at the level of the still included $P_4$ and has the aspect of a postero-inferior irregular oval depression in which two foramen open, one inferiorly and slightly inferiorly and the second anteriorly. The longitudinal diameter of the depression is about 5.5 mm and its height nearly 4.1 mm.

The right foramen (Scla 4A-1; Figure 14b) is duplicated. The main aperture, 4.4 mm long and 2.7 mm high, is at the level of the embedded $P_4$ and


Figure 11: Scla 4A-1 right hemimandible, external aspect (photograph Joël Éloy, AWEM).

Figure 12: Scla 4A-9 left hemimandible, external aspect (photograph Joël Éloy, AWEM).

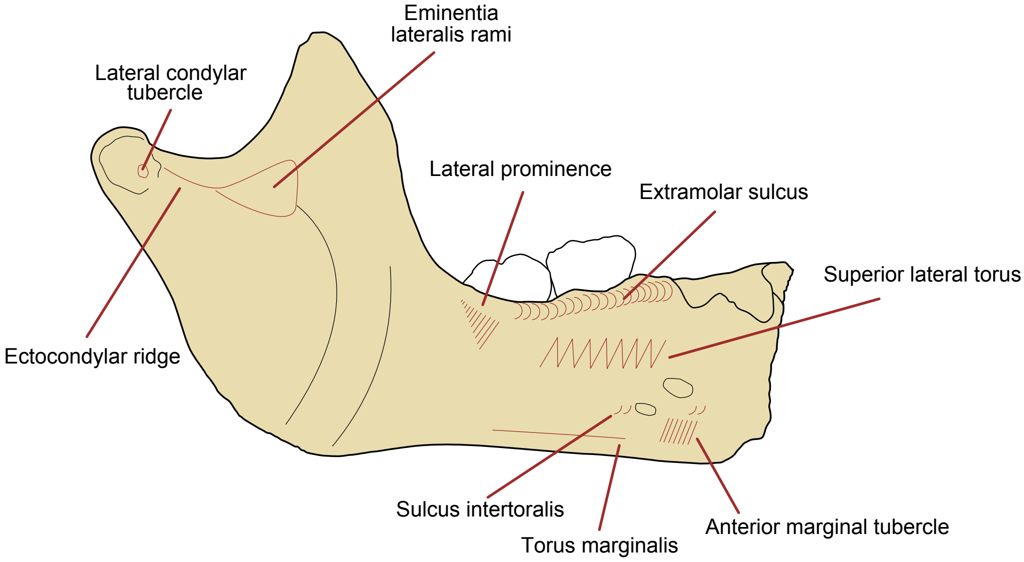



**Figure 13:** Scladina right hemimandible (Scla 4A-1), external aspect of the body (graphics Sylviane Lambermont, AWEM).

is posteriorly orientated. The accessory foramen (3.8 × 2.0 mm) is behind and slightly below the main one, at which it is internally connected but externally separated by a bony bridge of ±2.8 mm; this foramen just at the level of the septum between $P_4$ and $M_1$, and is posteriorly orientated. A bridging of the mental foramen has been reported on other Neandertals: adults as the Regourdou right ramus (Piveteau, 1963-1966); adolescents or young adults such as Cova del Gegant (Daura et al., 2005) or juveniles such as Combe-Grenal (Garralda & Vandermeersch, 2000).

The left mental foramen and the main right one are on the lower half of the mandibular body, but just below the middle of the body height. The small right foramen is near the limit between the middle and lower third of the ramus. Different methods are used to assess this low position. The Virchow index compares the distance from the center of the aperture to the basal border (A) with the corpus height (B) at that level (I = 100 × A / B). Some other authors compare the distance from the mental foramen to the basal border and to the alveolar border (Rosas, 1995: 552–553). Table 1 provides all these measurements for Scla 4A-1 and 4A-9 as well as for some other (pre-) Neandertal and modern mandibles. It confirms that on both sides of the Scladina I-4A mandible, the main mental foramen is located in the upper part of the lower half of the corpus.


**Figure 14:** Scladina mandible, mental foramen: a. left (Scla 4A-9); b. right (Scla 4A-1; photographs Joël Éloy, AWEM).

| Specimen | Age at death | | | Mental foramen | | | | Reference |
|---|---|---|---|---|---|---|---|---|
| | Classic | Histology or Granat's technique | Class | Height of corpus | Height from basal margin | Height to alveolar margin | Virchow index | |
| Scla 4A-9 (left) | 10-11 yrs | 8 yrs | S3 | 24.5 | 11.0 | 13.5 | 44.9 | Present author (M. T.) |
| Scla 4A-1 (right) | | | | 23.9 | 10.3 | 13.6 | 43.1 | Present author (M. T.) |
| Ehringsdorf 6 (F, 109/69; right) | adult | | | 27 | 15 | 12 | 55.5 | Vlček, 1993: 128, 130, 136 |
| Ehringsdorf 6 (F, 109/69; left) | | | | 27 | 13.5 | 13.5 | 50 | Vlček, 1993: 128, 130, 136 |
| La Naulette | adult | | | 25 | 12 | | 48 | Leguebe & Toussaint, 1988 |
| Mauer | adult | | | 34 | 18 | | 53 | Billy & Vallois, 1977 |
| Montmaurin | adult | | | 29 | 15 | | 51.7 | Billy & Vallois, 1977 |
| Bañolas (right) | adult | | | | | | 61.5 | de Lumley-Woodyear, 1973 |
| Bañolas (left) | adult | | | | | | 61.6 | de Lumley-Woodyear, 1973 |
| Arago 2 | adult | | | | | | 39.6 | de Lumley-Woodyear, 1973 |
| Spy 1 | adult | | | 33 | 15 | | 45.5 | Billy & Vallois, 1977 |
| La Ferrassie 1 | adult | | | 35 | 14 | | 40 | Billy & Vallois, 1977 |
| Krapina H | adult | | | 35 | 14 | | 40 | Billy & Vallois, 1977 |
| La Quina H9 | adult | | | | | | 48.4 | de Lumley-Woodyear, 1973 |
| Regourdou (sup. foram.) | adult | | | | | | 48.4 | de Lumley-Woodyear, 1973 |
| Regourdou (inf. foram.) | | | | | | | 33.4 | de Lumley-Woodyear, 1973 |
| Circé II (sup. foram.) | adult | | | | | | 48.5 | Sergi & Ascenzi, 1955 |
| Circé II (inf. foram.) | | | | | | | 34.2 | Sergi & Ascenzi, 1955 |
| Circé III (sup. foram.) | adult | | | | | | 35.1 | Sergi & Ascenzi, 1955 |
| Circé III (inf. foram.) | | | | | | | 32.4 | Sergi & Ascenzi, 1955 |
| Cova del Gegant | 15 yrs or adult | | | (31.0) | 11.1 | (17.0) | 35.8 | Daura et al, 2005: 63 |
| Atapuerca AT-1 | adult | | | 30.2 | 12.1 | 17 | 40.1 | Rosas, 1997: 322, 324 |
| Atapuerca AT-2 | adolescent | | | 26.5 | 9.6 | 15 | 36.2 | Rosas, 1997: 324 |
| Atapuerca AT-3 | immature | | | 27.8 | 10.9 | 17.7 | 39.2 | Rosas, 1997: 324 |
| Atapuerca AT-172 | immature | | | 28 | 11.8 | 17.1 | 42.1 | Rosas, 1997: 324 |
| Atapuerca AT-250 | senile | | | 31 | 11.5 | 19.8 | 37.1 | Rosas, 1997: 324 |
| Atapuerca AT-300 | adult | | | 34.3 | 12.5 | 22.5 | 36.4 | Rosas, 1997: 324 |
| Atapuerca AT-505 | adult | | | 26.7 | 10.4 | 16.9 | 38.9 | Rosas, 1997: 324 |
| Atapuerca AT-605 | adult | | | 37.1 | 16.3 | 19.8 | 43.9 | Rosas, 1997: 324 |
| Atapuerca AT-607 | adolescent | | | 27.1 | 11.9 | 13.8 | 43.9 | Rosas, 1997: 324 |
| Atapuerca AT-888 | | | | 42 | 13.3 | 21.7 | 31.7 | Rosas, 1997: 324 |
| Atapuerca AT-950 | | | | 43.6 | 11.8 | 17.8 | 27.1 | Rosas, 1997: 324 |
| Roc de Marsal (left) | ± 3 yrs | 2 yrs 5 months | S1 | 17.6 | (7.6) | 10 | (43.2) | Madre-Dupouy, 1992 |
| Roc de Marsal (left) | | | | | (9.8) | 7.8 | (55.7) | Madre-Dupouy, 1992 |
| Roc de Marsal (right) | | | | 17.4 | (7.9) | 9.5 | (45.4) | Madre-Dupouy, 1992 |
| Roc de Marsal (right) | | | | | (8.3) | 9.1 | (47.7) | Madre-Dupouy, 1992 |
| Archi 1 | 5-6 yrs (or 3) | 2.5 yrs | S1 | 21.3 | 6.8 | 11.2 | 31.9 | Arnaud, 2014 |
| Combe-Grenal | 6-7 yrs | 4.5 yrs | S3 | 26.9 | 10.5 | 16.4 | 39.0 | Genet-Varcin, 1982 |
| Fate 2 | 9-10 yrs | | S3 | 19.9 | (9) | | 45.2 | Giacobini et al., 1984 and M. T. |
| Hortus 2-3 | 9 yrs | | S3 | 25.5 | 7.8 | (17.7) | 30.9 | de Lumley-Woodyear, 1973 |
| Malarnaud 1 | 12 yrs | 11 yrs 2 months | (S4) | 24 | (11.2) | | 46.9 | Heim & Granat, 1995 |
| Montgaudier 1 | 12.5-14.5 | | S4 | 23.3 | 8 (lowest foram.) | 13.1 (highest foram.) | 34.3 | Mann & Vandermeersch, 1997 |
| Valdegoba VB1 | 13-14 yrs | | S4 | | | 11.7 | | Quam et al., 2001: 402, 404 |
| Petit-Puymoyen 1 | 16-17 yrs | 14 yrs 4 months | S4 | 28.2 | 10.5 | 17.7 | 37.2 | Present author (M. T.) |
| Neandertal | juveniles | | S1-S4 | 23.3 ± 4.5 (n= 13) | 10.1 ± 3 (n= 13) | 11.5 ± 1.8 (n= 13) | | Arnaud, 2014 |
| MHSS | juveniles | | S1 | 18.2 ± 1.9 (n= 14) | 7.4 ± 0.6 n= 14) | 9.9 ± 1.8 (n= 14) | | Arnaud, 2014 |
| MHSS | juveniles | | S2 | 21.9 ± 2.2 (n= 16) | 9.7 ± 1.6 (n= 16) | 11.1 ± 1.2 (n= 16) | | Arnaud, 2014 |
| MHSS | juveniles | | S3 | 25.4 ± 4.7 (n= 13) | 11.0 ± 2 (n= 13) | 13.3 ± 2.8 (n= 13) | | Arnaud, 2014 |
| MHSS (Virchow) | adult | | | | | | 42-58 | Billy & Vallois, 1977 |
| MHSS (Schultz) | adult | | | | | | 36-65 | Billy & Vallois, 1977 |

Table 1: Position of the mental foramen of Scladina I-4A and comparisons (heights in mm; for age classes, see § 5.1).


Figure 15: Scladina right hemimandible (Scla 4A-1), internal aspect (photograph Joël Éloy, AWEM).

Figure 16: Scladina left hemimandible (Scla 4A-9), internal aspect (photograph Joël Éloy, AWEM).

### 4.2.2.2. Internal aspect

This area is well preserved on both sides of the mandible (Figures 15–17).

The mylohyoid line (*linea mylohyoidea*) extends from the anterior part of the $M_3$ where it is close to the alveolar margin. This line is then diagonally inclined. On both sides, it merges with the surrounding surface of bone below the $P_3$–$P_4$ septum, about 5 mm behind and slightly above the "éminences arrondies" (see 4.1.1.2.) and around 15 mm below the alveolar margin.

There is no *torus mandibularis* as can be seen on some adult Neandertals, such as Regourdou (Piveteau, 1964: 161).

The *planum subalveolaris* (also called *fossa sublingualis* and *fossa subalveolaris anterior*; see Weidenreich, 1936: 49) exhibits a triangular shape and is flat and smooth.

The submandibular/sublingual fossa (also known as *fossa subalveolaris posterior* by Weidenreich, 1936: 48, *fossa submaxillaris* by Weidenreich 1936: 48 or *fovea submaxillare*) is relatively deep and anterio-posteriorly elongated, parallel to the inferior rim.

### 4.2.2.3. Inferior border

In lateral view, the base of the right hemimandible Scla 4A-1 only touches the basal plane on two points, below the very posterior part of the right $P_3$ and at the gonial angle. The *incisura praeangularis*, or pregonial notch, of Scla 4A-1 between these two points, is very long, i.e. 52 mm. The depth of this notch is low but regularly increases up to the middle of $M_2$, at the level of which the deepest point of the incisura is located, then rapidly decreases posteriorly.

The anterior marginal tubercles which are above the limit between the submental incisure of the anterior face of the symphysis and the long *incisura praeangularis* are extremely weak.

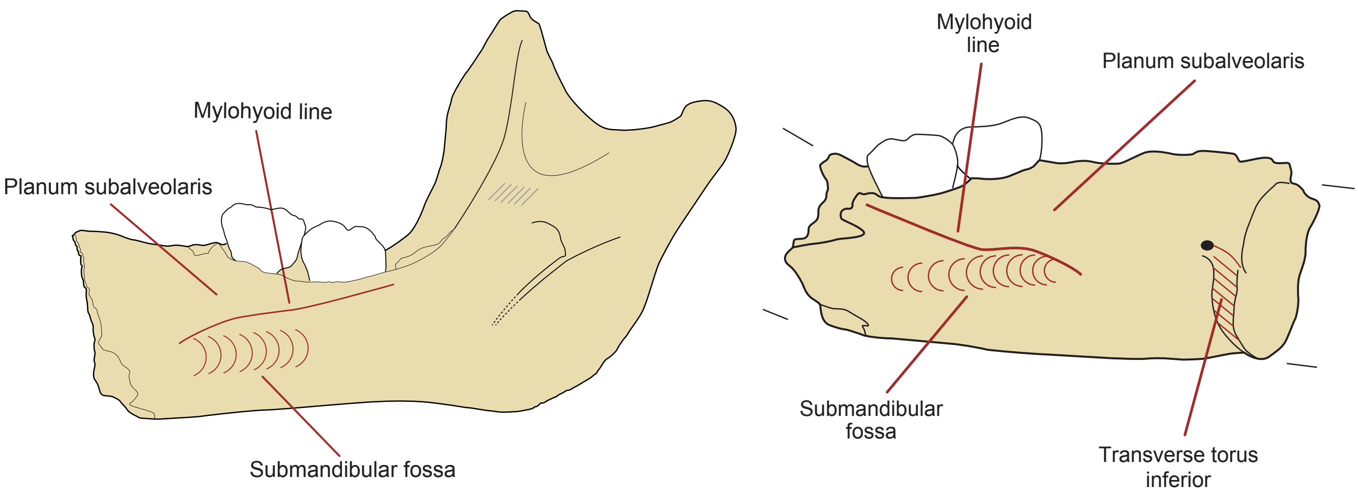



Figure 17: Scladina mandible, internal aspect of the right (Scla 4A-1) and left (Scla 4A-9) bodies (graphics Sylviane Lambermont, AWEM).

In basal view and on both sides, the lower margin of the body is slightly lingually concave from the gonion to the interdental septum $P_4/P_3$ where it turns strongly medially at the posterior limit of the digastric fossa. The margin expands from a thin rear edge behind unerupted $M_3$ to a progressively thicker one from $M_2$ to $P_4$ and even more in the symphyseal region. So, this structure decreases continuously and regularly from the symphysis to the ramus.

#### 4.2.2.4. Superior border

The superior border of the Scladina mandible does not have any retromolar space on the right side (Scla 4A-1) on which the corresponding area is well preserved; apparently the same is true on the left side (Scla 4A-9) where this area is only partially preserved. It has been shown that the retromolar space only develops near the end of the growth period (Tillier, 1988) while the Scladina Child is around eight years old (Smith et al., 2007).

In the superior view, the root sockets of the left and right $P_3$ and of both $dm_2$s can be observed. The sockets of the $P_3$ are slightly buccoanteriorly orientated. The upper parts of the septa between the first $P_3$s and the $dm_2$s exhibit marks of remodelling inherent to the exfoliation of the $dm_2$s and root resorption, a result of the beginning eruption of the still embedded $P_4$. Both $P_3$ sockets are not bifurcated. The sockets of the $dm_2$s show two roots, mesial and distal, with bony septa — also with marks of remodelling — separating them.

### 4.2.3. Taxonomy

#### 4.2.3.1. Mental foramen

A frequent suggestion is that a distal mental foramen position, under $M_1$, is a derived feature of the European Classic Neandertals (Stringer et al., 1984; Tillier, 1988: 127; Rosas, 2001: 81; Condemi, 2005). However, the mental foramen of more than half of the European Classic Neandertal specimens is mesial of the $M_1$, i.e. below $P_4/M_1$ or below $P_4$ (Trinkaus, 1993), while mental foramina placed below the $M_1$ are present in other non-classical Neandertal fossils (Atapuerca 1, Arago 2 and 13) as well as in modern human samples (usually in a small percentage, but sometimes up to 12,7%). Therefore, it is inappropriate to use this trait as a Neandertal derived characteristic.

On Scladina I-4A, the mental foramina are under $P_4$ on the right side as well as under $P_4$ and under the septum $P_4/M_1$ on the left side.

#### 4.2.3.2. High placement and diagonal disposition of the mylohyoid line

A high placement of the mylohyoid line at the level of $M_3$ and a diagonal, or inclined, trajectory have both been suggested to be derived Neandertal characteristics (Rosas, 2001: 81; see also Daura et al., 2005: 65) while in modern humans, the trajectory of the line is more parallel to the alveolar border. On both sides of the Scladina mandible, the mylohyoid line is close to the alveolar margin at the level of the non-erupted $M_3$ and is diagonally inclined in front of this tooth.

#### 4.2.3.3. Retromolar space

The retromolar space is often included in the list of Neandertal autapomorphies (Stringer et al., 1984; Tillier, 1988; Condemi, 2001; Rosas, 2001, etc.). However, such a view has been challenged (Franciscus & Trinkaus, 1995). According to Rak (1998[b]: 362), the space itself is not an autapomorphy but, rather, a result of the anterior position of $M_3$.

In fact (Tillier, 1986: 213-214; 1988: 129), the presence of a retromolar space is linked to a complete permanent dentition including the erupted $M_3$. The space is due to the anterior projection of the lower facial area (Tillier, 1986: 213). So none of the Neandertal mandibles with only deciduous teeth erupted, such as Pech de l'Azé, Roc de Marsal, Archi, etc., has a retromolar space. The same absence occurs on mandibles with only an erupted $M_1$ such as Fate II, or with erupted $M_1$ and $M_2$, such as Scladina I-4A.

#### 4.2.3.4. Basal border

From the inferior view, the basal border thickness regularly decreases from the symphysis to the gonion and this is sometimes considered as a derived characteristic of European Neandertals (Piveteau, 1957, 1963; Rosas, 2001: 81). Scla 4A-1 exhibits this feature.

#### 4.2.3.5. Submandibular fossa

A highly excavated submandibular fossa could be another derived characteristic of European Neandertals (Creed-Miles et al., 1996; Rosas, 2001: 81). Both submandibular fossae Scla 4A-1 and 4A-9 are relatively deep and anterio-posteriorly elongated, parallel to the inferior rim.

## 4.3. Ramus

Only the right ramus and gonial region are preserved on Scla 4A-1. These areas are totally missing on the left Scla 4A-9 hemimandible. The ramus is in the same plane as the corpus.

### 4.3.1. Dimensions

The ramus has a minimum width of 35.1 mm., a high value compared to other Neandertals of similar age.

### 4.3.2. Description

#### 4.3.2.1. Internal surface

*Upper and anterior reliefs of the ramus*

The reliefs of the upper part of the internal (orlingual) surface of the right ramus are differently marked (Figure 18). The *crista endocoronoidea*, or endocoronoid crest, coursing nearly vertically along the inner side of the coronoid process is well expressed. The *crista endocondyloidea*, running anterio-inferiorly from the internal border of the condyloid process (von Lenhossék, 1920; Weidenreich, 1936: 50; 68), is well developed in its inferior part but is strongly attenuated near the condyle. Both cristae delineate a distinct *planum triangulare*, which is slightly concave in its anterior part, but the depth of which is increased by the relief of the surrounding *crista endocoronoidea*. The *planum triangulare* is, by contrast, often nearly flat on some other Neandertals mandibles, for instance Regourdou and La Ferrassie 1.

At the junction of the *crista endocoronoidea* and the *crista endocondyloidea*, just before the *foramen mandibulare*, is a clear eminence, the *torus triangularis* (Weidenreich, 1936: 49; 50; 68).

In front of the medial part of the condyle, the *fovea subcondylea* is nearly imperceptible.

From the *torus triangularis*, one rounded crest, which prolongs the endocoronoid crest, runs down anterio-inferiorly to join the *linea mylohyoidea* (see Figure 18) and is known as the *crista pharyngea* (Weidenreich, 1936: 68).

*Mandibular foramen*

The right mandibular foramen of Scladina I-4A, i.e. the aperture of the mandibular canal, points posteriorly and superiorly (Figures 18 & 19). There is a clearly defined *lingula*, but it does not project strongly. The specimen exhibits a narrow V-shaped notch in its postero-inferior margin, the mylohyoid notch; the specimen does not have a

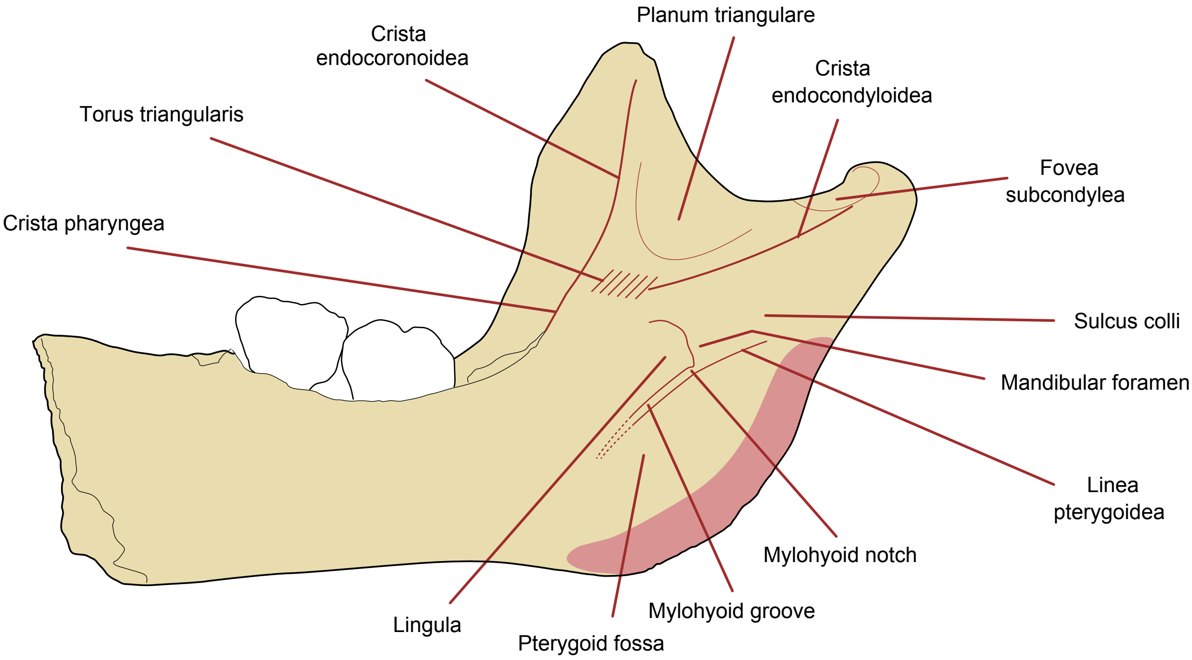



Figure 18: Scladina right hemimandible (Scla 4A-1), internal aspect of the ramus (graphics Sylviane Lambermont, AWEM).


Figure 19: Scladina mandible, right mandibular foramen (Scla 4A-1; photograph Joël Éloy, AWEM).

lingular bridging (Richards et al., 2003: 63). So, the Scladina I-4A foramen does not exhibit the specific form described as 'Horizontal-Oval'. In this H-O type, the inferior rim of the foramen does not dip but extends straight across the foramen; in addition, the *lingula* blends into the inferior rim of the mandibular foramen and extends over the foramen (see also Coqueugniot, 1999).

A small vascular foramen is present 5.5 mm above the upper part of the mandibular foramen.

### *Mylohyoid groove*

The mylohyoid groove descends antero-obliquely directly from the mylohyoid notch. The groove is not bridged but continuous, like in the Regourdou mandible. This sulcus is shallow and not perfectly rectilinear but very slightly concave postero-inferiorly. The sulcus disappears just behind the level of the distal end of the crown of the still included third molar, at about 8 mm from the inferior border of the mandible.

### *Pterygoid fossa*

The internal side of the inferior half of the right Scla 4A-1 ramus exhibits a well demarcated subcircular and deeply excavated pterygoid fossa, the depth of which is emphasized by the internal inflection of the gonial region. The fossa has a diameter of almost 2 cm. Moving forward, it merges into the submandibular fossa which is distinct thanks to a blunt rise.

### *Sulcus colli and tubercles of the posterior border of the ramus*

Behind and below the inferior part of the *crista endocondyloidea* is the well marked sulcus colli. The crest which composes the anterior part of the inferior border of this sulcus and continues as the posterior, albeit low, border of the mylohyoid groove can be called *linea pterygoidea* (Weindenreich, 1936: 70; Richards et al., 2003: 20). The length of the sulcus colli is just above 15 mm at its axis, which is long when the immature state of the fossil is taken into account. The maximum width is 5.5 mm. The anterior part of the sulcus is relatively deep while its posterior component is shallow.

Considerable controversy exits in the naming of the tubercles of the postero-medial part of the mandibular ramus, (Figures 20 & 21; see Rak et al., 1994, 1996; Creed-Miles et al., 1996; Richards et al., 2003).

A small tubercle is present at the posterio-inferior end of the sulcus colli, near and on the posterior border of the ramus of Scla 4A-1. It is the *tuberculum sulcis colli* (tsc) of Richards et al. (2003: 10), and serves as the attachment for the sphenomandibular ligament. In Rak et al.'s (1996) terminology, based on Weidenreich (1936), this feature would be the *tuberculum pterygoideum inferius* (tpi), even if tpi and tsc are not identical (see Richards et al., 2003: 55).

A strongly developed tubercle occurs in the upper area of attachment of the *pterygoideus medialis* muscle, a few mm below the *tuberculum sulcis colli*. This structure is the medial pterygoid tubercle (m.p.t.) of Rak et al., 1994, 1996). In reference to Schumacher's (1959, 1961, 1962) numbering system for tendons of the *pterygoideus medialis* muscle, this fits with septum 6 but also, slightly below, the less marked septum 4.

At the internal part of the Scla 4A-1 gonion are the scallop tubercles (Antón, 1996: 395, 401) which correspond to Schumacher's septa 2' 2'' 2''' of the *pterygoideus medialis* muscle. These three septa are well separated by shallow depressions.

As far as size is concerned, the septa 6 and in a lesser extent 4 are the most hypertrophied while the *tuberculum sulcis colli* and septa 2', 2'' and 2''' are less developed.

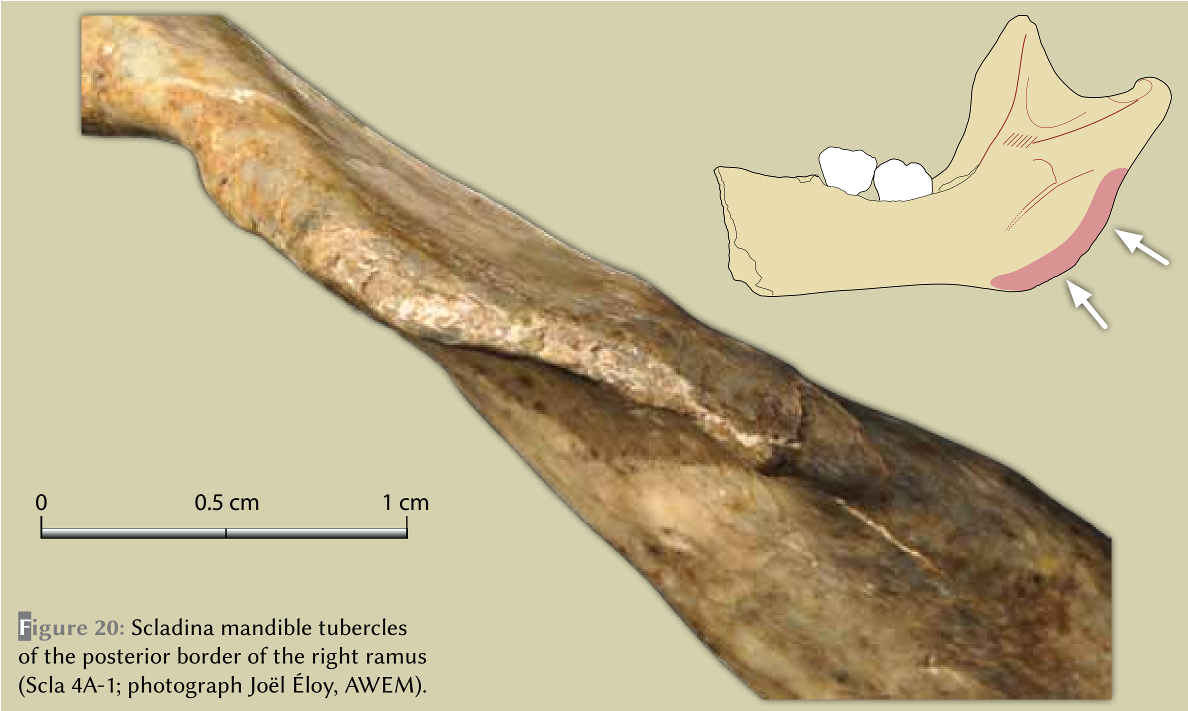



**Figure 20:** Scladina mandible tubercles of the posterior border of the right ramus (Scla 4A-1; photograph Joël Éloy, AWEM).

#### 4.3.2.2. Anterior border

In side view, the outline of the anterior margin of the ascending ramus is sinuous: nearly straight in its anteriorly oblique upper third, and anteriorly concave in its lower part. The ramus displays rather shallow pre-angular notch (Rak, 1998[b]: 360). This depression, when present in Neandertals like Regourdou or La Ferrassie, is not well defined. By contrast, an often well marked pre-angular notch is found in early *Homo sapiens* as well as in modern human mandibles.

In upper as well as in side views, the anterior border does not exhibit a retromolar space.

Behind the still included $M_3$, the socket from which being already largely opened, is a triangular area. The buccal border of this area is the buccinator crest. This crest is well marked in adult Neandertals such as Regourdou or Spy I. At the mesial end of this area is the opening of Robinson's canal (see Heim & Granat, 1995).

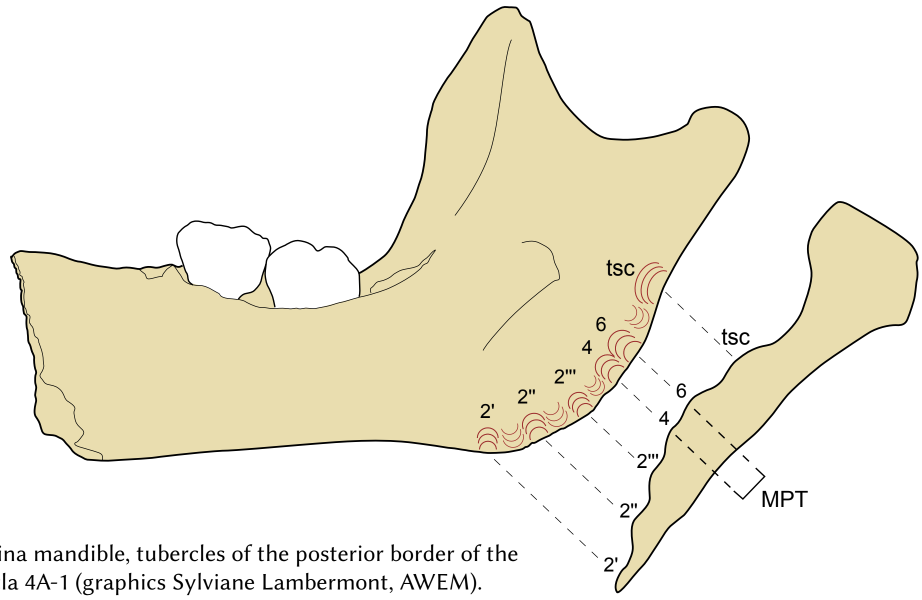



**Figure 21:** Scladina mandible, tubercles of the posterior border of the right ramus of Scla 4A-1 (graphics Sylviane Lambermont, AWEM).

#### 4.3.2.3. Posterior border

In posterior view, the posterior border of the ramus is slightly medially convex in its inferior two thirds because of the inward inflection of the gonial area. The border thickens from the gonion to the condyle, being 3.37 mm at septum 2'' and 5.37 mm just above the *tuberculum sulcus colli*.

In side view, the posterior border is sinuous. It is posteriorly concave below the condyle until the inferior border of the sulcus colli, then posteriorly convex.

#### 4.3.2.4. Inferior border and outline of the gonial region

The gonion of the Scadina mandible is only preserved on the right side (Scla 4A-1) which is slightly abraded. In side view, the gonion does not exhibit a sharp angle nor the typical Neandertal truncated outline in its uppermost segment, such as the one of Saint-Césaire. Nevertheless, this trait is present on Scla 4A-1, as pointed out by Heim & Granat (1995: 88), but strongly attenuated as its gonion profile shows a regular slightly rounded outline with a large radius of curvature.

The Scla 4A-1 gonial region is inwardly inflected. So, no lateral flaring of this area is present. Such an internal inflection is common on adult Neandertals (Billy & Vallois, 1977: 420), for instance Saint-Césaire, Regourdou, La Chapelle-aux-Saints, La Ferrassie 1, La Quina 5 and 9, or Malarnaud.

#### 4.3.2.5. External surface

A clear tubercle can be observed at the external (or lateral) border of the neck of the Scla 4A-1 condyle (Figures 13 & 22). It is the lateral condylar tubercle (LCT; Stefan & Trinkaus, 1998; Jabbour et al., 2002) or *tuberculum subcondyloideum laterale* (Weidenreich, 1936: 66) which is the attachment area for the *temporomandibular ligament*. In fact, only the base — well marked as a break in the general curvature of the area — of this eminence is preserved. Nevertheless, using Jabbour et al.'s criteria (2002: 148), a score of at least 2 and probably 3 — which would mean a large tubercle — can be proposed, as it seems to project beyond the missing part of the articular surface.

From the lateral condylar tubercle a blunt ridge begins, the *crista ectocondyloidea* (von Lenhossék, 1920; Weidenreich, 1936) or


**Figure 22:** Scladina right hemimandible (Scla 4A-1), lateral surface of the ramus (photograph Joël Éloy, AWEM).

ectocondylar ridge (Figure 13) which goes down anteriorly and obliquely to the middle of the surface of the ramus where it blends with a large raised and blunt swelling, the *eminentia lateralis rami* (Weidenreich, 1936: 65). The small fossa present between the posterior part of the mandibular notch and the ectocondylar ridge houses the deep masseter muscle (Antón, 1996).

The *eminentia* extends down to the middle region of the lateral surface of the ramus as a vertical, but anteriorly and convexly curved blunt line (Figure 13). In front of this curve, and parallel to it in the inferior part, is a second nearly vertical blunt curve. Both curves are related to the masseter insertions.

The lateral surface of the coronoid process and of all the ramus displays a narrow and shallow vertical depression between the anterior border of the ramus, the *eminentia lateralis* and both convex curved lines.

#### 4.3.2.6. Superior border

*Coronoid process (processus coronoideus)*

The moderately sharp but eroded tip of the right coronoid process as well as the anterior border of the ramus were damaged during the excavation: an elongated splinter 34 mm long and 7.5 mm in maximum width was pull off and later refitted.

The process is sub-triangular in shape. In a lateral view, this process is much larger than the condylar process. When Scla 4A-1 lies on its inferior border, the coronoid process is about 12 mm higher than the condyle.

#### *Mandibular notch (incisura mandibulae)*

In lateral view, the high configuration of the coronoid process gives the outline of the mandibular notch or mandibular incisure an asymmetrical appearance. The notch is also quite shallow. Its deepest point is in the middle third of the distance from the coronoid process to the condyle and is just behind the middle of its arch. The lowest point on the incisure is about 3 mm below the condylion when the mandible rests on its base. This is also about 16.5 mm from the posterior ramal margin at the same level below the condyle. This distance is nearly 47% of the minimum ramus breadth (Stefan & Trinkaus, 1998: 300, 304).

The length of the notch (condylion-coronion) is 30.3 mm and its maximum depth (perpendicular to the length) is 9.6 mm; the index is 31.6. The length from the coronion to the juncture between the crest of the mandibular notch and Scladina I-4A's very well marked anterior border of the articular surface of the condyle, is 26.5 mm.

#### *Mandibular condyle or condylar process (Processus condylaris)*

Only the right mandibular condyle, or condylar process, is preserved (Figure 23), however damaged postmortem: the internal part of the condyle is nearly complete, but abraded, while the lateral part is partially missing, having been strongly eroded. The surface of the condyle is also superficially abraded in its posterior part. In fact, only the central part of the articular surface and the central part of the anterior border of the condyle are completely preserved.

Based on the present state of preservation, the maximum length of the condyle is about 15.7 mm, divided in 9.2 mm for the preserved mesial part and 6.5 mm for the lateral part; adding at least 1.5 mm for the lateral missing part and about 0.5 mm for the eroded internal part, the real maximum length seems to be at least 17.7 mm. The preserved part of the articular surface of the condyle is 13.2 mm. The preserved antero-posterior diameter is 8.18 mm, but due to some erosion this region was at least 8.3 mm.

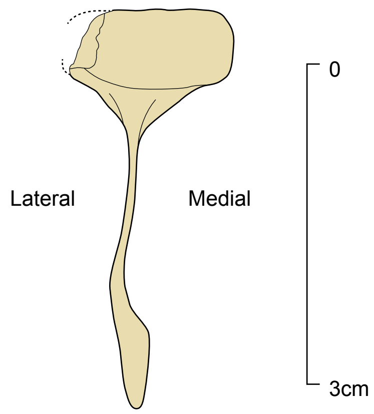



**Figure 23:** Scladina right hemimandible (Scla 4A-1), condyle in superior view (graphics Sylviane Lambermont, AWEM).

Approximately half of the Scla 4A-1 condyle is, in superior view (Figure 23), located outside the plane defining the ramus or more precisely by the intersection between the condyle and the posterior part of the upper edge of the mandibular notch. In other words, the condyle occupies a medial position with regards to the crest that defines the mandibular notch (CMN). This corresponds to score IV of Jabbour et al. (2002).

Viewed from the top, the main axis of the condyle is directed towards the back and inside forming an open angle with the crest of the mandibular notch.

## 4.3.3. Taxonomy

### 4.3.3.1. Corpus and ramus in the same plane

The alignment of the corpus and the ramus in the same plane is seen to be a derived characteristic of the Neandertal lineage (Rosas, 2001: 81, 88). This is the situation observed on the right Scla 4A-1 hemimandible.

### 4.3.3.2. Relationship between the mandibular condyle and the crest of the mandibular notch

The relationship between the mandibular condyle (condyloid process) and the crest of the mandibular notch has long been considered of primary importance in the discussion of Neandertal facial morphology as well as taxonomy.

In modern humans, the condyle has been described as projecting, at least for its main part, inside the ramus, and more precisely inside the virtual posterior extension of the crest of the mandibular notch (for instance Boule, 1911-1913; Billy & Vallois, 1977: 426; Vandermeersch, 1981: 154). On the contrary, the argument that with Neandertals an important part of the condyle, often half of it or even more, is located outside the plane defining the ascending ramus (laterally expanded condyle) has been presented. In other words, the crest of the mandibular notch is often seen as intersecting the anterior margin of the condyle in an approximate medial position. This feature has been interpreted as a Neandertal lineage apomorphy (Rak & Kimbel, 1995; Rak, 1998[a,b]; Rosas, 2001: 81; Rak et al., 2002).

However, a more statistical analysis has argued that the central position of the crest is not autapomorphic in Neandertals (Jabbour et al., 2002), which was confirmed some years later (Wolpoff & Frayer, 2005). Indeed, some modern humans have a crest that shows the so-called 'Neandertal' morphology while a few Neandertals exhibit the lateral 'modern' position (La Quina 9, Zaffaraya 2; see Wolpoff & Frayer, 2005: 249). Nevertheless, on average, the Neandertal crest is significantly placed in a less lateral position than in modern humans (Jabbour et al., 2002).

On Scladina I-4A, approximately half of the only preserved condyloid process is located outside the plane defining the ramus. So, in this regard, the mandible shows the more common, but not autapomorphic, Neandertal disposition.

#### 4.3.3.3. H-O shape of the mandibular foramen

The H-O variety was first pointed out by Gorjanović-Kramberger (1906) in his original description of the Krapina fossils. Later, Kallay (1955, 1970), designated this variant the horizontal-oval (H-O) type. The horizontal-oval (H-O) shape was seen as an autapomorphy of the Neandertals (Stringer et al., 1984: 55), as the correlated lingular/mylohyoid bridging (Creed-Miles et al., 1996: 152; Trinkaus, 2006: 601).

In fact only about half of the Neandertals (43% in Smith, 1976: 170; 46.2% in Smith, 1978: 526; 52.6% in Frayer, 1992: 31) exhibit the HO morphology which, in addition, is present in one fifth of the early Upper Palaeolithic Modern Humans (18.2% in Frayer, 1992). and even in very small percentages in Late Upper Palaeolithic, Mesolithic and Medieval humans. In the Krapina sample, this feature is found in 56% of the specimens (Smith, 1976: 170). Mandibles exhibiting the H-O mandibular foramina pattern include, among others, La Ferrassie I, Tabun II or Kebara 2, Krapina J or 59, etc. While other specimens, such as Regourdou and Fate II, whose mandibular foramen are close to Scladina I-4A, Amud 1, La Chapelle-aux-Saints or the pre-Neandertal juvenile Atapuerca SH AT-6O6 do not exhibit this shape.

In conclusion, it seems wise not to include the H-O variety of the mandibular foramen in the list of Neandertal autapomorphies even if this configuration is a common feature in that taxon.

The Scla 4A-1 hemimandible does not exhibit this particular form. On the contrary, the foramen exhibits a narrow V-shaped notch in its postero-inferior margin.

#### 4.3.3.4. Truncated gonion

The gonion of the Neandertal mandible often exhibits a distinctive truncated morphology (Boule, 1911-13; Weidenreich, 1936: 73; Patte, 1955: 245-246; Heim 1976: 263; Billy & Vallois, 1977: 419). In this configuration, the gonial angle is formed by an oblique, but quite rectilinear, border or third "arista" (Creed-Miles et al., 1996: 152; Rosas 2001: 78), between the basal border of the corpus and the posterior margin of the ramus. This is, for instance, the case at La Chapelle-aux-Saints (Boule, 1911-13), La Ferrassie 1 (Heim, 1976) and Malarnaud (Heim & Granat, 1995) or Saint-Césaire. This trait, which is referred to as a truncated gonion or a truncated gonial area, is sometimes interpreted as derived (Creed-Miles et al., 1996: 151-152; Rosas, 2001). However, according to Rosas (2001: 87), such a configuration is only found in 70% of the Neandertals as well as in Arago XIII and Mauer.

In contrast, the gonion is well-developed in modern humans and in the Sima de los Huesos (SH) pre-Neandertal sample. In detail, the posterior margin of the ramus and the inferior margin of the corpus of recent *Homo sapiens* connect as a marked angle or a curve with a small radius. The SH gonial profile defines a gradual arc connecting the posterior border of the ramus with the basal border whereas the Neandertal pattern is foreshadowed in some fossils such as the AT-605 mandible. On the mandible of Montmaurin (Billy & Vallois 1977: 419), the gonial area forms a regular rounded arc with an important curvature of the radius.

The gonion of the Scadina mandible is only preserved on the right side (Scla 4A-1) and is slightly abraded. In side view, it does not exhibit the modern pattern with a sharp angle or an arc with a small radius. In contrast, the Scla 4A-1 gonial profile shows a regular and slightly rounded outline with a large radial curvature like other Neandertal mandibles such as La Quina 5 (Verna, 2006). However, the gonial area of Scla 4A-1 does not present the typical Neandertal truncated outline in its extreme expression; nevertheless, this trait is present but attenuated.

#### 4.3.3.5. Curve of the mandibular notch

According to Rak (1998[b]) and Rak et al. (2002), the Neandertal curve of the mandibular notch is characteristic and corresponds to a derived condition, being apomorphic or synapomorphic. And indeed, the outline of the Neandertal's mandibular notch is seen as asymmetric and shallow with a posterior position for its deepest point. By contrast, in modern humans the deepest point would be near the midpoint between the coronoid and the condylar processes and the shape of the notch is symmetric. Scla 4A-1 is closed to this so-called Neandertal shape.

However, such a view has been challenged and is no longer seen as a Neandertal autapomorphy (Stefan & Trinkaus, 1998: 330; Wolpoff & Frayer, 2005) as the shape of the mandibular notch exhibits tremendous variability within human samples, Neandertals included (Weidenreich, 1936; Piveteau, 1963-66; Heim, 1976; Billy & Vallois, 1977).

#### 4.3.3.6. Deeply excavated pterygoid fossa

A deeply excavated pterygoid fossa is a classical trait in Neandertals and is considered as derived by some authors (Creed-Miles et al., 1996: 152; Rosas, 2001: 81). The internal right Scla 4A-1 ramus exhibits such a well demarcated pterygoid fossa. However, it should be pointed out that, up to now, this feature has not been discussed in the same critical way as some other so-called Neandertal apomorphies.

#### 4.3.3.7. Highly excavated submandibular fossa

A highly excavated submandibular fossa is also interpreted as a derived feature by some researchers (Creed-Miles et al., 1996; Rosas, 2001: 81). On Scla 4A-1, this fossa is quite deep on both sides.

| Character | Archaic feature | Possible Neandertal derived | Frequent in Neandertals but not derived | Scladina | Reference |
|---|---|---|---|---|---|
| Absence of modern chin | x | | | yes | Rak et al., 2002 |
| *Planum alveolare* and genioglossal fossa | x | | | yes | Tillier, 1979 |
| Inferior orientation of digastric fossae | x | | | yes | Tillier, 1984 |
| Frontal alignment of anterior alveoli and teeth | | | x | yes | Tillier, 1986 |
| Posterior position of mental foramen below $M_1$ | | | x | no ($P_4$) | Stringer et al., 1984; Rosas, 2001 |
| Inclination of the mylohyoid line close to alveolar margin at M3 level | | x | | yes | Rosas, 2001 |
| Highly excavated submandibular fossa | | x | | yes | Creed-Miles et al., 1996; Rosas, 2001 |
| Thin basal border of the body, decreasing from symphysis to ramus | | x | | yes | Piveteau, 1957, 1964: 163 |
| Developed retromolar space | | | x | no | Coon, 1962; Howells, 1975; Stringer et al., 1984; Rak, 1998[b] |
| Deeply excavated pterygoid fossa | | x | | yes | Creed-Miles et al., 1996 |
| Corpus and ramus in same plane | | x | | yes | Rosas, 2001 |
| Truncated gonial area | | x | | slight | Boule, 1911-13; Billy & Vallois, 1977; Rosas, 2001 |
| Horizontal-Oval (HO) mandibular foramen | | | x | no | Stringer et al., 1984; |
| Laterally expanded condyle with regards to the ramus plane | | | x | yes | Rak & Kimbel, 1995; Jabbour et al., 2002 |
| Curve of the mandibular notch | | | x | yes | Rak, 1998[b]; Stefan & Trinkaus, 1998 |

Table 2: Some features of the Scladina mandible (Scla4A-1 & 9) compared with Neandertal characteristics.

| Corpus | Value |
|---|---|
| Infradentale-pogonion angle on resting plane (Scla 4A-9) | (98°) |
| Infradentale-gnathion angle on resting plane (Scla 4A-9) | (73°) |
| Height of the symphysis (Scla 4A-9) | 27.75 |
| Thickness at symphysis (Scla 4A-9) | 12.36 |
| Index of robustness at the symphysis (Scla 4A-9) | 44.5 |
| Height of the body at the canine (Scla 4A-9) | 26.32 |
| Thickness of the body at the canine (Scla 4A-9) | 13.1 |
| Index of robustness at the canine (Scla 4A-9) | 49.8 |
| Height of the body at the C-$P_3$ border (Scla 4A-9) | 26.55 |
| Thickness of the body at the C-$P_3$ border (Scla 4A-9) | 13.1 |
| Index of robustness at the C-$P_3$ border (Scla 4A-9) | 49.3 |
| Height of the body at the $P_3$ (Scla 4A-1) | (24.5) |
| Thickness of the body at the $P_3$ (Scla 4A-1) | 12.8 |
| Index of robustness at the $P_3$ (Scla 4A-1) | 52.2 |
| Height of the body at the $P_3$-$P_4$ border (Scla 4A-1) | (24.35) |
| Thickness of the body at the $P_3$-$P_4$ border (Scla 4A-1) | 13.2 |
| Index of robustness at the $P_3$-$P_4$ border (Scla 4A-1) | 54.2 |
| Height of the body at the $P_4$ (Scla 4A-1) | 23.9 |
| Thickness of the body at the $P_4$ (Scla 4A-1) | 13.1 |
| Index of robustness at the $P_4$ (Scla 4A-1) | 54.8 |
| Height of the body at the $P_4$-$M_1$ border (Scla 4A-1) | 23.5 |
| Thickness of the body at the $P_4$-$M_1$ border (Scla 4A-1) | 13.4 |
| Index of robustness at the $P_4$-$M_1$ border (Scla 4A-1) | 57.0 |
| Height of the body at the $M_1$ (Scla 4A-1) | 22.2 |
| Thickness of the body at the $M_1$ (Scla 4A-1) | 14.0 |
| Index of robustness at the $M_1$ (Scla 4A-1) | 63.0 |
| Height of the body at the $M_1$-$M_2$ border (Scla 4A-1) | 20.55 |
| Thickness of the body at the $M_1$-$M_2$ border (Scla 4A-1) | 14.45 |
| Index of robustness at the $P_4$-$M_1$ border (Scla 4A-1) | 70.3 |
| Height of the body at the $M_2$ (Scla 4A-1) | 20.3 |
| Thickness of the body at the $M_2$ (Scla 4A-1) | 15.8 |
| Index of robustness at the $M_2$ (Scla 4A-1) | 77.8 |
| **Ramus** | **Value** |
| Angle of the ramus | 118.5° |
| Minimum breadth | 35.1 |
| Maximum breadth | 38.1 |
| Height of the coronoid process (perpendicular to resting plane) | 56.0 |
| Height of the coronoid process (projection) | 54.0 |
| Length of the mandibular notch | 30.3 |
| Maximum depth of the mandibular notch | 9.6 |
| Index of the mandibular notch | 31.6 |
| Height of the condyle (perpendicular to resting plane) | 43.0 |
| Height of the condyle (projection) | 41.6 |
| Length of the ramus | 45.5 |
| Minimum height of the ramus (perpendicular to resting plane) | 40.2 |
| Minimum height of the ramus (projection) | 38.2 |
| **Mandible** | **Value** |
| Maximum mandibular length (Martin 68-1) | (85.0) |
| Corpus length (Martin 68) | (± 70) |
| Bicondylar breadth (Martin 65) | (± 140) |
| Bigonial breadth (Martin 66) | (± 80) |

Table 3: Principal measurements (mm and °) of the Scladina mandible (Scla 4A-1 & 9).

### 4.3.3.8. Basal border

A continuous and regular decrease of the basal border from the symphysis to the ramus is considered to be a derived characteristic (Piveteau, 1964: 163; Rosas, 2001: 81). The Scladina I-4A mandible corresponds to this pattern.

## 4.4. Discussion

Table 2 summarizes the main anatomical features developed in the paragraphs concerning the taxonomy of the symphysis (4.1.2), the mandibular body (4.2.3) and the ramus (4.3.3). The few characters of the Neandertals mentioned therein are considered archaic, Neandertal derived or simply as frequent characters in this taxon. It should be noted that in many cases features initially regarded as derived are contradicted by scholars when they are the subject of detailed studies. In the present state of research, it is possible, on Scladina I-4A, to consider as possibly derived the inclination of the mylohyoid line close to alveolar margin at $M_3$ level, the highly excavated submandibular fossa, the decreasing of the basal border thickness from symphisis to ramus, the deeply excavated pterygoid fossa, the corpus and ramus in same plane, and the tendancy to have a truncated gonial area. Other characters present on Scladina I-4A are common among Neandertals, but not exclusive of this taxon, notably (Table 2): frontal alignment of anterior alveoli and teeth, horizontal-oval (HO) mandibular foramen, laterally expanded condyle

| | | Ramus minimum breadth | | | |
|---|---|---|---|---|---|
| **Scla 4A-1 values** | 8 years | 35,1 | | | |
| | | **Mean** | **n** | **St. dev.** | **Ref** |
| **EN (Early Neandertals)** | adult | 39.15 | 6 (r) | 2.93 | 1 |
| **LN (Late Neandertals)** | adult | 40.55 | 10 (r) | 3.09 | 1 |
| **Neandertals (EN + LN)** | adult | 40.03 | 16 (r) | 3.01 | 1 |
| **NE** | juvenile | 28.5 | 11 | 3.47 | 5 |
| **MPMH (Middle Palaeolithic Modern Humans)** | adult | 36.66 | 3 (r + l) | | 1 |
| **UPMH (Upper Palaeolithic Modern Humans)** | adult | 39.69 | 11 | 3.12 | 1 |
| **MHSS (Modern Human *sapiens sapiens*)** | S1 | 22.4 | 15 | 1.6 | |
| **MHSS** | S2 | 23.8 | 4 | 4.2 | 2 |
| **MHSS** | S3 (7-10 years) | 27.4 | 12 | 1.9 | 2 |
| **MHSS** | adult | 33.99 | 1107 | 3.19 | 1 |

Table 4: Dimensions and comparisons (mm and °) of the right ramus of the Scladina mandible (Scla 4A-1).

with regards to the ramus plane, and curve of the mandibular notch. It also appears that the absence of modern chin of the Scladina mandible, the *planum alveolare* and genioglossal fossa, as well as the inferior orientation of digastric fossae are archaic traits. The absence of retromolar space results from the young age of the subject (8 years old), as is also the case in other juvenile Neandertals. This could also be the case for the position of the mental foramen below $P_4$ and not $M_1$, although some adults Neandertals also do not have that posterior location.

In conclusion, what characterizes a Neandertal mandible like Scla 4A-1/9 lies less in one or another derived or supposed derived trait than in the unique combination of a set of traits that, taken together, correspond to the general pattern of Neandertals.

## 5. Morphometry

### 5.1. Material and Methods

This section statistically compares the Scladina mandible to samples of subadult Neandertals, subadult modern humans (Neolithic/ Middle Ages/submodern Modern; MHSS), Early (EN) and Late (LN) adult Neandertals and adult MHSS.

As in Chapter 12, which discusses the maxilla, all individuals are attributed to age classes that are based on dental eruption:

S1: deciduous dentition only;
S2: deciduous dentition and $M_1$ fully erupted;
S3: mixed dentition with the $M_1$ and at least another fully erupted permanent tooth (but usually not the $M_2$);
S4: permanent dentition only, with the $M_2$ fully erupted, but not the $M_3$.

The reported measurements of the Scladina mandible and comparison fossils are those commonly used in anthropology. These include angles such as that of the symphysis as well as measurements of the thickness and height of the various parts of the mandible. These values are presented in Tables 3 to 5.

Measurements of the Scladina mandible were repeatedly taken by the author himself and later averaged. Measurements of the comparison samples were collected from the literature, with the exception of some of Fate 2 and Krapina that were also taken by the author.

Significant differences may exist between values of the same dimensions obtained by various authors. For example, the measurements of the Malarnaud 1 mandible as published by Minugh-Purvis (1988) and Heim & Granat (1995) show significant differences, such as a thickness of 12.8 mm at the symphysis according to Minugh-Purvis but 14 mm for Heim & Granat. The same fossil has a canine height of 18.2 mm for Minugh-Purvis (1988) and 24.4 mm for Arnaud (2014). Another problem is that researchers sometimes propose different values for the same dimension, either

| Ramus height M 70 | | | | Ramus projection height M-70a | | | | Coronion height M 70-1 (projection) | | | | Ramus minimum height M 70-2 | | | | Mandibular angle M 79 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 45,5 | | | | 41,6 | | | | 54.0 | | | | 40,2 | | | | 116 | | | |
| Mean | n | St. dev. | Ref | Mean | n | St. dev. | Ref | Mean | n | St. dev. | Ref | Mean | n | St. dev. | Ref | Mean | n | St. dev. | Ref |
| 66.04 | 4 (r) | 3.23 | 1 | 60.37 | 4 (r & l) | 4.38 | 1 | 66.33 | 3 (r) | 4.86 | 1 | 49.47 | 3 (r) | 5.76 | 1 | 113.5 | 4 | 6.61 | 1 |
| 67.68 | 5 (r & l) | 5.77 | 1 | 64.69 | 8 (r & l) | 6.47 | 1 | 74.02 | 4 (r & l) | 3.02 | 1 | 55.42 | 6 (r) | 7.27 | 1 | 107.3 | 6 | 3.56 | 1 |
| 64.98 | 6 (r) | 3.63 | 1 | 63.25 | 12 (r & l) | 6.03 | 1 | 69.61 | 5 (r) | 6.33 | 1 | 53.44 | 9(r) | 7.09 | 1 | 109.8 | 10 | 5.63 | 1 |
| 41.4 | 6 | 10.01 | 5 | | | | | | | | | | | | | 120.7 | 10 | 7.79 | 5 |
| 71.33 | 1 (r) | | 1 | 70.5 | 1 (r) | | 1 | 71.5 | 1(r) | | 1 | | | | | | | | |
| 63.95 | 9 (r & l) | 6.25 | 1 | 57.4 | 5 (r) | 4.17 | 1 | 62.0 | 6(r) | 6.67 | 1 | | | | | 116.68 | 19 | 5.65 | 1 |
| | | | | | | | | | | | | | | | | 134.6 | 20 | 6.25 | 3 |
| | | | | | | | | | | | | | | | | | | | |
| 45.4 | 12 | 4.3 | 2 | | | | | | | | | 36.4 | 12 | 3.1 | 2 | 137 | | | 4 |
| 57.06 | 879 | 4.89 | 1 | | | | | 57.74 | 626 | 4.97 | 1 | | | | | 122.19 | 1037 | 6.42 | |

| Specimen | Age at death | | | Sex | Length | | | Breadth | | | | | | | I dent/ pog angle |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Classic | Histology or Granat's technique | Class | | Max | Cor-pus | di1-dm2 projec-tion | Bicon-dylar | Bigonial | Bicanine | Bi dm1/ P3 | Bi dm2/ P4 | Bi M1 | Bi M2 | |
| Scla 4A-1 & 9 | 10–11 yrs | | S3 | | (86.0) | (± 70) | | (± 140) | (± 80) | | | | | | |
| Scla 4A-9 (left) | 10–11 yrs | 8 yrs | | F | | | | | | | | | | | (98°) |
| Scla 4A-1 (right) | 10–11 yrs | | | | | | | | | | | | | | |
| Molare 1 | 3–4 yrs | | S1 | | | | | | | (33) | (46) | (60) | | | (90°) |
| Dederiyeh 1 | ± 2 yrs | | S1 | | | | | | | 30.7 | | | | | 98° |
| Dederiyeh 2 | ± 2 yrs | | S1 | | | | | | | 31 | | | | | |
| Barakai | ± 3 yrs | | S1 | | 78.1 | 55.9 | 26 | | | | | 50 | | | 84° |
| Archi 1 | 5–6 yrs or 3 yrs | 2.5 yrs | S1 | | | | 27.8 | | | 35.8 | 43.3 | 49.5 | | | 93° |
| Gibraltar 2 (Devil's Tower) | ± 3 yrs | | S1 | | 72 | | 25.6 | (105) | | (33.9) | 45.8 | 53.4 | | | 93° |
| Roc de Marsal | ± 3 yrs | G/H: 2 yrs 5 months | S1 | | (70) | (56) | 28.4 | (95) | (72) | 30.6 | 42.3 | 51.1 | | | 93° |
| Pech de l'Azé 1 | 2 yrs | G/H: 18.5 months | S1 | | 67 | 49 | (26.2) | (89) | (79) | 30.5 | (41.1) | (49.3) | | | 92.3° |
| Krapina A (51) | 5–6 yrs | | S2 | | | | | | | | | | | | |
| La Chaise 13 (S5) | 4–5 yrs | 2.5 yrs | S2 | | | | 27.8 | | | (31) | 42.5 | (52) | | | 83° |
| Zaskalnaya VI | 9–10 yrs | | S3 | | | | | 109 | 66 | | | | | | |
| Combe-Grenal | 6–7 yrs | 4.5 yrs | S3 | | | | | | | | | | | | |
| Krapina B (52) | 9.5 yrs | | S3 | | | | | | | | | | | | 106.5° |
| Teshik Tash 1 | 8.5–11 yrs | 7.5 yrs ± 6 months | S3 | | 95 | 71 | | 122 | 83 | | 46.5 | 54 | | | 90° |
| Sipka 1 | 8–10 yrs | | S3 | | | | | | | | | | | | |
| Fate 2 | 9–10 yrs | | S3 | | | | | | | | | | | | (90°) |
| Hortus 2-3 | 9 yrs | | S3 | F | | | | | | | | | | | 87° |
| Malarnaud 1 | 12 yrs | 11 yrs 2 months | S4 | F | 87 | | | 114 | 80.5 | | | | | | 90.5° |
| Petit-Puy-moyen 1 | 16–17 yrs | 14 yrs 4 months | S4 | F | | | | | | | | | | | |
| Ehringsdorf 7 (G, 1010/69) | 10.5–12 yrs | | S4 | | 104 | 84 | | (126) | 82 | (35) | (49) | | (71) | (81) | 92° |
| Montgaudier 1 | 12.5–14.5 yrs | | S4 | F | | | | | | | | | | | |
| Krapina C (53) | 11 yrs | | S4 | | | | | | | | | | | | 96.5° |
| Krapina E-55 | 15–17 yrs | | S4 | F | | | | | | | | | | | 95° |
| Le Moustier 1 | 15.5 yrs ± 1.25 | | S4 | M | | | | | | | | | | | 88° |
| Valdegoba VB1 | 13–14 yrs | | S4 | M | | | | | | | | | | | |
| Atapuerca SH AT-607 (XXIII) | adoles-cent | | S4 | M | | | | | | | | | | | |

Table 5: Dimensions (mm and °) of the symphysis and corpus of the Scladina mandible (Scla 4A-1 & 9) compared to other juvenile Neandertal specimens. H = height, T = thickness, I = index.

by mistake or by having measured it at different times. So for Krapina E-55, Minugh-Purvis (1988) gives 31.4 mm for the height at the symphysis (p. 179) contra 34.5 mm (p. 185), or 13.5 mm (p. 188) and 14.1 mm (p. 179) for the thickness at the symphysis. In view of such discrepancies, the choice of a particular value of a precise measurement of a fossil can, at least when the differences are significant, influence statistical analysis and inferences drawn from them. Ideally, to avoid

| I dent/ gna angle | Symphysis | | | Canine | | | Mental foramen | | | $P_3$ (m1-m2) | | | $P_4$ (m2) | | | $M_1$ | | | Reference |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | H | T | I | H | T | I | H | T | I | H | T | I | H | T | I | H | T | I | |
| (73°) | 27.75 | 12.36 | 44.5 | 26.32 | 13.1 | 49.8 | 23.9 | | | | 13.2 | | (24.1) | 13.2 | (54.8) | (23.0) | 14.2 | (61.7) | Present Author (M. T.) |
| | | | | | (13.45) | | 24.5 | | | (24.5) | 12.8 | | 23.9 | 13.1 | 54.8 | 22.2 | 14.0 | 63.1 | Present Author (M. T.) |
| 79° | 25.7 | 14 | 54.5 | | | | | | | 20.9 | 12.2 | 58.4 | | | | | | | Mallegni & Ronchitelli , 1987 |
| 75° | 21.6 | 10.6 | 49.1 | | | | | | | 16 | 11.6 | 72.5 | | | | | | | Dodo et al., 2002 |
| 74° | 20.3 | 10.5 | 51.7 | | | | | | | 15.2 | 10.3 | 67.8 | | | | | | | Ishida & Kondo, 2002 |
| | 24.1 | 12.5 | 51.9 | | | | 19.2 | 13.5 | 70.3 | 20.1 | 14.2 | 70.6 | | | | | | | Faerman et al., 1994 |
| 78° | 22 | 13.5 | 61.4 | | | | | | | 20 | 11.8 | 59.0 | 18.4 (r) | 13.4 (r) | 72.8 | | | | Ascenzi & Segre, 1971; Tillier, 1983[b]; Mallegni & Trinkaus, 1997; Arnaud, 2014 |
| 79° | 21.2 | 12.6 | 59.4 | | | | | | | 22.8 | 13.6 | 59.6 | | | | | | | Tillier, 1983[b] |
| 74° | 20.2 | 12.6 | 62.4 | | | | 17.6 (r) | 12.9 (r) | | 17.2 | 13.2 | 76.7 | | | | | | | Madre-Dupouy, 1992: 103; Tillier, 1983[b] |
| | 17.8 | 10 | 56.2 | | | | | | | 14.2 | 11.5 | 81.0 | | | | | | | Madre-Dupouy, 1992: 103; Tillier, 1983[b] |
| | | 11.5 | | 22.5 | 12.6 | 56.0 | | | | | 12.3 | | | 12.6 | | | | | Smith, 1976; Minugh-Purvis, 1988 |
| 85° | 22.1 | 12.8 | 59.9 | 21 | 12.1 | 57.6 | | | | 20.5 | 12.5 | 60.9 | 17 | 12.5 | 73.5 | 16.4 | 12.5 | 76.2 | Tillier & Genet-Varcin, 1980; Tillier, 1982; Minugh-Purvis, 1988 |
| | 30 | 13.4 | 44.7 | 19.8 | 14 | 70.7 | | | | (18) | 14 | 77.8 | 21.4 | 13.6 | 63.5 | 20.7 | 13.8 | 66.7 | Minugh Purvis, 1988 |
| | 26.2 | 13.4 | 51.1 | | | | 26.9 | 13.8 | | 26.9 | 13.8 | 51.3 | | | | | | | Genet-Varcin, 1982 |
| | 26 | (12.0) | 46.1 | (29.0) | 15.6 | 53.8 | | | | | 16.7 | | | 17.9 | | 23.5 | | | Smith, 1976; Minugh-Purvis, 1988 |
| 75° | 27.0 | 13.7 | 50.7 | 26.4 | 17.0 | 64.4 | 26 | 15 | 57.7 | 26.5 | 16.6 | 62.6 | 25.1 | 15.1 | 60.1 | 21.2 | 15.8 | 74.5 | Ullrich, 1955; Madre-Dupouy, 1992; Minugh-Purvis, 1988 |
| | 30.0 | 14.0 | 46.7 | | | | | | | | | | | | | | | | Heim & Granat, 1995; Madre-Dupouy, 1992 |
| (78°) | | | | (20.5) | 12.2 | 59.5 | 19.9 | 12.7 | | 22 | (12.5) | | | | | 18.5 | 14.0 | 75.7 | Giacobini et al., 1984 and M. T. |
| 79° | 25.0 | 13.6 | 54.4 | | | | 25.5 | 15.0 | 58.8 | | | | | | | | | | de Lumley-Woodyear, 1973 |
| | 25 | 14 | 56 | 24.4 | 14.9 | 61.1 | 24 | 14 | | 20.9 | | | 20.9 | | | 21.5 | 17.5 | 81.4 | Heim & Granat, 1995; Arnaud, 2014; Minugh-Purvis, 1988 |
| | 28.1 | 12.2 | 43.4 | 28.9 | | | 27 | 13 | 48.1 | 28.3 | | | 29.1 | | | 28.0 | | | Gabis, 1956; Minugh-Purvis, 1988 : 179, 185 |
| 73° | 28.3 | 15.3 | 54.1 | 25.6 | 15.6 | 60.9 | | | | | (17.0) | | | | | 20.8 | (15.0) | 72.1 | Vlček , 1993; Minugh-Purvis, 1988 |
| | 22.0 | 11.8 | 53.6 | 24.9 | 12.15 | 48.8 | (23.3) | (13.5) | (53.3) | 23.3 | 13.7 | 58.8 | 23.3 | 13.45 | 57.7 | 22.45 | 13.55 | 60.3 | Mann & Vandermeersch, 1997; Arnaud, 2014 |
| | 23.7 | 13.6 | 57.4 | (26.0) | 17.4 | 66.9 | 23.3 | 16.2 | 69.5 | | 17.9 | | 22.1 | 17.5 | 79.2 | 21.0 | 17.1 | 81.4 | Smith, 1976; Minugh-Purvis, 1988 |
| | 31.4 | 14.1 | 44.9 | 23.7 | 15.0 | 63.3 | 28.1 | 15.2 | 54.1 | 25.7 | 14.8 | 57.6 | 26.8 | 14.4 | 53.7 | 25.9 | 16.5 | 63.7 | Smith, 1976; Minugh-Purvis, 1988 |
| 82° | 30.0 | 15.0 | 50.0 | 27.5 | 15.0 | 54.5 | | | | 27.3 | 14.2 | 52.0 | 25.4 | 15.2 | 59.8 | 27.2 | 16.6 | 61.0 | Minugh-Purvis, 1988; Thompson & Bilsborough, 2005; Vlček , 1993 |
| | 30.6 | 15.5 | 50.6 | | 17.0 | | | | | | (16.9) | | | (16.6) | | | (16.6) | | Quam et al., 2001: 403–404 |
| | 28.6 | 14.7 | 51.4 | | | | 27.1 | 15.2 | | | | | | 15.2 | | | | | Rosas, 1995 |

these problems, each author should individually measure all the fossils they compare. This is obviously almost impossible, mainly for financial reasons and sometimes due to restricted access to fossils. Researchers therefore need to be critical about the measurements they use, especially by trying to validate them from good quality casts and photos. However, the relative inaccuracy of anthropological measurements is likely not sufficient enough to influence general trends, although the relatively small size of most juvenile mandible comparison samples is often an additional problem.

Univariate analyses using the methods developed by F. Houët (2001) were carried out to compare the measurements of the Scladina mandible with the above mentioned samples. These analyses include:

— Probabilistic distances (DP) to compare the measurements of a fossil to parameters of a reference population, according to the formula DP = student law (Abs (x−m) / s; n−1; 2);

— ECRA ("écart centré réduit ajusté" of Houët, 2001) = (x−m) / inverse student law (0.05; n-1)* s.

In both formulas, x = individual value, m = sample mean, s = standard deviation, n = number of fossils. In the tables corresponding to each specimen, the numbers in brown indicate values of DP and ECRA that diverge significantly from the estimated variation of the reference population (DP > 0.05 or < -0.05; ECRA > 1 or < -1).

The bivariate comparisons used the well-known technique of equiprobable ellipses (Defrise-Gussenhoven, 1955); 95% confidence ellipses were plotted using the statistical software package PAST (PAlaeontological STatistics, version 1.77, 2008; Hammer et al., 2001).

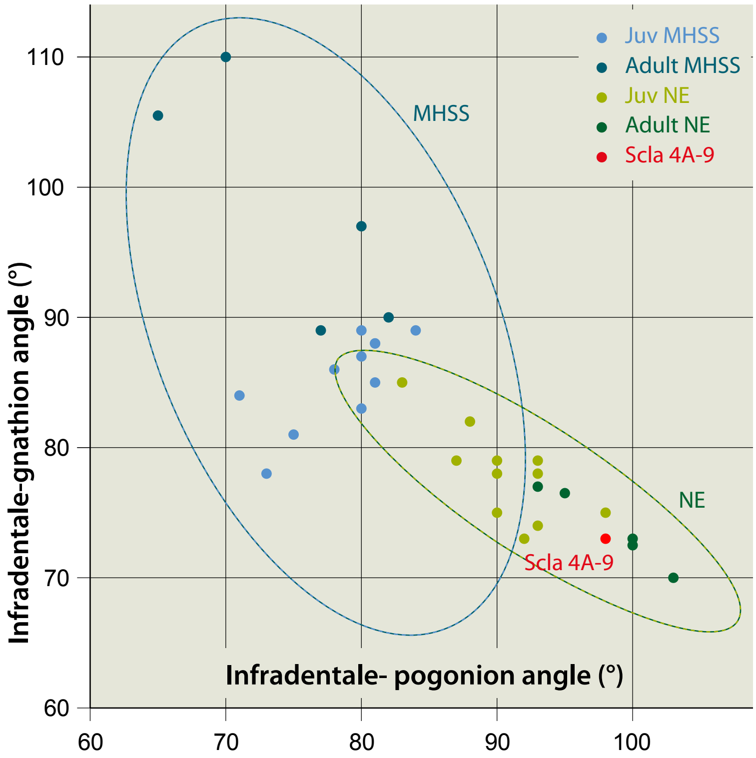



Figure 24: Bivariate analysis of the infradentale-pogonion and infradentale-gnathion angles of the Scladina symphysis (Scla 4A-9) with 95% equiprobable ellipses of Neandertals (adults and juveniles) and MHSS (adults and juveniles).

## 5.2. Results

The mental angle — infradentale-pogonion angle on resting plane — cannot be estimated with precision on Scla 4A-9 due to the erosion of the anterior borders of the alveoli of the central incisors. The value appears to be close to 100°. After extensive testing, we chose the approximate value of 98°. For the same reason, the infradentale-gnathion angle on resting plane (Martin 79-1a) is equally inaccurate: we estimate 73°. Both angles are not significantly different from those of juvenile and adult immature Neandertals, both using DP probabilistic distance and ECRA (Table 6). In contrast, the infradentale-pogonion angle departs significantly from immature and adult MHSS. Regarding

| | | |
|---|---|---|
| Scla 4A-9 | infradentale-pogonion | 98° |
| | infradentale-gnathion | 73° |

| Comparison Samples | Angle | n | mean | St dev | DP | ECRA |
|---|---|---|---|---|---|---|
| Immature NE S1–S4 | infra-pog | 17 | 91.8° | 5.47 | 0.274 | 0.535 |
| | infra-gna | 12 | 77.6° | 3.58 | 0.225 | –0.584 |
| Immature NE S1–S2 | infra-pog | 8 | 90.7° | 5.01 | 0.188 | 0.616 |
| | infra-gna | 7 | 77.7° | 3.9 | 0.274 | –0.493 |
| Immature NE S3–S4 | infra-pog | 9 | 92.8° | 5.96 | 0.408 | 0.378 |
| | infra-gna | 5 | 77.4° | 3.5 | 0.277 | –0.453 |
| Immature MHSS S1 | infra-pog | 17 | 78.7° | 3.64 | 0.000 | 2.501 |
| | infra-gna | 11 | 85.3° | 3.52 | 0.006 | –1.568 |
| Adult Neandertal | infra-pog | 15 | 97.8° | 6.27 | 0.975 | 0.015 |
| | infra-gna | 5 | 73.9° | 2.88 | 0.770 | –0.113 |
| Adult Palaeo MHSS (= UPMH) | infra-pog | 14 | 74.6° | 7.67 | 0.009 | 1.412 |
| | infra-gna | 5 | 98.3° | 9.3 | 0.053 | –0.980 |
| Adult Meso MHSS | infra-pog | 24 | 76° | 4.68 | 0.000 | 2.272 |

Table 6: Infradentale-pogonion angle and infradental-gnathion angle of the Scladina symphysis (Scla 4A-1 & 9) compared to those of immature and adult Neandertals and MHSS, with DP and ECRA.

| Scla 4A-9 | Symphysis | Height | 27.75 |
|---|---|---|---|
| | | Thickness | 12.36 |
| | | Index | 44.5 |

| Comparison Samples | Measurement | n | mean | St dev | DP | ECRA |
|---|---|---|---|---|---|---|
| Immature NE S1–S4 | Height | 24 | 25.4 | 4.08 | 0.57 | 0.278 |
| | Thickness | 25 | 13.1 | 1.46 | 0.617 | −0.246 |
| | Index | 24 | 52.3 | 5.49 | 0.191 | −0.652 |
| Immature NE S1–S2 | Height | 9 | 21.7 | 2.28 | 0.029 | 1.151 |
| | Thickness | 10 | 12.1 | 1.34 | 0.85 | 0.086 |
| | Index | 9 | 56.05 | 4.61 | 0.042 | −1.049 |
| Immature NE S3 | Height | 6 | 27.4 | 2.14 | 0.876 | 0.064 |
| | Thickness | 6 | 13.3 | 0.69 | 0.231 | −0.53 |
| | Index | 6 | 48.9 | 3.69 | 0.328 | −0.422 |
| Immature NE S4 | Height | 9 | 27.9 | 3.82 | 0.97 | −0.017 |
| | Thickness | 9 | 14 | 1.3 | 0.243 | −0.547 |
| | Index | 9 | 50.8 | 5.51 | 0.316 | −0.464 |
| Immature MHSS S1 | Height | 11 | 21.8 | 1.07 | 0.000 | 2.496 |
| | Thickness | 11 | 10.9 | 0.64 | 0.046 | 1.024 |
| | Index | 11 | 49.9 | 2.72 | 0.096 | −0.825 |
| Immature MHSS S2 | Height | 9 | 22.8 | 1.69 | 0.019 | 1.27 |
| | Thickness | 9 | 12 | 0.99 | 0.726 | 0.158 |
| | Index | 9 | 52.9 | 3.55 | 0.054 | −0.977 |
| Immature MHSS S3 | Height | 11 | 27.8 | 2.86 | 0.986 | −0.008 |
| | Thickness | 11 | 12.7 | 1.0 | 0.741 | −0.153 |
| | Index | 11 | 46.0 | 5.0 | 0.83 | −0.099 |
| Immature MHSS S1–S3 | Height | 32 | 24.3 | 3.38 | 0.315 | 0.50 |
| | Thickness | 32 | 11.9 | 1.16 | 0.694 | 0.194 |
| | Index | 32 | 49.3 | 4.75 | 0.361 | −0.454 |
| Adult Early Neandertals | Height | 11 | 34.71 | 5.53 | 0.237 | −0.565 |
| | Thickness | 9 | 15.23 | 1.6 | 0.111 | −0.778 |
| | Index | 9 | 43.69 | 6.78 | 0.863 | 0.077 |
| Adult Late Neandertals | Height | 14 | 35.34 | 4.15 | 0.09 | −0.847 |
| | Thickness | 14 | 15.4 | 1.27 | 0.032 | −1.108 |
| | Index | 12 | 45.12 | 6.18 | 0.972 | −0.016 |

Table 7: Height and thickness (mm) of the Scladina symphysis (Scla 4A-9) compared to those of immature and adult Neandertals and MHSS, with DP and ECRA.

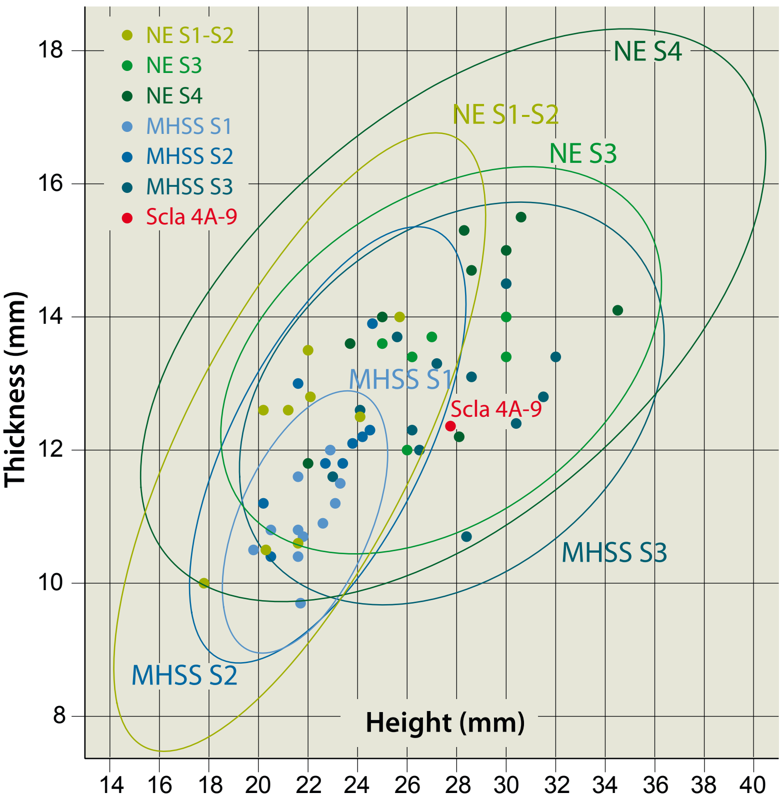



Figure 25: Bivariate analysis of the height and thickness of the Scladina symphysis (Scla 4A-9) with 95% equiprobable ellipses of juveniles Neandertals and MHSS.

Neandertals, the infradentale-pogonion angle changes from 90.7° in the immature class S1-S2 to 92.8° in immature S3-S4 and to 97.8° in adults, indicating a more recessed mandible as the individual ages. In the bivariate graph of Figure 24, the infradentale-pogonion angle and the infradentale-gnathion angle of the Scladina mandible are compared to two samples: Neandertals (immature and adult) and MHSS (immature and adult). Scla 4A-9 is situated outside the area of the graph where the two ellipses slightly overlap, in an area where only Neandertals are present.

The symphyseal height of Scla 4A-9 departs significantly from the average of the comparison samples in the case of immature Neandertals of classes S1-S2 and modern humans (MHSS) of age classes S1 and S2, both using DP probabilistic distance and ECRA (Table 7). In contrast, the symphyseal thickness of the Scladina mandible only departs from immature MHSS of class S1 and from adult late Neandertals. In the bivariate graph of Figure 25, symphyseal height and thickness of the mandible are compared to three age

| Scla 4A-9 | Canine | Height | 26.32 |
|---|---|---|---|
| | | Thickness | 13.1 |
| | | Index | 49.8 |

| Comparison Samples | Value | n | mean | St. dev. | DP | ECRA |
|---|---|---|---|---|---|---|
| Immature NE S2-S4 | Height | 13 | 24.6 | 3.03 | 0.581 | 0.261 |
| | Thickness | 13 | 14.6 | 1.91 | 0.447 | −0.36 |
| | Index | 12 | 58.9 | 6.1 | 0.164 | −0.678 |
| Immature NE S2 & S3 | Height | 6 | 23.2 | 3.69 | 0.436 | 0.329 |
| | Thickness | 6 | 13.9 | 2.01 | 0.707 | −0.155 |
| | Index | 6 | 60.3 | 6.22 | 0.152 | −0.657 |
| Immature NE S4 | Height | 7 | 25.8 | 1.81 | 0.784 | 0.117 |
| | Thickness | 7 | 15.3 | 1.71 | 0.246 | −0.526 |
| | Index | 6 | 59.2 | 6.52 | 0.209 | −0.561 |
| Immature MHSS S1 | Height | 12 | 19.6 | 1.35 | 0.000 | 2.262 |
| | Thickness | 12 | 9.6 | 0.71 | 0.000 | 2.24 |
| | Index | 12 | 48.5 | 3.67 | 0.73 | 0.161 |
| Immature MHSS S2 | Height | 13 | 20.9 | 1.85 | 0.013 | 1.345 |
| | Thickness | 13 | 10.3 | 1.08 | 0.024 | 1.19 |
| | Index | 13 | 49.2 | 3.2 | 0.854 | 0.086 |
| Immature MHSS S3 | Height | 14 | 23.5 | 3.87 | 0.479 | 0.337 |
| | Thickness | 14 | 10.9 | 1.18 | 0.085 | 0.863 |
| | Index | 14 | 47.3 | 4.6 | 0.596 | 0.252 |
| Immature MHSS S1–S3 | Height | 39 | 21.4 | 3.07 | 0.117 | 0.792 |
| | Thickness | 39 | 10.3 | 1.14 | 0.019 | 1.213 |
| | Index | 39 | 48.32 | 3.88 | 0.705 | 0.188 |
| Adult Early Neandertals | Height | 8 | 32.54 | 4.24 | 0.186 | −0.62 |
| | Thickness | 8 | 15.71 | 1.36 | 0.096 | −0.812 |
| | Index | 8 | 49.2 | 6.7 | 0.931 | 0.038 |
| Adult Late Neandertals | Height | 10 | 33.75 | 2.35 | 0.012 | −1.398 |
| | Thickness | 9 | 14.96 | 1.17 | 0.151 | −0.689 |
| | Index | 8 | 44.01 | 3.71 | 0.163 | 0.66 |

Table 8: Height and thickness (mm) of the Scladina mandible (Scla 4A-9) at the level of the left canine compared to those of immature and adult Neandertals and immature MHSS, with DP and ECRA.

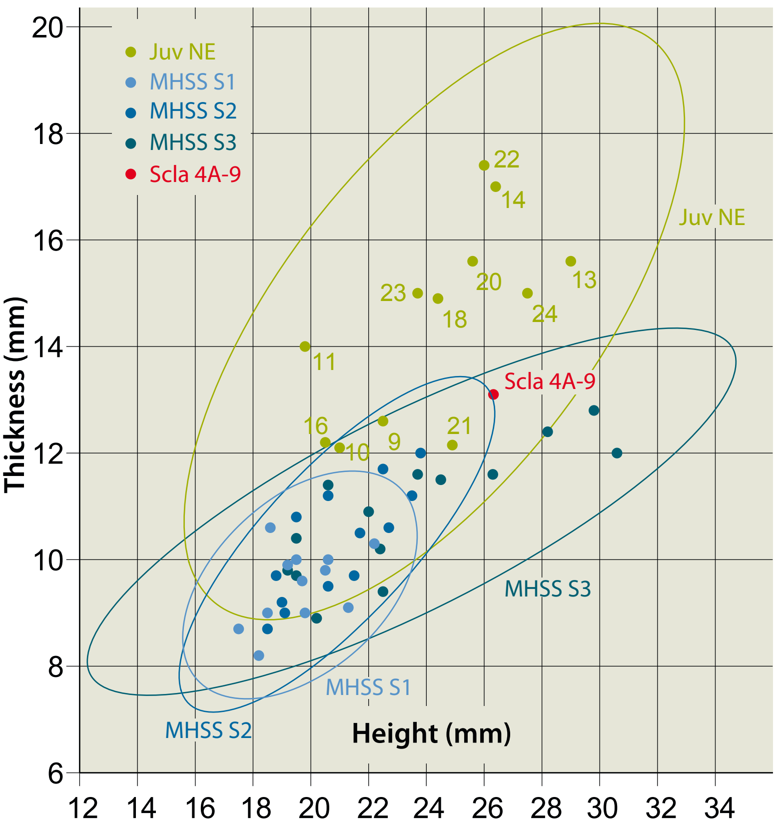



Figure 26: Bivariate analysis of the height and thickness (mm) of the Scla 4A-9 hemimandible at the level of the canine with 95% equiprobable ellipses of juvenile Neandertals and juvenile MHSS.

samples of immature Neandertals and immature MHSS. Scla 4A-9 is situated in the central area where the ellipses of the two oldest immature Neandertal groups (NE S3 & NE S4) and the MHSS S3 immature groups overlap, but only just over the NE S1-S2 and MHSS S2 groups. Even if the symphyseal thickness mean is slightly higher in Neandertal age groups than in corresponding MHSS age groups, symphyseal dimensions do not provide clear taxonomic indications in the case of the Scladina specimen.

At the level of the canine, the height and thickness of the left hemimandible (Scla 4A-9) do not depart significantly from the average of the juvenile Neandertal comparison samples nor from immature modern human (MHSS) from age class S3, both using DP probabilistic distance and ECRA (Table 8). In contrast, both the height and thickness of the Scladina mandible at the canine significantly depart from immature MHSS of classes S1 and S2. The height of the mandible also significantly departs from adult Late Neandertals. The bivariate graph of Figure 26 compares the height and thickness of the Scladina mandible at the canine to juvenile Neandertals as a whole and also to three age groups of immature MHSS. Scla 4A-9 is situated close to the centre of the ellipse of immature Neandertals and inside the ellipses of the MHSS S3 immature group, but just at the limit of the MHSS S2 group and outside the MHSS S1 group.

At the level of the $P_3$, the height and thickness of the right hemimandible Scla 4A-1 do not depart significantly from the average of the three juvenile Neandertal comparison samples nor from immature modern humans (MHSS) from age class S3, both using DP probabilistic distance and ECRA (Table 9). In contrast, both the height and thickness of the mandible at the $P_3$ significantly depart from immature MHSS of class S1. Concerning immature MHSS of class S2, Scladina is only significantly different in terms of the thickness.

**Table 9:** Height and thickness (mm) of the Scladina right hemimandible (Scla 4A-1) at the level of the right $P_3$ compared to those of immature Neandertals and MHSS as well as of adult Neandertals, with DP and ECRA.

| | | | |
|---|---|---|---|
| **Scla 4A-1** | **First premoral** | Height | (24.5) |
| | | Thickness | 12.8 |
| | | Index | 52.2 |

| Samples | | n | mean | St dev | DP | ECRA |
|---|---|---|---|---|---|---|
| **Immature NE S1–S4** | Height | 18 | 21.4 | 4.32 | 0.483 | 0.34 |
| | Thickness | 21 | 13.8 | 2.12 | 0.642 | −0.226 |
| | Index | 16 | 63.9 | 9.2 | 0.223 | −0.597 |
| **Immature NE S1** | Height | 8 | 18.3 | 3.07 | 0.083 | 0.854 |
| | Thickness | 8 | 12.3 | 1.28 | 0.708 | 0.165 |
| | Index | 8 | 68.1 | 8.5 | 0.104 | −0.791 |
| **Immature NE S2–S3** | Height | 5 | 22.7 | 3.93 | 0.671 | 0.165 |
| | Thickness | 7 | 14 | 1.95 | 0.561 | −0.251 |
| | Index | 5 | 61.8 | 9.9 | 0.387 | −0.349 |
| **Immature NE S4** | Height | 5 | 25.1 | 3.01 | 0.852 | −0.072 |
| | Thickness | 6 | 15.7 | 1.73 | 0.155 | −0.652 |
| | Index | 3 | 56.1 | 3.6 | 0.392 | −0.252 |
| **Immature MHSS S1** | Height | 10 | 19.6 | 1.96 | 0.034 | 1.105 |
| | Thickness | 10 | 9.6 | 0.73 | 0.002 | 1.938 |
| | Index | 10 | 49.4 | 5.6 | 0.629 | 0.221 |
| **Immature MHSS S2** | Height | 13 | 22.9 | 2.76 | 0.573 | 0.266 |
| | Thickness | 13 | 10.8 | 0.85 | 0.037 | 1.08 |
| | Index | 13 | 47.5 | 7.4 | 0.537 | 0.292 |
| **Immature MHSS S3** | Height | 12 | 24.9 | 3.55 | 0.912 | −0.051 |
| | Thickness | 12 | 11.6 | 0.97 | 0.242 | 0.562 |
| | Index | 12 | 46.9 | 7.8 | 0.511 | 0.309 |
| **Immature MHSS S1–S3** | Height | 35 | 22.7 | 3.45 | 0.605 | 0.257 |
| | Thickness | 35 | 10.7 | 1.18 | 0.084 | 0.876 |
| | Index | 35 | 47.8 | 6.96 | 0.531 | 0.311 |
| **Adult Early Neandertals** | Height | 7 | 32.2 | 4.71 | 0.153 | −0.668 |
| | Thickness | 8 | 15.66 | 1.5 | 0.098 | −0.806 |
| | Index | 7 | 49.55 | 5.24 | 0.631 | 0.207 |
| **Adult Late Neandertals** | Height | 11 | 33.42 | 1.92 | 0.001 | −2.085 |
| | Thickness | 9 | 14.77 | 1.23 | 0.148 | −0.695 |
| | Index | 9 | 44.56 | 3.86 | 0.083 | 0.858 |

The height of the mandible also significantly departs from adult Late Neandertals. In the bivariate graph of Figure 27, the height and thickness of the mandible are compared to two age samples of Neandertals (NE S1-S2 & NE S3-S4) and three age groups of immature MHSS. Scla 4A-1 is situated in the central area of the graph where the ellipses of the two immature Neandertal groups and the MHSS S2 and S3 immature groups overlap, but far outside the MHSS S1 group. So, as for symphyseal dimensions, dimensions at the $P_3$ do not provide clear taxonomic indications in the case of the Scladina specimen.

The height at the $M_1$ of Scla 4A-1 and 9 only departs significantly from the average of the immature modern human (MHSS) of age classes S1 and S2 as well as from adult late Neandertals and adult MHSS, using DP probabilistic distance and ECRA (Table 10). In contrast, the thickness at the $M_1$ only departs from adult MHSS. In the bivariate graph of Figure 28, the height and thickness at the $M_1$ are compared to samples of immature MHSS taken as a whole — but with different symbols according to the age classes — and to juvenile Neandertals also taken as a whole (due to their small number). Both Scladina hemimandible are situated in the central area where the ellipses of the immature Neandertal and MHSS S1-S3 groups overlap, but in an area where only specimens of age group S3 MHSS are present, over the specimens of MHSS groups S1 and S2.

The minimum breadth of the Scla 4A-1 ramus only departs significantly from immature modern humans (MHSS) of age classes S1 and S3 (class S2 does not contain enough fossils to provide reliable results), using DP probabilistic distance and ECRA (Table 11). In contrast, the Scladina I-4A mandible minimum breadth fits well within the variability of both immature and adult Neandertals and, despite the young age of eight years, within that of adult Upper Palaeolithic and modern humans (MHSS).

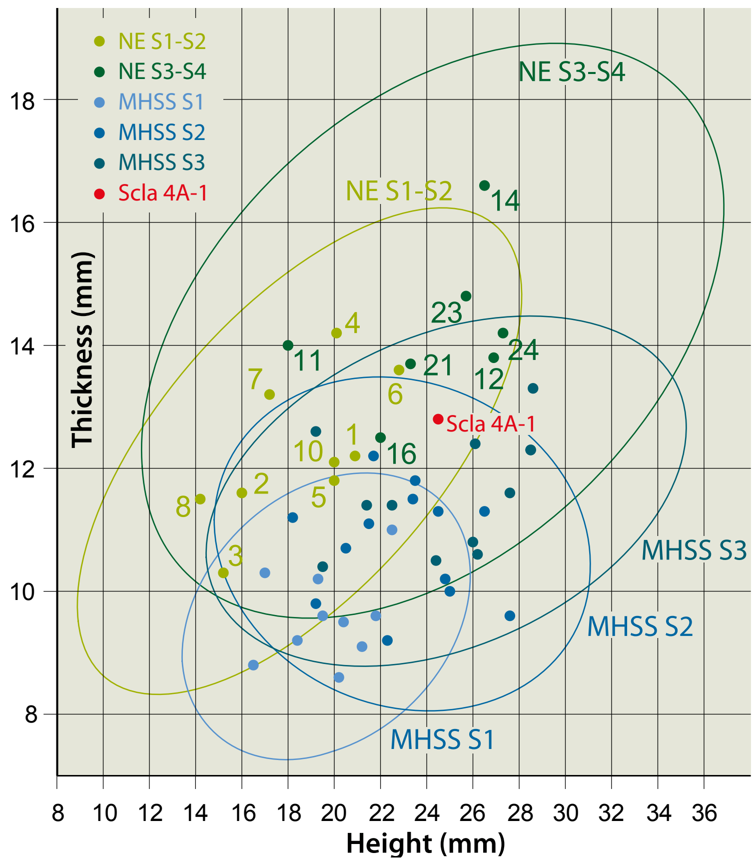



**Figure 27:** Bivariate analysis of the height and thickness (mm) of the Scla 4A-1 right hemimandible at the level of the $P_3$ with 95% equiprobable ellipses of juvenile Neandertals and MHSS.

| Scla 4A-9/$M_1$ | | | Scla 4A-1/$M_1$ | | |
|---|---|---|---|---|---|
| | Height | 23 | | Height | 22.2 |
| | Thickness | 14.2 | | Thickness | 14 |
| | Index | 61.6 | | Index | 63.1 |

| | | | | | | vs Scla 4A-9 | | vs Scla 4A-1 | |
|---|---|---|---|---|---|---|---|---|---|
| **Comparison Samples** | | **n** | **mean** | **St dev** | | **DP** | **ECRA** | **DP** | **ECRA** |
| **Immature NE (S1-S4)** | Height | 11 | 23.7 | 3.79 | | 0.857 | −0.083 | 0.701 | −0.178 |
| | Thickness | 10 | 15.8 | 1.31 | | 0.253 | −0.540 | 0.203 | −0.607 |
| | Index | 10 | 70.1 | 10.9 | | 0.456 | −0.345 | 0.537 | −0.284 |
| **Immature MHSS (S1)** | Height | 11 | 16.7 | 2.1 | | 0.013 | 1.346 | 0.026 | 1.175 |
| | Thickness | 11 | 13.4 | 1.1 | | 0.484 | 0.326 | 0.597 | 0.245 |
| | Index | 11 | 80.2 | 5.7 | | 0.009 | −1.465 | 0.013 | −1.346 |
| **Immature MHSS (S2)** | Height | 10 | 17.7 | 1.81 | | 0.017 | 1.294 | 0.035 | 1.099 |
| | Thickness | 10 | 14.3 | 0.96 | | 0.919 | −0.046 | 0.762 | −0.138 |
| | Index | 10 | 81.5 | 6.6 | | 0.015 | −1.333 | 0.021 | −1.232 |
| **Immature MHSS (S3)** | Height | 12 | 23.5 | 3.1 | | 0.875 | −0.073 | 0.683 | −0.191 |
| | Thickness | 12 | 14.4 | 0.9 | | 0.828 | −0.101 | 0.665 | −0.202 |
| | Index | 12 | 62.0 | 8.8 | | 0.965 | −0.021 | 0.903 | 0.057 |
| **Immature MHSS (S1-S3)** | Height | 33 | 19.5 | 3.9 | | 0.376 | 0.441 | 0.494 | 0.340 |
| | Thickness | 33 | 14.0 | 1.0 | | 0.843 | 0.098 | 1 | 0.000 |
| | Index | 33 | 73.9 | 11.6 | | 0.297 | −0.521 | 0.359 | −0.457 |
| **Adult Early Neandertals** | Height | 11 | 30.52 | 4.26 | | 0.108 | −0.792 | 0.079 | −0.877 |
| | Thickness | 10 | 15.49 | 1.04 | | 0.246 | −0.548 | 0.186 | −0.633 |
| | Index | 9 | 52.07 | 7.69 | | 0.250 | 0.537 | 0.189 | 0.622 |
| **Adult Late Neandertals** | Height | 11 | 33.1 | 1.8 | | 0.000 | −2.518 | 0 | −2.718 |
| | Thickness | 9 | 14.71 | 1.49 | | 0.741 | −0.148 | 0.646 | −0.207 |
| | Index | 9 | 44.6 | 3.53 | | 0.001 | 2.088 | 0.001 | 2.273 |
| **Adult MHSS** | Height | 490 | 30.67 | 3.31 | | 0.021 | −1.179 | 0.011 | −1.302 |
| | Thickness | 200 | 11.8 | 1.18 | | 0.043 | 1.031 | 0.064 | −0.945 |

Table 10: Height and thickness (mm) of the Scladina mandible (Scla 4A-1 & 9) at the level of the $M_1$ compared to those of immature and adult Neandertals and MHSS with DP and ECRA.

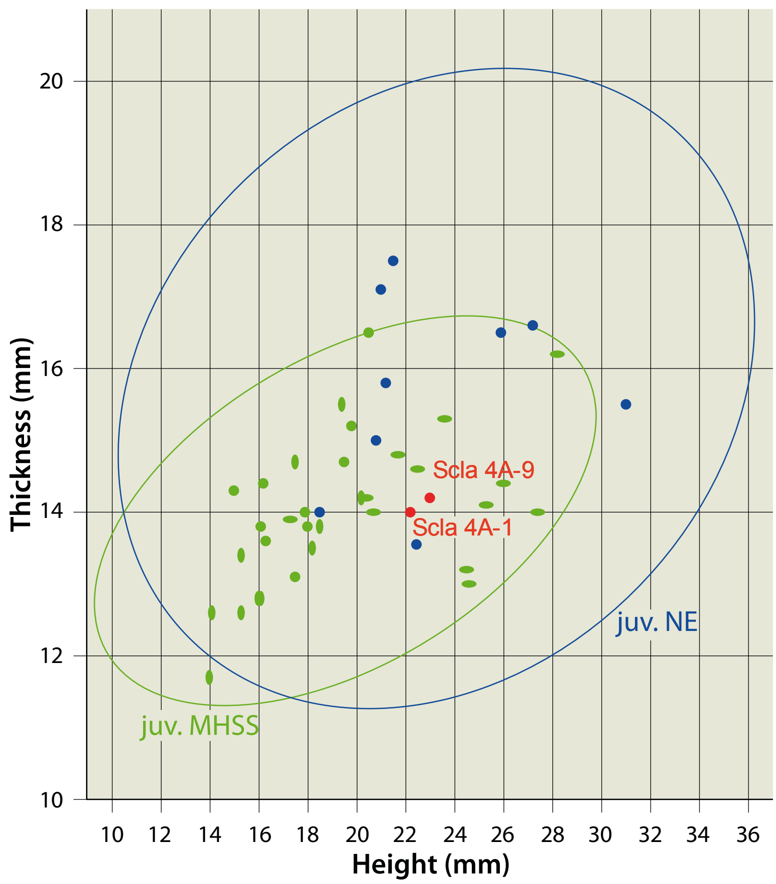



Figure 28: Bivariate analysis of the height and thickness (mm) of the Scladina mandible (Scla 4A-1 & 9) at the level of the $M_1$ with 95% equiprobable ellipses of juvenile Neandertals and MHSS.

| Scla 4A-1 | Ramus minimum breadth | 35.1 |
|---|---|---|

| Comparison Samples | | n | | Mean | Stand. dev. | DP | ECRA |
|---|---|---|---|---|---|---|---|
| NE (Neandertal) | juvenile (S1-S4) | 11 | | 28.5 | 3.47 | 0.086 | 0.854 |
| MHSS (Spitalfields) | 2–5 years (S1) | 15 | | 22.4 | 1.6 | 0.000 | 3.701 |
| MHSS (Hasanlu–Tapeh) | S2 | 4 | | 23.8 | 4.2 | 0.074 | 0.845 |
| MHSS | 7–10 years (S3) | 12 | | 27.4 | 1.9 | 0.002 | 1.841 |
| EN | adult | 6 | r | 39.15 | 2.93 | 0.225 | –0.538 |
| LN | adult | 10 | r | 40.55 | 3.09 | 0.112 | –0.78 |
| N (EN + LN) | adult | 16 | r | 40.03 | 3.01 | 0.122 | –0.768 |
| UPMH | adult | 11 | | 39.69 | 3.12 | 0.172 | –0.66 |
| MHSS | adult | 1107 | | 33.99 | 3.19 | 0.728 | 0.177 |
| Belgian MHSS | adult | 11 | | 33.3 | 3.45 | 0.613 | 0.234 |
| Belgian MHSS | S3 | 8 | | 27.3 | 3.59 | 0.066 | 0.919 |

Table 11: Ramus minimum breadth of the Scladina right hemimandible (Scla 4A-1) compared to that of immature and adult Neandertals and MHSS with DP and ECRA.

| Scla 4A-1 | Ramus height | 45.5 |
|---|---|---|

| Comparison Samples | | n | | Mean | Stand. dev. | DP | ECRA |
|---|---|---|---|---|---|---|---|
| NE | S1-S4 | 6 | | 41.4 | 10.01 | 0.699 | 0.159 |
| MHSS | 7–10 years (S3) | 12 | | 45.4 | 4.3 | 0.982 | 0.011 |
| Belgian MHSS | S3 | 8 | | 45.2 | 4.1 | 0.944 | 0.031 |
| EN | adult | 4 | r | 66.04 | 3.23 | 0.008 | –1.998 |
| LN | adult | 5 | r&l | 67.68 | 5.77 | 0.018 | –1.385 |
| NE (EN + LN) | adult | 6 | r | 64.98 | 3.63 | 0.003 | –2.088 |
| UPMH | adult | 9 | r&l | 63.95 | 6.25 | 0.018 | –1.28 |
| MHSS | adult | 879 | | 57.06 | 4.89 | 0.018 | –1.204 |
| Belgian MHSS | adult | 11 | | 56.04 | 4.21 | 0.031 | –1.124 |

Table 12: Ramus height of the Scladina right hemimandible (Scla 4A-1) compared to that of immature and adult Neandertals and MHSS with DP and ECRA.

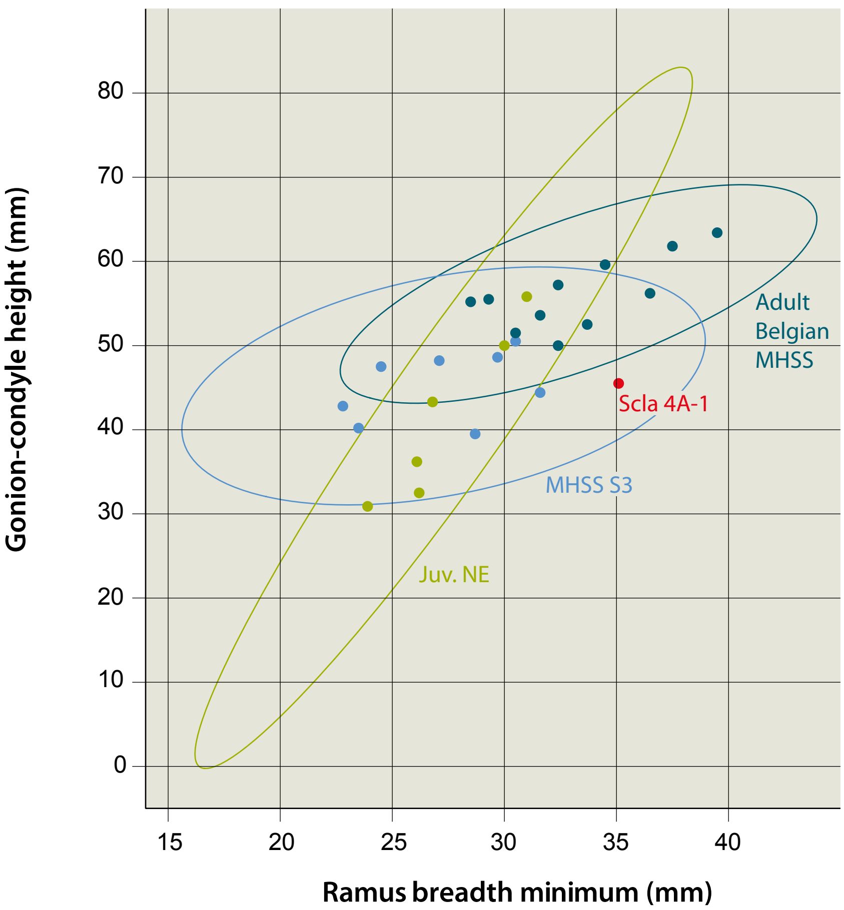



Figure 29: Bivariate analysis of the minimum breadth (mm) of the right ramus and the gonion-condyle height. The hemimandible Scla 4A-1, compared to immature Neandertals as well as to some Belgian immature and adult MHSS.

The gonion-condyle height (M 70) along the posterior border of the ramus of Scla 4A-1 does not significantly differ from the average of immature Neandertals or of immature modern human (MHSS) of age class S3 (Table 12). In contrast, it significantly differs from all Neandertal and MHSS adults.

In the bivariate graph of Figure 29 the minimum breadth of the ramus and the gonion-condyle height of the mandible are compared to immature Neandertals as well as to some Belgian immature and adult MHSS. Scla 4A-1 is situated outside the area of adult MHSS but also outside the too small sample of juvenile Neandertals and, in contrast, in the area of juvenile MHSS of age class S3.

The mandibular angle of Scla 4A-1 (116°) only departs significantly from immature modern humans (MHSS) of age class S1 (Table 13). Clearly, the ramus is less inclined on the corpus than in modern children (see Giacobini et al., 1984).

### 5.3. Discussion

In the previous section, some dimensions of the Scladina mandible were statistically compared

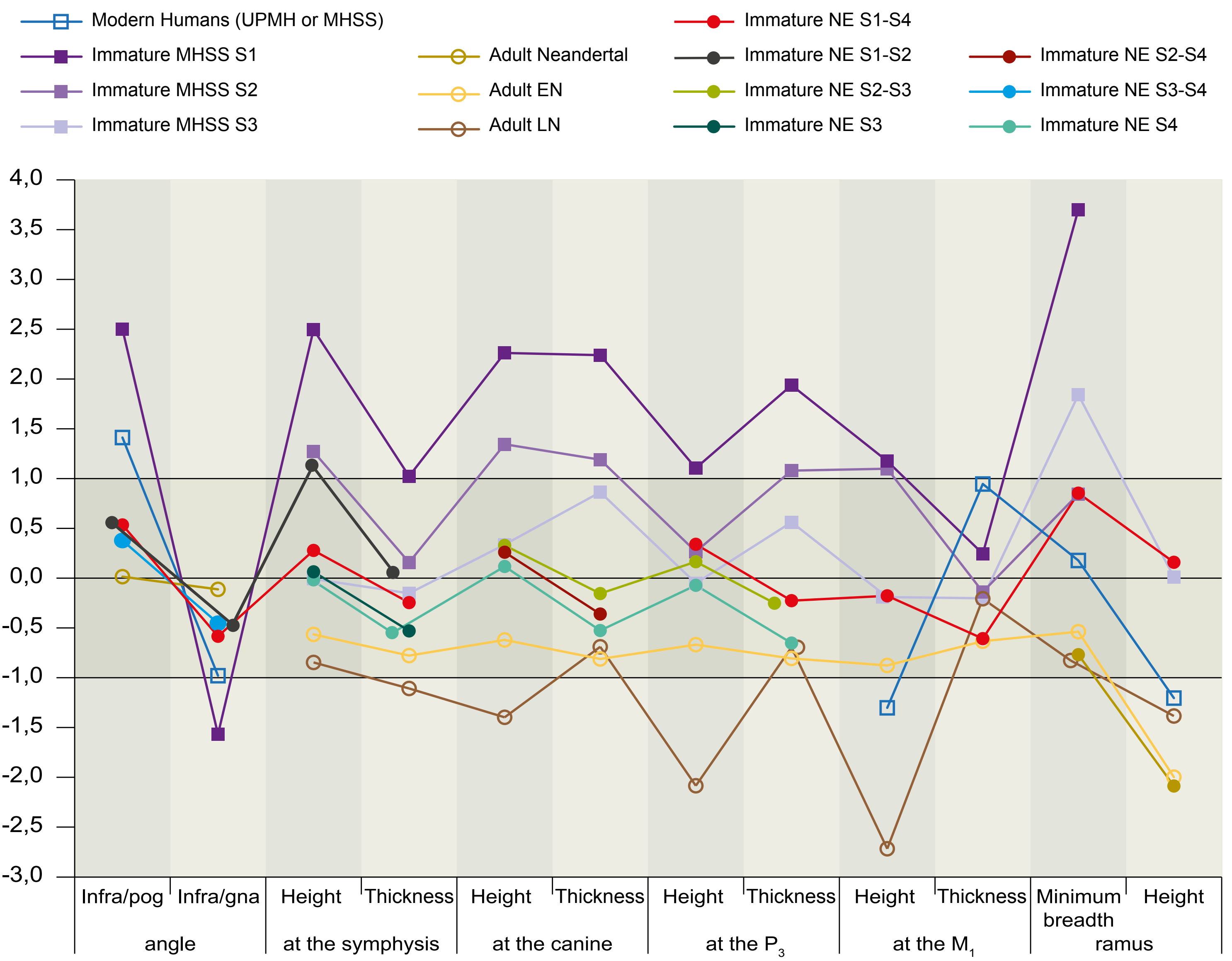



Figure 30: ECRA of the symphysis angles as well as of the height and thickness of the Scladina mandible.

| Scla 4A-1 | Mandibular angle (°) | | 116 | | | |
|---|---|---|---|---|---|---|
| **Comparison Samples** | | **n** | **Mean** | **St. Dev** | **DP** | **ECRA** |
| EN (Early Neandertals) | adult | 4 | 113.5 | 6.61 | 0.73 | 0.119 |
| LN (Late Neandertals) | adult | 6 | 107.3 | 3.56 | 0.058 | 0.951 |
| Neandertals (EN + LN) | adult | 10 | 109.8 | 5.63 | 0.299 | 0.487 |
| NE | juvenile | 10 | 120.7 | 7.79 | 0.561 | −0.267 |
| UPMH | adult | 19 | 116.68 | 5.65 | 0.906 | −0.057 |
| MHSS | juvenile S1 | 20 | 134.6 | 6.25 | 0.008 | −1.422 |
| MHSS | adult | 1037 | 122.19 | 6.42 | 0.335 | −0.491 |

Table 13: Mandibular angle of the right hemimandible (Scla 4A-1) compared to those of immature and adult Neandertals and MHSS with DP and ECRA.

to different immature and adult Neandertal and MHSS samples. In Figure 30, we analyse all ECRA dimensions as a series. It shows that the Scladina I-4A mandible differs from immature MHSS of classes S1 and frequently S2 as well as, often, from adult modern humans (UPMH or MHSS). The Scladina mandible fits perfectly with immature NE S2-S3-S4, including the angles at the symphysis, which clearly mark the difference with MHSS. It differs more from adult Late Neandertals than from adult Early Neandertals, which could be linked to the approximate age of the fossil at 80,000, which relates to either MIS 5b or 5a (see Chapter 5: § 4.3).

## 6. Conclusion

The anatomical observations and morphometric analysis in this chapter highlight a range of features found on immature and adult Neandertals.

In terms of morphology, the Scladina mandible combines some features generally considered as derived — such as, among others (Table 2), the highly excavated submandibular fossa or the deeply excavated pterygoid fossa — and some features not unanimously accepted as derived, but frequent among Neandertals, for instance the laterally expanded condyle. In fact, what characterizes a Neandertal mandible, both adult and juvenile, lies less in supposed derived traits and more in the unique combination of a set of traits that, taken individually, are not typical of this taxon. In this regard, the Scladina mandible matches the general pattern of Neandertals.

Statistically, the Scladina mandible is close to immature Neandertals, particularly those who were about the same age at death. Compared to adult Neandertals, it seems closer to Early Neandertals than to Late Neandertals.

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