Chapter 9

IS SEX DETERMINATION OF THE SCLADINA I-4A JUVENILE NEANDERTAL POSSIBLE?

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1. Introduction

Sexual dimorphism is obvious in living and extinct primates, including human species (Brace, 1973; Frayer & Wolpoff, 1985; Oxnard, 1987). It is acknowledged that males are, on average, taller in stature than females, possess stronger bones, bigger teeth, and greater strength and muscularity. Throughout human evolution, there is also ample evidence of reduction in sexual dimorphism.

Consequently, the interpretation of the morphology and morphometry of any human remain, either modern or ancient, should include as accurate an estimation of the sex as possible. As with the determination of age at death, the identification of the sex of fossil remains has implications in fields as varied as taxonomy, palaeodemography, palaeopathology, behaviour and phylogeny.

Numerous sexing techniques have been developed for adult modern human bones. They are based either on morphological traits, or on metric differences (Ferembach et al., 1980; Krogman & Işcan, 1986; Bass, 1986). Nearly all categories of bones have been taken into account.

Morphological male or female traits may sometimes be differentiated by shape, for instance the prominent aspect of the male chin against the female rounded one (Ferembach et al., 1980; Bass, 1986), the development of the glabella and inion, or the morphology of postcranial features such as the distal humerus (Rogers, 1999). However, the accuracy of assessment using cranial and long bone characteristics is never as good as that using pelvic bones, which have a higher prediction accuracy in this regard, over 95% (Krogman & Işcan, 1986; Bruzek, 2002). Many discriminant functions have been increasingly utilized for sex diagnosis over the last half century (among the first to develop them were: Giles & Elliot, 1963; Giles, 1964; Howells, 1965; Kajanoja, 1966; Boulinier, 1968). They were developed through the use of modern *Homo sapiens sapiens* skeletal collections of known ancestry, sex and age such as the Hamann-Todd and Terry Collections. These functions should be applied only to bones closely related to the series for which they were developed.

Estimating the sex of juvenile and subadult skeletal remains is more difficult. Most techniques in current use derive from adult-centric ones, so the question often arises of whether juvenile bones, including those from the pelvis, can be accurately sexed using these criteria (Bass, 1986; Majo, 1992). In fact, due to limited sexual dimorphism before puberty, no really reliable sex diagnosis techniques are applicable for juveniles (Henry-Gambier et al., 2007).

In the case of fossillized specimens, the attribution of sex using modern standards is even more difficult. This probably results from the use of the general level of robusticity as a sexual indicator (Trinkaus, 1983). Under such conditions, robust females are often classified as males while slender males might be mistaken for females. As for discriminant function analyses, these modern standards are almost inapplicable to fossils.

With Neandertal juvenile cranial remains, such as those from Scladina, the three problems referred to above are combined: the remains belonged to sub-adults; traits commonly used for sexing modern humans are not accurate enough for fossils; and, finally, mandibles and maxillae are not the most accurate bones to use in determining sex.

As a consequence of all these problems, some palaeoanthropologists with an interest in Neandertals simply do not try to assess the sex of the fossils they study, especially if the skeletal remains do not include the pelvic bones (Madre-Dupouy, 1992: 247-249; Verna, 2006: 109). The assessment of sex is even more problematic with fossils of juveniles (Heim, 1982; Teilhol, 2001). In the context of the analysis of the Scladina I-4A remains it is important to re-emphasize this difficulty (Heim, 1981–1982: 462) as the remains are from a juvenile represented by an isolated mandible and portions of the maxilla. Obviously, such precautions are wise. Nevertheless, other experts do prefer to discuss and assess the identification of the sex of their cranial and mandibular specimens, even when they are well aware that it is often a quite delicate process (Thoma, 1975; Mann & Vandermeersch, 1997; Quam et al., 2001; Thompson & Nelson, 2005). This is exactly the approach taken in the present chapter. Even though the determination of the sex of the Scladina remains may finally prove to be a tricky objective, trying to discuss such a nightmarish issue is not without interest.

However, as the Scladina fossil remains are juvenile and comprised of just a mandible, a small piece of maxilla and a few teeth, only a few criteria could be taken into account. Metrical traits which should still increase during the end of the growth were only used when it was possible to get comparative data from other juvenile Neandertals.

2. Methods

Since the beginning of Neandertal palaeoanthropological research, attempts have been made to determine the sex of the remains palaeontologists were studying. For example, as early as 1887, Fraipont classified Spy 1 as female and Spy 2 as male (Fraipont & Lohest, 1887: 707-709). Two decades later, Boule (1911-1913) considered La Chapelle-aux-Saints male. Henri-Martin suggested that the partial skeleton from La Quina 5 was female, then expressed reservations on his determination (Martin, 1923); nevertheless, most palaeoanthropologists think the fossil is really female (e.g. Vandermeersch, 1965; Heim, 1976; Trinkaus, 1980; but see Verna, 2006 for a critical discussion).

In fact, determination of sex of Neandertal bones is always difficult. More than half a century ago, Genoves (1954) drew palaeoanthropologists' attention to the fact that the sex of some fossils had already changed up to five times since their discovery!

Regardless of the above reservations, the current — if debated — state of the art in Neandertal estimation of sex is summarized in some papers and books.

In regards to cranial remains, Smith pointed out that the morphological and metrical features that have to be taken into account are the same as for modern humans (Smith, 1980: 364), only with varying degrees of differences. Smith focused primarily on the shape of the supraorbital torus, the morphology of the mastoid process and its surrounding area as well as the robustness of the nuchal plane. The sexual value of the overall dimensions of the Neandertal skull has also been emphasized (Heim, 1981-1982); and indeed, cranial capacity is generally acknowledged as a reliable indicator when sexing adult and subadult Neandertals (Thoma 1975; Holloway, 1985; Thompson & Nelson, 2005).

Some features of the mandible are also seen as useful in sexing Neandertals (Smith, 1976: 183-187; Wolpoff, 1976; Heim, 1981-1982), in particular the height and thickness of the symphysis, the height at the condyle as well as the condylar breadth.

Other authors emphasize the importance of the dimensions of teeth in the attribution of sex (Oxnard, 1987). On the contrary, Wolpoff (1979) concluded his study of the Krapina remains by stating that the dentition was by no means a reliable indicator of sex with that sample, as both large and small teeth may be found in the same dentition. However, it has recently been noted (Mann & Vandermeersch, 1997: 524) that the sample of teeth from Krapina is at the upper end of the Neandertal range as far as size is concerned. Therefore Krapina might not represent the best series for studying the importance of tooth size in evaluating sexual dimorphism in Neandertals. So, recent papers resort to Oxnard's tooth dimensions as a sex indicator for Neandertals (Quam et al., 2001; Thompson & Nelson, 2005).

According to Trinkaus (1983: 43), Neandertal pelvic morphology provides the most secure criteria for the determination of sex although a variety of other morphological features can also be used.

Trinkaus also notes that "it is possible to use [...] appendicular dimensions to assign sex to Neandertal specimens" but not without difficulties such as an overlap in size between males and females (Trinkaus, 1983: 44; see also Trinkaus, 1980). For instance, amongst the numerous dimensions of postcranial bones that have been used to indicate the sex of modern humans (Krogman & Işcan, 1986; Bass, 1986), the vertical diameter of the femoral head is supposed to be able to distinguish male and female Neandertals quite well (Trinkaus, 1980, 1983; Thompson & Nelson, 2005).

In conclusion of this quick overview, it seems clear that only specifically designed techniques, which do not presuppose that modern morphological features are valid for determining the sex of Neandertal remains, should be applied. Since both taxa bear obvious differences in robustness, some of their anatomical features may not have the same sexual meaning. As for the estimation of the sex of the Scladina remains, only a few mandibular and dental criteria could be used. They are discussed below.

2.1. Measurements

2.1.1. Teeth

2.1.1.1. Crowns

In his monograph dealing with the pattern of sexual dimorphism in human evolution, Oxnard (1987) developed a technique which cleverly avoids the pitfall of applying modern humans measurements to fossil taxa. He analysed a number of dental samples of extinct hominins, including Neandertals. He noticed statistically significant bimodal distributions in the BL or MD diameters of some categories of fossil teeth whose gender had not been estimated from the morphology of the hip bone. He interpreted these bimodal distributions in the size of the teeth as evidence of sexual dimorphism.

In practice, most researchers who referred to Oxnard's approach (Mann and Vandermeersch, 1997; Quam et al., 2001; Thompson & Nelson, 2005) made use of the permanent mandibular canine breadth, as it is acknowledged that the size distribution of the canines shows the greatest differences between males and females in recent human populations.

Indeed, in Oxnard's Neandertal sample, the range of permanent mandibular canine breadth, both sexes included, exhibit a clear bimodal pattern. The smaller values, presumably female, range from 7.5 to 9.0 mm, with an average of 8.5 mm (Oxnard, 1987: 81), while the larger values, probably male, range from approximately 9.4 to 10.5 mm, with an average of 10.0 mm.

More recently, Bermúdez de Castro et al. (1993; Bermúdez de Castro & Nicolás, 1997) assessed the sexual dimorphism of the Atapuerca–Sima del Huesos Neandertal sample from the crown area.

2.1.1.2. Tooth roots

In modern humans, sexual dimorphism is greater in root length than in crown diameters (Garn et al., 1978, 1979), and males have longer roots than females (Jakobsson & Lind, 1973). The role of sex chromosomes in root length also seems to be important (Lähdesmäki, 2006; Lähdesmäki & Alvesalo, 2007; Le Cabec et al., this volume, Chapter 16).

2.1.2. Mandibular corpus

Usually adult male cranial and postcranial remains are bigger and more robust than those of females. It is reasonable to suppose that this is also true for juveniles and conclude that, at an equal age, the smallest specimens are female and the biggest male.

According to Smith (1976: 185) the height of the symphysis might be indicative of sexual differences. This trait has to be very cautiously used as there are important differences between this measurement depending on who took it. For Smith (1976), the symphyseal height of the Krapina C mandible is 29.6 mm but only 23.7 mm for Minugh-Purvis (1988); Krapina E has a symphysis height of 34.8 mm for Smith but 34.5 or only 31.4 mm for Minugh-Purvis. For Smith, the height at the condyle and the condylar breadth also exhibit sexual dimorphism. Other mandibular dimensions are also used insofar as they reflect the size of the mandible with small ones reasonably supposed to be female.

If these measurements really exhibit sexual differences, the mandible of Scladina must not, however, be compared with adult specimens but with other immature Neandertals and Early Moderns aged over 8 years.

2.2. Morphological features

2.2.1. Teeth

2.2.1.1. External morphology

According to some authors (Scott 1977; Scott & Turner, 1997: 106) the presence of a distal accessory ridge on permanent maxillary and mandibular canines is one of the most sexually dimorphic, albeit moderately, dental traits in modern humans. In fact, although more pronounced expressions of this trait have a higher frequency in males than in females, they are present in both sexes. In the case of Neandertals, it has been shown that this feature is present on around two thirds of the canines (Bailey, 2006) but its significance in the attribution of sex is unknown and, therefore, reference to it when assessing the sex of the mandible of Scladina is unwise.

2.2.1.2. Internal morphology

Secondary dentine deposition could be related to sexual dimorphism; males would have thicker radicular dentine than females (Schwartz & Dean, 2005). A large root pulp volume is also considered a female trait, though little is known about the variability of sexual dimorphism in dental root dimensions of fossil populations, which calls for some caution in this regard (Le Cabec et al. this volume, Chapter 16).

2.2.2. Mandibular features

2.2.2.1. Development of the *incisura submentalis*

A decade ago, Loth & Henneberg (1997) suggested that the development of the *incisura submentalis* at the base of the symphysis is usable as a reliable morphological indicator of sex in both modern and Palaeolithic mandibles. According to them, males would tend to exhibit a stronger and more frequent expression of this character than females. However, the validity of this criteria has not yet been rigorously tested.

2.2.2.2. Morphology of the chin

In modern humans, one of the classic traits used for sexing mandibles is the robust and square shape of the chin in males versus the small and rounded aspect with a point in the middle in females (Ferembach et al., 1980; Bass, 1986). Such a feature is totally inadequate for Neandertals as the structure of this region is very different (Weidenreich, 1936).

2.2.2.3. Mandibular ramus posterior flexure

According to Loth & Henneberg (1996, 1998), the angulation of the posterior border of the mandibular ramus differs between modern males and females. In females it would be straight, whereas it would be angled at the level of the occlusal surface of the molar in males. The accuracy of the method would be of 94.2% on combined American and African subjects. However, blind tests conducted by other researchers to assess the precision of this method as an indicator of sex provided a much lower overall probability of accuracy than that initially reported by Loth and Henneberg: below 70% or even much less (Koski, 1996; Donnelly et al., 1998; Haun, 2000; Hill, 2000; Kemkes-Grottenthaler et al., 2002; Balci et al., 2005). Loth & Henneberg (1997) also stated that the same differences in ramus shape are present on fossil material, notably on Neandertals, *Homo erectus* and australopithecines. Indeed, the Neandertal adolescent mandible of Le Moustier 1 might, at first glance, provide an argument in favour of Loth and Henneberg's technique. The distinctive flexure of the posterior border of the ramus is present, suggesting that the fossil is likely male and is in accordance with other sex indicators, e.g. cranial capacity, dental metrics and femoral head diameter (Thompson & Nelson, 2005). On the contrary, a test conducted on three Neandertal and three Early Modern Human mandibles whose sex had already been estimated from the associated os coxae — the bones that exhibit most sexual dimorphism in adults — produced results which drastically contrasted with those published by Loth and Henneberg (Coqueugniot et al., 2000). The three Neandertal mandibles turned out to be male according to the hip bone but female according to the posterior flexure of the mandibular ramus, while two of the three Early Modern Human mandibles also provided opposite sexual diagnoses. Therefore, it seems that the potential usefulness of the presence or absence of a distinctive flexure on the posterior margin of the mandibular ramus in the determination of sex for fossil hominids could have been largely overestimated.

2.2.2.4. Gonial Eversion

Traditionally, gonial eversion of the mandible is cited as an adult male sex indicator (Ascádi & Neméskeri, 1970; Ferembach et al., 1980). However, it has recently been proven that this criteria has 'a lower probability of determining sex than could be predicted by chance' and is consequently not a reliable indicator of sex (Loth & Henneberg, 2000: 86; see also Kemkes-Grottenthaler et al., 2002 and Oettlé et al., 2009). Furthermore, it is well known that most Neandertal gonions are inwardly inflected (Billy & Vallois, 1977: 420), even those that are clearly male, such as La Ferrassie 1. Therefore, this trait is inapplicable to this taxon.

3. Results

3.1. Teeth

3.1.1. Crowns

The breadth of the Scladina permanent mandibular right canine (Scla 4A-12) is 8.75 mm. By comparison with Oxnard's Neandertal bimodal distributions — 7.5 to 9.0 mm for probable females and 9.4 to 10.5 mm for probable males — such a dimension supports the hypothesis that the fossil might be female (Figure 1). This diameter is also below the average for the permanent mandibular canines of European Neandertal as computed by Trinkaus (1983: 167), both sexes included: 9.2 mm ± 0.8 (n = 29). The breadth of the permanent maxillary lateral incisors also has a bimodal distribution and the two specimens from Scladina (Scla 4A-14 and 17) also fit within the upper part of the female range (Figure 1).

However, compared to the crown area of the Atapuerca-SH sample (Bermúdez de Castro & Nicolás, 1997: 348), the Scla 4A-12 permanent mandibular canine is in an intermediate position (69.2) between the upper range of specimens referred to as females and the lower range of supposed males.

Using the crown area, the Scla 4A-6 permanent mandibular first premolar is also in the area where it is difficult to distinguish between males and females of Atapuerca–Sima del Huesos.

Table 1 presents MD and BL diameters and the calculated means of other permanent teeth, especially incisors and permanent maxillary canines, which are supposed to present significant sexual dimorphism according to Oxnard (1987). With regard to these dimensions, the Scladina fossils are either at the upper part of the female distribution — for instance breadth of the permanent mandibular central incisor Scla 4A-15 — or undetermined.

3.1.2. Roots

The short roots of these teeth would suggest that the Scladina Child may have been female (Le Cabec et al., this volume, Chapter 16).

In addition, the pulp cavity volumes of all the investigated Scladina teeth are among the largest of the Neandertal teeth, which would be another argument to suggest a female attribution (Le Cabec et al., this volume, Chapter 16).

3.2. Mandible corpus dimensions

Table 2 lists corpus dimensions of the Scladina mandible as well as comparable measurements from other immature Neandertals and Early Moderns aged from about 8 to 16 years.

The Scladina symphyseal height is 27.75 mm. The range of Neandertal females close in age extend from 22.0 mm in Montgaudier to 28.1 in Petit-Puymoyen, while the male range seems to

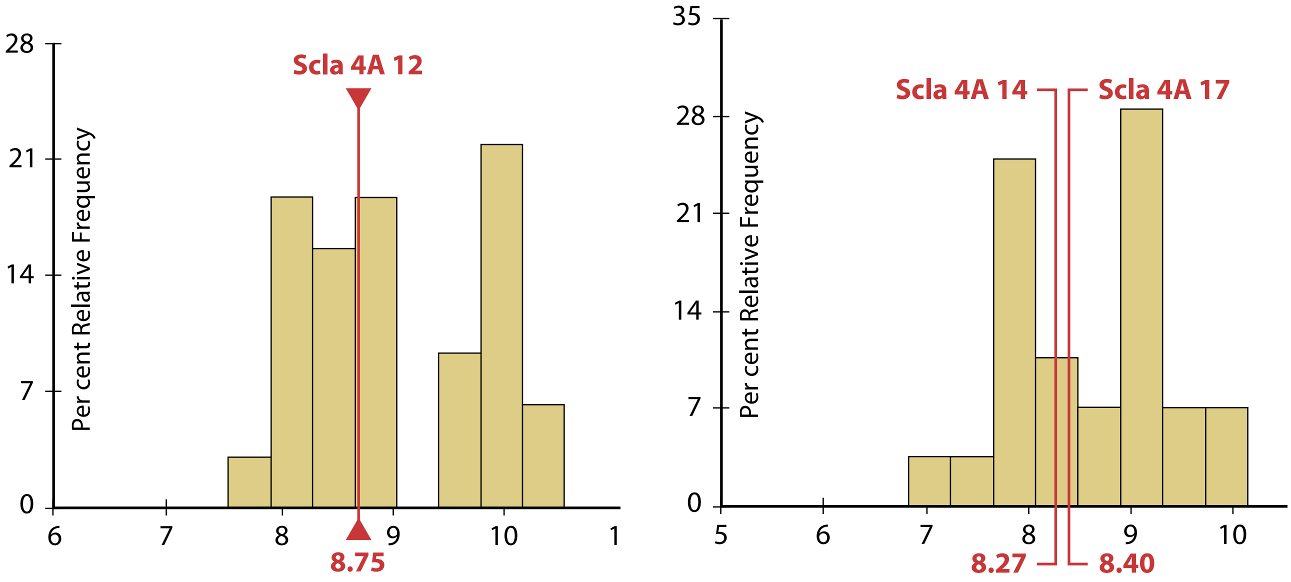

Figure 1: Left, permanent mandibular canine breadth (after Oxnard, 1987: 72); right, permanent maxillary lateral incisors breadth (after Oxnard, 1987: 74).

Permanent Tooth	Oxnard (1987)							Scladina			
Type	Measurement	Mode	Female	Transition	Male	Female mean	Male mean	Inventory number	Side	Dimension (mm)	Diagnosis
Mandibular central incisor	breadth	bimodal				7.0	8.0	Scla 4A-15	right	6.79	(female)
Mandibular lateral incisor	length	bimodal				6.2	7.5	Scla 4A-20	right	7.03	undetermined
Mandibular canine	breadth	bimodal	7.5–9.0	9.0–9.4	9.4–10.5	8.5	10.0	Scla 4A-12	right	8.75	female
Maxillary lateral incisor	length					7.2	8.4	Scla 4A-14	right	8.21	undetermined
								Scla 4A-17	left	8.38	undetermined
Maxillary lateral incisor	breadth	bimodal	6.9–8.5	8.5–8.9	8.9–10.25	8.0	9.2	Scla 4A-14	right	8.27	female
								Scla 4A-17	left	8.4	female
Maxillary canine	length					8.2	9.0	Scla 4A-18	left	8.6	undetermined
								Scla 4A-16	right	9.05	undetermined
Maxillary canine	breadth	bimodal	8.0–9.4	9.4–9.9	9.9–11.3	9.0	10.3	Scla 4A-18	left	9.95	undetermined
								Scla 4A-16	right	9.65	undetermined
Maxillary second molar	length					10.0	11.3	Scla 4A-3	right	10.21	(female)
Maxillary third molar	length	bimodal	8.2–8.7	8.7–9.9	9.9–11.4	8.8	10.1	Scla 4A-8	right	9.55	undetermined

Table 1: Ranges and means of some Neandertal teeth (Oxnard, 1987: 72, 74, 77, 81) compared with the Scladina teeth.

extend from 28.6 in Atapuerca–Sima del Huesos AT-607 Preneandertal to 30.6 mm in Valdegoba. According to its height, Scladina might be female, but that dimension is very close to the higher range of females, so near the interval where male and female dimensions overlap.

As far as symphyseal thickness is concerned, the Scladina jaw is quite small in comparison with other immature specimens of comparable age. In fact, only the Montgaudier and Petit-Puymoyen mandibles are slightly thinner. If all the sexual determinations of the fossils listed in Table 2 are correct, Scladina, with a symphyseal thickness of 12.36 mm, is clearly in the range of perceived Neandertal females of similar age. These values range from 11.8 mm at Montgaudier to 13.6 mm at Hortus 2-3 and might be extended to 14 mm if the Malarnaud mandible was proven to be female. Males are obviously thicker, 15 mm at Le Moustier 1 and 15.5 mm at Valdegoba.

Other measurements of the Scladina corpus thickness provide the same kind of results. Corpus thickness at the level of the canine, the first and second premolars as well as at the first molar is quite small; only the female mandible of Montgaudier has smaller dimensions. All males have much higher measurements than Scladina. Height measurements are less conclusive but Scladina always yields small or middle size results.

In conclusion, as far as corpus dimensions are concerned, the Scladina mandible is relatively small compared with a sample of other Neandertal mandibles of comparable ages at death. Such observations could tentatively indicate that the fossil is female.

3.3. Morphological mandibular features

The *incisura submentalis* of the Scladina mandible is only minimally expressed. According to Loth & Henneberg's observations (1997), this might suggest that the fossil belonged to a female.

The other possible morphological indicators of the sex of mandibles are not usable in the case of Scladina as it has been shown that they are not really reliable, especially for Neandertals.

4. Discussion

Oxnard's technique is a valuable alternative in the analysis of Neandertal teeth as it avoids the problems encountered through the application of methods elaborated for the analyses of modern humans. (Madre-Dupouy, 1992). Based on Oxnard's data, some of the teeth from Scladina fit within the female range, particularly the permanent mandibular canine which is one of the most informative teeth for the determination of sex. The dimensions of other teeth fall into the range of overlap between males and females. In addition, the MD and BL diameters of the Scladina teeth are almost always below the mean of supposed male Neandertals which might substantiate a female designation.

However, it seems important to ask oneself if the bimodal aspect of the curves of Oxnard is not, at least partially, an illusion. Can we really consider Neandertals as a homogeneous population? They were scattered over a wide geographic area (most of Europe and the Middle East) for hundreds of

Specimen	Taxon	Age at death (years)	Possible sex	Symphysis			Canine		P3		P4		M1		Reference
				Height	Thickness	Index (Th/H)	Height	Thickness	Height	Thickness	Height	Thickness	Height	Thickness	
Scladina 4A-9 (left)	Neandertal	8 (histology); 10–11 (anthropo)		27.75	12.36	44.5	26.32	13.1		13.2	(24.1)	13.2	(23.0)	14.2	MT, present paper
Scladina 4A-1 (right)	Neandertal	8 (histology); 10–11 (anthropo)						(13.45)	(24.5)	12.8	23.9	13.1	22.2	14.0	MT, present paper
Hortus 2-3	Neandertal	9	(Female)	25.0	13.6	54.4									de Lumley-Woodyear, 1973: 345
Montgaudier	Neandertal	12.5–14.5	Female	22.0	11.8	53.6	24.9	12.15	23.3	13.7	23.3	13.45	22.45	13.55	Mann & Vandermeersch, 1997
Malarnaud 1	Neandertal	15	Female	25	14	56	24.4	14.9	20.9		20.9		21.5	16.1	Minugh-Purvis, 1988: 179, 185, 188; Heim & Granat, 1995
Petit-Puymoyen 1	Neandertal	16–17	Female	28.1	12.2	43.4	28.9		28.3		29.1		28.0		Minugh-Purvis, 1988: 179, 185
Krapina E	Early Neandertal	15–17	Female	31.4	13.5 (14.1)		23.7	15.0	25.7	14.8	26.8	14.4	25.9	16.5	Minugh-Purvis, 1988: 179; 185, 188
Valdegoba	Neandertal	13–14	Male	30.6	15.5	50.6		17.0		(16.9)		(16.6)		(16.6)	Quam et al., 2001
Le Moustier 1	Neandertal	15.5	Male	30.0	15.0	50.0	27.5	15.0	27.3	14.2	25.4	15.2	27.2	16.6	Minugh-Purvis, 1988: 179, 185, 188; Thompson & Nelson, 2005
Atapuerca SH AT-607 (XXIII)	pre-Neandertal	Adolescent	Male	28.6	14.7	51.4						15.2 (P4/M1)			Rosas, 1995
Teshik-Tash 1	Neandertal	8.5–11		27.0	13.7	50.7	26.4	17.0	26.5	16.6	25.1	15.1	21.2	15.8	Minugh-Purvis, 1988: 179, 185, 187
Zaskalnaya VI	Neandertal	9–10		30.0	13.4	44.7	19.8	14.0	(18.0)	14.0	21.4	13.6	20.7	13.8	Minugh-Purvis, 1988: 184, 187
Sipka 1	Neandertal	9–10.5		28.4	14.0	49.3									Minugh-Purvis, 1988: 179
Fate 2	Neandertal	9–10					(20.5)	(17.2)	(22.0)	(12.5)			18.5	14.0	Giacobini et al., 1984 & MT
Krapina B (52)	Early Neandertal	9.5		26.0	(12.0)	(46.2)	(29.0)	15.6		16.7		17.9	23.5		Minugh-Purvis, 1988: 179; 184, 187
Krapina C (53)	Early Neandertal	11		23.7	13.6	57.4	(26.0)	17.4		17.9	22.1	17.5	21.0	17.1	Minugh-Purvis, 1988: 179; 184, 187
Ehringsdorf 7	Early Neandertal	12		28.3	15.3	54.1	25.6	15.6		(17.0)			20.8	(15.0)	Minugh-Purvis, 1988: 179
Modern *Homo sapiens sapiens*		8–11		22.0–27.2	11.7–14.7		20.7–28.4	11.1–14.7	22.2–28.6	10.8–14.5	19.2–26.6	11.5–18.8	15.0–23.8	12.3–15.4	Minugh-Purvis, 1988: 179, 184, 185, 187, 188
Modern *Homo sapiens sapiens*		10–12		21.3–30.4	12.0–16.9		24.8–28.8	10.3–14.9	18.9–27.8	10.7–15.1	19.8–27.0	11.4–14.1	15.2–25.2	13.7–17.3	Minugh-Purvis, 1988: 179, 184, 185, 187, 188
Modern *Homo sapiens sapiens*		13–17		24.5–35.0	10.8–15.3		23.3–33.1	9.9–13.3	21.4–32.9	9.4–13.6	20.5–31.3	10.4–14.5	20.8–29.9	12.1–17.5	Minugh-Purvis, 1988: 179, 184, 185, 187, 188

Table 2: Height, thickness and index of robusticity (thickness/height × 100) of mandibles at the symphysis, C, P$_3$s, P$_4$s and M$_1$s.

millennia! If the Oxnard method was applied to a more limited region, such as the Belgian Meuse Basin as well as to fossils of the same period (for instance the OIS 3 Neandertals), the method might gain more credibility. Unfortunately, the extremely small samples of Neandertal teeth which can be employed in relatively small geographical areas make this attempt difficult.

Mann & Vandermeersch (1997) also emphasize another problem with Oxnard's analysis. Indeed, Oxnard presents only some graphs and a summary table that identifies teeth with significant sexual dimorphism, but unfortunately, without providing numerical data to support his observations, which must therefore remain provisional.

In conclusion, even if the results of Oxnard are interesting and are increasingly used by scholars, they should only be accepted as presumption and not as unquestionable evidence. Only when they are in accordance with other kinds of results can they be trusted.

In this regard, it is interesting to note that the tooth roots in Scladina are very short and that their pulp cavities are very large. Most of the root dimensions of Scladina fall within the lower end of the Neandertal variation (Le Cabec et al., this volume, Chapter 16). These arguments support the hypothesis that Scladina would be female.

The measurements of the mandible are often used for sexing. The smallest, such as those of Montgaudier, are seen as females and the largest, such as Le Moustier 1, as males (Mann & Vandermeersch, 1997). Obviously, this technique is size dependent. If fossil mandibles do exhibit sexual dimorphism, then the small size of the Scladina mandible suggests the specimen is female. However, the validity of this technique would be enhanced if a bimodal distribution was obtained from samples whose sex was previously determined using the pelvis.

The reliability of the shape of the *incisura submentalis* as a sex indicator is unknown, contrary to, for instance, the mandibular ramus posterior flexure.

To conclude this short discussion, it seems clear that the indications useful in determining the sex of a Neandertal mandible, especially a juvenile one, are indeed tenuous. We therefore have to admit that, as cautiously pointed out by Heim (1981-1982: 462, 465) a third of a century ago, the sexual determination of an isolated mandible is often unfounded.

5. Conclusion

In view of the above-mentioned difficulties, it is clear that sexual determination of isolated Neandertal fossils, e.g. mandibles, should, in the future, be envisaged through approaches other than those exclusively based on morphology or morphometry. In this regard, nuclear DNA is sometimes able to provide good results (Green et al., 2006). Unfortunately, DNA is not always preserved, or not well preserved enough, especially in the case of very old fossils (over a hundred millienia) and discoveries from more than a few years. This reliable technique is therefore not applicable very often. Other methods such as the identification of the male form of the TRAP protein could help resolve this complication (Nielsen-March et al., 2009).

In the meantime, hopefully other fragments of the Scladina Child will be discovered in the years to come, possibly even some pelvic fragments, which are more diagnostic for determination of sex, although less reliable in the case of juveniles.

In conclusion and to refer to the question expressed in the title of this chapter, and even if it is tempting to suggest that the Scladina Child might be female, it is obvious that accurate sexing of this fossil is probably closer to a dream than to an objective achievement.

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