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ALMOST GONE: HUMAN SKELETAL MATERIAL FROM FINNISH STONE AGE EARTH GRAVES

Abstract

Human skeletal remains have been found very rarely in Stone Age graves in Finland. The rare preserved bones or teeth are extremely fragile and fragmented. Typically, Stone Age graves are identified only because of distinct ochre features, sometimes associated with grave goods of stone and amber. In many cases, the ochre features have been interpreted as graves because of their size, shape and the artefacts found. Moreover, the lack of organic material has also complicated the dating of the graves. In January 2015, we systematically collected and analysed this sparse and fragile human osteological material. Human teeth or bone were identified from nine sites mainly located in the southern and central parts of Finland. Our analysis shows that adults and subadults were buried in these studied graves. We also found that prehistoric people experienced childhood stress, indicated by the linear enamel hypoplasia in some of the teeth. They also had caries, although we did not observe dental calculus.

Keywords: Human skeletal remains, osteology, Stone Age, Finland, ochre earth graves, mortuary practices

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INTRODUCTION

During the Stone Age in Finland (c 8900–1800 BC) and northern Europe, a multiplicity of mortuary practices co-existed. The dead were given both inhumations and cremations, and at the same time, scattered loose human bones have also been documented from contemporary settlement sites (Brinch Petersen & Meiklejohn 2003; Katiskoski 2003; Nilsson Stutz 2003; Zagorskis 2004[1987]; Edgren 2007; Lõhmus 2007; Zagorska 2008; Koivisto 2010; Tõrv 2016). From an archaeological perspective, the most commonly observed, however, was to place the dead in an earth grave without cremation. In a simple way, this means that the body was deposited in a shallow pit that corresponded to the physical parameters of the deceased. In most cases, the burials were furnished with a variety of grave goods and ochre and were filled with soil that sometimes originated from previous activity areas (e.g. Nilsson Stutz 2003; Zagorskis 2004[1987]; Edgren 2007; Lõhmus 2007; Zagorska 2008). Since the preservation of organic material at some sites, for example from Sweden, Latvia and Russia (Gurina 1956; L. Larsson 1989; Oshibkina 1989; Larsson & Zagorska 2006), is very good, they offer exceptional potential to study the population history and burial customs of prehistoric societies.

In contrast with the well-preserved graves in neighbouring areas, the Finnish Stone Age graves represent a special challenge for archaeological research. This is because unburnt bone material is generally not preserved in the acidic soil of Finland, and typically, the only feature that marks a Stone Age grave is the presence of ochre or stained soil, sometimes together with grave goods of stone or amber (Fig. 1). However, even if this is the most common case, human bones have occasionally been identified from Finnish Stone Age graves (Fig. 2). Although this material is very scarce and fragmented, in the case of some sporadic sites, a human osteological analysis has also been conducted (Lahti 2003; 2004). However, the main potential of the material has been noted by the realization that these structures, and possibly others like them, are Stone Age graves (e.g. Edgren 1959; 1966: 97; 2007; Halinen 1999; 2015: 97–104).

Fig. 1. An ochre earth grave (grave 5) furnished with slate rings from the Middle Neolithic cemetery of Hartikka, central Finland. Photo: M. Miettinen, National Board of Antiquities.

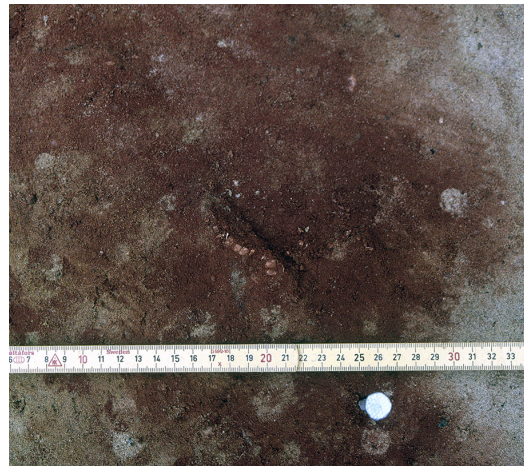


Fig. 2. Tooth fragments of Vaateranta burial 2 in situ. Photo: K. Katiskoski, National Board of Antiquities.

However, when the scarce human bones are studied from the perspective of identification alone, the full potential of bone and enamel fragments is overlooked. In fact, these sparse fragments may yield important information about the health, demography and mortuary practices of prehistoric populations. Hence, the aim of this paper is to provide a systematic overview of the burnt and unburnt human bone material found in association with the Finnish Stone Age earth graves. The focus is in the description of bone material since basic human osteological methods can be applied only coarsely to such poorly preserved material (see Lahti 2003).

The material of this study is derived from mainland Finland and was collected in excavations and surveys over the past 50 years. We have excluded the relatively well-preserved Stone Age human bone material from the Åland Islands (e.g. Götherström et al. 2002). The core of this paper is the results of our new osteological analysis conducted on unanalysed materials, but we will also discuss the previous human osteological analysis by Eeva-Kristiina Lahti at the Vaateranta and Kanava sites (Lahti 2003; 2004). In light of these combined results, we discuss the importance of this unique material and make some suggestions for how this fragile material could be studied in the future.

THE FINNISH STONE AGE EARTH GRAVES

In all, approximately 70 Stone Age earth grave sites are known to exist in mainland Finland thus far (see Fig. 3a). Most of these sites are the so-called 'red ochre graves' that are associated with Mesolithic (c 8900–5200 BC) and Neolithic (c 5200–1800 BC) hunter-gatherer societies. They are typically situated in contemporary settlement sites (Edgren 1984: 48) or are in the close vicinity of a settlement (Kukkonen et al. 1997: 4) and are found either to be single burials or small cemeteries (Edgren 1984: 48; see also Torvinen 1979; Miettinen 1992a; 1992b; Purhonen & Ruonavaara 1994; Katiskoski 2003). In addition to the earth grave sites, burnt human bones have also been discovered from the burnt refuse material of sporadic settlement sites (Koivisto 2010: 16–9 with references) suggesting that, also in Finnish territory only, part of the Stone Age population was buried according to the earth grave tradition (Koivisto 2010: 16–9; see also Nilsson Stutz 2003; Gray Jones 2011; Tõrv 2016).

The term 'red ochre grave' was introduced by Edgren (1959; 1966) along with the discovery of grave I from the Kolmhaara cemetery (Fig. 3b). From this grave, preserved human bone was unearthed for the first time, together with large amounts of ochre, amber pendants and flint artefacts, which shows that the Stone Age hunter-gatherers in the Finnish territory inhumed their dead (Edgren 1959; 1966: 98). After this seminal research on hunter-gatherer graves (Edgren 1959; 1966; 1984; 1993; 2006; 2007), the term 'red ochre grave' became rooted deeply in Finnish archaeology. However, the use of the term has recently become problematic (Lappalainen 2007. This is because the term has now been applied to both Mesolithic (e.g. Schulz 1999; Pesonen et al. 2014) and Neolithic (e.g. Miettinen 1992a; 1992b; Katiskoski 2003; Mökkönen 2013) burials, giving the false impression of a static funerary practice, although changes have

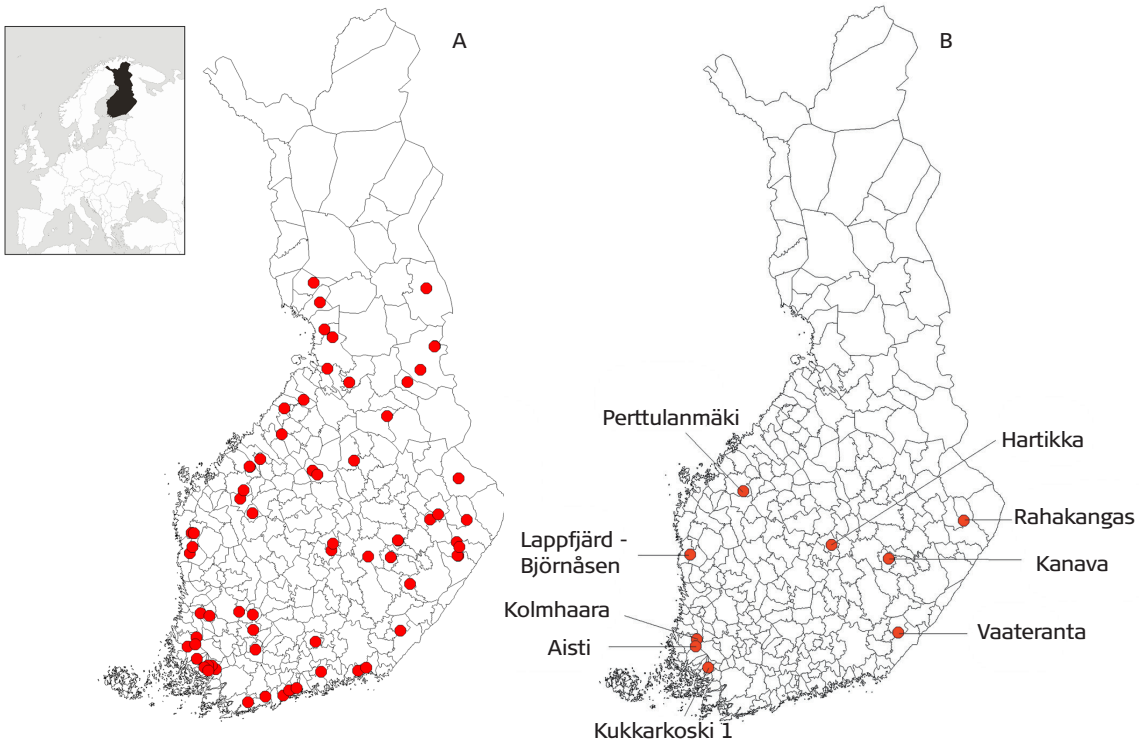


Fig. 3. a – Finnish Stone Age earth grave sites; and b – the locations of Finnish Stone Age graves with identified human skeletal remains. Maps: M. Ahola.

Site	Muncipality	Grave	Relative dating (typology/shore displ.)	Lab-index	BP	±	CalBC/AD (2δ)
Forsberg	Porvoo	I	Middle Neolithic (Corded Ware)	GrN-6250	4105	55	2875 (90.5%) 2565 calBC 2532 (4.9%) 2496 calBC
Jönsas	Vantaa	IV	Middle Neolithic (Corded Ware)	Hel-1006	4520	130	3627 (1.7%) 3597 calBC 3526 (93.7%) 2904 calBC
Kanava	Joroinen	2 (*)	Middle Neolithic (Typical Comb Ware)	Hela-775	1735	65	128 (95.4%) 426 calAD
Keelaharju	Ii	1	Early Neolithic	Ua-43683	3747	35	2281 (8.0%) 2249 calBC 2232 (87.4%) 2036 calBC
Keelaharju	Ii	1	Early Neolithic	Ua-43684	3762	36	2290 (81.6%) 2120 calBC 2095 (13.8%) 2041 calBC
Kierikki	Oulu	1	Middle Neolithic (Typical Comb Ware)	Hela-1956	4780	40	3648 (88.8%) 3513 calBC 3424 (6.6%) 3383 calBC
Kierikki	Oulu	1	Middle Neolithic (Typical Comb Ware)	Hela-1957	4715	40	3634 (31.1%) 3555 calBC 3540 (20.9%) 3491 calBC 3470 (43.4%) 3373 calBC
Kukkarkoski 1	Lieto	1a	Middle Neolithic (Typical Comb Ware)	Hel-832	4890	150	4036 (0.4%) 4022 calBC 3995 (95%) 3358 calBC
Kukkarkoski 1	Lieto	9	Middle Neolithic (Corded Ware)	Hel-831	4320	150	3482 (0.1%) 3477 calBC 3370 (94.6%)2568 calBC 2519 (0.6%) 2499 calBC
Kolmhaara	Eura	XX (**)	Early–Middle Neolithic	Hela-244	2210	65	399 (95.4%) 106 calBC
Kolmhaara	Eura	XXIII (**)	Early–Middle Neolithic	Hela-245	1505	55	427 (95.4%) 643 calAD
Kolmhaara	Eura	XVII (**)	Early–Middle Neolithic	Hel-38	5420	150	4593 (95.4%) 3950 calBC
Marketanhiekka	Pieksämäki	1	Early–Late Neolithic	Hela-539	2195	75	397 (92.9%) 88 calBC 77 (2.5%) 56 calBC
Nästinristi	Laitila	I	Middle Neolithic (Late Comb Ware)	Hel-1348	4460	130	3621 (0.3%) 3609 calBC 3522 (95.1%) 2876 calBC
Nästinristi	Laitila	II	Middle Neolithic (Late Comb Ware)	Hel-1349	4910	130	3971 (89.4%) 3496 calBC 3461 (6.0%) 3376 calBC
Nästinristi	Laitila	II	Middle Neolithic (Late Comb Ware)	Hel-1350	4850	130	3945 (95.4%) 3368 calBC
Rahakangas	Joensuu	1	Early Mesolithic	Hela-2379	7726	58	6650 (95.4%) 6459 calBC
Sarvisuo	Kitee	1	Middle–Late Neolithic	Hela-166	3010	80	1431 (95.4%) 1016 calBC
Tainiaro	Simo	1990	Early Neolithic	Hel-2977	5410	120	4464 (95.4%) 3975 calBC
Tainiaro	Simo	1989 / 1	Early Neolithic	Hel-2978	5760	120	4851 (93.9%) 4356 calBC 4896 (1.5%) 4867 calBC
Tainiaro	Simo	1989 / 2	Early Neolithic	Hel-2979	5430	120	4493 (95.4%) 3987 calBC
Vaateranta	Taipalsaari	D (***)	Middle Neolithic (Typical Comb Ware)	Ua-3326	5775	100	4847 (92.6%) 4441 calBC 4425 (2.8%) 4371 calBC
Vaateranta	Taipalsaari	D (***)	Middle Neolithic (Typical Comb Ware)	Hela-739	5045	45	3957 (89.9%) 3760 calBC 3743 (5.5%) 3714 calBC
Vaateranta	Taipalsaari	3	Middle Neolithic (Typical Comb Ware)	Hela-317	5010	75	3956 (95.4%) 3661 calBC
Vaateranta	Taipalsaari	4	Middle Neolithic (Typical Comb Ware)	Hela-315	4895	70	3933 (4.6%) 3875 calBC 3807 (78.9%) 3622 calBC 3606 (11.9%) 3522 calBC
Vaateranta	Taipalsaari	9a	Middle Neolithic (Typical Comb Ware)	Hela-318	4835	80	3788 (85.8%) 3497 calBC 3458 (9.6%) 3377 calBC
Vaateranta	Taipalsaari	9b	Middle Neolithic (Typical Comb Ware)	Hela-319	4315	80	3329 (7.0%) 3217 calBC 3180 (1.0%) 3158 calBC 3123 (76.4%) 2840 calBC 2814 (11%) 2677 calBC
Vaateranta	Taipalsaari	1	Middle Neolithic (Typical Comb Ware)	Hela-237	3460	70	1957 (95.4%) 1613 calBC

Table 1. Radiocarbon dates from Finnish Stone Age graves. The direct dates obtained from human skeletal material are marked in gray. All ^{14}C dates were calibrated using the OxCal v. 4.2.4 Bronk

Radiocarbon dating	Dated material	Notes	References
Middle Neolithic	Charcoal	From a wooden structure surrounding the grave pit	Edgren 1970; Lanting 1973
Middle Neolithic	Charcoal	From the filling	Purhonen 1986
Early Metal Period	Tooth fragments (Homo sapiens)	Combined sample from four individuals	Schulz 2006
Late Neolithic	Charred seed (bearberry /cowberry)	From the ochre layer	Mökkönen 2013
Late Neolithic	Charred twig (pine)	From the ochre layer	Mökkönen 2013
Middle Neolithic	Charcoal	Beneath the ochre layer	Viljanmaa 2008
Middle Neolithic	Resin	Indirect dating (from a ceramic concentration cut by the grave)	Viljanmaa 2008
Middle Neolithic	Charcoal	From a wooden structure at the bottom of the grave	Torvinen 1976
Middle–Late Neolithic	Charcoal	Carbonized wood from the bottom of the grave pit	Torvinen 1976
Bronze Age	Skull fragments (Homo sapiens)		Edgren 1999
Middle Iron Age	Bone fragments (Homo sapiens)		Edgren 1999
Early Neolithic	Charcoal	Beneath the burial structure	Edgren 1999
Early Metal Period	Charcoal	From the ochre layer at the depth of 80 cm	Kankkunen & Katiskoski 2004
Middle Neolithic	Charcoal		Vikkula 1986
Middle Neolithic	Charcoal	From a wooden structure at the bottom of the grave	Vikkula 1986
Middle Neolithic	Charcoal	From a wooden structure at the bottom of the grave	Vikkula 1986
Late Mesolithic	Charcoal	From the filling	Pesonen et al. 2014
Early Metal Period	Charcoal	Sample 1	Pesonen 1998
Early Neolithic	Charcoal	Sample 1	Jungner 1991
Early Neolithic	Charcoal	Sample 1	Jungner 1991
Early Neolithic	Charcoal	Sample 3	Jungner 1991
Early Neolithic	Charcoal		Räty 1995; Katiskoski 2003
Middle Neolithic	Skull fragments (Homo sapiens)		Katiskoski 2003
Middle Neolithic	Resin	Birch bark pitch	Katiskoski 2003
Middle Neolithic	Resin	Birch bark pitch	Katiskoski 2003
Middle Neolithic	Resin	Birch bark pitch	Katiskoski 2003
Middle Neolithic	Resin	Birch bark pitch	Katiskoski 2003
Early Metal Period	Charcoal	From heavy ochre at the depth of 50 cm	Katiskoski 2003

*Ramsey (2013) with atmospheric curve IntCal13 (Reimer et al. 2013). Periodization adapted after Nordqvist & Herva (2013). * – collective burial; ** – stone cist grave;, *** – cremation.*

clearly occurred (Halinen 1999; Edgren 2007; Ahola 2016). Complicating the issue even further is the fact that not all earth graves from Finnish Stone Age contexts have been treated with ochre (Halinen 1999: 173; Lappalainen 2007 4–5). For example, at the cemetery of Kukkarkoski 1, several burials furnished with flint artefacts connected with the Middle Neolithic period lacked ochre altogether (Torvinen 1979: 60–2; Ahola 2016). Moreover, even though the colour red is emphasized, the colour of the ochre actually varies from intense red to yellow (Vikkula 1986; Miettinen 1992a).

It must also be noted that from the later part of the Neolithic period, earth graves from the Corded Ware culture (c 2800–2300 BC) are also known. These graves have mainly been identified as solitary graves (Nordqvist & Häkälä 2014: 12) but are occasionally located at the same cemeteries as the preceding ochre earth graves (Torvinen 1979; Purhonen 1986), suggesting some connection between the cultures (Ahola 2016; in press). Thus, in this paper, we have decided to use the term 'ochre earth grave' when referring to earth graves treated with ochre. Although not perfect in every sense, the chosen term gives more emphasis to the grave structure while still following the established Finnish tradition. In addition, the chosen terminology refers to graves without ochre simply as 'earth graves', while the more structured graves can be described accordingly.

Due to the lack of human bone material, the identification of the Finnish Stone Age earth graves is often ambiguous and is generally based on the size and shape of the grave-like feature together with the existence of ochre and artefacts (Edgren 1966: 97–106; Halinen 1999: 173–4; Kukkonen et al. 1997: 4). In practice, this means that the burials have been observed as pit-shaped features of loose, stained soil (Lehtosalo-Hilander 1973: 143, 165) in which artefacts are situated at the bottom (Edgren 1966; 2006; 2007; Torvinen 1979; Miettinen 1992b; Halinen 1997). Due to the decomposition of the body, the soil might also have had a greasy characteristic (Lehtosalo-Hilander 1973: 165).

Although artefacts are only rarely encountered from the possible burial features connected with the Mesolithic period (Edgren 1984: 23; Halinen 1999: 173), amber, flint and slate artefacts in pristine condition are recurrently discovered from the ochre features associated with the Typical Comb Ware culture (Edgren 1966; 2006; 2007; Torvinen 1979; Engblom 1992; Miettinen 1992b; Halinen 1997; Katiskoski 2003) and have thus been used as an indicator of a Middle Neolithic ochre earth grave (Edgren 1959; 1966: 99; Halinen 1999: 174; Ahola 2016: 28). Similarly, the Corded Ware graves have often been recognized due to the occurrence of typical Corded Ware grave assemblage, i.e. pottery vessels, adzes and ground-stone axes (e.g. Edgren 1984: 76–7; Nordqvist & Häkälä 2014).

In many cases, however, the possible burial features have not yielded any artefacts, making the identification process difficult (Purhonen 1980; Pesonen 1998; Katiskoski 2003; see also Torvinen 1979 and the critique presented by Kostyleva & Utkin 2006). It must also be noted that since the artefacts described above may also indicate votive deposits (Zagorska 2001; 114; Johanson 2006; Ahola 2016: 26), they cannot solely be used to identify the presence of a grave. Thus, even though previous studies have interpreted stray finds of ochre-stained artefacts or Corded Ware pottery vessels and battle axes as destroyed graves (Edgren 1959; 1966; 1970; Miettinen 1992a; Halinen 1999; Nordqvist & Häkälä 2014), we decided not to include stray find sites in this paper. Therefore, the map in Fig. 3a consists only of sites with documented grave features, with or without artefacts.

The lack of organic materials has also affected the dating of the graves. Since radiocarbon determinations are usually not available, the dating is often based on the typology of the artefacts found from the grave context (Edgren 1966: 99; 1984: 76; Halinen 1999: 174). Because the graves are often situated at dwelling sites (Edgren 1984: 48) or in the nearby region (Kukkonen et al. 1997: 4), the graves lacking artefacts have also been dated according to the associated settlement sites (e.g. Edgren 1966: Appendix 1; Lappalainen 2007: Appendix 1). However, because the burials are sometimes placed among older graves (e.g. Torvinen 1979; Ahola 2016; in press) or at multi-periodic settlement sites (e.g. Purhonen & Ruonavaara 1994; Pesonen et al. 2014), relative dating according to a nearby settlement site can be questionable.

Fig. 4. a – Stone cist grave XI from the Kolmhaara cemetery; and b – a mandible from the grave XI. Photos: T. Edgren & M. Ahola, National Board of Antiquities.

In some rare cases, radiocarbon dates are also available, mainly obtained from charcoal collected from the fill of the grave. However, as can be observed from Table 1, many of these dates are at odds with the typological dating of the burial. This can be because the charcoal could have been derived from a later forest fire and found its way into the fill of the grave structure along with growing or decaying roots, burrow holes or movements caused by frost or wind-toppled trees (Mökkönen 2013: 21). Some dates have also been obtained directly from human bones (marked with gray in Table 1). Surprisingly, most of these dates are likewise at odds with the typological dating of the grave and have thus raised the question of whether the AMS dates of material that have been so poorly preserved can be reliable (Edgren 1999; Schulz 2006; Mökkönen 2013).

For example, when the excavations at the Kolmhaara cemetery continued, in addition to ochre earth graves, nearly 20 graves with a stone cist (Fig. 4a) or headstones were unearthed (Edgren 1966: 27–49). Since these graves, treated with ochre, did not yield artefacts and had a different grave structure than those of the ochre earth graves, they were connected with the Early Neolithic phase of use of the nearby settlement site (Edgren 1966: 96). The interpretation was supported further by a radiocarbon date obtained from a piece of charcoal located at the bottom of cist grave XVII (Table 1). However, in the late 1990s, two cist graves, located just six metres from each other (Edgren 1966: 28), were AMS dated to the Bronze Age and the Middle Iron Age (Table 1). The result was surprising; although some Bronze Age pottery had been discovered from the site, no Iron Age artefacts have been found (Edgren 1999: 319–24). Moreover, even though a similar discovery has recently been made in Estonia, where inhumation burials from Stone Age contexts were unexpectedly AMS dated to the Early Bronze Age (Tõrv & Meadows 2015) according to the AMS dates, the Kolmhaara cist graves may date 400–1000 years from each other (Table 1). As has recently been noted by Mökkönen (2013: 32), this wide gap of time between the AMS dates makes the dates even more controversial and suggests that the results could also be somehow biased. In fact, according to Mökkönen (2013: 32), the best parallels to the Finnish cist graves can be found in the cist graves of Bjästamon and Lagmansören, which are located in Norrland, Sweden and date to the 3rd millennium BC.

RESEARCH MATERIAL

In January 2015, we studied the Stone Age human skeletal material collected from mainland Finland during the past 50 years. The database was established from excavation reports and find catalogues that were kept in the collections of the Finnish National Board of Antiquities. For the purposes of this paper, it was compiled in Table 2.

At the same time, the reports of previous osteological analyses conducted on the sites of

Site	Municipality	Grave	Description in the find catalogue	Find nr (KM)	Typological dating	Radiocarbon dating
Kolmhaara	Eura	I	Human bone with the lenght of c 11 cm	14717: 35–36	Middle Neolithic (Typical Comb Ware)	
Kolmhaara	Eura	XI	Tooth fragments, mandible	14898: 81–82	Unknown	
Kolmhaara	Eura	XVII	Bone fragments	15218: 251	Unknown	
Kolmhaara	Eura	XIX	Tooth enamel, bone fragments	15218: 249–250	Unknown	
Kolmhaara	Eura	XX	Bone fragments, a fragmented skull	15512: 195	Unknown	Bronze Age
Kolmhaara	Eura	XXII	Bone fragments	16077: 268	Unknown	
Kolmhaara	Eura	XXIII	Tooth enamel, skull fragments	16077: 271–274	Unknown	Middle Iron Age
Kotikangas	Evijärvi	1	Tooth fragment?	19261: 286	Middle Neolithic (Typical Comb Ware)	
Hiittenharju	Harjavalta	1	Burnt human bones, ochre-stained	22009: 20	Middle Neolithic (Pyheensilta Ware)	
Rahakangas 1	Joensuu	1	Tooth and enamel fragments, partly collected within a lump of soil	37962: 782–811	Unknown	Late Mesolithic
Kanava	Joroinen	2	78 fragments of human teeth	33923: 8494–8535	Middle Neolithic (Typical Comb Ware)	
Perttulanmäki	Kauhava	1	Two fragments of human molar	9252: 6	Middle Neolithic (Corded Ware)	
Kangas	Kaustinen	3	A small piece of shinbone	29906: 2067	Middle Neolithic (Typical Comb Ware)	
Lappfjärd-Björnåsen	Kristinankaupunki	1	Ochre-stained fragments of human teeth	26222: 3	Middle Neolithic (Typical Comb Ware)	
Nästinristi	Laitila	IX	Unburnt fragments of human bone	20902: 4529	Middle Neolithic (Late Comb Ware)	
Hartikka	Laukaa	1	Tiny fragments of tooth enamel in ochre-stained soil	23591: 5	Middle Neolithic (Typical Comb Ware)	
Hartikka	Laukaa	7	A lump of soil with human teeth and small pieces of clay	25346: 195	Middle Neolithic (Typical Comb Ware)	
Kukkarkoski 1	Lieto	5	Tooth fragments	19991: 585	Middle Neolithic (Typical Comb Ware)	
Aisti	Mynämäki	AV	Tooth and bone fragments	16078: 118	Unknown	
Vihi	Rääkkylä	1	Tooth fragment	30460: 11946	Middle Neolithic (Typical Comb Ware)	
Vaateranta	Taipalsaari	D	C 1400 g of burnt human bones	19239: 677	Middle Neolithic (Typical Comb Ware)	Middle Neolithic
Vaateranta	Taipalsaari	D?	Human bones	20659: 2066	Middle Neolithic (Typical Comb Ware)	
Vaateranta	Taipalsaari	2	Tooth fragments	30887: 1377, 1606–1632	Middle Neolithic (Typical Comb Ware)	

Vaateranta	Taipalsaari	3	Tooth fragments	30887: 1633–1635	Middle Neolithic (Typical Comb Ware)
Vaateranta	Taipalsaari	9a	Tooth fragments, bone fragments	30887: 1462, 1463, 1482, 1492, 1498, 1500, 1502, 1636–1645	Middle Neolithic (Typical Comb Ware)
Vaateranta	Taipalsaari	9b	Tooth fragments	30887: 1531, 1541, 1546, 1547, 1646–58	Middle Neolithic (Typical Comb Ware)
Vaateranta	Taipalsaari	9a or 9b	Tooth fragments, bone fragments	30887: 1659–1663	Middle Neolithic (Typical Comb Ware)
Vaateranta	Taipalsaari	13	Tooth fragments	31494: 2355, 2351, 2354,2349, 2353, 2364, 2365, 2350, 2352	Middle Neolithic (Typical Comb Ware)
Vaateranta	Taipalsaari	14	Tooth fragments	31494: 2356, 2357, 2359, 2362, 2361, 2363, 2360, 2365, 2358, 2350, 2366	Middle Neolithic (Typical Comb Ware)
Vaateranta	Taipalsaari	16	Tooth fragments, thigh bone fragment	31494: 2367, 2371, 2354,2369,2368, 2370	Middle Neolithic (Typical Comb Ware)

Table 2. Summary of research material. KM – the National Museum of Finland.

Kukkarkoski 1, Kanava and Vaateranta (Kirveskari 1977; Ukkonen 1999; Lahti 2003; 2004) were also carefully examined. In general, the material analysed by dental surgeons was reanalysed, but materials analysed by professional osteologists specializing in human osteology was simply surveyed without further action. The results of the analyses are summarized in Appendix 1 and will be taken into consideration in the final discussion.

Aside this material, possible tooth enamel or highly decomposed bone material has been found from sporadic sites (e.g. Engblom 1992; Schulz 1999), but since these fragments were not collected, they have been excluded from the material. However, as can be noted from Table 2, the material includes human bones from the sites with anomalous dates (Kolmhaara cist graves and Kanava ochre earth graves). Although the AMS dates suggest a considerably younger date according to the grave contexts, the possibility of a Stone Age date cannot be ruled out. If from a younger period, these graves nevertheless continue the tradition of using ochre in burials.

To obtain a general view on the material, all possible human skeletal fragments were analysed at the premises of the Finnish National Board of Antiquities in Helsinki. Most of the bones are stored in small cardboard or plastic boxes and have occasionally been wrapped in silk paper. In one case (grave 1 in Hartikka), the possible human remains have been collected as a soil sample of ochre-stained soil, and in two cases (grave 7 in Hartikka and a single burial in Rahakangas 1), the human remains are contained within a lump of soil (Figs. 5a–b). We did not wish to disturb either one of these lumps and thus decided to conduct the analysis only on human bone fragments on the surface.

METHODS

The fragments were identified by species and anatomical element. At the same time, the bones were photographed, and a database with relevant osteological and archaeological information was created. Some of the tooth fragments were also refitted to make the pieces larger, but the fragments were not glued together.

The age of each individual was estimated when possible. In cases where, for example,

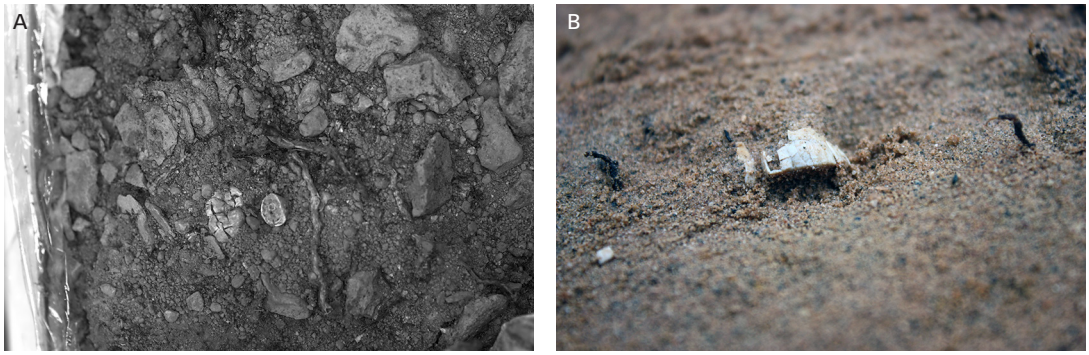


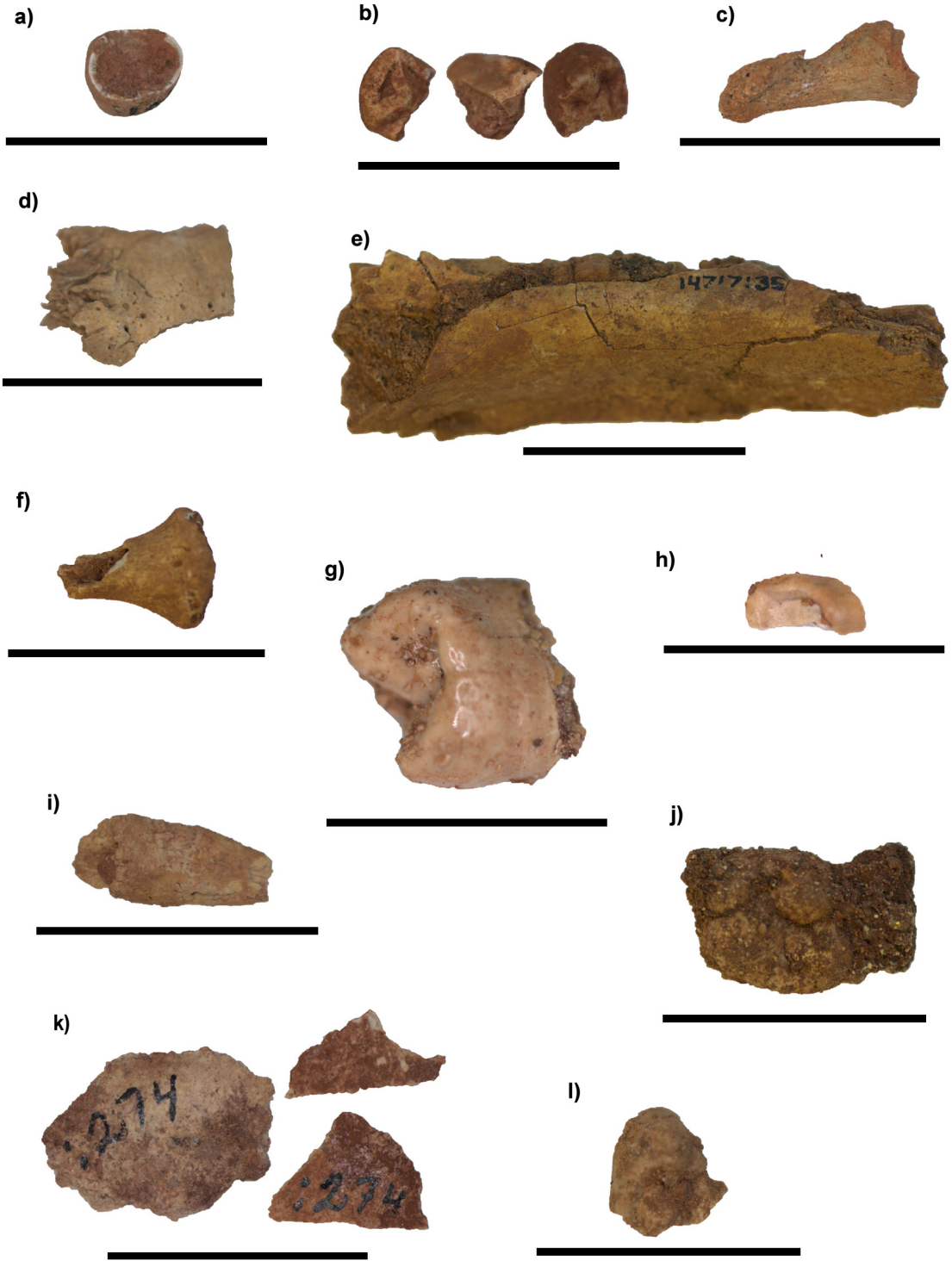
Fig. 5. a – Tooth fragments and small pieces of clay in the Hartikka grave 7 collected en bloc*; and b – a tooth fragment from the Rahakangas grave* in situ *before lifting. Photos: M. Ahola & E. Hertell, National Board of Antiquities.*

skull fragments or long bones had been preserved, we estimated the age according to the size and fusing of the bones (Buikstra & Uberlaker 1994: 39). In some cases, age estimations were also given based on tooth eruption (e.g. Schour & Massler 1941; Ubelaker 1989). However, due to the fragmentary nature of the material, we did not use the age groups often used by skeletal biologists (e.g. Scheuer & Black 2000: 468–9). Instead, we classified the individuals only as adults or subadults. By using the term adult, we imply individuals with full skeletal development and subadults with unerupted teeth and the presence of decidous.

In previous human osteological analyses, E.-K. Lahti (2003; 2004) also used dental wear to estimate the age of death, positing that teeth with no occlusal wear are those of children, teeth with slight dental wear are those of young individuals, and teeth with strong wear are those of adults (Lahti 2003: 123–4). Although tentative, the method of Lahti seems to function in cases where a single burial feature yields teeth with both heavy dental wear and no wear. It must be noted, however, that tooth wear in Stone Age populations may progress rapidly because of abrasive particles in the food (e.g. Alexandersen 1998: 18; Palubeckaitė & Jankauskas 2006) or the use of the teeth as tools (Molnar 2008: 423–31). In fact, although Lahti used tooth wear as an age indicator, due to the fragmentary nature of the material, she nevertheless did not attempt to age the individuals more precisely (Lahti 2003: 123).

Although we measured the tooth wear by using score standards discussed by Buikstra & Ubelaker (1994: 52–3; see also Scott 1973: 214; Smith 1984: 45–6) (Table 3), due to knowledge of heavy dental wear possessed by the hunter-gatherer populations (Alexandersen 1998: 18; Palubeckaitė & Jankauskas 2006), we decided

Fig. 6. Tooth and enamel fragments from Finnish Stone Age graves: a – lower 2nd premolar (KM 25436: 194) from the Hartikka grave 7; b – premolars and a canine (KM 26222: 3) showing dental wear from the Lappfjärd-Björnåsen grave; c – distal hand phalanx (KM 20659: 2066) from the Vaateranta cremation burial; d – glabella fragment (KM 20659: 2066) from the Vaateranta cremation burial; e – right humerus (KM 14717: 35) from the Kolmhaara grave 1; f – distal hand phalanx (KM 14717: 36) from the Kolmhaara grave 1; g – upper premolar (KM 14898: 81) showing traces of enamel hypoplasia from the Kolmhaara grave XI; h – a shovel-shaped incisor (KM 14898: 81) from the Kolmhaara grave XI; I – an upper canine root (KM 15512: 195) from the Kolmhaara grave XX; j – unworn upper molars (KM 16077: 271) from the Kolmhaara grave XXIII; k – skull fragments (KM 16077: 274) from the Kolmhaara grave XXIII; l – unworn upper molar fragment (KM 16078: 118) from the Aisti grave. Scale bars: 2 cm. Photos: M. Ahola, National Board of Antiquities. ▶


a)
b)
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14717:35
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.274
.274
l)

Site	Grave	Find nr (KM)	Anatomical part	Bone part	Amount	Weight (g)	Dental wear	Mediod.(mm)	Buccol. (mm)	Crown (mm)	Other observ.
Kolmhaara	I	14717: 35	Humerus right	Distal diaphysis fragment	1	8.26					
		14717: 35	Indetermined	Fragment	15	4.2					
		14717: 36	Phalanx 3 hand	Proximal 2/3 fragment	1	0.18					
		14717: 36	Phalanx	Distal fragment	1	0.07					
		14717: 36	Indetermined	Fragment	106	0.965					
Kolmhaara	XI	14898: 81	Tooth 24	Enamel	1	0.34	Wear 0	7.5	9.6	9.5	Linear enamel hypoplasia
		14898: 81	Mandible	Corpus excluding exterior fragment	1	In situ					
		14898: 81	Tooth 43	Enamel	1	In situ	In eruption				
		14898: 81	Tooth 44	Enamel	1	In situ	Unerupted				
		14898: 81	Tooth 46	Enamel	1	In situ	Wear 9	11.6	11.1	8.3	
		14898: 81	Tooth 47	Enamel	1	In situ	Unerupted				
		14898: 81	Tooth 33	Part of enamel	1	In situ	Erupted				
		14898: 81	Tooth 34	Enamel	1	In situ	Unerupted				
		14898: 81	Tooth 35	Enamel	1	In situ	Unerupted				
		14898: 81	Tooth 36	Part of enamel	1	In situ	Wear 9				
		14898: 81	Tooth 37	Enamel	1	In situ	Unerupted				
		14898: 81	Tooth 74	Part of enamel	1	In situ	Wear visible, undetermined				
		14898: 81	Tooth 84	Part of enamel	1	In situ	Wear visible, undetermined				
		14898: 81	Molar	Part of enamel	8	8.31	No wear visible				
		14898: 81	Canine	Part of enamel	5	0.15					
		14898: 81	Incisor	Part of enamel	2	0.05					
		14898: 81	Canine	Part of enamel	2	0.06					
		14898: 81	Incisor	Part of enamel	1	0					Shovelling
		14898: 81	Molar	Part of enamel	1	0.03					
		14898: 81	Dentes	Part of enamel	12	0.22					
		14898: 81	Incisor	Part of enamel	1	0,02					
		14898: 81	Dentes	Part of enamel	9	0.2					
		14898: 81	Dentes	Part of enamel	2	0					
		14898: 81	Canine	Part of enamel	4	0.12					
		14898: 81	Molar	Part of enamel	6	0.27					
		14898: 81	Indetermined	Fragment	2	0.2					

Site	Grave	Find nr (KM)	Anatomical part	Bone part	Amount	Weight (g)	Dental wear	Mediod.(mm)	Buccol. (mm)	Crown (mm)	Other observ.
		14898: 81	Incisor	Part of enamel	2	0.06					
		14898: 81	Incisor	Part of enamel	1	0.05					
		14898: 81	Dentes	Part of enamel	1	0.05					
		14898: 81	Premolar maxilla	Part of enamel	1	0.14					Linear enamel hypoplasia?
		14898: 81	Tooth 41/42	Enamel + part of dentes?	1	0.17					
		14898: 81	Tooth 25	Enamel	1	0.36	Wear 0	8.1	9.9	7.9	
		14898: 81	Tooth 14	Part of enamel	2	0.27	Wear 0				
Kolmhaara	XX	15512: 195	Canine maxilla	Radix	1	0.31	Wear 5				
Kolmhaara	XXIII	16077: 271	Tooth 17/18	Enamel	1	0.55	Wear 5	10.5	11.2		
		16077: 271	Molar	Part of enamel	2	0.18					
		16077: 271	Dentes	Part of enamel	5	0.07					
		16077: 271	Dentes	Part of enamel	6	0.43					
		16077: 272	Tooth 11 or 21	Part of enamel	1	0	Wear 4			10.8	
		16077: 272	Molar maxilla right	Part of enamel	1	0.22	No wear visible				
		16077: 272	Tooth 23	Enamel	1	0.24	Wear 4	8.5	9.6		
		16077: 272	Molar	Part of enamel	1	0.12	No wear visible				
		16077: 272	Indet.	Fragment	4	0.06					
		16077: 272	Molar	Part of enamel	2	0.06					
		16077: 272	Molar	Part of enamel	1	0.01					
		16077: 272	Dentes	Part of enamel	22	0.43					
		16077: 272	Dentes	Part of enamel	31	0.51					
		16077: 274	Calva	Fragment	3	0.35					
		16077: 274	Calva	Fragment	6	0.18					
		16077: 273	Indetermined	Fragment	6	0.23					
		16077: 273	Indetermined	Fragment	8	0.41					
		16077: 273	Indetermined	Fragment	2	0.85					
Rahakangas 1	1	37962: 782	Dentes	Part of enamel							
		37962: 783	Dentes	Part of enamel							
		37962: 784	Dentes	Part of enamel	3						
		37962: 785	Dentes	Part of enamel							
		37962: 786	Dentes	Part of enamel							
		37962: 787	Dentes	Part of enamel							
		37962: 788	Incisor	Part of enamel	1	0	Wear 2–3				

Site	Grave	Find nr (KM)	Anatomical part	Bone part	Amount	Weight (g)	Dental wear	Mediod.(mm)	Buccol. (mm)	Crown (mm)	Other observ.
Rahakangas 1		37962: 788	Dentes	Part of enamel	4						
		37962: 789	Dentes	Part of enamel							
		37962	Dentes	Part of enamel	2	0					
		37962: 790	Dentes	Part of enamel							
Rahakangas		37962: 793	Dentes	Part of enamel							
		37962: 796	Dentes	Part of enamel	3						
		37962: 799	Dentes	Part of enamel	5						
		37962: 802	Dentes	Part of enamel							
		37962: 806	Dentes	Part of enamel							
		37962: 809	Dentes	Part of enamel							
Perttulanmäki	1	9252: 6	Molar	Part of enamel	1	0.21	Slight wear				
Lappfjärd-Björnåsen	1	26222: 3	Premolar maxilla	Part of enamel	1	0.09	Wear 4–5				
	1	26222: 3	Canine	Part of enamel	1	0.08	Wear 4				
	1	26222: 3	Tooth 35	Part of enamel	1	0.08	Wear 4				
	1	26222: 3	Molar	Part of enamel	1	0.05					
	1	26222: 3	Dentes	Part of enamel	105	1.7					
Hartikka	7	25346: 194	Tooth 44 or 34	Enamel	1	0.13	Wear 0 (unerupted?)	7.7			
	7	25346: 195	Premolar mandible	Part of enamel	1	0.2	Wear 0 (unerupted?)				
	7	25346: 195	Molar mandible	Enamel	1	In situ	Wear 9				
Kukkarkoski 1	5	19991: 585	Dentes	Part of enamel	27	0.15					
	5	19991: 585	Premolar/Molar	Part of enamel	1	0					
Aisti	A5	16078: 118	Incisor maxilla	Part of enamel	2	0					
	A5	16078: 118	Molar	Part of enamel	1	0.12	No wear visible				
	A5	16078: 118	Molar maxilla	Part of enamel	1	0.23	No wear visible				
	A5	16078: 118	Molar	Part of enamel	2	0.08					
	A5	16078: 118	Canine	Part of enamel	1	0					
	A5	16078: 118	Dentes	Part of enamel	28	0.4					
	A5	16078: 118	Indetermined	Fragment	6	0					
	A5	16078: 118	Canine	Part of enamel	1	0.09					
	A5	16078: 118	Molar	Part of enamel	1	0					
	A5	16078: 118	Incisor	Part of enamel	1	0					
	A5	16078: 118	Molar/Premolar	Part of enamel	2	0.09					

Site	Grave	Find nr (KM)	Anatomical part	Bone part	Amount	Weight (g)	Dental wear	Mediod.(mm)	Buccol. (mm)	Crown (mm)	Other observ.
	A5	16078: 118	Canine	Part of enamel	2	0.08					
	A5	16078: 118	Dentes	Part of enamel	19	0.3					
	A5	16078: 118	Dentes	Part of enamel	46	1.24					
Vaateranta	D?	20659: 2066	Frontal	Glabella fragment	1	0.58					Burned
	D?	20659: 2066	Vertebra	Fragment	1	0.27					Burned
	D?	20659: 2066	Mandible	Condyle fragment	1	0.21					Burned
	D?	20659: 2066	Mandible	Alveolus fragment	2	0.31					Burned
	D?	20659: 2066	Maxilla	Alveolus fragment	2	0.2					Burned
	D?	20659: 2066	Long bone (femur?)	Diaphysis fragment	1	2.18					Burned
	D?	20659: 2066	Calva	Fragment	30	11.41					Burned
	D?	20659: 2066	Indetermined	Fragment	208						
	D?	20659: 2066	Vertebra lumbal	Articular surface fragment	1	0.8					Burned
	D?	20659: 2066	Calva	Sinus fragment	1	0.44					Burned

Table 3. List of osteological material analysed in this study. KM – the National Museum of Finland. Dental wear 0–9 refer to the wear stages by Buistra & Ubelaker (1994). Mediod. – Mediodistal width; Buccol. – Buccolingual width; Crown – Crown height.

not to estimate the age of death according to tooth wear. However, in line with the analysis by Lahti, we did interpret teeth with no wear as being unerupted and noted cases where a single burial structure yielded teeth with considerable dental wear, together with enamel fragments with no dental wear suggesting the presence of a child.

Pathological lesions, such as caries (Hillson 2001: 249–89) and linear enamel hypoplasia (Schultz 1988), and key morphological non-metric traits (Turner et al. 1991) were recorded whenever observed, but systematic recording was not possible since the material was very fragmentary. For the estimation of the age of the formation of hypoplastic lines, Goodman and Rose (1990) regression equations were used – these equations are basically the same as those of Swärstedt (1966). Most standard methods do not radically differ from those of Schour and Massler (1941), from which they were developed (Goodman & Rose 1990: 98–9).

RESULTS

As a result, we identified or confirmed the identification of preserved human bone material from eight sites: Aisti, Hartikka, Kolmhaara, Kukkarkoski 1, Lappfjärd-Björnåsen, Perttulanmäki, Rahakangas 1 and Vaateranta. The osteological and archaeological information of the human bones and their contexts is given in Table 3 and Appendix 1.

In addition, our survey of the material revealed that all of the material did not consist of human bones; occasional animal bone fragments were also identified. For example, instead of a human tooth, the finger bone of a seal (Phocidae) was identified from the Kotikangas grave (Table 2). Moreover, the bone fragment said to be found from the Vihi grave (Table 2) turned out not to be bone but may have been some other organic material. In many cases (i.e. the sites of Hiittenharju, Nästinristi, Kangas), the bone material collected by the excavators was also so poorly preserved that it could not be determined. In the case of Hartikka grave 1 (Table 2), we were able conclude that the small fragments collected with ochre were tooth enamel, but it was impossible to conclude whether these originated from a human or an animal.

Site	Grave	Size (l x w cm)	Grave type	Burial type	MNI	Frag.	Age estim.	Dental pathologies	Previous osteol. anal.	Typological dating according to artefacts	Radiocarbon dating	Reference
Aisti	AV	c 170 x 60	cist grave	inhumation	1	113	subadult			Unknown		Edgren 1966
Hartikka	7	c 180 x 50	ochre earth grave	inhumation	1	3	subadult			Middle Neolithic (Typical Comb Ware)		Miettinen 1992a; 1992b
Kanava	2	c 200 x 80	ochre earth grave	inhumation	4	78	three adults, one subadult*	Caries, linear enamel hypoplasia	Lahti 2004	Middle Neolithic (Typical Comb Ware)	Early Metal Period	Schulz 2006; Mustonen 2008
Kolmhaara	I	c 280 x 75	ochre earth grave	inhumation	1	124	adult			Middle Neolithic (Typical Comb Ware)		Edgren 1959; 1966
Kolmhaara	XI	c 160 x 70	cist grave	inhumation	1	77	subadult	Linear enamel hypoplasia		Unknown		Edgren 1966
Kolmhaara	XX	c 190 x 80	cist grave	inhumation	1	1				Unknown	Bronze Age	Edgren 1966
Kolmhaara	XXIII	unknown	cist grave	inhumation	1	103	subadult			Unknown	Middle Iron Age	Edgren 1966
Kukkarkoski 1	5	c 160 x 250	ochre earth grave	inhumation	1	28	subadult*		Kirveskari 1977	Middle Neolithic (Typical Comb Ware)		Torvinen 1979
Lappfjärd-Björnåsen	1	unknown	ochre earth grave	inhumation	1	109				Middle Neolithic (Typical Comb Ware)		
Perttulanmäki	1	unknown	earth grave	inhumation	1	1				Middle Neolithic (Corded Ware)		Äyräpää 1931
Rahakangas 1	1	c 70 x 40	ochre earth grave	inhumation	1	18				Unknown	Late Mesolithic	Pesonen et al. 2014
Vaateranta	D	c 160 x 140	ochre earth grave	cremation	3	7315	adults		Lahti 2003	Middle Neolithic (Typical Comb Ware)	Middle Neolithic	Räty 1995; Katiskoski 2003
Vaateranta	13	c 300 x 100	ochre earth grave	inhumation	1	148	subadult*		Lahti 2003	Middle Neolithic (Typical Comb Ware)		Katiskoski 2003
Vaateranta	14	unknown	ochre earth grave	inhumation	2	18	adult, subadult*		Lahti 2003	Middle Neolithic (Typical Comb Ware)		Katiskoski 2003
Vaateranta	16	c 300 x 100	ochre earth grave	inhumation	1	9			Lahti 2003	Middle Neolithic (Typical Comb Ware)		Katiskoski 2003

* – Based on tooth wear

Table 4. Summary of combined results from previous osteological analyses and the current study. The results of the current study are marked in gray.

In total, our analysis consisted of 825 bone fragments, of which 577 fragments were unburnt. Aside from a well-preserved mandible from Kolmhaara cist grave XI (Fig. 4b), our study confirmed that all of the unburnt human bones were extremely fragile and consisted mainly of small fragments of tooth enamel (Figs. 5a–b & 6). Making the material even sparser is the unfortunate fact that some of the possible unburnt human bones were lost during storage over the past decades. For example, from the Vaateranta cemetery, tooth and bone fragments from ochre earth graves 2 (Fig. 2), 3, 9a and 9b have been lost. In addition, we have not managed to locate the skull fragments from the Kolmhaara cist grave XX (Table 2), mentioned in the excavation report.

In addition to the unburnt bone fragments, we also identified 248 burnt bone fragments from Vaateranta (Figs. 6c–d). These, together with one burnt, ochre-stained undetermined animal bone were found in 1978 beneath the cremation grave (Vaateranta grave D) and seem to be part of the same context (see Appendix 1).

From the burnt and unburnt material, we were able to identify a minimum of 10 individuals. Dental calculus was not noted in any of our samples, but we noted signs of linear enamel hypoplasia (Fig. 6g) in one case (Kolmhaara cist grave XI), suggesting that the individual had suffered from nutritional or other stress at the age of 4–5 years (Goodman & Rose 1990). In addition, the presence of shovelling, an epi-genetic trait that has mainly been found in Asian populations (Scott & Turner 1997: 6–7, 183), was also noted for this individual (Fig. 6h).

Age estimations were assigned to five individuals (Table 4), and it was concluded that four of the individuals had died as subadults and one as an adult. In the case of the Kolmhaara cist grave XI (Fig. 4b), the age estimation was based on tooth eruption (Schour & Massler 1941; Ubelaker 1989), and it was concluded that the individual was a subadult that had died at the age of c 10 years (Table 3). Since the premolars of Hartikka ochre earth grave 7 (Fig. 6a) and the molars of Aisti cist grave AV (Fig. 6l) showed no sign of dental wear (Table 3), these individuals were also interpreted as being subadults.

Judging from the size of the arm long bone and finger bones of Kolmhaara ochre earth grave I (Figs. 6e–f; Table 3), this belongs to an adult. Similarly, judging by the thinness of the small skull fragments from Kolmhaara grave XXIII (Fig. 6k; Table 3), the bones seem to be fragments from the skull of a child. Curiously, aside from the skull fragments, the Kolmhaara grave XXIII also yielded molar enamel fragments with no dental wear (Fig. 6j; Table 3), together with heavily worn enamel fragments of incisors and canines (Table 3), suggesting that this burial might have been a multiple burial of a subadult and an adult.

DISCUSSION

To present an overview of human bone material as whole, we have combined our results in Table 4 with the results of previous human osteological analyses, conducted at the sites of Kanava in Joroinen, Vaateranta in Taipalsaari and Kukkarkoski 1 in Lieto (Kirveskari 1977; Lahti 2003; 2004). In light of these combined results, the unburnt human bones from potential Stone Age graves in Finland are derived from at least 21 individuals from nine sites (Fig. 3b).

According to the combined results, age estimations have been given in total to 16 individuals (Table 4) concluding that eight of the individuals had died as subadults and eight as adults. It must be noted, however, that in all of the previous analyses (Kirveskari 1977; Lahti 2003; 2004), dental wear has been used to estimate the age of the individual, and only in the case of cremation burial D from the Vaateranta cemetery was the age estimation based on the size and fusing of the bones (Lahti 2003: 123). However, in the case of Vaateranta ochre earth grave 14, an unerupted deciduous molar was discovered in addition to a molar showing signs of heavy wear, suggesting the presence of an adult and a subadult in the same burial (Lahti 2003: 124). Similarly, from Kanava grave 2, teeth with heavy attrition were unearthed together with milk teeth (Lahti 2004).

Although tentative, the age estimations nevertheless suggest that both adults and subadults were buried in the earth graves. The age estimations are important for the Finnish material also because many small ochre features have traditionally been interpreted as burials of children (e.g. Edgren 1984: 50; Engblom 1992: 54;

Katiskoski 2003: 89). However, it is known from neighbouring countries that the use of ochre does not necessarily follow the total area of the body (e.g. Zagorska 2008). Additionally, our results of age estimations suggest that the size of the ochre feature is not a reliable basis for the estimation the body size/age of the deceased. For example, the ochre feature connected with the Hartikka child burial was nearly two metres long, although it was not very wide (Table 4).

The dating of the sites discussed in this study is not unambiguous. Seven of the identified individuals buried in Kanava and Kolmhaara derive from contexts that resemble Stone Age burials but were radiocarbon dated to younger periods. Since the AMS date of the Kanava burial was obtained from a combined sample of four individuals (Table 1) and is clearly at odds with both the typological dating of the settlement site and the grave inventory (Schulz 2006: 135–6), it seems reasonable to assume that the measurement is somehow biased.

However, in the case of the Kolmhaara cist graves, the picture is more blurred. When observed solely from the perspective of the human bone material, it is clear that the largest and best preserved unburnt human bone materials derives from the Kolmhaara cist graves, which may in fact indicate that the cist graves date to a younger period. It must be noted, however, that in the Finnish territory, even Iron Age inhumations may not yield any preserved human bones (e.g. Lehtosalo-Hilander 1973: 165; Salo 2016: 27–8), and thus, other factors may have also contributed to the preservation of the bones.

From this perspective, it is interesting to note that the majority of the studied human bones in this paper are derived from sites that are associated with Middle Neolithic ochre earth graves of the Typical Comb Ware culture, which is in contrast to the single Corded Ware burial site with human remains. Since the Corded Ware graves succeed the ochre earth graves of the Typical Comb Ware culture, it seems reasonable to assume that the human remains have been better preserved in the iron-rich ochre (e.g. Salomon 2009: 101–2). In fact, since all the human bone material from the Kolmhaara cist graves were discovered from burials with a heavy use of ochre (Edgren 1966: 42–6; see also Appendix 1), the preservation of the bones could also relate to the presence of ochre.

To conclude, it appears that new AMS dates would be needed to solve the problem of ambiguous dating. This is also because the closest parallels to the Kolmhaara cist graves in Finland are found from the Aisti site (Fig. 3b), and although the Aisti cist graves have not been AMS dated and the typological dating of the site is solely Stone Age (see Appendix 1), when observed in light of the Kolmhaara dates, the Aisti graves could also date to the metal periods (e.g. Edgren 1999: 319–24). In fact, if the Aisti cist graves are also excluded, the number of identified individuals from unambiguous Stone Age contexts is 13, and the number of sites is seven. However, it must be noted that even if the burials of Kanava, Kolmhaara and Aisti date to younger periods, the mortuary practice of these burials nevertheless seem to follow the tradition of an ochre earth grave, suggesting a continuation in the funerary practices of the prehistoric populations of the Finnish territory.

The lack of dental calculus may indicate a real situation but can also be due to poor preservation. We find this latter explanation more plausible because high amounts of calculus are often observed in hunter-gatherer teeth (Lieverse 1999: 226). Not surprisingly, we observed few dental pathologies in the human tooth fragments. These pathologies were, however, connected only to burials with ambiguous dates and cannot be used to determine the health of the Stone Age populations. Caries found in the teeth of the individuals buried in the Kanava grave 2 by Lahti (2004; see Appendix 1) suggest a diet rich in carbohydrates. Poor oral hygiene, the absence of fluoride in the drinking water, being female, advanced age, genetic predisposition and the poor quality of dental enamel may also contribute to the formation of caries (Powell et al. 1985: 317; Hillson 1996: 283; 2001: 253–72; Larsen 1997: 72–6; Lukacs & Largaespada 2006: 540–55). However, most interestingly, the presence of caries indicates the presence of *Streptococcus mutans* bacteria in the population in question.

Dental caries is, however, rare in hunter-gatherer populations (Lukacs 1989: 276), and aside from the teeth of Mesolithic–Neolithic cemetery of Zvejnieki, northern Latvia

(Palubeckaitė & Jankauskas 2006), it is not commonly found in the Mesolithic and Neolithic populations of northern Europe (Alexandersen 1988; 2003; Ahlström 2003). Several studies have nevertheless shown that the prevalence of dental caries has increased through time worldwide, and this also seems to apply to Finland and its neighbouring countries (Swärstedt 1966; Salo 2005; 2016; Limbo 2013).

In addition to caries, the Kanava teeth also showed evidence of linear enamel hypoplasia (Lahti 2004), a condition that results in having a line of thinner enamel than normal, which, in archaeological contexts, is often interpreted as caused by dietary stress during one or several stages of childhood (Goodman & Rose 1990; King et al. 2005). This stress can affect both deciduous and permanent teeth and generally occurs before the age of three, when the enamel is still developing and is more vulnerable to genetic or environmental factors (e.g. Hillson 1996). In our analysis, linear enamel hypoplasia was noted on the teeth of the individual buried in Kolmhaara grave XI. According to Goodman and Rose (1990), we concluded that the individual had suffered from nutritional stress at the age of 4–5 years.

Since the human bone material presented in this study is very fragmented, the next step in the research should be the detailed documentation of these materials with non-destructive paleoimaging methods (e.g. micro CT-scanning or synchrotron) and a microwear analysis. These studies could reveal the individual history of dental enamel formation and possible minor disruptions in the formation as well as the type of nutrition and possible use of teeth as tools for some activities. It must also be noted that the material discussed in this study is partly unburnt, and it could be subjected to analyses of ancient DNA and stable isotopes (e.g. Haak et al. 2008; Lynnerup et al. 2008; Brown & Brown 2011), which could offer very valuable, unique information about the prehistoric human populations in Finland. However, aside from the mandible from Kolmhaara cist grave XI, all these methods would destroy the scarce material. Since similar material from Finland has so far not been subjected to biomolecular research, we cannot even be certain that the results from these analyses would be successful. Fortunately, the analysis methods are developing continuously and less material is needed to obtain positive results than before (e.g. Krause et al. 2010; Oinonen 2011; Sawyer et al. 2015).

In the future, loose burnt human bones (Koivisto 2010 with references) should also be systematically investigated. Mortuary practices during the Stone Age were diverse (e.g. Brinch Petersen & Meiklejohn 2003; Nilsson Stutz 2003; Lõhmus 2007; Å. Larsson 2009; Gray Jones 2011; Fahlander 2012; Brinch Petersen 2015; Tõrv 2016), and it is impossible to understand the situation without looking at the large picture and a whole distribution of human bones found in places of past human activity.

CONCLUSIONS

Our results show that even sparse enamel and bone fragments can yield valuable information on the demography and mortuary practices of Stone Age populations in Finland. Although problematic methodologically, this material is of special importance because it is all that has been preserved of the bodily remains of the early settlers of Finland.

The human remains from the Finnish Stone Age consist of 7315 burnt and 535 unburnt human skeletal fragments from at least 13 individuals at seven sites. Since approximately 70 Stone Age burial sites are known in the Finnish mainland territory, this material represents only a fraction of the buried bodies.

In addition, 295 fragments of unburnt human bone from eight individuals are also known from contexts with a Stone Age -type grave structure but an AMS date from a younger period. Although the reliability of these dates has been questioned (Edgren 1999; Schulz 2006; Mökkönen 2013), the graves could also represent the continuity of funerary practices from the Stone Age to the metal periods. It must be noted, however, that even though AMS dates have rarely been obtained, the ambiguous dates also affect similar grave types without a typological date.

According to our analysis, most of the Stone Age material originates from contexts with ochre earth graves from Middle Neolithic hunter-fisher-gatherer societies, although one possible Mesolithic site is also included. Interest-

ingly, only one Corded Ware burial exists from all the observed sites, possibly suggesting better preservation of organic materials in the iron-rich ochre context.

In the entire material, age estimations, some of which are tentative estimations based on tooth wear, are assigned to 13 individuals. However, when only the unambiguous Stone Age contexts are included, the number of individuals with age estimation is seven. Although the number of individuals is low, the material nevertheless suggests that both subadults and adults are represented in the Finnish Stone Age earth graves. Importantly, our study also showed that the size of the ochre feature cannot solely be used to estimate the size and age of the deceased.

Aside from age estimation, we also noted some signs of dental pathologies in the form of linear enamel hypoplasia and dental caries. These pathologies were, however, connected only to burials with ambiguous dates and cannot be used to determine the health of the Stone Age populations. Notably, dental calculus was totally absent from the samples.

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APPENDIX 1: CONTEXT INFORMATION OF EARTH GRAVE SITES WITH PRESERVED HUMAN BONE MATERIAL

Rahakangas 1 in Joensuu (ochre earth grave at a settlement site)

The Rahakangas ochre earth grave was located in the Joensuu municipality, eastern Finland (Fig. 3b). The grave was excavated underneath a pithouse at a multi-periodic settlement site and lacked all artefact finds. Although the grave itself was AMS dated to the Late Mesolithic period (Table 1), the radiocarbon determinations of the settlement site show three periods of use, one in the Early Mesolithic, one in the Late Mesolithic and one in the Early Metal Period (Pesonen et al. 2014). Thus, given the multi-periodic nature of the site and the fact that the dating of the grave was obtained from charcoal collected from the filling of the pit, the dating should be regarded with caution.

The grave itself was formed by a small oval feature of ochre that was 70 x 40 cm in size. The human remains of the north-east – south-west oriented grave were discovered in the south-western part of the grave, in an area of intensive ochre surrounded by light-coloured sand. The dental remains were preserved *in situ* (Fig. 5b) but broke into pieces when lifted. The head end of the grave was thus taken to the laboratory *en bloc* to be excavated later (Pesonen et al. 2014: 186–7). Our study included only the collected human remains, and no further studies were conducted on the bloc of soil containing the head end of the grave.

Osteological material: Since the Rahakangas material was very fragmented, we were able to identify only one fragment of dental enamel showing heavy dental wear (Table 3).

Summary from Rahakangas in Joensuu: MNI 1

Hartikka in Laukaa (ochre earth grave 7 in a cemetery)

The Hartikka Middle Neolithic ochre burial ground comprises nine excavated graves is located in the Laukaa municipality, central Finland (Fig. 3b). The graves were located on a hill outside a large settlement site that was dated with two radiocarbon samples, derived from two adjacent hearths, to the Typical Comb Ware period (Miettinen 1992b: 25–7). Although the graves have not been radiocarbon dated, their rich flint and amber assemblages suggest a date that is contemporaneous with the settlement site (Miettinen 1992b: 37).

At the Hartikka burial ground, possible human remains were collected from graves 1 and 7 (Miettinen 1992a: 12; 1992b: 33). The small pieces of bone from grave 1 were too fragmented for further analysis but were authenticated as tooth enamel. We could not conclude, however, whether these enamel fragments originated from a human or an animal. In fact, even though these fragments were recovered from heavy ochre at the eastern end of the burial together with three amber pendants (Miettinen 1992a: 12), aside from human teeth, these enamel fragments could also derive from an animal tooth pendant, for example.

The tooth fragments from the grave 7 were better preserved and located in an intensive layer of ochre at the eastern end of the grave (Miettinen 1992a: 18). The Hartikka grave 7 was an east–west oriented feature of ochre that was 180 x 50 cm in size and narrowed towards the west. No artefacts were found in the grave, but the tooth fragments were surrounded by small pieces of unburnt clay (Miettinen 1992a: 17). This might represent a plastered skull, a tradition known also from other Comb Ware burials with better preserved skeletal material (e.g. Zagorska 2001: 112; Edgren 2006).

Osteological material: The bone material from the grave 7 was collected with surrounding soil that was not excavated further by us (see Fig. 5a). The analysis was conducted only on canine, lower second premolar and molar enamel that were visible on the surface of the soil (Fig. 6a). The molar was slightly worn, but since the premolars showed no sign of dental wear (Table 3), they had probably not erupted yet, suggesting that the individual had died as a subadult.

Summary from Hartikka in Laukaa: MNI 1; age estimation: subadult

Kukkarkoski 1 in Lieto (ochre earth grave 5 in a cemetery)

The Kukkarkoski 1 Middle Neolithic cemetery site is situated in the Lieto municipality in western Finland (Fig. 3b). Similar to the Hartikka site, the burial ground with 13 Neolithic earth graves was located on a hill slope near a Typical Comb Ware period settlement site. Nine of the Kukkarkoski burials are ochre earth graves that can be dated typologically to the Typical Comb Ware period (Torvinen 1979). A single radiocarbon dating supporting the artefact typology also exists (Table 1). In contrast to the ochre earth graves, four graves that were treated with considera-

bly less ochre and fewer artefacts were also unearthed (Torvinen 1979; 1980). Since some of these graves were positioned on the ochre earth graves, it is plausible that the structures are from a younger phase of site's use (Ahola 2016: 29). Indeed, a Corded Ware earth grave was also discovered at the burial ground, indicating long-term use of the site (Torvinen 1979).

Osteological material: Only one of the Kukkarkoski graves yielded human skeletal material. These tooth fragments were discovered in the west-south-western end of the grave 5, a south-east – north-west oriented ochre earth grave that included amber pendants and two small stone adzes (Torvinen 1979: 50). Since the grave feature was formed by two oval areas of ochre side by side, the burial may have been a collective burial of two individuals (Ahola 2016: 33).

According to an osteological analysis conducted in the 1970s (Kirveskari 1977), the tooth fragments represent dental wear that suggest the presence of one 5–20-year-old individual. Since the teeth are currently further fragmented, it was not possible to verify the age estimation.

Summary from Kukkarkoski in Lieto: MNI 1; age estimation: subadult?

Lappfjärd-Björnåsen in Kristiinankaupunki (ochre earth grave)

One grave has been found and excavated at the Lappfjärd-Björnåsen site in the Kristiinankaupunki municipality, Ostrobothnia (Fig. 3b). The grave was destroyed by modern land use, and there is no excavation report available. Therefore, the context of the find material is vague. However, fragments of tooth enamel were found with ochre and amber artefacts characteristic for the Middle Neolithic Typical Comb Ware period, indicating an ochre earth grave.

Osteological material: From the Lappfjärd-Björnåsen material, enamel fragments from upper and lower premolars were identified (Fig. 6b). The fragments were heavily ochre-stained and showed advanced dental wear (Table 3).

Summary from Lappfjärd-Björnåsen in Kristiinankaupunki: MNI 1

Vaateranta in Taipalsaari (inhumation ochre earth graves 13, 14 and 16 and a cremation in an ochre earth grave in a cemetery)

The Vaateranta burial ground, which comprises 21 graves, is located in the Taipalsaari municipality, eastern Finland (Fig. 3b). The burial ground, consisting mainly of ochre inhumation burials of one or a few individuals, was located at the edges of a Neolithic settlement site and is typologically dated to the Middle Neolithic Typical Comb Ware period (Katiskoski 2003). Among the inhumations, a cremation burial in an ochre pit was discovered (Räty 1995). The AMS dates obtained from both the cremation and inhumations mainly support the typological dating (Table 1).

Osteological material (analysis by E.-K. Lahti): From the Vaateranta burial ground, human skeletal material, mostly tooth fragments preserved *in situ* (see Fig. 2), was discovered from eight graves (Katiskoski 2003: 90–1). Unfortunately, some of the skeletal material, identified by Ukkonen (1999), from the Vaateranta graves have gone missing (including the tooth fragments shown in Fig. 2) from the collections of the National Board of Antiquities and have thus not been subjected to further analysis.

In 2003, Eeva-Kristiina Lahti (2003) analysed the human skeletal material of three inhumations (graves 13, 14 and 16). According to the analysis, grave 14 contained teeth with heavy dental wear as well as teeth with no dental wear – consequently, it was interpreted as a multiple burial of an adult and a child. From grave 13, only one individual whose teeth showed almost no attrition at the occlusal surface was identified. Based on the dental wear, this individual was interpreted as a subadult. The tooth fragments in grave 16 were too fragmented for further analysis. From this grave, however, a fragment of a femur was identified.

Lahti's analysis included also parts of the cremation burial. The cremation burial was excavated partly in 1971, partly in 1978 (Räty 1995: 165–6), and Lahti studied the human bones collected from the 1971 excavations (Lahti 2003). According to this study, the cremation consisted of at least three individuals, and the bones bore masculine characteristics. The corpses were burned at low temperature of 300°C with the soft tissues included.

Osteological material (this study): The cremated human bone material in our study is from the 1978 excavations. From this material, we identified heavily ochre-stained fragments of the frontal bone, maxilla, mandible, skull, vertebrae and hand phalanxes of an adult individual (Figs. 6c–d; Table 3).

Summary from Vaateranta in Taipalsaari: MNI /inhumations: 4, /cremation: 3; age estimation / inhumations: adult, 2 subadults, /cremation: adults

Kanava in Joroinen (ochre earth grave 2 at a settlement site)

The Kanava graves are located in the municipality of Joroinen in eastern Finland (Fig. 3b). The two ochre earth graves that were typologically dated to the Typical Comb Ware period were found in a Middle Neo-

lithic settlement site, AMS dated to the Typical Comb Ware period but with few artefacts indicating Late Neolithic activity (Schulz 2006). However, in contrast with the dating of the settlement, the AMS date from a grave dates it to the Early Metal Period (see Table 1).

Osteological material (analysis by E.-K. Lahti): Osteological analysis of the human skeletal material from the Kanava site was conducted by E.-K. Lahti in 2004, and the material has not been re-analysed in this study. 78 tooth fragments were found from the Kanava grave 2 (Lahti 2004). Of the fragments, 19 were identified and based on dental wear. The grave contained a minimum of four individuals, one of which was a child. The grave feature and the location of the tooth fragments in several clusters suggest the possibility of at least two overlapping burials (Mustonen 2008: 60–1). Caries and enamel hypoplasia were also noted (Lahti 2004).

Summary from Kanava in Joroinen: MNI 4, age estimation: three adults, one subadult; dental caries and enamel hypoplasia.

Kolmhaara in Eura (ochre earth grave I and stone cist graves XI, XX and XXIII in a cemetery)

The Kolmhaara burial ground with 23 ochre graves is located in the Eura municipality, western Finland (Fig. 3b). Seven of the Kolmhaara graves were ochre earth graves and 17 graves had stone cist (Fig. 4a) or head stones (Edgren 1966: 27–49). The ochre earth graves were richly furnished with amber, flint and slate artefacts typical of the Middle Neolithic Comb Ware period (Edgren 1959). The cist graves did not yield any artefacts but were also marked by the use of ochre and were connected to the Early Neolithic use phase of the nearby settlement site (Edgren 1966: 96). The ochre earth graves have not been AMS dated. Instead, during the late 1990s, two cist graves that were located near one another were AMS dated to the Early Metal Period and the Iron Age (see Table 1). The settlement site has yielded some pottery typical of the Early Metal Period, but no Iron Age finds have been found (Edgren 1999: 319–24).

Osteological material: Human skeletal material was found from six graves (Edgren 1966: 27–49). Unfortunately, some bone fragments have been misplaced in the past decades, and therefore, we were only able to analyse the material of the following four graves:

Grave I

Kolmhaara grave I was an ochre earth grave with rich flint and amber find material that dates the burial to the Middle Neolithic Typical Comb Ware period. The artefacts and human bone material of the grave were located in heavy ochre underneath several layers of birch bark (Edgren 1959: 8–13).

Osteological material: The human bone material of the Kolmhaara grave I consisted of fragments from right arm bone (Fig. 6e) and hand phalanxes (Fig. 6f) of an adult individual (Table 3).

Summary from grave I at Kolmhaara in Eura: MNI 1, age estimation: adult

Grave XI

The Kolmhaara grave XI was a stone cist grave (Fig. 4a) with no artefacts (Edgren 1966: 42). The cist was small, c 160 x 70 cm, made mainly of red sandstone (Edgren 1966: 42). The intensive ochre layer of the grave was described as human-shaped with a thickness of c 10 cm (Edgren 1966: 42). The human skeletal material in the grave, consisting of a relatively well-preserved lower mandible (Fig. 4b) together with enamel fragments from incisors, canines, premolars and molars of the maxilla, were located at the south-western end of the grave and were heavily covered with ochre (Edgren 1966: 42). The location of the skeletal material and the shape of the ochre indicate that either the deceased or the clothing of the deceased was dyed with ochre. According to the dental development, the age of the individual was estimated at c 10–12 years (Edgren 1984: 50).

Osteological material: From the lower mandible canines, premolars and molars were identified (Table 3). Being in line with the previous research, the age estimation of the individual was c 10 years old at death based on dental development. Traces of linear enamel hypoplasia (Fig. 6g) was noted on two of the upper premolars, indicating that the deceased had suffered from causes leading to linear enamel hypoplasia formation (e.g. nutritional stress) at the age of 4–5 years (Goodman & Rose 1990). The incisors of the individual were shovel-shaped (Fig. 6h).

Summary from grave XI at Kolmhaara in Eura: MNI 1, age estimation: subadult; linear enamel hypoplasia, shovel-shaped teeth

Grave XX

The Kolmhaara grave XX was a stone cist grave with no artefacts. The cist was made of red sandstone and included more ochre than any other grave in the burial ground (Edgren 1966: 45). The skeletal material of the grave was located at the south-western end of the grave.

Osteological material: According to the excavator (Edgren 1966: 45), the grave yielded well-preserved pieces of human skull and several tooth fragments. However, only one fragment, the root of an upper

canine (Fig. 6i) showing heavy dental wear (Table 3), was found from the collections of the National Board of Antiquities. The grave was AMS dated to the Bronze Age (see Table 1).

Summary from grave XX at Kolmhaara in Eura: MNI 1

Grave XXIII

The Kolmhaara grave XXIII, a stone cist grave, was partly destroyed by modern land use; therefore, some of the human bone material was actually collected from a gravel pit and pressed against an ochre-stained sandstone slab (Edgren 1966: 45–6). However, some of the human skeletal material was also found in the preserved western end of the grave structure, underneath a sandstone slab from a small 15 x 15 cm feature of ochre-stained soil (Edgren 1966: 45–6).

Osteological material: The human bone material of the grave XXIII consisted of skull fragments with enamel fragments from upper incisor, canine and molars (Table 3). The incisor and the canine showed considerable dental wear, whereas the molars (Fig. 6j) showed no wear. As the skull fragments (Fig. 6k) were also very thin, the grave might have been a multiple burial of an adult and a subadult.

Summary from grave XXIII at Kolmhaara in Eura: MNI 1, age estimation: subadult

Aisti in Mynämäki (stone cist grave AV at a settlement site)

The Aisti Neolithic site with five stone cist graves is located in the Mynämäki municipality, western Finland (Fig. 3b). The settlement site yielded find material from the Early Neolithic Jäkärlä culture and from the Neolithic Corded Ware culture (Edgren 1966: 57). The graves were located on the settlement site and were furnished with large amounts of ochre (Edgren 1966: 58). Aside from small shards of Early Neolithic pottery and stone flakes collected from the filling of the graves, no artefacts were discovered (Edgren 1966: 59–62).

The Aisti graves resemble the Kolmhaara stone cist graves, but no AMS dating has been conducted. However, at the Aisti site, human skeletal material was preserved only in grave AV, where tooth fragments were located at the southern end of the grave, inside a ring-shaped feature of possible decomposed bone material (Edgren 1966: 61). The ochre feature of the grave formed a human-shaped feature in a crouched position (Edgren 1966: 61).

Osteological material: The Aisti skeletal material consisted of enamel fragments from an upper incisor and a molar along with enamel fragments from either upper or lower incisors, canines and molars (Fig. 6l). Since the molars showed no evidence of dental wear (Table 3), the deceased was likely a subadult.

Summary from Aisti in Mynämäki: MNI 1, age estimation: subadult

Perttulanmäki in Kauhava (earth grave)

The Perttulanmäki grave is located in the Kauhava municipality, Southern Ostrobothnia (Fig. 3b). The grave is the only Finnish Corded Ware burial with preserved human bone material. Differing from the central European Corded Ware graves (e.g. Å. Larsson 2009: 61), the Perttulanmäki grave was an earth grave (Äyräpää 1931). The grave was partly destroyed by modern land use, but the preserved section had a dark, rectangular-shaped feature, which is interpreted as the remains of an animal hide (Äyräpää 1931: 10–1). The skeletal remains were located at the north-western end of the grave, and the burial was furnished with a Corded Ware vessel, a stone chisel and two stone adzes (Äyräpää 1931: 6–9).

Osteological material: The Perttulanmäki material consisted of molar enamel with slight dental wear (Table 3), but further anatomical identification and age estimation was impossible to pursue. The molar was plastered in the 1930s.

Summary from Perttulanmäki in Kauhava: MNI 1