What Ancient Human Teeth Can Reveal?
Demography, Health, Nutrition and Biological Relations in Luistari

Master thesis in archaeology
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Tutkielmassa esitellään miten muinaisista ihmisen hampaista saatavaa tietoa voidaan käyttää arkeologisessa tutkimuksessa. Esimerkkiaineistona on käytetty Euran Luistarin kalmiston vainajien hammaslöytöjä. Euran Luistarin kalmisto on ollut käytössä 500- luvun lopusta varhaiskeskiajalle.

Hampaiden avulla pystytään tekemään ikä- ja sukupuolimäärityksiä vainajista, tutkimaan hammassairauksia ja muita hampaissa ilmeneviä sairauksia sekä tutkimaan vainajien ja populaatioiden geneettisiä suhteita. Sen lisäksi hampaista saatavaa tietoa voi käyttää tutkittaessa muinaisten ihmisten käyttämää ravintoa. Hampaista voi myös löytyä merkkejä, jotka viittaavat hampaiden käyttöön työkaluina.

Luistarissa muutamasta vainajasta oli jäänyt jäljelle ainoastaan hampaita. Ilman osteologista analyysiä näiden vainajien olemassaolo olisi jäänyt todistamatta. Ikämäärityksiä tehtiin 26 vainajasta ja määritetyt iät vaihtelivat 1-2 vuotiaasta 44-64 vuotiaaseen. Lisäksi yhdentoista vainajan sukupuoli määritettiin hampaiden koon perusteella. Tätä menetelmää voi suositella laajempaankin käyttöön osteologiassa. Huonon säilyvyyden takia tarkempia demografisia päätelmiä (esim. miesten/naisten keski-ikä) ei kuitenkaan pystytty tekemään. Nuorilla ja vanhoilla havaittiin erilaisia hammassairauksia. Mahdollisuuksia ikämääritysten tekemiseen hammassairauksien perusteella pitäisi tutkia.
Naisilla oli enemmän reikiä hampaissa kuin miehillä. Se on ollut yleistä esihistoriallisina aikoina. Hypoplasia (lapsuuden aikana koetusta ravintoainepuutoksesta tai vakavasta sairaudesta johtuva hammaskiilteen kehityshäiriö) oli kolme kertaa yleisempää miehillä kuin naisilla. Se ei välttämättä johdu siitä että naisilla olisi ollut parempi ravinto tai että naiset ovat sairastelleet vähemmän lapsuudessaan. Lapsivainajilla oli eniten hypoplasiaa. Voi olla että hypoplasiasta kärsineet tytöt eivät eläneet aikuisiksi. Se selittäisi myös sen miksi miesten hautoja on enemmän kuin naisten hautoja. Hammassairauksien perusteella pääteltiin, että ravinto on sisältänyt vain vähän hiilihydraatteja ja että vilja ei ehkä vielä rautakaudella ole ollut niin suuressa asemassa ravinnon lähteenä, kuin arkeologinen aineisto osoittaa. Maanviljelystyökaluja sisältävistä haudoista löydettiin enemmän hammassairauksia, jotka voidaan liittää viljatuotteiden syömiseen, mutta hauta-antimien rikkauden, oletettujen soturien tai kauppiaiden hautojen ja hammassairauksien välillä ei löydetty yhteyttä. Pienten kiillevaurioiden hampaissa arveltiin johtuvan myllynkiven palasista jauhojen seassa. Muita hammassairauksia olivat hammaskivi, hammassementin liikakasvu, leukaluun vetäytyminen, hampaan menetys elinaikana ja tulehduksen aiheuttama pesäke leukaluussa. Röntgenkuvista löydettiin lisää patologisia muutoksia. Luistarin hampaat olivat yllättävän isokokoisia. Niiden koko vastasi kivikautista hampaiden kokoa. Geneettisiä merkkitekijöitä on tutkittu vähän Koillis- Euroopassa. Harvoista vertailukohteista virolainen keskiaikainen Jougan kalmisto oli kuitenkin lähellä Luistaria. Myös yksilöiden välisiä geneettisiä suhteita voidaan tutkia merkkitekijöiden avulla, mutta huonon säilyvyyden ja harvinaisten merkkitekijöiden vähyyden vuoksi sitä ei pystytty Luistarissa tekemään. Säilyvyydestä johtuvien ongelmien vähentämiseksi on suositeltu, että osteologinen analyysi tehtäisiin heti kaivausten jälkeen tai jo kentällä.

Avainsanat – Nyckelord
osteologia, arkeologia, hammas, hampaat, Luistari, rautakausi, merovingiaika, viikinkiaika

Säilytyspaikka – Förvaringställe
Arkeologian laitos, Topelia kirjasto, Hämäläis-Osakunnan kirjasto

Muita tietoja

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Introduction

A few years ago I became interested in researching human bones and especially teeth. For that reason I went to study Osteo-Archaeology at the Archaeo-Osteological Research Laboratory at the University of Stockholm between the years 2000-2002. During the second year I wrote a thesis, which is a part of this work. To get material for my present thesis I turned to the National Board of Antiquities in Finland and it was suggested that I study human teeth from Luistari. It was a good choice. I chose this material for four main reasons. First, the place is archaeologically interesting and has been investigated thoroughly. Secondly, due to the exceptional burial practice, inhumation, teeth from many different periods have been preserved. (Here it should be noted that if teeth are cremated, dental enamel breaks in the heat and therefore often only parts of tooth roots are found in cremation burials. Also it is more difficult to differentiate individuals from some other types of burials.) Thirdly, the material was large enough for a thesis. And finally, the material was easily accessible and easy to transport to Sweden. In other words, besides being a large, thoroughly researched cemetery with rich archaeological finds, the Luistari cemetery is one of the oldest inhumation burial grounds in Finland. It is also exceptional that the same burial ground has been in use from the Merovingian period to medieval times. My Professor in Archaeology at the time, Ari Siiriäinen, accepted my topic and we agreed that, at the beginning, my supervisor would be Ebba During, my Professor in Osteo-Archaeology. After I moved back from Sweden, Forensic Dentist Helena Ranta offered an opportunity to take x-rays at the Department of Forensic Medicine. A Professor of Radiology, Juhani Wolf, was kind enough to give statements from the x-rays. In Finland my supervisor has been Tuija Kirkinen, an Assistant in the Department of Archaeology at the University of Helsinki,.

Using graves and graveyards, archaeologists usually want to explain phenomena in society such as settlement history, settlement structure, group forming, hierarchy, equality of tasks and interaction of populations (Pihlman 1997:9). Some of the most popular study subjects in funerary archaeology in Finland have been dress, artifacts, social status, artifact and grave typology, size of community, equality and the tasks of men and women in society, the richness of grave goods, settlement history, landscape, religion and influences from outside the community. Most of these aspects have already been researched from Luistari, at least in some form. Conclusions about livelihood have sometimes been based on graveyards, because other types of Iron Age sites are rarely researched. By studying human teeth and bones it is possible to add further aspects to the list: demography, biological relations and health. Further it is possible to research social status, equality and the tasks of men and women in society and nutrition from another perspective. Differences between diffusions and migrations could also be studied from a different perspective.

Focusing on human teeth has several advantages, the single most obvious one having to do with preservation. Tooth enamel is the hardest and most durable tissue in the body and therefore teeth can survive adverse conditions of preservation for longer than other parts of the skeleton. During cremation, however, enamel breaks easily. That is why Luistari gives a good opportunity to analyze human teeth from as early as the Merovingian period. Tooth enamel grows during childhood and does not change morphologically or chemically later, thereby providing a permanent record of the events of childhood, such as malnutrition or disease. Furthermore, dental development is a valuable indicator of the age of an individual at death. Besides their importance for age estimations, the form and condition of a person's teeth may reveal much information concerning health status, biological relations, nutrition and the use of teeth as tools.

Aim of the study

The main goal of archaeology is to explain how people lived in the past. One of the main study subjects should be to study the remains of the people themselves. The aim of this study is to show how dental remains can be used in archaeological research in Finland. This paper, which analyses dental material from Luistari, gives one example of the possibilities. The three main themes of the study are demography, health, and the biological relationships of the deceased. The questions this study intends to address are the age at death and sex of the persons buried, their diseases (i.e. dental diseases or other conditions affecting the teeth) and the genetic relationships inside this population in comparison with other populations. The dental status and genetic markers are also compared to grave goods. Teeth may also tell something about nutrition and human behavior, but here these aspects are discussed only in a preliminary form.

This chapter presents the previous studies in the Luistari cemetery. The next chapter deals with the research history of osteology and dental anthropology in Finland and Scandinavia. In the third chapter, the material is presented, the MNI (Minimum Number of Individuals) is counted, and the preservation and taphonomical reasons for this kind of preservation are discussed. The fourth chapter presents the research methods. The fifth chapter presents the results of the primary analysis, while the sixth chapter analyses the results and presents comparisons with previous studies in prehistoric teeth and studies in archaeology. The fifth and sixth chapters are divided into sections for age, pathology and genetic relations. The last chapter presents further conclusions.

The new information obtained from the analysis of the dental material can easily be linked to the results available from the archaeological investigations of the graves. Material from the first excavations (see following chapter) has been used in a dissertation (Lehtosalo-Hilander 1982:a-c) and will also be used in this research in order to make comparisons with the archaeological data. In other words, the dental material from 421 graves out of a total of nearly 1300 graves will be used.

Archaeologically, the most interesting questions that arise are: What demographic information can be obtained? Is it possible to discuss child mortality, birth and death rates, generation length, life expectancy and mean longevity? Have these figures changed from the Merovingian period to medieval times? Is there any difference in furnishing or the dental status of the graves of young and old persons? Did women live longer than men? What kind of dental (and other) diseases did they suffer from? Is there any connection between dental health and the relative wealth of the graves? Is any disease more common in richly furnished or poorly furnished graves? Is there any correlation between dental status and the artifact types found in the graves? Did all have the same subsistence and hygiene? Do women have more pathologies than men? What does it tell about nutrition, the tasks and equality of men and women? Do dental diseases vary from period to period? What does it tell about health, nutrition and economy? Have teeth been used as tools in some activity? Is the Luistari population closely related to some other population? Are some individuals in the cemetery closely related? Are there any artifacts that can be connected to closely related populations or graves?

Luistari

During nearly all of the Iron Age, cremation was the prevailing form of burial in Finland. It was only in the 11th century A.D. that this practice was given up in favor of inhumation burial in cemeteries.

Luistari is one of the few cemeteries around Lake Pyhäjärvi in Southwest Finland where inhumation was used already in the Merovingian period. The oldest graves date from approximately 600 AD. Cemeteries have been found at Köyliö, Yläne and Eura around Lake Pyhäjärvi. Pihlman (1997:23) suggested that the burial customs at Eura originated from the south side of the Baltic Sea. She also suggests that, because of the ideal landscape in the Eura and Köyliö areas, it was possible to use field cultivation instead of the slash-and-burn technique and that this is reflected in burial practices.

The Luistari burial ground is situated in the Eura parish in Southwestern Finland. Luistari is situated 200 m from the Eurajoki river and 1500 m from Lake Pyhäjärvi. Other (smaller) Iron Age cemeteries and a dwelling site are situated nearby as well as the Village of Kauttua, mentioned already in medieval sources. The cemetery area is partly planted field and partly unused land. The area of unused land and planted field was roughly the same in the 17th century as it is today. There has been activity on the site during historical times, which is shown by the overlaying cultural layer which is usually 35-40 cm or even 100 cm thick. There have been several buildings on the site in historical times (Lehtosalo-Hilander 2000b: 27). Under it the ground was silt or, in places, fine sand. Excavation was done as a complete level excavation. (Lehtosalo-Hilander 1982a: 7-13) Unfortunately not much more can be said about the excavation technique (find collection, possible sieving and so on) because the excavation reports from the years 1969-72 were missing from the archive of the National Board of Antiquities.

The Luistari cemetery was discovered in the spring of 1969, when the municipality of Eura started drainage works through the area. At this stage a digging machine scooped up a silver-ornamented sword and the drainage works were temporarily stopped. The first rescue excavations were carried out in the following summer (Lehtosalo-Hilander 1969). The excavations continued in the three following years (1970-1972) with the help of donated funds (Lehtosalo-Hilander 1970, 1971, 1972). Lehtosalo-Hilander did her licentiate work in Viking Age men's weapons in Luistari. Some articles were also published. (Lehtosalo-Hilander 1976a+b, 1978a) The investigations continued in 1977 as a training excavation of the Department of Archaeology at the University of Helsinki (Lehtosalo-Hilander 1977). Minor scale excavations were also performed in 1979 (Lehtosalo-Hilander 1979). Dr. Pirkko-Liisa Lehtosalo-Hilander published a trilogy concerning Luistari in 1982. The first part was about the graves, the second about the artifacts and the third about the Viking age society (Lehtosalo-Hilander 1982a-c). In the first part she describes graves 1-421, of which 86 had human teeth. She determined the children's graves by the size of the grave pit, the length of the child and the diameters of rings and other ornaments (Lehtosalo-Hilander 1982a: 25-26) At the end of the grave description there is a table of graves (Lehtosalo-Hilander 1982a: 293-303). The table of graves contains the location and orientation of the graves, the sexing of the individuals based on grave goods (see Lehtosalo-Hilander 1982c: 16-19 for explanations), rough dating, the size of the grave pits, and the finds (grave constructions, weapons, horse equipment, tools, textiles, pottery, animal bones, slag, scales and weights etc.). The table is useful in this and many other kinds of research. The first part also contains studies of coins by Tuukka Talvio and animal bones by Leif Blomqvist and Mikael Fortelius. In the second part she describes the artifacts and, among other things, makes remarks about the origin of the artifacts (Lehtosalo-Hilander 1982b). The third part is the furthest reaching and most interesting of all the three parts. It studies Finnish Viking Age Society: the size and structure of the society, the distribution of wealth and social status. The sources of livelihood were also studied. (Lehtosalo-Hilander 1982c) Since then, the Luistari Cemetery (and the Bronze Age dwelling site) have been excavated in 1984 and 1986-92 (Lehtosalo-Hilander 1984, 1986, 1987 Kujanen 1987, Lehtosalo-Hilander 1988, 1989, 1990, 1991, 1992 Saari 1992). Another article was published in 1988 (Lehtosalo-Hilander 1988).

The Luistari cemetery in Eura has inspired many other Finnish archaeologists during recent decades with its rich grave goods and exceptional burial practices. Several other archaeologists have researched different aspects of Luistari - for example, social and economic structures, wood samples, structural analyses of the graves, origins of animal bones and dress details (Halinen 1988, 2001 Jäkärä 1998, 2002, Raninen 2003, Suhonen 1993, Tupala 1999, 2000, Vajanto 2003). Even a dress reconstruction has been made from grave 56 (Lehtosalo-Hilander 2001a: 48). In 2000 Lehtosalo-Hilander published her fourth Luistari book about weapons and ornaments (Lehtosalo-Hilander 2000a). In the fourth part she also describes the rest of the graves 422-1294 (Lehtosalo-Hilander 2000a: 13-154). Lehtosalo-Hilander has also written books about the prehistory of Eura (Lehtosalo-Hilander 1993, 1994, 2000b, 2000c). In 2001, a Nordic conference was held in Eura, where Luistari was one of the subjects (Lehtosalo-Hilander 2001b). The Luistari cemetery is also special because it was fully investigated between the years 1969-1992. Almost 1300 graves were excavated of which 463 contained artifacts and had 481 burials (Lehtosalo-Hilander 2000a: 144). The excavation area is large, around 6000 square meters (Lehtosalo-Hilander 2001a: 23). In Finland it is an exceptionally large investigation (Lehtosalo-Hilander 2000b: 146). However the human remains from the graves have been left out of the research so far. It has been supposed that the human remains are not well enough preserved for osteological analysis (Lehtosalo-Hilander 2000b: 97).

2. Research history

Human Osteology is a new branch of science in Finland. Efforts have been made by researchers in subjects other than archaeology (biologists, geologists, dentists and so on) to study bones from archaeological sites. However, lack of education (and therefore know-how) has perhaps been the biggest obstacle hindering human osteological research in Finland. Osteo-archaeology is not a subject in any Finnish universities and only occasionally has it been possible to arrange a course in osteology in the Universities of Helsinki and Oulu. So far, all Finnish osteo-archaelogists have been trained in Sweden in the Universities of Stockholm and Lund. However, it has recently become popular among students in archaeology to go to Sweden to study osteology and hopefully that will increase the amount of human osteology research in Finland.

Pirjo Lahtiperä was the first to do large-scale human osteological analysis in Finland. Her interest was mainly cremated bones (Lahtiperä 1970, 1974, 1975, 1979, 1980). She was a student in the Archaeo-Osteological Research Laboratory in Stockholm. Tarja Vormisto (later Formisto) was also a student in the same laboratory. She wrote her doctoral thesis on bones from Leväluhta (Vormisto 1981, 1983, 1985, Formisto 1993, 1996, 1997).

Milton Nunez, Professor of the University of Oulu, has given courses in bio-anthropology and has also published many articles on bones from Åland (Nunez 1988, 1989, 1990, Liden et al. 1996, Nunez 1995, 1997, see also http://oyklotus.oulu.fi/db/cris/cris.nsf/). Although osteological research has been more popular in the Åland islands than on the mainland, only a few human osteological papers have been published besides those written by Milton Nuñez (Gröönroos 1913, Martinsson-Wallin et al.1986, Götherström et al. 2002 and Gustavsson 1988). The best-researched site in the Åland islands is Jettböle (Gröönroos 1913, Nunez 1995, Götherström et al. 2002) and on the mainland Leväluhta (Pesonen 1940, Formisto 1993 and 1997). Another researcher from Oulu, Markku Niskanen, has been mainly interested in physical anthropology. (Niskanen 1994, 1997, 1998a, 1998b, 2000 Jarva et al. 2001, Niskanen 2004a, 2004b Niskanen et al. 2004, see also http://oyklotus.oulu.fi/db/cris/cris.nsf/). Barbro Hårding has researched human and animal bones from Pönullbacken, Österbotten (Hårding 2002).

Nicklas Söderholm, like Lahtiperä and Formisto before him, has been studying at the Archaeo-Osteological Research Laboratory at the University of Stockholm. His master's thesis in archaeology deals with the anatomical collections of the University of Helsinki, but he has also done a few bone analyses on prehistoric human bones (Söderholm 2002, Raike 2002). Nowadays he is mostly interested in forensic archaeology.

I still need to mention two more active researchers in human osteology in Finland, who both studied osteo-archaeology at the University of Stockholm. A young researcher from Turku, Auli Tourunen, has already published one bone analysis of human bones from Hämeenkoski (Ratilainen et al. 2003). Another active Finnish human osteologist, Eeva-Kristiina Lahti, wrote her master's thesis in osteo-archaeology on human bones from the Pälkäne church (Lahti 2004). Eeva-Kristiina Lahti has also published an analysis of burned bones and unburned teeth from Vaateranta in Taipalsaari (Lahti 2003). Appendix 3 presents all the Finnish human osteological reports done so far, that have not been published. As can be seen from Appendix 3 and all the above-mentioned studies, human osteology can be said to have began in Finland in the 1970s when it also became common to take up all the bone material from excavations in Finland (Taavitsainen 1997:58).

Heikki S. Vuorinen has researched the history of diseases. He is a doctor of medicine and surgery with an interest in archaeology (Vuorinen 1991, 1996, 1997 and 2002).

Kirsti Paavola, a third researcher from the University of Oulu, has researched graves in churches and taken the bones into account as well (Paavola 1998). Osteology in historical times has been also researched from the Hailuoto and Manamansalo islands (Pirttiniemi et al. 1988, 1992, Heikkinen 1988). As a curiosity, it can be mentioned that even holy relics have been researched scientifically (Kajava 1932).

Only a few studies in prehistoric teeth have been made. Dentists, and not archaeologists or osteologists, have done most of these studies. Per von Bonsdorff was the first to publish articles about prehistoric teeth in Finland (Bonsdorff 1923, 1933). Also worth mentioning is definitely dentist Tiina M. Varrela who did her dissertation about "Plaque-related diseases in different dietary environments" (Varrela 1996, Varrela 1997). Her research subjects included medieval teeth from Turku. Another dentist, Ulla Saarnisto, did her master's thesis on teeth from the Kirkkailanmäki cemetery in Hollola parish (Saarnisto 1996). Teeth from the 15th to the 18th centuries at Hailuoto have also been researched (Heikkinen 1988). An archaeologist and his brother, a dentist, wrote an article on cranial bones and teeth from Pälkäne (Nykänen et al. 1999). The above-mentioned research on Pälkäne concentrates on teeth (Lahti 2004).

Dental anthropological research in Finland has a short history (see Kirveskari 1976), but a few names are worth mentioning. Kajava (1912) researched Saami dentitions. Göran Hjelmman (1929) and Kalevi Koski and Eeva Hautala (1952) also researched Finnish dentitions. Lassi Alvesalos' most cited work showed that sex-chromosome affects tooth size (1971). Pentti Kirveskari (1974) did his dissertation on Saami dentition, among other dental anthropological work. Paleoanthropologist Björn Kurtén also had an impact on dental anthropological research (see for example Kurtén (ed.) 1982).

The Danish skeletal material is the most systematically investigated skeletal material in the Nordic countries (Sellevold 1993: 102). Studies in prehistoric teeth in North Europe have been made most often in Denmark, as can be seen in the following chapters. Most of the credit goes to dental anthropologist Verner Alexandersen whose bibliography is presented in a book called "A Tooth for a tooth" (Iregren et al. (ed.) 2003). Also worth mentioning is Osteologist Pia Bennike, e.g. "Paleopathology of Danish Skeletons" (Bennike 1985). Because there has been no active research in the field in Northeastern Europe, all available comparisons to tooth size, traits and pathologies found have been presented in this study. Some of the references are therefore, unfortunately, quite old.

3. Material

Out of the 421 graves surveyed for this study, 86 were found to comprise dental remains and could thus be singled out for further study (see Appendix 2 and Appendix 4). Most of these 86 graves were single graves. Nine of them were double or multiple graves (graves 280, 281, 291, 294, 295, 303, 335, 358 and 404) according to Lehtosalo-Hilander (1982a: 36). Thus the graves represented a minimum of 95 persons and, taking all possible burials into account, they represented a maximum of 101 persons. Furthermore, archaeologists had already deduced whether the deceased was a man, woman or child from 182 graves. The deductions were made using grave finds and the sizes of grave pits. Of these 182 graves, 64 belonged to men, 48 to women and 33 to children (Lehtosalo-Hilander 1982a: 13, 25-26 1982c: 16-19). The teeth studied here belonged to 34 women, 38 men and 14 children according to Lehtosalo-Hilander. In 11 cases, there was not enough evidence to make a deduction (Lehtosalo-Hilander 1982a: 293-303).

In most cases osteological analysis supports the above results. However, there are five graves in which MNI (Minimum Number of Individuals) estimates show more individuals than expected (namely graves 139, 283, 285, 345 and 359). The MNI estimate based on the teeth from these graves shows that at least two individuals were buried instead of one. It is also possible that, when digging a new grave pit, some teeth from a previous grave ended up in the filling and were misinterpreted as belonging to the new grave. This is probably true for grave 359. Most of the graves have several extra teeth. For example, in grave 345 eleven extra teeth were found, but in grave 283 only one extra teeth was found. Grave 139 shows the remains of two children's teeth under the same find number (NM 18000:2441). The grave was made directly above grave 140 (10-15 cm in between), but there should be a man in grave 140 (Lehtosalo-Hilander 1982a: 132,296). A woman should have been buried in grave 285, but the remains of a child's teeth were also found. Teeth were found from two different find numbers (NM 18000:3268 and NM 18000:3269). The former contains three permanent teeth and one deciduous tooth. They were found on the right side of the woman's head. The grave pit is 100 cm wide (Lehtosalo-Hilander 1982:192). A child was probably buried on the right side of the woman. There were no artifacts that would indicate the presence of a child. Without osteological analysis this child would have disappeared from the records. Graves 283 and 345 should have contained one man, but the remains of two individuals' teeth were found. The teeth in grave 283 were found in three different locations and were given four different find numbers, of which the teeth from numbers NM 18000:3233 and NM 18000:3234 must be from different individuals. The teeth in grave 345 were found in three different locations. Most of the teeth are listed under find number NM 18000:3851 and even all these cannot be from the same individual. Some teeth from find number NM 18000:3852 are also from a (second) different individual than the previous mentioned. This find number was found 40 cm above the burial layer of the grave in a stone setting. Grave 359 should have contained one woman, but again the remains of at least two individuals' teeth were found. The grave was partly destroyed when digging graves 354 and 356 and later when plowing the field (Lehtosalo-Hilander 1982a: 249). The teeth are listed under three different find numbers. Numbers NM 18000:4130 and NM 18000:4131 cannot be from the same individual as number NM 18000:4132. Nor can all teeth from NM 18000:4132 be from the same individual either.

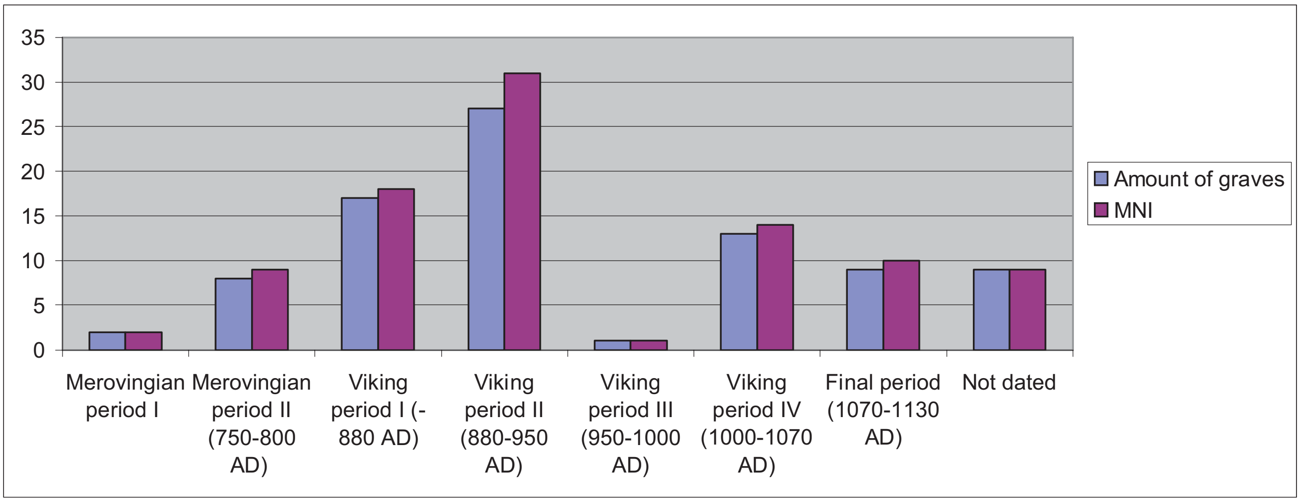
The MNI estimate based on teeth from the assumed double or multiple graves was in six cases one person only, and in three cases two individuals (graves 295, 303, 335). With regard to the possible multiple burial (grave 294) of five people, the MNI estimate shows only the presence of two adult persons, and, since there are no milk teeth in the grave, the presence of the three children indicated by the published sources cannot be proven. However, these observations may not jeopardize the published results, because the teeth could have been lost due to various taphonomical processes. Teeth have been found from ten different find numbers around the grave. In grave 303 all the teeth were found in the same place under the same find number. In grave 335 teeth were found from three different find numbers in three different places. The published estimates of the number of persons are based on archaeological observations such as grave width and grave goods.

Based on the MNI estimates established by this study of the dental material, the 86 graves represent altogether a minimum of 94 individuals.

Women's graves are under-represented in Luistari. It would be interesting to study whether the graves that contained traces of more individuals than expected contain female bones. To do that, a full osteological analysis of all bones would be required. Another possible explanation could be that women died prematurely more often than men, due to conditions leading to hypoplasia (malnutrition, childhood illnesses etc.) as discussed below.

The graves at Luistari have been dated, and can be arranged in a system of seven use-phases or periods: two Merovingian, four Viking Age and one Final (Crusade) period (Lehtosalo-Hilander 1982a). The graves that could not be dated are probably the youngest. The material studied here is dominated by graves from the Viking Age phases, table 1.

Table 1. Numbers of graves and MNI from different periods



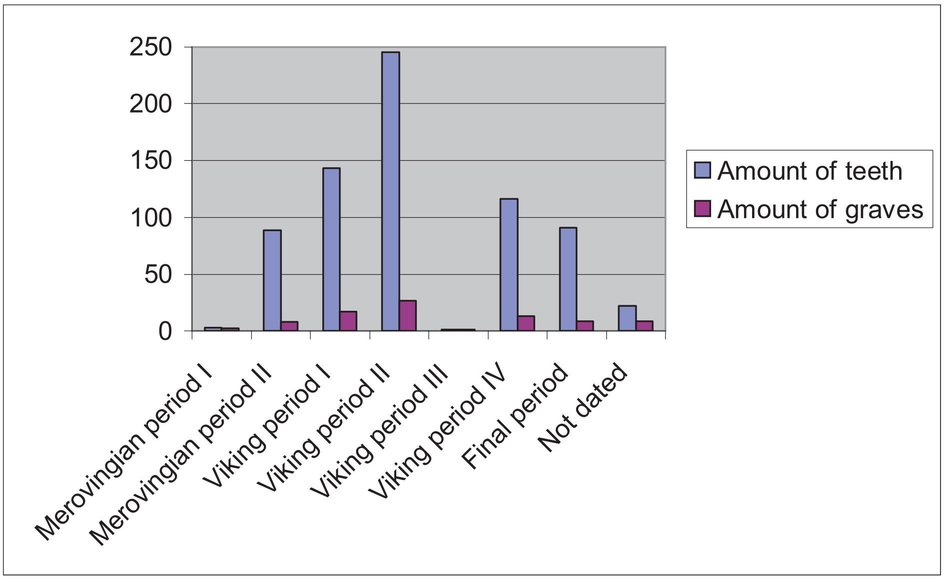
Period	**Number of graves**	**MNI**
Merovingian period I	2	2
Merovingian period II (750-800 AD)	8	9
Viking period I (-880 AD)	17	18
Viking period II (880-950 AD)	27	31
Viking period III (950-1000 AD)	1	1
Viking period IV (1000-1070 AD)	13	14
Final period (1070-1130 AD)	9	10
Not dated	9	9

MNI Minimum number of individuals

Preservation and taphonomy

The bones from skeletons have been poorly preserved, like almost all bone finds in Finland, because the ground is generally acidic. Teeth are the most solid elements of the skeleton and may survive in conditions where other parts of the skeleton have already been destroyed (see below). From 421 graves, only 86 contained dental remains (see Appendix 2 and Appendix 4). A total of 672 teeth were available for the study. Other human bones, excluding teeth and jaws, were found from 52 graves, most of them (from 22 graves) being finger bones (Phalang) preserved inside a bronze ring. Skull bones (Cranium) were preserved in eleven graves. The remaining 19 graves contained also (or only) other post-cranial bones. In addition, 31 graves contained unburned bones, which have not yet been analyzed to determine whether they are human or animal bones. These numbers have been counted from the find list, but, looking at the excavation maps, it seems that many graves showed traces of bones, but probably in such poor condition that they could not be collected. The bones and teeth could not be analyzed "in situ", because at the time of the excavation there were no osteo-archaeologists in Finland. It is of great advantage to be able to analyze teeth directly after excavation (Christophersen 1941a:6).

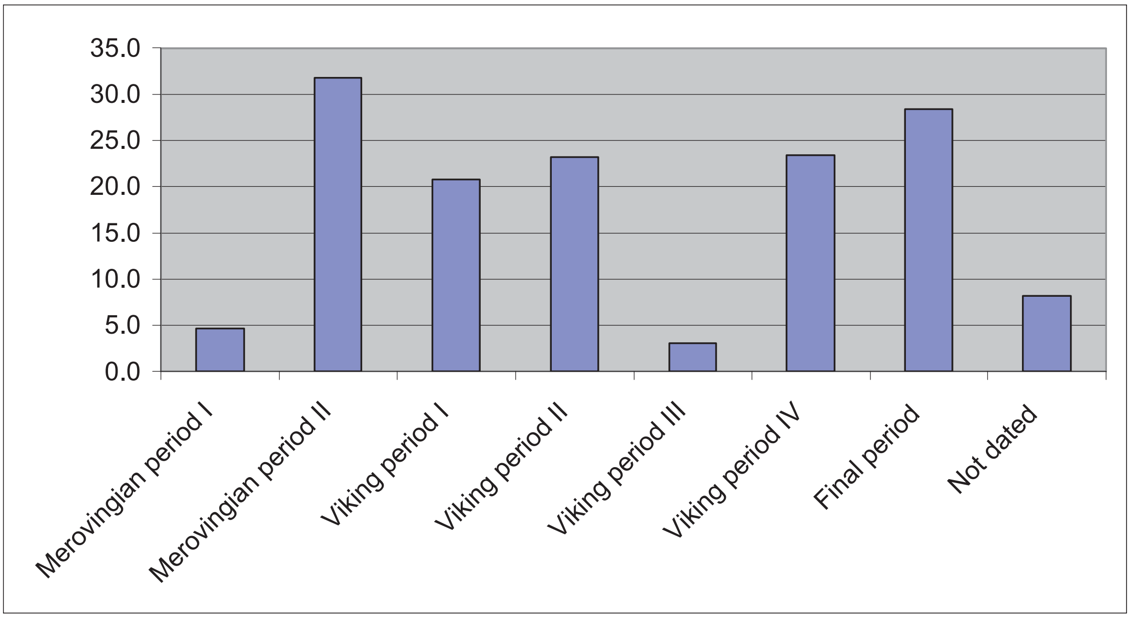
Table 2. Numbers of teeth preserved from different periods



Period	**Number of teeth**	**Number of graves**
Merovingian period I	3	2
Merovingian period II	89	8
Viking period I	143	17
Viking period II	245	27
Viking period III	1	1
Viking period IV	116	13
Final period	91	9
Not dated	22	9

Taking into consideration the occurrence of double graves, the percentage of teeth per person (as estimated by the dental MNI) that have been preserved from different periods can be counted. Graves that include children are here left out, because children have a varying number of teeth according to their specific age class. The highest number of teeth, namely 24 teeth, from one person could be identified in grave 302, a man's grave from the Viking period IV. The percentage of preserved teeth in the material, as compared to the theoretically possible available number, i.e. 32 per adult, is shown in Table 3.

Table 3. Percentage of teeth preserved in adult individuals

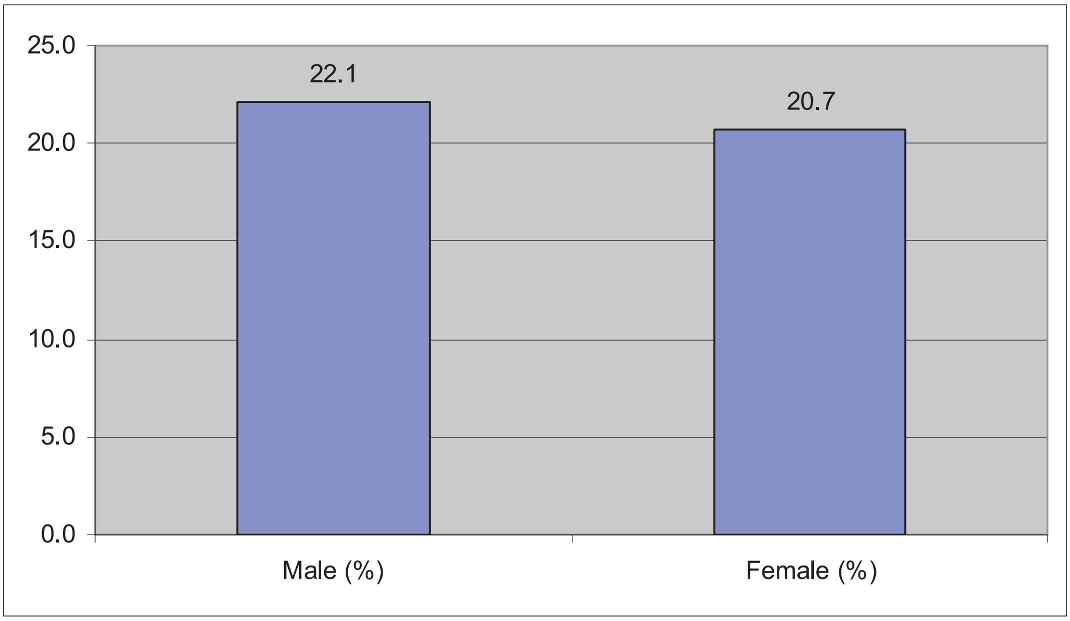


Period	Percentage of teeth preserved
Merovingian period I	4.7%
Merovingian period II	31.8%
Viking period I	20.8%
Viking period II	23.2%
Viking period III	3.1%
Viking period IV	23.4%
Final period	28.4%
Not dated	8.2%

The percentage of preserved teeth does not grow from the earlier to the later periods as might be expected.

When the teeth of men, women or children were counted, material from all double and multiple graves were excluded, unless all represented individuals belonged to the same category - for example, the two men in grave 281. A total of 219 teeth from 31 men were identified, as well as 172 teeth from 26 women, and a further 78 teeth from 10 children. The percentage of preserved teeth in the material, as compared to the theoretically possible available number, i.e. 32 per adult, is shown in Table 4.

Table 4. Percentage of teeth preserved from the graves of males and females.



	Male	**Female**
Percentage of teeth preserved	22.1%	20.7%

It is shown above that only a small part of the dental material has been preserved well enough for identification. Although some of the missing teeth were lost antemortem, many of these teeth and jaws were destroyed and lost postmortem. What has happened to them is called their taphonomic history.

Taphonomic histories have been divided into seven different phases by Lyman (1987:95): mortality factors, pre-burial factors, burial factors, post burial factors, sampling and collection, curation and identification, and publication. After burial, bones can also be re-exposed, transported and redeposited.

In this case, transportation and storage should be added, because the teeth could not be identified in situ or right after excavation.

Part of the Luistari population may have been buried somewhere else. It is possible that some individuals lost their teeth right before death, so that jaws show no signs of the healing process. As the study object is a human tooth, it can be assumed that corpses were buried quite soon after death. Adverse conditions above the ground did not have much time to affect these teeth.

After they were buried, the Iron Age deceased people were not always left to rest in peace. In the later part of the Iron Age in Scandinavia, graves were sometimes opened in order to “wake up” the deceased to help the living, or to use the remains of the deceased to hurt others, especially in the Viking period. Swords and spears were dug up from the graves in Luistari around the year 900 (Pihlman 1997:12). Graves 150, 295 and 320 that contain dental remains were supposedly robbed (Lehtosalo-Hilander 1982c: 20). Older graves were sometimes destroyed in digging up new ones. Teeth were found in the filling of six graves 17, 35, 23, 149, 177 and 230 (Find numbers 1194, 1449, 1284, 2499, 2657 and 3005). Only the remains of one tooth per grave filling were found. These teeth are probably originally from older graves that were destroyed digging these graves. Later cultivation and other human activities in historical times on the site also destroyed some graves near the surface. Ditch digging and removal of stones from the field by explosives have also destroyed graves (Lehtosalo-Hilander 1982a: 15).

According to Lepiksaar (1988: 26), post-burial factors can include tramping on the ground, decalcification in acid soil (although at the same time preservation of the collagen fibers) and the one-way oxidation process. The mechanical, biological and chemical effects of this phase are shown in the Luistari material. None of the jaws were found intact. Not even the lower jaw (mandibula), although it is one of the densest bones in the skeleton. Many times the lower jaw (mandibula) was split in two, as in other Finnish cemeteries. The reason for that could be pressure caused by tramping on the ground, especially if the head had been laid on its side. However it is highly likely that decalcification and micro-organisms have been the most destructive factors in Luistari. For preservation of the animal bones see Tupala (1999)

By weight, dry bone is about 70 per cent mineral and 30 percent organic. The great majority of the organic component is collagen, a protein that forms long fibers. Bone mineral is chiefly hydroxyapatite, a form of calcium phosphate (Mays 1998:1). Enamel is almost entirely composed of inorganic matter, whose chemical composition approximates that of bone mineral (hydroxyapatite) and is arranged in rods or prisms. Enamel lacks a cell structure and, unlike other skeletal hard tissues, is not a living tissue. Dentine consists of about 75 per cent inorganic material and Cements´ composition is like the composition of bone. Both are living tissues (Mays 1998:11). Hydroxyapatite dissolves in acid soil. On the other hand, bacteria destroys collagen in alkaline soil (Cronyn 1990: 227). According to Lindsay (1979: 181-182), hydroxyapatite is relatively insoluble at PH 7.5, but becomes more soluble as PH decreases to 6.5 and is very soluble at PH values below 6 (Mays 1998:17). Water is essential for both chemical and microbiological degradation of bone. The passage of water leaches out the bone mineral, and micro-organisms cannot live without water. Chemical reactions are affected by temperature. The reaction rate approximately doubles for a 10 ◇c rise in temperature (Mays 1998:21). All-in-all, neutral, dry or waterlogged and cold environments are the best for bone survival. In a few cases in Luistari, copper in bronze objects located near the teeth poisoned the micro-organisms and helped to preserve the teeth and bones (Cronyn 1990:22,28). Calciumfosfate in the soil also helps to preserve bone. The depth of the grave pit may also have had an effect in preserving the bones. The soil in Luistari is mainly silt and partly fine sand, as mentioned above, which lets water pass through moderately. Micro-organisms have destroyed the bone collagen in Luistari except near bronze objects. Other factors, such as rodents, should also be taken into consideration. Remains of the skull (cranium) of a water vole (Arvicola terrestris) were found in the filling of grave 76 (NM 18000:1983). It is possible that rodents like these could have gnawed the bones.

Young persons are preserved worse than grown-ups. Old people have fragile bones because of osteoporosis, and their teeth have often fallen out and been destroyed by wear and caries. That is why it is difficult to calculate basic paleodemographical indicators such as child mortality, birth and death rates, generation length, life expectancy, and mean longevity by sex, or to make population pyramids.

Sampling, collection, curation, identification and publication have also affected taphonomy. It is possible that, during excavation, some teeth (such as anterior teeth, as discussed below) are lost. Some teeth may have been in such bad condition, that it is impossible to collect them. Furthermore, assistants may be too effective in cleaning the teeth and may also remove the calculus deposits. Transportation and storage seems to have crushed some teeth, because the number of teeth in the find lists is often more (or in some cases less) than could be identified. Identification and publication always depends on the skills of the osteologist. These skills are dependent on experience and education.

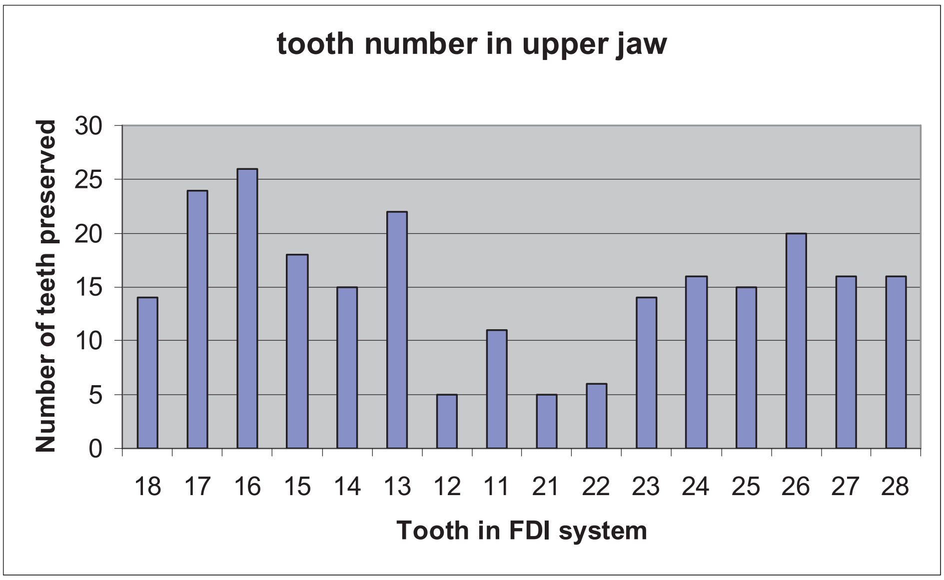
The dental material allowed the identification of individual teeth. They are here presented according to the code of the FDI system (Federation Dentaire Internationelle). Teeth 11-18 are the teeth on the right side of the upper jaw (Maxilla dx.). Teeth 21-28 are the teeth on the left side of the upper jaw (Maxilla sin.). Teeth 31-38 are the teeth on the left side of the lower jaw (Mandibula sin.) and teeth 41-48 are the teeth on the right side of the lower jaw (Mandibula dx.). The numbers in this code system represent the incisors, canines, premolars and molars of the human dentition as follows:

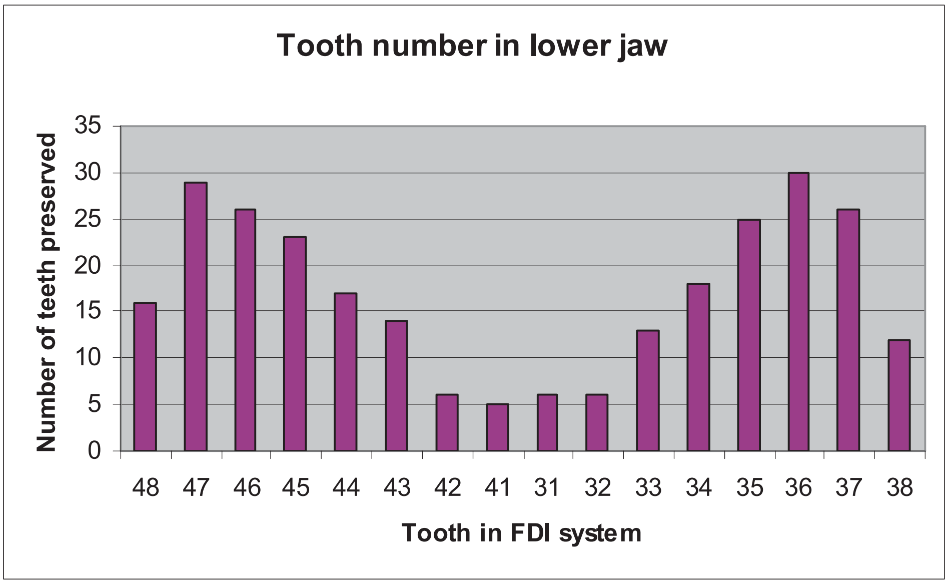
Upper jaw (Maxilla):		**Lower jaw (Mandibula):**	
left (sin.)	**right (dx.)**	**left (sin.)**	**right (dx.)**
11=1I	**21=I1**	**31=I1**	**41=1I**
12=2I	**22=I2**	**32=I2**	**42=2I**
13=C	**23=C**	**33=C**	**43=C**
14=1P	**24=P1**	**34=P1**	**44=1P**
15=2P	**25=P2**	**35=P2**	**45=2P**
16=1M	**26=M1**	**36=M1**	**46=1M**
17=2M	**27=M2**	**37=M2**	**47=2M**
18=3M	**28=M3**	**38=M3**	**48=3M**

I	Incisor
C	Canine
P	Premolar
M	Molar

Table 5 shows that, concerning the permanent dentition, cheek teeth are encountered more often than other types and that a slightly higher number of mandibular teeth has been identified than maxillary teeth.

Table 5. Number of different permanent teeth identified (Coding according to the FDI system).





N	14	24	26	18	15	22	5	11	5	6	14	16	15	20	16	16	243
Tooth	**18**	**17**	**16**	**15**	**14**	**13**	**12**	**11**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**Tot.**
Tooth	**48**	**47**	**46**	**45**	**44**	**43**	**42**	**41**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**Tot.**
N	16	29	26	23	17	14	6	5	6	6	13	18	25	30	26	12	272

Tooth Description of teeth in the FDI system

N Number of identified teeth

Tot. Total number of teeth from maxilla and mandibula respectively

Deciduous teeth were also registered according to the FDI system. Teeth 51-55 are the teeth on the right side of the upper jaw (Maxilla dx.). Teeth 61-65 are the teeth on the left side of the upper jaw (Maxilla sin.). Teeth 71-75 are the teeth on the left side of the lower jaw (Mandibula sin.). Finally teeth 81-85 are the teeth on the right side of the lower jaw (Mandibula dx.). The codes represent the different types of milk teeth as follows:

Upper jaw (Maxilla):		**Lower jaw (Mandibula):**	
left (sin.)	**right (dx.)**	**left (sin.)**	**right (dx.)**
51=1i	**61=i1**	**71=i1**	**81=1i**
52=2i	**62=i2**	**72=i2**	**82=2i**
53=c	**63=c**	**73=c**	**83=c**
54=1m	**64=m1**	**74=m1**	**84=1m**
55=2m	**65=m2**	**75=m2**	**85=2m**

i Deciduous incisor

c Deciduous canine

m Deciduous molar

Table 6. Number of deciduous teeth identified. (Tooth coding is according to the FDI system).

N	4	1	1		2	3			1	3	15
Tooth	**55**	**54**	**53**	**52**	**51**	**61**	**62**	**63**	**64**	**65**	**Tot.**
Tooth	**85**	**84**	**83**	**82**	**81**	**71**	**72**	**73**	**74**	**75**	**Tot.**
N	2		1						2	3	8

Tooth Description of teeth in the FDI system

N Number of identified teeth

Tot. Total number of teeth from maxilla (upper jaw) and mandibula (lower jaw) respectively

This is a small amount of material for studying the preservation of deciduous teeth. However it is obvious that the second molar was the most usual find. It is also the largest of all the deciduous teeth. More maxillary teeth have been identified than mandibular teeth. The reverse was true concerning permanent teeth.

There are several taphonomical reasons for this kind of preservation. It seems that the first 300-400 years from the Merovingian period to the Final period was not as destructive as the last 900 years after it, because the preservation percentages hardly change at all from the first period to the last. The only noticeable differences can be seen in three periods: the Merovingian period I, the Viking period III and the graves that are not dated. The undated graves do not usually have many finds either. This could be explained by a taphonomical reason (differences in the soil, etc.). As the two other periods have only a few graves preserved, the result may be biased. It seems that women's teeth have been preserved slightly worse than men's teeth. It seems that cheek teeth have been preserved better than front teeth. Molars, being the largest of all types of teeth, are probably more durable than smaller teeth and the easiest to find. Molars are better attached to the alveolar bone and do not often fall out of the jaw. Molars are likely to be found near each other.

To minimize taphonomical problems, the osteologist should be on the site to analyze and document bones in situ that cannot be lifted up. This would be most critical when digging closed assemblages, such as graves. If no osteologists are available, a skeletal recording form should be used. First the whole skeleton should be exposed and documented in situ. Then all the surrounding soil should be carefully removed before lifting the bones. Fine sieving should be used, at least for a grave layer. Extra care should be given to temporal bones, because the small ear bones are easily lost. Care should be taken to ensure that teeth will not fall out of jaws. Different individuals' bones should not be mixed. Ideally, bones should be analyzed during or directly after excavation. This is most important with unburned bones and teeth.

4. Methods

The teeth from Luistari were identified with the help of osteological handbooks (Bass 1995, Hillson 1996) and the comparative collections at the Osteo-Archaeological Research Laboratory, Stockholm University. The analysis follows the catalogue system of the National Museum of Finland (NM).

The age estimates for adolescents were based on recent data from dental eruption and development, using the diagram published by Ubelaker (1989). Dental wear is recorded using the numbers code for each individual tooth as described in "Standards for data collection from human skeletal remains" (Buikstra et al. 1994:52-53).

The age of immature skeletons can be estimated from the skeletal development and from the development of the dentition. Teeth have the advantage of being less affected by intrinsic factors such as nutrition and disease (Mays 1998:44).

Dental wear was recorded and used together with information from x-rays to estimate the age of adults. The Miles method was applied to wear. (Miles 1963:191-209) The method is based on the fact that first molars erupt and come into contact approximately six and half years earlier than second molars. Therefore it is possible to calculate how much a tooth has worn in six and half years and make an estimate of the individual's age. All double and multiple graves were excluded to avoid mixing different individual's teeth. However, an exception was made in the case of grave 285 where an approximately 5-9-year-old child was buried with a woman. The child's teeth were found from a different place in the grave than the woman's, and the woman's molars are too well developed to belong to an adolescent. All other graves that had both the first and the second molar preserved well enough are included in the study. If there was more than one first molar preserved (or respectively a second molar) the mean value of wear from these teeth was used in the calculations.

X-rays of the teeth were taken in the Department of Forensic Medicine at the University of Helsinki, as this opened up the possibility to do a more specific analysis of age and pathology. The X-rays will be later given to the National Board of Antiquities to be available to other researchers for future research. Kvaal's method (Kvaal et al. 1995:175-185) was applied to the radiographs. Only complete teeth were chosen for the study. The method is based on secondary dentine apposition by measuring the size and shape of the pulp chamber from dental radiographs. Kvaal's method is also suited for archaeological purposes, although it was developed mainly for forensic medicine purposes. Compared to other similar methods, it has the advantage that it does not require thin sectioning. That would destroy the tooth and one of the goals of archaeology is to preserve the items studied. Taphonomical processes do not destroy or change the size and shape of the pulp chamber as much as other age-related changes also used in age assessment (for example, color and root translucency).

Pathologies were noted as absent or present when observed by the naked eye and identified in accordance with osteological and paleopathological references (Hillson 1996, Brothwell 1981, Iscan et al. 1989). The severity and placement of caries, hypoplasia, calculus, periodontal disease and abscesses should also be measured or classified according to standards (Buikstra et al. 1994:54-58, Lukacs 1989: 261-286). From the measurements of hypoplasia, researchers can estimate the approximate age at which the individual was stressed – usually at six-month intervals (Scott et al. 1992: 195). It is debatable whether x-rays should be used to observe caries. According to Rudney, Katz and Brand, who studied the inter-observer reliability of scoring dental caries, visual inspection is the most reliable method for caries in skeletal populations (Rudney et al. 1983, see Varrela 1991:554). However, Olsson et al. found a number of small cavities only on radiographic examination (Olsson et al. 1976:17). An exclusively visual examination of caries was used in order to be able to compare results with the caries rates of Scandinavian and other spatially and temporally close populations. X-rays were used to find new types of pathologies which are not possible to observe by the naked eye. Pathology alone might give hints regarding an individual's health status. Pathology may also give some indications of the composition of the diet.

Three measurements of the teeth were taken: the crown height and the buccolingual and mesiodistal diameters. These measurements are described in “Standards for data collection from human skeletal remains”(Buikstra et al. 1994). The teeth were measured only once (disregarding inter- and intra-observation errors) because the material was in a fragile state and could break easily. The teeth were measured in three dimensions according to osteological standards, thus enabling other researchers to compare their results with my data and vice versa. These applied measurements are easy to perform and can be taken using only a sliding caliber. Measuring crown morphology would demand special technical equipment, which presently is not available. In comparisons, teeth from the left and right sides of the jaws were combined. In previous studies, no significant difference was reported between the sides (see for example Lunt 1969: 29). Only slightly worn teeth were measured, because it has been shown that heavy amounts of wear decrease crown diameters (Sagne 1976: 100).

Measurements of the teeth from Luistari were compared to the modern, worldwide distribution of tooth size. For the comparison three different calculations were made. Summary tooth size (TS) is the sum of the cross-sectional areas (MD x BL) of all 16 tooth classes (for example, UI2, LM1, UC). Midsex mean tooth size was also computed from the averages of female and male teeth. Some researchers have preferred summary tooth sizes not including incisors and third molars. Therefore it had to be calculated, too.

The tooth size of different individuals was compared with the estimated sex and the size of the grave pit to see if there was a correlation. Because a correlation was found between the sex and size of teeth, the sex of some of these individuals was estimated, based on the average tooth sizes of men and women. All individuals that had at least one measurable permanent tooth preserved were included in the study. If the tooth sizes of two or more teeth showed values above the mean tooth size of men, and no values below the average tooth size of all individuals, an individual was estimated as being male. If the tooth size of two or more teeth showed values below the mean tooth size of females, and no tooth had closer values to men’s average tooth size, an individual was estimated as being female. If the values were between the mean female tooth size and the average tooth size of all teeth, an individual was estimated as being possible female. And vice versa for men.

Non-metrical variations were noted according to “Scoring procedures for key morphological traits of the permanent dentition” (Turner et. al. 1991:13-31), the so-called ASU system (Arizona State University). The worldwide distribution of the traits was also presented (Scott et. al. 1997). Dentist Eeva-Maija Maula, who is preparing her doctoral thesis on non-metrical traits, was also consulted when in doubt. The inter- and intra-observer errors for this method have been reported to be 6-10% and 6-7% respectively (Scott et al. 1997:71). The most difficult traits to score are the marginal accessory tubercles of the upper first premolar, the anterior fovea of the lower first molar, the tuberculum dentale of the upper anterior teeth, and the distal accessory ridge of the upper and lower canines (Scott et al. 1997:72).

Some types of non-metrical traits used in the scoring procedures for key morphological traits of the permanent dentition (Turner et al 1991:13-31) were excluded from the study. Some of them are connected to pathologies and were discussed in the previous chapter (tooth status, caries, abscessing and periodontal diseases, crown chipping). If there had been signs of cultural and other treatment, they would have been treated in a different chapter as well. Most traits of alveolar bone or requiring alveolar bone have been left out, because the jaws are poorly preserved (winging, torsomolar angle, palatine torus, mandibular torus, rocker jaw, temporo-mandibular joint damage). All other traits were studied and are listed in this chapter. Some traits do not occur in the Luistari material, but the recording of absence (how many there could have been) is considered important. Traits are compared to the worldwide distribution, whenever comparative figures are available. In looking at the comparisons it should be kept in mind that the percentages from the Luistari material are derived from single teeth, while the percentages of modern populations are derived from individuals. Therefore, the Luistari material can have more than one score of a trait from the same individual. The occurrence of a trait is described in the number of teeth that carries the trait. The study also shows the occurrence in percentages out of the total number of teeth and the graves these come from.

Later, some of the most frequently scored traits were compared to previous studies in Scandinavian, Baltic and Russian research in dental anthropology. Percentages were calculated for the purpose of comparison (see appendix 6). The percentages show how many teeth, from all the teeth preserved well enough for the study, possessed the trait. These traits are genetically determined and, by employing distance statistics, they can be used to estimate relative degrees of similarity among groups that have diverged from common ancestors many hundreds or thousands of years in the past (Scott et al 1988:99-126). An attempt was made to group individuals who have the most similar dental traits in order to find relatives among the individuals buried. The recorded dental traits were fed to an SPSS statistics computer program and a cluster-analysis was attempted (two-step cluster analysis).

5. Analysis

5.1 Age

The following estimations of the age of adolescent individuals are based on the dental eruption and development diagram published by Ubelaker (1989).

According to previous investigations, eleven graves contained at least one child, namely graves 41, 139, 290, 294, 303, 313, 321, 333, 335, 393 and 401. Grave 294 was determined to be a multiple burial of two women and three children and grave 335 was determined to be a double grave of one woman and one child.

No proof was found in this investigation for the presence of children in five of these graves, namely 273, 294, 303, 321 and 401. The teeth found could have been from children as well as from adults. All the other graves proved to be the graves of children. One grave, number 139, proved to be a double burial of two children. In addition, graves 51, 62 191 and 285 contained teeth from children. Grave 285 is a double burial of a woman with a child, and not as previously assumed the grave of one woman only. Graves 62 and 191 were determined to be the graves of women, but both women were only about 15-21 years old. Grave 51 was supposed to be the grave of a man, but there is a possibility that the person buried was only about 5-7 years old.

Table 7. Estimated age of the adolescent individuals.

Grave no.	Estimated age
41	4-10
51	5-7
62	15-21
139 a	1-2
139 b	2-4
191	15-21
285a	5-9
290	4-5
313	6-11
333	Under 11
335	3-15
393	Under 11

The estimated age of all adolescent individuals is shown in table 7.

Based on wear, it was possible to estimate 15 individuals' age using Miles' method. Miles' method is based on the idea that first molars erupt and come into contact with the opposite teeth 6.5 years earlier than second molars. It was not possible to estimate five individuals' age using the method, because in three cases the second molar had been worn more than the first (graves 98, 319 and 358) and in three cases the first and second molars showed similar wear (graves 301, 313 and 346). However, grave 358 is a double or multiple grave according to Lehtosalo-Hilander (1982a: 36) and grave 313 was determined earlier in this research to belong to an approximately six to eleven years old child. The teeth are also only slightly worn. Slightly worn teeth support the idea of the person being near the age when the first and second molars erupt. The man in grave 301 is probably at about the same age, because the molars have only slightly worn. The following estimates are more inaccurate than the estimates of adolescent individuals and should be treated only as guidelines.

Table 8. Estimated age of the individuals based on wear.

Grave no.	Estimated age
62	42
73	24
135	20
191	22
208	23
273	22
280	35
285b	34
302	44
323	22
325	20
331	17
352	17
356	18
390	36

The mean age (26 years) and the age of the oldest individual (44 years) seem to be low. This may be explained by taphonomy. Teeth that are heavily worn also break down more easily. In my material, not a single molar could be identified where wear had proceeded below the enamel-cementum junction.

Using Kvaal's method (Kvaal et al. 1995) it was possible to estimate age from nine teeth. These teeth came from six graves. Among these graves there are two double graves (graves 345 and 359).

Table 9. Estimated ages based on Kvaal's method and comparisons to other estimates.

Grave no.	Find no.	Age in years	S.E.E. (years)	Miles	Ubelaker
62	1889:3	36	11	42	15-21
191	2754:1	16	9,5	22	15-21
191	2754:2	14	10	22	15-21
302	3494:11	64	10,5	44	
345	3851:22	28	11		
359	4132:3	30	11		
359	4132:16	34	10,5		
359	4132:17	48	10,5		
390	4440:11	37	10,5	36	

Grave no. Grave number

Find no. Find number

Age in years Age in years determined using Kvaal's method (Kvaal et al.1995)

S.E.E Standard error of estimation in years using Kvaal's method

Miles Age in years determined using Miles method (Miles 1963)

Ubelaker Adolescent individual's age in years determined using Ubelaker's diagram

Graves 62 and 191 were included in the study even though these individuals were earlier determined to be adolescent, approximately 15-21 years old. Comparing all three methods, it seems that the age of young individuals is younger using this method and older using the Miles method. It also seems that the opposite pattern applies in the case of older individuals. Using this method, ages tend to be older than they are with the Miles method, at least in graves 302 and 390. I think it would be worth studying whether these observations are correct or whether it is just a coincidence. Grave 359 is a double grave of two women. However two teeth (find numbers 4132:16 and 4132:17) come from the same individual, because they are still in the same jaw.

Table 10. Age as estimated by these three different methods compared to period, sex, pathology and relative wealth of the deceased individuals.

Age Ubelaker	Age Miles	Age Kvaal	Grave No.	Period	Sex	Pathology	Wealth
1-2			139a	Viking II		Hypoplasia	48?
2-4			139b	Viking II			48?
4-5			290	Viking IV		Hypoplasia, caries?	21
5-7			51	Viking I			52
4-10			41	Viking I		Hypoplasia	8
5-9			285a	Viking II			30?
6-11			313	Viking I			5
Under 11			333	Meroving II			
Under 11			393				
15-21	42	36	62	Viking II	Woman	Calculus, trauma, resorption	113
15-21	22	14/16	191	Viking I	Woman	Calculus, trauma, resorption	27
	17		331	Meroving II	Man	Hypoplasia, trauma	
	17		352	Meroving II	Woman	Calculus, hypoplasia, trauma	
	18		356	Final period	Woman	Calculus	
	20		135	Viking II	Man	Calculus, hypoplasia, resorption, trauma	61
	20		325	Viking II	Man	Calculus, hypoplasia, trauma	99
	22		273	Viking I		Calculus	
	22		323	Viking II	Man	Calculus, trauma	18
	23		208	Viking IV	Man	Calculus, hypoplasia	102
	24		73	Viking I	Woman	Calculus	39
		28	345	Final period	Man	Calculus, hypoplasia, resorption	
	34		285b	Viking II	Woman	Calculus, trauma	30?
	35		280	Viking II	Man ?	Calculus	46
	36	37	390	Viking II	Woman	Calculus, hypoplasia, trauma	72
		30/34/48	359	Viking IV	2 Women	Calculus, hypoplasia, resorption, AMTL, aabscess	105?
	44	64	302	Viking IV	Man	Calculus, resorption, trauma, caries	19

Age Ubelaker Adolescent individuals' age in years determined using Ubelaker's diagram

Age Miles Age in years determined using Miles method (Miles 1963)

Age Kvaal Age in years determined using Kvaal's method (Kvaal et al.1995)

Grave No. Grave number

Period Period the grave is dated to

Sex Sex estimation based on grave goods (Lehtosalo-Hilander 1982a: 293-303)

Pathology Pathological conditions as described above

Wealth Relative wealth in units as estimated by Lehtosalo-Hilander (1982c: 41-43)

Table 10 shows no clear connections between age and period, age and sex, nor age and relative wealth. However it shows some connection between age and different pathologies, as would be expected. Calculus was found from all except one individual, whose estimated age is over 15 years. Trauma and resorption have also been found only from persons whose estimated age is over 15 years. Ante mortem tooth loss and abscesses are common in old individuals. Also caries is more common in older individuals. Two individuals estimated to be the oldest in this diagram have suffered from these pathologies. It would be worth studying how pathologies could be used in age estimation.

5.2. Pathologies

Eight different types of pathologies were observed. The most common pathological conditions were *calculus, hypoplasia, trauma* and *resorption*. Less common conditions were *caries, abscess, ante-mortem tooth loss* and *hypercementosis*. Also new types of pathologies were found with the information from x-rays.

Calculus

Driessens and Verbeeck describe calculus as follows: "Calculus is a mineralized plaque, which accumulates at the base of a living plaque deposit, and it is attached to the surface of the tooth. The mineral is deposited from plaque fluid, but ultimately derives from the saliva" (Driessens and Verbeeck 1989, quoted from Hillson 1996:255).

Picture 1. Calculus on a molar.

The most common condition observed in the material was calculus. It occurred on 154 teeth. Occlusal calculus was observed on three teeth indicating ante mortem tooth loss in the opposite jaw. Unfortunately none of these jaws were preserved.

Although calculus was still seen on many Luistari teeth, it may have been even more common, because it easily detaches from the enamel, for example, during excavation or when cleaning the finds. Usually, however, osteologists can determine whether it has been on the tooth, through observations of small residual parts left or by observing a different coloring of those parts of the teeth which have been under the calculus. The occurrence of dental calculus in agricultural societies has been observed to be high compared to hunter-gatherer societies (Lukacks 1989:276).

Hypoplasia

“Enamel hypoplasia is the term applied to a defect in the structure of the tooth enamel resulting from a body-wide, metabolic insult sufficient to disrupt ameloblastic physiology. The enamel lesion has been called a biological window through which one can observe the long-term consequences of metabolic stress, providing a record from which investigators may infer the time at which the hypoplasia formed and therefore the time of the stressful event that caused it" (Goodman and Armelagos 1988, as quoted by Langsjoen 1998:405, Alexandersen et al. 1998:14-16).

"Hypoplasia is known to be associated with a wide variety of disorders, including rickets, scurvy, measles, smallpox, vitamin A or D deficiency, diabetes, birth injury, diarrhea, allergies, congenital defects, neonatal hemolytic anemia, maternal rubella, syphilis and fever" (Hillson 1996:165-166). A high occurrence of hypoplasia is typical for societies with an agricultural economy (Lucaks 1989:276). Iregren et al. found that conditions leading to hypoplasia affect the height of the person involved as measured from the femur (Iregren et al 1993:107-110). Another stress indicator, Harris lines (growth arrest lines) are transverse lines of radiodensity at the ends of long bones (Aufderheide et al. 1998:422). Enamel hypoplasia leaves permanent traces of childhood stress, while bone remodeling can wipe out signs of Harris lines.

Picture 2. Two rows of hypoplasia can be seen in this tooth.

Hypoplasia was found in 71 teeth. This phenomenon indicates stressful periods during childhood (disease or a lack of nutrition). It is usually found in incisors and canines, but also in premolars and molars. At Luistari, cheek teeth are better preserved than front teeth, so hypoplasia may be under-represented here. Because both the central maxillary incisors and canines represent hypoplasias, they have been formed both before the age of 3 and also after it (Huss-Ashmore et al. 1982:445).

Trauma

Similar ante mortem enamel injuries were found in several teeth from Luistari. Most of them were situated in the borders of the occlusal surface, irregular in shape and around one mm in width, depth and height. They are too irregular to be carious lesions. They were so similar, that they are most likely caused by the same activity. Trauma was found in all tooth types from incisors to molars. Trauma was significantly correlated with Calculus and periodontitis (see appendix 8).

Trauma has affected 46 teeth. Unfortunately it is not possible to infer why little pieces of enamel have been lost during the life of many of these people. Maybe their food comprised unwanted small parts of millstones and sand or maybe they used their teeth in biting some hard material (As for example nutshells). When using millstones, sand particles can have ended up in the flour (Lehtosalo-Hilander 2000b:266). Also nutshells have been found from Luistari graves (Lehtosalo-Hilander 2000b:268). However trauma was significantly correlated with calculus. Thus it is more likely that flour with millstone particles, causing plaque accumulation and calculus, was also the cause of trauma.

More information on how teeth have been used could be obtained by conducting microwear research (see for example Hillson 1996:243).

Caries

“Dental caries is a multifactorial, multibacterial disease of the calcified teeth tissues, characterized by demineralization of the inorganic portion and destruction of the organic component. It is both infectious and transmissible. Caries is a progressive disease in that a continuation of the same environmental conditions that induced the lesion will inevitably complete the destruction. Though odontoplasts lining the pulp chamber wall can produce secondary dentine in response to the effects of attrition as well as caries, the absence of formative cells or vessels within enamel and dentin preclude the healing or replacement of tissue destroyed by a carious lesion” (Langsjoen 1998:402). “Untreated caries can give rise to potentially lethal complications” (Mays 1998:148). A low occurrence of caries is typical for hunter-gatherer economies (Lukacs 1989:276).

Picture 3 Large caries cavity in molar.

Caries was found in 12 teeth only. Caries has probably been more common, as it is detrimental to the preservation of the affected teeth. Caries may lead to ante mortem tooth loss intentionally (pulling out teeth that hurt) or unintentionally. Teeth with large cavities are also more likely to suffer from mechanical damage, for example during excavation. Caries is found more usually in cheek teeth than in front teeth. As we recall, in this material, cheek teeth were encountered more often than teeth from the front of the jaw, so this cannot explain the small number of caries cavities found.

Picture 4 Caries in cement-enamel junction.

Caries in the cement-enamel junction was observed in two teeth. Both cement and enamel (root and crown) were affected in both teeth. Root caries usually occurs in older individuals. In Medieval and Prehistoric times root caries was more common than today (Scott et al. 1988:115). In this material it must be under-represented because the roots of the teeth are only rarely preserved.

Hypercementosis

Hypercementosis is usually a consequence of periapical periodontitis, or may affect isolated functionless teeth. Paget's disease of bone may be complicated by hypercementosis (Scully et. al. 1996:178).

Severe hypercementosis was observed in four teeth, all from the same grave. A diagnosis of the underlying diseases would have required that the alveolar bone had been preserved.

Diseases of the alveolar bone

In a few rare cases the alveolar bone has been preserved and in a few instances pathologies were observed, namely resorption of the alveolar bone, probably due to periodontal disease for 41 teeth, ante mortem tooth loss in five cases and abscesses (or inflammatory periapical cavities) in three cases. As mentioned before, occlusal calculus was observed in three cases indicating ante mortem tooth loss in the opposite jaw.

Picture 5. Ante mortem tooth loss due to an abscess (inflammatory periapical cavity).

Picture 6.Example of ante mortem tooth loss.

Periodontitis is a chronic, slowly progressive and destructive inflammatory process affecting one or more of the four components of the periodontium (Burnett and Schuster 1978:213 as quoted by Langsjoen 1998:400-401). Resorption can be caused by the presence of high amounts of calculus, because calculus irritates gingiva and causes inflammation (periodontitis). Inflammation causes resorption. Calculus is common in the Luistari material, so it is natural that also resorption is relatively common.

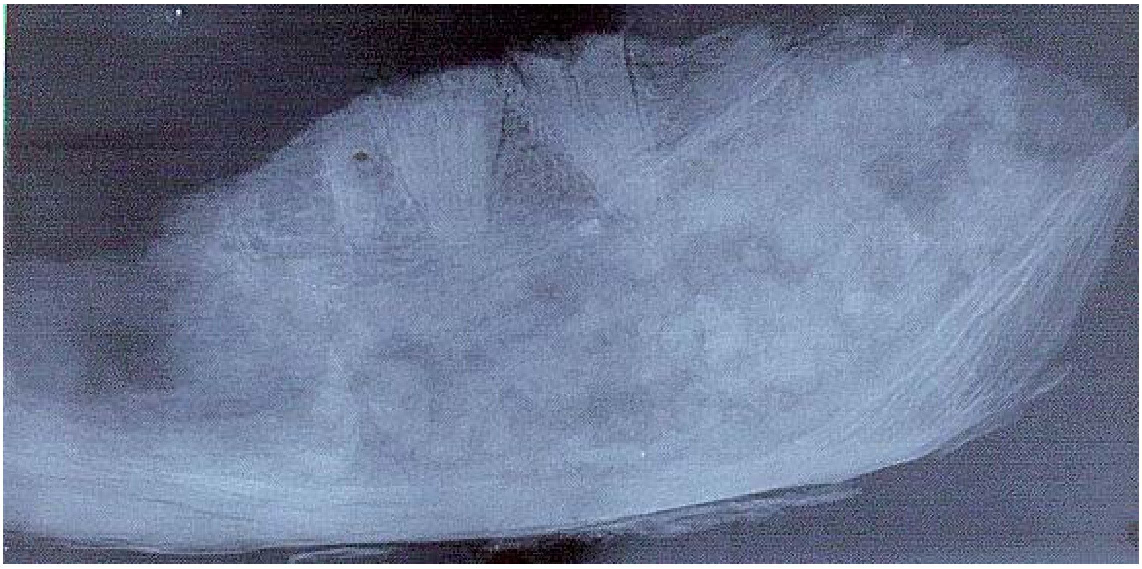
Teeth can be lost ante mortem due to various reasons: intentional pulling (usually because of a disease), trauma and diseases (for example caries, periodontal disease etc.).

The abscess forming at the tooth root is an extension of the bacterial infection of acute pulpitis (Langsjoen 1998:408).

Observations from x-rays

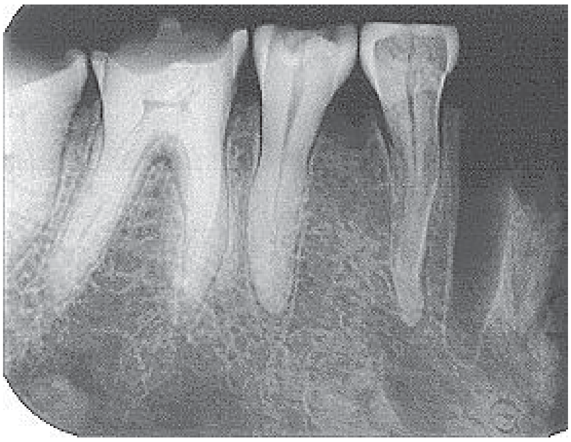
X-rays were mainly taken for the purposes of age determination. However after taking the x-rays, a Professor in Radiology, Juhani Wolf, was consulted. He was kind enough to give the following statements about the new types of pathologies observed. The types of pathologies as described above were not searched for from the x-rays.

One observation is from grave 95, which is a woman's grave from Viking period I. The observation was made from a part of the mandibular corpus (find number 2095:1-4) from the area of teeth numbers 35-38. Abnormal bone structure was found. There are rounded condensations from one to seven millimeters in diameter. Taphonomical reasons are unlikely. Possible causes are: *Fibrous dysplasia, Paget's disease, osteosarcoma* or *familial adenomatosis coli.* Histopatological research could reveal the cause. Fibrous dysplasia is a common, idiopathic arrest of bone maturation resulting in localized foci of fibrous tissue (Aufderheide et al.1998: 420). Paget's disease is a bone lesion of unknown etiology characterized by a profound increase in both bone resorption and new bone formation (Aufderheide et al. 1998:413) and it is a disease of elderly people. Osteosarcoma is the most common primary malignant bone tumor (Lindqvist et al. 1986:759). Familial adenomatosis coli is an autosomally dominant inherited condition leading to colorectal carcinoma at the mean age of about 40 years (Wolf et al. 1986:410).



Picture 7. Abnormal bone structure seen in x-ray. (Grave 95)

Also from grave 404, a double grave from the final period, one condensation in alveolar bone is found (idiopathic osteosclerosis). It is also a part of the mandibular corpus (find number 4592:16-20) from the area of teeth numbers 43-47. Several condensations would imply familiar adenomatosis coli.



Picture 8. Condensation in alveolar bone seen in x-ray (Grave 404)

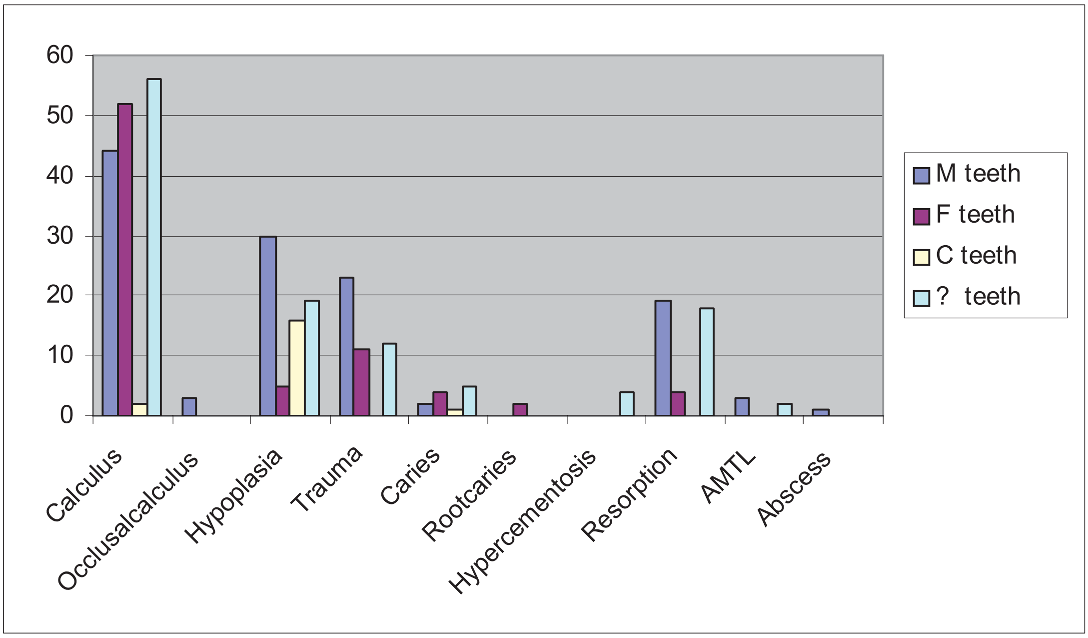
From grave 293 an additional condensation in the alveolar bone is found (find number 3381:3-5). The grave has not been dated, but the person in the grave is an adult, based on the development of the molars. Near the root of tooth number 47 there is a condensation from six to seven millimeters in diameter. An even more concrete layer surrounds the condensation and the same kind of layering is visible inside the condensation. This is most likely caused by periapical cement dysplasia, which is a disease of middle-aged or older women. It could also be caused by fibroma.

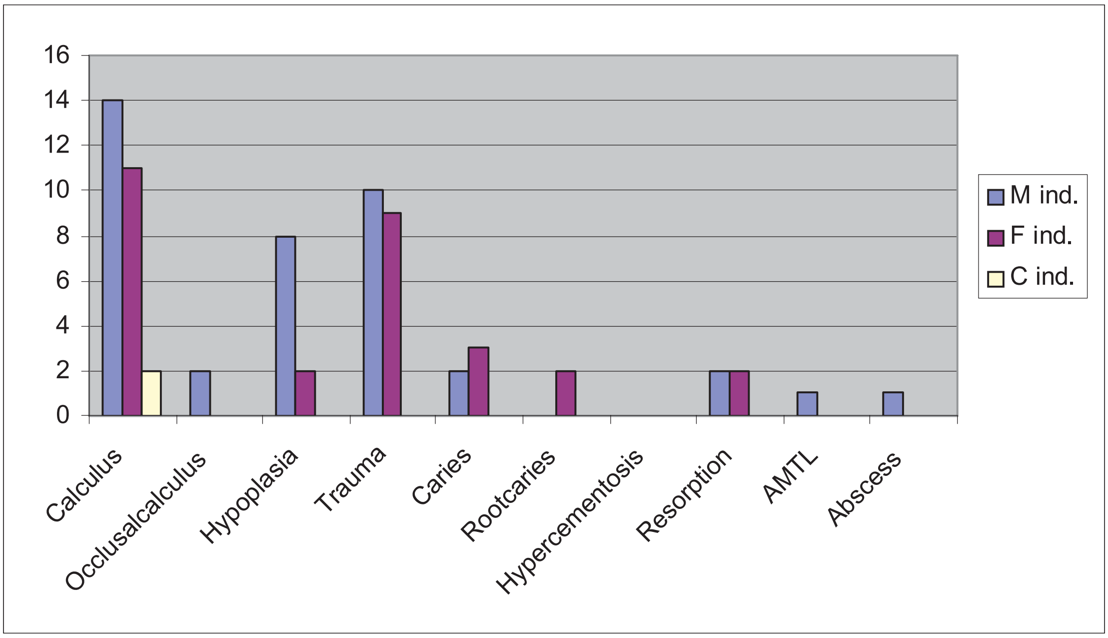
Picture 9. Condensation in the alveolar bone seen in x-ray. (Grave 293)

Summary of pathologies

The following tables, 11-12, summarize the occurrence of the pathologies in graves belonging to men, women or children. Mixed burials (i.e. those where more than one of the three groups is represented) are included in a separate column. Both the number of teeth and the number of graves where pathologies occurred are listed. Double and multiple graves are included. This explains why the number of individuals can vary. If, for example, in the same grave there were two persons and three instances of calculus, it would be marked as 1-2 individuals and 25-50%.

Table 11. Pathologies observed in men, women and children. Both the number of teeth and the number of persons affected by the pathology are presented.





Disease:	M teeth	M ind.	F teeth	F ind.	C teeth	C ind.	? teeth	? ind.	tot. teeth	tot. ind.
Calculus	44	14	52	11	2	2	56	11-17	152	37-43
Occlusalcalculus	3	2	0	0	0	0	0	0	3	2
Hypoplasia	30	8	5	2	16	3	19	7-10	70	20-23
Trauma	23	10	11	9	0	0	12	7-11	46	26-30
Caries	2	2	4	3	1	1	5	4	12	10
Caries in CEJ	0	0	2	2	0	0	0	0	2	2
Hypercementosis	0	0	0	0	0	0	4	1	4	1
Resorption	19	2	4	2	0	0	18	4-6	41	8-10
AMTL	3	1	0	0	0	0	2	1-2	5	2-3
Abscess	1	1	0	0	0	0	2	2	3	3

M Male

F Female

C Child

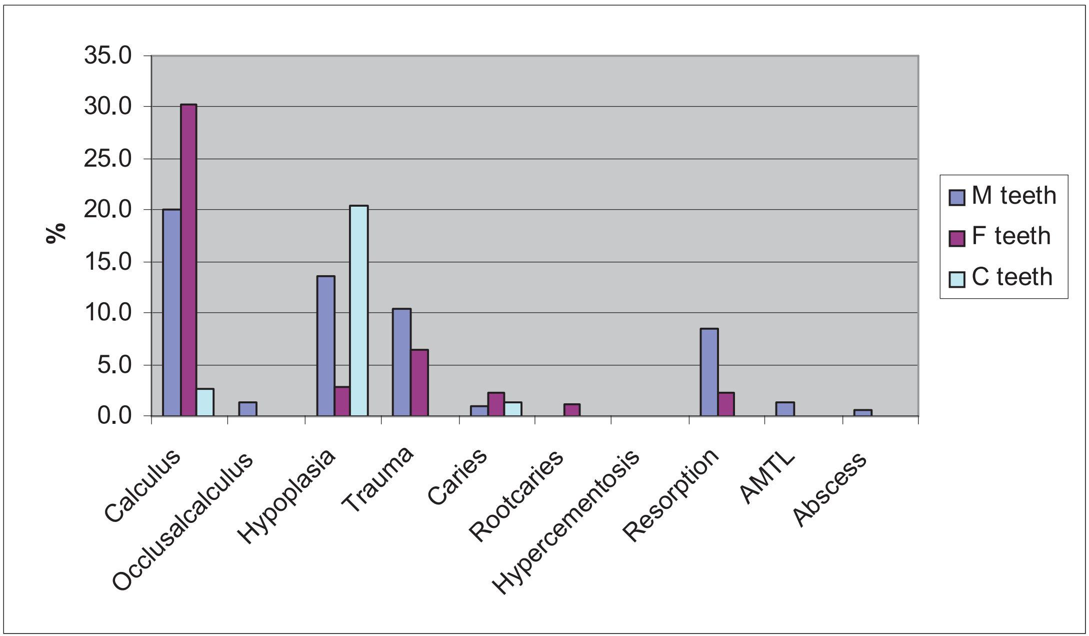
? Sex and age unknown

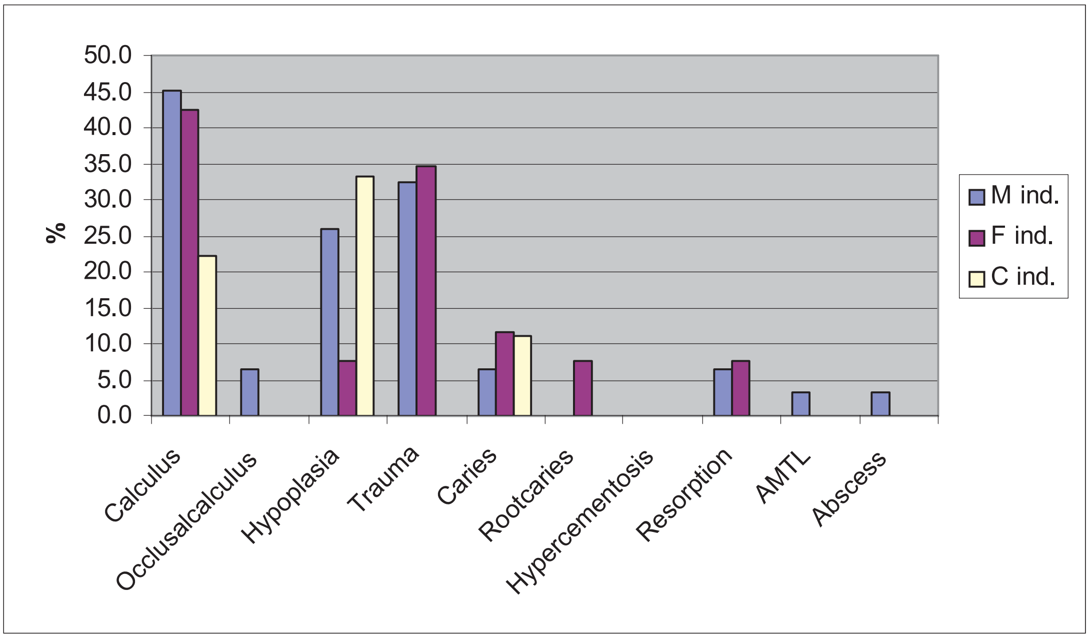
teeth Number of teeth affected

ind. Number of individuals affected

tot. Totally

Table 12. Percentage of pathologies observed in men, women and children. Both the frequency of occurrence in the teeth (in percent of all teeth in the group) and the frequency of occurrence in the individuals (in percent of all individuals in the group) are presented.





Disease:	M teeth	M ind.	F teeth	F ind.	C teeth	C ind.
Calculus	20.1%	45.2%	30.2%	42.3%	2.6%	22.2%
Occlusalcalculus	1.4%	6.5%	0%	0%	0%	0%
Hypoplasia	13.7%	25.9%	2.9%	7.7%	20.5%	33.3%
Trauma	10.5%	32.3%	6.4%	34.6%	0%	0%
Caries	0.9%	6.5%	2.3%	11.5%	1.3%	11.1%
Caries in CEJ	0%	0%	1.2%	7.7%	0%	0%
Hypercementosis	0%	0%	0%	0%	0%	0%
Resorption	8.6%	6.5%	2.3%	7.7%	0%	0%
AMTL	1.4%	3.2%	0%	0%	0%	0%
Abscess	0.5%	3.2%	0%	0%	0%	0%

M Male

F Female

C Child

? Sex and age unknown

teeth Number of teeth

ind Number of individuals

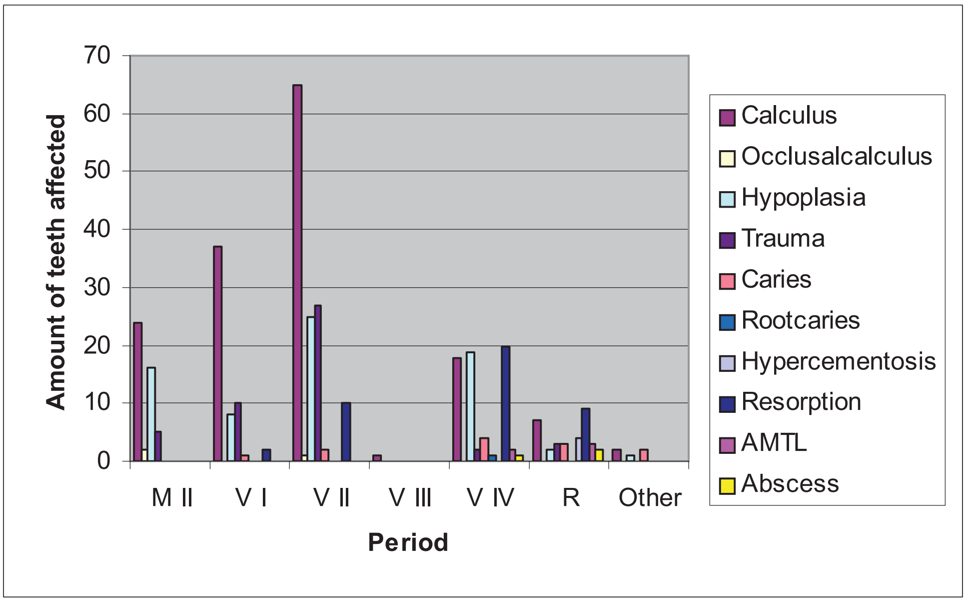
Tot. Totally

The frequencies of the occurrence of different pathologies did not show any marked differences in dental health between women and men. However, although hypoplasias were found to have affected more than a quarter of all men (25.9%), they were only encountered in 7.7% of women. It might appear at first that women had better nutrition and a healthier life during childhood. However, one third of children have hypoplasias and it has not been determined whether they are boys or girls. There is a possibility that the girls suffering from conditions leading to hypoplasia did not make it into adult ages as often as boys suffering from the same.

Caries seems to be more common in women than men. Children seem to have had few dental pathologies, as might be expected, except hypoplasias, which occur quite commonly in children. At least more than one third of the dead children had suffered from conditions leading to hypoplasias. It may not be a surprising result that children who had suffered from serious health problems were prone to die young.

The frequencies of the pathologies in the different time periods are presented in table 13. Both the number of affected teeth and the number, i.e. MNI, for affected individuals are presented. Double and multiple graves are included. This explains why the number of individuals can vary. If, for example, in the same grave there were two persons and three instances of calculus, it would be marked as 1-2 individuals and 25-50%.

Table 13. The occurrence of different pathological conditions through time from the Merovingian period II to the Final period. (The Merovingian period I has been left out because no pathologies were found from the three teeth of that period.) The number of teeth and the number of individuals affected are listed in separate columns.



Disease:	M II	M II Ind.	V I	V I Ind.	V II	V II Ind.	V III	V III Ind.	V IV	V IV Ind.	R	R Ind.	Other	Other Ind.
Calculus	24	4	37	10-11	65	14-16	1	1	18	4-5	7	4	2	1
Occlusalcalculus	2	1	0	0	1	1	0	0	0	0	0	0	0	0
Hypoplasia	16	4	8	3-4	25	9-10	0	0	19	3	2	1-2	1	1
Trauma	5	4	10	7-8	27	11-13	0	0	2	2	3	2-3	0	0
Caries	0	0	1	1	2	1	0	0	4	4	3	2	2	2
Caries in CEJ	0	0	0	0	0	0	0	0	1	1	0	0	0	0
Hypercementosis	0	0	0	0	0	0	0	0	0	0	4	1	0	0
Resorption	0	0	2	2	10	2	0	0	20	2-3	9	2	0	0
AMTL	0	0	0	0	0	0	0	0	2	1-2	3	1	0	0
Abscess	0	0	0	0	0	0	0	0	1	1	2	2	0	0

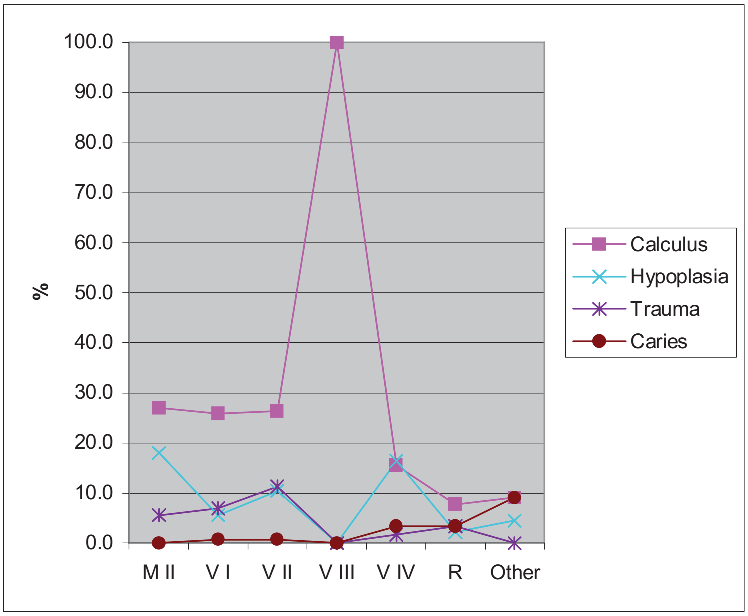
M II Merovingian period II

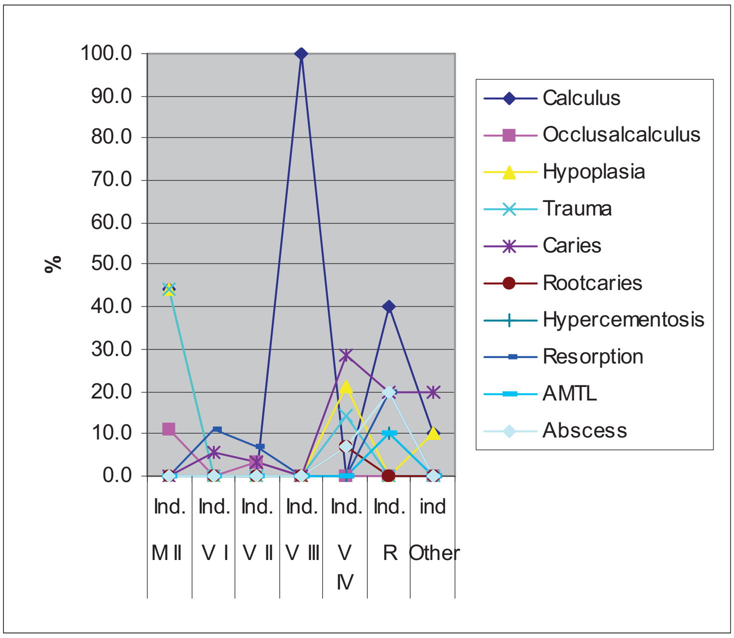
V Viking period (periods I-IV)

R Final period

Ind. *Individuals affected*

Table 14. The frequency of different diseases through time from the Merovingian period II to the Final period. (In percent of all teeth from the period and in percent of all the individuals from the period)





Disease %	M II	M II Ind.	V I	V I Ind.	V II	V II Ind.	V III	V III Ind.	V IV	V IV Ind.	R	R Ind.	Other	Other ind
Calculus %	*27.0*	*44.4*	*25.9*	*55.6-61.1*	*26.4*	*45.2-51.6*	*100*	*100*	*15.5*	*28.6-35.7*	*7.7*	*40.0*	*9.1*	*10.0*
Occlusalcalculus %	*2.2*	*11.1*	*0*	*0*	*0.4*	*3.3*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Hypoplasia %	*18.0*	*44.4*	*5.6*	*16.7-22.2*	*10.5*	*30.0-33.3*	*0*	*0*	*16.4*	*21.4*	*2.2*	*10.0-20.0*	*4.5*	*10*
Trauma %	*5.6*	*44.4*	*7.0*	*38.9-44.4*	*11.3*	*36.7-43.3*	*0*	*0*	*1.7*	*14.3*	*3.3*	*20.0-30.0*	*0*	*0*
Caries %	*0*	*0*	*0,7*	*5.6*	*0.8*	*3.3*	*0*	*0*	*3.4*	*28.6*	*3.3*	*20.0*	*9.1*	*20*
Caries in CEJ %	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0.9*	*7.1*	*0*	*0*	*0*	*0*
Hypercementosis %	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*4.4*	*10.0*	*0*	*0*
Resorption %	*0*	*0*	*1.4*	*11.1*	*4.2*	*6.7*	*0*	*0*	*17.2*	*14.3-21.4*	*9.9*	*20.0*	*0*	*0*
AMTL %	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*1.7*	*7.1-14.3*	*3.3*	*10.0*	*0*	*0*
Abscess %	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0.9*	*7.1*	*2.2*	*20.0*	*0*	*0*

M II Merovingian period II

V Viking period (periods I-IV)

R Final period

Ind. Individuals affected

While the occurrence of dental conditions does not change drastically over time, some minor variations can be seen. Calculus diminishes in frequency from the first periods to the last. The frequencies of hypoplasia and trauma decrease slightly too, but caries increases slightly from the first periods to the last. The Viking III period percentages are misleading, because too few teeth have been preserved.

5.3. Non-metrical traits

The possibilities of using non-metrical traits are described below. Non-metrical traits have not been studied on Finnish prehistoric material before.

Maula describes non-metrical traits as follows: Non-metrical traits are morphological variants of the crown and root structures. Standardized reference plaques have been developed. Non-metrical traits vary between populations, which is why they can be used to research the ancestry of human populations. Evolutionary changes appear quicker in the more distal teeth of every tooth group (Maula 1993:416).

An extensive database, built from studies in many countries on museum material and dental models of living patients, is now available, and has yielded broad morphological groupings that can be interpreted in terms of the migrations and ancestry of human populations (Hillson 1996:289). Optimistically one could try to calculate when two populations differed from each other (Alexandersen 1988b: 28) using dentochronology (Scott et al 1988:104). Brabant (1964) showed that tooth morphology changes very slowly from the Paleolithic up to modern times. There was a tendency towards decreased frequency of shovel-shaped incisors, in molars with 4 cusps in the upper jaw and molars with 5 cusps in the lower jaw. A tendency towards increased frequency was found as to Carabellis tubercle and congenital absence of third molars (Brabant 1964, as quoted by Alexandersen 1988a: 153). The oldest traits are found in most parts of the continent, while other traits develop as an adaptation to the natural environment and subsistence (Zachrisson et al. 1997: 41).

Shoveling

Hillson defined shoveling (1996:86) as follows: In incisors, and sometimes canines, the marginal ridges may be especially prominent and enclose a deep fossa in the lingual surface.

Picture 10. Shoveling.

The frequencies of shoveling are quite low in Europe, as they are in the African and Sahul-Pacific groups, all showing percentages below 20 %. However, the prehistoric occurrence of the trait is bigger in Europe. Sino-Americans, Sunda-Pacific and some Asian groups have more shoveling, all showing frequencies over 20% (Scott et al. 1997:183). Shoveling is in some sources considered to be a primitive character absent or diminuend in modern dentitions (Scott et al. 1997:6-7). Shoveling commonly occurs in Neanderthals and Eskimos – groups that subjected their anterior teeth to pronounced stresses (Scott et al. 1988:107).

A total of 16 upper central incisors from 12 graves showed varying degrees of shoveling. Four teeth (25%) showed no signs of shoveling; five teeth (31.3%) showed faint shoveling (grade 1 in the Arizona State University Dental Anthropology system). Five teeth (31.3%) showed trace shoveling (grade 2 in the ASU system), which is considered by most observers to be a minimal expression. One tooth (6.2%) showed semi-shoveling (grade 3 in the ASU system) and one tooth (6.2%) showed marked shoveling (grade 6 in the ASU system).

The breakpoint in the ASU system is grades 3-6. Two teeth (12.4%) of all the studied teeth belong to that.

Labial Convexity

Turner et al. defines Labial convexity (1991:15) as follows: The labial surface of the upper incisors, when viewed from the occlusal aspect, can range from being essentially flat to showing a marked degree of convexity.

A total of 29 upper incisors from 16 graves were studied. Of these 14 teeth (48.3%) had a flat labial surface, ten teeth (34.5%) had a trace of convexity in the labial surface (score 1 in the ASU system). Five teeth (17.2%) showed weak labial convexity (score 2 in the ASU system).

This trait is inversely correlated with double-shoveling (Turner et al. 1991:15) and therefore is not considered further here.

Double-shoveling

Hillson (1996:88) describes double-shoveling as follows: Some incisor and canine crowns have prominent marginal ridges on their labial surfaces, a condition known as double-shoveling, whether or not strong lingual ridges are also present.

The modern distribution of this trait shows that it is uncommon in Europe and Africa. The frequencies found in the material from Luistari is thus in concordance with these results. The highest frequencies for double-shoveling are found in American Indians (55-70%). It is also quite common in Eastern and Northern Asia and in the American Arctic (20-40%) (Scott et al. 1997:187).

A total of 21 upper central incisors from 15 graves were studied. Of these 18 teeth (85.7%) showed no signs of double-shoveling, three teeth (14.3%) showed faint double-shoveling (grade 1 in the ASU system). The breakpoint of the trait is grade 1.

Interruption groove

Turner et al. (1991:16) defines the interruption groove as follows: Grooves which cross the cingulum and often continue down the root, are occasionally seen on the upper incisors. (More frequently on the lateral incisor than on the central). The morphogenesis of the grooves is not understood, but they seem to be related to the tuberculum dentale.

In Western Eurasian and in the Sunda-Pacific groups the frequency of this trait is 20-40%. In Western Eurasia it has a higher occurrence in Western Europe than in North Africa. In Sub-Saharan Africa and in the Sahul-Pacific it is less common and in Sino-America more common.

The material comprises 11 upper lateral incisors from eight graves. Seven teeth (63.6%) showed no signs of an interruption groove. Two teeth (18.1%) had a medial groove, while one tooth (9.1%) had a groove on the mesiolingual border and another tooth (9.1%) had grooves on both the mesiolingual and the distolingual border. Altogether four teeth (36.4 %) had interruption grooves.

Tuberculum dentale

Turner et al (1991:16) describes tuberculum dentale as follows: This feature occurs in the cingular region of the lingual surface of the upper incisors and canine. This feature can take the form of ridges on the lingual surface or various degrees of expression of a cusp. No attempt to classify this feature has been fully satisfactory and big inter- and intra-observer errors have been found.

A total of 71 upper incisors and canines from 32 graves were studied. Out of these 40 teeth (56.3%) did not have Tuberculum dentale. One teeth (1.4%) had faint ridging in the cingular region (grade 1 in the ASU system), one teeth (1.4%) had trace ridging (grade 2 in the ASU system) and one teeth (1.4%) had strong riding (grade 3 in the ASU system), while 16 teeth (22.5%) had a weakly developed cuspule attached to either the mesio- or distolingual marginal ridge (grade 5 in the ASU system), eight teeth (11.3%) had a weakly developed cuspule with free apex (grade 5 in the ASU system) and four teeth (5.6%) had a strong cusp with a free apex (grade 6 in the ASU system).

Canine mesial ridge (Bushmen canine)

The canine mesial ridge is defined by Turner et al. (1991:16) as follows: Occasionally in upper canines the mesial ridge is larger than the distal, and, in pronounced cases, it possesses a distal deflection approximately two-thirds of the way down from the occlusal surface due to its attachment to the tuberculum dentale.

In the world today, the frequency of this trait ranges from 0% to 35.1%. It is most commonly seen in Sub-Saharan Africa, where the frequency ranges from 12 to 35%. Throughout the rest of the world the frequency is never higher than 10%. In Western Eurasian populations it should normally be from 4 to 7% (Scott et al. 1997:190-191).

A total of 26 upper canines from 22 persons were studied. Of these 19 teeth (73.1%) did not have a mesial ridge. Seven teeth (26.9%) had a slightly enlarged mesiolingual ridge (grade 1 in the ASU system). The breakpoint for the trait is grades 1-3.

At Luistari, the frequency would be similar to Sub-Saharan Africans, but it should be noted that neither the so-called Morris-type forms (grade 3 in the ASU system) nor even grade 2 was found in the Luistari material. It might well be that a different observer would have graded these seven teeth as not having a mesial ridge.

Canine distal accessory ridge

This trait occurs on the distolingual marginal ridge of the tooth (Turner et al. 1991:17). It is one of the most difficult to score (Scott et al. 1997:72). Also this trait shows a pronounced sexual dimorphism with men having significantly higher frequencies and more pronounced expressions of the trait than women (Scott et al.1997:33).

A total of 49 canines from 31 graves were available for the study. Out of these 21 teeth (42.9%) did not have a distal accessory ridge, 16 teeth (32.7%) had a very faint distal accessory ridge (score 1 in the ASU system), 10 teeth (20.4%) had a weakly developed distal accessory ridge (score 2 in the ASU system), one teeth (2.0%) had a moderately developed distal accessory ridge (score 3 in the ASU system) and one teeth (2.0%) had a strongly developed distal accessory ridge (score 4 in the ASU system).

A total of 13 teeth from men's graves were studied as well as 11 teeth from women's graves (the sex estimations are based on archaeological finds according to Lehtosalo-Hilander (1982a: 293-303)). The average score from women's graves is 1.18 and from men's graves 0.77. This study does not show sexual dimorphism as expected.

Premolar mesial and distal accessory cusps

Small accessory cusps are sometimes seen at the mesial and/or distal ends of the sagittal grooves of the upper premolars. These cusps are defined by a strong separation from both the buccal or lingual cusps (Turner et al. 1991:17). This trait is among the most difficult to score (Scott et al. 1997:72).

A total of 53 upper premolars from 26 graves were studied. Out of these 39 teeth (73.6%) did not have accessory cusps and 14 teeth (26.4%) had accessory cusps.

Tricusped premolars

An upper premolar with three cusps represents a rare variant (1:8000 teeth). This trait has been observed in southwestern U. S. Indians but among almost no other populations of the world.

At Luistari, 72 upper premolars from 29 graves were available for study. In one of these teeth (1.4%) the trait probably occurred. The individual had two other upper premolars, but these had only two cusps. This feature has only been seen unilaterally (Scott et al. 1997:39).

The trait should be found only in a totally different part of the world, so it is a rare coincidence to find it among the Luistari population. However it is just one tooth and drawing any further conclusions based on just one incidence is considered speculative.

Picture 11. Probably a tricusped premolar.

Distosagittal ridge (Uto-Aztecan premolar)

A distosagittal ridge occurs when a pronounced ridge from the apex of the buccal cusp extends to the distal occlusal border at or near the sagittal sulcus (Turner et al. 1991:18).

The trait was originally discovered among Uto-Aztecan speaking peoples of the southwestern United States. Now known to occur in many other Amerindian populations, but nowhere else in the world (Turner et al. 1991:18).

A total of 31 upper first premolars from 18 graves were studied. None of these had a distosagittal ridge. This can be explained by the world-wide distribution.

Metacone

Hillson (1996:88) explains Metacone (distobuccal cusp) variations as follows: The distobuccal cusp is normally prominent in upper molars but occasionally it may be reduced, or absent, particularly in third molars.

A total of 122 upper molars from 45 graves were studied. In the Luistari material, metacone was absent in one tooth (0.8%) (Grade 0 in the ASU system). Faint ridging was found in two teeth (1.6%) (Grade 1 in the ASU system). Faint cuspule was present in 36 teeth (29.5%) (Grade 2 in the ASU system). Weak cusp was present in 52 teeth (42.6%) (Grade 3 in the ASU system). An intermediate-sized cusp was present in 30 teeth (24.6%) (Grade 3.5 in the ASU system) and a large metacone was found in one teeth (0.8%) (Grade 4 in the ASU system).

Hypocone

Hypocone (distolingual cusp) is considerably more variable than Metacone, and is best developed on upper first molars, but reduced on second and particularly third molars. (Hillson 1996:88)

The frequency of the trait in Europe is usually above 20%, with the early European being 19.4%. The Finnic-Permian group has a higher frequency of 27.1%. The trait is less common in Sunda-Pacific groups (under 11.8%) and is rare (under 10%) in Sub-Saharan African, Australian and New Guinean groups (Scott et al. 1997:194-197).

A total of 33 upper second molars from 24 graves were available for study. Two teeth (6.1%) did not have a hypocone. Four teeth (12.1%) had faint ridging present at the site (score 1 in the ASU system). Two teeth (3.4%) had faint cuspule (score 2 in the ASU system). Nine teeth (27.3%) had a small cusp (score 3 in the ASU system). Nine teeth (27.3%) had a large cusp (score 4 in the ASU system). Seven teeth (21.2%) showed a very large cusp (score 5 in the ASU system). Absence of the trait (scores 0 and 1) in 18.2% of the teeth can be compared to the worldwide variation in the occurrence.

Cusp 5 (Metaconule)

A fifth cusp, the metaconule, may occasionally be present in the distal fovea of the upper molars between the metacone and the hypocone (Turner et al. 1991:18).

Western Eurasian and Sino-American groups have frequencies ranging from 10-25%. The trait is more frequent in other groups: Sunda-Pacific and South-African (30-40%), Sahul and West African groups have the world's highest frequencies (45-60%) (Scott et al. 1997:202-203).

A total of 32 upper first molars from 25 graves were studied. In 28 teeth (87.5%) no cusp was found. One tooth (3.1%) had a faint cuspule (score 1 in the ASU system). One tooth (3.1%) had a trace cuspule (score 2 in the ASU system). One tooth (3.1%) had a small cuspule present (score 3 in the ASU system). One tooth (3.1%) had a small cusp present (score 4 in the ASU system). Altogether four teeth (12.4%) had a fifth cusp.

Carabelli's trait

Hillson (1996:91) describes the cusp of Carabelli and associated variants as follows: Carabelli's cusp is in fact only one of a group of features arising from the base of the mesiolingual cusp in upper molars. The cusp may rival the main cusps in size, whereas other related forms include a small ridge, pit or furrow.

Picture 12. Carabelli´s cusp

Worldwide distribution of the trait: Western Eurasian and all Sunda-Pacific and Sahul-Pacific groups have frequencies close to 21%. The frequency is the highest in Western Eurasia (20-30%). The Finnic-Permian group has a frequency of 16.4%. Fewer examples of Carabelli's cusps are found in Sub-Saharan Africa, but they are still close to the frequencies in Sunda and Sahul-Pacific (15-20%). Still fewer instances of Carabelli's cusp are found in East Asia (10-15%). It is most uncommon in North Asia, Eskimo-Aleuts, American Indians, Jomon, Ainu and in Prehistoric Europe and India, where the frequencies are as low as 0%-10% (Scott et al. 1997: 198-201). Carabelli's cusp is considered in some sources as a primitive character rare in modern dentitions (Gregory 1922, as quoted by Hillson 1996:6-7).

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A total of 38 upper first molars from 25 graves were studied. Out of these 38 teeth, 20 teeth (52.6%) had no sign of a Carabelli's trait. Six teeth (15.8%) had a groove present at the site (score 1 in the ASU system). Three teeth (7.9%) had a pit present at the site (score 2 in the ASU system). Three teeth (2.9%) had a small Y-shaped depression (score 3 in the ASU system). Five teeth (13.1%) had a small

Carabelli's cusp (score 5 in the ASU system). Two teeth (5.3%) had a medium-sized Carabelli's cusp (score 6 in the ASU system) One tooth (2.6%) had a large Carabelli's cusp. Altogether eight teeth (21.0%) had Carabelli's cusp.

Parastyle

Parastyle occurs in the buccal surfaces of cusps 2 and 3 (Turner et al. 1991:19). The feature ranges from a pit near the buccal groove up to a large, well-separated cusp. It is found on all permanent upper molars, but is most common on the third and is rare on the first (Hillson 1996:91). The parastyle may provide insights into dental evolution and development (Scott et al. 1997:47).

A total of 117 upper molars from 45 graves were studied. Out of these, 116 teeth (99.1%) had the buccal surfaces of cusps 2 and 3 smooth. One tooth (0.9%) had a pit present at the site.

Enamel extensions

This trait consists of projections of the enamel border in an apical direction (Turner et al. 1991:19).

All Western Eurasian, Sub-Saharan and Sahul-Pacific groups, along with Micronesians and the Jomon, exhibit frequencies of less than 10%. At the other extreme, East and North Asian and Native American populations have trait frequencies in the 45% to 55% range. Frequencies for Denmark and Norway are 6.5% and 1.8% respectively (Scott et al. 1997:204-205).

A total of 36 upper first molars from 25 graves were studied. Of these, 31 teeth (86.1%) had no enamel extensions, and five teeth (13.9%) had a faint enamel extension. These types of faint enamel extensions are, however, excluded in the survey of the worldwide distribution of this trait.

Premolar root number

Premolars are usually single-rooted, but may occasionally have more than one root.

The world distribution of two rooted upper first premolars is North Asia and the Americas 5-15%, East Asia and Jomon (20-30%), Western Eurasia, Sunda-Pacific and Sahul-Pacific (30-60%) and Sub-Saharan Africa (over 60%) (Scott et al. 1997:225-226).

Out of 12 upper first premolars from 8 graves, 11 teeth (91.7%) had one root. One tooth (8.3%) had two roots.

My sample is too small for any far-reaching conclusions.

Upper molar root number

The upper first molar usually has three roots. The greatest variation in root number occurs on the second molar, the key site. The third molar usually has one or two roots (Turner et al 1991:20).

In Western Eurasian and North and South American Indian populations, the frequencies of the 3-rooted upper second molar is 50-70%. In Western Eurasia, frequencies under 60% are found in Western Europe. In Northern Europe and North Africa the trait is slightly more frequent, while in the American Arctic and Northwest North-America somewhat less frequent (35-45%). In North Africa, Southeast Asia, Micronesia and Melanesia high frequencies are found (70-80%), and the highest occurrences, over 80%, are found in Sub-Saharan Africa and in Australia (Scott et al. 1997:226-227).

In this material, 12 upper second molars from eight graves could be studied. Four teeth (33.3%) had one root. Two teeth (16.7%) had two roots. Six teeth (50%) had three roots.

Radical number

In a cross-section, a root may be single and lack any developmental grooving. More often, a single-rooted tooth will exhibit developmental grooves which partition the cross-section into two or more "unseparated" root-like divisions termed radicals (Turner et al. 1991:20).

In this material, 109 teeth from 25 graves were studied. Out of these, 27 teeth (24.8%) had one radical, 48 teeth (44.0%) had two radicals, 23 teeth (21.1%) had three radicals, 10 teeth (9.1%) had four radicals and one tooth (0.9%) had seven radicals.

Peg-Shaped Incisor

The Peg-Shaped Incisor (upper lateral incisor) is very reduced in size and lacks the normal morphology, being instead peg-shaped. It is probably related to congenital absence (Turner et al. 1991:20).

A total of nine upper lateral incisors from seven graves were available for the study. In the Luistari material, no peg-shaped incisors could be identified.

Peg-Shaped Molar

A peg-shaped molar (upper third molar) is very reduced in size, lacking the appropriate crown morphology. It is also probably related to congenital absence (Turner et al. 1991:21).

A total of 17 upper third molars from 11 graves were available for the study. In this material no peg-shaped molars could be identified.

Premolar Lingual Cusp Variation

Scott et al defines premolar lingual cusp variation as follows: Multiple lingual cusps are common in the lower premolars, which can exhibit one, two, three or more lingual cusps and cusplets. This trait has been difficult to quantify because the lingual cusp is expressed in such a variety of forms. The ASU system tries to score the number of lingual cusps and their relative size (Turner et al. 1991:21).

A total of 66 lower premolars from 25 graves were studied. Out of these, 13 teeth (19.7%) had one lingual cusp (score 0 in the ASU system), 17 teeth (25.8) had one or two lingual cusps (score 1 in the ASU system), 16 teeth (24.2%) had two lingual cusps, mesial being much larger than distal, seven teeth

(10.6%) had two lingual cusps, mesial being larger than distal (score 3 in the ASU system), five teeth (7.6%) had two equal sized lingual cusps (score 4 in the ASU system), one tooth (1.5%) had two cusps, the distal cusp being very much larger than the mesial (score 7 in the ASU system) and two teeth (3.0%) had three lingual cusps (score 8 in the ASU system).

Anterior Fovea

A fovea located on the anterior occlusal surface (Turner et al.1991: 22). This trait is among the most difficult to score (Scott et al. 1997:72). Because of rapid wear it is recommended that anterior fovea observations be limited in non-industrial individuals to those whose age is less than 12 years (Turner et al. 1991:22).

A total of eight teeth from four graves were studied. One teeth (12.5%) did not have anterior fovea. Two teeth (25.0%) had a faint groove, produced by a weak ridge that connects mesial aspects of cusps 1 and 2 (score 1 in the ASU system). One tooth (12.5%) had a deeper groove (score 2 in the ASU system). Two teeth (25.0%) had a longer groove than the previous (score 3 in the ASU system) and two teeth (25.0%) had a very long groove with a robust mesial ridge (score 4 in the ASU system).

Groove pattern

The groove pattern determines which cusps are in contact with each other (Turner et al. 1991:23). The different patterns resemble the letters Y and X and the + mark. Pattern Y is formed when cusps 2 and 3 are in contact. Pattern X is formed when cusps 1 and 4 are in contact. Pattern + is formed when all four main cusps are in contact (Turner et al. 1991:23). The groove pattern has changed during hominid evolution (Scott et al. 1997:51).

Western Europeans, Melanesians and Jomon people show slightly higher frequencies of pattern Y (20-30%) than all other populations, whose frequencies range from 10 to 20%. The San population however exhibits a high frequency of 60-70%. The Finnic-Permian groups have a frequency of 9.6%. This trait does not, however, exhibit a pattern of geographic variation that clearly differentiates between the different groups of human populations (Scott et al. 1997:211). For lower second molars in living homo, pattern + is the most common as in this case. In Australopithecines, pattern Y is the most common (Hillson 1996:96).

A total of 41 lower second molars from 24 graves were studied. Out of these 41 teeth, 25 teeth (61.0%) had a groove pattern +. Nine teeth (22.0%) had a groove pattern Y. Seven teeth (17.0%) had a groove pattern X.

Cusp Number

Lower first molars.
Most permanent lower first molars have five cusps - mesiobuccal, mesiolingual, centrobuccal, distobuccal and distolingual - but there may be four or three. In four-cusped forms, the distobuccal cusp is missing, whilst the distolingual is additionally missing in three-cusped forms. At the distal margin of the crown there may be an extra cusp to the lingual of the distobuccal cusp, called cusp 6, which can only be distinguished when there are five other cusps present, because a single distobuccal element may be either the distobuccal cusp or cusp 6, and it is conventional to assume that a single cusp of this kind is the distobuccal cusp. A further cusp called cusp 7 may lie on the lingual margin of the crown between the mesiolingual and distolingual cusps and may be present even when cusps 5 and 6 are not (Hillson 1996:93).

The variation of the frequency of four-cusped lower first molars:
In most human populations 4-cusped lower first molars are rare. They are most common in Western Eurasian populations. In all other populations the frequency is under 5%. Inside Western Europe it is more common in Northern Europe (about 10%) than in Western Europe (about 7.5%). Finnish-Permians for example had 12.7%. Other groups with frequencies quite close to this are the Indo-Iranian group (13.4%) and early Afro-Asiatic group (13.6%) (Scott et al. 1997:206-207).

The variation in the frequency of six-cusped lower first molars:
Low frequencies are found in Western Eurasia (0-10%) with Finnish-Permian at 3.9%. Low to intermediate frequencies (10-20%) are found in Sub-Saharan Africa, South Siberia, New Guinea and in Altaic speakers. High to intermediate frequencies (30-50%) are found in Northern and Eastern Asia, the

Americas and in Melanesia. The highest frequencies (over 50%) are found in Polynesia and Australia (Scott et al. 1997:214-217).

The variation in the frequency of seven-cusped lower first molars:
Low frequency groups (0-10%) are the Western Eurasian, Sino-American, Sunda-Pacific and Sahul-Pacific. Finnish-Permian groups have a frequency of 3%. All others are high frequency groups (25-40%) (Scott et al. 1997:217-219).

In this material, 33 lower first molars from 23 graves were available for study. Four teeth (12.1%) had four cusps and 23 teeth (69.7%) had five cusps. Five teeth (15.2%) had six cusps and one tooth (3.0%) had seven cusps.

Lower second molars.
The highest frequency of 4-cusped lower second molars is found in Western Eurasia, over 80%. The Finnish-Permian group has a frequency of 81.6%. Somewhat lower frequencies, 60-80 %, are found in New Guinea, Melanesia, East Africa and Altaic (Turkish) groups (Scott et al. 1997:208-211).

A total of 43 lower second molars from 23 graves were studied. Of these, 34 teeth (79.1%) had four cusps. Seven teeth (16.3%) had five cusps. Two teeth (4.6%) had six cusps.

Deflecting wrinkle

Deflecting wrinkle is described by Scott et. al. (1997:23), partially quoted from Weidenreich (1937) and Morris (1970) as follows: The median occlusal ridge of the metaconid often follows a straight course from the cusp tip to the central fossa. In some cases, however, this ridge assumes a more mesial position toward the apex and then, about midway along its course, angles toward the central fossa. A strait ridge is considered normal while ridges that exhibit angulation are referred to as deflecting wrinkles. In the scoring procedures (Turner et al. 1991:23) it is noted that: It is difficult to score individuals much older than 12 years of age due to wear.

Western Eurasians can be expected to have frequencies of only 10-20%, while the Finnish-Permian group has a 12.7% frequency and all other groups show a much higher, 25-50%, trait frequency (Scott et al. 1997:217).

A total of 16 lower first molars from 12 graves were studied. Of these, 11 teeth (68.8%) did not have a deflecting wrinkle. On five teeth (31.2%) the mesial ridge is deflecting distally (score 2 in the ASU system).

The geographical variation of this trait is not particularly distinctive. Nor is my sample large enough for definite conclusions.

Distal trigonid crest

Hillson (1996:96) describes the distal trigonid crest as follows: The distal trigonid crest is a rare variant of permanent lower molars. It is a high ridge that unites the mesiobuccal and mesiolingual cusps, which is not cut by the mesial fissure, and therefore isolates the mesial fossa.

This trait is rare throughout the world, except for Sino-American populations where its frequency of occurrence is greater than 10%. Finnic-Permian groups have a frequency of 2.0% (Scott et al. 1997:217).

A total of 13 lower first molars from 11 graves were studied. Of these, eleven teeth (84.6%) did not have a distal trigonid crest. Two teeth (15.4%) had a distal trigonid crest (score 1 in the ASU system). My sample is clearly too small for any far-reaching conclusions.

Protostylid

Protostylid is a paramolar cusp found on the buccal surface of cusp 1, according to Turner et al. (1991:23).

A total of 115 lower molars from 37 graves were studied. Of these, 87 teeth (75.7%) did not have any signs of protostylid, 26 teeth (22.6%) had a pit in the buccal groove (score 1 in the ASU system), one tooth (0.8%) had a buccal groove curving distally (score 2 in the ASU system) and one tooth (0.8%) had a faint secondary groove extending mesially from the buccal groove (score 3 in the ASU system).

Cusp 5

Cusp 5, or the hypoconulid, occurs on the distal occlusal aspect of the lower molars. It is graded in terms of size only in the absence of cusp 6 (Turner et al. 1991:24).

A total of 100 lower molars from 35 graves were studied. Of these, 55 teeth (55.6%) did not have a cusp 5. One tooth (1.0%) had a very small cusp 5 (score 1 in the ASU system). Four teeth (4.0%) had a small cusp 5 (score 2 in the ASU system). Three teeth (3.0%) had a medium sized cusp 5 (score 3 in the ASU system). Nine teeth (9.0%) had a large cusp 5 (score 4 in the ASU system) and 28 teeth (28.0%) had a very large cusp 5 (score 5 in the ASU system).

Cusp 6

Cusp 6, the endoconulid or tuberculum sextum, occurs in the distal fovea of the lower molars lingual to cusp 5. It is scored by size relative to cusp 5 (Turner et al 1991:24).

Cusp 6 is a commonly found in most of the world except in Western Eurasia, New Guinea and the San, where the trait is found only in 5-15% of the population. In living humans both cusp 6 and cusp 7 are rare, but they are common in Paranthropus (Robinson, 1956 as quoted from Hillson 1996:93).

A total of 33 lower first molars from 22 graves were studied. The majority, 30 teeth (90.9%) do not have this sixth cusp. In two teeth (6.1%) cusp 6 is much smaller than cusp 5 (score 1 in the ASU system). In one tooth (3.0%) cusp 6 is smaller than cusp 5 (score 2 in the ASU system). Totally three teeth 9.1% have cusp 6.

Cusp 7

Cusp 7, the metaconulid or tuberculum intermedium, occurs in the lingual groove between cusps 2 and 4 of the lower molars, most commonly on the first molar (Turner et al. 1991:24).

This trait is found throughout the world in frequencies of about 5-10%, except for Sub-Saharan Africa where the trait frequencies are 25-40% (Scott et al. 1997:217). In living humans both cusp 6 and cusp 7 are rare, but they are common in Paranthropus (Robinson, 1956 as quoted from Hillson 1996:93).

A total of 35 lower first molars from 23 graves were studied. The majority, 32 teeth (91.5%) did not have a Cusp 7. One tooth (2.8%) had a faint cusp (score 1 in the ASU system). One tooth (2.8%) had a small cusp (score 2 in the ASU system). One tooth had a medium sized cusp 7 (score 3 in the ASU system). Altogether three teeth (8.4%) had cusp 7.

Canine Root number

The mandibular canine can have one or two roots (Turner et al. 1991:24).

The frequencies for this trait are highest in Europe (over 5%) and lowest in Sub-Saharan Africa, Sino-America, Sunda-Pacific and Sahul-Pacific, where it is found in less than 1% of cases. North African and South Siberian groups have frequencies falling between 1% and 5% (Scott et al. 1997:228-229).

Only three lower canines from two graves could be studied. None of these had two roots.

Tome's root

The mesial surfaces of the root of the lower first molar are deeply grooved (Turner et al. 1991:24-25).

The frequency variation in Western Eurasia ranges from 0 to 10% among the Jomon, American Arctic and New Guinean groups. Elsewhere it is higher, and the highest values are found in Sub-Saharan Africa and Australia (over 25%) (Scott et al. 1997:229-231).

No more than four lower first premolars from four graves were studied. None of them had signs of Tome’s root.

Lower molar root number

Lower molars usually have two roots.

The lowest frequencies of three-rooted lower first molars are found in Western Eurasia (especially Northern Europe), Sub-Saharan Africa, South Siberia and Sahul-Pacific, all having frequencies below 5%. It is most common in North and East Asia and in the American Arctic, where the frequencies are all more than 20% (Scott et al. 1997:231-233).

A total of 13 lower first molars from 10 graves were studied. All of the teeth had two roots.

The highest frequencies in the world of one-rooted lower second molars are seen in North and East Asia, South Siberia and in the Americas (over 30%), followed by Europe, Southeast Asia and Polynesia with 20-30%. In North America, Micronesia and New Guinea the trait frequency is from 10 to 20%, and in the rest of the world even lower frequencies are found (Scott et al. 1997:233-235).

A total of 13 lower second molars from 11 graves were studied. Nine teeth (69.2%) had two roots. Four teeth with one root only (30.8%) were found.

Odontome

Alexandersen defines odontomes (1970 as quoted by Turner et al. 1991:21) as follows: Any pin-sized, spike-shaped enamel and dentin projection occurring on the premolar occlusal surface.

The fewest odontomes are found, among others, in Western Eurasia 0-1%. In northern Europe it is even more rare.

A total of 75 premolars from 23 graves were available for the study. No signs of odontomes were found.

Congenital Absence

Hillson (1996:113) defines congenital absence as follows: In human dentitions it is quite common for teeth not to be formed at all. Rarely, the entire dentitions may be congenitally absent although, more frequently one or only a few teeth are missing. The third molars are the most commonly missing teeth, followed by upper second incisors and upper or lower second molars. The proportion of individuals with absence of other teeth than third molar rarely reaches frequencies of more than a few percent.

Congenital absence occurs more commonly in women than men (Scott et al. 1997:105). Kirveskari et al. (1978) found an especially high frequency of premolar agenesis among the Skolt Saamis (Alexandersen 2003:25).

Tooth no 45 in grave 345 is congenitally absent (see find numbers 3851:14-17). A deciduous molar remains in the jaw. Grave 345 is a double grave for a man and another individual.

Other observations

According to Juhani Wolf, a Professor in Radiology, it is unusual to find in living humans as much erupted third molars as in the Luistari material. In living Finnish people third molars tend to remain inside the jaw.

Summary of non-metrical traits

The occurrences of non-metrical traits at Luistari were recorded and their worldwide distributions were given. Most frequencies of traits correlated well with the values found for the Western Eurasian type of teeth. Seven traits out of a total of 26 observed did, however, correlate considerable better with some other population than the Western Eurasian ones. These seven traits were: canine mesial ridge, tricusped premolars, hypocone, premolar root number, cusp number of lower molars, deflecting wrinkle and distal trigonid crest. These seven traits correlated with values found for populations in different parts of the world, and consequently did not provide any information about the origins of the Luistari population.

Later, some of the most frequently recorded traits will be compared to spatially (and temporally) close populations.

6. Results

The MNI (minimum number of individuals) calculated during this investigation specified the number of individuals in each grave. Five graves, thought to be single graves, were found to contain the remains of at least two individuals' teeth. It is now suggested that four of these are double graves. Teeth have previously been used to specify the number of deceased - for example, in stone-age Sweden (Holmer et al. 1956:445).

Luistari has been described as being predominantly a single grave cemetery. Sometimes a child is buried with an adult, and sometimes two men are buried together. A woman and a man were buried in the same grave just prior to the Christian period in Finland (Lehtosalo-Hilander 2000b:157). Examination of the teeth from the graves made clear that there are four double graves more than had previously been assumed, and thus there are 13 double or multiple graves out of 85 graves. If all the bone material were to be analyzed, the number of double graves would probably increase further. So although Luistari remains a cemetery predominantly of single graves, double graves are not exceptional. The question arises as to the identity of the second person in the grave. Did the two buried persons die at about the same time (coincidentally or during a crisis) or did they have some relationship during life? In times of crisis - wars, epidemics, famine - several individuals could have been buried in the same grave. It has been supposed that victims of an epidemic were buried in grave 294 at about the year 800 AD (Lehtosalo-Hilander 2000b: 156). In connection with double burials in cremation cemeteries, references have usually been made to the Indo-European practice of suttee (Lehtosalo-Hilander 1982a: 36). Other possibilities are that a master was buried with a slave as a sacrifice (a practice from the Viking Age known from Ibn Fadhlan's description). However, Lehtosalo-Hilander writes that the Luistari graves lend no support to the theory that Viking chiefs were buried with slave girls (Lehtosalo-Hilander 2000b: 164). At Luistari the multiple burial furnishings are fairly modest (Lehtosalo-Hilander 1982a: 36).

The preservation of the dental material has also been considered. No more than 24 teeth (out of 32) were found from one person, and most graves had a much lower recovery rate. The highest numbers of teeth were found in Merovingian II period graves (31.8%), and the lowest number in Viking III period graves (3.1%). Although there was no notable difference in preservation between men's and women's teeth, men's teeth were preserved slightly better. Similar results (i.e. a difference in preservation of less than three percent) have been found in teeth from Fröjel, Gotland, dating from 500 to 1180 AD. In "material A", men's teeth were preserved slightly better, while in "material B" women's teeth were preserved slightly better (Liebe-Harkort 2000:10-11). Somewhat higher frequencies of losses of teeth post mortem among women have been demonstrated in Westerhus and in a medieval population in Northern Sweden (Swärstedt 1966: 82-83, Sagne 1976: 35). Cheek teeth were better preserved than other types, possibly because they are larger and thus easier to find. Mandibular (lower jaw) teeth were better preserved than maxillary (upper jaw) teeth, maybe due to the thicker bone in the Mandible or the fact that Caries is more commonly found in Maxillary than Mandibular molars. Although acidity and grain size of the soil have probably been the most destructive factors at Luistari, several other taphonomical processes have been found to be destructive as well.

6.1 Age

Three different methods were used to estimate the ages of the deceased. It was possible to estimate the age of 26 or 27 individuals using these methods. Out of these, the age of two individuals was determined using both Miles' and Kvaal's methods, while the age of another two individuals was determined using all three of these methods. The oldest individual determined according to Kvaal's and Miles' methods comes from grave 302. Grave 302 is a man's grave from the Viking IV period. The youngest individual comes from grave 139 - a double grave of two small children, the younger being 1-2 years old and the older 2-4 years old from the Viking II period. Pirjo Lahtiperä previously estimated from the dental material that some of the deceased may be under three years old (Lehtosalo-Hilander 1982a: 26).

Young individuals tended to be older when their age was determined by Miles' method rather than Kvaal's method. The opposite was true for old individuals. The ages of East Greenland Eskimos were determined according to Miles' norms. Their estimated ages either compared with the actual ages or made them younger than they, in fact, were (Alexandersen 1988a:107). Similar results have been obtained from medieval Northern Sweden as well. There the ages were 3-4 years younger when determined by Miles' method than when determined by conventional methods. The differences between the two methods were greater for the oldest individuals (Sagne 1976: 46-49). During and Kvaal (2000: 53) have made comparisons of osteological and odontological age estimation methods.

Age was compared with the period the grave is dated to, the sex of the individual, the pathologies observed and the relative wealth of the graves (see table 10). Only the pathologies seem to have a connection with age. Similar results have been obtained before. Sagne et al. (1977) pointed out that the distance between the cemento-enamel junction and the marginal bone crest was greater in mature individuals than in adult individuals, indicating more parodontitis in the mature individuals. In addition, caries was more common in mature than adult individuals, while in the juvenile age group, occlusal caries was the most common (Olsson et al. 1976:17). Periapical bone destruction (parodontitis) was not found to appear before the age of 20 and was more common in women than men and in mature individuals than adult individuals (Olsson et al. 1976:20). Also, Swärstedt found a higher amount of periapical destruction (parodontitis) in women and elderly individuals. In the same material, calculus, caries, abscesses and AMTL were more common in maturus than adultus (Swärstedt 1966:73-82). Hypercementosis was found in older individuals with advanced wear, while parodontitis was also found in the oldest age groups and caries was three times as common in mature than adult individuals (Christophersen 1941a:11-13). In the Danish medieval town of Holbæk, caries and parodontitis were also found to be closely related to age (Jakobsen 2003:73).

Age and archaeological finds

Children's graves have been separated from adults' graves by using grave length, length of the deceased, diameters of rings and ornaments (Lehtosalo-Hilander 1982a: 26). The length limit of adult graves has been supposed to be 160 cm (Lehtosalo-Hilander 1982a: 25). Ages (see above) are compared to length of the deceased, ring diameters and diameters of bracelets (Lehtosalo-Hilander 1982a: 26) in the following table.

Table 15. Age estimation compared to estimated lengths of the individual, ring diameters and size of bracelets.

Grave	Age	Length	Ring	Bracelet
41	4-10 y	under 130 cm		
139	1-2 y, 2-4 y	70 cm	10mm	35mm
273	22 y	65 cm	13mm	
290	4-5 y	under 120 cm	13mm	
313	6-11 y	under 110 cm		
321		130 cm		
333	under 11 y	over 100 cm	12mm	37x32mm
393	under 11 y			
401		under 90 cm		

Length Length of the deceased as estimated by Lehtosalo-Hilander (1982a: 26)
Ring Ring diameter as estimated by Lehtosalo-Hilander (1982a: 26)
Bracelet Bracelet diameter as estimated by Lehtosalo-Hilander (1982a: 26)

Most age estimations are supported by archaeological data. It was previously supposed that grave 273 contained a 65 cm long newborn child (Lehtosalo-Hilander 1982c: 28), but an age estimation of 22 years was obtained. The person in the grave has below been estimated as a male. One thinkable explanation could be that the deceased was laid in a Hocker position, but still the small diameter of the ring could not be explained.

In grave 313 a child under 110 cm is supposed to have been buried (Lehtosalo-Hilander 1982a: 26). Most likely the child is closer to six years, because modern six-year-old children are 110 cm tall. However, the Iron Age growth rates of children in Finland are not known and it is possible that the child suffered from a disease that had retarded growth. However, no signs of enamel hypoplasias were seen. The person in the grave has below been estimated as a female.

It could also be questioned whether the person in grave 321 is really a child as previously determined from the length of the deceased (Lehtosalo-Hilander 1982a:26). The teeth show moderate wear and calculus formation.

Four graves that were previously thought to be adults' graves contained deciduous teeth (graves 51, 62, 191 and 285).

6.2 Pathology

The pathological conditions observed in the material are, listed from the most common to the least common, calculus (155 occurrences), hypoplasia (70), trauma (46), resorption (41), caries (14), ante mortem tooth loss (5) and abscesses (3). New types of pathologies were also observed from the x-rays. A similar x-ray study was made on 15th-18th century Hailuoto, where carcinoma was diagnosed from an x-ray of a mandible (Heikkinen 1988:86). Three cases of occlusal calculus were observed indicating ante-mortem tooth loss in the opposite jaw. Caries has probably been more common, as it is detrimental to the preservation of the affected teeth. Root caries could also be observed, only in those teeth that had the roots preserved. Comparisons of caries and calculus percentages with those of previous studies are shown later. Hypoplasia is also probably under-represented in the Luistari material because it usually occurs in front teeth, which are poorly preserved. In Fröjel only one case of hypoplasia was found, possibly because so many teeth were worn in the cement-enamel junction (Liebe-Harkort 2000:25-29). All traumas in the material look alike and it is probable that the same activity caused it. It is found in all teeth types. Traumas could have been caused by millstone particles in the food.

In medieval Finns from Turku the occurrence of periodontal diseases was also low (7.5%), but a direct comparison cannot be made to this material, due to the very poor preservation of the alveolar bone in the Luistari sample (Varrela 1996:44). Comparisons of the occurrence of periodontal diseases and abscesses would be interesting, but the observed number of persons affected at Luistari is too small.

The occurrence of diseases in women and in men was quite equal. However, hypoplasia is more than twice as commonly seen in men as it is in women. Swärstedt (1966) reaches a similar conclusion in his study of a medieval population from the province of Jämtland, Mid-Sweden (Swärstedt 1966:97). Also in Westerhus and Risby, hypoplasias were seen more frequently among men (Alexandersen 2003:29). Two types of theories can be created: Women may have had better nutrition and health during childhood. Or girls who suffered from conditions leading to hypoplasia may have died young. (Note the high occurrence of hypoplasias among children.)

Caries seems to be significantly more common in women than in men. Similar results are commonly seen, because the teeth of women erupt earlier and women also tend to live longer. Therefore female teeth are exposed to a caries risk for a longer period of time (Brace et al. 1991:194, Swärstedt 1966:77, Bennike 1985:163, Olsson et al. 1976:18). Another explanation might be that women were responsible for plant gathering and therefore they would eat starch-rich food more frequently (Brace et al. 1991:198). It has also been shown that pregnancy increases caries (Boldsen 2003:77-83). Liebe-Harkort, however, observed the opposite relation in her study of teeth from the Fröjel "material A" (Liebe-Harkort 2000:16-17). In the same material she also found more calculus on the teeth of men than on the teeth of women (Liebe-Harkort 2000:19).

Fewer pathologies were seen in children, except hypoplasias. Every third child had hypoplasia. It is not surprising that children who had suffered from poor nutrition or diseases should also die young. Swärstedt (1966) found (in the above-mentioned study of a medieval population from the province of Jämtland) the highest frequency of hypoplasias in juveniles and the lowest frequency in mature individuals (Swärstedt 1966: 91).

The frequency of the occurrence of dental diseases at Luistari did not vary drastically over time. Calculus, hypoplasia and trauma were reduced slightly and caries increased slightly. If the economy had become more agricultural over time, it is probable that not only caries would have increased, but also calculus and hypoplasia would have been more frequent. However, the differences are so small that it is hard to reach any definite conclusions. Swärstedt (1966) did not find, in his study of a medieval population from the province of Jämtland, any significant differences between different periods in the occurrence of calculus either. In this study, the caries frequency was significantly lower and hypoplasia was significantly higher in the last period (Period IV). His first period dates partly to the Viking IV and the Final period (Swärstedt 1966:73,93). Danish investigations show only a slight variation in the frequency of caries over time from the Iron Age (4.8% of teeth and 29.1% of individuals) through the Viking Age (3.4% of teeth and 25.6% of individuals) to the Middle Ages (3.7% of teeth and 27.5% of individuals) (Bennike 1985:162).

Diet

Finnish Iron Age society has been described in general as a peasant society. However, some researchers have stressed the importance of hunting and fishing (Lehtosalo-Hilander 1982c: 15). Paleobotanical studies have not been made in Eura, but in Laitila they show wheat and barley from the earliest Iron Age and rye and oats in the Viking period. The most common grain was barley. Weeds were also common (Lehtosalo-Hilander 2000b:266). All the most important domestic animals were present, including the cow (Bos Taurus), horse (Equus caballus), sheep (Ovis aries), goat (Capra hircus), pig (Sus domestica) and dog (Canis familiaris) (Blomqvist and Fortelius in Lehtosalo-Hilander 1982a: 309-312). However Tupala (1999) showed in her master thesis, that many of these animals were younger than previously supposed and therefore did not originate from the graves. Probably milk, butter, cheese and meat were eaten. Only one little fish-spear (NM 20552:240) has been found at Luistari (Lehtosalo-Hilander 1982c:68). Still, it is impossible to believe that fishing was not done, because the area is situated near one of Europe's most fish-rich lakes (Lehtosalo-Hilander 2000b:203, Lehtosalo-Hilander 2001b: 9). Fish bones are smaller than other bones and therefore hard to find. Arrowheads found from the graves could have been used for hunting, but no other proof of hunting is present in the graves. Small amounts of starch could have been obtained from plant roots (Lehtosalo-Hilander 2000b: 268). Small amounts of sugar could probably also have been obtained from berries. Mead could have been sweetened with honey (Lehtosalo-Hilander 2000b: 272). Neither sugar nor potatoes were consumed in Finland during the prehistorical or medieval periods.

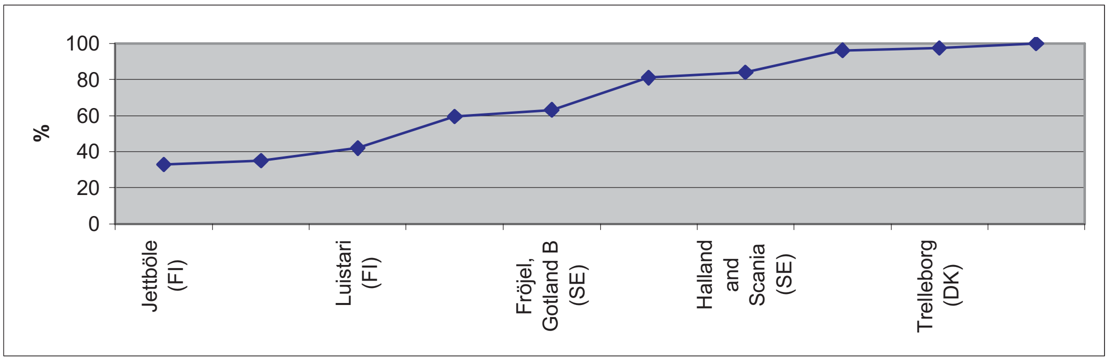
Knives were used for eating (Lehtosalo-Hilander 2000b:265). Food was leavened in order to preserve it. Nettle was used in the leavening process (Lehtosalo-Hilander 2000b:268). Drying, salting and smoking were probably also used. Eating dried foods required powerful chewing. Millstone particles in the food probably caused abrasion of the teeth.

In an economy based on agriculture the frequencies of calculus, hypoplasia and caries can be expected to be high, whereas in hunter-gatherer economies these diseases are less common (Lucacs 1989:276). The frequency of caries increases with the consumption of corn foods. The amount of calculus implies that the food was not always hard and tough. Enamel caries in permanent and temporary teeth apparently occurs first after the introduction of agriculture in Scandinavia (Alexandersen 1988a:161). Caries could be expected to be common in agricultural societies (about 8.56% as compared to hunter-gatherers at about 1.72% and mixed economies at about 4.37% (Mays 1998:153)). In prehistoric times, hypoplasia rates of 30-40% are common and a transition to intensive agriculture may raise the frequency of hypoplasia (Alexandersen 1988b: 30). Fats, oils and meats are non-cariogenic (Mays 1998: 149) in contrast to food that is rich in starch and sugars. Caries is generally known to be positively correlated with dietary carbohydrate intake (Huss-Ashmore et al. 1982:441).

The two most common pathologies found in the Luistari material - calculus (157 occurrences) and hypoplasia (70) - are the most common pathologies found in agricultural societies. The high frequencies of calculus and hypoplasia imply that agriculture was the basis of the economy at Luistari. Resorption (41 occurrences) can be connected to high amounts of calculus. The caries rate at Luistari is low (about 1.71%). The relatively low amount of caries (12 occurrences), even though it is usually frequent in agricultural societies, could be explained by the taphonomical bias. Trauma (46) is most likely caused by small millstone particles in the food. Other pathologies (hypercementosis (4), ante mortem tooth loss (5) and abscesses (3)) are rare, probably because tooth roots and alveolar bone is poorly preserved. The hypoplasia rate alone suggests that the Luistari population would have lived more in a mixed economy and did not subsist only on agriculture, but again taphonomy must be considered. Based solely on the frequency of caries, it could be suggested that agriculture became more popular after the Viking III period. On the other hand, the frequencies of calculus and hypoplasia would imply a decrease in agriculture over time. Hunter-gatherers usually show rapid wear with heavy anterior tooth attrition compared with agriculturalists (Hillson 1996:237). A comparison of attrition patterns with those of other populations supported by different economies could provide more specific conclusions on the Luistari economy.

The best results in prehistoric diet research come from multi-scientific analyses. Studies of pollen and macrofossil analyses, faunal remains, trace elements (see for example Liden 1995) and analysis of organic crust on pottery could be combined with dental research. In a Swedish study of medieval Westerhus, dental research was used with trace elements. It is most interesting to note the relationship between C^{13} analysis and caries (Iregren et al. 2000 and Alexandersen et al. 2000).

Table 16. Calculus percentages from the Stone Age to the Middle Ages in Scandinavia



Site	Dating	Author	Individuals	Teeth	C.D.I.	Calculus/Individuals %
Jettböle (FI)	Stone Age	Nunez 1995, Liden et al. 1996		60		33
Kökar (FI)	14-15th Century	Nunez 1995, 1997				35
Luistari (FI)	6th Century-Medieval	Author	94	710	23.6	42
Fröjel, Gotland A (SE)	6-11th century	Liebe-Harkort 2000		467		59.5
Fröjel, Gotland B (SE)	Early Christian Period	Liebe-Harkort 2000		754		63.2
Halland and Scania (SE)	Late Middle Ages	Mellquist et. al. 1939	(71)?			81
Halland and Scania (SE)	Early Middle Ages	Mellquist et. al. 1939	(120)?			84
Jämtland (SE)	Middle Ages	Swärstedt 1966	132			96.2
Trelleborg (DK)	Viking Period	Christophersen 1941a	83	1372	51.7	97.5
Lund (SE)	Middle Ages	Olsson et al. 1976, Sagne et al. 1977	122	2513	64.4	100

As can be seen from the table the amounts of calculus tend to increase in Scandinavian countries from the Stone Age to the medieval period. Unfortunately only a few studies mention the calculus percentage. Therefore it is not possible to give a more precise picture of amounts of calculus during the prehistoric and early historic periods in different parts of Scandinavia.

The caries rate per affected tooth at Luistari would imply a hunter-gatherer economy. However, there are other cases where lower values than expected are found. In medieval Iceland and Greenland the caries rates are 0.0% (Scott et al.1992: 193). In a similar study from a Norse colony in Greenland dating to 985-1450 AD the caries rate is 0.0%.

One problem in comparisons of the caries percentages of different materials is that caries causes ante-mortem tooth loss and, therefore, the more missing teeth there are, the more unsure the results are. To get comparable results Brinch et al. (1949:361) developed a Comparative Dental Index (C.D.I = the percentage of existing erupted teeth in relation to the optimal number 32). Olsson et al. (1976:12) showed that at high values of CDI there was a tendency towards an increased number of carious teeth per individual, while individuals with carious lesions remained unchanged (Olsson et al. 1976:16).

The following tables represent the amounts of caries in prehistoric and medieval Finland, Sweden and Denmark. A comprehensive table is presented under the pictures.

Table 17. Percentages of caries in Finnish prehistoric and medieval populations

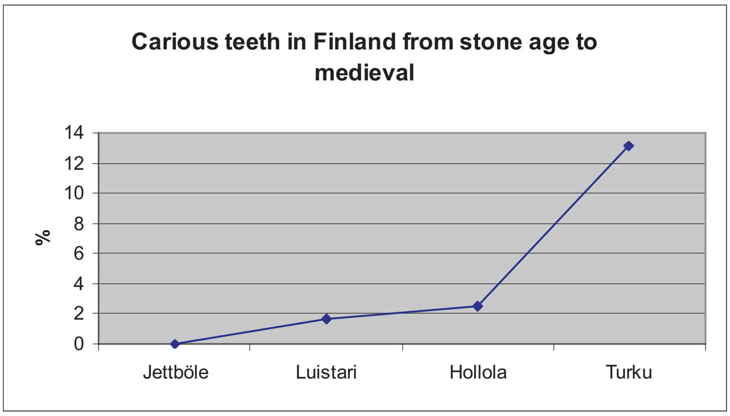


Table 18. Percentages of caries in Swedish prehistoric and medieval populations

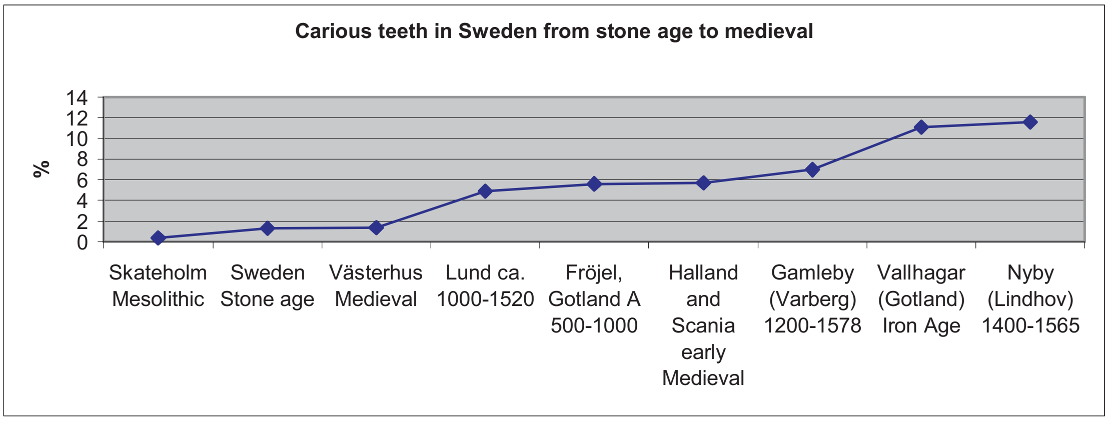
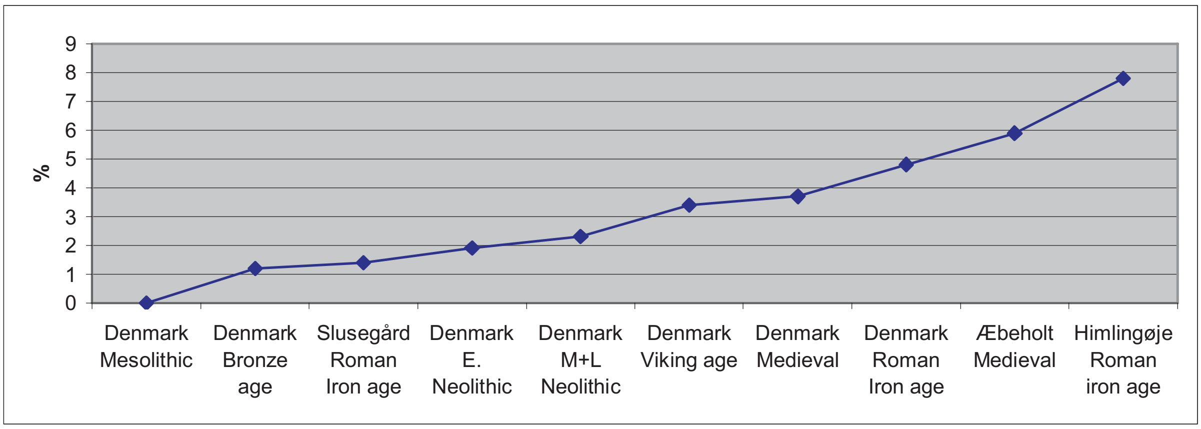


Table 19. Percentages of caries in Danish prehistoric and medieval populations



Site	Dating	Author	Caries/ individuals	Caries/ teeth	C.D.I.
Denmark (DK)	Mesolithic	Bennike 1985	0	0	66.1
Jettböle (FI)	Stone Age	Nunez 1995, Liden et al. 1996		0	
Skateholm, Vedbæk and others (SE+DK)	Mesolithic	Borrman et al. 1996		0.3	
Skateholm (SE)	Mesolithic	Alexandersen 1988a		0.4	
Trelleborg (DK)	Viking Age	Cristophersen 1941a	7	0.7	51.7
Trondheim (NO)	Middle Age	Scott et al. 1992	8	1	37.6
Denmark (DK)	Bronze age	Bennike 1985	12	1.2	39.8
Sweden (SE)	Stone Age	Holmer et al. 1956		1.3	38.0
Denmark (DK)	Viking Age	Brinch et al. 1949	13	1.4	49.7
Slusegård	Roman Iron Age	Bennike et al. 2000	19	1.4	78.9
Westerhus (SE)	Middle Age	Lysell 1958, Alexandersen et al. 2000		1.4	73.1
Denmark (DK)	Bronze age	Cristophersen 1939	12	1.6	55.8
Denmark (DK)	Neolithic	Cristophersen 1939	14	1.6	41.2
Denmark (DK)	Stone Age	Cristophersen 1938	15	1.6	46.3
Luistari (FI)	6th century-Middle Age	Author	11	1.7	23.6
Denmark (DK)	Early Neolithic	Bennike 1985	15	1.9	38.5
Denmark (DK)	Middle and Late Neolithic	Bennike 1985	16	2.3	35.3
Hollola (FI)	Iron Age	Saarnisto 1996		2.5	
Øm (DK)	Middle Age	Isager 1938 as quoted by Brinch et al. 1949	41	2.9	83.4
Norway (NO)	Late Middle Age	Rygge 1913 as quoted by Mellquist et al. 1937		3.3	
Denmark (DK)	Viking Age	Bennike 1985	26	3.4	40.4
Denmark (DK)	Middle Age	Bennike 1985	28	3.7	65.5
Denmark (DK)	Iron Age (500bc.-800 ad.)	Cristophersen 1941b	28	3.8	48.5
Denmark (DK)	Migration period	Cristophersen 1941b	26	3.9	48.1
Denmark (DK)	Roman Iron Age	Cristophersen 1941b	33	3.9	52.3
Halmstad (SE)	about 1500	Mellquist et. al. 1939	25	4.5	30.7
Denmark (DK)	Roman Iron Age	Bennike 1985	29	4.8	44.3
Skovgåde (SE)	Younger Roman Iron Age	Bennike et al. 2000	33	4.9	72.1
Lund (SE)	1000-1520	Mellquist et. al. 1939	41	4.9	47.1
Fröjel, Gotland A (SE)	500-1000	Liebe-Harkort 2000	46	5.6	
Lund (SE)	Middle Age	Olsson et al. 1976, Sagne et al. 1977	48	5.7	64.4
Halland and Scania (SE)	Early Middle Age	Mellquist et. al. 1939		5.7	
Æbeholt (DK)	Middle Age	Brinch et al. 1949, Brinch 1952	55	5.9	92.1
Jôuga (EE)	Middle Age	Sarap 1993		6.3	
Halland and Scania tot. (SE)	1000-1700	Mellquist et. al. 1939	42	6.7	87.1
Gamleby, Varberg (SE)	1200-1578	Mellquist et. al. 1939	37	7	52.4
Fröjel, Gotland B (SE)	Early Christian Period	Liebe-Harkort 2000		7	
Lund (SE)	1250-1550	Mellquist et. al. 1939	48	7.1	58.4
Halland and Scania (SE)	Late Middle Age	Mellquist et. al. 1939		7.7	
Himlingøje (DK)	Roman Iron Age	Alexandersen 1995	58	7.8	50.1
Vallhagar, Gotland (SE)	Iron Age (Roman Iron Age-Vendel Period)	Lundström 1955		11.1	
Nyby, Lindhov (SE)	1400-1565	Mellquist et. al. 1939	61	11.6	58.3
Göteborg (SE)	Historical	Engström et al. 1981		13	
Turku (FI)	Middle Age	Varrela 1991, 1997	54	13.1	34.9
Halmstad (SE)	1530-1700	Mellquist et. al. 1939	74	14	52.0

Nyby, Lindhov (SE)	1565-1612	Mellquist et. al. 1939	82	19.1	63.1
Pälkäne (FI)	1400-1800	Lahti 2004		47	
Denmark and Southern Sweden (DK+SE)	Mesolithic	Alexandersen 1989	3		
Denmark and Southern Sweden (DK+SE)	Battle-axe	Alexandersen 1989	5		
Sweden (SE)	Prehistoric	Billing 1930	8		
Denmark and Southern Sweden (DK+SE)	Stone Age	Alexandersen 1989	10		
Denmark and Southern Sweden (DK+SE)	Late Neolithic	Alexandersen 1989	15		
Denmark and Southern Sweden (DK+SE)	Middle Neolithic	Alexandersen 1989	17		
Denmark and Southern Sweden (DK+SE)	Early Neolithic	Alexandersen 1989	22		
Simonsborg (DK)	Roman Iron Age	Bennike et al. 2000	36		
Jämtland (SE)	Middle Age	Swärstedt 1966	57		
Kökar (FI)	1300-1400	Nunez 1995, 1997	60		

(See also Appendix 5 for more information)

The caries rate at Luistari is low (about 1.71%). A caries rate of 2.5% is reported from Hollola, Finland, dating from 1000-1300 AD (Saarnisto 1996:10). Medieval Finns from the Julin site in Turku, less than one hundred kilometers from Eura, dating to 1300-1650 AD, had more carious teeth (13.2%) than what was found at the Eura cemetery (1.7%), and more persons suffered from caries (54.1%) as compared to Eura's 10.9% (Varrela 1996: 32). In comparing these results we must take into account, however, that the preservation (as shown in C.D.I) in the Turku sample was better. When the Jettböle (100 AD), Kärsämäki and Leväluhta finds were researched, no carious lesions were observed, but in the Viking and Crusade periods caries is found in many instances (Bonsdorff 1933:14). The history of caries in Finland is still rather poorly researched, but it seems that in the Stone Age caries was uncommon or absent. During the Iron Age there was a moderate increase and caries became more common during the Middle Ages in Finland. This might be explained by the spread of agriculture and it's importance as a source of living.

Similar curves are presented from Sweden and Denmark. More studies have been made in both these countries. Generally caries increases from the Stone-Age to the medieval period, but there are exceptions (for example the Roman Iron age in Denmark and Westerhus in Sweden).

Dental status and archaeological finds

The archaeologist, Pirkko-Liisa Lehtosalo-Hilander, has studied the value of grave goods (Lehtosalo-Hilander 1982c: 37-52). The method she used for evaluating them is based on assumptions about the value of different grave goods. Important assumptions concerning the value of raw materials (for example the ratio between silver and bronze being 1:30), and the value of the workmanship (for example, in silver ornaments one-sixth of the price) were made to enable these calculations. The maximum number of units from one grave is 375 (Lehtosalo-Hilander 2000b: 97). Some of the assumptions have been questioned (see for example Halinen 1988:9-10, Moisanen 1989:4), but no alternative calculations have been made.

Based on her estimates I have studied an additional sample of 381 teeth from 47 graves containing 57 persons. The graves were distributed in three groups according to the value of the grave goods: poor, wealthy and the wealthiest. There were 15 graves in the poorly furnished group of graves, and their value (the value of one unit being one silver dirham) ranged from one unit to 29 units. In the wealthier furnished group of graves there were 16 graves with values ranging from 30 to 66 units. In the wealthiest furnished group of graves there were 16 graves with values ranging from 72 to 208 units. The number of teeth preserved per person was approximately the same in each group, the poor having on average 6.2 teeth, the wealthier having on average 7.6 teeth and the wealthiest having on average 6.2 teeth per person. Double and multiple graves were recognized by counting teeth per MNI, although there is a possibility that there were more individuals than the minimum number. The pathologies in the teeth were surveyed and no significant variation between the graves of these three groups was found. The greatest difference was observed in the caries frequencies, where caries appeared to have been more common in poorly furnished graves.

Table 20. Pathology and relative wealth of the graves.

Relative wealth	Calculus	Occlusalcalculus	Hypoplasia	Trauma	Caries	Caries in CEJ	Resorption
Number of teeth from poorly furnished graves	27	0	16	6	3	1	2
Number of graves these come from	6	0	3	4	2	1	2
Number of teeth from wealthier furnished graves	33	1	17	15	1	0	7
Number of graves these come from	9	1	5	7	1	0	1
Number of teeth from the wealthiest furnished graves	27	1	13	10	1	1	3
Number of graves these come from	7	1	4	6	1	1	1

The different pathologies occurred equally frequently in rich and poor graves at Luistari, which indicates that the different social classes, if there were any, ate the same food.

Dental health has been compared to the relative wealth of the graves before in Himlingøje, Slusegård, Skovgårde and Medieval Jämtland. In Himlingøje there was no significant difference in the occurrence of caries between rich and poor graves, but ante mortem tooth loss, parodontitis and wear was more common in poor graves. In Slusegård, wear and parodontitis were more common in poor graves (Alexandersen 1995:267-281). In Skovgårde, caries was as common in rich as in poorly furnished graves. Wear was found to be more severe in poorly furnished graves, and slightly more hypoplasia was found in richly furnished graves (Bennike et al. 2000:379-382). In Iron age and Viking Age Denmark, Sellevold et al. (1984, as quoted by Alexandersen 1995:267) found a relationship between body size, health and status. People with imported and precious metal objects in their graves had healthier nutrition. More extensive wear and parodontitis were found in higher social status individuals in medieval and historic times at the Gränna church in Sweden. Caries was more common in the lower social status group (Hartzell 2004:13).

Swärstedt (1966) found a significant difference in the amounts of calculus, caries and hypoplasia between different social groups in the medieval Jämtland population, with slaves (S III) having the most hypoplasias and the least calculus and caries (Swärstedt 1966: 73, 77, 92).

Livelihood could be better reflected in dental diseases. Dental diseases might also be dependent on other factors than diet - the consumption of honey, the Ph of the mouth, the individual tendency towards caries, etc. However, farming and hunting objects were compared to dental status. Lehtosalo-Hilander (2000b: 197) has pointed out that sickles and scythes are usually found in the graves of farmers. There is not much evidence of fishing and hunting in the graves. None of the graves in which arrowheads are found contained sickles or scythes (Lehtosalo-Hilander 2000b: 197-204). The following table shows which pathologies are found with sickles, scythes and arrowheads.

Table 21. Farming and hunting objects compared to dental diseases found from the graves.

Grave	Car.	Calc.	H	T	Other diseases	Finds	No of teeth
13	1				3 AMTL, abscess	skythe	19
41			1			arrowhead	9
55		9		1		sickle	11
56	1					sickle	7
64						sickle/scythe tip end fragment	1
73		1	1			fragmentary sickle	12
135		3	6	3	7 resorption	sickle	22
155		1				sickle	1
281		1			occlusalcalculus	skythe	2
283		7	3	2		sickle	25
288		1		1		arrowhead	2
334						sickle	2
346		8				sickle	8
348		2		3		scythe	6
349						skythe	9
358						sickle/scythe, tang end fragment	
359	1	11	1	1	8 resorption, 2 AMTL, abscess	sickle	27
375		1			calculus	arrowhead	3
383						sickle	0
404	2	4		1	4 resorption, 4 hypersementosis, abscess	sickle	22

Car. Carious teeth in the grave

Calc. Teeth with calculus in the grave

H Teeth with hypoplasia in the grave

T Teeth with trauma in the grave

Table 21 shows that caries was not found in the same grave as arrowheads. However there are only three graves containing arrowheads, in which dental remains have been found. Out of a total of 12 caries occurrences, five are found in graves with sickles or scythes.

The differences in population members' access to nutritional resources have been studied using trace elements by Liden et al. (1997), but they did not found any differences in the Vendel and Viking period boat graves from Uppland. Differential access to food resources was however shown by Schutkowski (1995).

Finally correlations between different archaeological find types and pathologies were calculated with an SPSS computer program (see Appendix 8). This was done mainly in order to find out whether some correlation to livelihood could be found. The main point of interest was to find out whether scales, weights and coins (possible traders' objects), or weapons and horse equipment (possible warriors' objects), had a correlation with dental pathologies. The following correlations were obtained:

Correlations significant at the 0.01 level:

Trauma – Ornaments **
Trauma – Bronze spirals **

Correlations significant at the 0.05 level:

Hypoplasia – Parts of belts *
Trauma – Stone settings*
Calculus – Textiles*

Unfortunately, no expected correlations were found. It could be assumed that trauma would be associated with the richest graves, but no further conclusions were made. Hypoplasia probably correlates with parts of belts, because both are found in men's graves.

6.3 Genetic relations

Non-metrical traits were recorded and compared to the worldwide distribution of the traits. In this chapter the percentages of traits are compared to populations in neighboring areas and an attempt is made to compare genetic relations inside the Luistari population. Tooth size has also been included in this chapter.

Biological kinship may be studied by using a specific genetic marker revealing Y chromosomal (paternal) kinship, mitochondrial (maternal) kinship or Mendelian inheritance (paternity tests) (Götherström et al. 2002:51). It can be difficult to extract ancient DNA, because it undergoes fragmentation during preservation, so that ancient DNA molecyles are relatively short, normally 100-200 base pairs (Brown et al. 1992:12). Ancient DNA is highly degraded and only a minor part of the extracted DNA is from the studied individual, with the rest being from organisms that have been living in the tissue (Götherström et al. 2002:51-52). However DNA has been extracted from over 11,000-year-old human bones (Brown et al 1992:17). Acidity degrades the DNA molecyles (Brown et al 1992:16).

Skeletal and dental traits are of importance in research on migration and diffusion in archaeology. Any hypothesis regarding immigration (or invasion) should be tested on the biological remains of the peoples concerned, that is, their skeletons (Petersen 1993:178). Traditional archaeological methods, such as typology, are based on secondary evidence, mainly artifacts. Primary evidence, i.e. the remains of the people themselves, is often disregarded. However, in order to obtain the most accurate information, archaeological, skeletal and dental traits, DNA/bloodgroups and linguistic information should all be combined. In principle, language, culture and race are not rigidly interconnected (Zubov 1991:33). The results of studies of craniometric and gene frequency have been found to be in strong agreement with each other (Niskanen 1998a:136). The roots of peoples and languages in Northern Eurasia have been researched in Finland and a paper presenting the results has been published (Julku et al. 1998). One number (4/1998) of the “Muinaistutkija” journal is dedicated to examining the roots of the Finnish population from the archaeological perspective. Aspects of physical anthropology have also been taken into account (Niskanen 1998b).

The conclusions drawn by researcher Markku Niskanen about cranial anatomy can be directly applied to teeth as well. First, the aspects of cranial anatomy affected by natural selection give clues about a population's geographical areas of origin, its subsistence practices and diet. Second, it allows direct and easy comparison of past and present populations. The poor preservation and contamination of DNA in bones will always be a problem (Niskanen 1998a: 135).

Of the many types of biological data that can be retrieved from human skeletal material, the morphological variables of tooth crowns and roots are suggested by Scott et al. as the most informative for genetically characterizing individuals and groups (Scott et al. 1992). It has been shown that dental traits have a strong heritable component (Mizoguchi 1977; Scott et al. 1984, as quoted by Scott et al. 1992). However dental anthropology is not sophisticated enough to resolve population's historical relations and, in the study of historical skeletal populations, dental research must be supplemented with historical/archaeological data (Zachrisson et al. 1997: 99). It has been demonstrated that environmental factors such as nutrition affect tooth size, the depth of the occlusal relief and the degree of asymmetry (Paynter and Graigner 1956; Kruger, 1966; Moller 196; Bailit et al., 1970 as quoted by Kirveskari 1974:7).

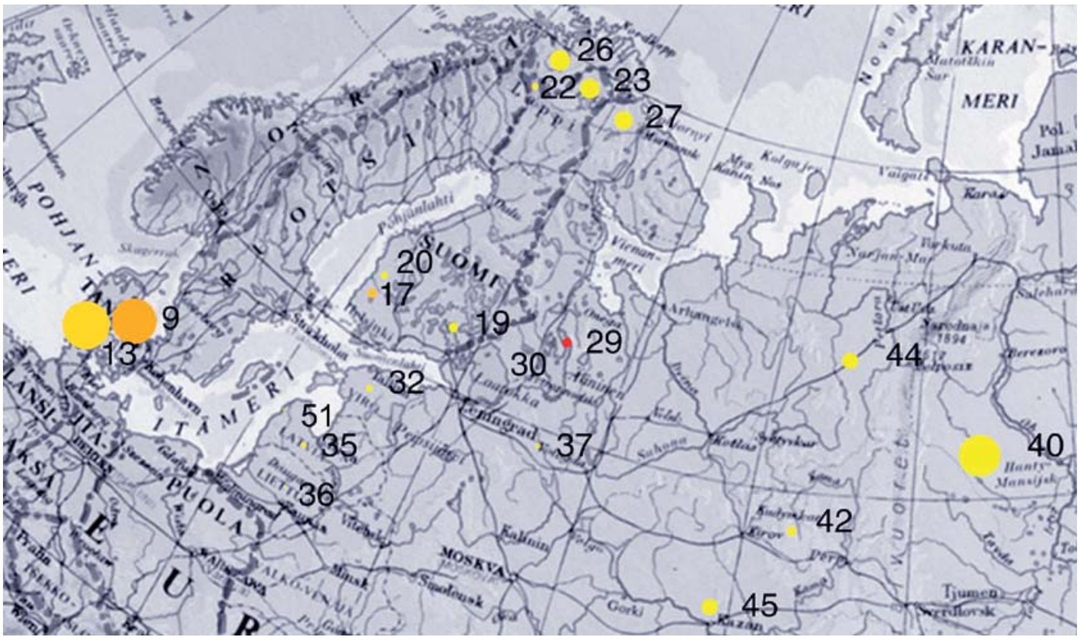
Genetic relationships between Luistari and populations in neighboring areas

Some of the most commonly recorded traits were compared to the distribution in neighboring areas (Scandinavia, the Baltic countries and Russia). These traits are the most frequently recorded and are the easiest to record: inter-observer differences are thus expected to be quite low.

Eastern dental anthropologists divide European dental traits into four groups: Middle European, southern gracile, northern gracile and Northern European relic types (Zubov 1991, Gravere 1987, Haldeyeva 1993). Saami and Finnish teeth usually follow the northern gracile dental pattern (Alexandersen 2003:15). Studies made in eastern (former Soviet Union) countries differ from western research. Eastern researchers are keen to count average taxonomic distances (ATD) between populations and they use some (furrow) traits developed by A.A. Zubov (see for example Zubov 1991, Haldeyeva 1993) with other more commonly used traits. Western dental anthropologists use MMD (mean measure of divergence) statistical analysis.

Shoveling

Specific percentages of shovel-shaped incisors in Northern Europe are shown in the map below.



Map 1 Percentages of shovel-shaped incisors in modern and archaeological populations.

Red - Mesolithic
Yellow – Modern times
The orange shades represent the times in between.
The size of the balls represents the percentages of the trait in populations.
The numbers refer to Appendix 6.
(See Appendix 6 for more information)

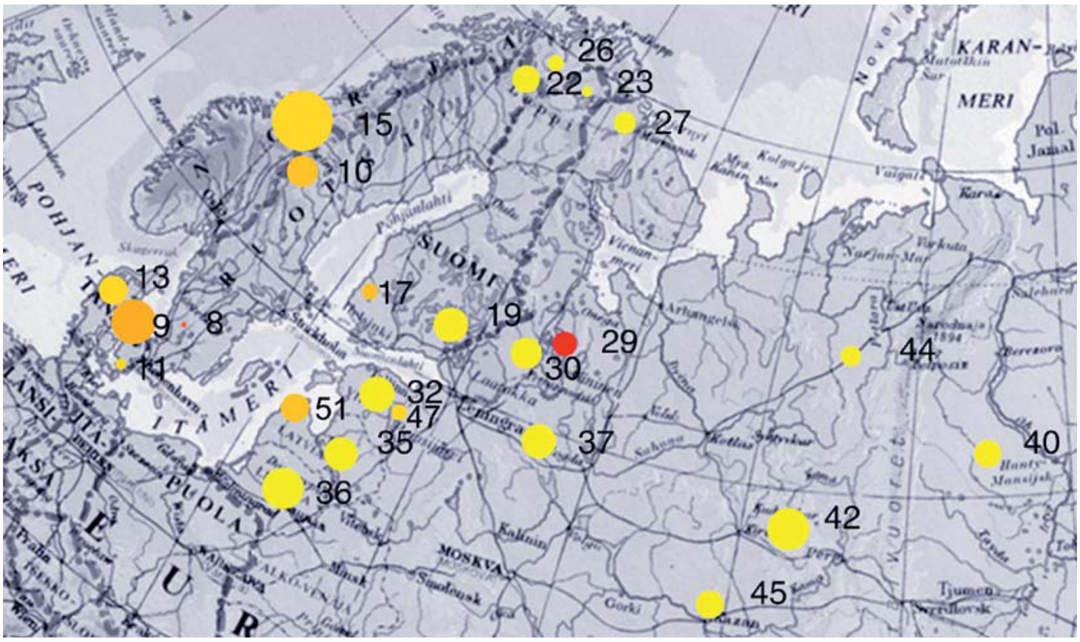
The map shows that low occurrences of shovel-shaped incisors are found in an area stretching from the eastern side of the Baltic Sea to the Ural Mountains in Russia. Saami groups in the north have medium values.

Alexandersen has researched dental traits in Denmark and suggests that, within Europe, shoveling is found in eastern and northern Europe (Alexandersen 2003:15). Zubov (1979:101-104) has shown that shoveling decreases in Russia from the east to the west. This can be seen from the map as well. The Northern European relic type has the highest frequency of shovel-shaped incisors, followed by the northern gracile type (Haldeyeva 1993).

Comparing shovel-shaped incisors to a synthetic map of Europe and Western Asia obtained using the second principal component shows similarities. The highest frequencies are found in the north and the east. The second principal component has been interpreted as migrations of Mongoloid Uralic speakers from Northwestern Asia (Cavalli-Sforza et al 1994:292).

Carabellis cusp

Specific percentages of Carabellis in Northern Europe are shown in the map below.



Map 2 Percentages of Carabellis cusp in modern and archaeological populations.

Red - Mesolithic

Yellow – Modern times

The orange shades represent the times in between.

The size of the balls represents the percentages of the trait in populations.

The numbers refer to Appendix 6.

(See Appendix 6 for more information)

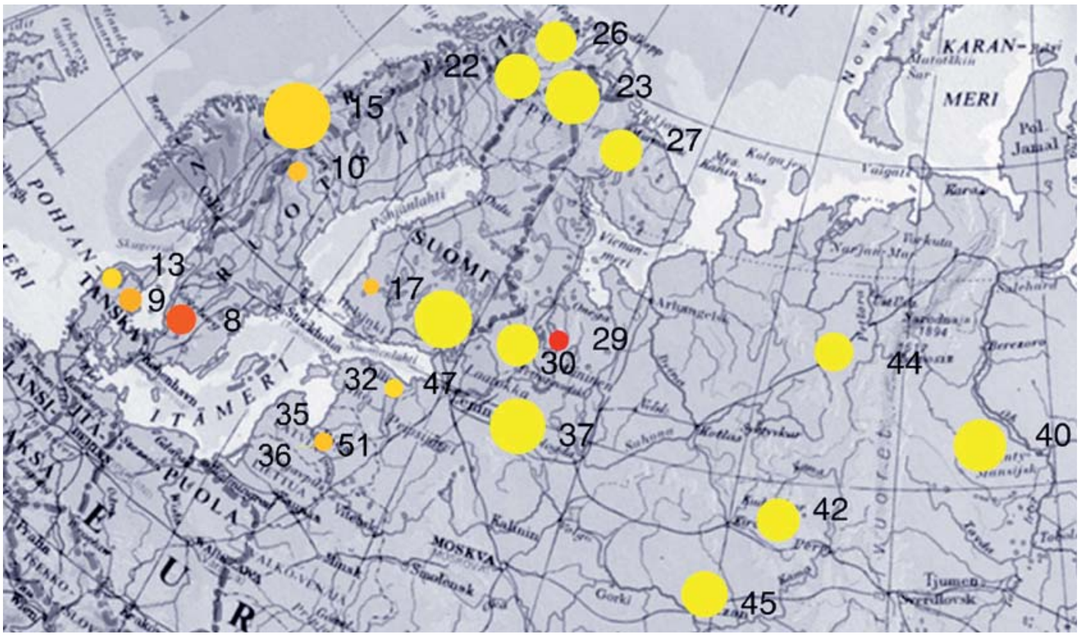
The map shows that Carabellis cusp is not as common at Luistari as in the surrounding areas. Medieval Jouga in Estonia has percentages that are similar to Luistari.

Compared to the worldwide distribution of the trait, the frequency is the highest in Western Eurasia (20-30%). The groups showing the greatest similarity from Western Eurasia are Western Europeans (22.1%) and Eastern Europeans (Slavs) (20.1%). The Finnish-Permian group has a frequency of 16.4%. In prehistoric Europe the frequencies are as low as 0%-10% (Scott et al. 1997: 198-201).

Alexandersen supports the idea of Carabellis cusp being a Western European trait (Alexandersen 2003:15). Carabellis cusp increased in frequency and expression in Europeans because it added mass to the upper molar crown and thereby impeded rapid rates of attrition (Scott et al. 1988:107-108). According to eastern dental anthropologists, the northern gracile type has the highest frequency of Carabellis cusp (Haldeyeva 1993:101).

Hypocone

The specific percentages of hypocone absence in Northern Europe are shown in the map below.



Map 3 Percentages of hypocone reduction in modern and archaeological populations.

Red - Mesolithic

Yellow – Modern times

The orange shades represent the times in between.

The size of the balls represents the percentages of the trait in populations.

The numbers refer to Appendix 6.

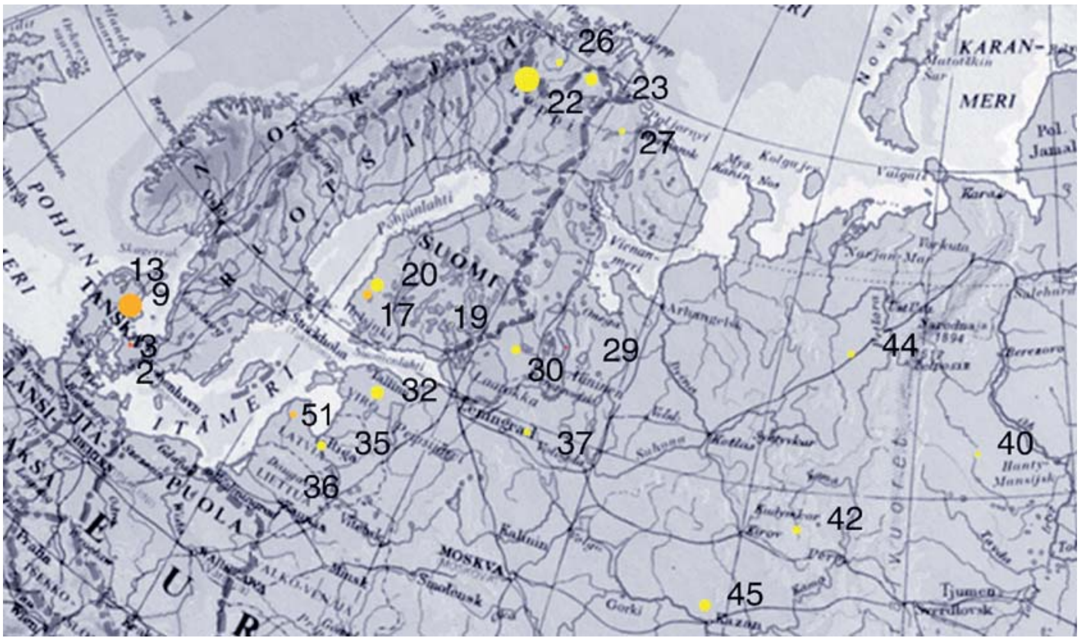
(See Appendix 6 for more information)

The map shows that the trait is more common in modern than prehistoric teeth. Again, similar percentages are found from Medieval Jouga in Estonia (no. 47 in the map).

The frequency of the trait in Europe should be over 20%. The early European (19.4%) group had a slightly lower frequency (Scott et al. 1997:194-197). The map above supports the idea that the frequency in prehistoric Europe was lower.

Cusp number of lower first molar

The specific percentages of the cusp number of the lower first molar in Northern Europe are shown in the maps below.

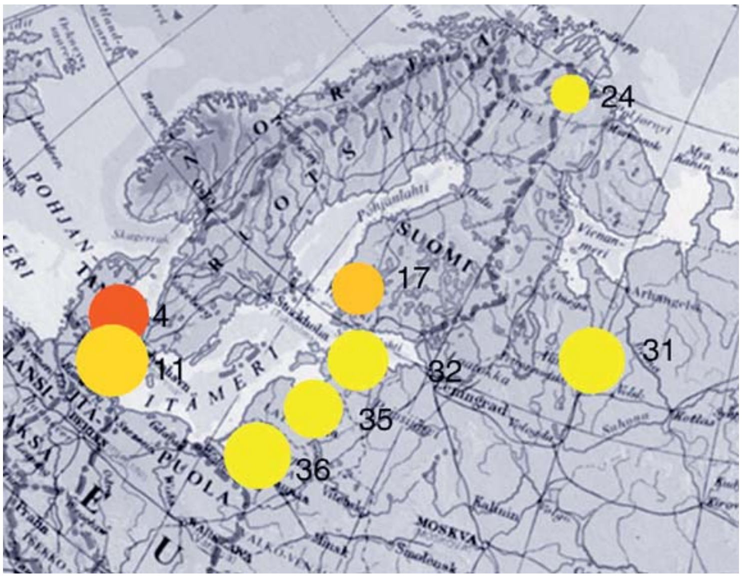


Map 4 Percentages of four-cusped lower first molars in modern and archaeological populations.

Red - Mesolithic
Yellow – Modern times
The orange shades represent the times in between.
The size of the balls represents the percentages of the trait in populations.
The numbers refer to Appendix 6.
(See Appendix 6 for more information)

The percentages are low in most populations. The trait does not seem to be a good indicator of differences in the research area.

Previous studies have shown that four-cusped lower first molars are the most common in Western Eurasian populations. Within Western Europe it is supposed that they are more common in Northern Europe (about 10%) than in Western Europe (about 7.5%) (Scott et. al. 1997: 207-208).



Map 5 Percentages of five-cusped lower first molars in modern and archaeological populations.

Red - Mesolithic

Yellow – Modern times

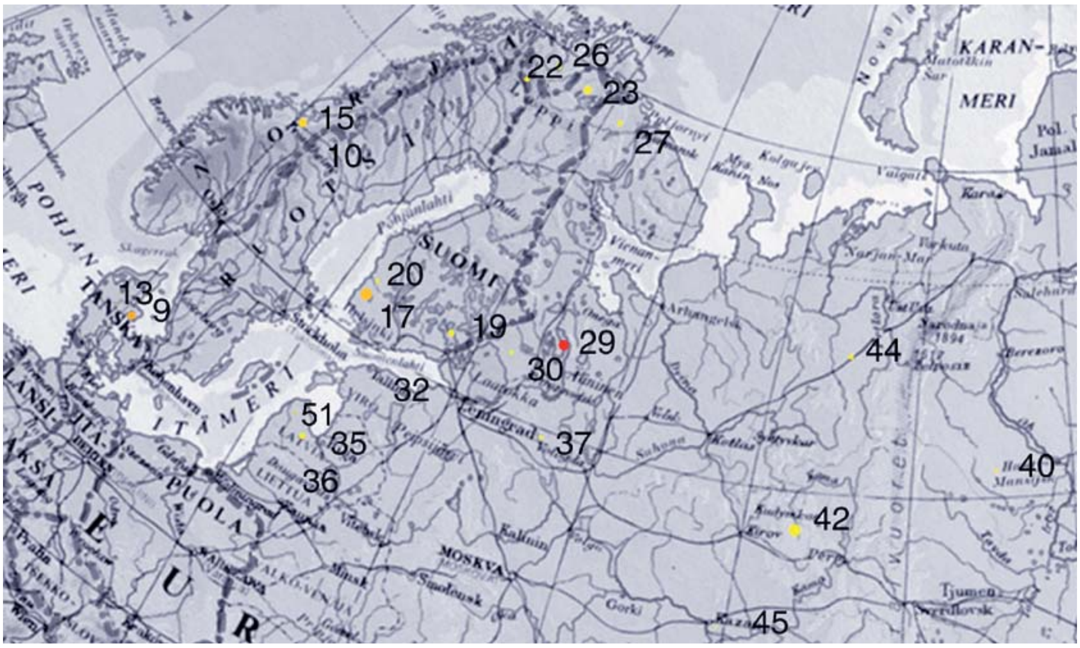
The orange shades represent the times in between.

The size of the balls represents the percentages of the trait in populations.

The numbers refer to Appendix 6.

(See Appendix 6 for more information)

The percentages are quite equal in most populations. The trait does not seem to be a good indicator of population differences in the research area.



Map 6 Percentages of six-cusped lower first molars in modern and archaeological populations.

Red - Mesolithic

Yellow – Modern times

The orange shades represent the times in between.

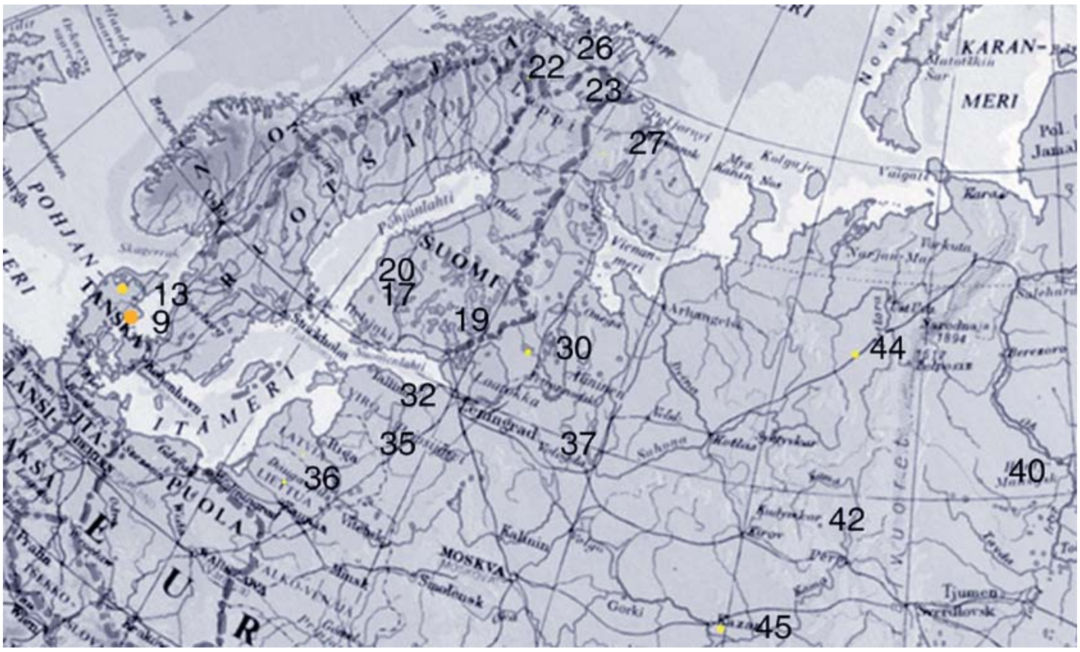
The size of the balls represents the percentages of the trait in populations.

The numbers refer to Appendix 6.

(See Appendix 6 for more information)

The frequencies are low in all the research areas, but the prehistoric percentages seem to be somewhat higher.

It is supposed that cusp 6 is an eastern trait (Alexandersen 2003:15, Scott et. al. 1997:215).



Map 7 Percentages of seven-cusped lower first molars in modern and archaeological populations.

Red - Mesolithic

Yellow – Modern times

The orange shades represent the times in between.

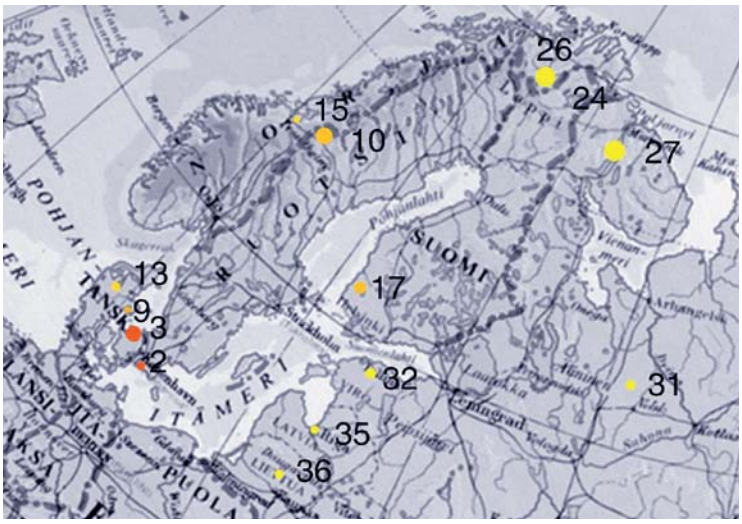
The size of the balls represents the percentages of the trait in populations.

The numbers refer to Appendix 6.

(See Appendix 6 for more information)

The map shows that the trait frequencies in the research area are low (ranging mostly from 1 to 9 %). Only in Iron Age Denmark are the frequencies somewhat higher (from 13 to 18 %).

It is supposed that cusp 7 is an eastern trait (Alexandersen 2003:15 Scott et. al. 1997:218).



Map 8 Percentages of five-cusped lower second molars in modern and archaeological populations.

Red - Mesolithic

Yellow – Modern times

The orange shades represent the times in between.

The size of the balls represents the percentages of the trait in populations.

The numbers refer to Appendix 6.

(See Appendix 6 for more information)

The map shows quite equal percentages of the trait (9-20%). The Saami groups have somewhat more five-cusped lower second molars (22-27%).

Only a few studies of dental traits have been made in this area. Therefore, data from different periods ranging from the Mesolithic times to Modern times have been used in the same picture. However large areas in the map do not have any comparative data. When more research is done on the subject, the roots of the Luistari population will also be clarified. A statistical distance analysis between different groups could then also be made.

Not all dental characteristics are regarded as having the same value for studies of racial comparison (Hanihara 1967: 925, Kirveskari 1974: 61).

For some traits - including shovel-shaped incisors, the Carabellis trait and cusp 6 - the between-group differences are so pronounced that workers have defined Mongoloid and Caucasoid dental complexes (Scott et al. 1988:102-103). Shovel-shaped incisors, the reduction of lower molars and the Carabellis trait are cited by Kirveskari (1974:61) as the best racial characteristics. He also noted that many studies have shown that, while hypocone has no racial diagnostic value, it may be useful in distinguishing two closely related populations (Kirveskari 1974: 29). In this work, too, shovel-shaped incisors, the Carabellis trait, hypocone reduction and five-cusped lower second molars appear to be the best traits showing between-group differences. Four- and five-cusped lower first molars do not seem to be a good indicator of population differences in the research area.

Appendix 9 presents the archaeological origins of archaeological finds from the graves (as represented by Lehtosalo-Hilander 1982:b). These are compared to the traits that have been analyzed in this chapter. Only those that proved to be the best for differentiating the populations have been presented. They are shoveling, Carabellis cusp, hypocone and five-cusped lower second molars. No connections were observed between artifacts and trait origin, however.

Genetic relationships of the Luistari individuals and other applications of non-metric dental traits in archaeology

An attempt was made to group individuals having the most similar dental traits, in order to find relatives among the individuals buried. The recorded dental traits were fed to an SPSS statistics computer program and a cluster analysis was attempted (two-step cluster analysis). However, too many teeth were missing for taphonomic reasons. Therefore, no meaningful results could be obtained. Multivariate analysis seemed a promising method in skeletal samples where most of the teeth are preserved. In Finland this method could be tested on a medieval or Leväluhta skeletal population, for example.

Cluster analysis has been used in Olennij Ostrov to divide graves into groups based on artifacts, cranial dimensions and femur length. This data has been used to divide the skeletal population into two sub-groups. One sub-group anatomically represents modern homo sapiens, while the other has been suggested to represent a remnant of the Neanderthal type of homo sapiens (Jacobs et al. 1996:202-206).

Research on family relations based on dental morphology has been done before, but, as far as I know, no statistical comparisons have been made. Mostly these studies are based on rare, genetically determined traits as in Dolni Vestonice (Alt et. al. 1997, as quoted by Alexandersen 2003:11). Another example comes from the megalith graves at Kyndeløse in Denmark. There, the dental morphological distance between the two periods is smaller than between the two grave chambers from the same period. This could be coincidental, but the different frequencies of the inherited Carabelli's tubercle and the agenesis of the wisdom teeth in the two grave chambers indicate that they contained two different families (Alexandersen 2003:18). The third example comes from Norway. Sellevold interpreted the agenesis of all 4 wisdom teeth among individuals from northern Norway (Ytre Elgsnes) as an indication of family similarities (Sellevold 1998, as quoted by Alexandersen 2003:27). A fourth example also concerns the agenesis of all four wisdom teeth. Many individuals from Skovgården Denmark have been found with this trait, which has been considered as a sign of close family relations (Bennike et al. 2000:375). There is still another example of the study of family relations in Mesolithic Skateholm in Sweden. Two individuals in the double grave 63 both had long enamel extensions on the molars and this trait was not common in the populations. It is possible (but unprovable) that these two individuals were related to each other. A few other traits were also researched and mapped. In an earlier grave field, these traits are found in graves near each other, but in Skateholm 2 they are more spread out (Alexandersen 1988a: 152). Unfortunately, rare morphological traits such as the agenesis of teeth could be observed in only one grave at Luistari.

Rare morphological traits could also be compared, for example, to modern dental material. This could be done either by direct observation from volunteer’s mouths or by using plaster casts. Dentists do not normally record these dental traits, except for major anomalies, such as congenitally missing teeth or supernumerary teeth. However dentists cannot give information on their patients without permission. It would be an interesting subject of study to compare the dental traits obtained from Luistari to modern dental traits in the Eura parish.

If rare genetically determined traits are found from two individuals, either from skeletal samples or from a skeletal sample and modern dental material, family relations could be tested using DNA analysis.

Size of teeth

Crown diameters show a small, but positive, correlation with the body size and sex of the deceased. It is also known that the size of human teeth has been reduced over time at least from the late Pleistocene period up to the present day. Tooth size also varies in different regions of the world (Brace et al. 1991:33-59). Tooth size shows a modest (2-7%), but consistent, sex dimorphism.

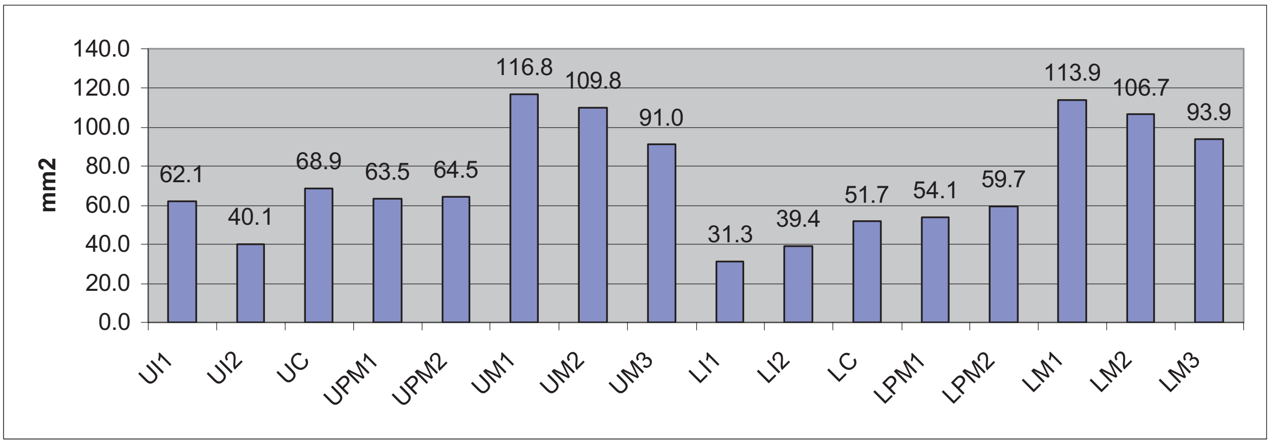


Chart 1. Average tooth sizes of all tooth classes at Luistari

U - Upper jaw (Maxillary teeth)
L - Lower jaw (Mandibular teeth)

I - Incisor
C - Canine
PM - Premolar
M - Molar

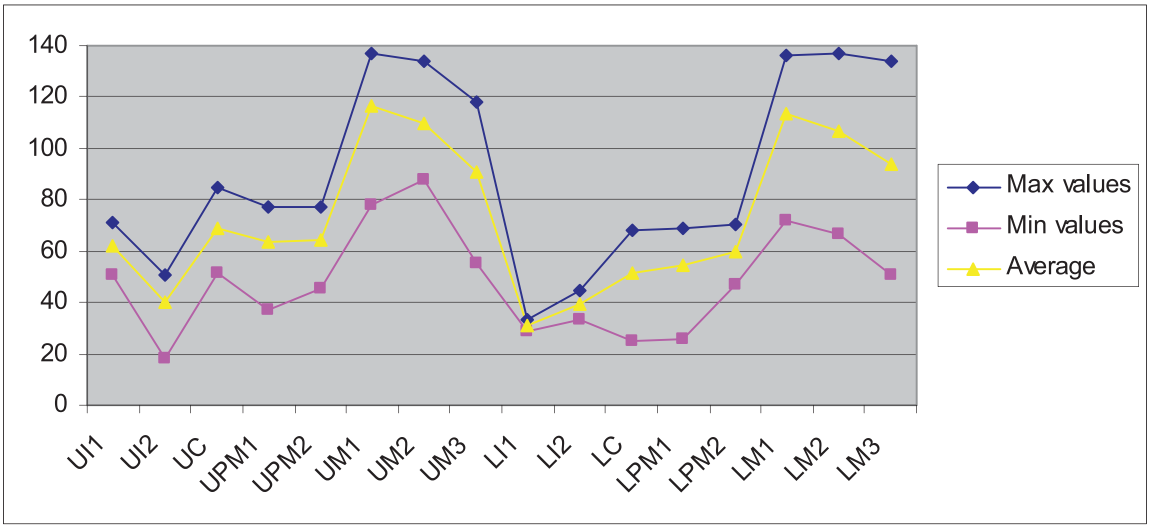


Chart 2 Range of tooth sizes of all tooth classes at Luistari

U - Upper jaw (Maxillary teeth) I - Incisor

L - Lower jaw (Mandibular teeth) C - Canine

PM - Premolar

M – Molar

The summary tooth size of all the teeth (1167.2 mm^2) can be compared to different regions of the world. It can also be compared to earlier stages of hominid evolution. The midsex mean tooth size, computed from the averages of female and male teeth, (1186.8 mm^2) was also used in comparisons. Some comparisons were made using summary tooth sizes, not including incisors and third molars (809.6 mm^2). Australians have the largest teeth in the world and Europeans and Asians the smallest (Hillson 1996: 82). Tooth size has been reduced through time since the beginning of the late Pleistocene (Brace et al. 1991: 39).

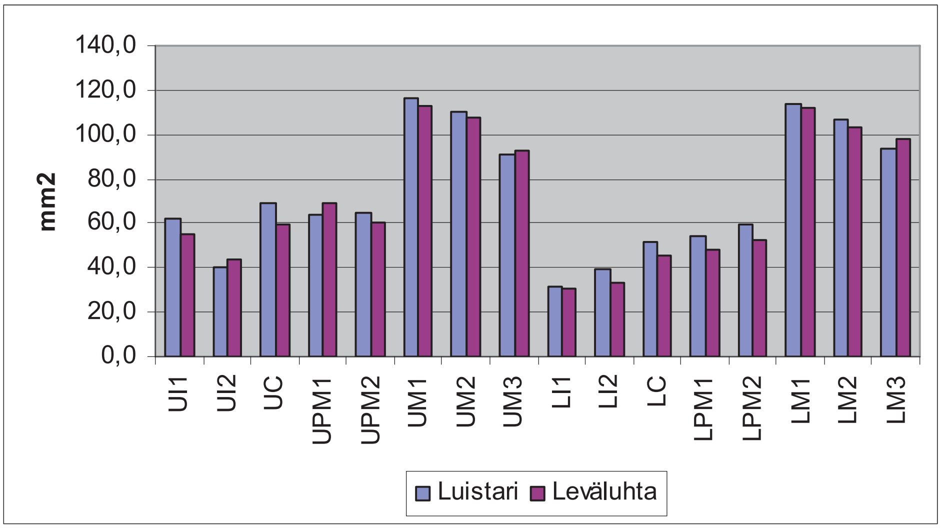


Chart 3. Luistari and Leväluhta mean tooth sizes compared

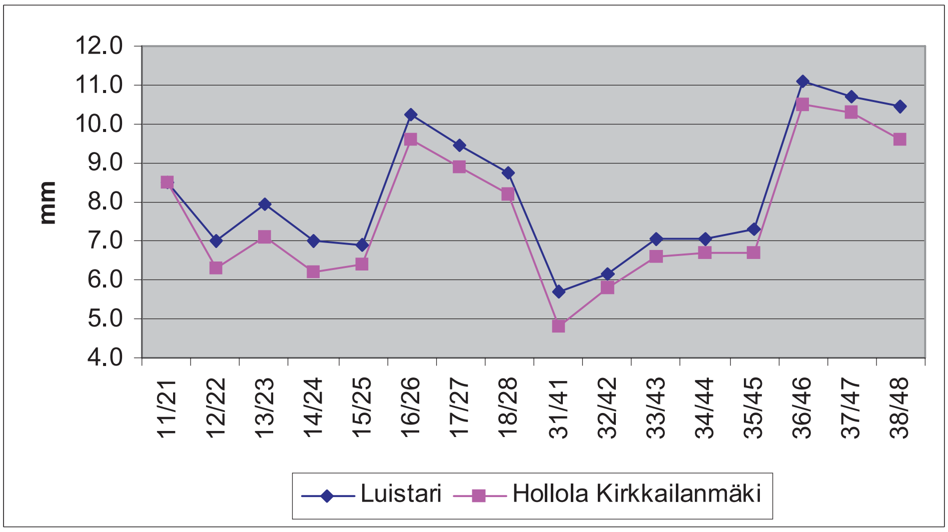


Chart 4. Mesio-distal tooth dimensions in two Iron Age cemeteries in Finland

Leväluhta and Hollola are geographically and chronologically the closest places that can be used for comparison. In general Leväluhta and Hollola individuals have smaller teeth than Luistari individuals. However, it must be kept in mind that there is a female preponderance in the Leväluhta material (Formisto 1993: 101).

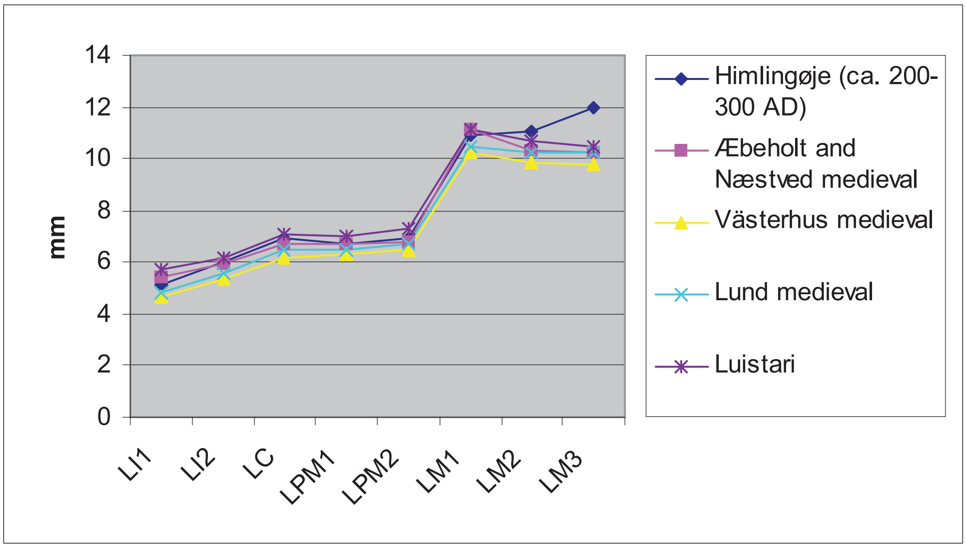


Chart 5. Mesio-distal tooth dimensions from five Scandinavian excavation places

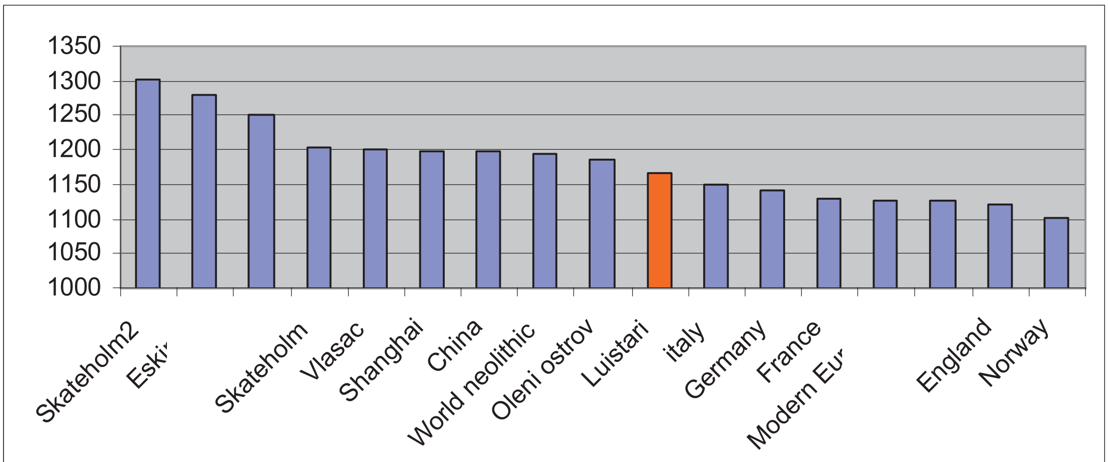


Chart 6.

Tooth size (TS) of Luistari compared to modern and prehistoric populations

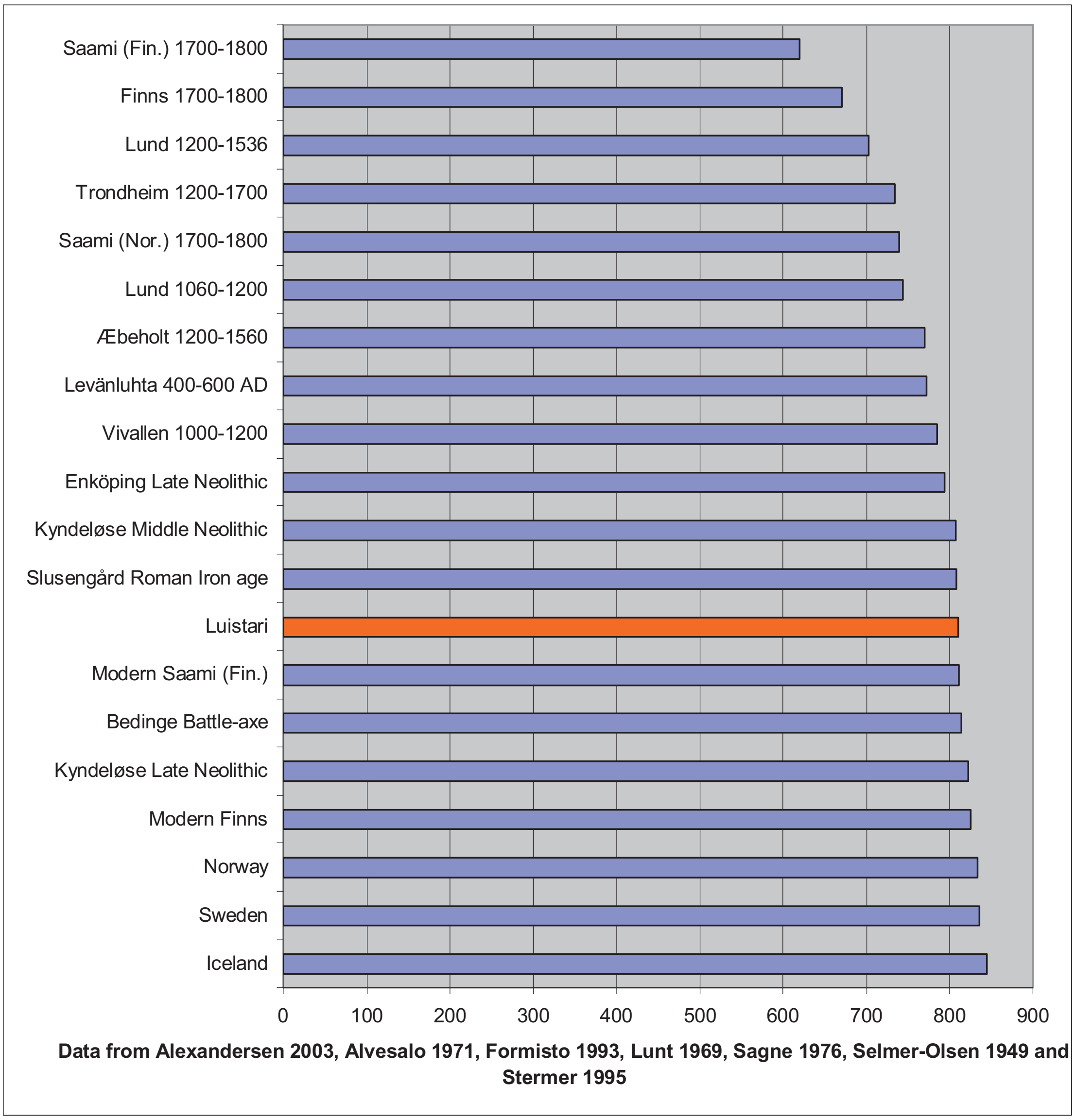


Chart 7. Tooth size (TS, not including incisors and third molars) of Luistari compared to modern and prehistoric populations

Worldwide comparisons of tooth size give interesting results. Luistari individuals have bigger teeth than could be expected. Modern Europeans have smaller teeth than Luistari individuals and the closest modern comparisons are found in the Far East. Tooth size alone suggests an eastern origin for the Luistari population. Chronologically, the Luistari tooth size is closer to Neolithic values and a Mesolithic site (in Russia, not far from Finland) than contemporary sites (in Scandinavia). It has been assumed that the amount of dental reduction is related to changes in diet and skeletal robusticity, with meat eating populations having preserved larger teeth (Smith 1982: 366-377).

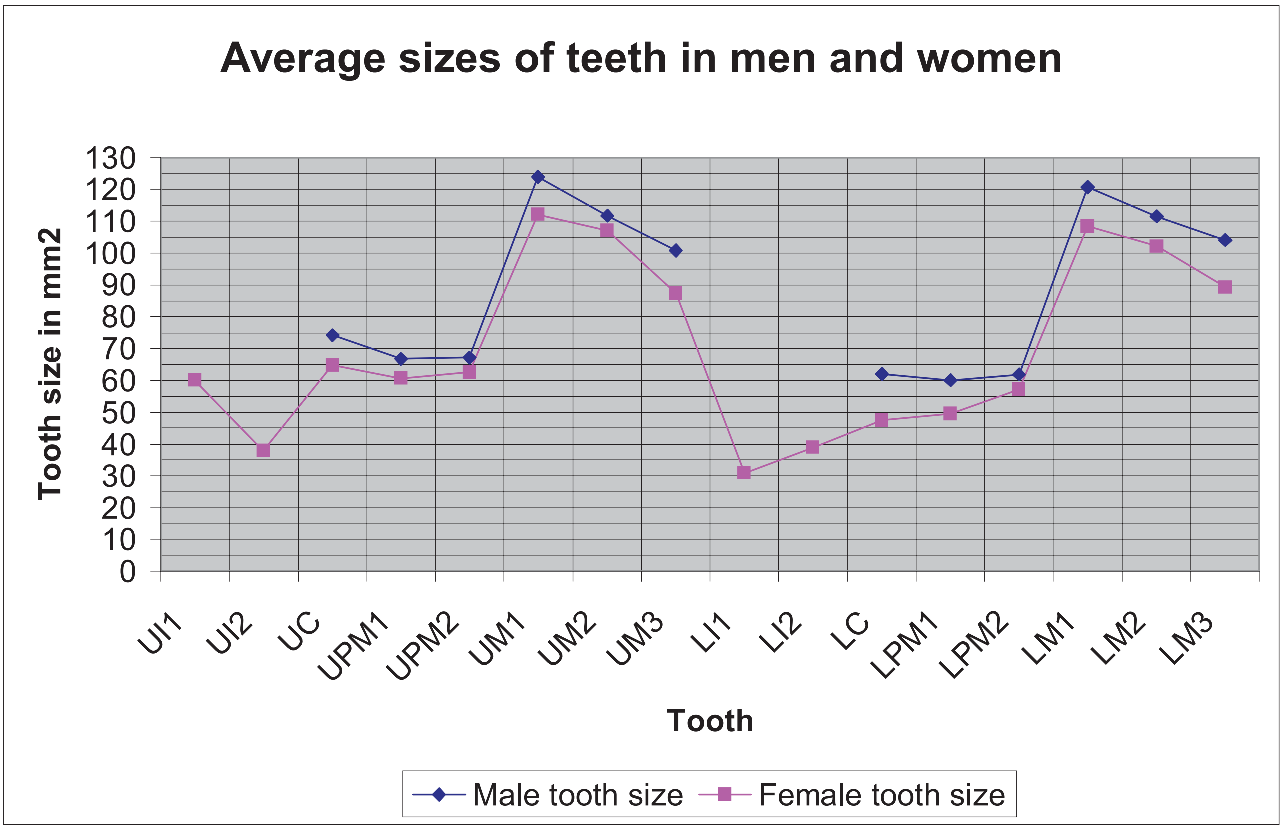


Chart 8. Average sizes of teeth in men and women

As shown in chart 8, male teeth tend to be larger than female teeth.

Some graves from Luistari have not been sex-estimated in previous studies. These graves are mainly children's graves and double burials. An estimation of the sexes of some of these individuals was made based on the average tooth sizes of men and women. All the individuals that had at least one measurable permanent tooth preserved were included in the study. If the tooth sizes of two or more teeth showed values above the mean tooth size of men, and if no values below the average tooth size of all individuals were shown, an individual was estimated as being male. If the tooth size of two or more teeth showed values below the mean tooth size of females, and if no tooth had closer values to men's average tooth size, an individual was estimated as being female. If the values were between the mean female tooth size and the average tooth size of all teeth, an individual was estimated as being possible female. And vice versa with men. One grave, namely 290, gave both male and female values. It has been age-estimated as the youngest. It was not possible to estimate the sex of two still younger individuals from gave 139, because the two permanent teeth from the graves could not be measured.

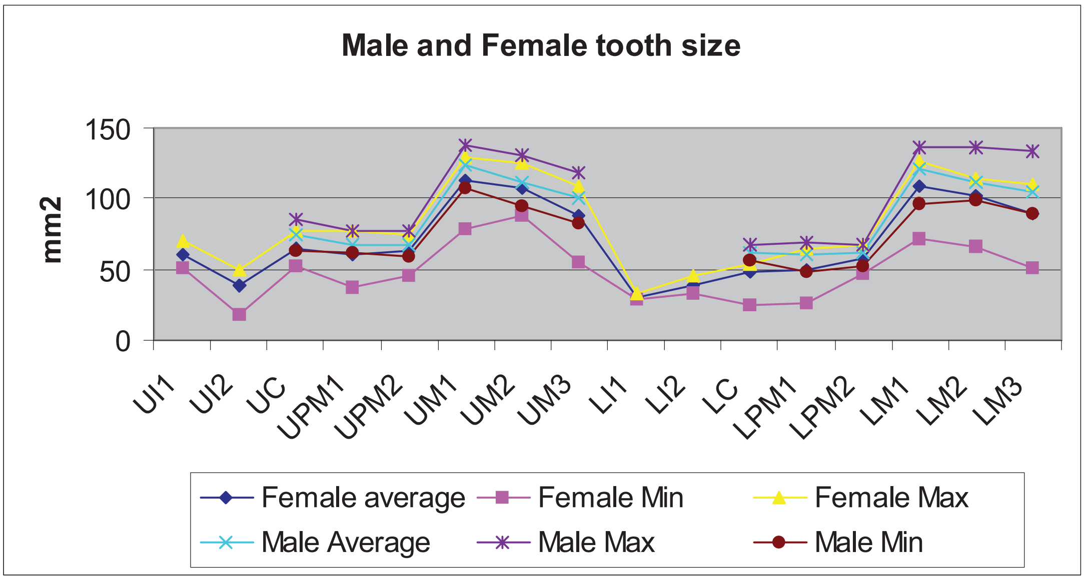


Chart 9. Male and female tooth sizes compared

The above figure shows the maximum and minimum values of female and male tooth sizes. The reliability of the sex estimations, based on the tooth sizes of Luistari individuals, can be valued by comparing the minimum values of the male teeth and the maximum values of the female teeth. In this case, for example, the smallest male teeth seem to be as big as the average female teeth and the largest female teeth seem to be only a little larger than the average male teeth. In my opinion, this makes the following estimates quite reliable.

Table 22. Sex estimations

Grave	Sex estimation	Age
22	Female?	
41	Female	4-10
98	Female	
273	Male	22
285a	Male?	5-9
290	?	4-5
295	Female	
303	Female	
313	Female	6-11
335b	Female	Child?
358	Female?	
404	Female	

Sex estimations based on teeth are thought to be uncertain. In fact, the Recommendations for Age and Sex Diagnoses of Skeletons recommend that only deciduous teeth be used in sex diagnosis (Workshop of European Anthropologists 1980: 525). Sex estimation based on tooth size has been attempted at Skateholm and Trondheim (Alexandersen 1988a: 149, Stermer et al. 1995: 274-284). Alexandersen estimated a 75% level of trust for the method and preferred the unworn and slightly worn teeth of juveniles and younger adults (Alexandersen et al. 1993:16). Canines are usually found to be most sexually dimorphic (Lunt 1969: 33, Sagne 1976: 100, Sten et al. 2000: 77). In some cases it can be very difficult to make any other types of sex estimation.

In areas such as Finland, where other bone material has not been preserved, teeth are still intact. Teeth are the only bones left for sex estimation. The remains of children are usually also difficult to sex-estimate, because some characteristics do not appear until their teens. (Permanent) teeth are valuable in sex estimations, because once developed, their size or form does not change. However, tooth size varies among populations and sexes, so no universal female/male tooth sizes can be given. Before making sex estimations based on tooth size, it is good to calculate the average tooth size and gender of the population. The anterior teeth were the last to be reduced intact with the general gracilisation which began in the late Upper Paleolithic and Mesolithic periods and continued through the Neolithic. A minimum was reached during the Middle Ages (Alexandersen 1988a:154-155, Alexandersen 2003:

26). It has been suggested by Goose that alterations in the nutritional status generate fluctuations in tooth size over a few generations (Goose 1971, as quoted by Alexandersen 2003:21). Change of diet (from hunter-gatherers to agriculturalists), food preparation, climate, diminished skeletal robusticity and perhaps even the replacement of the use of teeth as tools by other tools (blade tools) may have diminished tooth size, but only over a longer time span (minimum 40,000 years) (Smith 1982: 366-377). As tooth size has been reduced from Paleolithic times to modern times, sexual dimorphism has also decreased (Armelagos et al. 1980:437-446). Dimorphism in the mandibular canine has been reduced from 18% in the Paleolithic period to 13% in a modern population (Frayer 1978: 85). It could be concluded that teeth are the most resistant to evolutionary changes of all the bones, and have also preserved the best sexual dimorphism. Therefore, they are valuable in sex estimation.

The sex of five children was estimated. Two of them were estimated as boys and three as girls. Thus, grave 285 contained not only a woman, but also the remains of the teeth of a boy child. A woman and a girl child were buried in grave 335. Two graves (graves 22 and 98), previously not sex-estimated, were now considered to be women's graves. Four individuals from double or multiple graves (graves 295, 303, 358 and 404) were also analyzed. All of them were estimated to be females. It was previously assumed that grave 303 contained a man and a child, but the teeth were estimated as belonging to a woman.

7. Conclusions

The aim of this study was to show how dental remains could be used in archaeological research in Finland.

The number of individuals in graves can be determined more accurately by counting the MNI from teeth or bones. Age estimations can also be made. Teeth can give more accurate ages of both immature and adult individuals than other bones can. However, for taphonomic reasons, demographic indicators such as child mortality, birth and death rates, generation length, the life expectancy of men and women and mean longevity could not be established at Luistari. Archaeologists' estimations concerning the ages of children or adults can be further refined. At Luistari, the youngest individual was about 1-2 years old and the oldest about 44-64 years old. Age can be further compared to artifacts, dental diseases, etc. At Luistari, the people who died young had different dental diseases than those who lived longer. Similar results have been obtained before. Hopefully, the potential of dental diseases in assessing age will be tested in future research.

The distribution of dental diseases in men, in women and in graves containing different artifacts can reveal differential access to food resources. Differential access to food resources is related to equality and the tasks of different members of society. At Luistari, the differences were small, which speaks for equal access to food resources. Some exceptions were noticed, however. Hypoplasia was more than three times as common in men as in women. Women may have had better nutrition and health, or they may have died as children more often from conditions leading to hypoplasia. That could explain the under-representation of women's graves at Luistari. Caries was observed to be more common in the graves of supposed farmers and absent in the graves of supposed hunters. Subsistence-related objects seemed more closely related to dental diseases than the wealth of the grave.

The history of dental (and other) diseases and their connection to subsistence is of interest to researchers in subjects such as dentistry and medicine, too. The history of caries, calculus and hypoplasia in the Nordic countries was presented. Further research on prehistoric dental diseases has been done in Sweden and especially in Denmark. Hopefully, the amount of research done on prehistoric Finnish teeth will also increase in the future. At Luistari a few rarely found diseases were also observed from x-rays. On the basis of dental diseases alone, it was suggested that the Luistari population would have lived more in a mixed economy and did not subsist totally on agriculture, as all the other finds imply. Only minor changes in the frequencies of dental diseases through time could be observed. Possibly agriculture became more popular after the Viking III period. It could even be surmised that fewer famine years were encountered during the later periods. Hopefully, pollen analysis and trace element analysis will be done in the future, in order to more accurately describe the Luistari economy. The small traumas in the teeth enamel are probably due to small millstone particles ending up in the food. There were no other signs of the use of teeth as tools and no signs of the practice of dental hygiene or dentistry. Hopefully, enamel microwear analysis will be done in the future and more information will be obtained about the attrition and abrasion of teeth.

Teeth can also be used to reconstruct the genetic relations of archaeological populations. Spatially and temporally close comparative dental anthropological research is rare. Most of the compared traits had similar frequencies to the Estonian medieval Jouga cemetery. Hopefully, it will be possible to compare different dental genetic markers to the Luistari frequencies in the future. An interesting research subject would be to compare the Luistari genetic dental traits to other late Iron Age cemeteries in Finland or to compare genetic markers to the modern population of Eura. Dental genetic markers could also be used in researching family relations. Because rare genetic markers were found from only one grave, no conclusions could be drawn concerning closely-related individuals at Luistari. A comparison of combinations of the more usual dental genetic markers was attempted using cluster analysis. However, too many observations on teeth were missing for taphonomic reasons. Therefore no meaningful results could be obtained. However, multivariate analysis seemed a promising method in skeletal samples where most of the teeth are preserved. In Finland this method could be tested on a medieval or Leväluhta skeletal population, for example. The Luistari teeth were large - as large as Stone Age teeth. It is also suggested that the size of the teeth is a good indicator of sex and therefore should be used more widely in osteological and forensic research - especially when other skeletal material is poorly preserved, as in Finland. Teeth size was used to estimate the sex of eight individuals whose sex was previously unknown.

The problems encountered during the research were mainly due to taphonomical factors. The lack of research on teeth from archaeological sites also hindered comparisons. Taphonomical factors could be minimized if osteological analyses were carried out directly, or even during the excavations. They would be most important in excavations of closed assemblages such as skeletons.

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Appendix 1: Explanations of osteological terms used

Abscess	Inflammatory periapical cavity
Alveolar	Tooth sockets in jaw
Ante mortem	Before death
AMTL	Ante mortem tooth loss
Anterior	Towards the front (al side)
Apex	Tip of the root
Apical	Towards the tip of the root
Arvicola terrestris	Water vole
ASU system	Arizona State University system (see Turner et al. 1991)
Bos Taurus	Cow
Buccal	Tooth surface facing the cheek
Buccolingual (BL)	Width of the tooth in the Buccal-Lingual direction
Calculus	Secondary, calcified deposit found on the sides of the tooth
Canine	Eyetooth
Canis familiaris	Dog
Capra hircus	Goat
Caries	Decay of dental tissues
Carsinoma	Cancer
C.D.I	Comparative dental index (see Olsson et al. 1976)
Cementum	Bonelike tissue that covers the external surface of the tooth roots
Cingulum	Ridge of enamel that encircles the sides of a tooth crown
Cranium	Skull
Cusp	Major elevation of the occlusal surface
Dexter (Dx.)	Right
Distal	The tooth surface facing away from the symmetrical midline of the jaw
Enamel	Puter layer of tooth
Equus caballus	Horse
FDI	Federation Dentaire Internationelle
Femur	Thighbone

Fossa	Pit
Fovea	Small concavity
Hypersementosis	Layering of cement around the tooth roots
Hypoplasia	Disturbance in mineralization of enamel
Incisor	Anterior tooth
Labial	The tooth surface facing the lips
Lingual	The tooth surface facing the tongue
Mandibula	Lower jaw, mandible
Maxilla	Upper jaw
Mesial	The tooth surface facing the symmetrical midline of the jaw
Mesiodistal (MD)	Length of the tooth in the Mesial-Distal direction
MNI	Minimum number of individuals
Molar	Molar tooth
Non-metric traits	Morphological variations which can be recorded by their presence or absence
Occlusal	The tooth surface facing the teeth of the opposing jaw
Osteoporosis	Loss of bone mineral
Ovis aries	Sheep
Palatine torus	Congenital trait of Maxilla and Mandible
Periodontitis	Inflammatory bone loss in the jaw
Phalang	Finger bone
Post-cranial	Other bones except the cranium and mandible
Postmortem	After death
Premolar	Premolar tooth
Radical	Pertaining to the root (lat.radix)
Secondary dentin	New dentin formation in worn tooth
Sinister (sin.)	Left
Sulcus	Groove
Sus domestica	Pig
Temporo-mandibular joint	Joint between temporal bone and the lower jaw
TS	Summary tooth size

Tuberculum Small elevation

(The aspect of a tooth which is towards the middle of the jaw(s) is **mesial,** while its opposite is **distal**. The aspect of a tooth which is towards the cheek is **buccal** and that which is nearest the tongue is **lingual**. The surface that contacts the tooth in the opposite jaw is **occlusal.**

The major part of the tooth is **dentin**, which forms the core of the tooth. The crown is covered by **enamel** and the root is covered by **cement**. In between the crown and the root is the **cervix**, the neck of the tooth.

The **pulp** chamber is situated in the middle of the tooth.

In the occlusal surface of premolars and molars, there are **cusp**s (major elevations) and **fissures** (depressions). Grooves are linear depressions and ridges are linear elevations of the occlusal surface. **Fossae** refer to major deoressions, while the **cingulum** is the convexity near the cervical margin.)

Appendix 2: Dental material grave by grave

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
88	-	-								

Grave 301

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
151	1	13				1:1	1	H	PE	
	2	15	5,3	5,4	7,9	8:0, 9:0, 16:0	4		E	
	3	16				12:5, 14:2, 16:0			PE	
	4	17	4,5	10,3	8,6	11:3.5, 12:5, 13:0, 14:0 15:0, 16:0	4		E	
	5	23	9,7	5,9	6,9	1:1, 3:1, 5:5-, 6:0, 7:0	1	H	E	
	6	24	6,8	7,7	5,3	3:0, 8:0, 9:0, 10:0, 16:0	1		E	
	7	25	5,5		7,5		1		PE	
	8	26	5,0	9,5	9,2	11:4, 12:4, 13:0, 14:1, 15:0, 16:0	4		E	
	9	27				11:3.5, 12:4, 13:0, 14:0, 15:0, 16:0	4		PE	
	10	33				1:1, 3:0, 7:0	1	H	PE	
	11	34	9,0	5,2	7,8	3:0, 8:1, 10:0, 16:0	1		E	
	12	35		5,7		22:03	1		PE	
	13	36	4,6	10,0	9,0	23:0, 24:+, 25:6, 26:0, 27:0, 28:0, 29:4, 30:2, 31:0	4		E	
	14	37	4,4	9,6	8,9	24:+, 25:4, 27:0, 28:0, 29:0, 30:0, 31:0	4		E	
	15	45	5,5	5,6	7,5	22:03	1		E	
	16	47				28:0, 25:4, 29:0, 30:0, 31:0			PE	
	17	M							PE	
	18	I				3:0			PE	
	-	-							(PE)	

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
419	1	13		6	6,3	1:1, 3:0, 5:0, 6:0, 7:1	1	H	E	
	2	17		8,9	9,2	11:3.5, 12:3, 13:0, 14:0, 15:0, 16:0	5		E	
	3	18/28					1	Car	E	
	4	34	5,8	5,0	5,9	3:0, 22:1	1		E	
	5	35	4,8		~6,2	22:3	2		PE	
	6	16/36	3,3	8,4		3:0	15		PE	
	7	43		5,1			1,5		PE	
	8	44	5,5	5,0	5,8	3:0, 22:0	2		E	
	9	47/48	5,4	8,9	8,1	24:+, 25:4, 26:0, 27:0, 28:0, 29:0, 30:0, 31:0	6		E+PC+PD	
	10	47	4,2	8,6	9,7	24:y 25:4, 26:0, 27:0, 28:0, 29:0, 30:0, 31:0	18		E+PC+PD	
453	-	M Mand dx				24:+, 25:4, 27:0, 28:0, 29:0, 30:0, 31:0	5		PE	
464	-	22	7,9			3:0, 20:0	3		PE+C+PD	

Grave 9

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
1018	1	13	6,6	6,2	7,1	1:3, 3:0, 5:5-, 6:1, 7:2	4		E+C+PD	
	2	24	3,2	4,8	7,3	3:0, 10:0, 16:0	5		E+PC+PD	
	3	C				19:1			C+PD	Root complete
	-	-							(PC+PD)	

Grave 13

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
1129	1	34	5,7			3:1, 22:1	1		PE+PD	
	2	35					2		PE+PD	
1130	1	31							C+PD	In mand. Adult
	2	32							C+PD	In mand. Adult
	3	33							C+PD	In mand. Adult
	4	34				17:1			C+PD	In mand. Adult
	5	35				17:1			C+PD	In mand. Adult
	6	36						AMTL+Ab		In mand. Adult
	7	37						AMTL		In mand. Adult
	8	38						AMTL		In mand. Adult
	9	41							C+PD	In mand. Adult
	10	43							C+PD	In mand. Adult
	11	44	6,4			3:1			PE+C+PD	In mand. Adult
	12	45	4,9		5,5	17:1, 22:1	2		PE+C+D	In mand. Adult
	13	46				24:y, 29:5, 34:2			PE+C+D	In mand. Adult
	14	48				34:1			C+PD	In mand. Adult
1131	1	32		4,5		1:2, 3:2	2		PE+PD	
	2	42		4,2	4,3	1:2, 3:2	3		PE+PC+PD	
	3	47				19:2, 34:1		Car	C+D	Layering of cement
	-								PE+C+PD	

Grave 17

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
1194	1	26/27/28				12:3			PE	

Grave 20

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
1228	1	M							PE	
	-								(PE)	

Grave 22

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
1253	1	13	7,7	6,1	6,6	1:2, 3:1, 5:2, 6:0, 7:1	3,5		E+PC+PD	
	2	18	3,9	6,1	9,4	16:0, 18:1, 19:2, 21:0	20	Car ?	E+C+D	Layering of cement, Adult
	3	28	3,7	5,7	9,4	16:0, 21:0	18		E	
	4	22/12				1:1, 2:2, 3:0, 4:Med, 5:5-, 20:0	4		PE	
	5	14/15	4,4	5,6	8,1	16:0	6		E+PC+PD	
	6	24/25	4,6	4,7	7,3	16:0	4,5		E	
	7	PM Max.				16:0	5,5		PE	
	8	I		~4,9		1:2	4,5		PE	
	9	PM				17:2, 19:2			PC+PD	Root complete
	-								(PE+PC+PD)	

Grave 23 filling

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
1284	1	38/48				24:+		Car?	PE	

Grave 25

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
1362	1	16	6,2	8,5	9,8	11:4, 12:4, 13:0, 14:5, 15:0, 16:1?	11		E	

Grave 35 filling

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
1449	1	16							PE	

Grave 40

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
1487	1	18	~3,5	8,1	8,8	16:0, 21:0	26	Calc+Tr	E+PD	
	2	23/33	~6,7	~5,3		1:2, 3:0, 5:6, 7:2	4		PE	
	3	M					4		PE	
	-								(PE)	

Grave 41

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
1499	1	16	4,3	7,9	8,8	11:3.5, 12:5, 13:2, 14:5, 16:1	4	H	E	(4-10 years old)
	2	21				1:1, 4:0			PE	(4-10 years old)
	3	26	4,5	7,7	8,9	11:3.5, 12:5, 13:3, 14:5, 15:0, 16:1	4		E	(4-10 years old)
	4	36	5,2	9,3	8,2	23:4, 24:+, 25:5, 26:0, 28:0, 29:5, 30:0, 31:0	4		E	(4-10 years old)
	5	46	4,5	8,1	9,1	23:3, 24:y, 25:5, 26:0, 27:1, 28:1, 29:4, 30:0, 31:0	4		E	(4-10 years old)
	6	55	3,7	6,7	7,5	11:3.5, 12:5, 13:0, 14:1, 15:0, 16:0	4		E	(4-10 years old)
	7	65	3,4	6,7	8,0	11:3.5, 12:4, 13:0, 14:2, 15:0, 16:0	6		E	(4-10 years old)
	8	75	3,4	8,1	7,0	24:y, 25:5, 27:1, 28:1, 29:5, 30:0, 31:0	6		E	(4-10 years old)
	9	85	~3,5			26:1			PE	(4-10 years old)

Grave 51

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
1569	1	44				3:0, 22:1	3		PE	
	-								(PE)	
1570	1	37/47		8,8	7,6		9		E	Possibly developing(5-7 year old)
	-								(PE)	

Grave 55

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
1597	1	23	6,4	5,3	5,6	1:1, 3:1, 5:0, 6:0, 7:1	4	Calc	E	
1607	1	M dec.						Calc	PE	
1608	1	26				12:5, 14:0		Calc	PE	
	2	27	4,8	6,9	9,6	11:4, 12:4, 13:0, 14:0, 15:0, 16:1	17	Calc	E	
	3	43				1:2, 3:1, 7:2	4		PE	
	4	24/25							PE	
	5	PM Max.	4,4	6,4	7,0	8:0, 9:1, 16:0	3		E	
	-								(PE)	
1609	1	13	6,4	6,5		1:1, 3:1, 6:0, 7:3	4	Calc	PE	
	2	14	5,1	4,8	7,0	3:1, 9:0, 10:0, 16:0	3	Calc	E+PC+PD	
	3	15	3,9	4,7	6,9	9:0, 10:0, 16:0	3	Calc	E+PC+PD	
	4	16	3,1			11:3.5, 13:0, 14:0, 15:0, 16:0, 18:3, 19:3		Calc+Tr	PE+C+D	Root complete
	5	M Max.						Calc	PE	
	6	I/C							PE	
	-								(PE)	

Grave 56

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
1776	1	PM Mand.				19:1, 17:1	6		PE+PC+PD	
	2	PM							PE+PD	
	3	M Max.	5,0	9,8	10,2				E+PD	
	4	M							PE	
	5	C?					8		E+C+D	
	6	C?					8		E+C+D	
	-							rootCar	(PE+PC+PD+	Layering of cement
1777	1	I Mand.					8		E+C+D	Layering of cement

Grave 62

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
1881	1	PM Max.					8		PE+PC+PD	
1882	1	22	~7,6	4,5	4,4	1:6, 2:1, 3:0, 4:M, 5:0, 20:0	1		E	
	2	35	~7,0		6,1	22:1	2		E	
	3	42	7,5	4,1	4,3	1:1, 3:0	2		E	
	4	43		4,8	5,3	1:3, 3:0, 5:0, 6:0, 7:2	1		E	
	5	21/11				2:0, 3:0			PE	
	-								(PE+PD)	
1889	1	23	8,9	6,0	6,2	1:4, 3:0, 5:5, 6:0, 7:0	1		E	
	2	24	6,6	5,2	7,6	3:0, 8:0, 10:0, 16:0, 17:1, 19:2	2		E+C+D	
	3	25	5,4	5,2	7,8	8:0, 7:0, 16:0, 17:1, 19:2	2	Tr+R	E+C+D	15-21 years old, In max.
	4	26	5,0	8,5	10,0	11:4, 12:5, 13:0, 14:0, 15:0, 16:0, 18:5, 19:4	14	R	E+C+D	15-21 years old, In max.
	5	27	~5,7	7,7	9,7	11:4, 12:0, 13:0, 14:0, 15:0, 16:0, 18:3	12	R	E+C+D	15-21 years old, In max.
	6	28				11:3, 12:0, 13:3, 14:7, 15:0, 21:0	4		E+C+D	Unerupted,15-21 years old, In max.
	7	36	4,7	9,6	8,5	19:4, 23:0, 24:+, 25:5, 28:0, 29:0, 30:0, 31:0, 34:2	15		E+C+D	
	8	37	6,1	9,1	8,4	24:y, 25:4, 26:2, 28:1, 29:0, 30:0, 31:0, 34:2	13	Calc	E+C+D	15-21 years old, In mand.
	9	38				24:+, 25:4, 27:1, 28:1, 29:0, 30:0, 31:0			E+C+D	Unerupted, 15-21 years old, In mand
	10	45	6,2	5,5	7,1	17:1, 19:1, 22:1	2		E+D	
	11	46	5,0	9,8	8,7	19:4, 23:0, 24:x, 25:5, 28:1, 29:5, 30:0, 31:0, 34:2	15		E+C+D	
	12	47	6,1	8,7	8,1	24:+, 25:4, 27:0, 28:1, 29:0, 30:0, 31:0, 34:1	11		E+C+D	
	13	48	6,5	8,3	7,2	24:x, 25:4, 27:0, 28:0, 29:0, 30:0, 31:0, 34:1	4		E+C+D	Developing, 15-21 years old
	14	31/32	7,2	3,3	4,1	1:0, 3:0	3		E	
	15	41/42	6,6	3,2	4,3	1:0, 3:0, 19:2	3		E+C+D	
	-								(PE+PC+PD)	

Grave 64

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
1903	1	M							PE	
	-								(PE+PD)	

Grave 73

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
1942	-							H	(PE)	Glued together with1943:5
1943	1	13	9,9	~6,2		3:1			PE	
	2	16	5,1	8,3	10,0	11:4, 12:4, 13:0, 14:1, 15:0, 16:0	12		E	
	3	17	5,2	7,7	9,6	11:4, 12:1, 13:0, 14:0, 15:0, 16:1	8		E	
	4	18	3,6	6,3	7,4	11:3, 12:1, 13:4, 14:0, 15:0, 16:0, 21:0	4		E	
	5	26	5,0	8,9	9,9	11:4, 12:3.5, 13:0, 14:0, 15:0, 16:0	13	Calc	E	
	6	27	6,7	7,9	9,5	11:4, 12:0, 13:0, 14:0, 15:0, 16:0	10		E	
	7	28	3,8	6,5	7,1	11:3, 12:1, 13:0, 14:0, 15:0, 16:0, 21:0	4		E	
	8	36	4,7	9,9	8,3	25:5, 28:0, 29:5, 30:0, 31:0	17		E	
	9	37	6,6	9,6	8,2	24:+, 25:6, 27:0, 28:0, 30:1, 31:0	8		E	
	10	46	4,6	9,9	8,8	23:3, 24:4, 25:5, 26:0, 28:0, 29:5, 30:0, 31:0	12		E	
	11	47	5,9	9,4	8,8	24:y, 25:5, 27:0, 28:0, 29:3, 30:0, 31:0	9		E	
	12	48	4,8	8,5	7,6	23:0, 24:x, 25:5, 27:0, 28:1, 29:5, 30:0, 31:0	8		E	

Grave 95

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
2095	1	35							C+PD	In mand. Adult
	2	36							C+PD	In mand. Adult
	3	37							C+PD	In mand. Adult
	4	38							C+PD	In mand. Adult
	-								PE	

Grave 98

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
2129	1	46	3,9	9,2	8,1	24:x, 25:5, 28:1, 29:4, 30:0, 31:0	17		PE	
	2	47	4,0	8,3	7,7	24:x, 25:4, 28:1, 29:0, 30:0, 31:0	18		E	

Grave 115

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
2271	1	26	~4,6	7,8	8,5	11:4, 12:4, 13:0, 14:0, 15:0, 16:0	18		E+PD	
	2	28	5,3	6,3	7,3	11:3.5, 12:0, 13:0, 14:0, 15:0, 16.0, 21:0	14		E	
	3	24/25	4,7	~4,5		8:0, 9:0, 16:0	2		PE	

Grave 130

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
2363	1	23		5,5		1:1, 3:0, 6:0, 7:0	4,5	Calc	PE	
	2	22/12				1:6, 4:0, 5:0, 26:0	2	Calc	PE	
	3	13/43				1:1, 3:0	4	Calc	PE	
	4	35/45	3,4				4	Calc	PE	
	5	PM Max.		4,1		9:0, 16:0, 17:1, 19:2	6	Calc	PE+PC+PD	
	6	PM Max.	2,6	4,8	6,8	9:0, 16:0	6	Calc	E+PD	
	-							Calc	(PE+PD)	
2364	1	26/27		7,5	8,7	11:3.5, 12:4, 13:0, 14:0, 15:0, 16:0	18	Calc+Car	E	
	2	46/47	~3,5	8,5	6,9	24:+, 25:5, 27:0, 28:0, 29:2, 30:0, 31:0	18	Calc+Tr	E	
	3	M Max.Sin.			7,9	11:3, 12:0, 13:4, 14:0, 15:0		Calc	PE	

Grave 135

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
2404	1	11	~5,7		5,0	1:0, 3:0, 4:Med., 5:5-, 19:1	4	R	PE+C+D	In max.(palatine torus:0)
	2	12	5,7	~4,5		1:2, 2:1, 3:1, 4:0, 5:5, 20:0	4	R	PE+C+D	In max.
	3	13	5,3	5,2	7,2	1:1, 3:1, 5:5, 6:1, 7:0, 19:1	5	R+H	PE+C+D	In max.
	4	14	3,4	4,3		3:1, 9:0, 10:0, 16:0, 17:1	5	R+H	PE+C+D	In max.
	5	15	4,1	4,5		9:0, 16:0, 17:1, 19:2	5	R	PE+C+D	In max.
	6	16		7,0		11:3.5, 12:5, 14:0, 15:0, 16:0, 18:3, 19:4	36	R	PE+C+D	In max
	7	17				11:3.5, 12:5, 13:0, 14:0, 15:0, 16:0, 18:2, 19:4	20	R	PE+C+D	In max.
	8	21	5,2	~5,7	5,0	1:0, 2:0, 3:0, 4:0, 5:0	4	Tr	PE	
	9	22		4,4		1:2, 2:1, 3:0, 4:0, 5:5, 20:0	4		PE	
	10	23		~5,4		1:1, 5:5-, 6:0, 7:0		H	PE	
	11	24	3,5	4,7	7,2	3:1, 8:0, 9:0, 10:0, 16:0, 17:1, 19:2	4	H	E	
	12	25		4,6	7,2	8:0, 9:0, 16:0, 17:1, 19:2	5	H?	E	
	13	26		7,3		11:3.5, 12:4, 13:0, 14:0, 15:0, 16:0, 18:3, 19:3	30		PE+PC+PD	Root complete
	14	27	4,4	7,6	8,9	11:3.5, 12:4, 14:0, 15:0, 16:1, 18:2	16	Tr+Calc	E+PC+PD	
	15	36				34:2			C+PD	
	16	37	~2,9	8,3	7,6	24:y, 28:0, 25:4, 29:0, 30:0, 31:0	18	Calc	E+C+D	
	17	43	5,4	~5,4	5,6	1:1, 3:0, 7:0, 32:1	5	Calc	PE+PD	
	18	44	3,6	4,6		3:0, 17:1, 19:2, 22:1, 33:0	4	H+Tr	PE+C+D	Root complete
	19	45		4,9		17:1	6		PE+C+D	
	20	46	~1,7	6,7	8,5	28:0, 33:2	36		PE+C+D	
	21	47	~2,0			24:y, 25:4, 28:0, 29:0, 30:0, 31:0, 34:1	21		PE+C+D	
	22	48		8,7		19:2, 24:y, 34:2			PE+C+D	

Grave 139

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
2432	1	C?						H	?	Mand., (12-24 month)
2441	1	31		4,1		1:0, 3:0	1		PE	
	2	36	4,9	9,3	8,0	23:0, 24:y, 25:5, 26:2, 27:1, 28:0, 29:5, 30:0, 31:0	4		E	
	3	51	3,8	4,7	2,8	1:2, 3:0, 4:0, 5:6	2		E	
	4	51	4,4	4,6	1,8	1:0, 3:0, 4:0, 5:0	1		E	
	5	53	4,7	5,0	4,4	1:2, 3:0, 4:0, 5:6	1		E+PD	
	6	54	3,0	5,2	6,5	11:3.5, 12:0, 13:0, 14:0, 15:0, 16:0	4		E	
	7	55	4,0	7,2	7,6	11:3.5, 12:1, 13:0, 14:0, 15:0, 16:0	4		E	
	8	61	3,9	4,7	3,1	1:2, 3:0, 4:0, 5:6	2		PE+PC+PD	
	9	61		4,5		1:0, 3:0, 4:0, 5:0	1		PE	
	10	64	4,1	4,9	6,8	11:3.5, 12:0, 13:0, 14:0, 15:0, 16:0	7		E+PD	
	11	65	4,5	7,1	7,7	11:3.5, 12:1, 13:0, 14:0, 15:0, 16:0	4		E	
	12	72	3,0	2,6	1,9	1:1, 3:0	4		E+PC	Older than 9 months
	13	74	3,5	6,3	4,7	23:4, 24:y, 25:5, 27:0, 28:0, 29:3, 30:0, 31:0	4		E	
	14	75	4,4	8,6	7,0	23:3	4		E+C+PD	(12-24 month)
	15	83	3,6	3,5	3,7		1		E+C+D	2-4 years old
	16	85	4,3	8,7			4		PE	
	17	M							PE	

Grave 149 filling

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
2499	1	16/17		7,9	9,3	11:3, 12:4, 13:0, 14:0, 15:0	6		E	

Grave 150

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
2532	1	17/18	4,5	7,5	9,0	11:3.5, 12:0, 13:5, 14:0, 15:0, 16:0	14	H	E	

Grave 155

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
2566	1	PM/M						Calc	PE	

Grave 177 filling

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
2675	1	PM Max.							PE	

Grave 190

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
2729	1	37	5,8	9,6	8,3	24:+, 25:4, 27:0, 28:0, 29:0, 30:0, 31:0	4		E	
2734	1	11		~6,7		1:3, 2:0, 3:1	1		PE	

Grave 191

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
2746	1	15	5,0	5,7	8,0	8:0, 9:0, 16:0, 17:1, 19:2	3		E+PC+PD	
	2	21	9,2	6,8		1:2, 2:0, 3:0	3		PE	
	-								PC	
2754	1	11	9,6	7,3	5,9	1:2, 2:0, 3:0, 4:0, 5:0, 19:1	3		E+C+D	Root complete
	2	12	8,5	5,3	4,8	1:2, 2:1, 3:0, 4:0, 5:5-, 19:1, 20:0	2		E+C+D	Root complete, Sloping wear
	3	13	8,8	6,3	6,5	1:1, 3:1, 5:5-, 6:1, 7:2, 19:2	4		E+PC+PD	
	4	14	6,2	6,0	7,9	3:1, 8:1, 9:0, 10:0, 16:0, 17:1, 19:2	3		E+PC+PD	
	5	16	4,8	8,9	9,9	11:4, 12:5, 13:0, 14:2, 15:0, 16:0	16		E+C+D	
	6	17	5,8	8,6	10,6	11:3, 12:5, 13:0, 14:0, 15:0, 16:0	12		E+C+D	
	7	22	8,5	5,2	5,0	1:3, 2:0, 3:0, 4:MD, 5:5, 19:1, 20:0	1	Calc+Tr	E+PC+PD	
	8	23	9,1	6,0	6,4	1:2, 3:0, 5:5-, 5:1, 7:2, 19:1	2	Calc	E+PC+PD	
	9	24	6,3	5	~9,1	3:1, 8:1, 9:0, 10:0, 16:0, 17:1, 19:2	3		E+C+D	Root complete
	10	25	5,0	5,7	7,8	8:1, 9:0, 16:0, 17:1, 19:2	3		E+PC+PD	
	11	26	4,6	9,3	9,6	11:4, 12:5, 14:6, 15:0, 16:0, 18:3	18	R	E+C+D	Root complete, In max.
	12	27	6,5	8,8	9,9	11:4, 12:5, 13:0, 14:0, 15:0, 16:0, 18:1, 19:3	8		E+C+D	Root complete, In max.
	13	18 ?	3,6	7,9	6,2		4		E+C+D	Developing, (15-21 years)
	-								(Max.)	

Grave 208

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
2866	1	13	9,9	6,3	7,6	1:2, 3:1, 5:5-, 6:1, 7:1	1		E+PD	
	2	34	7,4	5,7	6,3	3:1, 17:1, 22:1	2		E+PC	
	3	35	7,0	5,1	6,6	22:2	1,5		E+PC+PD	
	4	36	4,9	9,5	9,3	24:y, 25:6, 28:0, 30:1, 31:0	14	Calc	E+PD	
	5	37	6,2	9,2	9,2	24:x, 25:5, 26:0, 27:0, 28:0, 29:1, 30:0, 31:0	6	Calc	E+PC+PD	
	6	43		6,4	5,8	1:2, 3:0, 5:0, 7:0	1	H	E	
	7	44	7,4	5,9	6,3	3:1, 22:0	2	Calc	E+PC	
	8	45	6,3	5,8	6,6	22:2	1,5		E	
	9	46	4,7	9,4	9,1	28:0, 31:0	14		E+PD	
	10	47	6,0	9,2	8,3	24:x, 25:4, 27:0, 28:0, 29:0, 30:0, 31:0	6		E	
	11	16/17	~6,0	~8,2		11:4, 12:3, 13:1, 14:0, 15:0	10	H	E	
	12	17/18	~4,4	7,1	9,5	11:3, 12:3, 13:3, 14:0, 15:0, 16:0	6		E	
	13	26/27	6,0	8,0	10,0	11:4, 12:2, 13:1, 14:0, 15:0, 16:0	6	H	E+PD	
	14	PM Max.	6,5	5,5	8,3	8:0, 9:0, 16:0	2		E	
	15	I				3:0			PE	
	16	M						H	PE	
	-								(PE+PD)	

Grave 225

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
2968	1	31/32				3:00	4	Calc	PE	

Grave 230 filling

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3005	-								(PE)	

Grave 273

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3113	1	13		6,9		1:2, 3:1, 5:5-, 6:1, 7:0	1		PE	
	2	14		6,4	8,0	3:1, 8:0, 9:0, 10:0, 16:0	1		E+PD	
	3	15	5,2	5,4	7,9	8:1, 9.0, 16:0	1		E+PD	
	4	16		8,6	10,2	11:4, 12:5, 13:0, 14:1, 15:0, 16:0	10		E+PD	
	5	17	4,9	8,3	11,5	11:0, 12:5, 13:0, 14:0, 15:0, 16:0	6		E+PD	
	6	34							PE	
	7	35	5,9	5,9	7,4	22:8	1		E	
	8	36		9,6	8,6	23:0, 24:y, 25:5, 27:0, 28:1, 29:5, 30:0, 31:0	6		E+PD	
	9	37		9,2	8,5	24:+, 25:4, 27:0, 28:1, 29:0, 30:0, 31:0	4	Calc	E+PD	
	10	43		5,2		1:1, 3:1, 7:0	1		PE+PD	
	11	44	6,1	5,9	6,2	3:1, 22:2	1		E	
	12	45	5,6	5,5	6,6	22:3	1		E+PD	
	13	47		8,9	8,2	24:+, 25:4, 27:0, 28:1, 29:0, 30:0, 31:0	4		E	
	14	I				3:0			PE	
	-								(PE)	

Grave 280

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3141	1	13		6,1	5,7	1:1, 3:1, 5:0, 6:0, 7:0	2	Calc	E	
	2	14	4,5	4,9	7,0	3:1, 8:0, 9:0, 10:0, 16:0	3	Calc	E	
	3	15	3,8	4,8	7,1	8:0, 9:0, 16:0	2	Calc	E+PC+PD	
	4	16	3,3	8,5	9,5	11:4, 12:5, 13:0, 14:0, 15:0, 16:0	18	Calc	E+PC+PD	
	5	17	4,1	7,8	8,8	11:4, 12:2, 13:0, 14:0, 15:0, 16:0	14	Calc	E+PC+PD	
	6	I	7,8			3:00	1	Calc	PE	
	-								PE+PD	
3142	-								PE+PC+PD	

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3189	1	14/15	5,3	5,0	7,2	8:1, 9:0, 16:0	1		E	

Grave 281

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3190	1	47	4,3	8,4	8,4	19:2, 28:0, 30:0, 31:0, 34:2	26		E+C+D+Manc	Root complete, Adult
	2	48		8,3		24:x, 25:6, 27:0, 28:0, 29:3	4	occlusalCalc	E+C+D	

Grave 282

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3208	1	37				24:+, 25:4, 27:0, 28:0, 29:0, 30:0, 31:0	4		PE	
3209	1	36		~9,5	7,9	23:0, 24:y, 25:5, 27:0, 28:0, 29:5, 30:0, 31:0	14		PE	
	2	47		8,4	7,5	24:+, 25:4, 26:2, 27:0, 28:0, 29:0, 30:0, 31:0	4		E	
	3	38/48		7,6		25:4, 27:0, 29:0, 30:0, 31:0	12		PE	

Grave 283

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3232	1	M							PE	
3233	1	45	6,6	5,1	5,6	22:2	1	H	E	
	2	17/18		8,0	9,0	11:4, 12:1, 13:0, 14:0, 15:0, 16:0	4		E	
	3	M Max.							PE	
	4	M							PE	
3234	1	14	~7,0	4,9	6,6	3:1, 8:0, 9:0, 10:0, 16:0	3	Calc	E	
	2	15	4,5	4,8	7,2	9:0, 10:0, 16:0	3	Calc	E	
	3	16	4,3	9,3	10,3	11:3, 12:5, 13:0, 14:0, 15:0, 16:0	22	Calc+Tr	E	
	4	24		5,1	6,8	3:0, 9:0, 10:0, 16:0	3	Calc	E	
	5	25	~4,8	5,1	7,3	9:0, 16:0	3		E	
	6	33		4,9		1:2, 3:0, 7:0	4		PE	
	7	34	7,1		5,5	3:0, 22:0	3	Calc	PE	
	8	35		5,4	6,2	22:3	2		E	
	9	36	3,9	~10,3	~9,2	28:0	19	Tr	PE	
	10	44	6,2	4,9	5,5	3:0, 22:0	3	Calc	E	
	11	45		5,3	6,2	22:3	3	H+Calc	PE	
	12	21/11				2:1, 3:0			PE	
	13	I	6,0			3:0			PE	
	14	I	7,6			3:0			PE	
3235	1	37/47				24:+, 25:4, 28:0, 29:0, 30:0, 31:0	4	H	PE	
	2	C							PE	

Grave 284

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3241	1	38/48		9,2	7,8	25:4, 28:0, 29:0, 30:0, 31:0	14	rootCar	E+PD	

Grave 285

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3268	1	11				1:2, 2:0, 3:0			PE	(5-9 year old)
	2	16	5,4	9,1	10,2	11:3.5, 12:5, 13:4, 14:7, 15:0, 16:0	4		E	(5-9 year old)
	3	23		6,5		3:1, 7:0	1		PE	(5-9 year old)
	4	55	3,7	7,3	8,0	11:3.5, 12:5, 13:4, 14:7, 15:0, 16:0	5		E	(5-9 year old)
3269	1	13		6,6	6,6	1:1, 3:0, 5:5-, 6:1, 7:1	4		E+PC+PD	
	2	16	2,5		10,2	11:3.5, 12:4, 14:0, 16:0, 18:3, 19:3	25		PE+PC+PD	Root complete
	3	17	~3,9	8,0	9,7	11:4, 12:5, 13:0, 14:0, 15:0, 16:0	18		E+PC+PD	Root complete
	4	33		5,0	5,6	1:1, 3:1, 5:0, 7:1	3	Calc	E	
	5	36	3,3	9,2	8,7	19:2, 24:y, 25:5, 28:0, 29:5, 30:0, 31:0	21	Tr	E+PC+PD	
	6	37	4,1	8,3	7,3	19:2, 24:y, 25:6, 28:0, 30:1, 31:0, 34:2	17	Calc	E+C+D	Root complete
	7	47	3,6	8,0	7,4	24:y, 28:6	18		E+PC+PD	
	8	I Mand.		3,8		1:1, 3:0	1		PE	
	9	17/18	3,8	5,8	8,2	11:3, 12:0, 13:3, 14:6, 15:0, 16:0	5		E+PC+PD	
	10	21/11	7,2		5,3	1:2, 2:0, 3:0, 4:0, 5:0	4	Tr	PE	
	11	PM Mand.				3:0	4		PE	
	12	PM Max.					6		PE	
	13	M Mand.				28:1	20		PE+PC+PD	
	14	C				1:2, 3:1	1		PE	
	15	C				1:2, 3:1	1		PE	

Grave 288

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3297	1	17/18	3,5	6,8	7,8	11:3, 12:0, 13:0, 14:0, 15:0, 16:0	14	Calc+Tr	E	
	2	M							PE	

Grave 289

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3307	1	45	4,0	5,0		22:0	4	Calc+Tr	E+PC	
	2	47	4,1	8,6	8,2	19:2, 24:x, 25:4, 28:0, 29:0, 30:0, 31:0, 34:1	18	Calc+Tr	E+PC+PD	
	3	48	3,2	7,3	7,9	28:1, 29:0, 30:0, 31:0	16	Calc	E	
	4	M				25:4, 28:0, 29:0, 30:0, 31:0		Calc+Tr	PE+PC	
	5	PM/C					3	Calc	PE	
3308	1	37	3,0	8,9	8,1		19		E	
	2	M							PE	

Grave 290

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3324	1	11	10,4	7,3	5,2	1:2, 2:2, 3:0, 4:0, 5:0	1	H	E+PD	
	2	12	9,1	5,8	4,4	1:2, 2:2, 3:0, 4:Med, 5:0, 19:1, 20:0	1	H	E+C+PD	(4-5 years old)
	3	13	8,7	6,7	6,7	1:1, 3:1, 5:1, 6:0, 7:0	1	H?	E	
	4	16	5,6	9,3	10,2	11:4, 12:5, 13:0, 14:0, 15:0, 16:0	4	H?	E+C+D	
	5	22		6,4	4,3	1:2, 2:2, 3:0, 4:0, 5:0	1		PE+C+D	(4-5 years old)
	6	24	4,4	5,1	7,3	3:1, 8:0, 9:0, 10:0, 16:0	1		E+C+D	(5 years old)
	7	26	5,7	9,1	9,6	11:3, 12:5, 13:0, 14:0, 15:0, 16:0	4	H	E+C+D	
	8	31	8,4	4,2	3,6	1:0, 3:1, 19:2	1	H	E+C+D	(5 years old)
	9	32	8,7	4,6	4,2	1:0, 3:0, 19:1	1	H	E+C+D	(5 years old)
	10	33	8,1	5,8	6,1	1:2, 3:1, 5:0, 7:1	1	H	E+C+D	(4 years old)
	11	35	5,5	5,4	6,1	22:3	1		E+C+D	(5 years old)
	12	36	6,3	10,4	8,7	23:1, 24:+, 25:5, 26:2, 27:0, 28:0, 29:5, 30:0, 31:0	4	H	E+PC+D	(4 years old)
	13	41	8,5	4,7	3,6	1:0, 3:0	1	H	PE+C+D	(5 years old)
	14	42	8,1		4,1	1:1, 3:1	1	H	PE+C+D	(5 years old)
	15	43	8,2	~6,1	5,6	1:1, 3:1, 5:0, 7:2	1	H	E+C+D	(4 years old)
	16	46	6,9	10,4	8,6	23:1, 24:x, 25:7, 26:2, 27:0, 28:1, 29:5, 30:0 31:3	4	H	E+C+D	(4 years old)
	17	55	3,9	7,3	8,4	11:4, 12:5, 13:0, 14:0, 15:0, 16:0	9	H	E+PC+PD	
	18	61		5,0	2,8	1:1, 2:2, 3:0, 4:0, 5:0	3		PE+PC	
	19	65					5		PE+PC+PD	
	20	74	4,6	6,5	5,2		4	Car?	E+PC+PD	
	21	53/83		4,2	3,2	1:2, 3:0, 5:0, 7:0	3		E+PC+PD	
	22	63/73	4,8	4,1	3,6	1:2, 3:0, 5:0, 7:0	3		E+PC+PD	
	23	75/85							PE+PC+PD	
	24	M Dec.							PC+PE+PD	

Grave 291

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3352	1	11				2:0, 3:0	4		E	
	2	27/28	3,6			11:4, 12:0, 13:0, 14:0, 15:0, 16:0	13		E+PD	

Grave 292

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3371	1	C				1:2, 7:1			PE	
3372	1	35		5,9	6,2	22:2	1		PE	
	2	36	5,2	9,0		23:0, 24:y, 25:5, 26:2, 27:0, 28:1, 29:5, 30:0, 31:0	9		PE	
	3	37/47							PE	
	-								(PE)	
3373	1	46				23:0, 24:+, 25:5, 26:0, 27.1, 28:0, 29:5, 30:0, 31:0	10		PE	
	2	PM Mand.				3:1, 22:1			PE	
	-								(PE)	

Grave 293

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3381	1	44				17:1			C+PD	In mand. Adult
	2	45				17:1, 32:0			C+PD	In mand. Adult
	3	46							C+PD	In mand. Adult
	4	47							C+PD	In mand. Adult
	5	48							C+PD	In mand. Adult
	-								(PE)	
3382	-								(PE)	
3383	-								(PE)	

Grave 294

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3398	1	26/27		7,6		11:4, 12:4, 13:0, 14:0, 15:0, 16:0	18	Calc	PE	
	2	M Max.							PE	
3399	1	13	5,8	5,8	6,4	1:0, 3:1, 5:5, 6:0, 7:1	4	Calc	E+PC+PD	
	2	16				18:3, 19:3	38		E+C+D	Layering of cement
	3	22	5,7	4,5	4,5	1:6, 2:1, 3.0, 4:0, 5:0, 20:0	4	Calc	E+PC+PD	
	4	27	1,1			18:3	38		E+PC+PD	
	5	28				11:3.5, 12:0, 14:0, 15:0, 16:0, 18:1, 19:4	22		PE+C+D	
	6	46				19:2, 34:2	38	R	C+D	Root complete
	7	48	2,2	8,0	7,7	19:3, 34:2	30	Calc+Tr	E+PC+PD	
	8	14/24	3,3	4,5	6,7	3:1, 9:0, 10:0, 16:0, 17:1, 19:2	5	Calc+Tr	E+PC+PD	
	9	15/25	1,6	3,7	7,0	9:0, 16:0, 17:1, 19:1	6	Calc	PE+PC+PD	
	10	PM Mand.	2,7	5,1	5,5	17:1, 19:0	4	Calc+Tr	E+PC+PD	
	11	PM Mand.						Calc	PE	Can be same tooth with 3400:5
3400	1	17	0,8			16:0, 18:1, 19:3	37		PE+C+D	In max. Adult
	2	18				18:1, 19:3	22		PE+C+D	In max. Root complete, Adult
	3	37				19:2, 34:2	38		PE+C+D	In mand. Adult
	4	38				34:2	28	Calc	PE+C+D	In mand. Adult
	5	45				17:1			C+PD	In mand. Adult
	6	46				19:7, 34:2			C+PD	In mand. Adult
	7	47				34:2			C+D	In mand. Adult

Grave 295

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3442	1	M Mand.							PE	
	-								(PE)	
3443	-								(PE)	
3444	1	M							PE	
3445	1	34	6,2	5,4	5,5	3:1, 22:2	1		E	
	2	45	5,6	5,3	6,3	22:1	1		E	
	3	46/47		9,0	7,7	23:3, 24:+, 25:6, 26:0, 27:0, 28:0, 30:4, 31:0	4		E	
	4	C							PE	
3446	1	35	5,7	5,2	6,4	22:2	1		E	
	2	36				23:0, 24:+, 26:0, 27:0, 28:0, 29:5			PE	
	3	PM	6,2						PE	
3447	1	42	7,2	3,7	4,0	1:1, 3:1	2	Calc	E	
	2	44	6,2	5,7		3:1, 17:1, 22:1, 33:0	1	H	PE+PC+PD	
	3	31/41	6,8	3,3	3,3	1:1, 3:0	2	Calc	E	
3448	-								C+PD	
3449	1	11				1:0, 2:0, 3:0	1	H	PE	
	2	13		5,0	5,2	1:1, 3:1, 5:0, 6:0, 7:2	1	H	E	
3450	1	33	7,6	5,0	6,5	1:2, 3:1, 15:1, 7:1	1		E	
	2	37	4,7	8,2	7,6	19:4, 24:+, 25:4, 27:0, 28:0, 29:0, 30:0, 31:0	8	Calc	E+PC+PD	
	3	38	5,3	9,4	8,6	24:+, 25:4, 26:0, 27:0, 28:0, 29:0, 30:0, 31:0	4	H	E	
	4	14/15	6,0	4,4	6,3	8:1, 9:0, 16:0	1	H	E	
	5	27/28	4,8	7,0	8,5	11:4, 12:0, 13:0, 14:0, 15:0, 16:0	4		E	
3451	1	PM Mand.	5,5	4,7	4,8	22:1	2	H	E+PC+PD	

Grave 302

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3493	1	13								Max. Adult
	2	14				17:2, 19:2				Max. Adult
	3	15				17:1, 19:2				Max. Adult
	4	16	6,2	10,8		11:3.5, 12:3.5, 13:0, 14:0, 15:0, 16:0, 19:3	21	Calc+R	PE+C+D	In max. Adult
	5	17	7,4	9,4	7,2	11:3.5, 12:4, 13:0, 14:0, 15:0, 16:1, 19:3	16	Calc+R	E+C+D	In max. Adult
	6	18				19:3, 21:0		R	PE+C+D	In max. Adult
	7	23				1:1, 19:2	4	Calc	PE+PC+PD	Layering of cement, Root complete
	8	PM				17:1, 19:2			PE+PC+PD	Root complete
	-								(PE+PC+PD)	
3494	1	31				19:2		R	PC+PD	In mand. Adult
	2	32				19:2		R	PC+PD	In mand. Adult
	3	33				19:2				Mand. Adult
	4	35		7,7	8,6	17:1, 22:2	3		PE+PC+PD	In mand. Adult
	5	36	5,1	11,2	10,5			Tr+R	E+C+D	In mand. Adult
	6	37				24:y, 25:4, 28:0, 29:0, 30:0, 31:0		Car+R	PE+PC+PD	In mand. Adult
	7	38								In mand. Adult
	8	41								In mand. Adult
	9	42								Mand. Adult
	10	43						R	PC+PD	In mand. Adult
	11	44	7,0	7,1	8,7		3	R	E+C+D	In mand. Adult
	12	45	6,4	7,4	8,8		4	R	E+C+D	In mand. Adult
	13	46	5,6	11,5	~11,(	21:0,24,y,28:0,34:2	20	R	PE+C+D	In mand. Adult
	14	47		11,5		21:0, 24:+, 25:4, 29:0, 30:0, 31:0, 34:2	18	R	PE+C+D	In mand. Adult
	15	48								In mand. Adult
	16	M				21:0	18		PE+PC+PD	
	-								(PE)	

Grave 303

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3504	1	16	5,0	7,7	8,6	11:4, 12:4, 13:0, 15:0, 16:1			PE	
	2	16				1:0, 3:1			PE	
	3	17		6,4	8,8	11:3, 12:1, 13:0, 14:0, 15:0, 16:0	12		PE	
	4	25	4,6	4,9	7,0	8:0, 9:0, 16:0	2		E	
	5	26	4,7	7,7	9,1	11:3.5, 12:4, 13:0, 14.0, 15:0, 16:0	15		E	
	6	27	5,3	2,1	8,6	11:3, 12:1, 13:0, 14:0, 15:0, 16:0	12		E+PD	
	7	28	3,7	6,1	8,1	11:3, 12:0, 13:4, 14:0, 15:0, 16:0	12		E	
	8	33				1:1, 3:1, 5:0, 7:4		H	PE	
	9	34	5,7	4,9	5,0	3:0, 22:0	3	Calc	E	
	10	35		5,2	5,1	22:2	2	Calc	E	
	11	36	3,9		8,0	24:y, 25:5, 28:0, 29:5, 30:0, 31:0	17	Calc	PE	
	12	37	5,1	8,5	8,3	24:x, 25:5, 28:0, 29:4, 30:0, 31:0	15	Calc	E+PC+PD	
	13	45	4,4	5,0	5,9	22:1	3		E	
	14	46	3,5	8,9	8,1	24:+, 25:5, 28:0, 29:5, 30:0, 31:0	19		E	
	15	47	5,0	8,7	7,6	24:x, 25:5, 28:0, 29:4, 30:0, 31:0	6		E	
	16	14/24				8:00	4		PE	

Grave 309

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3538	-								(PE)	
3539	1	17	3,3	7,6	9,1	11:5, 12:4, 14:0, 15:0, 16:0	17	Tr	E+PC	
	2	18	3,3	7,9	8,6	11:3.5, 14:0, 15:0, 16:0	16	Tr	E	
	3	16/26							PE	

Grave 313

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3557	-								(PE+PC+PD)	
3558	1	13		5,9	5,5	1:2, 3:0, 5:5-, 6:1, 7:2	1		PE	
	2	15	6,1	4,9	6,8	8:0, 9:0, 16:0	1		E	
	3	PM Max.							PE	
	-								(PE)	
3559	1	16	5,7	8,0	9,2	11:4, 12:4, 13:0, 14:5, 16:0	5		E	
	2	36/37	5,7	9,0	7,7	23:2, 24:+, 25:5, 26:0, 27:0, 28:0, 29:4, 30:0, 31:0	5		E	
3560	1	33		5,0		1:2, 3:1, 5:0, 7:1	1		PE	
	2	35	5,0	5,0	5,5	22:1	1		E+Mand.	Unerupted, (6-11 years old)
	3	44	6,5	5,4	5,4	3:1, 22:8	1		E+Mand.	Unerupted, (6-11 years old)
	4	M Mand.							PE	

Grave 317

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3585	1	28	3,6	6,2	8,5	11:2, 12:0, 13:0, 14:6	12	OCalc	E+PC+PD	
	2	13/23	4,5	5,9	6,2	3:1, 5:5-, 6:0, 15:0, 16:0, 21:0	5	Calc+Tr	E+PD	
	3	M Max.Dx.	4,5	7,8	8,2	11:3.5, 12:0, 13:4, 14:0, 15:0, 16:0	12	OCalc	E+PC+PD	
	4	M Mand.				19:3, 34:2	36		PE+PC+PD	

Grave 318

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3598	1	26/28				14:0, 15:0			PE	
	2	PM Max.					4	H	PE	
	3	I Mand.				1:1, 3:0	3	H	PE	

Grave 319

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3613	1	28	4,6	7,5	9,4	11:4, 12:1, 13:4, 14:0, 15:0, 16:0, 18:1, 19:3, 21:0	12	Car	E+C+D	Root complete, Layering of cement
3614	1	17	3,5	7,5	8,1	11:4, 15:0, 16:2, 18:1, 19:3	30		E+C+D	Root complete
	2	18	5,7	7,4	9,8	11:4, 12:0, 13:1, 14:0, 15:0, 16:0	12		E+C+D	Root complete, Layering of cement
	3	27	4,6		9,4	11:4, 12:3, 13:0, 14:0, 15:0, 16:1, 18:1, 19:4	18	Car	PE+C+D	Root complete
	4	36				34:2	22		PE+PC+PD	Root complete
	5	47	3,1		8,1	19:4, 34:2	20		PE+C+D	Root complete
	6	21/11	3,8		4,6	2:1, 3:0, 4:0, 5:0	6		PE+PC+PD	
	7	21/11	3,8		9,6	2:1, 3:0, 4:0, 5:0	6	Tr?	PE+PC+PD	Root complete
	8	I Mand.					6		PE+PC+PD	
	9	PM							PE+PC+PD	
	-								(PE+PC+PD)	

Grave 320

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3627	1	M						Calc	E	Sloping wear
	2	M						Calc	E	Sloping wear

Grave 321

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3629	1	23	8,9	5,7		1:2, 3:1, 5:5, 6:0, 7:0	3		E	
	2	M						Calc	PE	
	-								(PE)	

Grave 323

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3640	1	11				2:0, 3:0	3	Calc	PE	
	2	13		7,2		1:1, 3:1, 5:0, 6:0, 7:1	4	Calc	PE	
	3	14	6,3	5,1	7,6	3:0, 8:0, 9:0, 10:0, 16:0	2	Calc+Tr	E	
	4	15		5,2	8,0	8:0, 9:0, 16:0	2	Tr+Calc	E+PD	
	5	16	3,6	8,4	9,8	11:3, 12:5, 13:0, 14:1, 15:0, 16:0	20	Calc	E	
	6	17		7,8	9,0	11:3.5, 12:1, 13:0, 14:0, 15:0, 16:0	12		E	
	7	18	4,4	6,8	8,1	11:3, 12:0, 13:4, 14:0, 15:0, 16:0, 21:0	4		E	
	8	21				2:0, 3:0	3	Tr	PE	
	9	24		5,3	7,9	3:1, 8:0, 9:0, 10:0, 16:0	2	Calc	E	
	10	25		5,2	9,0	8:0, 9:0, 16:0	2	Tr+Calc	PE	
	11	28	4,9	6,8	8,7	11:3, 12:0, 13:4, 14:0, 15:0, 16:0	5	Calc	E+PD	
	12	35	5,9	5,7	6,9	22:2	3	Tr+Calc	E	
	13	36	4,3	8,7	8,3	25:4, 28:0, 29:0, 30:0, 31:0	22	Calc	E	
	14	37	5,0	9,0	8,3	24:+, 25:4, 28:5, 29:0, 30:0, 31:0	12	Tr	E	
	15	38	5,1	7,7	8,0	24:x, 25:4, 28:0, 29:0, 30:0, 31:0	10	Calc	E	
	16	47		9,5	8,2	24:+, 25:4, 28:1, 29:0, 30:0, 31:0	14	Calc	E	
	17	48		8,4	7,7	24:+, 25:4, 28:0, 29:0, 30:0, 31:0	11	Calc	E	
	-								(PE)	

Grave 324

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3679	1	13	5,2	5,8	6,9	5:3, 6:0	5	Tr+Calc	E+PC+PD	
	2	14/15	2,5	4,7	7,0	9:0, 16:0, 17:1, 19:2	5		E+PC+PD	
	3	24/25	3,2	4,6	7,0	8:0, 9:0, 16:0	4	Calc	E	
	4	PM Max.			7,0	9:0, 16:0	5	Calc	PE	
	5	I/C				3:0		Calc	PE	
	-								(PE+PC)	
3680	1	47	2,4	8,8	8,2	24:+, 25:4, 28:0, 29:0, 30:0, 31:0	22		E+PC+PD	
	2	38/48		8,9	7,9	28:0	14	Calc	E+PC+PD	
	3	PM Mand.							PE	
	4	M						Tr	PE	
	-								(PE+PC+PD)	

Grave 325

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3714	1	14	6,6	5,5	8,0	3:1, 8:1, 9:0, 10:0, 16:0	2	Calc+H	E+PD	
	2	15	6,1	5,7	8,5	8:0, 9:0, 16:0, 17:1, 19:2	2	Calc+H	E+PC+PD	
	3	16				11:3.5, 12:5, 13:1, 14:1, 15:0, 16:0	17	Tr	PE	
	4	17	6,0	8,3	10,3	11:4, 12:3, 13:0, 14:2, 15:0, 16:0	10	H	E+PD	
	5	18	5,4	7,7	10,4	11:4, 12:1, 13:0, 14:1, 15:0, 16:0	4		E+PD	
	6	23	10,0	6,6	8,0	1:1, 3:1, 5:0, 6:0, 7:1	2	H	E	
	7	24	5,6	5,8	8,0	3:1, 8:0, 9:0, 10:0, 16:0	2	H	E	
	8	25	5,1	5,4	8,1	8:0, 9:0, 16:0	2	Tr	E	
	9	26	6,4	8,8	10,6	11:4, 12:4, 13:0, 14:1, 15:0, 16:0, 19:3, 34:3	17	Calc+Tr	E+PC+PD	Root complete
	10	33	10,0	5,8		1:2, 3:1, 5:0, 7:1	2	H	PE	
	11	34	7,0	5,6	5,7	3:0, 22:7	2		PE	
	12	35		6,0	6,5	22:0	2	H	E	
	13	45	5,6	5,9	6,8	22:0	2	H	E	
	14	46	5,1	10,2	9,4	23:1, 25:5, 26:0, 28:0, 29:5, 30:0, 31:0	16	Calc	E	
	15	47							PE	
	16	48	5,4	10,5	8,6	24:x, 25:5, 27:1, 28:1, 29:5, 30:0, 31:0	4		E+PD	
	17	I Mand.				1:1, 3:0	3	Calc	PE	
3715	1	27	6,2	7,5	10,1	11:3.5, 12:3, 13:0, 14:1, 15:0, 16:1, 18:3, 19:3	10	Calc	E+PC+PD	Root complete
	2	28	5,5	7,7	10,2	11:3, 12:1, 13:0, 14:1, 15:0, 16:0, 18:3, 19:3	6		E+PC+PD	
	3	36	5,0	10,5	9,1	23:0, 27:0, 28:0			PE	
	4	37		10,2	9,2	24:+, 25:5, 27:0, 28:0, 29:2, 30:0, 31:0	7	H	E	
	5	38	6,1	10,4	8,4	24:x, 25:5, 27:0, 28:0, 29:5, 30:0, 31:0	4		E+PC+PD	
	-								(PE+PC+PD)	

Grave 331

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3752	1	17		7,0	9,1	11:4, 12:1, 13:0, 14:0, 15:0	5		E	
	2	26	4,9	8,3	9,7	11:4, 12:4, 13:0, 14:3, 15:0, 16:1	14	H	E	
	3	33				1:1, 3:1, 7:0	1		PE	
	4	34	6,8	5,3	6,2	3:1, 22:2	1	H	E	
	5	35	7,1	5,4	5,8				PE	
	6	36	5,0	9,2	8,2	23:0, 24:y, 25:5, 28:1, 29:5, 30:0, 31:0	14	H+Tr	E	
	7	37	5,8	8,5	7,9	24:+, 25:4, 27:0, 28:0, 29:0, 30:0, 31:0	5		E	
	8	45	6,5	5,7	6,3	22:0	2		E	
	9	46	4,9	9,1	8,2	23:1, 24:+, 25:5, 28:1, 29:5, 30:0, 31:0	12	H	E	
	10	47		9,3	7,7	24:+, 25:4, 26:1, 27:0, 28:0, 29:0, 30:0, 31:0	6		E	
	11	38/48							PE	
	-								(PE)	

Grave 333

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3762	1	54/55					5		PE	Under 11 years old
	-								(PE)	

Grave 334

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3769	1	17				11:3, 12:4, 13:0, 14:0, 15:0	16		PE	
	-								(PE)	
3770	1	M							PE	
	-								(PE)	

Grave 335

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3774	1	14	4,7	4,2	6,8	3:1, 9:0, 10:0, 16:0	4		E	
	2	15		4,4	6,6	8:0, 9:0, 16:0	4	Calc	E	
	3	17	3,7	6,7	8,9	11:3, 12:4, 13:0, 14:0, 15:0, 16:0	20	Calc	E+PD	
	4	24		4,4	6,9	3:1, 8:0, 9:0, 10:0, 16:0	3	Calc	E	
	5	25	3,5	4,1	6,8	8:0, 9:0, 16:0	5	Calc	E	
	6	26	4,0	8,0	9,0	11:4, 12:5, 13:0, 14:0, 15:0, 16:0	21	Calc	E	
	7	27	4,5	7,1	9,5	11:4, 12:4, 13:0, 14:0, 15:0, 16:0	17	Tr+Calc+H	E	
	8	28	4,1	7,2	8,3	11:3, 12:3, 13:0, 15:0	13		E+PD	
	9	33	6,5	5,2	5,7	1:1, 3:1, 5:5, 7:0	4		E	
	10	34	5,5	4,4	5,0	3:1, 22:0	3		E	
	11	35	4,6	4,6	5,2	22:1	3	H	E	
	12	43	6,8	4,7	5,7	1:1, 3:1, 5:5, 7:0	4		E	
	13	44	5,0	4,6	4,8	3:1, 22:5	4		E	
	14	45	4,3	4,3	5,3	22:4	3	Tr+H	E	
	15	48	3,1	6,9	7,6	24:x, 28:0	19	Calc	E+PD	
	16	M							PE	
	17	M						H	PE	
3775	-								(PE)	
3776	1	16		7,4	7,9	11:3.5, 12:4, 13:0, 14:6	4		E	
	2	24	5,4	4,4	6,9	3:0, 8:0, 9:0, 10:0, 16:0	1		PE	Developing
	3	25	3,3	4,5	7,6	8:1, 9:0, 16:0	1		E	Developing
	4	26		7,5	8,6	11:4, 12:4, 13:0, 14:5, 15:0, 16:0	4		E	
	5	31	7,8	3,4		1:2, 3:0	1	H	E	
	6	34			5,9	3.0, 22:5	1		PE	
	7	42		3,5		1:0, 3:0	1		PE	
	8	44		4,7	5,7	3:1, 22:4	1		E	
	9	46		8,1	7,2	23:0, 24:x, 25:4, 26:0, 27:0, 28:1, 29:0, 30:0, 31:0	1		E	
	10	C						H?	PE	

Grave 345

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3851	1	13	8,5	6,4	7,1	1:1, 3:1, 5:0, 6:0, 7:2	3	H	E+PC+PD	
	2	14	5,7	5,1	7,4	3:1, 8:1, 9:0, 10:0, 16:0, 17:1, 19:2	3		E+PC+PD	
	3	15	4,6	4,7	7,2	9:0, 16:0, 17:1	3		E+PC+PD	
	4	16	3,8	8,1	9,6	11:3, 12:5, 13:0, 14:2, 15:0, 16:0, 18:3	20		E+PC+PD	
	5	17	4,0	7,8		11:4, 12:3, 13:0, 14:0, 15:0, 16:0, 18:3, 19:3	16		E+PC+PD	
	6	18	4,1	6,4	9,2	11:3, 12:2, 13:4, 14:0, 15:0, 16:0	8		E+PC+PD	
	7	23			6,3	1:1, 5:0, 19:1			PE+C+PD	Root complete
	8	24	5,8	5,0	7,3	3:0, 8:1, 9:0, 10:0, 16:0, 17:1, 19:2	3		E+PC+PD	
	9	25	4,7	4,9	7,5	8:1, 9:0, 16:0, 17:1, 19:1	2	Calc	E+PC+PD	
	10	26	3,7	8,0		11:3, 12:4, 13:0, 14:0, 15:0, 16:0, 18:3	20		E+PC+PD	
	11	27	3,6	7,4		11:4, 12:2, 13:0, 14:0, 15:0, 16:0, 18:3	18		PE+PC+PD	
	12	28	3,4	5,6	9,2	11:2, 12:1, 13:3, 14:0, 15:0, 16:0	11		E	
	13	34	5,8	5,0	5,4	3:0, 22:5	3		E+PC	Crowding
	14	74/75	2,4						PE+PC+PD	In mand., Crowding
	15	36	4,1			28:0, 34:2			PE+C+PD	In mand
	16	37	4,8	8,8	7,9	25:4, 28:0, 29:0, 30:0, 31:0	21		E+C+D	In mand.
	17	38		10,0	6,8	24:x, 25:5, 27:0, 28:0, 29:5, 30:0, 31:0	16		E+PC+PD	In mand.
	18	46	2,7						PE+PC+PD	
	19	47	3,9	8,9	7,8	19:3, 24:+, 25:4, 28:0, 29:0, 30:0, 31:0, 34:2	19		E+C+D	
	20	48		8,1	6,3	24:4, 25:4, 28:0, 29:0, 30:0, 31:0	16		E+PC+PD	Root complete
	21	24		7,4		8:0, 9:0, 16:0, 17:1, 19:2	4	R	PE+C+D	In mand.+zyg. Adult
	22	25	6,0	7,0	9,3	3:1, 9:0, 10:0, 16:0, 17:1, 19:2	4	R	E+C+D	In mand.+zyg. Adult
	23	26				11:3, 12:4, 16:0,	24	R	PE+C+D	In mand.+zyg. Adult
	24	27				11:4, 12:5, 13:0, 14:0, 16:2	20	R	PE+C+D	In mand.+zyg. Adult
	25	28	5,8			15:0, 16:2, 21:0	18	R	PE+C+D	In mand.+zyg. Adult
3852	1	34	4,2	4,7	5,9	3:0, 22:2	2	Tr	E+PC+PD	
	2	35	3,3	8,8	8,5	22:2	21	Tr	PE+PC+PD	
	3	36	3,9	8,5	8,7	25:5, 28:0, 29:4, 30:0, 31:0	16		PE+PC+PD	
	4	37	3,8	9,7	8,3	24:+, 25:5, 28:0, 29:5, 30:0, 31:0	15		E+PC+PD	
	5	43	8,2	5,0	5,0	1:2, 3:1, 7:0	2	H	E+PC+PD	
	6	44	5,2	4,5	5,2	3:1, 22:1	2		E+PC+PD	
	7	45	3,7	4,8	5,9	22:2	2		E+PC+PD	
	8	46	3,0	9,0	7,7	25:5, 28:0, 29:5, 30:0, 31:0	22		PE+C+D	Root complete
	9	47	3,5	9,7		25:5, 28:0, 29:5, 30:0, 31:0	17		PE+PC+PD	
3853	1	PM Max.				8:0, 9:0	1		PE+PD	
	2	C							PE	

Grave 338

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3789	-								(PE)	

Grave 339

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3794	1	M Mand.	5,8	4,7	5,0		2		E+PD	

Grave 346

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3862	1	17	~5,8	9,3	11,2	11:3.5, 12:4, 13:0, 14:0, 15:0, 16:0	16	Calc	E	
	2	18	4,4	9,6	9,6	11:4, 12:3, 13:4, 14:0, 15:0	13	Calc	E	Adult
	3	35	6,8	6,9	7,5	22:1	4	Calc	E	
	4	36	5,6	10,8	10,0	24:+	16	Calc	E	
	5	45				22:0	4	Calc	PE	
	6	14/15	~7,2	7,2	9,6	8:0, 9:0, 16:0	4	Calc	PE	
	7	24/25	6,6	12,0	9,5	8:0, 9:0, 16:0	4	Calc	E	
	8	M						Calc	PE	
	-								(PE+PC+PD)	

Grave 347

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3870	1	PM Max.				8:0, 9:0	1		PE+PD	Developing
	2	PM Max.				8:1, 9:0	1		PE+PD	Developing

Grave 348

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3946	1	13					5		PE+C+PD	In max.
	2	14				8:0, 9:0, 16:0, 17:1	5	Tr	PE+C+PD	In max.
	3	15	4,6	4,2	7,1	8:0, 9:0, 16:0	5	Tr	E	In max.
	4	36	2,4	8,8	7,2	25:5, 28:0, 29:4, 30:0, 31:0	18	Tr+Calc	E+PC	
	5	46	3,2	8,5	7,2	25:5, 28:0, 29:4, 30:0, 31:0	17		E	
	6	17/18	4,0	6,6	7,6	11:4, 12:0, 13.0, 14:0, 15:0, 16:0	15	Calc	E	
	-								(PE+PC+PD+Mand.)	

Grave 349

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
3999	1	46/47	1,2	8,6	9,3	34:2	35		PE+C+D	Root complete
	2	PM Max.				17:2, 19:2	6		PE+PC+PD	Root complete
	3	PM Max.	2,4	4,5	8,1	9:0, 16:0, 17:1, 19:2	6		E+PC+PD	
	4	PM Max.				17:2, 19:2	6		PE+PC+PD	
	5	PM				17:1, 19:2	6		PE+PC+PD	
	6	PM				17:1, 19:2			C+PD	
	7	M Max.				34:3			PC+PD	
	8	C/PM					5		PE+PC+PD	
	9	C/I							PE+PC+PD	

Grave 352

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
4013	1	45	5,2	5,3	6,1	17:1, 19:1, 22:4	2	H	E+C+D	Root complete
	2	46	4,2	8,5	7,6	24:y, 25:4, 26:0, 28:1, 29:0, 30:0, 31:2	15		E+PC+PD	
	3	47	4,7	8,7	7,3	24:x, 25:4, 26:0, 28:0, 29:0, 30:0, 31:1	6	Calc	E+PC+PD	
4014	1	14	5,1	5,1	7,5	3:0, 8:0, 9:0, 10:0, 16:0, 17:1, 19:2	2	H	E+PC+PD	
	2	15	5,2	5,2	7,6	8:0, 9:0, 16:0	2	Calc+H	E+PD	
	3	16	4,4	8,3	9,0	11:4, 12:4, 13:0, 14:0, 15:0, 16:0	15	Calc	E+PC+PD	
	4	17	5,4	7,3	8,7	11:3.5, 12:3, 13:0, 14:0, 15:0, 16:0	6	Calc	E+PC+PD	
	5	24	5,5	5,1	7,9	3:0, 8:0, 9:0, 10:0, 16:0	2		E	
	6	25							PE	
	7	31	5,1	3,5	3,8	1:0, 3:0, 19:2	4		E+PC+PD	
	8	32	6,6	4,9	4,6	1:1, 3:0, 19:1	4	Tr	E+PC+PD	
	9	34	6,2	5,0	5,7	3:0, 22:5, 17:1, 19:1, 33:0	2		E+PC+PD	
	10	35	5,5	5,2	6,1	17:1, 19:1, 22:2	2	Calc	E+PC+PD	
	11	36	4,6	8,2	8,2	24:y, 25:4, 26:0, 28:0, 29:0, 30:0, 31:0	16	Calc	E+PC+PD	
	12	37	4,5	8,3	8,2	24:x, 25:4, 27:1, 28:0, 29:0, 30:0, 31:0	7	Calc	E+PC+PD	
	13	38	9,0	7,9	7,0	24:y, 25:4, 27:0, 28:1, 30:0, 31:1	4		E+PD	
	14	41				1:0, 3:0	4	Calc	PE	
	15	48	4,6	7,9	7,0	24:y, 25:4, 26:1, 27:0, 28:0, 29:0, 30:0, 31:0	4		E+PC+PD	Developing
	16	13/43	6,8	5,2	5,8	1:0, 3:0, 5:0, 7:1, 19:1	3	H	E+PC+PD	
	17	M							PE	
	-								(PE+PC+PD)	

Grave 356

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
4071	-								(PE)	
4072	1	27	5,1	8,4	10,3	11:4, 12:3, 13:0, 14:0, 15:0, 16:0	4		E	
	2	34	6,3	4,8	4,9	3:0, 22:0	1		E+PC+PD	
	3	35	6,0	5,6	6,8	17:1, 19:2, 22:2	1		E+PC+PD	
	4	46		8,8	8,8	23:0, 24:y, 25:6, 27:0, 28:0, 30:1, 31:1	9	Calc	E+PC	

Grave 359

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
4130	1	46	5,8	9,0	8,7	23:0, 24:x, 25:6, 27:0, 28:0, 30:1, 31:0	9		E	
4131	1	26	5,0	8,6	10,2	11:3, 12:5, 13:0, 14:0, 15:0, 16:0	4		E	
4132	1	11	5,7	5,7		1:1, 2:1, 3:1, 19:1	4		PE+C+D	Root complete
	2	12	6,0	4,4	4,2	1:1, 2:0, 3:0, 4:0, 5:0, 19:1, 20:0	3		PE+PC+PD	
	3	15	4,5	4,7	7,9	9:0, 16:0, 17:1, 19:1	4	Calc	E+C+D	Root complete
	4	16	3,3	8,2	9,1	11:3.5, 12:3, 13:0, 14:0, 15:0, 16:0, 18:3, 19:3	22	Calc+R	E+C+D	In max. Adult
	5	17	4,2			11:3, 12:3, 13:0, 15:0, 16:1, 19:3, 34:3	17	Calc+R	PE+C+D	In max. Adult
	6	18	3,0	6,5	8,7	11:4, 12:3, 13:3, 14:0, 15:0, 21:0	15	Calc+R	E+C+D	In max. Adult
	7	21	5,9			1:1, 2:1, 3:0, 4:0, 5:0, 19:1	4		PE+C+D	
	8	26	4,0			11:4, 12:4, 15:0, 16:0	24	R	PE+C+D	In max. Adult
	9	27				18:3	17	R	PE+C+D	In max. Adult
	10	28	3,3	7,3	8,0	11:4, 12:2, 13:0, 14:0, 15:0, 16:0	16		E+C+D	In max. Adult
	11	35						R	PE+C+PD	In mand. Adult
	12	36	3,0	8,0	8,6	28:0, 34:2	22	R	E+C+D	In mand. Adult
	13	36	6,1			23:1, 24:x, 26:2, 27:0, 28:0, 29:2, 31:0			PE	
	14	37	4,3			24:+, 25:4, 28:0, 29:0, 30:0, 31:0	18	R	PE+C+D	In mand. Adult
	15	38						AMTL+Ab		Adult
	16	43	6,3	4,3	5,9	1:1, 3:0, 5:0, 7:0	4	H+Calc	E+C+D	In mand. Adult
	17	44	5,0	4,5	5,9	3:0, 17:1, 22:1	3	Calc	E+C+D	In mand. Adult
	18	45	4,0	4,5		22:0	3	Calc	PE+C+D	In mand. Adult
	19	46	3,2	7,2		34:2		Car+Calc	E+C+D	In mand. Adult
	20	47	4,1	7,8		24:+, 25:4, 29:0, 30:0, 31:0,34:2	18	Calc	PE+C+D	In mand. Adult
	21	48						AMTL		In mand. Adult
	22	24/25				9:0, 16:1, 17:1, 19:2	4		PE+C+D	Root complete
	23	PM Max.						Tr+Calc	PE	
	24	I Mand.				1:0, 3:0	3	Calc	PE	
	25	C/I							PE	

Grave 361

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
4136	1	43		5,0		1:2, 3:1, 6:0, 7:1	1		PE	
	2	PM Mand.							PE	
	-								(PE)	

Grave 368

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
4170	1	28				11:3.5, 12:0, 13:0, 14:0, 15:0, 16:0	9		E	2 exTracusps
	2	37	3,6	8,5	8,0	24:y, 28:1	15		PE	
	-								(PE)	

Grave 369

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
4179	1	31/32	7,6	4,0		1:1, 3:0	3	Calc	PE+PC	
	2	I Mand.				1:0		Calc	PE	
	-								(PE)	

Grave 358

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
4218	1	36	4,9	9,1	7,4	23:4, 24:x, 25:6, 26:0, 28:0, 29:2, 30:0, 31:0	4		E	Can be from grave 358
	2	37	5,3	8,8	8,1	24:+, 25:4, 27:0, 28:0, 29:0, 30:0, 31:0	6		E+PD	Can be from grave 358
	3	47	5,5	8,8	8,0	24:+, 25:4, 27:0, 28:1, 29:0, 30:0, 31:0	6		E	Can be from grave 358

Grave 375

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
	1	16/17	4,8	6,9	9,1	11:4, 12:5, 13:0, 14:0, 15:0, 16:0	14	Calc	E+PC	
	2	17/18				12:2, 13:0, 14:0, 15:0			PE	
4231	3	47/48	3,5			24:+, 25:4, 27:1, 28:1, 29:0, 30:0, 31:0	6		PE	

Grave 381

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
4331	-								(PE)	

Grave 383

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
4350	-								(PE)	

Grave 390

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
4439	1	37	4,7	8,5	8,3	24:+, 25:4, 28:0, 29:0, 30:0, 31:0	15		E+PC+PD	
	2	38	4,8	7,9	7,3	24:+, 25:5, 28:0, 29:0, 30:0, 31:0	6		E+PC+PD	
	-								(PE+PC+PD)	
4440	1	11	6,3	6,3	5,0	1:1, 2:0, 3:0, 4:0, 5:0, 19:1, 20:0	3	Calc	E+PC+PD	
	2	14	4,2	5,0	7,0	3:0, 8:0, 9:0, 10:0, 16:0	3	H	E+PC+PD	
	3	15	3,9	5,2	7,4	9:0, 16:0	3	Tr	E+PD	
	4	16	3,0	7,0	9,3	11:4, 12:5, 13:0, 14:0, 15:0, 16:0, 18:3, 19:4	20	Calc	E+PC+PD	
	5	17	3,8	6,6	10,0	11:4, 12:3, 13:0, 14:0, 15:0, 16:0	16	Calc	E+PC+PD	
	6	32	6,0	4,0	4,4	1:0, 3:0	2		E	
	7	33		4,6	5,9	1:1, 3:1, 5:0, 7:0	3	Calc	E+PC+PD	
	8	34	5,0	5,4	6,6	3:0, 22:1	2	Calc	E+PC+PD	
	9	35	4,6		6,8	22:5	3		PE	
	10	41	5,2	3,2	4,6	1:0, 3:0	3	Calc	E	
	11	44	5,2	5,5	6,7	3:0, 17:1, 22:5, 33:0	3	Calc	E+C+D	In mand.
	12	45	4,8	5,9	7,2	17:1, 22:4	3		E+C+D	In mand.
	13	46				34:2			C+D	In mand.
	14	47	4,9	8,5	8,1	24:+, 25:4, 28:0, 29:0, 30:0, 31:0	16		E+C+D	In mand.
	15	48	4,8	7,7	7,3	24:x, 25:4, 28:1, 29:0, 30:0, 31:0, 34:2	10		E	

Grave 393

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
4462	1	75	4,3	8,3	7,0	25:5, 28:0, 29:5, 30:0, 31:0	4		E	(Younger than 11 years)

Grave 400

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
4494	1	23	5,5	6,3	7,1	3:1, 5:5-, 6:1	5	H	PE	

Grave 401

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
4501	-								(PE)	

Grave 404

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
	1	11	6,6	8,6	~7,0	1:0, 2:0, 3:1, 4:0, 5:0, 19:1	5	Tr	PE+PC+PD	In max. Adult
	2	12								Max. Adult
	3	13								Max. Adult
	4	14								Max. Adult
	5	15		6,7		9:0, 16:0, 17:1	3	Hs	PE+C+D	In max. Adult
	6	16								Max. Adult
	7	17				18:3, 19:3	38	Car+Hs	C+D	In max. Adult
	8	18	5,3	8,4	10,3	11:3, 12:2, 13:1, 14:0, 15:0, 16:0, 18:2, 19:2, 21:0	4	Hs	E+C+D	In max. Adult
	9	23	5,7	8,2		1:0, 3:1, 19:1	5		PE+PC+PD	Root complete
	10	24				9:0, 10:0, 16:0, 17:1	4	R	PE+C+D	In max. Adult
	11	25		6,8		8:1, 9:0, 10:0, 16:0, 17:1	3	R	PE+C+D	In max. Adult
	12	26								Max. Adult
	13	27		9,6			21	R+Ab	PE+C+D	In max. Adult
	14	28		8,6		11:3, 12:2, 13:1, 14:0, 16:0, 21:0	4	R	PE+C+D	In max. Adult
	15	33	10,0		8,4	1:1, 3:1, 5:5-, 7:0, 19:1, 32:1		Calc+Hs	PE+PC+PD	
	16	43	8,2	6,5	7,4	1:2, 3:1, 5:0, 7:0, 19:2, 32:1	4	Calc	E+PC+PD	In mand.
	17	44	6,0	6,7	8,3	17:1, 19:2, 22:4	4	Calc	E+PC+PD	In mand.
	18	45		6,8		17:1, 19:2, 22:1	4	Calc	PE+C+D	In mand.
	19	46		~10,4		34:2	32		PE+C+D	In mand.
	20	47		~10,4		34:2	33		PE+C+D	In mand.
	21	36/37	4,5			34:2			PE+PC+PD	Root complete
	22	M						Car	PE+PC+PD	Root complete
4592	-								(PE+PC+PD)	

Find	Sub nr	Tooth	C	MD	BL	Non-meTrical variation	Wear	Pathology	Preservation	Other observation
4710	1	27/28	5,9	8,9	10,9	11:3, 12:5, 13:0, 14:0, 15:0, 16:1, 18:3, 19:3	8		E+PC+PD	

Grave Number of the grave
Find Find number in the findlist KM 18000:XXXX
N Subnumber of the find number KM 18000:XXXX:XX
Tooth Tooth number according to FDI system
C Crown height in mm.
MD Crown mesiodistal diameter in mm.
BL Crown buccolingual diameter in mm.

Non-metrical variation

1 Shovelling
2 Labial convexity
3 Double-shoveling
4 Interruption groove
5 Tuberculum dentale
6 Canine mesial ridge (Bushmen canine)
7 Canine distal accessory ridge
8 Premolar distal accessory cusps
9 Tricusped premolars
10 Distosagittal ridge (Uto-Aztecan premolar)
11 Metacone
12 Hypocone
13 Cusp 5 (Metaconule)
14 Carabelli s trait
15 Parastyle
16 Enamel extensions
17 Premolar root number
18 Upper molar root number
19 Radical number
20 Peg-Shaped incisor
21 Peg-shaped molar
22 Premolar Lingual Cusp variation
23 Anterior fovea
24 Groove pattern
25 Cusp number
26 Deflecting wrinkle
27 Distal trigonid crest
28 Protpstylid
29 Cusp 5
30 Cusp 6
31 Cusp 7
32 Canine root number
33 Tomes root
34 Lower molar root number

Wear Wear rate according to (Buikstra et. al. 1994

Pathology

Ab Abscess
AMTL Antemortem tooth loss
Calc Calculus
Car Caries
H Hypoplasia
Hs Hypersementosis
OCalc Occlusalcalculus
R Resorption
RootC Rootcaries
T Trauma

Preservation

E Enamel
C Cement
D Dentine
PE Part of enamel
PC Part of cement
PD Part of dentine

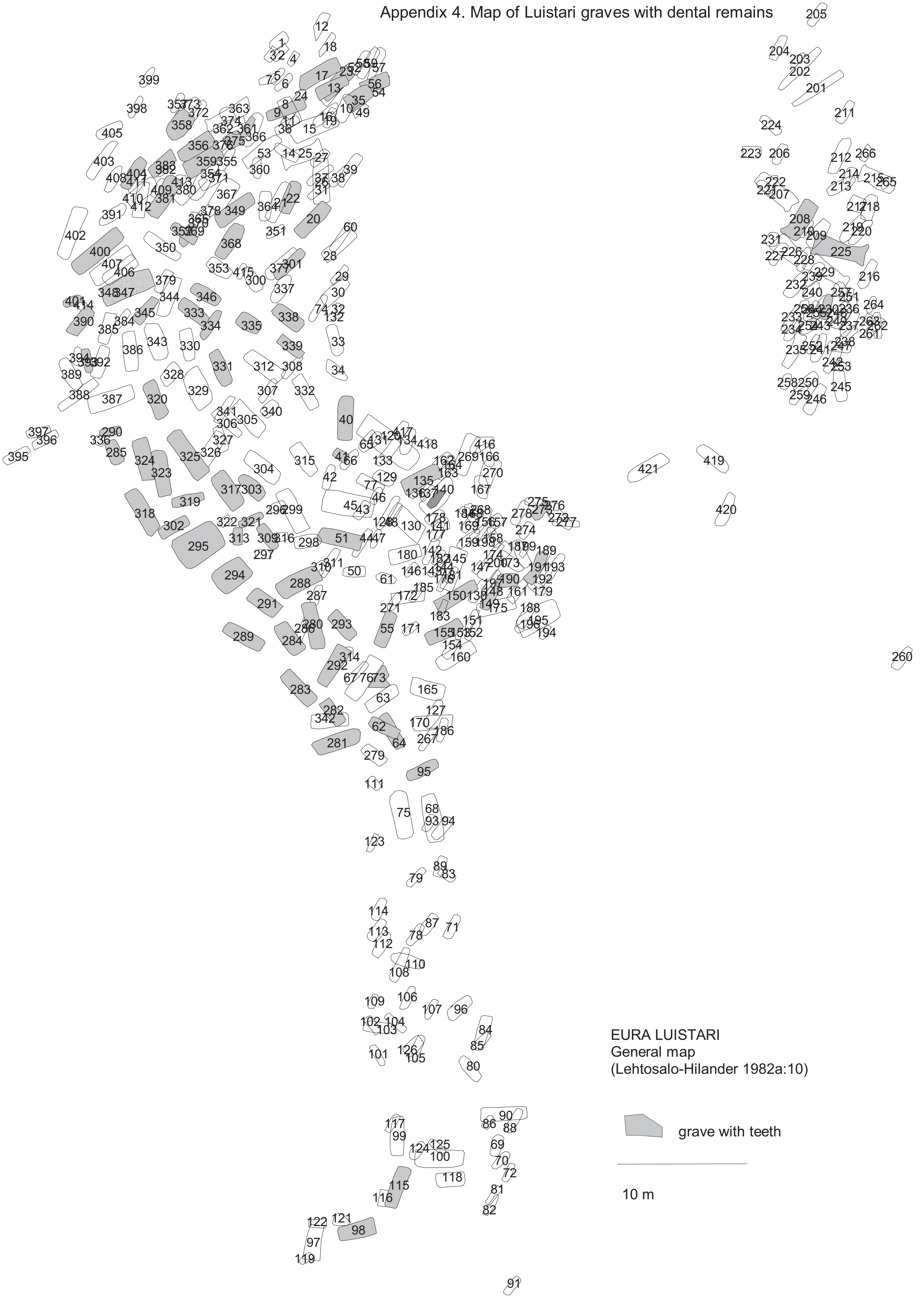
Other obsevation

Mand. Mandibula
Max. Maxilla

Appendix 3: Finnish humanosteological reports

Muncipality	Site	NM	Excav. leader	Osteologist	Dating
Alastaro	Vaaramäki		Pukkila J. 2004	Lahti E. 2004	
Enontekiö	Markkina	32854		Lahti E., Mannermaa K. 2001	Historical times
Halikko	Hiisimäki	22493		Formisto T. 1985	Migration-Meroving period
Halikko	Isoriihenmäki	18837		Fortelius M. 1980	Viking period
Halikko	Kirkkomäki	34020	Raike E. 2003	Salo K. 2004	Viking period
Helsinki	Santahamina Kadettikoulun puistikko	2005002	Lahti E-K. 2004	Lahti E. 2005	Historical times
Helsinki	Snellmaninkatu 4-6	2000 002:2212		Rasilo T., Tuhti A. 1999	Historical times
Hämeenlinna	Imatran voima			Formisto T. 1992	Iron Age
Hämeenlinna	Riiihimäki	30304	Seppälä S-L 1997	Söderholm N. 1998	
Hattula	Retulansaari	19704		Andors V. 1977	
Hollola	Kirkkailanmäki			Salo K. 2003	Crusade period/Early medieval
Jaala	Pukkisaari	19915 29097 30871	Miettinen T. Mertanen T.	Salo K. 2005	Meroving-Viking period (8-11th century)
Joroinen	Kanava	33923		Lahti E. 2003	Stone Age
Jyväskylän mlk.	Pyhäsaari	27197		Söderholm N. 1992	Early metal age
Kaavi	Tyynelä	15040		Fortelius M. 1978	Stone Age
Kaukola	Heikki Teräväisen rantapelto	5963		Fortelius M. 1980	
Kokemäki	Käräjämäki	32705	Taivainen J.	Mannermaa K. 2001	Pyheensilta/Migration period
Kristiinankaupunki	Råvåsen	30588		Ukkonen P. 1998	Combware-Asbestware
Kullaa	Levanpelto	18181		Fortelius M. 1980	Stone Age
Kuopio	Kuusikkolahdenniemi	6154		Fortelius M.1978	Early metal age
Laitila	Vainionmäki	34726	Luoto K.	Salo K. 2004	Viking period
Lappi tl.	Sammallahdenmäki	33312	Raike E.	Söderholm N. 2002	Bronze age
Lempäälä	Päivääniemi	29290		Formisto T. 1996	Iron Age (7th-9th century)
Luopioinen	Järvenpää	32614		Mannermaa K. 2001	
Maalahti	Kopparbacken	22847		Formisto T. 1987	Migration-Meroving period
Mikkeli	Kyyhkylä	10862		From S., Ukkonen P. 1993	Iron Age
Mikkeli	Moisio Latokallio	10884 11070		Ukkonen P. 1993	Iron Age (11th century)
Närpiö	Frönäsudden	20729		Fortelius M. 1980	Bronze age/Iron Age
Nastola	Skinnari	31607		Formisto T. 1999	Viking period
Pihtipudas	Hämeensaari	27178		Ukkonen P. 1994	Stone Age-Iron Age
Pälkäne	Rauniokirkko	2002020		Lahti E. 2001	Iron age-Medieval
Salo	Meriniitynpuisto	32225		Lahti E. 2004	Roman iron age
Sauvo	Korvala	30303		Mannermaa K. 1997	Iron Age
Sauvo	Korvala	30891		Mannermaa K. 1998	Iron Age
Sauvo	Korvala	31696		Mannermaa K. 1999	Iron Age
Taipalsaari	Vaateranta	19239		Fortelius M. 1980	Combware/Early metal age
Taipalsaari	Vaateranta	30887		Ukkonen P. 1998	Combware/Early metal age
Taipalsaari	Vaateranta	19239 31494		Lahti E. 2003	Combware/Early metal age
Taipalsaari	Vammonniemi	19224 27190		Ukkonen P. 1993	Iron Age
Turku	Kaerla		Raike E.	Söderholm N. 2002	Historical times
Turku	Kaerla		Raike E.	Salo K. 2003	Historical times
Vantaa	Jönsas	23532		Fortelius M. 1980	Mesolithic-Pre Roman Iron age
Vehmaa	Piiloinen	17489:4		Salo K. 2004	Roman iron age
Viitasaari	Rantala	8825		Ukkonen P. 1994	Bronze age/Iron Age
Vöyri	Båtholmen			Formisto T. 1984	

Appendix 4. Map of Luistari graves with dental remains



Appendix 5: Prehistoric frequencies of dental diseases in North-Eastern Europe

Site	Dating	Author	Ind.	Teeth	Caries/ Ind. %	Caries/ Teeth %	C.D.I.	Calculus/ Ind %	Resorption/ Individuals %	Hypo- plasia%
Denmark (DK)	mesolithic	Bennike 1985	20	423	0	0	66,1			
Jettböle (FI)	stone age	Nunez et al. 1995, Liden et al. 1996		60		0		33		
Skateholm, Vedbæk and others (SE+DK)	mesolithic	Borrman et al. 1996		1899		0,3				
Skateholm (SE)	mesolithic	Alexandersen 1988a				0,4				57,8
Trelleborg (DK)	viking age	Cristophersen 1941a	83	1372	7,2	0,7	51,7	97,5		
Trondheim (NO)	medieval	Scott et al. 1992	110	1325	8,2	1	37,6			80
Denmark (DK)	Bronze age	Bennike 1985	34	433	11,8	1,2	39,8			
Sweden (SE)	stone age	Holmer et al. 1956	559	6789		1,3	38,0			
Denmark (DK)	viking age	Brinch et al. 1949	87	1385	13,3	1,4	49,7			
Slusegård	roman iron age	Bennike et al. 2000	84	2120	19	1,4	78,9			
Westerhus (SE)	medieval	Lysell 1958, Alexandersen et al. 2000	97	2270		1,4	73,1			51,4
Denmark (DK)	Bronze age	Cristophersen 1939	25	446	12	1,6	55,8			
Denmark (DK)	Neolithic	Cristophersen 1939	274	3612	14,2	1,6	41,2			
Denmark (DK)	stone age	Cristophersen 1938	183	2709	15,3	1,6	46,3			
Luistari (FI)	merovingian-medieval	Author	94	710	10,9	1,7	23,6	42		23,1
Denmark (DK)	Early neolithic	Bennike 1985	26	320	15,4	1,9	38,5			
Denmark (DK)	Middle and late neolithic	Bennike 1985	597	6742	15,9	2,3	35,3			
Hollola (FI)	iron age	Saarnisto 1996		361		2,5				
Øm (DK)	medieval	Isager 1938 as quoted by Brinch et al. 1949	286	7636	40,9	2,9	83,4			
Norway (NO)	late medieval	Rygge 1913		1839		3,3				
Denmark (DK)	viking age	Bennike 1985	125	1616	25,6	3,4	40,4			
Denmark (DK)	medieval	Bennike 1985	109	2283	27,5	3,7	65,5			
Denmark (DK)	iron age (500bc.-800 ad.)	Cristophersen 1941b	207	3212	27,5	3,8	48,5			
Denmark (DK)	Migration period	Cristophersen 1941b	85	1307	25,9	3,9	48,1			
Denmark (DK)	roman iron age	Cristophersen 1941b	88	1474	33	3,9	52,3			
Halmstad (SE)	about 1500	Mellquist et. al. 1939	112	1100	25	4,5	30,7			
Denmark (DK)	roman iron age	Bennike 1985	392	5552	29,1	4,8	44,3			
Skovgåde (DK)	younger roman iron age	Bennike et al. 2000	15	346	33,3	4,9	72,1			47
Lund (SE)	1000-1520	Mellquist et. al. 1939	533	8025	40,7	4,9	47,1			
Fröjel, Gotland A (SE)	500-1000	Liebe-Harkort 2000		467	46	5,6		59,5		
Lund (SE)	medieval	Olsson et al. 1976, Sagne et al. 1977	122	2513	47,5	5,7	64,4	100		
Halland and Scania (SE)	early medieval	Mellquist et. al. 1939	(120)?			5,7		84	64	
Æbeholt (DK)	medieval	Brinch et al. 1949, Brinch 1952	197	5804	54,8	5,9	92,1			
Jõuga (EE)	medieval	Sarap 1993		111		6,3				
Halland and Scania tot. (SE)	1000-1700	Mellquist et. al. 1939	319	8895	42,3	6,7	87,1			
Gamleby, Varberg (SE)	1200-1578	Mellquist et. al. 1939	271	4546	37,2	7	52,4			
Fröjel, Gotland B (SE)	early christian period	Liebe-Harkort 2000		754		7		63,2		
Lund (SE)	1250-1550	Mellquist et. al. 1939	188	3513	48,4	7,1	58,4			
Halland and Scania (SE)	late medieval	Mellquist et. al. 1939	(71)?			7,7		81	68	
Himlingøje (DK)	roman iron age	Alexandersen 1995	45	722	57,8	7,8	50,1			
Vallhagar, Gotland (SE)	iron age (roman iron age-vendel period)	Lundström 1955		611		11,1				
Nyby, Lindhov (SE)	1400-1565	Mellquist et. al. 1939	79	1473	60,8	11,6	58,3			
Göteborg (SE)	historical	Engström et al. 1981	66			13				
Turku (FI)	medieval	Varrela 1991, 1997	410	4581	54,1	13,1	34,9		7,5	
Halmstad (SE)	1530-1700	Mellquist et. al. 1939	35	582	74,3	14	52,0			

Nyby, Lindhov (SE)	1565-1612	Mellquist et. al. 1939	11	222	81,8	19,1	63,1		
Pälkäne (FI)	1400-1800	Lahti 2004		205		47			
Denmark and Southern Sweden (DK+SE)	mesolithic	Alexandersen 1989	81		3				56
Denmark and Southern Sweden (DK+SE)	Battle axe	Alexandersen 1989	19		5				21
Sweden (SE)	prehistoric	Billing 1930	75		8				0
Denmark and Southern Sweden (DK+SE)	stone age	Alexandersen 1989	186		10,3				
Denmark and Southern Sweden (DK+SE)	Late neolithic	Alexandersen 1989	94		15				49
Denmark and Southern Sweden (DK+SE)	Middle neolithic	Alexandersen 1989	29		17				31
Denmark and Southern Sweden (DK+SE)	Early neolithic	Alexandersen 1989	9		22				50
Simonsborg (DK)	roman iron age	Alexandersen 2000	36		36				
Jämtland (SE)	medieval	Swärstedt 1966	132		56,8			96,2	
Kökar (FI)	1300-1400	Nunez 1995, 1997			60			35	

Ind. No of individuals in the study **Teeth** No of teeth in the study **C.D.I** Comparative dental index

Appendix 6: Trait frequencies in North-Eastern Europe

	Place	Dating	Author	UI1 Shovel-ling(2+3) %	UM1 Carab. (4-7) %	UM2 Hypocone (3,3+) %	LM1 (4 cusps) %	LM1 (5 cusps) %	LM1 (cusp 6) %	LM1 (cusp 7) %	LM2 (5 cusps) %
1,2	Skateholm and Vedb k (SE+DK)	Mesolithic	Alexandersen 1988, 1989, 2003		29	13	0	100			11
3	Kyndel se (DK)	Neolithic	Alexandersen 1988, 2003		23	14	6				20
4	Kyndel se MN (DK)	Neolithic	Alexandersen 1989, 2003		29			81			
5	Kyndel se LN (DK)	Neolithic	Alexandersen 1989, 2003		11			83			
6	Enk ping	Neolithic	Alexandersen 2003		12	28	13				
7	Bedinge (SE)	Neolithic	Alexandersen 1989		27			80			
8	Sweden (SE)	Stone age	Holmer et al. 1956		7	39					
9	Skovg rde, Seeland (DK)	3rd century-Early Roman Iron Age	Bennike et al. 2000	57	57	30	30		10	18	9
10	Vivallen (SE)	10th-12th century	Zachrisson et al. 1997		40	25			0		22
11	Risby (DK)	Medieval	Alexandersen 1989		14			97			
12	Scandinavia	Medieval	Zachrisson et al. 1997		68	28	4		1		9
13	Denmark (DK)	Medieval	Bennike et al. 2000	60	37	26	3		3	13	12
14	Scania, beholt and Lund (SE+DK)	Medieval	Alexandersen 1988		4		2				11
15	Trondheim (NO)	Medieval (1100-1531)	Scott et al. 1992		77	86			11		9
16	beholt and Hiller d (derup, N stved) (DK)	Medieval	J rgensen 1955				4	97	0?	0?	11
17	Luistari (FI)	Merovingian-Early Medieval	Author	12	21	18.2/21.6	12	70	15	3	16
18	Finland (FI)	Modern	L fgren 1935, Hjelmman 1929, Koski et al. 1952	15	5.8-6.9						
19	South-Eastern finns (FI)	Modern	Zubov 1982	12	44	75	3		8	3	
20	South-Western finns (FI)	Modern	Zubov 1982	9	44	50	17		5	1	
21	North-Eastern finns (FI)	Modern	Zubov 1982, 2000	25	39	51	15		11	3	
22	North Western finns (FI)	Modern	Zubov 1982	9	35	59	32		7	4	
23	Finnish lapps (FI)	Modern	Zubov 1982, 2000	25	13	70	16		10	3	
24	Skolt lapps (FI)	Modern	Kirveskari 1974	10	16	60	16	52	11	9	2
25	Skolta lapps	Modern	Zachrisson et al. 1997	19	13	1	16		8		22
26	Norwegian lapps (NO)	Modern	Zachrisson et al. 1997	26	20	53	9		8		26
27	Kola lapps (RU)	Modern	Zubov 1982, Zachrisson et al 1997	23	28	55	7/7.7		7	4	27
28	North-Western russians (RU)	Modern	Zubov 1982	4	32	50	14		1	2	
29	Olennij ostrov (RU)	Mesolithic	Zubov 2000	12	31	26	4		13		
30	Karelians (RU)	Modern	Zubov 1982	3	40	55	12		5	8	
31	Russians tot. (RU)	Modern	Zubov 1979	3	43	49	7	89	4	3	13
32	Estonians tot. (EE)	Modern	Zubov 1979	8	45	1	17	82	2	2	14
33	Eastern estonians (EE)	Modern	Zubov 1982	8	43	62	19		2	3	
34	Western estonians (EE)	Modern	Zubov 1982	9	50	60	13		0	1	
35	Latvians tot. (LV)	Modern	Zubov 1979	7	43	1	12	79	8	4	11
36	Lithuanians tot. (LT)	Modern	Zubov 1979	4	53	0	2	90	2	5	12
37	Vepsi (RU)	Modern	Zubov 1982, 2000	6	44	72	9		5	2	
38	Hungarians (Behind Karpats) (HU)	Modern	Zubov 2000	1	34	49	1		18	3	
39	Hungarians (Budabest) (HU)	Modern	Zubov 2000	8	51	80	5		13	6	
40	Mansi (RU)	Modern	Zubov 2000	53	35	68	7		4	1	
41	Khanti (RU)	Modern	Zubov 2000	27	23	48	14		6	5	
42	Northern Udmurts (RU)	Modern	Zubov 2000	12	54	56	10		15	3	
43	Ukrain (UA)	Modern	Zubov 2000	2	40	43	11		2	3	
44	Komi-Zyrians (RU)	Modern	Zubov 1982	20	26	50	9		7	9	

	Place	Dating	Author	UI1 Shovel-ling(2+3) %	UM1 Carab. (4-7) %	UM2 Hypocone (3,3+) %	LM1 (4 cusps) %	LM1 (5 cusps) %	LM1 (cusp 6) %	LM1 (cusp 7) %	LM2 (5 cusps) %
45	Mari (RU)	Modern	Zubov 1982	20	36	60	15		4	9	
46	Mari (RU)	Modern	Zubov 1982	22	47	65	10		6	5	
47	Jouga (EE)	12-16th century	Sarap 1993		20	25					
48	Trelleborg (DK)	Viking period	Cristophersen 1941		12						
49	Saami (FI)	Modern	Kajava 1912		3		16	81	3		15
50	Halland andScania (SE)	Medieval	Mellquist et al. 1939		4						
51	Latvia (LV)	5-14th century	Gravere 1987	5	38	25	9		4		

Carab.	Carabelli's cusp
UI1	Upper first incisor
UM1	Upper first molar
UM2	Upper second molar
LM1	Lower first molar
LM2	Lower second molar

Appendix 7: Size of the teeth (MDxBL) compared to size of the grave

Grave	UI1	UI2	UC	UPM1	UPM2	UM1	UM2	UM3	LI1	LI2	LC	LPM1	LPM2	LM1	LM2	LM3	Sex	Lenght	Width	Area
400			76,4														M	370	110	40700
325			85,0	77,0	76,9	137,0	121,1	118,4			67,9	58,5	66,8	135,9	136,6	133,7	M	362	125	45250
135	62,2	45,4	69,2	58,9	58,9		104,5								101,9		M	360	100	36000
348					58,9									96,1			M	360	150	54000
115						99,8		77,1									F	350	130	45500
280				62,8	61,2	120,8	97,0										M?	350	110	38500
289													54,4		104,9	89,2	M	330	100	33000
292													65,5				M	320	125	40000
40								108,0									M	320	125	40000
25						125,8											F	315	95	29925
51															101,7		M	310	120	37200
324			67,1												109,1	109,9	F?	300	115	34500
368								101,7									F	300	100	30000
73						123,9	113,1	78,5						126,2	113,6	100,7	F	300	125	37500
9			72,0	62,6													M	300	115	34500
98														110,5	102,0			300	100	30000
208			77,1								56,2	64,0	65,9	126,5	117,1		M	295	90	26550
323			74,6	70,2	71,1	121,5	104,8	93,6					66,0	112,3	113,1	100,9	M	295	95	28025
331						107,0	105,9					59,8	62,0	112,7	104,0		M	285	105	29925
356							124,6					53,8	65,3	112,4			F	280	100	28000
317			63,2					83,2									M	265	110	29150
13													52,4				M	260	90	23400
282															98,7		M	260	100	26000
55			54,8	60,3	59,6		112,7										F	260	110	28600
390	57,4			63,0	66,7	111,1	102,0		31,2	37,8		64,4	67,6		106,1	90,2	F	255	115	29325
190							120,6										F	250	90	22500
22			71,3					94,1										250	105	26250
309							104,5	98,7									F	245	85	20825
319							95,9	108,4							109,2		F	245	90	22050
346							102,1	94,1					49,7	107,0			F	235	85	19975
191	70,8	49,0	68,0	76,8	74,4	129,1	113,1	80,2									F	230	110	25300
302						128,7	95,4					61,1	64,8	120,9	114,4		M	230	90	20700
62		39,7	64,8	68,4	69,6	121,8	113,0			39,7	48,9		63,4	124,7	111,2	93,8	F	230	95	21850
334																	F?	220	55	12100
352				68,9	70,8	112,3	104,3		33,0	44,9		53,9	57,6	104,0	107,1	89,1	F	220	70	15400
80			77,4	64,4	68,4	117,4	128,1										M	220	75	16500
301			68,5	69,1	71,5	126,4	130,7					69,1	63,1	127,6	120,6		M	190		0

U	Upper jaw	Sex	As estimated by (Lehtosalo-Hilander 1982a)
L	Lower Jaw	Length	Lenght of the grave in cm (Lehtosalo-Hilandert 1982a)
		Width	Width of the grave in cm (Lehtosalo-Hilandert 1982a)
I	Incisor	Area	Surface area in cm2
C	Canine		
PM	Premolar	M	Molar

Correlations

		Hypoplasia	Caries	Calculus	Periodontitis
Hypoplasia	Pearson Correlation	1	.329**	-.022	-.015
	Sig. (2-tailed)		.002	.843	.892
	N	86	86	86	86
Caries	Pearson Correlation	.329**	1	-.058	-.060
	Sig. (2-tailed)	.002		.598	.580
	N	86	86	86	86
Calculus	Pearson Correlation	-.022	-.058	1	.047
	Sig. (2-tailed)	.843	.598		.667
	N	86	86	86	86
Periodontitis	Pearson Correlation	-.015	-.060	.047	1
	Sig. (2-tailed)	.892	.580	.667	
	N	86	86	86	86
Trauma	Pearson Correlation	-.043	.083	.429**	.429**
	Sig. (2-tailed)	.692	.445	.000	.000
	N	86	86	86	86
Stonesetting	Pearson Correlation	.159	-.170	.179	.121
	Sig. (2-tailed)	.143	.118	.098	.268
	N	86	86	86	86
Woodenconstructions	Pearson Correlation	.107	.093	.130	-.082
	Sig. (2-tailed)	.326	.395	.234	.452
	N	86	86	86	86
Nails	Pearson Correlation	.000	.026	.071	-.141
	Sig. (2-tailed)	.999	.814	.515	.194
	N	86	86	86	86
Charcoal	Pearson Correlation	.110	.041	.004	.183
	Sig. (2-tailed)	.314	.707	.969	.092
	N	86	86	86	86
Slag	Pearson Correlation	-.164	.164	-.127	.206
	Sig. (2-tailed)	.130	.132	.243	.057
	N	86	86	86	86
Findsinthefilling	Pearson Correlation	.006	.094	.043	.076
	Sig. (2-tailed)	.959	.391	.694	.490
	N	86	86	86	86
Remainsofanimals	Pearson Correlation	-.067	.018	.076	-.145
	Sig. (2-tailed)	.537	.866	.488	.182
	N	86	86	86	86
Pottery	Pearson Correlation	-.007	-.002	.089	.193
	Sig. (2-tailed)	.950	.984	.414	.075
	N	86	86	86	86
Weapons	Pearson Correlation	-.067	-.195	.077	-.041
	Sig. (2-tailed)	.542	.071	.482	.710
	N	86	86	86	86
Tools	Pearson Correlation	.105	-.059	.142	-.047
	Sig. (2-tailed)	.336	.592	.191	.666
	N	86	86	86	86
Horseequipment	Pearson Correlation	-.015	.156	-.037	-.049
	Sig. (2-tailed)	.892	.151	.734	.656
	N	86	86	86	86

Correlations

		Hypoplasia	Caries	Calculus	Periodontitis
Ornaments	Pearson Correlation	.104	.043	.135	.122
	Sig. (2-tailed)	.340	.696	.216	.265
	N	86	86	86	86
Partsofbelts	Pearson Correlation	.218*	.021	-.051	-.089
	Sig. (2-tailed)	.044	.845	.642	.415
	N	86	86	86	86
Bronzespirals	Pearson Correlation	-.001	.209	.051	.132
	Sig. (2-tailed)	.994	.054	.639	.227
	N	86	86	86	86
Te1tiles	Pearson Correlation	.027	-.015	.258*	.064
	Sig. (2-tailed)	.806	.888	.016	.557
	N	86	86	86	86
Coins	Pearson Correlation	-.068	.021	.120	-.089
	Sig. (2-tailed)	.534	.845	.272	.415
	N	86	86	86	86
Scalesandweights	Pearson Correlation	-.046	-.088	-.074	-.071
	Sig. (2-tailed)	.675	.422	.497	.518
	N	86	86	86	86
Wealth	Pearson Correlation	-.126	.119	-.121	-.010
	Sig. (2-tailed)	.377	.405	.398	.942
	N	51	51	51	51

Correlations

		Trauma	Stonesetting	Woodenconstructions	Nails
Hypoplasia	Pearson Correlation	-.043	.159	.107	.000
	Sig. (2-tailed)	.692	.143	.326	.999
	N	86	86	86	86
Caries	Pearson Correlation	.083	-.170	.093	.026
	Sig. (2-tailed)	.445	.118	.395	.814
	N	86	86	86	86
Calculus	Pearson Correlation	.429**	.179	.130	.071
	Sig. (2-tailed)	.000	.098	.234	.515
	N	86	86	86	86
Periodontitis	Pearson Correlation	.429**	.121	-.082	-.141
	Sig. (2-tailed)	.000	.268	.452	.194
	N	86	86	86	86
Trauma	Pearson Correlation	1	.253*	.113	.048
	Sig. (2-tailed)		.019	.298	.659
	N	86	86	86	86
Stonesetting	Pearson Correlation	.253*	1	.315**	.107
	Sig. (2-tailed)	.019		.003	.328
	N	86	86	86	86
Woodenconstructions	Pearson Correlation	.113	.315**	1	.281**
	Sig. (2-tailed)	.298	.003		.009
	N	86	86	86	86
Nails	Pearson Correlation	.048	.107	.281**	1
	Sig. (2-tailed)	.659	.328	.009	
	N	86	86	86	86
Charcoal	Pearson Correlation	.077	.127	.233*	.165
	Sig. (2-tailed)	.480	.243	.031	.128
	N	86	86	86	86
Slag	Pearson Correlation	.193	.003	-.001	.032
	Sig. (2-tailed)	.075	.976	.992	.768
	N	86	86	86	86
Findsinthefilling	Pearson Correlation	.083	.098	.006	.135
	Sig. (2-tailed)	.450	.369	.959	.215
	N	86	86	86	86
Remainsofanimals	Pearson Correlation	.159	.132	.187	.192
	Sig. (2-tailed)	.143	.226	.084	.077
	N	86	86	86	86
Pottery	Pearson Correlation	.056	.009	.181	.193
	Sig. (2-tailed)	.607	.937	.096	.074
	N	86	86	86	86
Weapons	Pearson Correlation	.117	.304**	.181	.031
	Sig. (2-tailed)	.285	.004	.096	.778
	N	86	86	86	86
Tools	Pearson Correlation	.065	.105	.301**	.203
	Sig. (2-tailed)	.551	.335	.005	.060
	N	86	86	86	86
Horseequipment	Pearson Correlation	-.114	-.100	.036	.102
	Sig. (2-tailed)	.298	.358	.745	.351
	N	86	86	86	86

Correlations

		Trauma	Stonesetting	Woodenconstructions	Nails
Ornaments	Pearson Correlation	.283**	.250*	.322**	.171
	Sig. (2-tailed)	.008	.020	.002	.116
	N	86	86	86	86
Partsofbelts	Pearson Correlation	-.042	.086	.208	.112
	Sig. (2-tailed)	.700	.431	.054	.306
	N	86	86	86	86
Bronzespirals	Pearson Correlation	.278**	.066	.284**	.291**
	Sig. (2-tailed)	.010	.547	.008	.007
	N	86	86	86	86
Te1tiles	Pearson Correlation	.150	.059	.212	.266*
	Sig. (2-tailed)	.169	.588	.051	.013
	N	86	86	86	86
Coins	Pearson Correlation	-.042	-.116	.137	.407**
	Sig. (2-tailed)	.700	.289	.210	.000
	N	86	86	86	86
Scalesandweights	Pearson Correlation	-.066	-.065	.223*	.236*
	Sig. (2-tailed)	.544	.551	.039	.029
	N	86	86	86	86
Wealth	Pearson Correlation	.097	.095	.075	.429**
	Sig. (2-tailed)	.497	.508	.602	.002
	N	51	51	51	51

Correlations

		Charcoal	Slag	Findsinthe filling	Remainsof animals	Pottery
Hypoplasia	Pearson Correlation	.110	-.164	.006	-.067	-.007
	Sig. (2-tailed)	.314	.130	.959	.537	.950
	N	86	86	86	86	86
Caries	Pearson Correlation	.041	.164	.094	.018	-.002
	Sig. (2-tailed)	.707	.132	.391	.866	.984
	N	86	86	86	86	86
Calculus	Pearson Correlation	.004	-.127	.043	.076	.089
	Sig. (2-tailed)	.969	.243	.694	.488	.414
	N	86	86	86	86	86
Periodontitis	Pearson Correlation	.183	.206	.076	-.145	.193
	Sig. (2-tailed)	.092	.057	.490	.182	.075
	N	86	86	86	86	86
Trauma	Pearson Correlation	.077	.193	.083	.159	.056
	Sig. (2-tailed)	.480	.075	.450	.143	.607
	N	86	86	86	86	86
Stonesetting	Pearson Correlation	.127	.003	.098	.132	.009
	Sig. (2-tailed)	.243	.976	.369	.226	.937
	N	86	86	86	86	86
Woodenconstructions	Pearson Correlation	.233*	-.001	.006	.187	.181
	Sig. (2-tailed)	.031	.992	.959	.084	.096
	N	86	86	86	86	86
Nails	Pearson Correlation	.165	.032	.135	.192	.193
	Sig. (2-tailed)	.128	.768	.215	.077	.074
	N	86	86	86	86	86
Charcoal	Pearson Correlation	1	.082	.258*	.133	.090
	Sig. (2-tailed)		.455	.016	.222	.409
	N	86	86	86	86	86
Slag	Pearson Correlation	.082	1	.138	.005	.221*
	Sig. (2-tailed)	.455		.205	.966	.041
	N	86	86	86	86	86
Findsinthefilling	Pearson Correlation	.258*	.138	1	.142	.003
	Sig. (2-tailed)	.016	.205		.191	.980
	N	86	86	86	86	86
Remainsofanimals	Pearson Correlation	.133	.005	.142	1	-.041
	Sig. (2-tailed)	.222	.966	.191		.707
	N	86	86	86	86	86
Pottery	Pearson Correlation	.090	.221*	.003	-.041	1
	Sig. (2-tailed)	.409	.041	.980	.707	
	N	86	86	86	86	86
Weapons	Pearson Correlation	-.010	-.075	.003	.227*	-.041
	Sig. (2-tailed)	.928	.495	.980	.036	.711
	N	86	86	86	86	86
Tools	Pearson Correlation	.008	.009	.112	-.089	.124
	Sig. (2-tailed)	.943	.935	.304	.415	.255
	N	86	86	86	86	86
Horseequipment	Pearson Correlation	.071	-.015	.076	.215*	.076
	Sig. (2-tailed)	.518	.888	.490	.047	.486
	N	86	86	86	86	86

Correlations

		Charcoal	Slag	Findsinthe filling	Remainsof animals	Pottery
Ornaments	Pearson Correlation	.160	.094	.082	.183	.218*
	Sig. (2-tailed)	.140	.391	.455	.092	.044
	N	86	86	86	86	86
Partsofbelts	Pearson Correlation	-.008	-.028	.138	.027	-.003
	Sig. (2-tailed)	.942	.797	.206	.804	.976
	N	86	86	86	86	86
Bronzespirals	Pearson Correlation	.232*	.381**	.159	.214*	.388**
	Sig. (2-tailed)	.032	.000	.144	.048	.000
	N	86	86	86	86	86
Te1tiles	Pearson Correlation	-.019	.069	-.060	.033	.335**
	Sig. (2-tailed)	.863	.529	.584	.762	.002
	N	86	86	86	86	86
Coins	Pearson Correlation	-.076	.039	.028	-.119	.139
	Sig. (2-tailed)	.485	.721	.798	.275	.203
	N	86	86	86	86	86
Scalesandweights	Pearson Correlation	.184	-.103	.109	.051	.110
	Sig. (2-tailed)	.090	.347	.316	.643	.312
	N	86	86	86	86	86
Wealth	Pearson Correlation	.120	.174	.201	.256	.004
	Sig. (2-tailed)	.400	.222	.156	.070	.977
	N	51	51	51	51	51

Correlations

		Weapons	Tools	Horseequipment	Ornaments
Hypoplasia	Pearson Correlation	-.067	.105	-.015	.104
	Sig. (2-tailed)	.542	.336	.892	.340
	N	86	86	86	86
Caries	Pearson Correlation	-.195	-.059	.156	.043
	Sig. (2-tailed)	.071	.592	.151	.696
	N	86	86	86	86
Calculus	Pearson Correlation	.077	.142	-.037	.135
	Sig. (2-tailed)	.482	.191	.734	.216
	N	86	86	86	86
Periodontitis	Pearson Correlation	-.041	-.047	-.049	.122
	Sig. (2-tailed)	.710	.666	.656	.265
	N	86	86	86	86
Trauma	Pearson Correlation	.117	.065	-.114	.283**
	Sig. (2-tailed)	.285	.551	.298	.008
	N	86	86	86	86
Stonesetting	Pearson Correlation	.304**	.105	-.100	.250*
	Sig. (2-tailed)	.004	.335	.358	.020
	N	86	86	86	86
Woodenconstructions	Pearson Correlation	.181	.301**	.036	.322**
	Sig. (2-tailed)	.096	.005	.745	.002
	N	86	86	86	86
Nails	Pearson Correlation	.031	.203	.102	.171
	Sig. (2-tailed)	.778	.060	.351	.116
	N	86	86	86	86
Charcoal	Pearson Correlation	-.010	.008	.071	.160
	Sig. (2-tailed)	.928	.943	.518	.140
	N	86	86	86	86
Slag	Pearson Correlation	-.075	.009	-.015	.094
	Sig. (2-tailed)	.495	.935	.888	.391
	N	86	86	86	86
Findsinthefilling	Pearson Correlation	.003	.112	.076	.082
	Sig. (2-tailed)	.980	.304	.490	.455
	N	86	86	86	86
Remainsofanimals	Pearson Correlation	.227*	-.089	.215*	.183
	Sig. (2-tailed)	.036	.415	.047	.092
	N	86	86	86	86
Pottery	Pearson Correlation	-.041	.124	.076	.218*
	Sig. (2-tailed)	.711	.255	.486	.044
	N	86	86	86	86
Weapons	Pearson Correlation	1	.225*	.076	.276*
	Sig. (2-tailed)		.038	.486	.010
	N	86	86	86	86
Tools	Pearson Correlation	.225*	1	-.160	.287**
	Sig. (2-tailed)	.038		.141	.007
	N	86	86	86	86
Horseequipment	Pearson Correlation	.076	-.160	1	.122
	Sig. (2-tailed)	.486	.141		.265
	N	86	86	86	86

Correlations

		Weapons	Tools	Horseequi pment	Ornaments
Ornaments	Pearson Correlation	.276*	.287**	.122	1
	Sig. (2-tailed)	.010	.007	.265	
	N	86	86	86	86
Partsofbelts	Pearson Correlation	.139	.120	.070	.063
	Sig. (2-tailed)	.203	.272	.519	.566
	N	86	86	86	86
Bronzespirals	Pearson Correlation	-.007	.163	.132	.280**
	Sig. (2-tailed)	.946	.133	.227	.009
	N	86	86	86	86
Te1tiles	Pearson Correlation	.028	.260*	.179	.299**
	Sig. (2-tailed)	.798	.015	.099	.005
	N	86	86	86	86
Coins	Pearson Correlation	-.003	.188	.070	.222*
	Sig. (2-tailed)	.976	.082	.519	.040
	N	86	86	86	86
Scalesandweights	Pearson Correlation	.195	.095	-.071	.176
	Sig. (2-tailed)	.072	.383	.518	.104
	N	86	86	86	86
Wealth	Pearson Correlation	.227	.135	.289*	.361**
	Sig. (2-tailed)	.110	.343	.040	.009
	N	51	51	51	51

Correlations

		Partsofbelts	Bronzespirals	Te1tiles	Coins
Hypoplasia	Pearson Correlation	.218*	-.001	.027	-.068
	Sig. (2-tailed)	.044	.994	.806	.534
	N	86	86	86	86
Caries	Pearson Correlation	.021	.209	-.015	.021
	Sig. (2-tailed)	.845	.054	.888	.845
	N	86	86	86	86
Calculus	Pearson Correlation	-.051	.051	.258*	.120
	Sig. (2-tailed)	.642	.639	.016	.272
	N	86	86	86	86
Periodontitis	Pearson Correlation	-.089	.132	.064	-.089
	Sig. (2-tailed)	.415	.227	.557	.415
	N	86	86	86	86
Trauma	Pearson Correlation	-.042	.278**	.150	-.042
	Sig. (2-tailed)	.700	.010	.169	.700
	N	86	86	86	86
Stonesetting	Pearson Correlation	.086	.066	.059	-.116
	Sig. (2-tailed)	.431	.547	.588	.289
	N	86	86	86	86
Woodenconstructions	Pearson Correlation	.208	.284**	.212	.137
	Sig. (2-tailed)	.054	.008	.051	.210
	N	86	86	86	86
Nails	Pearson Correlation	.112	.291**	.266*	.407**
	Sig. (2-tailed)	.306	.007	.013	.000
	N	86	86	86	86
Charcoal	Pearson Correlation	-.008	.232*	-.019	-.076
	Sig. (2-tailed)	.942	.032	.863	.485
	N	86	86	86	86
Slag	Pearson Correlation	-.028	.381**	.069	.039
	Sig. (2-tailed)	.797	.000	.529	.721
	N	86	86	86	86
Findsinthefilling	Pearson Correlation	.138	.159	-.060	.028
	Sig. (2-tailed)	.206	.144	.584	.798
	N	86	86	86	86
Remainsofanimals	Pearson Correlation	.027	.214*	.033	-.119
	Sig. (2-tailed)	.804	.048	.762	.275
	N	86	86	86	86
Pottery	Pearson Correlation	-.003	.388**	.335**	.139
	Sig. (2-tailed)	.976	.000	.002	.203
	N	86	86	86	86
Weapons	Pearson Correlation	.139	-.007	.028	-.003
	Sig. (2-tailed)	.203	.946	.798	.976
	N	86	86	86	86
Tools	Pearson Correlation	.120	.163	.260*	.188
	Sig. (2-tailed)	.272	.133	.015	.082
	N	86	86	86	86
Horseequipment	Pearson Correlation	.070	.132	.179	.070
	Sig. (2-tailed)	.519	.227	.099	.519
	N	86	86	86	86

Correlations

		Partsofbelts	Bronzespirals	Te1tiles	Coins
Ornaments	Pearson Correlation	.063	.280**	.299**	.222*
	Sig. (2-tailed)	.566	.009	.005	.040
	N	86	86	86	86
Partsofbelts	Pearson Correlation	1	.038	.117	.032
	Sig. (2-tailed)		.731	.283	.773
	N	86	86	86	86
Bronzespirals	Pearson Correlation	.038	1	.386**	.172
	Sig. (2-tailed)	.731		.000	.112
	N	86	86	86	86
Te1tiles	Pearson Correlation	.117	.386**	1	.327**
	Sig. (2-tailed)	.283	.000		.002
	N	86	86	86	86
Coins	Pearson Correlation	.032	.172	.327**	1
	Sig. (2-tailed)	.773	.112	.002	
	N	86	86	86	86
Scalesandweights	Pearson Correlation	.333**	.110	.093	.449**
	Sig. (2-tailed)	.002	.312	.394	.000
	N	86	86	86	86
Wealth	Pearson Correlation	.230	.319*	.318*	.371**
	Sig. (2-tailed)	.105	.022	.023	.007
	N	51	51	51	51

Correlations

		Scalesand weights	Wealth
Hypoplasia	Pearson Correlation	-.046	-.126
	Sig. (2-tailed)	.675	.377
	N	86	51
Caries	Pearson Correlation	-.088	.119
	Sig. (2-tailed)	.422	.405
	N	86	51
Calculus	Pearson Correlation	-.074	-.121
	Sig. (2-tailed)	.497	.398
	N	86	51
Periodontitis	Pearson Correlation	-.071	-.010
	Sig. (2-tailed)	.518	.942
	N	86	51
Trauma	Pearson Correlation	-.066	.097
	Sig. (2-tailed)	.544	.497
	N	86	51
Stonesetting	Pearson Correlation	-.065	.095
	Sig. (2-tailed)	.551	.508
	N	86	51
Woodenconstructions	Pearson Correlation	.223*	.075
	Sig. (2-tailed)	.039	.602
	N	86	51
Nails	Pearson Correlation	.236*	.429**
	Sig. (2-tailed)	.029	.002
	N	86	51
Charcoal	Pearson Correlation	.184	.120
	Sig. (2-tailed)	.090	.400
	N	86	51
Slag	Pearson Correlation	-.103	.174
	Sig. (2-tailed)	.347	.222
	N	86	51
Findsinthefilling	Pearson Correlation	.109	.201
	Sig. (2-tailed)	.316	.156
	N	86	51
Remainsofanimals	Pearson Correlation	.051	.256
	Sig. (2-tailed)	.643	.070
	N	86	51
Pottery	Pearson Correlation	.110	.004
	Sig. (2-tailed)	.312	.977
	N	86	51
Weapons	Pearson Correlation	.195	.227
	Sig. (2-tailed)	.072	.110
	N	86	51
Tools	Pearson Correlation	.095	.135
	Sig. (2-tailed)	.383	.343
	N	86	51
Horseequipment	Pearson Correlation	-.071	.289*
	Sig. (2-tailed)	.518	.040
	N	86	51

Correlations

		Scalesand weights	Wealth
Ornaments	Pearson Correlation	.176	.361**
	Sig. (2-tailed)	.104	.009
	N	86	51
Partsofbelts	Pearson Correlation	.333**	.230
	Sig. (2-tailed)	.002	.105
	N	86	51
Bronzespirals	Pearson Correlation	.110	.319*
	Sig. (2-tailed)	.312	.022
	N	86	51
Te1tiles	Pearson Correlation	.093	.318*
	Sig. (2-tailed)	.394	.023
	N	86	51
Coins	Pearson Correlation	.449**	.371**
	Sig. (2-tailed)	.000	.007
	N	86	51
Scalesandweights	Pearson Correlation	1	.206
	Sig. (2-tailed)		.147
	N	86	51
Wealth	Pearson Correlation	.206	1
	Sig. (2-tailed)	.147	
	N	51	51

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Appendix 9: Origins of artifacts compared to origins of genetic traits

Grave	Find	Origin/Similar items found	Shovelling/ Carabellis cusp/ Hypocone/ Five cusped lower second molars
9	Belt buckle	Gotland	Shovelling (eastern)
13	Ring	East Baltic ?	
13	studs or mounds	Gotland, Latvia	
17	Ring	East Baltic ?	
17	Ring	East Baltic ?	
22	Ring	East Baltic ?	
23	Clay vessell	Latvia, Saarenmaa	
23	Ring	East Baltic ?	
23	Amber	Southern coast of Baltic	
23	Bead	Italy	
25	Clay vessell	Latvia, Saarenmaa	Carabellis cusp (western/central european)
25	pendant	estonia	Carabellis cusp (western/central european)
25	Ring	East Baltic ?	Carabellis cusp (western/central european)
25	Bead	East	Carabellis cusp (western/central european)
35	pendant	latvia and Estonia	
35	Ring	East Baltic ?	
35	Ring	East Baltic ?	
35	Bead	Italy	
40	Ring	East Baltic ?	
55	Ring	East Baltic ?	
56	Brooch	Finland	
56	pendant	East Baltic	
56	Ring	East Baltic ?	
56	Bead	East	
56	Bead	Italy	
56	pendant	Finland, Sweden	
62	Bead	Eastern Russia	Shovelling (eastern), Carabellis cusp (western/central european), Hypocone
64	Ring	East Baltic ?	
95	Brooch	Scandinavia	
95	Ring	East Baltic ?	
135	Ring	East Baltic ?	
139	Ring head pin	Finland, Estonia	
139	pendant	east	
150	Ring	East Baltic ?	Hypocone
225	Ring	East Baltic ?	
280	Ring	East Baltic ?	
280	Tassled belt	Gotland, Latvia	
281	Ring	East Baltic ?	
281	Tassled belt	Gotland, Latvia	

282	ringed pin	Birka	
282	Ring	East Baltic ?	
283	Spearhead	Latvia	Hypocone
283	Spearhead	Latvia	Hypocone
283	Ring	East Baltic ?	Hypocone
288	Ring	East Baltic ?	Hypocone
292	Ring	East Baltic ?	
295	Ring	East Baltic ?	Hypocone
303	Spinning-whorl	Gotland	Hypocone
309	Ring	East Baltic ?	
317	Spearhead	possible Central Europe	Carabellis cusp (western/central european), Hypocone
320	Ring	East Baltic ?	
323	Ring	East Baltic ?	Hypocone
324	Ring	East Baltic ?	
325	Tassled belt	Gotland, Latvia	Hypocone, Five cusped lower second molar
333	Spearhead	possible Central Europe	
333	Pin	Latvia	
333	bracelet	East Baltic ?	
335	Ring head pin	Finland, Estonia	
345	Sleight bell button	East	Five cusped lower second molar
348	ringed pin	Karelia	Hypocone
348	Ring	East Baltic ?	Hypocone
348	Ring	East Baltic ?	Hypocone
348	Tassled belt	Gotland, Latvia	Hypocone
356	Ring	East Baltic ?	
356	Bead	Italy	
356	pendant	Finland, Sweden	
356	studs or mounds	Saarenmaa, Estonia, Gotland	
358	Ring	East Baltic ?	
358	studs or mounds	Saarenmaa, Estonia, Gotland	
359	Brooch	Åland	Hypocone
359	Brooch	Scandinavia	Hypocone
359	Ring	East Baltic ?	Hypocone
359	studs or mounds	Saarenmaa, Estonia, Gotland	Hypocone
381	Ring	East Baltic ?	
383	Ring	East Baltic ?	
383	Bead	Italy	
383	pendant	Finland, Sweden	
390	Brooch	Russia	
390	Ring head pin	Finland, Estonia	
400	Tassled belt	Gotland, Latvia	
404	Axe	East baltic,Poland, Russia, Sweden	

404	Ring	East Baltic ?	
404	Bead	East	