Show me your teeth and I will tell who you are

The osteological analysis of the bone material from St Michael´s church at Pälkäne with special emphasis on the dental remains

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Eeva-Kristiina Lahti
Supervisor: Professor Ebba During
Assistant supervisor: M.A. Carola Liebe-Harkort
Osteoarchaeological research laboratory
University of Stockholm

1. Introduction

"Show me your teeth and I will tell who you are". These are the words that Baron Georg Cuvier the zoologist and anatomist of the 18th and 19th century is alleged to have said (Hillson 2002: 1). With this sentence Cuvier was actually referring to comparative anatomy and reconstructing the extinct animals from fragments of their teeth. However, the sentence is more than appropriate in human osteology. The dentition is the most valuable source when understanding biology, evolution and identifying individuals is considered (Hillson 2002: 1). With the help of dentition health status, nutritional status and even sometimes the lifelyhood of the individual can be clarified.

The nutritional status is much more than just a dietary intake. It is a reflection of the physiological balance of the individual, and it is a function of a variety of interacting factors, including political, economic and ecological conditions. Poor nutritional status places functional limits on the community (Goodman *et al*. 1991: 279).

Thus the nutritional status which can be manifested in the dentition for example as signs of enamel disruption can give us valuable information of the social balance in an ancient society (Lukacs 1989: 279). For example, questions like sexual and social equility can be observed. With the help of the dental material we can, in most favourable circumstances, study the gender roles of the individuals. This can be done by observing and recording the eventual signs of work related abration manifested at the surface of the teeth. Teeth can also reveal the quality of the food consumed. The amount of sugar and carbohydrate products surely leaves a trace manifested as caries and other dental disease. Finally, dental material can in certain circumstances reveal the exact origin place of an individual at an area, due to disruptions that a high fluoride water can cause to the forming teeth (Lukacs 1989: 279).

In this study the osteological material from Pälkäne was analyzed by the author at the Osteoarchaeological research laboratory at the University of Stockholm. The material was, when the collections in Finland are considered, quite well preserved, even though the skeletons were not complete and partly very eroded. The poor preservation of organic material is common in Finnish archaeological material due to the acid soil. At Pälkäne church the soil is mainly fine sand (Adell 1998).

The main aim of this study was to investigate the lives of the individuals, but also to learn more about the past population of Pälkäne. This was done with the help of the osteological analysis of the individuals buried at Pälkäne. Because the material was fragmented and the individuals were not complete the teeth were selected to be the main focus of the subject. Naturally the importance of this well preserved dental material from Finnish soil, as well as, personal interest influenced the focusing to the dental material. Questions like the overall health status and other phenomena like anomalous wear reflected in the dental set of the ancient Pälkäne individuals were emphasized.

2. Pälkäne church

The church ruins of Pälkäne are situated in the municipality of Pälkäne, ca. 140 km NE of the capital Helsinki. The church, dedicated to St. Michael was probably erected between 1475/80-1530. Typologically the church belongs to the class B1 among the Finnish medieval church classification made by Hiekkanen. Therefore it is similar to stone churches erected in Hollola, Sysmä, Sääksmäki and Vanaja. The church was probably erected during only a couple of summer seasons (Hiekkanen 1994: 229-230). The church, dedicated to St. Michael, is a typical late medieval rectangular

construction wich consists only of a nave and sacristy situated at the northern side and a weaponroom at the southern side of the church (Mentu 2002).

During the 18th century the church became too small for the parish and thus by the end of the century several plans to expand the church was made (Koukkula 1972: 556). During the Kostianvirta battle in 1713 the church was robbed and set to fire by Russian soldiers (Koukkula 1972: 300). At the beginning of the 19th century the church was found to be in such a bad condition that in 1811 the demolished east wall was replaced by a wooden construction. By 1839 a new church was erected and the old church of St. Michael was abandoned (Koukkula 1972: 564-565).

After the church was abandoned the decay was rapid. Most of the furniture was moved to the new church or sold as raw material. Even the floor planks were sold, which exposed the burials under the church floor. At this point, the crania situated in the Retzius collections was probably collected from the church. During the excavation in 2001 ca 30 crania were found at area 8. These were probably collected from the open burials during the exposing of the graves at the 19th century (Mikkola 2002). The church now served several purposes: first it was used as a dissection room and after the land division in 1885 it became a part of the Anttila farm at the village of Onkkaala. At this point the church was used as a barn and the old cemetery area as pasture. In 1890 a part of the roof collapsed during a winterstorm and the rest were removed in the spring. Finally, in 1902 Pälkäne parish gained again ownership of the church. The building was often under repair in the 20th century (Koukkula 1972: 565-566, 576; Vuorensola 1988: 228-231, 504, 680-681).

In the 19th century the cemetary was alloted. The cemetery area outside the church was divided amongst local villages, while the burial places inside the church were mainly divided into family vaults. The burying inside the church became scarce during the 18th century and finally in 1822 it was forbidden. Most of the coffins were covered only with the floor planks. When the church floor was sold the burials were left open. This was considered to be a scandal and the graves were disturbed by animals and people (Koukkula 1972: 569-573).

The antiquarian interest towards the church began during the change of 19th and 20th centuries (Mentu 2002). Several archaeological excavations have been made during 1992-2003. The main reason for the archaeological excavations of the church was the fact that the stone walls were in danger of collapsing. Therefore, the excavated areas were not chosen based on a scientific question but on the need of collecting the archaeological evidence before the supporting construction was destroyed by and under the church walls. The artefacts unearthed consist of Swedish coins, coffing nails, buttons, glass beads as well as fabrics and ceramics (Adel 1998; Jussila 1992; Mikkola 2002; Mikkola 2004).

During the archaeological excavations by the National Board of Antiquities the focus has mainly been on recording the structures of the church and therefore some of the skeletal material was reburied without further analysis. During the excavation in 1992 an osteological analysis was performed at several cranial elements by Petri Nykänen *DDS*. However, other skeletal elements were not analyzed (Jussila 1992; Nykänen 1992; Nykänen & Nykänen 1999). After the excavation of 1999 the entire unearthed skeletal material was immediately reburied (Adell 1999). In 2001 there was again an archaeological excavations at the site. At this point only the bones which were clearly without any context were reburied and the skeletal material was preserved for the purpose of osteological analyses (Mikkola 2002). Excavations continued in the summer of 2003, at which point one, late Iron Age burial was discovered at the site (Mikkola 2004; Vuoristo 2004). The continued practices from prehistoric times untill the 19th century make the Pälkäne church partiqularly interesting among medieval church sites.

3. Research history

Anders Retzius (1796-1860) is well known to be one of the founders of craniology. During his quite versatile career he served as the professor of the anatomical departement of the Karolinska Institute. Retzius is mainly known from his achievements in craniology, and it is said that he changed the thought of the uniformian european race. He established a method by which the width and length of the cranium sum up an index, which he then dealt to present *dolicocefal* (long skull) and *bracycephal* (short skull). Furthermore he presented the division between the *ortognathic* (snoutlike) and *prognathic* (straight) profile (Isaksson 2001:69, 320). However, craniology was only one phase in his research career. Retzius founded the anatomical collections at the Karolinska Institute, which is named after him.

Retzius received several crania from his former student Evert Julius von Bonsdorff many occasions during 1850. Von Bonsdorff became the professor of anatomy and fysiology in 1846, and influenced by his teacher, he started the anatomical collections at the University of Helsinki. However, the collection consisted of several types of material and was not a pure human skeletal collection. As many of his contemporaries von Bonsdorf also exercised exchange with his collegues. Among the crania that Anders Retzius received from his former student were several crania from the Pälkäne church (Söderholm 2002: 19-20). During this era the human crania were considered to be good merchandise and for example the founder of the lestadian movement, Lars-Levi Laestadius, unearthed and sold crania from the Finnish lappland to european universities (Lohi 2000: 74). The Pälkäne crania are deposited at the Osteoarchaeological laboratory at the University of Stockholm. Probably the crania were taken from the cemetery after the floor planks were removed and finally the crania were sold to the anatomical collection.

Gustav Retzius (1842-1919) followed his fathers path. He studied among other things Finnish crania from Pälkäne. In his publication from 1878 "*Finska cranier jämte några natur- och litteraturstudier inom andra områden af finska antropologi*" he stated that the longskulled crania of Pälkäne were some sort of a relic of the Swedish settlement in the area (Isaksson 2001: 73). Among 49 skulls (9 of them subadult) he found the crania to be variable in their width and length. Many of the crania seemed to be *dolicocephalic* and similar to the Swedish skull forms. However, he thought that the large amount of the *dolicocephalic* skulls in the material was a sign of the Finns not being homogenic *bracycefala* (Retzius 1878: 169-170).

During the excavation in 1992 cranial elements from eight individuals were analyzed by Petri Nykänen *DDS* (Jussila 1992; Nykänen & Nykänen 1999: 43-45). Among the elements were both females and males. The individuals seemed to have suffered from a variety of dental diseases like caries and parodontal disease, and almost all of them had suffered from premortal tooth loss. One individual, a male, had a severely broken mandibula, something which could have lead to death. The age structure varied from juvenile to mature.

4. The material

The material of this study comes from the excavations performed in 2001 by Esa Mikkola *MA,* and it is catalogisized at the National Museum collections KM 2002020: 81-101. During the excavations four small areas, alltogether ca 10 squaremeters were excavated both in- and outside of the western wall of the church. The burials were mainly oriented *SE-NW* (Mikkola 2002). The graves were not excavated entirely due to the limitations in the opened areas. This and the long timeperiod at which the burials were made, increase the difficulty of the analysis. This is mainly due to the fact that the stratigraphy is not intact and the skeletal remains can not be always found *in situ.* The material is

disturbed, eventhough an attempt was made to collect the skeletons individually. This is a common problem not being able to avoid at sites which have been in use for several centuries. Furthermore it makes the osteological analysis a difficult task, as it is very hard, and sometimes even impossible to separate different individuals *per se;* especially when the age of the deceased is similar. This is why the burials can not be represented as individuals. Only the minimum number of the individuals can be presented and other information, like sex, age, stature and other data can only be mentioned. A separation of the different individuals has mainly been impossible. Each individual in 20 different graves were only partly excavated. The burials can be dated to a long time period from ca 15th to 19th century, with some individuals being older then the stone church (Mikkola 2002).

The results of the osteological analysis are presented in the simpified bone lists, preserved at the Osteoarchaeological Research Laboratory. If there is no mentioning about the elements being from subadults or adults they are from adults, since all the subadult bones have been recorded in the list. All the information of the excavation of the burials and other archaeological information is taken from the excavation rapport (Mikkola 2002). The direction of the burials is mentioned if it has been described in the rapport. The analysis follows the catalogue system of the National Museum of Finland.

5. Applied methods

The recording of the teeth was done in a way which makes it easier to compare the material to other skeletal materials in the future. Otherwise the material was investigated, when possible by recording each individuals age (Buikstra & Uberlaker; Fazekas & Kósa 1978; Gray 1973; Meindl & Lovejoy 1985; Schour & Massler 1941; Smith 1984), sex (Ascàdi & Nemeskeri 1970; Bass 1995; Brothwell 1981; Buikstra & Uberlaker 1994; Milner 1992), and body height (Trotter & Gleser 1958; Holland 1995). Also pathological changes (Buikstra & Uberlaker 1994; Brothwell 1981, Czanetzki 1996; During 1996) in the skeletons, as well as non-metric traits (Buikstra & Uberlaker 1994) were studied. The subadult bones were mainly aged with the help of reference material, but mostly, when possible they were measured. The measurements are mentioned in the appendix as well as all the applied methods on every grave unit which is situated at the archive of Osteoarchaeological research laboratory or at appendix 1 and 2. The foetal bones were aged with the help of measurements taken from *Forensic Fetal Osteology* (Fazekas & Kósa 1978). The sexing of subadult individuals was done, when possible from the ilium and from the mandible. However, the sexing of subadults is highly questionable and should be considered carefully (Schuthowski 1994). All bones that were measurable were measured with a sliding calliper or with a osteometric board at the Osteoarchaeological laboratory. If there is no mentioning of the measurements, the bones could not be measured due to fragmentation or other taphonomic factors. However, this is not mentioned as regards every bone *per se*.The measurements were mainly taken from Standards (Buikstra & Uberlaker 1994).

Because the material was quite badly disturbed, special attention was made at the dental material. Sadly the mandibula and the maxilla were not often possible to sex since they were fragmented or ambiguous. All sorts of health conditions manifested in the teeth were studied in detail. This was done by recording dental *caries*, its severity and place, calculus and its position as well as *odontomes* and *periodontal* disease (Brothwell 1981; Hillson 2001; Ash & Nelson 2003). Also possible *abscess* and *premortal* tooth loss were recorded (Brothwell 1981; Hillson 2001). Finally *dental enamel hypoplasia* was recorded and studied further with the help of using a microscope at the *Odontological* unit at Karolinska Institute (Buikstra & Uberlaker 1994; Goodman et al. 1999). All cultural related wear was recorded as well as possible non-metrical variants (Hillson 2002; Smith 1984; Turner et al. 1991). The recording of the dental material was done by following the

classification of "*recording forms for caries*" constructed by Simon Hillson (2001). However, because of the presence of mixed dentitions in the material, the tables were modified, and also some condition as enamel hypoplasy were added to the tables. This was done to make the observation of the dental material easier to study. If possible, the teeth from the left side were measured with a sliding calliper as recommended mainly from the left side. (Mayhall 1992). This was done for the future sampling of Finnish tooth measurement. When the left side dentition was broken or missing, the measurements were if possible taken from the right side. The teeth were measured according to Buikstra and Uberlaker (1994: 62-63). Both the crown length (*mesiodistal*) and the crown breadth (*buccolingual*) were measured. Due to the attrition and fragmentation of the enamel the crown height was not measured.

5.1 Sex

The sexing of the skeletal elements in the material is mainly based on the methods presented in *Standars* (Buikstra & Uberlaker 1994) and based on ocular observation of different characters. The secondary sexual characters are developed at puberty and can therefore be used best for adult individuals (Buikstra & Uberlaker 1994: 16). Some attempts have been made to sex the individuals under 6 years of age (Schutkowski 1993: 199-205). The method is based on the *mandibular* (lower jaw) and *coxae* (hip bone) features known to have secondary sexual characters. The method were applied when sexing the *Infant* and *Juvenile* elements.

Because the skeletons were not separable and complete, a decision to resort to other metrical methods was made (Bass 1995: 126; Trotter & Gleeser 1952, 1958). The applied methods will be presented below.

5.1.1 Cranium

In general males are considered to have larger and more robust skulls. However, it can sometimes be quite challenging to separate the sexes, because individual differences as well as racial characters can influence the decision (Buikstra & Uberlaker 1994: 19). It is always possible that some cranial evidence can have different robustness in an individual *per se*. According to Buikstra & Uberlaker there are five areas on the cranium that are considered to have sexual dimorphism.

For example the nuchal crest (*protuberantia occipitalis externa*) is in general flat on females and prominent on males.The mastoid process (*processus mastoideus*) is in general small and gracile on females and robust on males. The female have a sharp edged supra-orbital margin (*crista orbitalia*) and male a more rounded one.The supra-orbital ridge (*glabella*) tends to be flat on females and more prominen on males. The mental eminence (*trigonum mandibulare*) is not or only slight projected on females as the male can have a more massive eminence. Each feature mentioned above can be scored from 1 to 5 from undetermined sex to masculine or feminine values (Buikstra & Uberlaker 1994).

There are other areas of the *cranium* (skull) that can also help when sexing of the individual is done. The females have a rounded *angulus mandibularis* (the angle of lower jaw) and a horisontal *rami* which is aligned with the *gonion* (external angle of the lower jaw) as males have an everted *gonion* and a more sharpr mandibular angle. (Sjøvold 1988.)

5.1.2 Os coxae

When sexing the adult skeleton, the most reliable part of the the skeleton is the pelvic region. At adolescence the female pelvis enlarges preparatory to child bearing, with alteration to size and shapes of many parts. When this metamorphosis is complete, these areas are trustworthy indicators (St. Hoyme & Işcan 1994: 76). The subpubic region is often considered to be of great importance (Buikstra & Uberlaker 1994: 17-18). Unfortunately it is often not well presented in the archaeological material and was lacking in the studied material as well. This is why in this study only the sexing of the *ilium* (the dorsal element of the hip bone) has been done. Several characters can be observed on *os ilium*. For example the females tend to have a more broader greater sciatic notch (*incisura isciadica major*), as the males tend to have a more narrow one. The broadness can be scored from 0 -5 (see appendix 1). The preauricular sulcus is more often present on female *coxae* than on males (Buikstra & Uberlaker 1994: 17-18). When scoring the presence of the sulcus, 5 different scores from absence to wide and deep sulcus are used (Millner 1992).

Other features which show sexual dimorphism are *arc composé* and *spina ischiadica*. The *arc composé* is the curvature of a line drawn from the *spina isciadica* past the medial border of the auricular surface. If the auricular surface will touch the line it is masculine. The coxae is feminine if a second parallel line is needed. The spina is considered to be feminine if it is sharp, when it is rounded it is considered to be masculine (Sjøvold 1988).

5.1.3 Metrical methods

Long bones, such as *humerus* (the upper arm bone) and *femur* (the thigh bone), can be used as an indication of sex. This is done by taking certain measurements from the bones (Bass 1995, Gejvall 1960), based on the apprehension that males are normally taller and more robust than females.

Also *scapula* (the shoulder blade) can be used for sex estimation. This is done, for example by measuring the length of the glenoid cavity (Bass 1995: 126-129).

5.2 Age

Following age groups have been used at the definition of age of the individuals (Sjövold 1978). Due to the nature of the material it was sometimes very difficult to age the adult individuals. Therefore the adult can rarely be aged in subgroups. The ageing of the foetuses is taken from Fazekas & Kósa (1978).

Infant: birth-1
Infans I: 0-7
Infans II: 5-14
Juvenilis: 10-24

Adult: 18-79
Adultus: 18-44
Maturus: 35-64
Senilis: 50-79

5.2.1 Cranial suture closing

During growing cranial sutures generally tend to fuse. There is, however, a considerable variability in closure rates (Krogman & Isçan 1986; Meindl & Lovejoy 1985). The variation reduces the value of pattern for age estimation. The observation of the fusion is nevertheless useful, when other criteria are lacking or when it is used in conjuncture with other methods. If ambiguous, postcranial elements should be given more weight. The degree of closure should be recorded for 10 *ectocranial* (outer surface of the skull), four *palatal* (palatal bone) and three *endocranial* (inner surface of the skull) locations (Krogman & Isçan 1986; Meindl & Lovejoy 1985). However this method is considered to be rather speculative and in ambiguous cases post cranial sites should be given more weight (Buikstra & Uberlaker 1994: 36).

5.2.2 Dental eruption

The ageing of the subadult individuals has been done with the help of dental eruption. There are several different methods for describing the process. They are either based on the morphological observation (Uberlaker 1989a; Schour & Massler 1941) or on radiographic pictures taken from living populations that reveal the development of the crown and the roots of individual teeth (Haavikko 1974; Moorres 1963). The dental eruption can be considered population specific (Goodman & Song 1999: 230). In this study the decision to use the Schour & Massler method was made because it is based on the dental eruption, but also because it is widely used and thus makes the comparison with other materials possible in future. The method divides dental eruption and formation into 22 sequences, each representing a certain age. Althoug the work is based on terminally ill children who died mostly under the age of two, it is considered to perform well in comparison with alternatives (Hillson 2002: 142).

5.2.3 The tooth wear

The ageing by an occlusal attrition score is based on the wear which is produced by tooth-to-tooth contact. It produces wear facets on the *occlusal* (chewing) surface or at the contact points between teeth. (Hillson 2002: 231.) Here the *occlusal attrition* is recorded by the stages according to Smith (1984). The material is presented in tooth tables. It is quite common to use the attrition score for ageing individuals using Brothwell (1981: 72). However, this method is based on medieval materials from London, and it is not considered suitable for the Pälkäne material due to the possible difference in nutrition.

5.2.4.Os coxae

5.2.4.1 Auricular surface

The auricular surface exhibits systematic age-related changes and is rather often preserved in the archaeological material. The age can be defined by age related changes manifested at the appearance of the surface and surrounding borders of the auricular surface. Values and sites for observations are shown in appendix 1 (Uberlaker 1989a: 81; Meindl & Lovejoy 1989: 140-141, 160-165).

5.2.5 The ageing of the subadult remains

When ageing subadult individuals several methods can be used. The fusion of different skeletal elements is a well known method and it is considered to be valid (Gray 1973). Long bones can be

aged due to the grade of *epiphyseal* (secondary ossification center) union with the schaft. However, other bones, such as *coxae, vertebrae* and *os occipitale* (bone in the back of the head) can be aged also by observing the union of the primary ossification centers (Gray 1973).
In this study the ageing of the bones has been made with using the grade of the ossification. Mostly the reference material at the Osteoarchaeological reseach laboratory has been used. The *Foetal* remains in the material have been aged applying different measurements (Fazekas & Kósa 1978).

5.3 Stature

The estimation of the stature can be counted from the length of certain long bones as well as other bones like the *talus* (ankle bone) and the *calcaneus* (heel bone).This is generally based on the idea that long people have long bones (Sjøvold 1990). The estimation made by the *talus* and *calcaneus* is not considered to be very reliable, since they are considered to have a big standard error and should only be used when no intact long bones are present. Consequently it was found to be quite suitable for this material. The measurements (see appendix 1 and 2) are taken from Holland (1995: 315-320). In the study the stature estimation formula for longbones constructed by Sjøvold (1990: 442) will be used. It is based on the *caucasoid* race (for formula see appendix 1).

5.4 Pathological changes

The pathological changes in the material were studied and recorded with the help of literature (Buikstra & Uberlaker; Brothwell 1981; During 1996; Czanetki 1996). The pathological conditions of the dental wear is discussed more thoroughly later.

5.5 Non-metrical traits

The non-metric traits are characters that can appear on the skeletal elements of some individuals and can be considered as genetic markers (Saunders 1989: 95-108). In this material these traits were studied and recorded with the help of literature (Buikstra & Uberlaker 1994). Some traits were studied from the dental material using *The Arizona State University Dental Anthropology System* (Turner *et al*. 1991). The questions considering the dental material will be presented later.

6. The recording of the dental material

In the study special attention was given to the dental material. In archaeological material the teeth are probably the most valuable material for understanding the biology of ancient societies and identifying individuals from fragmented remains. Teeth have a distinct anatomy and physiology of their own and they are the most resistant parts of archaeological and fossil remains. With dental anthropology one can study the tooth morfology of different populations and the development and the process of wear and other changes that occur during the life of the individuals. By studying the dental diseases conclusions can be made about the nutritional status of the society. Nowadays biochemical studies from the dental tissues are a widely developing area with interesting results (Hillson 2002: 1-2).

The dental anthropology has its roots in *odontology* but it is also widely used by archaeologists who wish to reconstruct demography, biological affinities like diet, health and the way of life from excavated human remains. Teeth also serve as perhaps the most important source of data for forensic anthropologists, who try to identify individuals from remains that are very fragmented (Hillson 2002: 3). The teeth are resistant to the destructive effects of being for a long time in the

ground and thus they are perfect material for an archaeologist especially working at a geographical area with sour soil, where sometimes nothing else is preserved but dental enamel.

During life, each individual has two dentitions. The *deciduous* (milk) teeth and the permanent teeth. The *deciduous* teeth are half formed by birth and erupt during the first two years. Gradually the *deciduous* dentition is replaced by the permanent dentition. The permanent teeth begin to form just before birth and the last tooth is completed in the early twenties (Hillson 2002: 6).

The *deciduous* dentition consists of eight *incisors* (cutting teeth), four *canines* (dog teeth) and eight *molars* (grinding teeth). The permanent dentition consist of eight *incisors*, four *canines*, eight *premolars* and twelve *molars*. However, not everyone has the whole set of molars, since the third ones are sometimes missing or remain unerupted. In the study the teeth will be referred to by the notation of *FDI, Fédération Dentaire Internationale* (1971). The system is designed for rapid entry into computer databases and is ideal for recording large collections (Hillson 2002: 8).

The morphological sites will be descripted as follows (Hillson 2002:11-12).

Gingivae	the tissue surrounding the teeth
Alveol	the teeth sockets
Crown	projects into the mouth
Enamel	outer layer of crown
Root	embedded in the jaw
Cement	outer layer of root
Dentine	core of the root
Pulpa	the pulp chamber inside the tooth
Cemento-enamel junction (*CEJ*)	boundary between crown and root
Cervix	the meeting point of the crown and the root
Cervical margin	base of the crown
Cingulum	bulge on the side of the crown
Occlusal aspect	the surface of the crown, chewing surface
Incisal aspect	the cheving surface at the front teeth
Apical aspect, *apex*	the tip of the root
Mesial aspect	the surface of the teeth towards the medial plane
Distal aspect	the surface of the teeth away from the medial plane
Approximal surface	the surface of the teeth against the neighbouring teeth (distal or mesial)
Interproximal	the surface of the teeth against the neighbouring teeth (distal or mesial)
Lingual	the surface against the tongue
Buccal	the surface against the cheek
Labial	towards the lips

The dental caries recording scheme suggested by Hillson (2001) will be used (see appendix 1). Hillson made separate tables for deciduous and permanent dentition. Due to the material in the present study a decision was made to change the table so that the dentition could be observed as it is in reality. The tables presented in this paper are then, in some cases modified to fit the purposes of the study. In the caries recording scheme many of the dental conditions like alveolar resorbtion or chipping, as well as attrition is taken into consideration. However, a decision was made to add some conditions to the tables. Such conditions were enamel hypoplasy, a more specific presentation for the eruption or tooth loss as well as the measurements taken from the teeth.

7. Dental caries

Dental caries is a disease process characterized by the focal demineralization of dental hard tissues by organic acids produced by bacterial fermentation of dietary carbohydrates such as sugars. Essential factors are exposure of the tooth surface to the oral environment and the presence of aggregates of complex indigenous oral bacterial flora, dental *plaque* (a collection of bacteria at the surface of the tooth) and diet (Hillson 2002: 284). Modifying factors include factors that affect primarily site distribution and speed development of the lesions such as morphology and size, developmental enamel defects, occlusal surface attrition, food texture, certain diseases, age, heredity, salivary composition and flow, nutrition, *periodontal* (situated or occuring around the tooth) disease, enamel element composition, presence of fluoride and other local geochemical factors. Some studies have shown a low caries rate in connection with the evidence of *fluorosis* (Hillson 2002: 284). The *genesis* of caries is thus a complex interaction of both essential and modifying factors (Larsen *et al*. 1991: 179).

Very often the carious lesions begin at the complex *fissure* (cleft or groove) or *fossae* (a trench or channel) sites at the occlusal surface or on the *buccal pit* sites of the premolars and molars. These sites are vulnerable to caries due to the thinning of the enamel at the *fissures*. The mesial and distal crown surfaces, just below the contact point between the neighbouring teeth are often initiated by lesions as well. *Caries* can also be initiated at the margin of the *gingivae*. However, this kind of smooth surface *caries* is difficult to record in archaeological material, since the margin of the *gingivae* is often untraceable on the enamel surface. (Hillson 2001: 277.) Caries can also begin from the root surfaces. This becomes more probable during ageing because the teeth constantly erupt due to attrition or the resorption of *gingivae* and other supporting tissues because the *peridontal* disease leaves the *cervical* area exposed (Hillson 2001: 250-252, 254).

8. Calculus, periodontal disease and bone loss

The most typical diseases which affect the teeth are related to a dence accumulation of micro-organisms on the tooth surface called *plaque*. *Plaque* often causes the vast majority of *ante mortem* tooth loss. Mineralized *plaque* attaches to the tooth surface as *calculus*. The most common sites are the surfaces of the *anterior* teeth and the *buccal* surfaces of the molars. The process of mineralization is not known but bacteria are supposed to have a major role. *Calculus* can be supra-gingival attached to the *cervical* part of the crown right at the margin of the *gingival* and can extend to the higher part of the crown or develop into a overhanging outgrowth in one teeth or throughout the dentition. *Calculus* is light in colour but can be stainable. In archaeological context the *calculus* is easily loosened and lost. Sub-gingival *calculus* deposits on the root when the gingival tissue recedes. It is thinner and harder with a similar coloration and is often difficult to distinguish from normal cement. Sub-gingival *calculus* leads to *peridontal* disease (*paradontitis*), since the sub-gingival *plaque* spreads down to the the root surface and creates a *periodontal* pocket. *Calculus* is influenced by poor hygiene and carbohydrate consumption. The condition is nowadays more often recorded in males and increases by age. At population level there can be slight inverse relationship between *calculus* and *caries*, even though both are frequently seen in the same tooth (Hillson 2002: 255-260). In this study calculus is recorded with the grading used by Brothwell (1981: 155). The teeth were observed with bare eyes and symptoms were given the values *slight*, *medium* and *considerable*.

The *peridontal* tissue that surrounds and supports the teeth consists of bone of the jaw (*alveoles*), *periodontal* ligament, cement, *gingivae* and *mucosa* (soft tissue gathered into a cuff around the base of each tooth crown).The *gingivae* can be divided to free and attached *gingivae*. The attached

gingivae covers the *cortical* bone of the jaw as the free *gingivae* creates the attachement on the base of the crown. Thus the *periodontal* pocket is created between the crown and the free *gingivae* (Hillson 2002: 260-261).

The *periodontal* pocket can escalate into advanced lesions due to the accumulation of sub-gingival *plaque* and thus create resorption of the alveolar bone. This condition is called the adult type of *peridontitis* and is quite common among individuals over 30 years. The advancement of the *periodontal* disease can lead to horisontal or vertical bone loss. The horizontal loss affects the surrounding walls of the teeth and is often spread to the whole dental arcade. It can be measured or scored by the extent of root exposure. Eventually the periodontitis can lead to tooth loss as the surrounding alveolar bone is lost. After the *periodontal* ligament attachement is lost the bone starts to remodel itself and finally all signs of of tooth sockets are erased (Hillson 2002: 262-267).

In this study the horisontal symptoms related to *periodontal* disease were recorded by grading suggested by Brothwell (1981: 155). The grades are: *no alveolar destruction, slight, medium* and *considerable*. In his "Caries recording scheme" Hillson (2001) suggests that measurements with sliding calliper should be used. However, due to the post mortal destruction of the *cemento-enamel* junction in the material, the grading by Brothwell was preferred.

9. Enamel hypoplasia and fluorosis

During the development of the teeth a wide range of factors can disrupt the development. *Hypoplasia* can be divided in to three conditions which are *hereditary anomaly, localized trauma* and a *systemic metabolic stress*. Hereditary anomalies normally affect the entire crown and are the most severe kind of *hypoplasia*. Localized trauma related *hypoplasia* can be severe but will effect only one or a few adjacent teeth. The *hypoplasia* related to systemic metabolic stress are usually found in several teeth manifesting the developmental time of the *hypoplasia* (Goodman *et al*. 1991: 281). These factors are for example dietary deficiency, childhood fevers and major infections such as congenital *syphilis*. All these conditions are recorded in the dental material as enamel defects. Studying the enamel defects gives an archaeologist a possibility to study the past health conditions as well as stress factors. Since the *hypoplasia* are developed during the formation of the teeth the exact point of the disruptions can be counted. However, the birth mechanisms of the disruptions are still poorly understod and and vary depending on which part of the teeth is being formed. The best way to study *hypoplasia* is in relation to the microscopic pattern of growth layering preserved in the enamel (Hillson 2000: 249-250).

The defects seen at the crown surface most often take the form of furrows, steps, or pits arranged circumferentially in bands around the crown side. Not all defects that can be seen are *hypoplasia*. Sometimes they can be inherited and show similar pattern in both decidous and permanent teeth. These are called *amelogenesis imperfecta*. The *hypoplasia* are often called *DDE* (*developmental defects of the enamel*) (Comission of the oral health 1982). The most common defects are the furrow-form, which can vary from microscopic symptoms to defects which can be seen with the naked eye. They are often called *linear enamel hypoplasy* (*LEH*). The furrows are particularly prominent on the sides of anterior tooth crowns, although they can also appear in the *cervical* half of cheek tooth crowns (Hillson 2002: 167). Sometimes whole layer or enamel is missing, which is considered to be an indication of a more marked growth disturbance. Large areas of brown *striae* planes are exposed creating irregular sloping facets (Hillson 2002: 167). Sometimes the *hypoplasia* can be seen as pitted area which can be accentuated in rows or on its own. The pits can be large or small (Hillson 2000: 252). Enamel hypoplasia may help when separated teeth from a commingled burial need to be matched (Hillson 2000: 252).

The *hypoplasia* can be studied by measuring the size and position with a sliding calliper and then estimating the timing and duration from a table that assumes linear growth in crown height. This is then calculated on the basis of an average final crown height and the start and completion of the crown formation taken from literature. The measurement is taken from the *cemento-enamel junction* to the middle point of the *hypoplasia*. Usually the *canine* is used. Although the method is widely used, it is not without difficulty. Problems like the differences in teeth eruption standards, crown height variations, wear and *abration* as well as the non existent definition of minimum size defect to be recorded as *hypoplasia* exist (Goodman et al. 1999: 227). Ideally *hypoplasia* should be studied microscopically and *histologically* (microscopical anatomy) from cross-sections (Hillson 2000: 252-3).

In this paper *hypoplasia* was studied because it seemed to be quite common in the material. The *hypoplasia* was studied with naked eyes and recorded with the help of *Index of developmental defects of dental enamel* (*DDE* index, see appendix 1) instead of the original subscription suggested by Hillson in his caries recording sceme. This was done because the former method seemed to be more adequate for this material than the other. It was the authors decision. Hillson suggests measurements from *CEJ*, which in the material was often eroded due to *taphonomy* and therefore less suitable.

The *hypoplasia* was measured with a microscope (16x and 6.4x) and photographed at the departement of *Cariology and Endodontology* at the Karolinska Institute, with the kind help of Sofia Tranæus *DDS, PhD* and research assistant Karin Trållsås. The *hypoplasia* were verified and further verified as *hypoplasia* or *fluorosis* related *hypoplasia* by Doctor Tranæus.

10. Results of the osteological analysis

10.1 Catalogue number 2002020: 81/Grave 15

Minimum Number of Individuals: 4
Fragments: 69
Weight: 816.8 gr
The burial number 15 was excavated from the area 5 from the northwestern end inside the church. The burial was made in a burial chamber with parts of the coffin still visible. However, the burial contains bones from at least four individuals. Due to the written information, the burial places inside the church were distributed to certain families. Then it is appropriate to assume that these individuals belonged to the same family. The minimum number of individuals is four, according to the presence of left *scapula* in the unit. In the material there are bones from an *Infans I* and an adult which probably come from an elderly person, since there are age related *osteon* (bone cell) growth at the *vertebrae* and *costae* (ribs). The adult bones carry masculine characters at temporal region and at the *orbita* region. The measurements made at the *humeral* head also gave masculine rate. The both *orbita* in the material show non-metric characters. The *Infans I* has an *incisura* (indention or depression) at the right side and a *foramen* (hole or small opening) at the left side on the *supraorbital* region. The adult male has an *incisura* at both sides. The *Infans I* has been suffering from some kind of disease since there are signs of *cribra orbitalia* (siewe-like appearance at the surface of the orbital region related to sickness) at the frontal bone.

10.1.1 The teeth KM: 81

The *maxilla* was fairly well preserved. The left second *incisor* and *canine* had *post mortal* damage on the *labial* surface The wisdom teeth had erupted, although the right one was lost *post*

mortem.The dentition showed medium attrition and there was a medium amount of *calculus*. The individual did suffer from some *caries*. The teeth had signs of *linear enamel hypoplasia*. The signs were very clear with horisontal grooves situated parallelly at the teeth. The colour of the enamel and the pattern of the *hypoplastic* symptoms were probably born originated due to *fluorosis* (Tranæus 2004). In the right *canine* there is a sc. *Morris´s type* form, a non-metric trait. This means that the mesial ridge is larger then the distal one, and it is fully incorporated into *tuberculum* (Hillson 2002:89). The dentition is covered with a brownish colour partly fastened on the *plaque*. This is probably tar resulting from the fact that the individual has been smoking (Tranæus 2004). Between the left second *incisal* and *canine* a trace left by the clay pipe can be observed (Plate 1, figure 3 and 4).

10.2 Catalogue number 2002020: 82/Grave 8

Minimum Number of Individuals: 6
Fragments: 267
Weight: 1315.7
Grave 8 was unearthed from the area 7 outside the southwestern wall of the church. The remnants of the coffin contained the burial of a child which was exceptionally buried with his or her head at the eastern end of the cist. The minimum number of individuals in this unit was according to left *humerus* five. However, there were six different age groups present in the material: *Infant*, *Infans I*: one ca two years of age and the other three to seven years of age. Some bones from an *Infans II* were also present. The adult bones come from an adult female (see appendix) but also from an older adult, since an *atlas* (first cervical vertebra) had signs of minor *osteophytes* growth, which can be age-related. The sex of the individuals was according to *coxae*, *mandibula* and *humerus* an *Infans I* (ca. two years) female and a adult female. The older *Infans I mandibula* showed *ambiguous* traits and thus the sex could not be assessed. The bones had non-metrical characters such as *incisura supraorbitalia* at the frontal bone of a subadult and *fossa olecrani perforatum* at the *humerus* of the adult female. The *Infant* and the younger *Infans I* had both been suffering from illness or malnutrition since there were signs of *cribra orbitalia* at the frontal bones. One subadult had some porosity at the *sulcus transversus* area of the occipital bone. There were some changes at the right side wrist bones *scaphoid* and *capitate* (wrist bones) (plate 7, figure 16). The bone seem to have their outer appearance as usual but the bones are *phneumatic* (air filled), maybe due to some sort of inflammation. The same kind of symptoms can be seen at on right *I metatarsal*, probably descending from the same individual. Two toe bones are fusioned, which can be age-related. There is one healed *Colle´s fracture* at a left *radius* (Plate 2, figure 5).

10.2.1 Maxilla 82 a

Only a part of the *maxilla* was present and only one tooth was in the *alveoles*. The left *canine* exhibited a *gross gross caries* (Hillson 2001) and the individual seemed to have suffered from *periodontal* dicease.

10.2.2 Maxilla 82 b & mandibula 82 c

The *maxilla* and *mandibula* descend from the younger, female *Infans I*. Most of the teeth were missing *postmortally* or possibly due to the eruption of permanent teeth. The individual did have slight *caries* at the root of the attritioned left second *incisor*. The erupting right first *incisor* has a brownish colour but any other symptoms related to *hypoplasia* are not present.

10.2.3 Mandibula 82 d & maxilla 82 e

The *maxilla* and *mandibula* come from the older *Infans I,* aged ca. seven. The sexual characters were not strongly present so the sex remains *ambiguous*. The individual seems to have been suffering from caries and especially the symptoms shown in the left deciduos second molar have probably been painful. The individual seems to have been exposed to something that has led to *hypoplastic* symptoms. This can be seen at the *incisors* and permanent *canines* as linear horisontal grooves and perhaps also as a brown colour of all the permanent second *molars*. These teeth start to form during the first year (Plate 2 and 3, figures 6, 7 and 8). The colour or the teeth, especially the whiteness of the incisals indicates that the *hypoplasia* was manifested due to *fluorosis* (Tranæus 19. 2. 2004).

10.2.4 Mandibula 82 g

The right side of the *mandible* has no teeth. The first *incisal* socket is missing, the second *incisor*, *canine* and the second *premolar* have been lost *post mortally*. The third *molar* has been lost perhaps post mortally, but it has been severely affected by *periodontal* disease. The first and second *molars* have been lost *premortally* since the remodeling of the alveolar sockets is almost perfect.

10.2.5 The loose teeth

One loose deciduous teeth shows brown discolouration but no other *hypoplastic* symptom. On the other deciduos tooth there is slight *calculus*.

The three *maxillary* loose teeth show in some specimen brownish colour. They exhibite somewhat *caries* symptoms.

The *mandibular* loose teeth show somewhat strong attrition in them. One first right molar shows a mesiodistal attrition on the *occlusal* surface, typical for using the teeth as a tool, the same tooth also shows a dark brown colour probably not *hypoplasia*.

10.3 Catalogue number 2002020: 83/No grave: supplemental layer of grave 8.

Minimum Number of Individuals: 3
Fragments: 53
Weight: 398.8 gr.
These bones were excavated from the area 7 and descend from disrupted layers of the graveyard, the supplemental layers of the previous grave 8. There is a strong possibility that the same individuals are presented in both units. This is however very troublesome to verify, due to the importance of not mixing the catalogue system of the National Board of Antiquity. It would also be extremely time consuming. The minimum number of individuals according to left *talus* was three. The bones came from *Infans I* and *Adultus*. Some adult *vertebrae* showed age related changes. No sexing could be made, since there were no proper elements in the material. The stature of the adults has been, according to *talus* 168.9 and 169.4±6.18 and according to *calcaneus* ca 164 (see appendix 2). There was a non-metric character at an adult skull fragments. Five sutural bones could be observed at the *lambdoid* suture.

10.3.1 Mandibula KM 83 a

The left fragment of mandible is from a child under the age of ten, since the second deciduous molar is still present. The permanent first *incisor* can be seen through the broken jaw. No signs of dental disease are present.

10.3.2 Mandibula KM 83 b

No teeth are present in the right *mandibula*. The canine alveol shows an anomalic eruption, the permanent *canine* has probably erupted behind the decidous *canine*.

10.4 Catalogue number 2002020: 84/Grave 9

Minimum Number of Individuals: 4
Fragments 108
Weight: 411.gr.
The grave was excavated from the area 7. The burial continued in to the profile and thus is not fully present. The *MNI* is four, since there are two right cuboid bones from adult individuals, and remains of two subadults as well; one *Infant* and one *Infans I*. Other adult is probably an elderly person, since the vertebral bones show minor age-related *osteon* growth. According to the measurements taken from the diameter of the left femoral head and the breadth of the *epicondyles* (rounded articular surfaces at the *distal* end of the *femur*) there is a female in the material. The stature was measured and defined from left *femur*. The female was approximately 154.96±4.52 tall. One *talus* was measured and a stature of 161.13±6.18 was determined. One of the bones, a right *scaphoid* (wrist bone), has pathological symptoms. The bone has a porous surface.

10.4.1 Mandibula KM 84 a

The *mandible* has no teeth left. The *incisals*, *canines* and first *premolars* have been lost probably *post mortem*. The right second *premola*r and the first *molar* and the left first and second *molars* are lost *ante mortem* since the remodelling of the bone is almost complete. The rest of the complete dental set has been lost shortly before the death, since the remodelling is not perfect.

10.4.2 The loose mandibular teeth KM 84

The left loose *maxillary* first *molar* is not fully developed, since the *apex* is still open. The tooth has a brown colour at the surface of the enamel, but it shows no other enamel defect. The other mandibular *canine* shows severe wear which seems to be connected with smoking a clay pipe. There is an abrasion similar to the canine in the unit 81, which has a typical wear linked to smoking clay pipe. The tooth also shows *hypoplastic* symptom.

10.5 Catalogue number 2002020: 85/Grave 12

Minimum Number of Individuals: 3
Fragments 145
Weight: 533.98 gr.
Grave 12 was unearthed from the area 7 outside the southwestern wall of the church and was partly destroyed by later burials. The *MNI* was counted to be two according to the right adult *scapula*. However, also a child, aged *Infans II*, was present in the unit. The sex of the deceased was measured and defined to be masculine from an left *scapula* with masculine characters, and from the

epicondylar breadth of the right sided *humerus*. The humerus had a non-metric character, sc. *foramen supratrochleare* (a hole at the *supratroclear* region) which is considered to be an indication of female sex (Bass 2002: 154). However, this character is common amongst male as well. According to the characters observed at a right *os coxae*, there is also an adult female in the material. However, the sexual characters of the *coxae* are vague. One of the adult was elderly, since there are some age related changes among the *vertebrae*, sc. *ligamenta flava*.

10.6 Catalogue number 2002020: 86/Grave 16

Minimum Number of Individuals: 5
Fragments: 192
Weight: 962 gr
Grave 16 was unearthed from the area 7 outside the southwestern wall of the church and was partly destroyed due to later burials. The burial was oriented *EW-NW* and consisted of subadult bones. However, the lower parts of the body were situated under the stone construction of the church, dating the burial older than the church itself. The *MNI* is five, since there are three left *ilium* bones present, as well as, two subadults aged *Infans I* and *Infans I/II* in the unit. The sexing was made from the *ilium* bones; two show masculine characters and one female characters. The *mandibula* of the *Infans I/II* shows more female characters. One of the male individuals is aged to ca. 20-24 years according to the appearance of the *auricular facies*. The stature of one individual was defined with measurements from the right *talus*. The stature was estimated to165.6±6.18. One of the individuals had *sutural* bones at the *lambdoid suture*, a character which considered to be non-metric in nature. One individual had some age related marks on the *vertebrae* and one showed marks of inflammation on the left V *metatarsal* bone.

10.6.1 Maxilla KM 86 a

There is only one tooth left in the left *maxillae*. The first *premolar* has been lost *antemortem* since the *alveol* shows signs of remodelling. The individual has been suffering of *periodontal* disease.

10.6.2 Maxilla 86 b & mandibula 86 c

The *mandibula* and *maxilla* belong to a ca. seven year old individual. The individual has lost most of her decidous *incisals* due to the eruption of the permanent teeth, which are partly visible. The dentition shows some attrition and there are some *carious* symptoms at the *molars*. The dentition is in a very poor condition and the enamel is flaking, which makes the observation of *hypoplasia* impossible.

10.6.3 The loose maxillary teeth 86

One incisal shows *hypoplasia* with linear horisontal grooves, the enamel carries white opacity and thuss it is probable that the *hypoplasia* was born due to *fluorosis*.

10.7 Catalogue number 2002020: 87/Grave 18 supplemental layer of grave 18

Minimum Number of Individuals: 2
Fragments: 41
Weight: 468.19 gr
The supplemental layer of the grave 18 was unearthed from the area 7 outside the southwestern wall of the church. The *MNI* was two according to the left *scapulae*. One individual is an adult male.

There are no clear subadult bones in the material, but the *cranial* sutures seemed to be open. It is possible that one of the individuals can be a young adult. The sexed bones show mainly masculine characters, but one occipital bone has a *protuberantia* of a more female character.

10.7.1 Maxilla 87 a & mandibula 87 b

The dentition comes from an adult male. The teeth have an altogether yellow colour which tells that the quality of the teeth is good. The third molar at the right side of the *maxillary* dentition has not been erupted and is not visible, since the jaw is not damaged. The person has suffered from very rapid *caries*, due to the small surface of a large *caries* cavity. (Tranæus 19.2.2004.) The *canines* have a *Morris´s type* cusp. There is an enamel pearl at the lingual surface at the second *premolar* on the right side. These enamel extensions sometimes appear at the upper *premolars* and *molars* (Turner *et al*. 1991: 19). There is a slight *mesiodistal* abrasion on the *occlusal* surface of the *molars* and *premolars*. A similar abrasion can be seen at the *lingual* surface of the *canines* as well, possibly due to the using of the teeth as a tool. The enamel at the dentition has a darkbrown spotty appearance, which seems to restrict to area above the *gingivae*.

The *mandibulary* dentition seems to be in a far worse condition. The individual has suffered from *caries*. The left second premolar has been lost *ante mortem* but not very long before death, since the socket is not fully remodeled. The the first left molar is almost completely destroyed by *caries* which may have led to a inflammation at the root (Plate 4, figure 9). The second *molar* on the left side has longer been missing, since the jaw is almost completely remodelled. At the left third *molar* a similar kind of abrasion, as in the *maxillary* dentition exists. On the right side the second *premolar* and first *molar* have been lost antemortem and the jaw is well remodelled. The second *molar* has a *gross gross carious* cavity . There is no sign of eruption of the third *molar* on the right side. The brown spotty colouration is limited mainly to the *buccal/labial* and *occlusal* surface, but the *lingual* surface seems to be unaffected (Plate 4, figure 10). The colouration and the severe condition of the dentition probably relates to the abrasion and thus to the use of the dentition as a tool. The *incisals* have also singns of abrasion possibly due to pulling leather or similar material.

10.8 Catalogue number 2002020: 88/Grave 18

Minimum Number of Individuals: 2
Fragments: 174
Weight: 596.56 gr
Grave 18 was unearthed from the area 7 outside the southwestern wall of the church. The burial was oriented *SW-NE*. Since the burial continued under the church constructions it was dated to be older than the building itself. The minimum number of individuals was two according to left radial bone. Both individuals were subadult, more precise *Infans I* and *Infans II*. Left *ilium* of *Infans I* showed *ambiguous* sexual characters.However, characters observed in the *mandible* and *cranium* were feminine. Sadly, the skull was *post mortem* deformed and thus could not be measured. The *cranial suture* closing showed little or no sign of fusioning, but according to dental eruption the individual was ca. five to six years old.

10.8.1 Maxilla & mandibula 88a & b

The individual is 5-6 years old and probably a female. Her dentition is almost complete, since only the right upper first *incisal* is missing *post mortem*. The upper right *canine* and second *molar* are present in the dental list since they were found in the material due to the fragmentation of the *maxilla*. In general the permanent dentition is of better quality than the *deciduous* ones (Tranæus

19.2.2004). Also the *caries* symptoms are stronger on the left side, especially on the *mandibular* teeth. The upper right permanent *canine* shows a dark brown colouration and linear enamel *hypoplasia*. It is probable that the coloration of the deciduous teeth as well as the abrasion and *caries* symptoms are related to some sort of activity, which this person has been doing with the left side of her jaw. The *hypoplasia* in the *canine* is related to something else, possibly something happening at childbirth (Tranæus 19.2.2004). However, the other tooth formed at the same time does not show such symptoms. The right *canine* was microscoped and the *hypoplasia* was measured at the Karolinska Institute (Plate 5, figure 12). The *hypoplasia* can be originated to ca. the time of birth (Tranæus 19.2.2004). The teeth show abrasion, especially on the left side, *mesiodistally* on the *occlusal* surface of the teeth. This as well as the brownish coloration of the enamel are not seen in the permanent teeth. The coloration is limited on the *occlusal* and *buccal/labial* surface of the teeth.

10.9 Catalogue number 2002020: 89/Grave 19

Minimum Number of Individuals: 5
Fragments: 60
Weight: 543.3 gr
Grave 19 was unearthed from the area 7 outside the southwestern wall of the church. The minimum number of individuals in the unit was four according to the left *os cuneiforme laterale* (third cuneiform). However, there are bones from at least two adult individuals according to right *talus*, which makes the *MNI* five. The bones originate from age groups *Infant, Infans I, Infans II* and *Adult*. At least some of the adult bones come from an older individual since there are age-related changes at the lumbal *vertebrae*. The stature of the individuals was measured from two *talus* one giving the stature 163.82±6.18, and the other 161.76±6.18.

10.10 Catalogue number 2002020: 90/Grave 1

Minimum number of individuals: 2
Fragments: 11
Weight: 104.68
Grave 1 was excavated from the area 8, outside the western wall of the church. The burial was found to be quite young, since the foot bones of the individual were musty. The musty foot bones may possibly descend from burials made during the civil war of Finland 1917, since some battles happened in the area. The bones were remains of at least two individuals; one *Infans I* and the other an *Adult*. It is possible that there are bones from several adult individuals in the material. One of the adults is fairly young, since the epifyseal line is still visible at the left *radius* (lateral bone of lower arm). One left temporal bone had a male-like *processus mastoideus*. The measurements taken from the glenoid cavity turned out to be ambiguous. The measurements made from left radial bone indicated a stature of 152.60 and the measured left *talus* a stature of 155.20±6.18.

10.11 Catalogue number 2002020: 91/Grave 3

Minimum number of individuals: 3
Fragments: 44
Weight: 194.8 gr
The burial was unearthed from area 8, the northeastern outside of the western wall, and it was probaly destroyed during the construction of graves 5 and 7. The burial was *W-E* oriented. The minimum number of individuals according to left humerus was 3. The material consists of one adult individual and two subadults, one *Infant/Infans I* and the other *Infans I*. According to characters of

os ilium one perhaps male and the other female. There is one bone in the material descending from an *Infans II*.

10.11.1 The loose tooth KM 91

The second right upper *molar* is affected with *gross gross caries*. There is a *mesiodistal* abrasion on the occlusal surface of the tooth. On the buccal and occlusal surface a brown patchy coloration can be seen.

10.12 Catalogue number 2002020: 92/Grave 4

Minimum Number of individuals: 4
Fragments: 137
Weight: 1218.9 gr
The burial was unearthed from area 8, northeastern outside of the western wall. The minimum number of individuals is three according to the *petrous* part of the left temporal bone. There are, however, two various aged subadults; *Infant* and *Infans I/II*, which makes the *MNI* four. The adult bones descend from at least two different individuals, since there are two left *talus*. Nothing can be said about the sex of the individuals, since there are no undisturbed bones with sexual characters. The stature of the individuals were measured and estimated from one right *calcaneus* (ca. 175 cm, see appendix 2) and two left *talus* (167.7±6.18 and 175.5±6.18).

10.12.1 Maxilla KM 92 a

The left *maxilla incisors* are lost *post mortem* and the enamel of the *canine* is broken. The third *molar* has been removed or lost *ante mortem*, since there is a sign of remodeling at the *alveolar* site. There is a small *carious* cavity on the second *molar*. All the teeth show a *mesiodistal* abrasion at the *occlusal* part of the tooth. The dentition is brown and patchy, coloration limited on the *occlusal* and *buccal* sides of the teeth. All the marks represented in the dentition probably relate to an activity in which the teeth are used as a tool.

10.12.2 The loose teeth KM 92

The permanent left *premolars* show a brown patchy coloration on their surface, similar to the dentitions described previously in the text. There is one loose deciduous *maxillary* right second *molar* in the material.

10.13 Catalogue number 2002020: 93/Grave 5

Minimum Number of Individuals: 3
Fragments: 286
Weight: 66.7 gr.
The burial was unearthed from area 8, the northeastern outside of the western wall. The deceased was in a small coffin sized 50*25 cm and was oriented east-west. The hands of the deceased were arranged on her tummy (Mikkola 2002). The minimum number of individuals is three, with only one eroded talus representing only one individual *Infans I*. Otherwise the bones belong to two infant, or foetus. (plate 6, figure 13 and 14) The children were probably deceased before actual birth, during it or shortly afterwards. There is a strong possibility that the individuals were twins, but other options are naturally possible. The foetuses have a small difference in their size, the bigger ca. 9-10 lunar months and the smaller 8-9 lunar months, according to measurements

(Fazekas&Kósa 1978). This does not nullify the fact that they can be twins, since in twin pregnancies one individual is usually bigger than the other. In this case it seems to be that the female individual was larger and the male smaller. The sexing was done with the help of one right *ilium* and the *mandibles*. The *ilium* had female characters but the *mandibles* could be sexed (only by comparing them to one another), since the characters were not so strong and the mandibles very small and also fragmented. The dentition of the mandible was recorded and identified (see appendix 2). Due to the young age the teeth were not registered for dental disease, since non were present.

10.14 Catalogue number 2002020: 94/Grave 6

Minimum Number of Individuals: 3
Fragments: 43
Weight: 245.2 gr.
The grave was unearthed from the area 8 outside the northeastern part of the western wall of the church. The grave had only some sparse bones left and it was considered to have been destroyed. The orientation of the burial was east-west (Mikkola 2002). There are three different aged individuals in the material, one adult, one juvenile and one *Infans II*. The mandible belongs to an adult.The *Infans II* is a male according to the secondary sexual characters visible at the right ilium (Plate 7, figure 15) the sexual characters are quite strong and thus they are mentioned here, although the sexing of this age group is highly questionable. The stature of the *Adultus* was measured and counted from the left *calcaneus*, the individual has been approximately 157±5.06-168.95±5.81 tall (see appendix 2).

10.14.1 The mandibula Km 94a

There is only one teeth present from the fragmented right *mandibula*. The the second *premolar*, first and third *molar* have been lost post mortually. There is caries at the *occlusal* surface of the molar. The tooth has a brown patchy surface at the *occlusal* and *buccal* surface, and at the *occlusal* surface there is a mesiodistal abrasion. The lingual surface of the *molar* has a normal appearence. On the contrary to the other stained dentitions, there is the same patchy presence on the surface of the remains of the mandible.

10.15 Catalogue number 2002020: 95/Grave 7

Minimum Number of Individuals: 3
Fragments: 102
Weight: 704.4 gr.
The grave was excavated from the area 8 outside the northeastern part of the western wall of the church. The burial was oriented *WEW-ENE*. Both the head and the lower parts of deceased were not excavated, due to their continuance in to the profiles. The left hand of the individual had been destroyed due to a later burial (Mikkola 2002). The minimum number of individuals was according to the whole right *diafyseal fibula* (lateral bone of the lower leg) two, but since they both are from an subadult person and there are also adult bones in the material the *MNI* is three. The sex of one bone could be defined by the right *ilium* coming from an subadult male with strong sexual characters visible on the *os ilium*. The subadult bones could not be aged more precisely but considering the *epifyseal* union of the bones one individual is younger than ca. 16 (based on the *proximal* head of the *radius* which fuses at ca. 16years).

10.16 Catalogue number 2002020: 96/Grave 10

Minimum Number of Individuals: 2
Fragments: 56
Weight: 821.4 gr.
The burial was excavated from the area 8 outside the northeastern part of the western wall of the church. It was directed *WNW-SES*. The burial had partly been destroyed by the younger grave number 13 and by the building of the stone church. Thus the burial is older than the church and it dates from the time when there was probably a wooden chapel at the site. The head of the individual was not unearthed due to the continuance of the body in to the profile of the excavation area.

The unit contains bones from at least two adult individuals according to the *acromial* (the *lateral* extension of the spine of the *scapula*) part of the right *scapula*. There were no bones at the unit which could be sexed, but the stature of one individual was measured and estimated from the right *femur* to 160.1±4.52.

10.17 Catalogue number 2002020: 97/Grave 11

Minimum Number of Individuals: 2
Fragments: 301
Weight: 921.4 gr.
The burial was excavated from the area 8 outside the northeastern part of the western wall of the church and is older than the stone church. The lower parts of the body were destroyed during the construction of the church, since the burial is cut by the walls (Mikkola 2002). The deceased was buried *NW-SE*. The bones shows no actual signs of the presence of more than one individual at the unit. However, there must be two individuals in the material since the leg bones of another adult individual are present. The individual was probably male but did not show strong sexual characters. The sex was observed from left fragmented *ilium*, both s*capulae*, *cranium* and *mandibulae*. The age of the deceased would be under 25 since the epiphyses of the *vertebrae* are not fused. However, the teeth of the individual look older in their appearance and the *cranial sutures* which could be partly observed were *endocranially* significantly closing, thus there is at least two differently aged adult present in the material. This burial was very interesting since the deceased shows marks of a healed trepanation (Plate 9, figure 19). Sadly, the skull could not be measured. It was too deformed post mortually.

10.17.1 The mandibula Km 97 a

The dental set is almost complete and only the first left *molar* is missing. The molar was lost *ante mortem*, since the remodeling of the jaw is complete. The first *molar* is very worn and the *dentine* is exposed. The individual has been suffering from a severe case of *caries*. The left second and third *molars* show an *interproximal gross gross caries* (Plate 8, figure 17). These teeth sit very tight together almost sharing the same *alveol*, which can be considered to be anomalic (Tranæus 19.2.2004). The lower *premolars*, however, seem to be unworn. Perhaps it has been impossible for the person to chew using the left side due to great pain. The third and second right *molars* show *buccal smooth surface caries* as well as root *caries*, by which the second *molar* is more severely attacked. Both teeth also have a beginning of *occlusal caries*. The dentition shows signs of *fluorosis*, since there is opacity and the *incisals* and *canines* have linear horisontal grooves. This can be due to an illness but due to opacity it indicates *fluorosis* (Tranæus 19.2.2004). In the canines there are other *hypoplasia* which manifests as pits. The right *canine* was microscoped and the origin age of the *hypoplasia* was measured at the Karolinska Institute. The measure with 6.4 enlargement

was 3.2 to the middlepoint of the *hypoplasia* from the *cementoenamel* junction. This makes the measurement 0.2 mm from the *CEJ* thus timing the origin to the age of ca. 6 years (Swärstedt 1966 in Goodman et al. 1999: 217) (Plate 8, figure 18). The third right *molar* has an non-metrical character, enamel pearl between the *lingual* roots, which extends almost to the root bifurcation. The person has suffered from *calculus*, but there are almost no signs of *parodontosis*. The dentition on the right side shows abrasion on the *occlusal* surface *mesiodistally*.

10.17.2 The maxilla KM 97a

The *maxilla* is very fragmented. The incisals from the right side are missing post mortally. On the right side the third *molar* has a well advanced root *caries buccodistally*. The second molar has been lost *ante mortem*. However, the remodeling is not perfect. The left side of the dentition is very disturbed. The upper *premolars* and *molars* are almost totally destroyed and the lowers lost or severely *carious*. The left first molar is presented only by a root stump probably due to a severe *caries*. There has probably been an *abscess* since the floor of the *alveol* has a well formed cavity which leads to the *sinus* cavity. The second *premolar* has been lost *post mortem* or shortly before the death, since there are no signs of remodelling. The first *molar* is so worn that only the dentine is left and the pulp visible. The second *molar* has been lost *ante mortem* since the remodelling of the *alveol* is almost perfect. The third *molar* shows a *gross gross caries* leaving only the root on the *maxillae*. The right side seems to be in a better shape, although both upper and lower first *molars* are strongly worn. From the first *molar* onwards to the *canine* the dentition shows *hypoplastic* seizure, linear horisontal grooves.It is suggested that the person has been using his dentition as a tool showing this typical abration. On the left side the *incisals* and the *canines* have a brown spotty surface at the *labial* side, but the *lingual* surface looks normal. The brown spotty texture found at the upper *incisals* and *canines* can not be observed in the *mandibular* dentition. The upper dentition has maybe been exposed to something sour (Tranæus 19.2.2004). Both *canines* have a *Morris´s type* cusp, which means that the *mesial cusp* at the *lingual* surface is larger than the *distal* one (Hillson 2002: 89).

10.18 Catalogue number 2002020: 98/Grave 13

Minimum Number of Individuals: 1
Fragments: 4
Weight: 62.4 gr.
The burial was excavated from the area 8 outside the northeastern part of the western wall of the church. It became slightly visible at the southern profile of the excavation area, and partly carved the graves 10 and 14. The unit contains only four bone fragments descending from an adult individual.

10.19 Catalogue number 2002020: 99/No grave pit

Minimum Number of Individuals: 1
Fragments: 179
Weight: 75.2 gr.
The bones were excavated from the area 8 outside the northeastern part of the western wall of the church, right by the outer wall of the church. The skeletal elements were found in a layer which contained chalkmortal but no clear burial pit was visible. The unit contain the bones of a foetus, perhaps deceased during the childbirth or shortly after. The skeleton was almost whole and the age could be measured from the bones (Fazekas & Kósa 1978). The child was aged ca. 9.5-10 lunar

pregnancy months. The individual had some *mandibular* teeth preserved (see appendix 2), but due to the fact that they had no dental diseases no dental chart was made.

10.20 Catalogue number 2002020: 100/No grave pit

Minimum Number of Individuals: 1
Fragments: 5
Weight: 177.5 gr.
The bones were excavated from the area 8 outside the northeastern part of the western wall of the church. The bones were not *in situ* (Mikkola 2002). The skeletal elements are from a subadult person who shows more male than female characters at his *cranial* elements. The individual shows non-metric character on his left orbita as he has a *incisura supraorbitalia*, sadly the right side was not present in the material.

10.21 Catalogue number 2002020: 101/Grave 14

Minimum Number of Individuals: 2
Fragments: 103
Weight: 1290.5 gr.
Grave number 14 was excavated from the area 8 outside the northeastern part of the western wall of the church, underneath the burial number 10. The direction of the grave was *NW-SE*. Nothing specific can be said about the age since there is only one left *ilium* to be observed, although fragmented. However, the appearance of the *articular* surface was youthful. The *cranial* elements in the material show vague female characters when the observation points were considered, the *cranial* elements give an impression of an adult male. The person has very strong non-metric characters. The mandible is a so called *rocker jaw* (Plate 10, figure 21). This means that it has a character, which is manifested via the *inferior* curvature of the horisontal *ramus.* In practise this means that the jaw will rock back and forth when set on a flat surface (Turner *et al*. 1991: 26). In this case it is strongly manifested. There is also a very marked non-metrical character on the palatinal region, *torus palatinus* (Plate 11,figure 23). *Torus palatinus* is a linear exostosis that can develope at the region of *palatinal suture*. The appearance of a *torus* so well marked is rare. Normally such a degree of development can be observed only in the arctic regions and even there it is rare (Turner et al. 1991: 26).

10.21.1 Mandibula KM 101 a

The dentition shows no *hypoplasia* but there are several *caries* symptoms. The *premolars* and *canines* seem to be in a fairly good condition, although the enamel is broken due to tafonomical factors which makes the observation difficult. The first *incisals* are quite worn but otherwise they are in a good condition, there is a large amount of *calculus* on the *lingual* side. The second right *incisal* is only a root stump probable due to abrasion. The *canines* and *premolars* on the right side show some wear and a large amount of *calculus* on the *lingual* side. The first left *molar* is very worn and the root canals are visible showing signs of infection which has spread to the tip of the roots and caused *abscesses* on both *buccal* roots (Plate 9, figure 20). The second left *incisor* is only a root stump, and it is difficult to say, whether it has been abraded or *carious*. However, the damage seems to be ante mortem. The left third and second molar are somewhat worn and there has probably been a slight *parodontal* effect on the gingival region. The first *molar* is very worn and like the rest of the *molars*, which are otherwise in good shape, they have a large amount of *calculus* around them. There seem to be *parodontal* symptoms in the *molar* region.

10.21.2 The maxilla 101 b

The *cranium* belongs to the same person as the previous *mandible*. All the *incisals* are missing probably post mortally. The dentition shows sign of continuous eruption, the teeth try to remain in *occlusion* despite the fact that the enamel is worn, and thus continue to erupt. The *maxillary* dentition is much more worn then the *mandibulary*. The *premolars* and the *canines* are worn to the dentine, with almost none enamel left on the sides. The *canine* and the *premolars* on the left side are totally worn. Except for the third *molars*, all the other teeth are worn to the dentine revealing the root canals. The right sided third *molar* is only slightly fastened in the jaw since the surrounding *alveol* is remodelled. This can be due to the *ante mortem* loss of the second *molar*, which maybe has been pulled out and probably has had an *abscess*. The *alveol* area is absorbed and the *distobuccal* root of the first *molar* and the *abscess* concavity on the root is revealed. The first *molar* has little enamel left but the root canals are visible and there are signs of *abscesses* both on the palatinal and *buccal* side of the *maxillae*. The second *molar* is partly abraded and has some *calculus buccal*. The third *molar* is in a fairly good shape.

11. Results and discussion

In archaeological material the *dental enamel defects* are normally related to *metabolic* stress. It is considered that the reliance on one food recource makes the population more vulnerable to seasonal deficiencies and sedentism increases enchancement of childhood diseases, similar to the change in subsistence from hunter-gatherer to agriculture. The question of the growth disruptions associated with weaning can be studied as well (Goodman *et al*. 281; Hillson 2002: 176; Palubeckaite et al. 2002: 197).

The relationship between the social status and the frequency and severity of *hypoplasia* is not clear, since social status cannot explain interpopulational differences in formations. Factors like selective morbidity and mortality should be considered. Childhood stress can reduse the adult life expectancy and some studies have shown that *hypoplastic* individuals die 5.37 years younger than individuals without *hypoplasia*, which suggests that the individuals who are exposed to stress prenatally or at early childhood have a reduced ability to cope with later hardships. Sex differences in *hypolasia* can be connected to selective morbidity of children due to biological or cultural factors due to selective treatment (Palubeckaite *et al*. 2002:197, 198).

Needless to say, high fluor values in the drinking water make the caries values lower due to the empowerment of the mineral components. The effect from drinking water lowers the values ca. 50-70 procents. The values of fluor in drinking water is over 2 mg per night and day during the mineralisation of the dental set, when the values come 20-80 over 10-20 years the effects are invalidising (Information received from Doctor Tranæus 19.2. 2004). Therefore the possible juvenile settlement place can be defined from the measurements taken from the ground- and wellwater in the area.

When the drinking water contains too much or too little fluoride several kinds of defect are created. Too low *fluoride* quantities produce *opacities* which become brown when food and *plaque* stains them. High volume of fluoride produce pitted *hypoplastic* defects. Normally cheek teeth are more easily affected then the *anterior* teeth (Hillson 2002: 171). The *fluorosis* can be separated from the other *hypoplasia* by the colour of the dentition. The enamel surface gets a "paperwhite" appearance and the border lines of the symptoms a more diffuse than in the other types of *hypoplasia*. the *fluorosis* is more often met in permanent teeth (Nevitt *at al.*).

The conditions related to *fluorosis* are very rare in archaeological material and they should be considered carefully (Hillson 2002: 171). In Pälkäne material (see table 1) three individuals show traces of *fluorosis* (KM: 81;82; 97, see plate 2 and 3, figures 6-8), a state that relates to a large or small amount of fluoride in the dental material. It is probable that their childhood settlement site could be traced with the help of the fluoride procents at the well water. Low level of *fluorosis* produces opacities and high level values produce pitted *hypoplastic* defects and cheek teeth seem to be more severely attaced (Hillson 2002: 171).

It seems that in Pälkäne material one of the individuals has suffered from low level values (KM: 97, see plate 8, figure 17) and the other probably from high values (KM:82, see plate 2-3, figure 6-8), since the symptoms differ in their appearance. However, the symptoms seem to be most drastic in the *anterior* dentition. Two individuals in this material had *hypoplasia* related to some incidence which happened during the formation of the teeth. The hypoplasia manifests itself as a large and low pit (KM: 88 see plate 5, figure 12; 97 see plate 8, figure 18). These incidents seem to have been happening at the birth (KM: 88, plate 5, figure 12) and at the age of 6 (KM: 97, plate 8, figure 18). Since there is hypoplasia both in adult and juvenile individuals, nothing can be said about the vulnerability to morbidity among the Pälkäne individuals. Due to taphonomical factors one dentition was severely disturbed (KM: 86). The enamel was flaking and thus no surface condition could be observed. One individual had signs of both *cribra orbitalia* in the orbital region and *linear enamel hypoplasia* in her dentition (KM: 82 see plate 2, figure 6). It is suggested that a link between these conditions is possible. However, the *hypoplasia* in this case was verified due to opacity on the teeth surface observed by Doctor Tranæus as fluoride related seizure.

Table 1. The dental enamel defects per number recorded in the Pälkäne material.

opacity white/cream	permanent 11	
opacity yellow/brown		decidous 1
pits	permanent 3	
grooves, horizontal	permanent 40	
discoloured enamel, no hypoplasia	permanent 31	decidous 20
other defects	permanent 26	decidous 13

Dental *caries* epidemiology is among the most important ways to reconstruct the diet of the past populations like the transition from hunter-gatherers to agriculturalists (Larsen *et al*. 1991: 179). The archaeological material provides a good field for studying the history of *caries*. *Caries* seizures show a strong contrast between cultures and modes of subsistence. The dental *caries* is often recorded at an osteological analysis as absent or present. However, the symptoms may be positioned in different surfaces and several classes of lesions with different aetiologies are produced. It is known that in populations with differing subsistence strategies, types of lesions and their distribution may vary; this kind of pattern can perhaps be observed in the archaeological material (Larsen *et al*. 1991: 179).

Research done among modern hunter-gatherer Inuits (Hillson 253-254) show that *caries* rates were extremely low. The nutrition of these groups normally consists of meat and fish with none or very small amount of carbohydrate. However, when *caries* seizures appear they seem to be present mostly in the *fissure* systems of the third molars and more common in females. The higher *caries* rates of females can be related to a slight earlier teeth eruption and/or that females had access to cariogenic food as they occupy the domestic front and thus have the opportunity to eat more often. Also, pregnancy and lactation can lead to consumption of more cariogenic nutrition and consequently to periodontal diseases. Needless to say, tooth hygiene also plays an important role (Larsen et al. 1991: 198).

The caries pattern among these populations (hunt gatherer Inuits) is partly due to the late eruption of the third molars. These teeth have fissures left. Other teeth had a high wear rate and normally the dentine was exposed by the age of 30. Even though the secondary dentine became exposed by the age of 50 the pulpal exposure was rare. *Gingivitis* was common but bone loss resulting from *periodontal* disease was extremely rare as well as related *ante mortem* tooth loss. Other groups of Inuits who had access to sugar and cereal seemed to suffer from drastically higher *caries* rates assosiated with lower wear rates (Hillson 253-254). Studies done on archaeological material show that caries increases with agriculture (Larsen et al. 1991; Lucas 1989; Varrela 1996). One can say that the dental status in the Pälkäne material reflects quite well the dental health typical among agricultural population. When *caries* appears, it seems to follow the pattern described above. The molars are very often affected. They often show no drastic wear and the *interproximal* surfaces normally seem to have been affected. *Caries* has also been recorded to be rising affliction with using the teeth as tools (Hillson 2001: 254). Among Pälkäne material the amount of caries related to chipping was not that high (the amount is under ten, see table 3).

Coronal caries can be initiated from the *occlusal* or the *approximal* side of the enamel. When it progresses it can involve the dentine and ultimately the pulpal chamber can be penetrated, which then can cause a *periapical* (relating to tissues encompassing the apex of a tooth) inflammation. Inflammation can develop pus and a *periapical granuloma* (a neoplasm made up of granulomar tissue) is developed. Without treatment the pressure is relieved by the pus passing through the bone of the jaw along a tunnel, *fistula* (an abnormal passage). A *fistula* can appear on the *buccal* side but also on the *lingual* side, nasal cavity or in the *maxillary sinus* (cavity) (Hillson 2002: 285). Such kind of traces are manifested as cavitations at the *apex* area could be found in three dentitions (KM 87 see plate 4, figure 9; 97 and ; 101 see plate 9-10, figure 20 and 22). When the tooth is so disturbed that the origin of caries can not be spotted it is called gross gross caries (Hillson 2001). These type of caries was found among two individuals (KM: 87 see plate 4, figure 9; 97 see plate 8, figure 17) and on loose tooth (KM: 91).

Table 2. The dental material from Pälkäne. When no information or symptom is present it is marked with -.

Catalogue number	**Age**	**Teeth-present**	**Teeth-carious**	**Teeth-hypoplastic**	**Calculus**	**Parodontal**	**Ante-mortem-tooth-loss**	**Abration-related-to-work**
KM 81 maxilla	Adult	15	2	15	15	15	-	Clay-pipe
KM 82 a maxilla	-	1	1	-	-	-	-	-
KM 82 b maxilla	Subadult ca.-2	3	1	-	-	-	-	-
KM 82 c mandibula	Subadult-same-as-previous	7	-	-	-	-	-	-
KM 82 d mandibula	Subadult-ca.-7	12	4	8	-	-	-	-
KM 82 e maxilla	Subadult-same-as-previous	12	6	3	-	-	-	-
KM 82 g maxilla	-	0	-	-	-	-	2	-
KM 82 loose teeth	-	5	3	-	-	-	-	1
KM 83 a	-	1	-	-	-	-	-	-
KM 83 b	-	0	-	-	-	-	-	-

maxilla								
KM 84 a mandibula	*Maturus*	-	-	-	-	-	7	-
KM 84 b loose teeth	-	3	1	1	-	-	-	-
KM 86 a loose teeth	-	3	1	1	-	-	-	-
KM 86 b maxilla	Subadult-ca.-7-8-	14	2	1	-	-	-	-
KM 86 c mandibula	Subadult-same-as-previous	15	-	-	-	-	-	-
KM 87 a maxilla	Adult-	11	5	-	-	-	-	Yes
KM 87 b mandibula	Adult-same-as-previous	14	5	1	2	1	3	Yes
KM 88 a mandibula	Subadult-ca.-6	13	4	2	-	-	-	Yes
KM 88 b maxilla	Subadult-same-as-previous	13	2	2	-	-	-	Yes
Km 91 loose teeth	-	1	1	-	-	-	-	Yes
KM 92 a maxilla	Adult	7	2	-	-	-	1	Yes
KM 92 b loose teeth	-	3	1	-	-	-	-	Yes
KM 94 a mandibula	Adult	1	1	-	-	-	-	Yes
KM 97 a maxilla	Adult	8	6	7	5	5	3	Yes
KM 97 b mandibula	Adult-same-as-previous	15	7	7	9	12	1	Yes
KM 101 a mandibula	Adult	17	3	-	17	17	-	-
KM 101 b cranium	Adult-same-as-previous	11	3	-	2	11	1	-

In general the most common form of *caries* is the *coronal caries* . The root *caries* developes more slowly (Hillson 2001: 250-252, 254). *Caries* is initiated equally in both upper and lower sides, the exception being the upper *anterior* teeth, which show more lesions than the lower teeth. The *premolars* and *molars* are most susceptible and specially the first erupting *occlusal* surfaces of the first *molars* show often even in populations with low rate *caries*. In populations whose caries rates are higher the seizures normally appear at the *occlusal* surface of the second *molars*, then at the *approximal* sites of the first upper and then the lower *molars*. The *occlusal* sites of the *premolars* become then influenced. In a population whose rates are high, the seizure appears at upper *incisal, approximal premolar* surfaces, *occlusal* lover *premolar* surfaces. In the end the upper *canines* are affected (Hillson 2001: 250-252, 254). In Pälkäne material the symptoms seem to be quite often related to the *occlusal* surface of the second *molars* and to the *approximal* surfaces of the first upper and the lower *molars.* Then the *occlusal* surfaces of the *premolars* become influenced (see also dental recording appendix).

In archaeological material the females are normally more affected than the males and the amount increases with age (Hillson 2001: 252; Larsen *et al*. 1991: 184). Also the amount of *ante mortem* tooth loss and and pulpal seizures caused by caries increase with age. The premortal tooth loss caused by caries seems to be the most common one, followed by *peridontal* illnesses and trauma.

The young adults are more affected by lesions confined to the enamel and this seem to be the most common caries among older persons as well. However, the dentine involvement increases in adulthood. The same pattern can be found at the root surface *caries*, being rare among young individuals but advancing with age. Altogether the molars are most often affected. (Hillson 2001: 252-253.) Sadly the Pälkäne material allows no opportunity to observe the sex or the more precise age of the individuals. Therefore such conclusions can not be drawn in this paper.

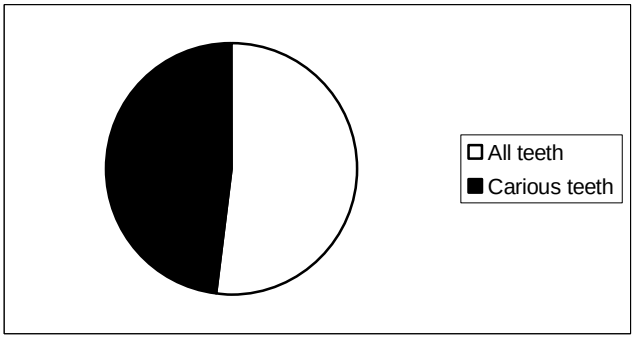

Figure 1. The amount of caries among all preserved teeth in the Pälkäne material.

Table 3. Different caries symptoms by number at Pälkäne material.

Pathology	**stage and number at teeth list (Hillson)**	**amount**
Gross gross caries	lesion point unsure(7)	4
	lesion point unsure, pulp open(8)	3
Occlusal fissura caries	stained area(1)	12
	slight surface destruction(2)	17
	small cavity(3)	14
	larger cavity(5)	7
	larger cavity, open to pulp chamber(6)	3
	gross coronal cavity(7)	1
Pit *caries*	slight surface destruction(2)	7
	small cavity(3)	1
Dentine caries	stained area(4)	53
	clear cavity(5)	12
	pulp open, clear cavity(6)	2
Enamel chipping *caries*	carious lesion(3)	9
Mesial/distal contact area *caries*	stained area(1)	26
	slight surface destruction(2)	27
	small cavity(3)	4
	discolouration in dentine(4)	2
	larger cavity, penetrates dentine(5)	1
	pulp open, clear cavity(6)	2
Mesial/distal root surface *caries*	stained area(1)	85
	shallow cavity(5)	7
	pulp open, clear cavity(6)	1
	gross cavity(7)	1
Buccal/labial/lingual smooth surface site	stained area(1)	4
	slight surface destruction(2)	6
	small cavity(3)	1
	gross cavity(7)	1
Buccal/labial/lingual root surface *caries*	stained area(1)	127

	slight surface destruction(2)	3
	larger cavity(5)	10
	pulp open, larger cavitycavity(6)	5

Totally 19 individuals in the Pälkäne material are represented by dental material. However, three of them are newborn (Table 2). The total amount of teeth in attrition is 189. Traces of *ante mortem* tooth loss (KM: 82; 84: 87 see plate 4, figure 9; KM: 92; 97; 101 see plate 10, figure 22-23) were found in totally 19 specimens (*MNI* six individuals), 11 of which show only slight remodeling. The most common *caries* symptoms in the Pälkäne material can be seen in figure 2 (see also tooth recording tables in the appendix bone list). All in all, the most common symptoms were at the *occlusal fissura* sites on molars followed by the root surface sites and dentine *caries*. The dentine *caries* is manifested at the worn surfaces of the teeth when there is no enamel left to cover the surface of the crown. Sadly, the sexing of the individuals was in most cases impossible, because the material was so fragmented or the traces ambiguous and no comparison between the sexes can be made. The dental material from Pälkäne reflect the well known formula for agricultural population. Symptoms like caries, parodontitis and calculus are well represented in the material. Despite of the fact that caries is quite common (ca. 47% of all preserved teeth, see figure 1), the amount of recorded gross gross caries (2 individuals, see above) and ante mortem tooth loss (19 teeth, see above) is quite small. This can be related to the fact that the drinking water in some areas of the municipality contains low or high amount of fluoride. However, the signs of developing caries seen as stained areas or as slight surface destruction can be seen in many teeth (see Figure 2).

When the *peridontitis* is considered, the age of the individual must be taken into consideration due to the constant eruption of the teeth caused by the attrition. Vertical bone loss afflicts individual or neighbouring teeth and can be seen for example at the *approximal* surface of the *alveoles*. In archaeological material the presence of such bone loss is sometimes very difficult to separate from *post mortal* destruction of the *alveolar* bone can produce similar kind of traces (Hillson 2002: 262-267). Four individuals had signs of *periodontal* disease (KM: 81; 87; 97;101). Periodontal disease affects most often the first two molars and then the incisors. It is increased in number as well as in severity among individuals over 40. Men are more affected by the condition. No sexual discrepancy can be found in bone loss, a condition strongly related to nutrition (Hillson 2002: 267). However, the *alveol* area was often disturbed in the Pälkäne material due to tafonomic factors and thus the symptoms are probably underrepresented in the material.

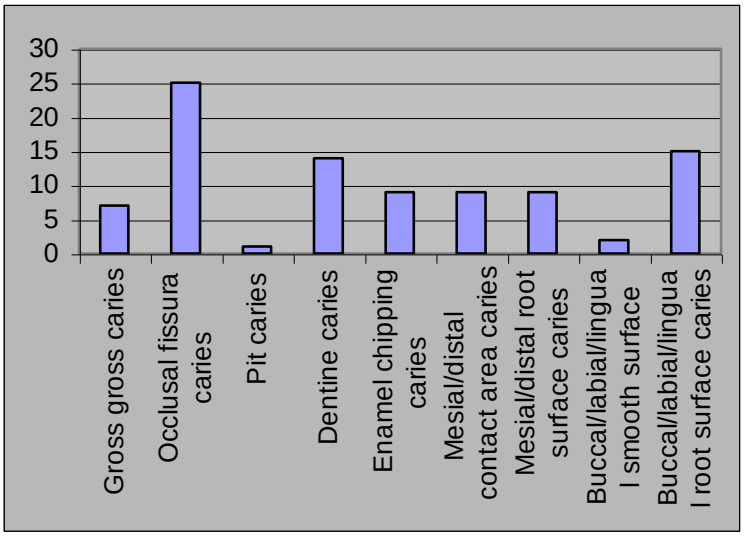

Figure 2. The division of different carious symptoms at Pälkäne material.

All the symptoms are counted together despite their severity. Symptoms like discolouration and slight surface destruction have been left out of this diagram.

Four individuals in the Pälkäne materiel show traces of *calculus* (KM: 81;87;97;101) still visible at the surface of the dentition. *Calculus* is problematic since it tends to fall off from archaeological specimen and be expected to be underrepresented. One individual has been smoking (Km: 81 see plate 1, figures 3 and 4). It can be seen as tar collected at the position of *calculus* and *plaque* at the gingival area. The person has also an semicircular abrasion manifested between the upper second *incisor* and the *canine*. This individual probably lived in the late 18th century, since the abraison between the teeth is quite narrow. It is a well known fact that the shaft of the clay pipes become more narrow atin time. It is probable that his person was from a noble family since he was buried inside the church.

The rate and pattern of dental wear is strongly related to the subsistence. In societies with a limited artifactual technology, teeth are often used producing artefacts, preparing food and handling materials. Tooth wear that results from contact with other things than opposite teeth is known as *abrasion*. In populations smoking clay pipes, specially in the 18th and 19th century, semicircular worn notches are often found on *canines* and *premolars* as a result of holding the clay pipe. In archaeological material *occlusal* wear facets and grooves are found on *incisors, canine* and *premolars*. It is considered that these traces are marks from holding fibers or yarn when processing material or weawing artefacts (Hillson 2002: 252-253; 2000: 254-258).

Totally five individuals had signs of abrasion in their dentition (KM: 87 see plate 5, figure 11;88;92;94;97) as well as two loose teeth (KM: 82;91;92). The abrasion was always manifested on the *occlusal* surface of the *molars* and *premolars* as a *mesiodistal* wear. The same dentitions often had a brown spotty appearance on the occlusal and *buccal/labial* surfaces (for example see plate 4, figures 9 and 10). They had often traces of rapid *caries* on their molars. In some cases the *incisals* and *canines* have also marks from abration. There is no doubt that these symptoms are indications of using the teeth as tools for something which is related to the secondary coloration of the teeth. Maybe they have been pulling rope or chewing roots or fibre related to fishing or foraging. Only two of the individuals could be sexed and their age estimated. One is an adult male and the other a five to six years old girl. The other three individuals are adult but their sex remain ambiguous. Thus, whatever it was that they made using their dentitions it is not age or gender related. These individuals were probably peasants, since they were buried outside the church wall.
The material contains both female and male individuals. However, complete since the individuals could not be reconstructed in the material and mostly only single skeletal elements could be sexed.

All age groups from newborn to old individuals were present in the material although the vast amount of children (25 individuals: three foetus, three *Infant*, one *Infant/Infans I*, nine *Infans I*, one *Infans I/II*, five *Infans II*, one *Juvenilis* and two subadults) in the material is a fact . The high values of children in a burial site can be due to bad health condition or higher birth rates. According to the osteological paradox (*Wood et al.*1992: 256) the archaeological material underrepresents the living populations and, high child morbidity can be related to high fertility rather than low health state of the population. The material from Pälkäne was so fragmented and small that no accurate statement can be drawn from it. All in all, more material should be analyzed conserning such conclusions. Perhaps the most special individuals are the three newborn. Two of them were probably buried in the same grave or at least very near one another, they were possibly twins.This question can not definitely be answered through morfological research. It would thus be very interesting to study the *DNA* of these individuals. The minimum number of individuals in the material is 63, but most of them are represented merely with a couple of bones. During the excavation only 20 burials were documented (Mikkola 2002). It is probable that the cemetery is disturbed due to its long use and

that the younger burials have destroyed older burials. There is a possibility that some bones, which were musty (KM: 90) descend from the civil war of Finland in 1917.

The stature of the individuals varies from ca 150-180 cm, though the differences between the sexes is impossible to say. The stature was most often estimated from the *talus* and *calcaneus.* These bones are not considered to be ideal for stature estimations and should only be used when no other option is present. In the study, these bones were used due to the fact that the more suitable bones were often too eroded or broken for the purpose in question.

All in all the individuals buried in and close to the Pälkäne church seem to have been fairly healthy, at least when the fragmented *post cranial* material is considered. The patologies in the *post cranial* material seem to be rare and only some slight changes perhaps related to inflammation, can be seen in some hand and wrist bones (KM: 82, see plate 7, figure 16). Some of the subadult individuals seem to have been suffering from some sort of illness or malnutrition, showing traces of *cribra orbitalia* at the *frontal orbita* region (KM:81;82). It is suggested that their in general poor health has led an early death. The individuals suffering from *cribra orbitalia* probably descend from different social classes, since they were buried both in-and outside the church. Thus, it can be said that malnutrition and sickness has been usual in both rich and poor. The elderly individuals have often age related changes like *osteophytes* growth on the *vertebrae* (KM: 82;83;84). This condition can not be considered to be an indication of illness when such changes normally appear with age or with hard work. One individual has a healed *Colle´s fracture* at the *distal* end of the left *radius* (KM: 82, see plate 2, figure 5). This type of fracture is quite typical and is normally caused by trauma, when a sudden weight is laidhas hit the hand. The distal *epifyseal* end of the *radius* is then broken at the *epifyseal* line and a sliding of the epiphysis in relation to the diaphysis can be occasionally observed on the healed bone. One individual has trepanation mark at the sagittal suture (KM: 97, see plate 9, figure 19). Motives for this kind of procedures are highly speculative ranging from therapeutic to ritualism. Why this individual receved such a treatment will remain a secret. This individual was however buried before the stone church was erected, so he probably died well before the end of the 15th century. The individual seems to have lived after the operation since the bone has remodelled and healed.

The non-metric characters in the material are mostly visible at the *supra orbital* region. The individuals have an *incisura* at the *foramina* area (KM: 82;82;100), sometimes only at one side. One *humerus* has a *foramen* at the *supratrochleatic* region (KM: 85). One individual has a rocker jaw and a prominent *tori* at the palatal region (KM: 101, see plate 10-11, figures 21-23). This character is very prominent and is normally present only in Arctic areas. Maybe this male individual with severe dental problems was not local, since non of the other individuals in the material presented similar kind of character. Two individuals showed *Morris´s type* cusps (KM: 81;87, see plate 5, figure 11) on their upper *canines*. Some non-metric variants are genetically inhereted (Hillson 2002: 100). Two individuals showed additional sutural bones at the *lambdoid* sutura (KM:83;86). Consequently a familiar relationship between some individuals may be possible. As already mentioned above, the material is not suitable for making conclusions of the biological relation between the people. It is however, emphasized that, if more individuals are analyzed from the cemetary in the future, these characters should be kept in mind.

The dental material from the Pälkäne church was recorded with high precision. Different kind of dental *caries* seizures were recorded as well as other conditions like *parodontal* disease and *hypoplasia*. The study was performed bearing upon future research of Finnish dental material. If the material will be reburied the dental set can easily be reconstructed from the tables compiled during this study.

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Plate 1

Figure 3. The semicircular trace between the upper second incisal and canine caused by clay pipe smoking (KM: 81).

Figure 4. The upper left dentition showing plaque covered with tar due to smoking clay pipe (KM: 81).

Photo Eeva Lahti

Plate 2

Figure 5. A healed Colle`s fracture in left radius (KM: 82).


Figure 6. Signs of hypoplasia caused by fluorosis in the left mandibulary dentition of a ca. 7 years old individual (KM: 82).

Photo Eeva Lahti

Plate 3

Figure 7. Linear enamel hypoplasy and pits at the incisors of a ca. 7 years old individual. The opacity of the teeth show that the symptoms were probably caused by fluorosis (KM: 82).


Figure 8. The lower right first incisor exhibiting linear horisontal and pit symptoms photographed via microscope (16 x enlargement) (KM: 82).

Photo Eeva Lahti

Plate 4

Figure 9. The dentition of an adult male. The second left molar is missing premortally and the jaw is completely remodelled. The first molar shows a gross gross caries cavity (KM: 87).

Figure 10. The teeth show a brown spotty colouration at buccal, labial and occlusal surface probably due to some sort of professional activity (KM: 87).

Photo Eeva Lahti

Plate 5

Figure 11. The maxillary dentition of an individual showing signs of activity related changes in dentition. There is abrasion distomesial at the occlusal surface of the teeth probably connected with the colouration of the dentition and rapid caries at the molars. The canines show a Morris´s type cusp (KM: 87).

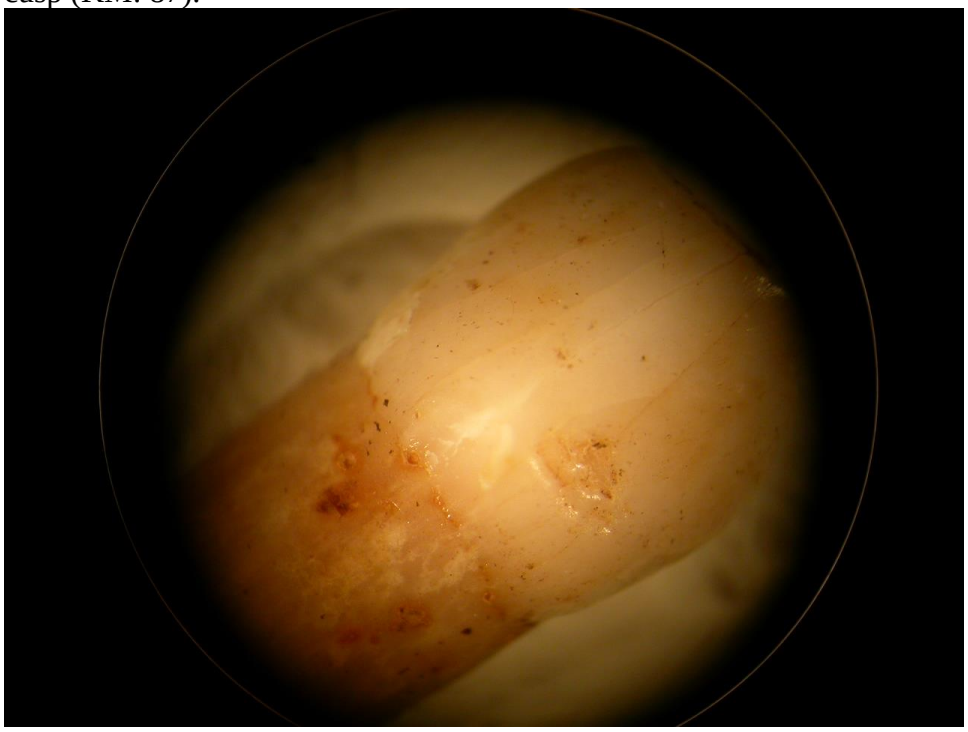

Figure 12. The hypoplasia in the deciduous maxillary right canine possibly due to birth related trauma. Photographed via microscope (16 x enlargement) (KM: 88).

Photo Eeva Lahti

Plate 6

Figure 13. The left ilium and iscium of a ca. 9-10 lunar months old fetus (KM:93).

Figure 14. The os petrosum of the two fetus, possibly twins. The infants were buried in the same coffin (KM:93).

Photo Eeva Lahti

Plate 7

Figure 15. The right iscium and ilium of a individual aged Infans II (KM: 94).

Figure 16. Wrist bones os scaphoideum and os capitatum. They may come from the same individual. The bones are pneumatic, possibly due to some sort of inflammation (KM: 82).

Photo Eeva Lahti

Plate 8

Figure 17. Gross cervical caries between the left second and third molars. The first molar has been lost premortally and the jaw is completely remodelled. The position of the second and third molars can be considered anomalic, since they almost share the same alveol. The dentition shows hypoplasia typical in fluorosis (KM: 97).


Figure 18. The hypoplasia at the right side of lower left canine (see picture 15) seen via microscope (6,4 x enlargement). The birth of the hypoplasia occurred at the age of ca. 6 years (KM: 97).

Photo Eeva Lahti

Plate 9

Figure 19. A well healed possible trepanation with postmortual damage (KM: 97).

Figure 20. Signs of inflammation at the first left molar. The inflammation has spread to the roots creating an abscess at both buccal roots. The teeth is almost totally worn (KM: 101).

Photo Eeva Lahti

Plate 10

Figure 21. Adult male individual exhibiting a character called rocker jaw mandibula (KM: 101).

Figure 22. The same individual as in two previous pictures. The second upper right molar has been lost premortually, probably due to inflammation. The third molar is barely fastened at the jaw. The first molar is almost totally worn and shows an abscess at the buccal roots (KM: 101).

Photo Eeva Lahti

Plate 11

Figure 23. The same individual as in pictures 18, 19 and 20. The individual has a highly prominent non-metric character, *torus palatinus*. This character, when prominent, is found mostly, though rare in arctic areas. The dentition is very worn. There are almost only root stumps left (KM: 101).

Photo Eeva Lahti

Appendix 1

Measurements and observations

Sexing

The values used in grading the sexual characters on os coxae or cranium and mandibula (Buikstra&Uberlaker 1994)

0 = undetermined sex
1 = female
2 = probable female
3 = ambiguous sex
4 = probable male
5 = male

Metrical methods used for sexing the individual bones

Femur	Femur
The vertical diameter of the caput	Epicondylar breath
Female = <41.5	=<72
Female? = 41.5-43.5	= 72-74
Allophys = 43.5-44.5	= 74-76
Male? = 44.5-45.5	= 76-78
Male = >45.5	= >78
Humerus	
The vertical diameter of the caput	Epicondylar breath
Female = <43	=<57
Female? =	= 58-60
Allophys =	= 61-62
Male? =	= 63-65
Male = >48	= >66

The values for sexing the glenoid cavity of the scapulae(Bass 1995: 126-129).

Female = <34
Allophys = 34-36
Male = >37

The cranial suture closing, the grading and the observation spots.

Blank = unobservable
0 = open
1 = minimal closure
2 = significant closure
3 = complete obliteration

Ectocranialt points:

The sites are scored at 1 cm length of suture surrounding following points. If possible they should be recorded from the left side.

1. midlambdoid
2. lambda
3. obelion

4. anterior sagittal
5. bregma
6. midcoronal
7. pterion
8. sphenofrontal
9. inferior sphenotemporal
10. superior sphenotemporal

If all ectocranial sites are present a composition score can be counted and following age classes can be determined, however the latero-anterior sites are considered to be more accurate.
Young adult (20-34)
Middle adult (35-49)
old adult (50+years)
(Meindl&Lovejoy 1985.)

Palatinal points:
The sutures of the palatinum should be scored across their entire length and rather from the left side if possible.
11. incisive suture
12. anterior median palatine suture
13. posterior median palatine suture
14. transverse palatine suture
the suture at the palatinal area as age estimation:
By young adulthood 11 fusioned, evident activity at 13 and 14.
Middle adulthood 11, 13 and 14 closed 12 partially open.
Old adult complete fusion.
Endocranial points:
15. sagittal suture
16. left lambdoid
17. laft coronal

Fusioning begins during young adulthood.
Advanced but incomplete closure middle adulthood.
Full fusioning old adulthood. (Krogman&Isçan 1986)

Ageing the auricular surface, sites and age groups

1. apex
2. superior demiface
3. inferior demiface
4. retroauricular area
Following features are important.
5. billowing
6. granularity
7. density
8. porosity

There are 8 phases to which the auricular surface should be assigned. Left and right side should both be recorded separately if possible. The age groups are following.

phase 1: 20-24
phase 2: 25-29
phase 3: 30-34
phase 4: 35-39
phase 5: 40-44
phase 6: 45-49
phase 7: 50-59
phase 8: 60+
(Uberlaker 1989a:81, Meindl& Lovejoy 1989: 140-141, 160-165).

Stature

Formules used to estimate the stature (Sjøvold 1990: 442).

Humerus	4.74hum+ 15.26 ± 4.94
Radius max	4.03rad + 69.96 ± 4.98
Ulna	4.65uln + 47.96 ± 4.96
Femur	2.63fem + 49.96 ± 4.52
Tibia	3.02tib + 58.94 ± 4.11
Fibula	3.78fib + 30.15 ± 4.06

The stature according to calcaneus and talus (Holland 1995: 315-320).

Calcaneus
MCAL maximum length of the calcaneus
PCAL posterior length of the calcaneus
This formulae is based on the white race mean age 48
A: 1.078(MCAL) + 82 ± 5.81
B: 1.552(PCAL) + 79.57 ± 5.11
C: 0.309(MCAL) + 1.220(PCAL)+73.94 ± 5.06

Talus
MTAL maximum length of the talus
White or black sex unknown mean age 42
1.411(MTAL) + 85.95 ± 6.18

Dental recording

In this study the teeth will be referred to by the notation of *Fédération Dentaire Internationale* (1971) (FDI) (Hillson 2002: 8).

Table 1. The permanent maxillary dentition according to FDI

Right								Left							
18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28
M3	M2	M1	P2	P1	C	I2	I1	I1	I2	C	P1	P2	M1	M2	M3

Table 2. The permanent mandibulary dentition according to FDI

Right								Left							
48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38
M3	M2	M1	P2	P1	C	I2	I1	I1	I2	C	P1	P2	M1	M2	M3

Table 3. The deciduous maxillary dentition according to FDI

Right					Left				
55	54	53	52	51	61	62	63	64	65
M2	M1	C	I2	I1	I1	I2	C	M1	M2

Table 4 The deciduous mandibulary dentition according to FDI

Right					Left				
85	84	83	82	81	71	72	73	74	75
M2	M1	C	I2	I1	I1	I2	C	M1	M2

The caries recording system based on Hillson and modified by the author

Table 5. The dental set recording

	Teeth number	
1		1. Tooth presence, absence, carious
2		2. Occlusal surface caries (fissure, groove, fossa sites)
3		3. Pit caries
4		4. Occlusal attrition score
5		5. Occlusal attrition facet dentine caries
6		6. Attrition facet enamel rim chipping/caries
7		7. Mesial attrition score
8		8. Mesial contact area caries
9		9. Mesial root surface caries
10		10. Mesial root exposure (Brothwell)
11		11. Distal attrition score
12		12. Distal contact point caries
13		13. Distal root surface caries
14		14. Distal root exposure (Brothwell)
15		15. Buccal smooth surface enamel caries
16		16. Buccal root surface caries
17		17. Buccal root exposure (Brothwell)
18		18. Lingual smooth surface enamel caries
19		19. Lingual root surface caries
20		20. Lingual root exposure (Brothwell)
21		21. Hypoplasy, type of defects
22		22. Number and demarcation of defects
23		23. Location
24		24. Buccolingual measure
25		25. Mesiodistal measure
26		26. Calculus mesial(Brothwell)
27		27. Calculus distal
28		28. Calculus buccal
29		29. Calculus lingual
30		30. Can be seen through alveol
31		31. Can be seen through broken bone
32		32. Erupting
33		33. Loose due to eruption of permanent tooth
34		34. Missing due to eruption of permanent tooth
35		35. Erupting root not ready

Clarifications for the values used in the table:

1. Presence/absence of tooth, and score for gross gross caries

Blank	missing post-mortem and jaw with socket missin too
0	tooth present without gross gross caries
7	gross gross carious cavity, so much loss that lesion point can not be decided
8	gross gross carious cavity, so much loss that lesion point can not be decided, clear opening into an axposed pulp chamber or root canal
10	tooth missing leaving an empty cavity without remodeling
11	tooth missing, little remodelling

12	tooth missing, full remodeling
13	no evidence of eruption (young age, impaction or agenesis)
14	partly erupted(crypt communicating with alveolar process, or tooth not yet in wear)
15	anomalous eruption, tooth not in a normal position

2. Occlusal surface caries in premolars and molars

Blank	sites missing for any reason or fully obscured
0	site present but enamel is translucent and with smooth surface
1	white or stained opaque area in enamel of fissure/groove/fossa, with smooth glossy or matte surface
2	White or stained opaque area with associated roughening or slight surface destruction
3	small cavity, where there is no clear evidence that it penetrates to the dentine
5	larger cavity, which clearly penetrates the dentine
6	large cavity, which was clearly initiated in a fissure/fossa/groove site within the occlusal surface(it does not involve the contact areas)within the floor of witch is the open pulp chamber or root canals.
7	gross coronal caries, involving the occlusal crown surface and contact area or pit
8	gross coronal caries, defined as in point 7 within the floor which is the open pulp chamber or open root canals

3. Pit sites in molars and upper incisors

blank	pite site not present or not visible
0	site present but enamel is translucent and with a smooth surface
1	White or stained opaque area in enamel of pit, with smooth, glossy or matte surface
2	white or stained opaque area, with associated roughening or slight surface destruction.
3	small cavity, where there is no clear evidence that it penetrates the dentine
5	larger cavity, which was clearly initiated in a pit site, within the floor of which is the open pulp chamber, or open root canals
7	gross coronal caries, involving a pit and the occlusal crown surface
8	gross coronal caries, defined as score 7 above, within the floor of witch is the open pulp chamber, or open root canals.

4. Occlusal attrition score

blank	occlusal surface not present, or obscured for any reason
1-8	Smith attrition stage
10	Tooth fractured leaving a surface which showes some wear

5. Occlusal attrition facet dentine caries and pulp exposure

blank	worn dentine surface, either not yet exposed, missing or obscured for whatever reason
0	dentine exposed in occlusal attrition facet but without any stained ares or cavitation
4	stained area or dentine adn or enamel which may or may not be a carious lesion
5	clear cavity in dentine
6	pulp chamber exposed in the attrition facet which is stained or appears to have been modified by the development of a cavity.
8	exposed pulp chamber in which ther is no sign of either staining or irregular formation of a cavity

6. Occlusal attrition facet enamel edge chipping and caries

blank	worn enamel rim not yet exposed at any point on the peimeter of the occlusal surface, missing or obscured
0	enamel rim of the occlusal attrition facet exposed at any point but intact with no chipping
1	chipping which appears to be post mortem in origin
2	chipping which appears to be antemortem, but is not affected by caries
3	chipping associated with carious lesions
7	gross carious lesion (scores 7 or 8 at rows 2, 3, 8, 12, 15,18) involving the enamel rim of the occlusal facet, but not clearly associated with chipping
8	gross carious lesion involving the enamel rim within the floor witch is open to pulp chamber or open root canal

7&11. Mesial and distal attrition score

blank	contact point missing
0	no attrition facet around contact points
1	approximal attrition facet confined to the enamel
2	approximal attrition facet exposing dentine at its centre
3	approximal attrition facet exposes dentine all the way down to the cemento-enamel junction
4.	occlusal attrition has proceede down into the roots of the teeth, so that ther is no longer any contact between the neighbouring teeth.

8&12. Mesial and distal contact area caries

blank	contact area missing, or not visible
0	contact area present, but enamel translucent nd with a smoot surface, any axposed dentine is unstained and not cavitated
1	white or stained opaque area in enamel, with smooth glossy or matte surface (or stained patch in dentine)
2	white or stained opaque area in enamel with associated roughening or slight surface destruction
3	small enamel cavity, where there is no clear evidence that it penetrates into the dentine
4	discolouration in exposed dentine of an approximal attrition facet
5	larger enamel cavity which clearly penetrates the dentine, or clear cavity in dentine at the approximal attrition facet
6	large cavity, clearly initiated in the contact area or approximal attrition facet, within the floor of of which the is the open pulp chamber or open root canals
7	gros cavity at the contact area or approximal attrition facet, which involves neighbouring occlusal sites (rows 2 or 6) and/or rooy surface sites (rowws 9 or 13)
8	gros caries cavity, within which the floor of which is open to pulp chamber or open root canals

9&13. Mesial and distal root surface caries

blank	no part of mesia/distal root surface or cement-enamel junction present or at least not visible if present.

0	root surface/cement-enamel junction present and visibl, with no evidence of staining or cavitation
1	area of darker staining along cement-enamel junction or on root surface
5	shallow cavity (stained or unstained) following the line of the cemento-enamel junction or confined to the root surface.
6	cavity involving the cemento-enamel junction, or root surface alone, within the floor which is open pulp chamber or open root canals.
7	gros cavity involving the root surface of cemento-enamel junction, which involves the neighbouring contact area site (row 9,13) or occlusal sites (2) or occlusal attrition facet sites (6).
8	gros cavity, defined as in score 7 above, within the floor of which is the open pulp chamber or open root canals.

10&14. Mesial and distal root exposure: Degree of alveolar resorption according to Brothwell (1981:154).

	This was the authors decision to use, since Hillson suggests measurements from CEJ. In the material however, this area is often eroded due to taphonomy.
0	No alveolar destruction
1	slight alveolar destruction
2	medium
3	considerable

15&18. Buccal/labial and lingual enamel smooth surface site. One site, just above the margin of the gingivae in life. Counted as present only when it is clearly separate from the cement enamel junction.

blank	site not present or not visible for any reason
0	site present, but enamel is translusent and with smooth surface
1	white or stained opaque area in enamel, with smooth glossy or matte surface.
2	white or stained opaque area, with assosiated roughening or slight destruction of the enamel surface.
3	small cavity, where there is no clear evidence that it penetrates to the dentine.
5	larger cavity, which clearly penetrates the dentine
6	large cavity, which has exposed the open pulp chamber, still without involving the cemento-enamel junction.
7	gross cavity, which involves neighbouring occlusal sites (rows 2 and 6) and/or root surface sites (rows 16 and 19).
8	gross cavity, defined as in score 7 above, within the floor of which is the open pulp chamber, or open root canals

16&19. Buccal and lingual root surface caries. One site per bucca/lingual surface, may run into the mesial or distal site.

blank	no part of the buccal/labial/lingual root surface or cement-enamel junction preserved, or at least not visible if present
0	site present and visible, with no evidence of staining or cavitation
1	warea of darker staining along cement-enamel junction or on root surface.
2	white or stained opaque area, with assosiated roughening or slight destruction of the enamel surface.

5 shallow cavity stained or unstained following the line of the cement-enamel junction, or confined to the surface of the root.

6 cavity involving the cement-enamel junction, or root surface alone, within the floor of the open pulp chamber, or open root canals.

7 gross cavity, including the cement-enamel junction, or root surface, which involves the neighbouring crown sites (rows 15 or 18), occlusal pit sites (rows 2 and 3) or occlusal attrition facet sites (row 6).

8 gross cavity, defined as in score 7 above, within the floor of which is the open pulp chamber, or open root canals

17&20. Buccal, labial and lingual root exposure: Degree of alveolar resorbtion in Brothwell (1981:154).

0 No alveolar destruction
1 slight alveolar destruction
2 medium
3 considerable

21, 22& 23 DDE index

Table 6. Type of defect

Type	Code for permanent teeth	Code for decidous teeth
Normal	0	A
Opacity (white/cream)	1	B
Opacity (yellow/brown)	2	C
Hypoplasia (pits)	3	D
Hypoplasia (grooves, horizontal)	4	E
Hypoplasia (grooves, vertical)	5	F
Hypoplasia (missing enamel)	6	G
Discoloured enamel (not associated with opacity)	7	H
Other defects	8	J

Table 7. Number and demarcation of defects

Number and demarcation of defects	Code for permanent teeth	Code for decidous teeth
Single (one well marked defect)	1	A
Multiple>one defect	2	B
Diffuse (fine white lines-following pattern of pkg)	3	C
Diffuse (patchy, irregular, lacking well-defined margins)	4	D

Table 8. Location

Location	Code
No defect	o
Gingival one-half	1
Incisal one-half	2
Gingival and incisal halves	3
Occlusal	4
Cuspal	5
Whole surface	6
Other combinations	7

24&25. Buccolingual and mesiodistal measurements

The measurements were made with sliding calliper, when possible from the left side.

27, 28&29. Calculus recording (Brothwell 1981:155).

0	Slight
1	Medium
2	Considerable

30, 31&32. The visibility of the unerupted teeth.

33&34.The recording of the dental set when the teeth are changing.

Appendix 2

Results, methods used in different units

KM: 81

Sex

Scapula sin 36.08 Sex?
Scapula sin 38.66 Male
Humerus distal breath 62.72 Sex?

Cranium:
Margo supraorbitalia 4 Male
Glabella 3 Male

Margo supraorbitalia 2 Female?

Temporale:
Processus mastoideus 4 Male

Age

Fusing of the suture:
Endocranial 2 Adult
Ectocranial C Adult

Age for Infants

Length/diameter
Tibia 89.55/8.64 Infans I
Radius 66.7/5.43 Infans I
Humerus distal breath 31.42 Infans I

KM: 82

Sex

Tibia dex: circumference at nutrient foramen 79 Female
Humerus sin: epicondylar breadth 59.37 Female
Humerus sin: vertical diameter of the head 42.79 Female

Scapula: cavitas glenoidalis 37.55 Male

Ilium dex: Incisura ischiadica major 2 Female?
Sulcus preauricularis 2-3 Female?
Arc composé: Female

Age

Ilium dex: Facies auricularis 3/ 30-34

Age for infants

Maximum length/max. diameter
Radius 82.74/5.64 Infans I

KM: 83

Stature

Calcaneus
A: 1.078(MCAL) + 82 ± 5.81
B: 1.552(PCAL) + 79.57 ± 5.11
C: 0.309(MCAL) + 1.220(PCAL)+73.94 ± 5.06
Calcaneus sin:
A: 75.02: stature 162.87±5.81
B: 55.24: stature 165.30±5.11
C: 164.51±5.06

Talus
MTAL maximum length of the talus
White or black sex unknown mean age 42
1.411(MTAL) + 85.95 ± 6.18

Talus sin:
59.14: 169.4±6.18
58.79: 168.90±6.18

KM: 84

Sex

Occipitale: protuberantia occipitalis externa 3 Sex?

Femur:
Epicondylar breadth 68 Female
Maximum diameter at head 39.53 Female

Stature

Femur: Maximum length 2.63(382.16)+49.96=154.96±4.52
Talus: 50.45= 161.13±6.18

KM: 85

Sex

Scapula: Cavitas glenoidalis 42.06 Male
Humerus: epicondylar breadth 64.55

Ilium:
Incisura isciadica major 3 Sex?
Sulcus preauricularis 0 Sex?
Arc composé Female

Age

Ilium: Facies auricularis 4-6 adult (35-49)

KM: 86

Sex

Os ilium sin:
Incisura isciadica major 4, sulcus preauricularis 0, Male
Incisura isciadica major 4, Male
Incisura isciadica major 1, sulcus preauricularis 1, Female

Age

Cranial suture fusion:
Ectocranial:
Midlabdoid 0, lambda 0, obelion 0 anterior sagittal 1, bregma (frontale not present) open
Endocranialt:
Sagittal 0-1, left lambdoid 0-1, left lambdoid (frontale not present) open.
Subadult

Os ilium sin: Facies auricularis 1: 20-24 years

Age for Infants

Axis: dens unfusioned: under 2 years

Stature

Talus

MTAL maximum length of the talus
White or black sex unknown mean age 42
1.411(53.62) + 85.95 ± 6.18

165.6±6.18

KM: 87

Sex

Occipitale: protuberantia occipitalis externa 1: Female

Temporale: Processus mastoideus 3/4
Mandibula: Male
Trigonum mandibulare 3
Margo inferior thick
Angulus mandibulae pointed and converted out

KM: 88

Sex

Cranium: Female
Temporale: Processus mastoideus 2
Margo supraorbitalia 3
Glabella 1
protuberantia occipitalis externa 1

Mandibula: Female
Protrusion male
Shape of the anterior arch female
Gonion female

Ilium dex: Sulcus preauricularis over 90°: Female
Depth of sulcus: Sex?
Curvature: broken

Age

Cranial suture fusion:
Ectocranial: Midlambdoid 0, lambdoid 0, obelion, anterior sagittal o, pregma 0 midcoronal 0, pterion 1, sphenofrontal 1, left lambdoid 0
Endocranialt: Sagittal 0, left coronal 0

Palatinum: Incisive suture 1, anterior median palatine sutura 0, posterior median palatine sutura 0, transverse palatine sutura 0

Age of subadult
Maximal length/diameter
Humerus sin: 182/12
Radius sin 139.59/9.02

KM: 89

Stature

Talus

Talus sin
1.411(55.19) + 85.95 ± 6.18

163.82±6.18
Talus dex
1.411(53.73) + 85.95 ± 6.18

161.76±6.18

KM: 90

Sex

Os temporale: processus mastoideus sin: 4 Male

Scapula: cavitas glenoidalis sin: 34.22 Ambiguous

Stature

Radius sin

403(20.5)+69.96±4.96

Talus sin
1.411(49.08) + 85.95 ± 6.18

155.20±6.18

KM: 91

Sex

subadults (Infant/infans I)

Os ilium sin: arc composé feminine
Incisura isciadica major feminine
Curvature crista iliaca feminine

Os ilium dex: arc composé masculine
Incisura isciadica major masculine
Curvature crista iliaca masculine

Age

subadults maximum length/diameter

Femur sin 72.35/5.54
Tibia sin 62.84/5.38
Humerus sin 60.33/5.02

KM: 92

Age

Cranial suture fusion:
Occipitale &parietale
Ectocranial midlambdoid 2, lambda 3
Endocranialt left lambdoid 3, sagittal 3

Stature

Fibula dex: 178.7+/-4.06

3.78(39.3)+30.15+/-4.06

Calcaneus dex:
A: 84.97: stature 173.6±5.81
B: 62.2: stature 176.1±5.11
C: 178.3±5.06

Talus sin
1.411(57.95) + 85.95 ± 6.18
167.7±6.18

Talus sin
1.411(63.58) + 85.95 ± 6.18

175.7±6.18

KM: 93

Sex

Mandibula: masculine
Shape of protrusion of the chin region: prominent
Anterior dental arcade not suitable for evaluation: broken
Eversion of the gonion region:everted

Mandibula: feminine
Shape of protrusion of the chin region: not prominent
Anterior dental arcade not suitable for evaluation: broken
Eversion of the gonion region:not everted

The difference at the mandibles becomes visible only in comparement!

Os ilium dex: possibly feminine
Angle of incisura isciadica major: over 90°
Depth of incisura isciadica major: feminine
Arc composé: goes through facies auricularis
Curvature at crista iliaca: quite straight (no S-shape)

Age

All of the bones witch were measurable where measure and age was determined from them (Fazekas&Kósa 1978). The measurements are recorded at the appendix bonelist.

The dentition

55	54	53	52	51	61	62	63	64	65
	x		x	2		x		x	

85	84	83	82	81	71	72	73	74	75
	x		x	x		x		x	

KM: 94

Sex

Os ilium dex: Male (Obs: Infans II)
Angle of incisura isciadica major: under 90°
Depth of incisura isciadica major: deep
Arc composé: masculine
Curvature at crista iliaca: S-shape

Stature

Calcaneus
A: 1.078(80.66) + 82 ± 5.81
B: 1.552(57.24) + 79.57 ± 5.11
C: 0.309(80.66) + 1.220(57.24)+73.94 ± 5.06
Calcaneus sin:
A: 80.66: stature 168.95±5.81
B: 57.24: stature 168.40±5.11
C: 157±5.06

Km: 95

Sex

Os ilium: Male
Incisura isciadica major: under 90°
Arc composé: masculine
Crista iliaca: S-curvature

Age

Maximum length/diameter
Femur sin unfusioned: 322.01/70.0
Fibula dex unfusioned: 254.84/10.39
Tibia sin unfusioned: 255.64/60.3

KM: 96

Stature

Femur dex: 160.10±4.52

2.63(41.9)+49.96±4.52

KM: 97

Sex
Cranium: Masculine?
Os temporale processus mastoideus dex: 4
Crista supraorbitalia: 3
Protuberantia occipitalis externa: 1

Mandibula: Masculine?
Trigonum mandibulae: 2
Breadth of jaw bone under second molar: thick
Angulus mandibulae: over 90°, but gonion everted

Scapula:
Cavitas glenoidalis sin: 35.99 Ambiguous
Cavitas glenoidalis dex: 35.24 Ambiguous

Os ilium sin: broken, masculine
Incisura isciadica major: under 90°
Arc composé: masculine

KM: 99

Age

All of the bones witch were measurable where measured and age was determined from them (Fazekas&Kósa 1978). The measurements are recorded at the appendix bonelist.

The dentition

55	54	53	52	51	61	62	63	64	65
x			x	x	x				x

85	84	83	82	81	71	72	73	74	75
x			x			x			

KM: 100

Sex

The individual is subadult.
Frontale sin: Male
Glabella 4
Margo supraorbitalia 4

Occipitale: Ambiguous
Protuberantia occipitalis externa: 3

KM: 101

Sex

Cranium: Masculine?
Temporale: processus mastoideus 3
Margo supraorbitalia: 4
Glabella: 3
Protuberantia occipitalis externa 3

Mandibula: Masculine?
Trigonum mandibulare: 4
Angulus mandibulae: over 90°, but gonion everted

Scapula: cavitas glenoidalis sin: 39.05 Male
Scapula: cavitas glenoidalis dex: 39.16 Male

Os ilium dex: broken
Incisura isciadica major: over 90°

Age

Os ilium: facies auricularis: broken, surface looks youthfull

Cranial index:

Brachycrany

Opiston-glabella 174
Euron: 140
Basion-bregma: 130

Appendix 3

Latin names (During 2000).

General terms in anatomical order

Dexter	Right
Sinister	Left
Medial	The middle
Lateral	To the side, away from the midline
Proximal	Closer to the trunk
Distal	Away from the trunk
Caput	Head
Collum	Neck
Diaphys	Schaft
Condylus	A rounded articular surface
Facies articularis	Articular surface
Corpus	Body
Arcus	Arc
Processus	Any kind of projection
Foramen	Hole or small opening
Ossa longa	Long bones
Ossa brevia	short bones
Ossa plana	Flat bones
Ossa pneumatica	Pneumatic bones
Epiphys	Secondary ossification center
Cartilago	Cartillage
Radix	Root

Postcranial skeleton

Vertebrae cervicales	Cervical vertebrae
Atlas	First cerv. vert.
Axis	Second cerv. vert.
Vertebrae thoracicae	Thoracic vertebrae
Vertebrae lumbales	Lumbar vertebrae
Os sacrum	Sacrum
Costa	Rib bone
Sternum	Breastbone, three segments
Manubrium	Handle upper segment
Corpus	Body, middle segment

Scapula	Schoulder blade
Clavicula	Collarbone
Humerus	Upper arm bone
Radius	Lateral bone of lower arm
Ulna	Medial bone of lower arm
Manus	Hand
Ossa carpi	Carpal or wrist bones
Os scaphoideum	Scaphoid or navicular
Os lunatum	Lunate
Os triquetrum	Triquetral
Os pisiforme	Pisiform
Os trapetzium	Trapetzium or greater multangulum
Os capitatum	Capitate
Os hamatum	Hamate
Os metacarpale/ossa metacarpalia	Metacarpal bones
Phalanx/phalanges manus	Fingers
Os coxae	Hip bone: three elements
Os ilium	Ilium, dorsal element
Os iscium	Iscium, inferior element
Os pubis	Pubis ,medioventral element
Femur	Thigh bone
Patella	Kneecap
Tibia	Medial bone of the lower leg
Fibula	Lateral bone of the lower leg
Pes	Foot
Ossa tarsi	Foot bones
Talus	Ankle bone
Calcaneus	Heel bone
Os naviculare	Navicular
Os cuneiforme mediale, intermedium, laterale	First cuneiform, second, third
Os cuboideum	Cuboid
Phalanx or *phalanges pedis*	Toes
Ossa sesamoidea	Sesamoid bones

Cranial skeleton

Cranium	Skull
Os occipitale	Occipital bone, bone in the back of the head
Os sphenoidale	Sphenoid bone, bone in the base of the skull
Os temporale	Temporal bone
Os malleus	Little hammer (ear)
Os incus	Anvil (ear)

Os stapes	Stirrup (ear)
Os frontale	Frontale bone, bone of the forehead
Os parietale	Parietal bone, bone in the middle of the skull
Os ethmoidale	Ethmoid bone (sievelike bone)
Os zygomaticum	Zygomatic bone or cheek bone
Os lacrimale	Lacrimal bone, in the wall of orbit
Os nasale	Nasal bone, the bridge of the nose
Vomer	Ploughshare bone (the posterior part of the nasal septum)
Os concha nasalis inferior	Lower turbinate
Maxilla	Upper jaw
Os palatinum	Palate bone
Mandibula	Lower jaw
Os hyoideum	Hyoid bone
Cartillago thyroidea	Thyroid
Dens	Tooth, teeth