DOES SIZE MATTER?

An osteological analysis of the relation between tooth size and dental caries from S:t Clemens cemetery in Lund.

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Abstract

The aim of this thesis was to investigate the relation between tooth size and dental caries in a medieval material from S:t Clemens cemetery in Lund. Dental caries is one of the most common infectious disease in humankind, both in prehistoric and modern populations. Evidence of caries gives the opportunity to study health and diet in populations. During evolution of humankind, there are evidence of a reduction in tooth size and there are different theories about why the teeth got smaller. In this thesis I want to see if there is a relation between the tooth size and caries. The theoretical framework is based on evolutionary theory and focal infection theory. A selection was made among the teeth, and molar teeth are only included, because they are often more afflicted with caries. The result from this analysis showed that there was a statistically significant difference in M1sup (upper), M1inf (lower), M2inf and M3sup, which means that there was a relation between the measurements, mesial-distal and buccal-lingual, and dental caries. There is a difference in size between females and males, but it is the larger teeth that are afflicted with caries. This means that even if the teeth have reduced in size over time, it is still the larger teeth that are afflicted with caries. I think that there is a relation between the revolution of agriculture and the evolution of tools, as pottery, that gave humankind the opportunity to softener the food. The diet of carbohydrates became sticky and could easily get stuck in the morphology of the teeth, which give caries a chance to evolve in the morphology of fissures and pits in the occlusal surface.

Keywords:

Human osteology, Dental Caries, Tooth Size, Focal Infection Theory, Evolutionary Theory, S:t Clemens, Medieval Lund.

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1. Introduction

Skeletons and other archaeological materials have contributed substantially to our understanding of hominin evolution. From the information we have gained from prehistoric humans, we can reconstruct and visualize the course of evolution. The knowledge has contributed to the understanding of prehistoric populations, diet, and cultural behaviour. During the evolution of the hominins, a reduction of the tooth size has been documented and there have been different explanations about why the teeth decreased in size over time. The relation between reduced tooth size and the evolution of diet seems to be one answer to why the teeth became smaller. Shifting from a coarse diet where humans needed larger teeth and facial muscles to a softer diet during the evolution of tool making and pottery, which resulted in that humans were no longer in need of large teeth (Cohen 1989:70).

Dental caries is one of the most common diseases in humankind and has been investigated in archaeological populations more than other dental diseases (Roberts & Manchester 1995:45). This infectious disease leaves evidence as dense spots or large cavities on the surface of the enamel. The studies of caries are many and it is a known field of research in the world, both in modern and prehistorical populations. Evidence of caries in prehistoric populations gives the opportunity to study the health and diet of early populations. It is known that caries has afflicted humans throughout history, and that there are relations between the disease and a diet rich in carbohydrates (Liebe-Harkort 2010:4). Medieval osteological materials from Sweden and Denmark have been studied and the results show that dental caries were a common disease during the Middle ages (Swärdstedt 1966; Bennike 1985; Arcini 1999).

In 1988, Calcagno and Gibson introduced a hypothesis that larger teeth should be more afflicted with caries than smaller teeth. They based their hypothesis on that larger teeth have a more complex morphology of fissures and pits, which should result in them being harder to keep clean than smaller teeth. This is interesting in light of the evolutionary theories about dental reduction and that teeth have in fact gotten smaller over time, in relation to the rise of agriculture and a diet rich in carbohydrates. The theoretical framework will be based on evolutionary theory, but foremost, focal infection theory.

1.2 Aims and research question

The aim of this thesis is to test the hypothesis if there is a relationship between tooth size and dental caries, based on a medieval material from S:t Clemens cemetery in Lund. Is it possible to observe a difference in the medieval material?

The aims could be subdivided into following research questions:

- Are the large teeth more afflicted by caries than smaller teeth?
- Is there a difference between females and males?

2. Background

2.1 Caries

Caries is due to an acid produced by bacteria in the dental plaque that has the effect of breaking down the enamel and dentine of the tooth. The dental plaque gathers on surfaces of the tooth that is hard to keep clean, such as pits and fissures in the crown of the tooth (Libe-Harkort 2010:4, Hillson 1996:269).

Caries evolve when there is an imbalance in the normal oral microbiota. The tissues of the tooth decompose by fermentation of the carbohydrates in food. It is more common that the fissures and pits get afflicted and caries can develop quickly in the occlusal surface (Waldron 2009:236; Marsh et al 2016:117). Below the surface of the enamel, small cavities begin to grow and once the enamel has been afflicted, caries can begin to decompose the dentine and into the pulp (Marsh et al 2016:115).

There are different factors that provide dental caries. The factors can be that the surface of the teeth is always exposed to the oral environment (i.e., the complex of indigenous oral bacteria such as *Streptococcus mutans, Lactobacillus acidophilus*, salivary glycoproteins and inorganic salts on the surface of the tooth), in other words, dental plaque and diet. Then there are a lot of other factors that influence the development and spread of the carious lesion, like the crown size and morphology, occlusal surface attrition, tooth structure and food structure (Larsen 2015:68).

Infectious diseases like caries can become so serious that it can lead to death by the impacts of the infection on general health (Ahlström 2003:48). It is possible that oral health affects general health, but it might not be a big problem in modern times because of the scientific advances that have been made to treat caries and other oral health issues. The standard of dental care in modern times differ depending on where you live. The horrible experiment of Vipeholm is unfortunately why Sweden has dental care today, where the population has free dental care until the age of 23 (Bommenel 2006:294). However, dental care in medieval times were rudimentary and people could potentially die of caries (Ahlström 2003:52). An infection in the oral cavity can lead to negative effects on the general health, and the ability to resist other infectious diseases (Calcagno et al 1991:60).

In human remains teeth are often well-preserved, and it is possible for osteologists to study dental caries. Teeth with caries can show valuable data of the past, and interpretations of the relationship between health and diet can be explored by a combination of clinical and palaeopathological methods (Liebe-Harkort 2010:12).

Fissures and pits of the premolar and molar are the most common sites for caries to develop. The fissures and pits make it easier for food to get stuck and they can be difficult to keep clean. When caries has started in the fissures and pits it can spread down to the pulp and root of the tooth. However, it can be difficult to take notice of caries in its early stages. Sometimes it does not appear on the surface of the tooth but starts instead in the fissures as a dark stain (Hillson 1996:272).

2.2 Caries in Archaeological material

Osteological materials can show a different pattern of caries in prehistoric populations. It is known that sugar is one factor that leads to caries, but in the prehistory sugar as we know it from modern times did not exist. Caries was uncommon among the early hominins but has been documented in Paleolithic and Mesolithic materials. There is a pattern of low caries rates in Paleolithic, Mesolithic, Bronze and Iron Age, and then a rise of caries in Medieval and modern times (Hillson 1996:282; Alexandersen 2008; Roberts et al 2012:156). Several studies have shown that the rise of caries can be associated with the change of diet, from the hunter-gatherer diet where meat dominated the meals to the agriculture where cereals became dominating in the diet (Hillson 1996:283).

Through archaeological finds there is information about medieval food consumption. The basic diet for both children and adults would be porridge, bread, dried fish and meat, and water or mead to drink. The porridge was often made from oats and barley which had the highest cariogenic outcome. This kind of food preparation makes the carbohydrates easy to break down into simple sugar molecules. Because of the consistency of the porridge it could easily stick in the morphology/irregular topography of the teeth, leading to plaque forming on the teeth and facilitating the fermentation of the carbohydrates by bacteria (Arcini 1999:84).

2.3 S:t Clemens cemetery

The first excavation in the quarter of S:t Clemens nr 8 took place in 1974 (fig 1). During the excavation, the archaeologist found a previously unknown cemetery with graves that were to be dated to c.990 AD. This is one of the earliest cemeteries found in Lund. In 1982 a new excavation of the quarter of S.t Clemens 9 and Drotten 6 began. It would take about three years to finish the excavation and the archaeologist had in the end discovered two new churches and cemeteries (Cinthio 1996:6).

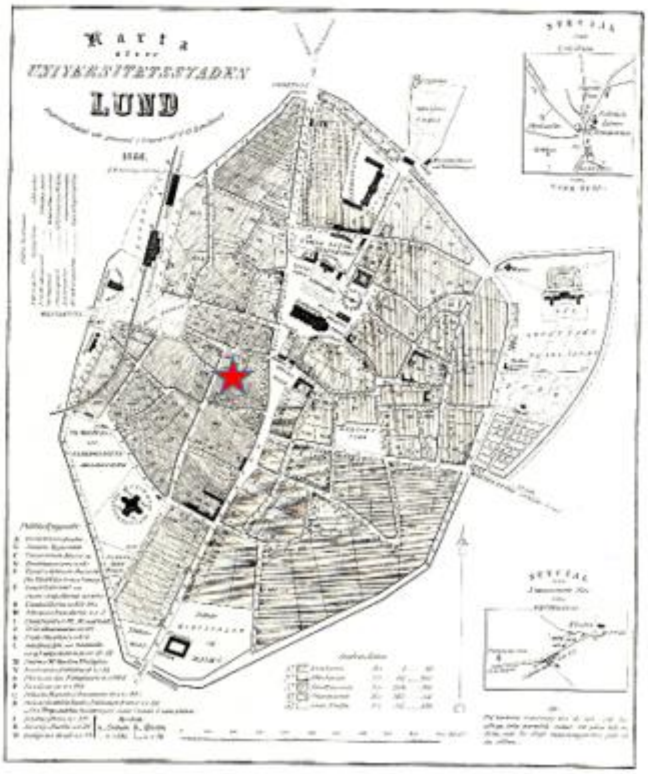

Fig 1, Map of Lund from Wikimedia.org. The red star shows the location of S:t Clemens cemetery.

Organic material has better preservation further down in the ground where the mud is saturated by groundwater deprived of oxygen. This made it possible to take dendrochronological samples of the coffins that were well preserved. The samples showed that the oldest coffin was dated to CE/AD 994 +/- 5 years. During 1050 the cemetery was flooded, and a layer of mud covered the graves. After this, the use of the S:t Clemens cemetery ended. It is believed that the inhabitants stopped using this cemetery because the wooden church associated with the cemetery was replaced by a stone church, south of the area (Cinthio 2002:231ff). It is, however, not clear how the flood and the new stone church is connected to why the inhabitants stopped using the cemetery.

The dating of the graves was based on the dendrochronological samples, but also on the positions of the arms of the skeletons and the types of coffins they were buried in. During the medieval period, the placing of the corpse’s arms has been shown to differ through the centuries. The majority of the individuals were buried with their arms by their sides. This position is classified as group 1 and was common between AD 990 and AD 1050 (Redin 1976:32). Characteristic for coffins in the years AD 990-1050 was trough and log-coffins, and both of these types were found in the cemetery (Carelli 2012:352). Still, to date, only 50 percent of the cemetery has been excavated, and the cemetery is believed to have contained about 2000 burials during the first 60-70 years of its use (Cinthio 1996:9).

3. Research history

This chapter will contain research history. First presentations of different studies concerning tooth size and reduction, where the researchers that presented the hypothesis will be introduced.

Then I will review studies dealing with dental caries based on medieval materials from Sweden and Denmark.

3.1 Tooth size

Dorothy A. Lunt (1969) did an odontometric study of medieval materials from Denmark. The aim was to compare the size of the Danish teeth to measurements of crown size in European materials previously published. The measurements were taken in two different dimensions, the mesiodistal diameter, and the labiolingual diameter. Lunt's purpose was to investigate the differences in tooth size between different populations in Europe (Lunt 1969:6ff).

C. Loring Brace and Alan S. Ryan (1980) discuss the sexual dimorphism and tooth size differences in populations. According to them the tooth size differences observed between females and males probably reflect dietary differences between the sexes and that the tooth size is modified of the host. When our body size changed during our hominin evolution, the female and male tooth size difference changed in reflection to the body size. In their sample of the modern European population, there is a larger difference in tooth size between females and males than Brace & Ryan expected. They suspect that this is a result of advantageous conditions of health and diet, which allow males to grow more than in the past.

An article from 1985 by Kieser et al. discusses different theories about why teeth have been smaller during the evolution of the hominin. Sofaer (1973) propose an evolutionary model of the jaw and tooth size, where tooth development and reduction are suggested to be a consequence of the neighbouring teeth. If the first molar is large, then the second molar will become smaller and the third molar even smaller. Kieser et al. (1985) studied material from Paraguayan Lengua Indians that contained 202 individuals. Teeth afflicted with caries or worn teeth were excluded from the study. The result of the analysis shows that if the first molar is large, then the second molar will tend to be large as well. Sofaer's model of the tooth size must, therefore, be re-examined (Kieser 1985:742).

Smaller tooth size, the absence of the third molar, and the first permanent molar hypoconulid absence are parts of human evolution. The hypoconulid is the distal cusp on the lower molar teeth (Ireland 2010). A hypothesis according to Andersen and Popovich (1977) is that these factors have a connection to dental caries. The first molar of children in the age of 16 was investigated for dental caries at the Burlington Growth Centre. The result showed that the first molar had a higher frequency of caries if the third molar was absence, and also that those first molar teeth where the hypoconulid was absent had a lower frequency of caries, unrelated to the size of the teeth. The conclusion was that an evolutionary dental reduction was not a result of the pressure from caries. The loss of the hypoconulids and the absence of the third molar seemed to be more related to the change of structure~~s~~ and not in relation to dental caries (Andersen et al 1977:381).

Calcagno and Gibson (1988) indicate that dental reduction among human populations is worthy of a scientific explanation. There is a controversial model that tries to explain the structural reduction in organisms, known as the "probable mutation effect" (PME). According to this model, ecological and cultural changes will cause selective pressure leading to a reduction or loss of non-essential organs. Calcagno and Gibson don't support this model and means that pressure from for example caries, will result in a reduction of the teeth. The purpose of their paper was to propose a model of dental reduction from a natural selection perspective that would be useful in both modern and archaeological populations, in order to understand the dental reduction during the hominin evolution.

There are studies that claim that the reduction in tooth size is related to the development of technology. Like Brace, Smith, and Hunt (1991) who say that the development of technology such as pottery must have had an influence on the reduction of tooth size. When the use of pottery increased, the populations were able to change the consistency of their food. It was no longer necessary to use the teeth as a tool (Brace et al 1991:47). Smith (1982) claims that dental changes during the course of hominin evolution were caused by different factors. The reduction of the jaw, body size, and cranial capacity are related to the change of diet due to behavioural modifications (Smith 1982:370).

In 1998 (published in 2003), Torbjörn Ahlström wrote an article where he tested the hypothesis of Calcagno and Gibson (1988). The hypothesis was that larger teeth are afflicted by caries more often than smaller teeth. In the paper Ahlström also investigated whether the reduction in tooth size could have been caused by dental caries. Calcagno and Gibson (1988) mean that larger teeth have a morphology with more fissures and pits, making them more prone to develop caries. Ahlström studied 28 populations from the Paleolithic, Mesolithic and Middle Neolithic. Ahlström discusses the biological changes in tooth size from the lifestyle of the Mesolithic populations to Neolithic populations. The intention was to see if the populations from the Mesolithic period had larger teeth than the populations introduced to the more cariogenic diet with the adoption of agriculture. Based on the hypothesis, Ahlström expected tooth size in the Pitted Ware culture population to have similarities with Mesolithic teeth, i.e., quite large teeth.

If the risk of being afflicted with caries increase in the populations with larger teeth, the cariogenic diet would not be a serious problem for the populations (Ahlström 2003:52).

Ahlström came to the conclusion that populations with larger teeth scored relatively high for instances of caries while populations with smaller teeth scored relatively low (Ahlström 2003:57). By ecofacts and stable isotopes, the results indicate that populations with a hunting-fishing economy exhibited relatively large teeth in all materials. The study of the frequency of caries in the different populations was unable to demonstrate any connection between the diet and frequency of caries. Ahlström means that caries is not the reason for the teeth getting smaller. For the tooth to change in size, but not in morphology, all enzymes must be involved to produce the normal structure but reduce in size at the same time (2003:60).

3.2 Dental Caries

Mellquist and Sandberg (1939) studied caries frequency in medieval materials from Greenland, Halland, and Scania. Their aim was to investigate if there was a difference in the frequency between the materials. Their result was that the populations from Halland and Scania had a higher frequency of caries than the one from Greenland, where caries was non-existing. This result could be due to differences in diet. Scania was the main cereal producing district during the medieval period. Animal products such as milk, cheese, butter, and meat were also important. In Halland, where agriculture was not as developed, the main food sources were fish, meat and other animal products. On Greenland, the diet was almost exclusively based on animal products, and cereals were more uncommon. Mellquist and Sandberg mean that the difference in the caries frequency observed between Scania-Halland and Greenland was explained by the consumption of cereals. Therefore, they think that the frequency of caries increases in relation to the agricultural diet (Mellquist & Sandberg 1939:39ff).

In 1945 an experiment called "the sugar experiment" was carried out in Sweden. Scientists wanted to see how carbohydrates, especially sugar, affected teeth. The experiment took place in a hospital for people with disabilities, called Vipeholm, and the study included 780 patients that would eat different forms of sugar every day. The results showed that caries was caused by sugar and the dental care in Sweden was established. This experiment was later deemed deeply unethical and many of the patients got serious dental diseases. Because of the patient's disabilities, we don't know how much they suffered during this experiment and this was not the right way to investigate the sugar impacts on teeth (Gustafson et al 1954; Bommenel 2006:164ff).

Odontological examinations have been made of osteological materials from the medieval cemetery of Westerhus. In this study, Swärdstedt analysed different odontological aspects, including caries. The analysis includes 68 males and 64 females between the ages of 14 and 60. The results show that the frequency of caries is higher on the molars and that the upper and lower molars have been afflicted quite equally. Of the 3016 teeth that were recorded, 245 were afflicted by caries. In addition, teeth from *maturus* individuals had a higher frequency of caries than the adults (Swärdstedt 1966). The separation between adult and *maturus* is an example of the osteological paradox which will be presented in the chapter on theory.

Studies of tooth size in a medieval material have been made by Sagne (1976), where tooth dimensions were included. The aim was to analyse the differences between populations, sexes, and age classes. The diameter of the tooth was observed to decrease with advancing age, a consequence of attrition of the surface. A difference in the size of the canines was observed between the sexes (Sagne 1976:103).

In Pia Bennike's thesis from 1985, an analysis of materials from Denmark was investigated. Bennike examinated materials from the Mesolithic up to the Middle Age, where the occurrence of dental caries was noted. An examination of teeth from four major periods was made using a table for characterizing dental caries. The distribution of caries within the dentition was compared between the four different periods. The result showed that the upper jaw was more frequently afflicted by caries, which is strange because it is often the lower jaw that has the highest frequency of caries according to Bennike (1985). Through the four periods, females had the highest occurrence of caries. Because the time periods were represented by an unequal number of individuals, it was not possible to conclude which periods had the highest occurrence of caries (Bennike 1985:157ff).

After the excavation of the cemetery of S:t Clemens 9, osteologist Caroline Arcini was assigned to analyze the osteological material in 1984 (Cinthio 2002:236). In 1999, she used the material in her thesis titled "Health and Disease in Early Lund". The aim of the thesis was to study if the health situations in Lund changed during the medieval period. Arcini analysed osteological material spanning from the initial urbanization until the reformation noting age, height, infections, dental diseases, joint diseases and trauma (Arcini 1999:17). Arcini claims that dental health worsened over time. The frequency of caries was higher during the late period, c.1300-1536, than in the earlier period. However, the caries frequency does not mean that the general health got worse, but merely that the change of diet with an increased consumption of carbohydrates increased the risk for caries to develop.

Verner Alexandersen (2008) discuss caries through time in Europe. During the Paleolithic and Mesolithic periods, the frequency of caries was relatively low in Europe. An increase of the affliction of caries could be observed through the Roman Iron Age to the Viking Age in northern Europe. By the medieval period in northern Europe, almost half of the population was afflicted with caries. Women were often more afflicted with caries than men. Alexandersen means that the main reason for the prevalence of caries is a diet rich in cereals and sugar (Alexandersen 2008:374).

In Carola Libe-Harkort's thesis from 2010, she investigates the impact of dental caries and its consequences on the health of populations in the early Iron Age from Smörkullen. Libe-Harkort also wanted to study possible relationships between oral pathology and cranial pathologies (Libe-Harkort 2010:12). To evaluate dental caries, Libe-Harkort used grading systems that combined clinical and paleopathological criteria. The grading of lesion severity was presented in a table separating coronal caries lesions, cemento-enamel junctions, root surface, and undetermined initiation of the lesion. Pictures showing the severity of caries lesions in the Smörkulla material provide a guide for classifying lesions in other materials (Libe-Harkort 2010:5f). According to Libe-Harkort, the population of Smörkullen had a high frequency of caries compared with other Scandinavian populations. However, she points out that caries diagnosis is dependent on the observers experience and that it is possible for caries frequencies in reports to be underestimated. The high instances of caries were interpreted as being a result of a diet rich in carbohydrates (Libe-Harkort 2010:70).

4. Theory

My theoretical framework is based on evolutionary theory, but foremost, focal infection theory. Evolutionary theory will briefly be presented with a focus on the dental evolution of hominins. Also, the osteological paradox that has to be taken into consideration for osteological materials.

4.1 Focal Infection Theory

The focal infection theory was a development of germ theory, influenced by ideas with infection and bacteriology. In the early 1900s, the germ theory became accepted with the ideologies of bacteriology, this increased the knowledge of public hygiene and that illness could cause infections in the body. Because of the germ theory, a new idea of the theory of focal infection was proposed with the outcome of focal bacteria localized other parts of the body (Gibbson 1998; Pallasch et al 2000). The spreading from the local infection occur directly through the blood or lymphatic metastasis of the infecting organism and their toxic product, and it is known that the oral bacteria can secondarily cause other infections in the body (Pallasch et al 2000). Focal infection theory is based on that one local infection has afflicted a small area in the body, and that the local infection can spread to other parts of the body, by travel through the blood. The infection can find new organs of tissues and cause a new infection.

Dr. Billings was one of the medical scientists that got ideas about health, based on the field of bacteriology (Gibbson 1998). In 1915, Dr. Billings proposed an explanation of the theory of focal infection. He meant that a focus of infection often occurred in areas of the body where pathogenic organisms were more common, usually occurring in the head. The airways and mouth are often more exposed to infectious agents. According to Dr. Billing, teeth are more exposed to pathogenic organisms and carious teeth are one evidence for the lack of personal hygiene. The crowns of the teeth are one common site to get infections that can easily be forgotten (Billings 1914).

The history of the focal infection theory is related to different general health conditions and in the early 20th century in Britain, the theory became applicated on dental diseases. Teeth in poor conditions could be one source that causes infections and diseases. The medical theory could be established by social and economic factors which had an outcome of the dental health (Dussault et al 1982). The focal infectious theory with an application to dental disease was developed by a British doctor, William Hunter. He wanted to visualize the relation between medical theory and its correlation to social and economic factors (Coulther 1977). His work visualized the relations between infections in the mouth and other diseases in organs of the body, and that teeth in poor condition was one important part of other infections. Hunters research became accepted by dentists in Britain at first, but evidence against the theory created doubts about his claims (Easlick et al 1951).

In 1940, Reimann and Havens published critique of the theory of focal infections with the arguments that it has not been proved and that infectious agents are unknown. However, in modern times we know that oral microorganisms and oral diseases can be responsible for other infections and diseases, this gave dentistry larger participation in dental care. The focus of infections has been described and limited to areas where pathogenic microorganisms can occur, and the most common place is in the tonsils, oral cavity or sinuses (Pallasch et al 2000). Teeth are most vulnerable to septic infections because of their relation to structure and their close relation to the bone (Dussault 1982).

If the bacteria from the oral cavity can transfer to other organs in the body has not been seriously tested, and the evidence of a relation in oral microorganisms and other diseases is limited. Mostly because there is an absence of studies in the aim and that there can be methodological difficulties to test this kind of clinical study (Pallasch et al 2000). However, the focal infection theory might explain diseases that are poorly understood. Theoretically, a bacterium that is nonvirulent can become virulent and cause systemic diseases and change location to target other organs. Clinical applications provided a drift to remove all focal infections to provide from getting other systemic diseases (Rosenow et al 1918).

The theory of focal infection was abandoned because it was non-scientific. However, recently periodontal medicine has provided evidence that there is a relation between periodontitis and systematic diseases. The focal infection theory has re-emerged, because of the new evidence of pathogenic microorganisms (Rivolo 2019). Developments have been made in the focal infection theory due to new techniques to identify and classify microorganisms. Investigations have shown that there are over 1000 bacterial species in the oral environment and that each individual has around 200 different species in their oral microbiome. Thanks to the new techniques the focal theory has re-emerged and we have learned that not all diseases occur from a local infection, chronic infections do exist in the oral environment and in other parts of the body, and that focal infection can result in other diseases (Kumar 2013).

This theory of focal infection is interesting due to a paleopathological perspective of general health. In addition to getting knowledge in which factors affected the occurrence of caries that can give an increased understanding of who is at greater risk of suffering from illness. The relation between caries and focal infection theory can mean that the individuals that are more exposed to dental caries are at greater risk to get other infections in the body. Vilhelm-Møller-Christensen (1982) studied material from the Æbelholt convent and he meant, for example, that arthritic changes could be a secondary infection that had begun in the oral environment, especially from dental diseases. The focal infection theory was one explanation for the cause of inflammatory rheumatic diseases. Møller-Christensen (1982) saw a relation in teeth afflicted with caries and joint diseases in the Æbelholt material.

4.2 Evolutionary Theory

"Whether we realize it or not, we carry in our mouths the legacy of our evolution" (Ungar 2017).

For modern humans to understand why we walk upright and do not have the same amount of body hair as apes, evolutionary anthropology has to explain how evolution changed the human body and mind. By reconstructing the path of prehistoric humans, we can get information about the cause of evolution. To understand evolution, scientists from different disciplines need to cooperate. Paleoanthropologists together with biological and earth sciences, social sciences and particularly archaeologists and cultural anthropologists are interdependent. Fossilized bones and archaeological materials are important for our history, especially for chronological patterns. However methodological and technical developments are important in paleoecology and molecular biology (Henke 2008:118ff).

Darwin has taken on evolution by the theories of natural selection and sexual selection (Henke 2008:121). Darwin meant that by natural selection each organic being is slowly changing, rejecting the bad developments and preserves the good. The sexual selection is not a battle within different specimens, instead, it is a battle within the individual sex. The better adapted individuals survive which results in a reproduction of the individuals best adapted to the environment, survival of the fittest (Darwin 1902:76f; Brace 1979:41; Darwin 1981:253ff). Darwin's theory about sexual selection (where the strongest and/or most attractive to the opposite sex succeeds to reproduce) has been shown to apply to prehistorical humans through archaeological finds as well (Landquist 1959:104ff).

The development in tooth size and the understanding of human evolution is a known subject. We understand that humans have developed over time, the question is why? What made the tooth size in hominins decrease? From investigating the difference in diet and the role of the environment with help from a geologist named Charles Kimberlin Brain (1953), they could in

1960 see a correlation between the change of diet and human tooth size (Le Gros 1955:180; Brace 1962:351f; Ungar 2017:71ff).

The change of diet had an impact on the evolution of hominins. The diet of hunter-gathering populations contained coarse and tough food, which made it necessary to have strong jaws in order to chew it. When farming became more explored, the diet contained more calories due to the increase of cereals and root vegetables that contains rich carbohydrate. The invention of pottery could soften the food by boiling it, which made it much easier to chew, and thus, the jaw did not need the same strength as before. The diet has effects on the jaws and teeth. During childhood, the development of the jaw depends on the chewing force. The chewing is important for the facial muscles, bones and the alignment of the teeth. The maxilla and mandible grow in response to the muscular activity, and the changes form a coarse diet to a soft diet would actively reduce the size of the jaws. Therefore, in line with the jaws, the teeth would respond by reducing in size (Calcagno & Gibson 1988:510).

The expose to infectious agents such as parasites, bacteria, and viruses, have resulted in a wide range of different infectious diseases during the evolution of hominins. The chronic infectious diseases leave evidence on the skeleton and are well documented. Through bioarchaeological investigations, the appearance and spread of infectious diseases depend on the interrelation between social, cultural and environmental situations. The risk of infectious diseases, together with the impact on the affected population, as well as the consequences for the pathogen, are all a result of evolution. The growing number of studies on prehistoric populations, their origins, and evolution of infectious diseases from a biocultural background helps us to understand our health and outcomes in modern times (Larsen 2015:66). We are the living product of human evolution (Henke 2008:120).

4.3 Osteological Paradox

The problem with an osteological material is that we only study the humans that did pass away and not the humans of the living society. The osteological paradox by Wood et al. (1992) discusses the underlying problems of osteological research. The problems are selective mortality, hidden heterogeneity, and demographic nonstationarity. Selective mortality means that we only study the individuals that died at a certain age and not the individuals that perhaps had been at risk of death or disease at a certain age but survived. This means that the frequency of diseases overrates the true frequency of diseases in the populations. The problem of hidden heterogeneity is that the prehistorical societies were built on different types of individuals and that they all had different susceptibilities to diseases and death. It could depend on genetic causes, socio-economic conditions, microenvironmental variations, or trends in health. The hidden heterogeneity makes it hard to do an interpretation of the specific age of death and the individual risk of death. Demographic nonstationarity refers to a population in a stationary state where migration, age-specific fertility and mortality are common. However, in a nonstationary population, the distribution of the age of death is more sensitive to changes in fertility than to changes in mortality. This means that life expectancies or the age of death should be measured by fertility and not in mortality (Wood et al 1992:344f).

The osteological paradox has to be taken into consideration for analysis. An individual that has manifestations of disease on the skeleton may have been healthier than an individual with no visible lesions. This means that an individual which did die of a disease did not develop visible alterations on the bones. But an individual that did survive a disease developed visible lesions on the bones (Wood et al 1992:345).

5. Material

From a total of 3000 graves, a sample of 200 individuals was examined from S:t Clemens cemetery 9. The material is housed at the museum Kulturen in Lund. A random selection from the well-preserved individuals was made. The examination of the material has been limited to an analysis of the molar teeth. This choice was made to determine the occurrence and the impact of caries since the molar teeth are often well-preserved and tend to be more afflicted by caries. All the preserved molar teeth of an individual were measured and examined for the presence of caries. The criteria for the inclusion of the teeth were that the individual was adult or *maturus*, and that the third molar, if it existed, was fully erupted. The analysis was not made from the individual perspective, but that from the teeth. Therefore, it did not matter if all the molar teeth were not preserved. The preservation of the individuals varied. In some cases, where the teeth were black, and it was difficult to determine the frequency of caries the individual was excluded. The teeth could not have high attrition and there were cases when a tooth displaying severe caries had to be excluded, because of the absence of enamel and the resulting risk for errors in measurement.

The material has been dated based on the different grave types (to c. 990-1050 AD). Some of the individuals that have been buried in a coffin, provided well-preserved skeletons. Teeth are, however, easy to lose during excavation if they are loose in the jaws.

5.1 Taphonomy

The preservation of osteological materials depends on a number of taphonomic factors. The preservation can vary depending on burial conditions; if the individual was buried in a coffin or directly in the soil. The soil has a huge impact on how well-preserved the skeleton will be. During the medieval period, the population were for the first time buried in cemeteries and there were rules about who and how the different people should be buried (Magnell 2008:128). The taphonomic factors influencing the breakdown of soft tissues and skeleton are temperature, humidity, oxygen and pH value. The majority of the individuals from S:t Clemens were buried in the soil, but some were buried in coffins. This has made the material quite well-preserved and has not been exposed to a great taphonomical impact. However, the archaeological excavation in itself is an important taphonomic factor, and the osteological material may be damaged if not excavated with care (Magnell 2008:144).

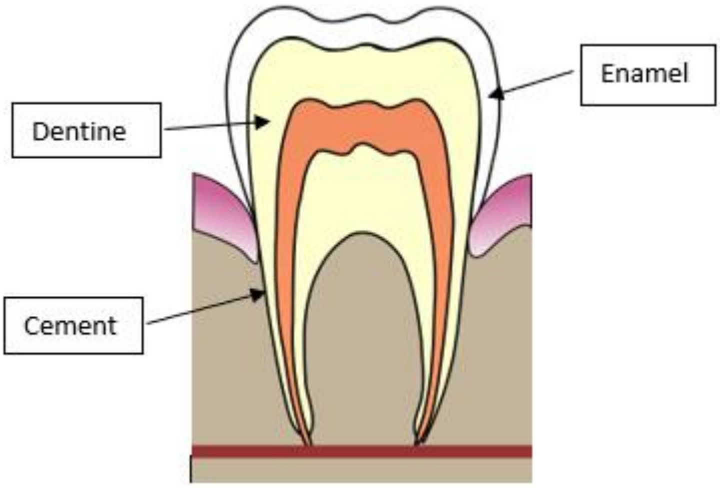

Fig 2. Tooth intersection from Wikimedia.org. Visualizing the enamel, dentine and cement.

The tooth is often a part of the body that is well preserved in organic archaeological materials. The part of the tooth that is usually the least affected is the enamel structure (fig 2), however, the enamel can be lost in acid soil and the organic remains of the dentine may survive instead. The dentine is a little softer than the enamel but if the dentine becomes fracturing, it can cause destruction in the enamel. It can be hard to visualize the destructed dentine only with the eye, but in light of a microscope, the changes in the mineralization can be visible. The cement of the tooth is a thin layer on the surface of the root. It often cracks and detached from the dentine and the surface of the root gets exposed (Hillson 1996:181ff). The teeth survive because they are the hardest tissue in the body and can resist against chemicals. However, once they have been excavated from the ground, the teeth are in need of care. If the teeth are in the jaws the cleaning has to be carefully preformed. The jaw tends to be fragmented during excavations and the teeth can easily be lost (Roberts & Manchester 1995:44f). Therefore, it is grateful to study teeth due to the lack of taphonomical impacts. In the material from S:t Clemens, the majority of the teeth where *in situ*. Some teeth had cracked enamel and there were teeth that had become black which was a taphonomical factor. However, these teeth or individuals was excluded from the study due to the importance of the measurements and dental caries. I chose to only include the individuals with teeth that were well-preserved.

6. Method

The intent of the analysis in this thesis is to establish age and sex, record tooth measurements, and to evaluate occurrence and severity of caries. The material has previously been examined by Caroline Arcini (1999), where a determination of age and sex of the individuals was made. Arcini has shared her determinations of the individuals. Although the documentations of age and sex were shared, about 100 of the individuals have been determined by me and then compared to Arcini's determinations.

6.1 Age

The individual was only classified as adult or *maturus*. A more specific age determination was irrelevant for the purpose of this study and juvenile individuals have been excluded. An individual was determined as adult or *maturus* if the third molar was fully erupted and the majority of the epiphyses were fused. For the osteological interpretation, the osteological paradox has to be considered. The inclusion of young individuals would have skewed the results of the analyses since juvenile individuals have not been exposed to the causes for caries for as long as an adult or *maturus* individual have. Also, adult and *maturus* individuals will be separated because of the mortality (Wood et al 1992:343). The osteological paradox is further presented in the chapter on theory (see chapter 4.3).

To establish the age range of the individuals pictures illustrating age phases of the pubic symphysis published by Todd (1920) has been used. Also, the pubic symphysis scoring system according to Brooks and Suchey (1990) as well, displaying casts on the development of age-specific degenerative changes of the pubic symphysis useful to establish the age.

The scoring system of the auricular surface by Lovejoy et al. (1985) has been used as a compliment to establish age. In this model, there are pictures and descriptions of how the auricular surface changes according to age. One similar model has also been used; the age estimation from the auricular surface of the ilium by Buckberry and Chamberlain (2002) where they describe the surface of the auricular. By investigating and classifying the different characters of the auricular surface into a scoring system, then multiplying the points and displaying the total sum in a chart, an approximate age can be determined. Both Lovejoy and Buckberry and Chamberlain were used to establish the age, because of their similar but still different methods.

Although the methods are old and difficult to use, because of the determinations are limited to only adult and *maturus*, they are deemed sufficient to give an approximate age on the individuals. The category of adults includes individuals between the age of 20-40 years and the category of the *maturus* individuals of the age of 40+.

6.2 Sex

The most reliable element for determining sex are hip bones. There are different characters of the pelvic bones that can be used. The pubic region (after Phenice 1969; Buikstra & Mielke 1985) has characterizing features such as the ventral arc, subpubic concavity, and the ischiopubic ramus ridge. The greater sciatic notch tends to be wide in females and narrow in males, scored according to a system with 5 different forms; where 1 is female and 5 is male (after Milner 1992; Buikstra & Ubelaker 1994). In addition to these features, the preauricular sulcus appears more often in females than males.

The second method for establishing the sex used is based on different characters of the cranium that indicates if the individual is a female or male (published by Buikstra and Ubelaker (1994). The cranium of a male is often generally more robust and display features that are more robust than females. You can determine the gender by looking at the nuchal crest in the lateral profile of the occipital, the mastoid process, orbital margin, glabella supraorbital ridge, and the mental eminence. If all these characters are deemed comparatively small in size, it is more likely a female and if they are distinct, the individual is more likely a male.

For the most accurate result, a combination of the determination of the pelvic bones and cranium should be used to determine sex. However, there are difficulties to establish sex because of the individual differences that can complicate the result. Using these methods, the result can show male, probably male, female, probably female or unidentified.

6.3 Tooth measurements

The following tooth dimensions were recorded, mesial-distal diameter and buccal-lingual diameter over the occlusal surface of the molar teeth (fig 3). All the preserved molar teeth have been measured with a caliper, the measurements were recorded with two decimals for the closest result of the size. The accuracy of the measurement is +- 0,03mm. When still present in the jaw measuring the teeth have proven difficult, especially if the neighbouring tooth was close. Also, the state of preservation of the teeth has been important. If the tooth was worn the measurement would have been inaccurate. With this in mind, the measurements were done as precise as they could be.

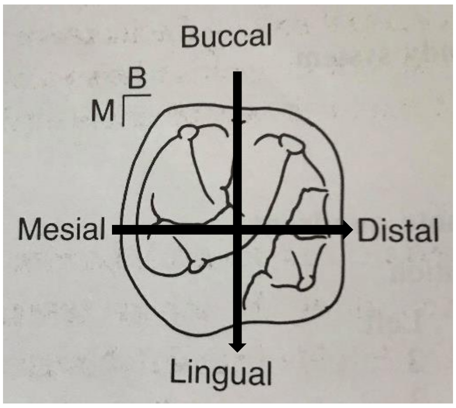

Fig 3, The measurements Mesial-Distal and Buccal-Lingual.

6.4 Caries evaluation

The evaluation of caries has been established from a scoring system, where 0 = no caries, 1 = low frequency of caries, 2 = high frequency of caries and 9 = can’t be evaluated (fig 4). The purpose of this thesis is to establish if the tooth has been afflicted by caries or not. Therefore, this system only evaluates the low or high frequency of caries. For the determination of caries, the tooth has been brushed, calculus have been removed, and in order to distinguish between wear and caries a magnifying glass has been used. However, caries diagnosis is dependent on the observer’s experience. It is possible that some afflicted teeth have been overlooked, depending on the evaluation of caries. The first sign should be a deep cavity and it isn’t until the enamel has collapsed that a diagnosis can be made (Hillson 1996:272). In this thesis, the cavity had to be visible for it to be determined as caries.

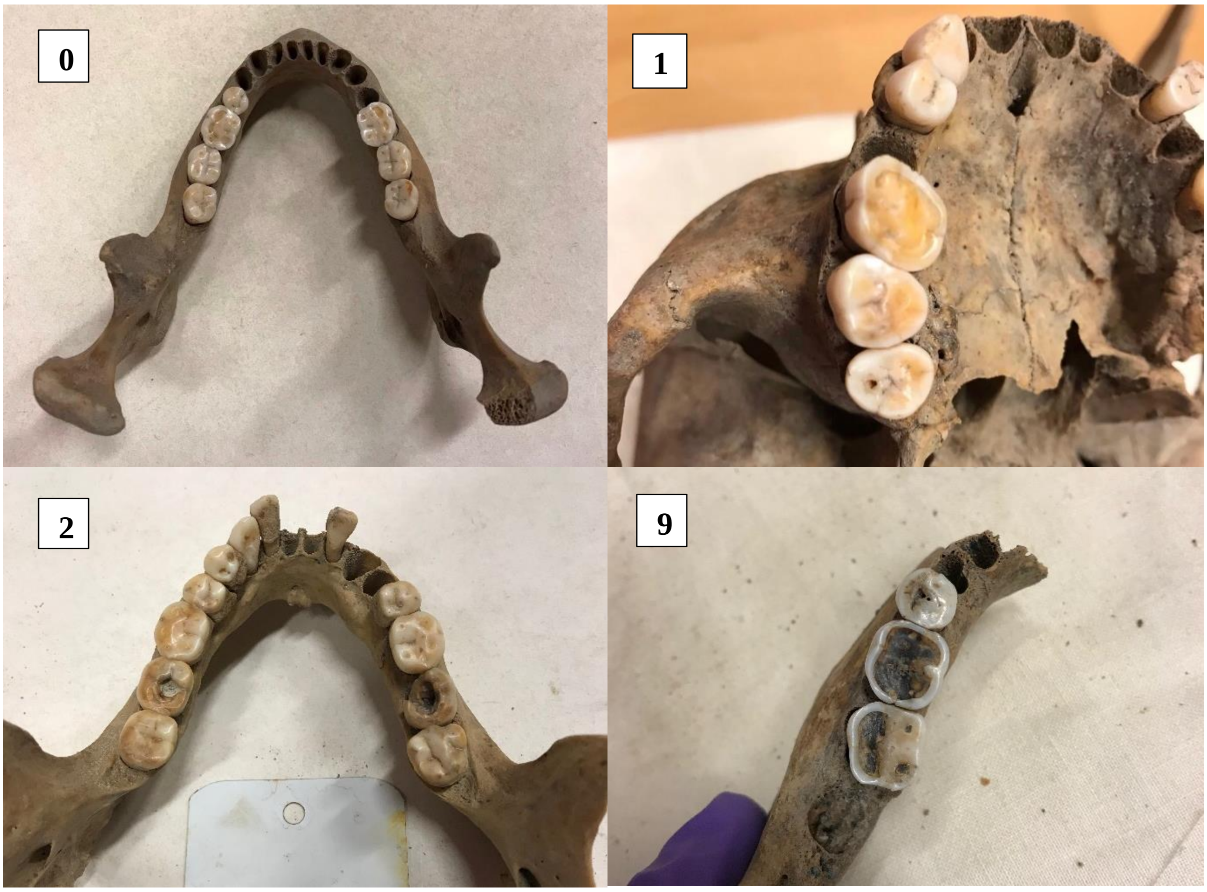

Fig 4, Caries evaluation. 0=no caries, 1=low frequency of caries, 2=high frequency of caries and 9=can't be evaluated.

7. Analysis

There are 86 females, 104 males and 10 individuals with unidentified sex that has been examined for this thesis. The total number of adults was 169 and the total number of *maturus* were 31 individuals. Of the adults, there were 105 individuals that were afflicted with caries and of the *maturus* there were 20 individuals afflicted with caries. However, I have chosen to not do the analysis on the individual level, instead, the analysis has been made on a teeth level. The total number of female teeth was 831 and there were 167 teeth afflicted with caries. The total number of male teeth was 918 and there were 176 teeth afflicted with caries. Thereby, the total number of teeth that have been examined for this thesis is 1491 teeth.

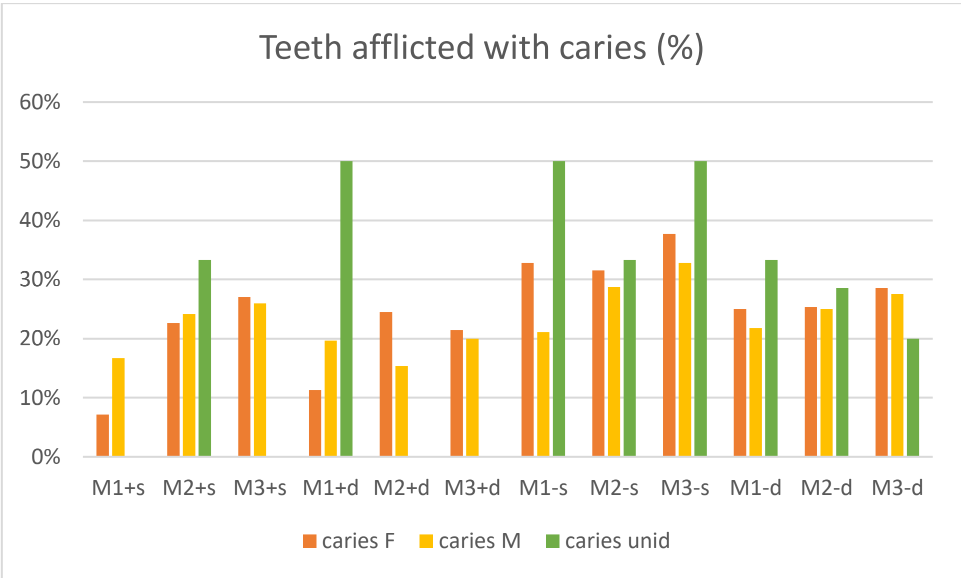

Fig 5, Teeth afflicted with caries in %. +=superior/upper -=inferior/lower. S=sinister/left d=dexter/right.

To visualize the percentage of teeth afflicted with caries in the different sexes, this diagram was made (fig 5). The percent of individuals with unidentified sex is high because of the low total number of individuals. Fig 5 shows that females have a higher frequency of caries than males; 9 out of 12 molars being affected.

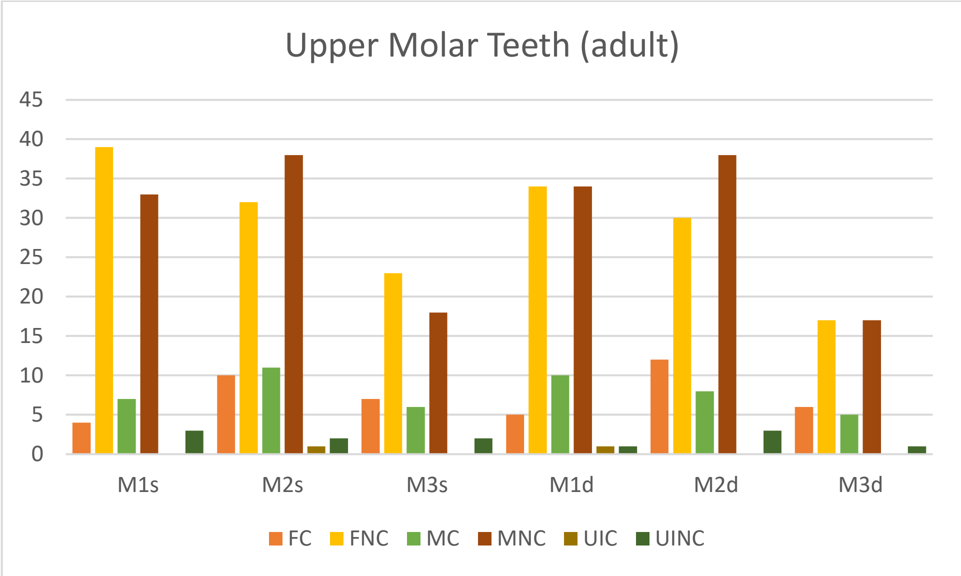

Fig 6, The upper molar teeth with and without caries in adults. FC= Females with caries, FNC= Females with no caries, MC= Males with caries, MNC= Males with no caries, UIC= unidentified with caries and UINC= unidentified with no caries. s= sinister/left, d=dexter/right.

The result of teeth with caries and with no caries from the upper jaw is displayed in fig 4. There is a low frequency of caries in all the upper molar teeth. The females have a higher frequency of caries on M3s (sin), M2d (dex), and M3d while the males have a higher frequency of caries on M1s, M2s and M1d. Still, there is a lower frequency of caries on the upper molar teeth in both sexes. The teeth of the individuals with unidentified sex are few and in fig 6, the percentage are regarded as more representative than in fig 5. There is a low frequency of caries in individuals with unidentified sex.

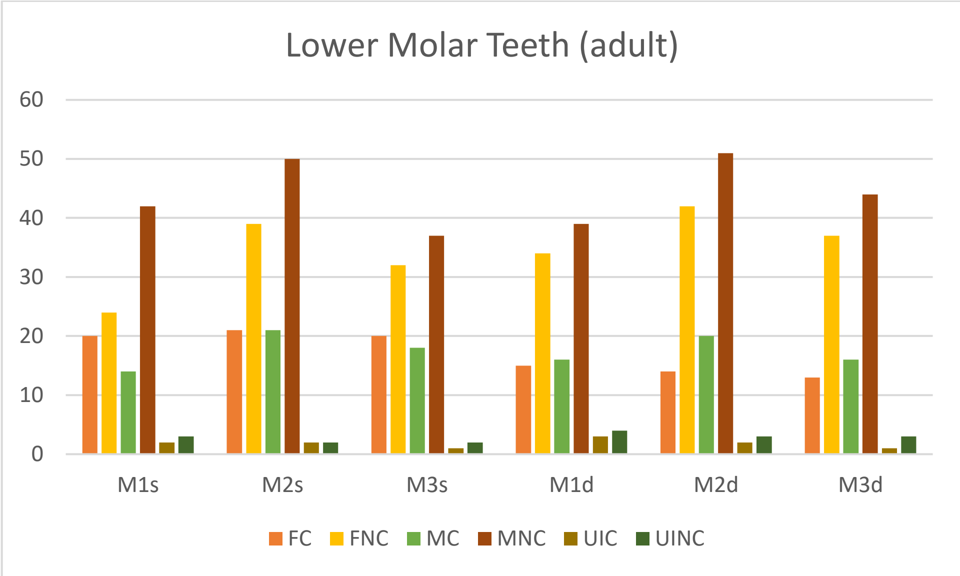

Fig 7, The lower molar teeth with and without caries in adults. FC= Females with caries, FNC= Females with no caries, MC= Males with caries, MNC= Males with no caries, UIC= unidentified with caries and UINC= unidentified with no caries. s=sinister/left, d=dexter/right.

A difference exists between teeth afflicted with caries in the lower jaw (fig 7), and the teeth afflicted with caries in the upper jaw (see fig 6), in both females and males. Among the females, there are around 5-13 teeth afflicted with caries in the different molar teeth in the upper jaw, and in the lower jaw, there are around 13-20 teeth afflicted with caries. Among the males, there are around 5-11 teeth afflicted with caries in the upper jaw, and in the lower jaw around 15-20 teeth afflicted with caries. There is a higher frequency of caries in females on M1s, M2s, and M3s, than the molars on the right (d) side. The males have a higher frequency of caries on M1d, M2d, and M3d than on the molars on the left (s) side. Also, here we can see that there is a low number of individuals with unidentified sex corresponding to a small number of molar teeth. There is a higher number of molar teeth from the lower jaw afflicted with caries among the unidentified individuals than molar teeth from the upper jaw (see fig 6).

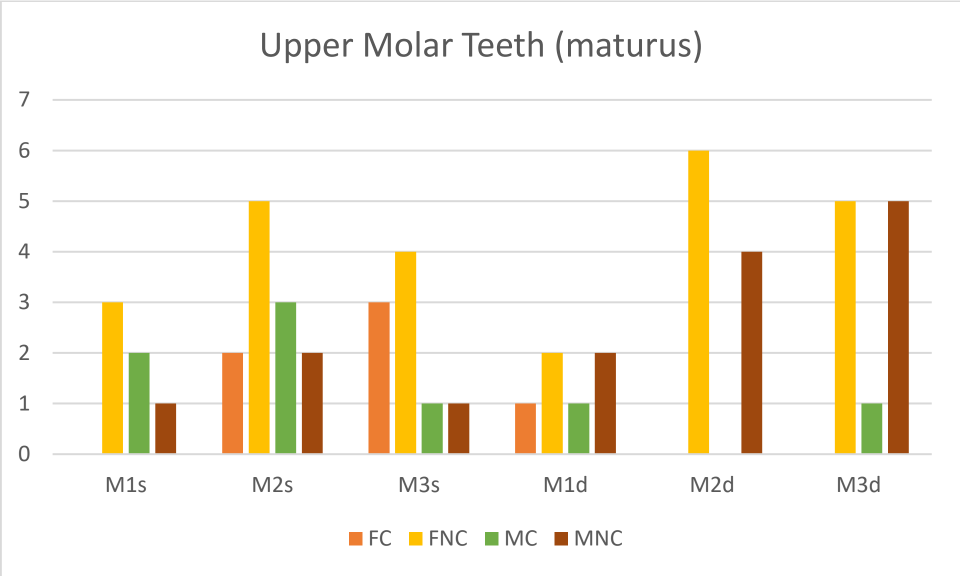

Fig 8, Upper molar teeth with and without caries (maturus). FC= Females with caries, FNC= Females with no caries, MC= Males with caries and MNC= Males with no caries. s=sinister/left, d=dexter/right.

There are 31 individuals that have been classified as *maturus* and in fig 8 we can see that there is a smaller number of teeth with caries and a higher number of teeth without caries among the females. Among the males, there is a higher number of teeth with caries on M1s and M2s. Because of the overall low number of upper molar teeth, it may seem like there is a large difference between the number of teeth with caries and without caries. But among the females, there is only a difference of between 1-3 teeth in M2s, M3s, and M1d. Among the males, there is only a difference of 1 tooth in M1s, M2s, and M1d, but in M3d the difference is made up of 4 teeth.

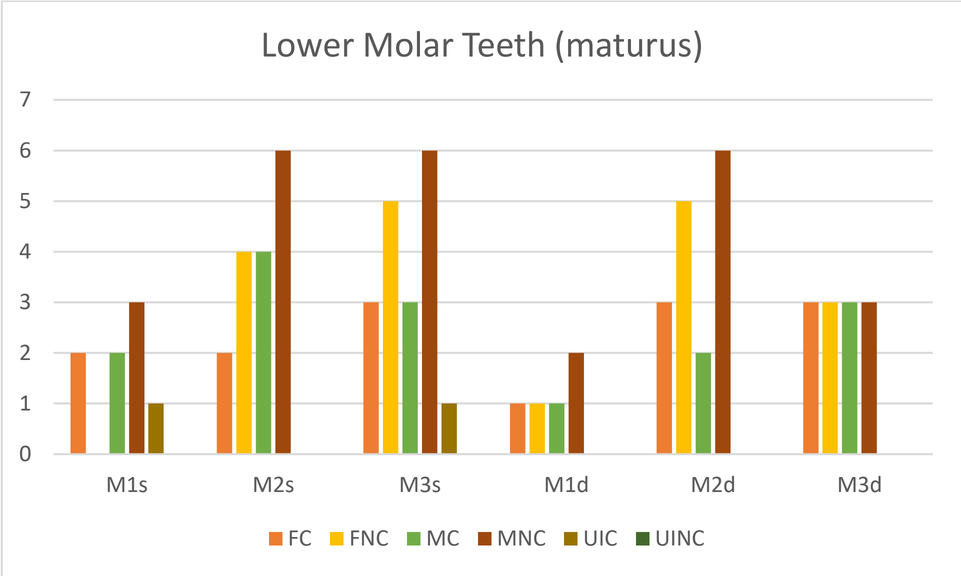

Fig 9, Teeth with and without caries in the lower molar teeth (maturus). FC= Females with caries, FNC= Females with no caries, MC= Males with caries, MNC= Males with no caries, UIC= unidentified with caries, UINC= Unidentified with no caries. s=sinister/left, d=dexter/right.

There is an even frequency of caries among females and males except for M2s and M2d. On M2s, M3s, and M2d there is a higher frequency of no caries among both females and males (fig 9). The difference in frequency of caries among the upper molar teeth (see fig 8) and the lower molar teeth (see fig 9) is not significantly large.

To see if it were possible to include both adults and *maturus* as one category in the statistical analysis a 2-sample test for equality of proportions with continuity correction was made, called proportion t-test. The test was made in the program R-3.5.3 (32/64 bit). The purpose was to test the 0-hypothesis to see if there were no differences in the proportion of dental caries between adults and *maturus*. Proportions show a statistically significant difference if the p-value is under 0.05 which gives the result a 95% probability and the 0-hypothesis can be rejected. The p-value of the t-test was 0.520 which is not statistically significant. This means that I can include both adults and *maturus* in the same statistical analysis of the molar teeth because there is no difference between the ages. The same test was carried out to explore the differences between the sexes. The p-value for this test was 0,665 which is not statistically significant. This meant that I could include both females and males in the analysis.

To investigate whether larger teeth are more afflicted with caries than smaller teeth an Analysis of Variance (ANOVA) was made in excel. An ANOVA is a statistical method for testing a hypothesis and can be used to analyze differences in the average and variance between two or more populations, in this study, the relation between the groups of the frequency of caries and measurements. It was not deemed necessary to consider the different sides of the molar teeth separately. Therefore, all molars from one side of the jaw (for example, all the M1sup (upper)), were clumped together. Since the purpose of the study was to see if the occurrence of caries is dependent on the tooth size (investigated through mesial-distal (MD) and buccal-lingual (BL) measurements) and not depending on the different sides of the oral cavity.

Table 1, Statistics of the ANOVA showing statistically significant difference in M1sup (MD), M1inf (BL), M2inf (MD&BL), M3sup (BL). P-value <0,05=*.

Teeth	Dependent variable	Groups of Caries	Quantity	Average	Variance	p-value	F-krit	F
M1sup	**MD**	0	152	10.75211	0.308541	0.001659*	3.045866	6.633393
		1	27	11.07926	0.27793			
		2	5	11.374	0.35428			
	BL	0	152	9.985	0.277834	0.367529	3.045866	1.00651
		1	27	10.13778	0.223295			
		2	5	9.996	0.10563			
M1inf	**MD**	0	152	10.23526	0.222634	0.056468	3.035617	2.910781
		1	65	10.36323	0.310997			
		2	13	10.03923	0.151658			
	BL	0	152	10.77546	0.404269	0.002258*	3.035617	6.259968
		1	65	10.792	0.424473			
		2	13	10.13231	0.452069			
M2sup	**MD**	0	159	10.6922	0.454778	0.075118	3.038877	2.620874
		1	44	10.94364	0.508889			
		2	10	10.59	0.325022			
	BL	0	159	9.127987	0.455926	0.245557	3.039085	1.413704
		1	44	9.313182	0.524478			
		2	10	9.057778	0.067419			
M2inf	**MD**	0	208	9.592019	0.317806	0.001671*	3.026257	6.534622
		1	78	9.859615	0.332713			
		2	13	9.766154	0.289842			
	BL	0	208	10.21202	0.45795	0.01167*	3.026257	4.518344
		1	78	10.42269	0.421467			

		2	13	10.62308	0.512306			
M3sup	**MD**	0	93	10.23151	0.561054	0.179555	3.072429	1.742296
		1	26	10.58154	1.169502			
		2	3	10.38667	2.392233			
	BL	0	93	8.514086	0.561944	0.033212	3.072429	3.504155
		1	26	8.901923	0.516904			
		2	3	9.153333	1.276633			
M3inf	**MD**	0	163	9.77908	0.518303	0.206457	3.032969	1.58795
		1	76	9.947105	0.456669			
		2	7	9.714286	0.170929			
	BL	0	163	10.47975	0.66638	0.087383	3.032969	2.462073
		1	76	10.68039	0.568111			
		2	7	10.16	0.2971			

In table 1, the p-values of MD and BL are presented. For a statistically significant difference the p-value has to be under 0,05. We can see that it is only the MD of M1sup that have a statistically significant difference. In M1inf, it is the measure BL that is statistically significant with a p-value of 0,0022. M2inf was significant in both MD and BL. M2sup and M3inf were not statistically significant. In M3sup, the measure BL was statistically significant with a p-value of 0,0332

In summary, M1sup has a significant difference in the MD measure, the M1inf has a significant difference in the BL measure. M2inf is the only teeth that have a significant difference within both MD and BL measurements and, M3sup has a significant difference in the BL measure. The teeth that did not show a significant difference were M2sup and M3inf. This means that these two groups of teeth did not show any relation between caries and tooth size.

Table 2, T-test with a Bonferroni adjustment of the ANOVA results. 0= no caries, 1=low frequency of caries and 2=high frequency of caries. Sup=upper, inf=lower, MD=mesial-distal and BL=buccal-lingual.

0-1			**0-2**		**1-2**	
M1sup (MD)	0	1	0	2	1	2
Average	10.75211	11.07926	10.75211	11.374	11.07926	11.374
Variance	0.308541	0.27793	0.308541	0.35428	0.27793	0.35428
P-value	0.005526		0.082617		0.348253	

M1inf (BL)						
Average	10.77546	10.792	10.77546	10.13231	10.792	10.13231
Variance	0.404269	0.424473	0.404269	0.452069	0.424473	0.452069
P-value	0.863317		0.005015		0.004753	
M2inf (MD)						
Average	9.592019	9.859615	9.592019	9.766154	9.859615	9.766154
Variance	0.317806	0.332713	0.317806	0.289842	0.332713	0.289842
P-value	0.000596		0.278203		0.573836	
M2inf (BL)						
Average	10.21202	10.42269	10.21202	10.62308	10.42269	10.62308
Variance	0.45795	0.421467	0.45795	0.512306	0.421467	0.512306
P-value	0.016955		0.065051		0.358841	
M3sup (BL)						
Average	8.514086	8.901923	8.514086	9.153333	8.901923	9.153333
Variance	8.901923	0.516904	0.561944	1.276633	0.516904	1.276633
P-value	0.020582		0.433164		0.742608	

A post-hoc test (t-test) of the ANOVA result was carried out for between all groups to see if there is a significant difference between them. Then a Bonferroni adjustment was carried out to test the problem of multiple comparisons. The Bonferroni adjustment is based on the p-value that show if there is a significant difference. In this case, the p-value had to be under 0,05, and then that p-value is divided with the groups (0,1,2). The Bonferroni adjustment is 0,05/3=0,01667, this means that the p-value of the t-tests of the groups (0-1,0-2,1-2) has to be under 0,01667 for a statistically significant difference. M1sup (MD) showed a significant difference between the groups 0-1 (table 2) with a p-value of 0.0055. M1inf (BL) displayed a significant difference in both 0-2 with a p-value of 0.0050 and in 1-2 with a p-value of 0.0047. M2inf (MD) showed a significant difference in 0-1 with a p-value of 0.0005, while M2inf (BL) did not have any significant differences between the groups. Neither did M3sup (BL), with no significant difference between the groups.

To visualise the trends in the relation between caries and tooth size, the sample was plotted. A boxplot was made for each tooth group with a significant difference. The females and males were plotted due to the caries evaluation. The area of each tooth was calculated in order to visualize the difference in tooth size and frequency of caries.

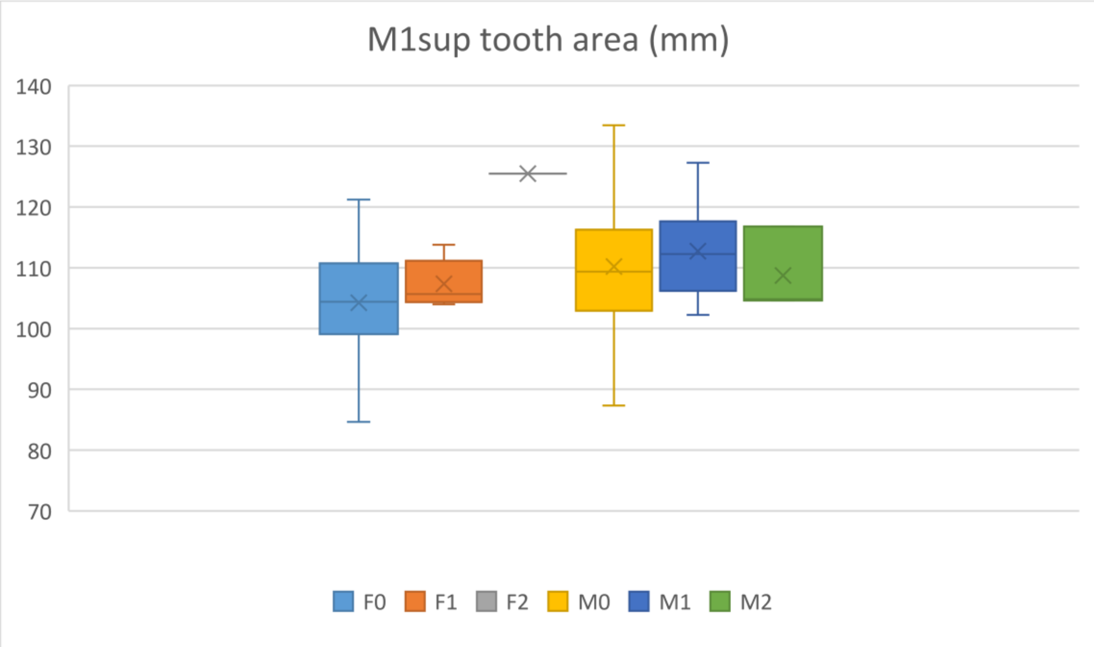

Fig 10, Boxplot of the M1sup (upper). F0=females teeth with no caries, F1=females teeth with low frequency of caries, F2=females teeth with high frequency of caries, M0=males teeth with no caries, M1=males teeth with low frequency of caries, M2=males teeth with high frequency of caries

On M1sup it was only the MD measurement that was statistically significant with a p-value of 0,0016. Among the females, the teeth afflicted with caries is among the larger teeth. However, there are larger teeth that is not afflicted with caries as well (fig 10). Among the males, the teeth with a low frequency of caries are among the large teeth, but there are teeth with a high frequency of caries that are smaller. Still, it clear that the smallest teeth are not afflicted with caries.

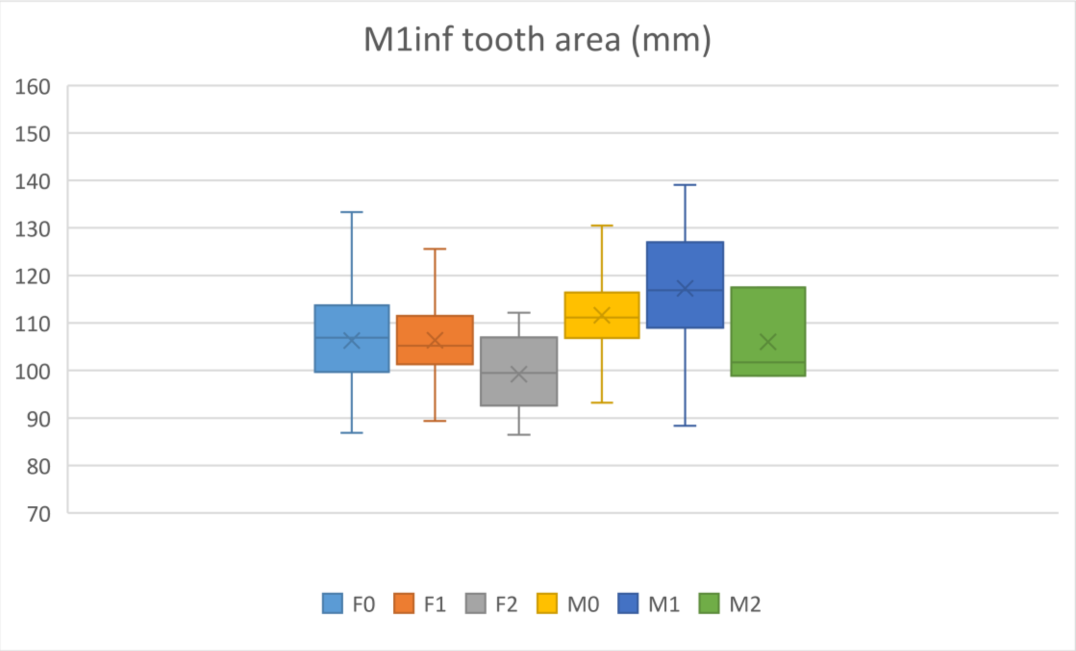

Fig 11, Boxplot of the M1inf (lower). F0=females teeth with no caries, F1=females teeth with low frequency of caries, F2=females teeth with high frequency of caries, M0=males teeth with no caries, M1=males teeth with low frequency of caries, M2=males teeth with high frequency of caries

On M1inf it was only the BL measurement that displayed a statistically significant difference with a p-value of 0,0022. There are a few smaller teeth that are afflicted with caries, but the majority of the afflicted teeth are large (fig 11). A difference between females and males exist; there are smaller teeth afflicted with caries among the females, yet only a few teeth. The majority of teeth afflicted with caries in both sexes are the larger teeth.

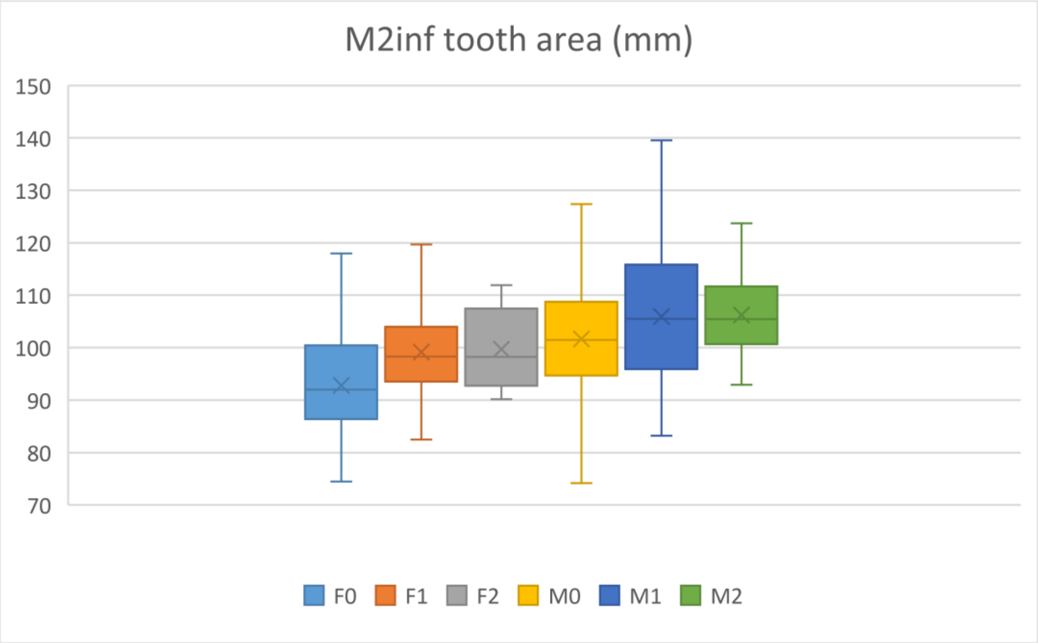

Fig 12, Boxplot of the M2inf (lower). F0=females teeth with no caries, F1=females teeth with low frequency of caries, F2=females teeth with high frequency of caries, M0=males teeth with no caries, M1=males teeth with low frequency of caries, M2=males teeth with high frequency of caries

In M2inf, both measurements displayed a statistically significant difference. MD with a p-value of 0,0016 and BL with a p-value of 0,0116. It is, thereby, apparent that the majority of teeth afflicted with caries are large and that there are only a few smaller teeth with caries (fig 12).

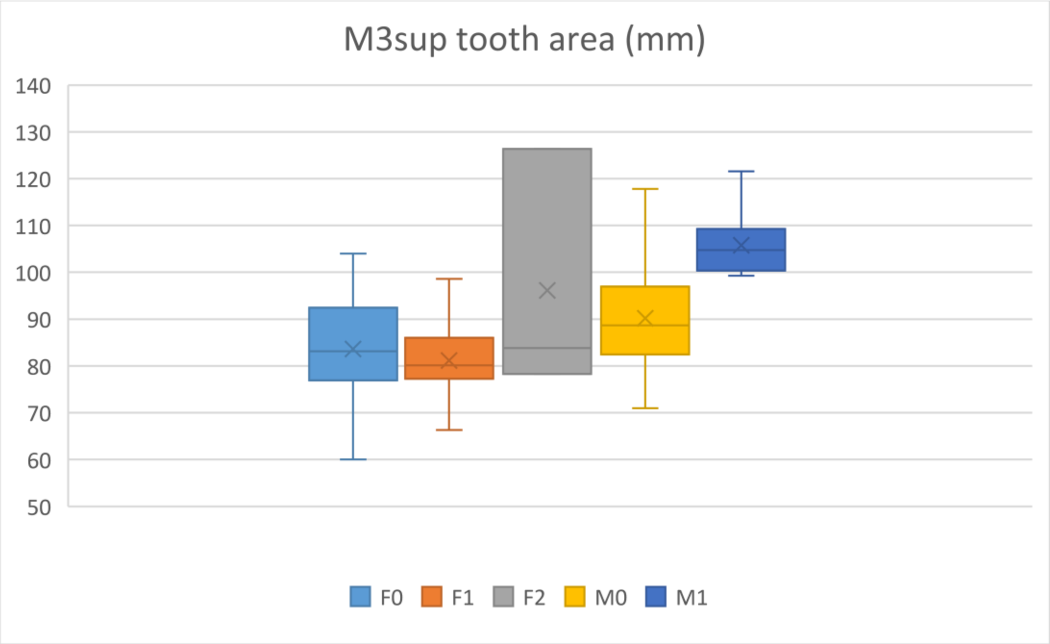

Fig 13, Boxplot of the M3sup (upper). F0=females teeth with no caries, F1=females teeth with low frequency of caries, F2=females teeth with high frequency of caries, M0=males teeth with no caries, M1=males teeth with low frequency of caries.

For M3sup, it was only the BL measurement that had a statistically significant difference. We can see that there is a difference in size between females and males (fig 13). Within the female group, the larger teeth are afflicted with caries to a greater extent even if the teeth overall are smaller than the male's teeth. Also, among the male's teeth, it is the larger teeth that are afflicted with caries.

Considering all the statistically significant differences between caries and the various measurements on the teeth, it is clear that there is a relation between the size of the tooth and the frequency of caries. However, it was only 4 out of 6 groups of molar teeth that showed a statistically significant difference in the ANOVA test.

8. Discussion

The purpose of this thesis was to investigate the hypothesis if larger teeth are more afflicted with caries than smaller teeth and if there was a difference between females and males. Are the larger teeth more afflicted with caries in both sexes? I chose to examine only the molar teeth because they are often more afflicted with caries and this is because of their complex morphology, having more fissures and pits. The hypothesis has previously been tested on materials from the Mesolithic and Neolithic Age. I used material from Medieval Lund to see if the larger teeth in this material are more afflicted with caries. A total number of 200 individuals have been examined and a total number of 1491 molar teeth, including the wisdom teeth (M3), if present, were examined. There was not a statistically significant difference between females and males, and the size does matter in relation to dental caries.

In the analysis, we can see that females are more afflicted with caries than males. In 9 out of 12 molar teeth, females have a higher occurrence of caries than males. Among the adult individuals, there is a difference between the upper molar teeth and the lower molar teeth. There are more teeth afflicted with caries among the lower molar teeth, in both females and males. Among the upper molar teeth, the females have a higher frequency of caries on 3 of the molar teeth (M3s, M2d, M3d) and the males have a higher frequency on the 3 of the molar teeth, though not overlapping with the occurrence in female molar teeth (M1s, M2s, M1d). Also, among the lower molar teeth, the females have a higher frequency of caries on 3 of the molar teeth (M1s, M2s, M3s) and the males have a higher frequency of caries on three different molar teeth (M1d, M2d, M3d).

Among the *maturus* individuals, there was not a significant difference between teeth with no caries and teeth with caries. Because of the low number of individuals, there were not a lot of teeth included in the analysis. Of the upper molar teeth there is only a minor difference (encompassing 1-3 teeth) between those with caries and those without caries among the females. Among the males the difference encompassed 1-4 teeth. The lower molar teeth have an even frequency of caries among both sexes. The largest difference of the frequency of caries is between the upper molar teeth and the lower molar teeth (see fig 8 & 9). The low number of molar teeth among *maturus* individuals is probably a result of the high frequency of attrition and tooth loss.

A t-test of adults and *maturus* was made to see if there was a difference between the frequency of caries, which would warrant them being considered separately or if both groups could be included in the same ANOVA-test in order to increase the sample size. From the result it was concluded that there was not statistically significant difference, and both could be grouped together. The same test was carried out to test for differences between females and males. This test did not show a statistically significant difference either and both sexes could be included in the same ANOVA-test. It is interesting that even if the females had a higher frequency of caries than the males, it was not a particularly large difference in relation to the t-test.

The result from the ANOVA-test was that M1sup (upper) had a statistically significant difference for the MD (mesial-distal) measurement, M1inf (lower) for the BL (buccal-lingual) measurement, M2inf for both MD and BL, and M3sup for the BL measurement. This means that these 4 molar teeth have a relation between the measurement and dental caries, while the other molar teeth (M2sup and M3inf) did not. However, this is interesting since it was only M1inf and M2inf that showed a statistically significant difference from the lower molar teeth and that M1sup and M3sup also showed a significant difference, despite the fact that it was the lower molar teeth that had a higher frequency of caries. It is more common for the lower molar teeth to get afflicted with caries (Bennike 1985). But there is a study showing that if the M1 and M2 are large, the M3 becomes smaller (Kieser et al 1985). It is a possibility that this coincides with my study, however, I have analysed the teeth dependent on tooth level and cannot see if large M1 and M2 has a relation to a small M3.

It is clear from the boxplots (fig 10-13), that the larger teeth have been afflicted with caries, among both females and males. By contrast, the smaller teeth have not been afflicted with caries. Among the M1inf, however, there are a few smaller teeth that have been afflicted with caries. But these smaller teeth are mostly teeth belonging to females. The conclusion is that the majority of teeth afflicted with caries are larger and we can see that there is a difference between the size of the teeth afflicted by caries in females and males.

In the boxplot for M2inf (fig 12), there is also a distinct difference in size between the sexes. The majority of the female's teeth are smaller than the male's teeth, but the teeth that are afflicted with caries are mostly the larger teeth. The larger teeth from males have a higher frequency of caries in this study. M2inf were the only teeth where both measurements were showing a statistically significant difference. In the boxplot for M3sup (fig 13), we can see that it is similar to the other boxplots. The female teeth are smaller overall compared with the males', but it is the larger teeth within both sex groups that have been afflicted with caries. All the boxplots show almost the same result; there is a statistically significant relation between caries and the size of the teeth.

Even though the teeth have gotten smaller through the course of human evolution, it is still the larger teeth that are more prone to develop caries. There is a difference in tooth size between females and males, but it is the larger teeth in both sex groups that are more afflicted with caries. Also, the result is showed between the sexes, indicating that females were afflicted with caries to a greater extent than the males, even though the difference between the sexes could not be established with statistical certainty in this study. There are other studies that show that females are more often afflicted by caries (Sagne 1976; Alexandersen 2008). The result showing no statistically verified significant difference between the sexes, the uneven number of males and females included in the analysis, and the resulting difference in the number of teeth between the sexes. The total number of female teeth was 831 (where 167 was afflicted by caries), and the total number of male teeth was 918 (where 176 afflicted by caries). If the total number of teeth had been evenly distributed between the sexes, maybe there would have been a significant difference.

Fissures and pits in the occlusal surface are the most common sites for caries to develop (Marsh et al 2016). Therefore, molar teeth are often more at risk to develop caries than other teeth. In the analysis, it was clear that larger teeth are more afflicted with caries than smaller teeth. In the post-hoc t-test with a Bonferroni adjustment of the ANOVA results (table 2), there was a significant difference in M1inf (BL) between the groups with scores 0-2 (no caries-high frequency of caries) and 1-2 (low frequency of caries-high frequency of caries). It is interesting that there is only a significant difference if the tooth had a high frequency of caries. The deciduous teeth are replaced by permanent teeth during childhood (Mays 1998:10) and of the molar teeth, DM1 is one of the first to become replaced by a permanent molar tooth. Therefore, M1 is exposed to the oral environment for a longer time than the other molar teeth, which can increase the risk for caries to develop. In M1sup (BL) and M2inf (MD), there was a significant difference between the teeth scored as 0 (no caries) and 1 (low frequency of caries). The reason why M1sup does not have a significant difference between 0-2 and 1-2 is probably because the lower jaw is the one more often afflicted with caries (Bennike 1985:157). In the material from S:t Clemens there are more teeth afflicted in the lower jaw than in the upper jaw, both in adults and *maturus*. But from the result of the ANOVA, the lower molar teeth did not show a majority of significant correlation between tooth size and occurrence of caries. This means that even if the lower molar teeth were more afflicted with caries, they don't have a stronger relation between size and caries than the upper molar teeth. It is possible that M3inf teeth in general are smaller than M1inf and M2inf. In modern times, it is not even sure that M3inf will develop and erupt due to the lack of space in the jaw.

If the total number of teeth had been more evenly distributed among the molar groups, maybe the result would be different for the ones that did not show a significant difference. The mesial-distal measurement of the M1inf had a p-value of 0.056, which is close to a significant difference. Because of the analysis on teeth level, it might have been good to have the same number of teeth in every group. It would, however, have taken more time to look for the individuals with a good dental condition. Unfortunately, there were many teeth that had a high degree of attrition or a greatly affected by caries which made the teeth unsuitable for metric analysis. Because tooth size was an important part of the analysis, these individuals had to be omitted from the study despite the fact that they displayed a large frequency of caries. Tooth loss *ante mortem* is one aspect that has to be considered. The tooth loss can be related to age, but also to dental diseases as caries. This means that there is a bias of the material from S:t Clemens. Teeth that may have been afflicted with a high frequency of caries is not present in the material due to tooth loss *ante mortem*. This can be recognized if there is an infilling of the sockets with new bone (Roberts & Manchester 1995:57). This means that there is a loss of teeth that could have increased the results of dental caries. However, if the tooth loss has been a result of severe dental caries, it is possible that they would have been unsuitable for metric analysis.

In addition, caries diagnosis is dependent on the experience of the observer (Libe-Harkort 2010:70; Tornberg 2018:77). Before the work for this thesis, I had never analysed caries, and it is possible that caries frequencies have been underestimated. For example, it can be difficult to distinguish caries from attrition if you have never analysed caries before. This is also the reason why I chose to only include the teeth where a cavity was present.

It is interesting that it is the larger teeth that are more afflicted with caries in light of the hypothesis concerning the changes to teeth through human evolution. There are different theories on why the teeth have reduced in size over time and caries has been proposed as one of the selective pressures leading to this reduction. Calcagno and Gibson (1988) presented the hypothesis that larger teeth are more afflicted with caries. Their theory proposes that pressure from caries may have caused a reduction of the teeth and, that the dental reduction, thereby, is a result of natural selection. If the dental reduction was a result of natural selection, why do modern humans get afflicted with caries? Natural selection, according to Darwin, favour traits that are advantageous for an organism’s survival and reproduction. Despite natural selection possibly favouring tooth sizes and morphology less prone to caries development, the frequency of caries has increased over time. In the material from S:t Clemens there is a high frequency of dental caries among both adults and *maturus*. Among the 169 adults, there were 105 individuals that were afflicted with caries and among the 31 *maturus*, there were 20 individuals afflicted with caries. This means that the prediction of the natural selection theory, stating that the prevalence of caries should be lower among recent populations (compared to earlier populations) where tooth size has been reduced through natural selection, cannot be unequivocally supported by the results of this study. What can be said for certain is that in the S:t Clemens material it was the larger teeth, in 4 out of 6 molar groups, that had been afflicted with caries. A variation in the size of teeth afflicted by caries was detectable in the material, but I believe that the size of the teeth is primarily dependent on the size of the jaw, which is individual. The morphology and tooth size are genetically regulated and the heredity is one of the most important influences (Brothwell 1981:114).

Larger teeth are most likely more exposed to dental caries and due to the focal infection theory, the individuals with larger teeth are more vulnerable for new infections. Hunter meant that the oral environment could increase other infectious diseases (Coulther 1977). The discussion about that new infections can be a cause from poorly teeth conditions can be related to the fact that teeth have a close relation to the bone and tissues, as gingival. The care of oral health is important, due to the information that caries can lead to death by the impacts of the infection on general health. The focal infection theory agrees on the knowledge of the spread of oral infections. If caries can lead to death, then it is a possibility that the infection can spread through the blood to new locations. Who is at greater risk of suffering from illness? In relation to this study, it should be individuals with larger teeth. Møller-Christensen (1982) showed that there was a relation between joint infections and dental caries from the Æbelholt convent. However, if these individuals had larger teeth than individuals with no caries is unknown. We cannot assume that the result of this study can be applied to other medieval materials. However, it would be interesting if the results were similar, this would mean that the individuals with larger teeth are more vulnerable to other infections. In relation to the natural selection and survival of the fittest, would it mean that individuals with poor dental conditions are at higher risk of mortality? Then the larger teeth would not be favorable to have. It is, in fact, the larger teeth that are in a higher risk of developing dental caries. Individuals with smaller teeth have a lower risk of developing caries, which means that they have a lower risk of developing other infectious diseases. The natural selection favours individuals that are more likely to survive. In correlation with the focal infection theory, the individuals with smaller teeth are more apt to survive. By studying focal infection theory and evolutionary theory from a biocultural background, we can get a greater understanding of health and diseases in prehistoric populations. We know that infectious agents have resulted in a wide range of different infectious diseases during evolution, and from the theory of focal infection, we get an understanding in how infectious diseases can spread from the oral environment to other parts in the body.

There are authors (for example Ahlström (2003), Anderson and Popovich (1977)) that oppose that dental reduction should have been caused by the selective pressure from dental caries, and Smith (1982) believe that the reduction of the jaw is, instead, related to a change of diet. It seems plausible that the reduction is related to diet since when the diet became soft, the strength of the larger jaw and muscles were no longer needed. The changes from a coarse diet to a soft diet would reduce the size of the jaw. When the jaw got smaller in size the teeth had to adapt to fit and this resulted in smaller teeth as well. However, the soft food got sticky and was more prone to get stuck in the complex morphology of the molar teeth. The shift in consumption to softened food, therefore, increased the occurrence of dental caries among populations (Cohen 1989:70). When we boil cereals, the carbohydrates break down into sugar. When this food gets stuck in the teeth it will lead to plaque forming which, in turn, can lead to dental caries developing. In modern times we know how to take care of our oral health, but from what I have seen during the analysis of the S:t Clemens material, the medieval populations did not have the same expertise in oral health care. This resulted in a high frequency of dental caries and tooth loss. Ahlström (2003) showed that larger teeth in materials from the Mesolithic and Neolithic periods were more afflicted by caries as well, despite ecofacts and stable isotopes indicating a hunting-fishing economy. However, this does not mean that the population did not have access to carbohydrates. This result is interesting in light of the material from S:t Clemens, where too it is the large teeth that are more frequently afflicted by caries.

Caroline Arcini discusses that the frequency of caries increased during the medieval period. Individuals in the late period (c.1300- 1536) had a higher frequency of caries than those from the early period. Arcini means that dental health declined over time. Even if the dental health declined it did not mean that the general health did so too. However, this statement does not agree with the focal infection theory, where we think that poor dental conditions can cause new infections. The change of diet is probably the reason why caries increased over time. Already in 1939, Mellquist and Sandberg saw a relation between caries and diet. As mentioned previously, the medieval materials from Halland, Scania, and Greenland showed different results in the frequency of caries, where Halland and Scania had a higher frequency than

Greenland. According to Mellquist and Sandberg, Scania was the main cereal producing district during the medieval period and that the frequency of caries increased as agriculture became more important for human subsistence. A diet containing cereal and sugar is one of the contributing factors to the development of caries according to Alexandersen (2008). It was not until 1945 a clinical study of the relationship between dental caries and sugar was initiated in Sweden (Krasse 2001:1785). For this, it is today known that caries is caused by sugar and carbohydrates. The archaeological evidence has shown that the diet in Sweden did not differ significantly from that in the rest of Europe during the middle age. This is so because animal bones, nuts, and seed corps are common finds during excavations, both in urban and rural areas. Meat was a luxury food item. By contrast, tubers and vegetables were some of the most common food sources during the medieval period, according to historical references. The most common beverage was beer or mead, which contains a high amount of carbohydrates (Harrison 2002:193ff). However, it is still difficult to determine the diet based solely on food remains (Roosevelt: 1984:565). It is the evidence of dental diseases that most closely can be associated to the diet, and we have evidence today that shows relations between carbohydrates and dental caries. This should mean that the diet contained carbohydrates during the medieval period. However, there are archaeological evidence that help us infer how earlier human populations took care of their oral health by chewing on sticks or using tooth-picks (Mays 1998:152). In comparison to the material from S:t Clemens, the diet containing a high amount of carbohydrates seems to be strongly connected to the teeth afflicted with caries. In light of the evidence of the diet during the medieval period, it is obvious from this study that the inhabitants from Lund were no exception. To be sure of what the diet looked like, stable isotope analysis could be used to infer the diet of these particular individuals. Based on the results from this study it is my conviction that food with carbohydrate was common among the individuals from S:t Clemens. There were teeth that were excluded because of the extensive damage resulting from caries, as I mentioned before, which means that there were additional teeth that possibly would have had an impact on the result by increasing the number of teeth afflicted with caries. The choice to exclude them was, however, based on the importance of the metric analysis, depending heavily on accurate measurements.

Females and males are believed to have had a similar diet during the medieval period and the increase of agriculture is believed to in part explain why the prevalence of dental caries increased through time. From the information about what the diet looked like, we assume that porridge from oat and barley, as well as and bread were the staple food sources for common people. This kind of food has a high cariogenic outcome (Arcini 1999), and the due to the consistency it can easily stick in the relatively complex morphology of the molar teeth. However, Brace & Ryan (1980) mean that the difference in tooth size between females and males can be a reflection of a difference in the diet. The reduction of teeth started in connection to the shifts in diet and the invention of tool making. As humans shifted from a subsistence based on hunting and gathering to an agricultural one, it is most probable that the diet changed for both sexes. However, before that, it is possible that the diet differed between males and females. Males may have had a diet with more meat than females to gain the strength in order to hunt. But if the differences in size are depending on diet, why is there a large difference in tooth size between females and males in modern populations of Europe? In the discussion about why females have a higher frequency of caries than males, the hormonal difference could be one contributing factor. The hormonal and genetic differences are in fact why females and males have a different body type. I think that it has to be the host of the teeth in relation to its body size that decides the size of the teeth. Kirveskari & Alvesalo (1982) means that the morphology of smaller teeth seems to be more simplified than on larger teeth. If this is the case, it is not strange that larger teeth with relatively more complex morphology, facilitating the aggregation of food residue on the teeth leading to an increased risk for dental caries.

Dorothy Lunt (1969) states that there is a difference in tooth size between populations and we can see in the analysis of the S:t Clemens material that there is also a size difference between females and males. The females generally tend to have smaller teeth than the males, but it is still the larger teeth within both sex groups that are afflicted by caries the most. The cranium of males tends to be more robust than the cranium of females (Buikstra & Ubelaker 1994), and we use characters of the cranium to determine the sex. The jaws of males are more robust than the jaws of females due to the size of the cranium. Tooth size can be helpful in determining the sex if the jaw has been fragmented because there is a variation between the shape and dimensions between sexes and populations (Brothwell 1981:111). Therefore, the difference in tooth size between the sexes in itself is not something odd. However, it is the larger teeth in both groups that are more afflicted with caries. The fact that females are more exposed to dental caries is not in their favour. When we applicate the focal infection theory on this fact, it would mean that females are at higher risk to get other infectious diseases. Even if the teeth of females are in general smaller than teeth of males, the analysis shows that the large teeth in both sexes are more often afflicted with caries. Females tend to get more afflicted with caries, but it was not a significant difference between females and males. Both sexes with large teeth are at greater risk of developing other infections. The difference between large and small teeth has to be studied within the individual sex. The ones with smaller teeth within the individual sex are the ones that are less afflicted with caries, which means, they are the ones with a greater chance to survive.

A general held belief why females have a higher frequency of caries is that caries can more easily develop during pregnancy. The argument is that the oral cavity is more often exposed to gastric acid. It is common that females suffer morning sickness during pregnancy and the acid from the stomach can erode the dental enamel (Boggess 2006; Silk et al 2008). Also, females change their diet and eat more during pregnancy. In a study comparing the development of caries in pregnant and non-pregnant patients from the US in 1999-2004 (Azofeifa et al 2016), there was no significant difference between the frequency in caries between the groups. However, in modern times we do have dental care that did not exist during the medieval period. Arcini (1999) and Darling (1970) mean that the evidence in favour of an increase of caries during pregnancy is weak. In the material from S:t Clemens the females have a higher frequency of dental caries in 9 out of 12 molar teeth. However, it is difficult to investigate the theory about increased dental caries during pregnancy in prehistorical materials. But from the information we have about consequences of pregnancy in relation to which factors that lead to an increase in caries, it may be an alternative theoretical explanation.

It can be difficult to compare modern clinical studies to a medieval material and we know how to avoid dental caries today. We know how important it is to brush our teeth and take care of our oral health. Silk (2008) suggests that pregnant females should brush their teeth every time they have thrown up. During the medieval period, the knowledge about what causes dental caries was probably non-existent, and it is possible that females did not take care of their dental health during pregnancy, or at all during their lifetime. Therefore, it is reasonable to assume that the frequency of caries increased as a result of increased risks from pregnancy. In addition, Maria Ferraro and Alexandre R. Vieira (2010) argue that pregnancies can have negative effects on oral health, because of the hormonal changes. Females experience different hormonal changes during their lifetime in connection with puberty, menstruation, and menopause. These experiences elevate the oestrogen levels and have been shown to have significant direct and indirect impacts on oral health, as the salivary flow and diet changes. The oral environment is the main contributing factor to the development of dental caries, and it is still a trend that females have a higher frequency of caries. This is in line with results from the study of the material from S:t Clemens where we can see that there is a higher frequency of caries among the females, and it is possible that the hormonal changes are the cause.

The establishment and spread of infectious diseases are dependent on social, cultural and environmental factors, and in relation to caries, it seems that these factors have a relation to why caries develop in larger teeth, both in females and males. The shift from a hunter-gathering society to an agricultural society, where both the cultural and environmental changes, has most probably impacted both the general and dental health. The change of diet could cause changes in the microbiota and due to the environmental changes, and people living closer together the risk of spreading infectious diseases could increase between individuals. According to the theory of focal infection, individuals with poor health conditions are at higher risk to develop other infectious diseases. Especially due to poor dental conditions where pathogenic microorganisms are more common (Pallasch et al 2000).

In this thesis, we have seen a relation between large molar teeth and dental caries, also, that there is a difference in tooth size between the sexes. Even if there is a difference between the sexes, it is the larger teeth that have been afflicted with caries. We have seen a reduction in tooth size due to evolution, however, the theory of natural selection and focal infection theory has to be correlated to visualize the bigger perspective. To only discuss the natural selection in relation to dental caries can be difficult. In relation to focal infection theory and the aspect of survival of the fittest, we can get a greater knowledge about who survived. Larger teeth have a disadvantage in relation to caries. Which should mean that individuals with large teeth are more prone to other infectious diseases.

There are some aspects that could be interesting for further research. Arcini (1999) shows that there is a difference between the frequency of caries during the early medieval period and the late medieval period. Therefore, it would be interesting to compare materials from different time periods to see if it is still the larger teeth that are afflicted with caries. Sugar is one factor that causes dental caries and it was during 1500 that sugar canes arrived in Europe. The first caries epidemic took place during 1500-1600 in Europe, and it was the people with good living conditions that had access to sugar (Roberts & Manchester 1995:50). Was it still the large teeth that became afflicted and/or did the sugar have a greater impact than only carbohydrate, so that the size of the tooth didn’t matter anymore? Unfortunately, it can be difficult to get access to large enough materials encompassing individuals that had a diet that contained sugar. Also, a comparison of tooth size and frequency of dental caries between individuals from a hunter-gathering population and a medieval population would be interesting. Has the morphology of the teeth changed in different time periods and is it the larger teeth that get more afflicted with caries? Has the difference in tooth size between sexes changed and is the frequency of caries related to living conditions?

This study can be developed due to the focal infection theory. It would be interesting to see if the individuals that had large teeth afflicted with caries has other evidence of infectious diseases. The theory approaches a relation between oral infections and other infections in the body and we know that Møller-Christensen (1982) saw relations in the material from the Æbelholt convent. Therefore, from the knowledge I have today about the focal infection theory and that larger teeth are more afflicted with caries, further research would be to analysis the individuals with caries in relation to infectious diseases that are visible on the bones. From a bioarchaeological perspective, and stable isotopes, it would be possible to get the knowledge of diet among the population. What did the inhabitants in Lund eat? Could there be a difference in diet between urban and rural populations in Medieval Scania? There are many different opportunities for further research.

9. Conclusion

The aim of this thesis was to test the hypothesis if larger teeth were more afflicted with caries than smaller teeth and if there was a difference between females and males. An investigation of tooth size and the frequency of caries conducted based on a medieval material from S:t Clemens cemetery in Lund. The result from the ANOVA test showed a statistically significant difference in M1sup (MD), M1inf (BL), M2inf (MD+BL), and M3sup (BL). This means that there is a relation between the size of the tooth and dental caries. There was a difference in the frequency of caries between the upper and lower molars, but the difference was not statistically significant. Why the larger teeth get more afflicted with caries is probably related to an increase of a diet rich in carbohydrates, coupled with a lack of oral health care during the medieval period. The tissues of the teeth decompose by fermentation of carbohydrates by bacteria, and it is more common that fissures and pits on the crown get afflicted. This makes it possible for dental caries to develop on the occlusal surface (Marsh et al 2016). We know that caries is caused by the consumption of carbohydrates and sugar because of "the sugar experiment" in 1945. Alongside the reduction in tooth size through human evolution, shifts in diet and development of tool technology took place. The shift from a coarse diet to a softer one facilitated by the ability to process the food by using pottery. Heating the food would result in a more soft and sticky texture and could more easily get stuck on the surface of the teeth, which in turn could lead to dental caries. The larger molar teeth have a more complex morphology with fissures and pits while smaller teeth have a more simplified morphology. Due to focal infection theory and natural selection (survival of the fittest), large teeth would not be in anyone's favour. The individuals with large teeth are at greater risk to develop caries, which results in a greater risk of other infectious diseases. There was a difference in tooth size between females and males, but within each sex group, it was the larger teeth that were afflicted with caries. It is common that females are more afflicted with caries probably caused by hormones, and that the host of the oral environment is the main contributing factor to modify the tooth size and develop dental caries. In conclusion, does size matter? Yes, it does.

10. Summary

The aim of this thesis was to investigate if there is a relation between tooth size and dental caries. The questions were if larger teeth are more afflicted with caries, and if there was a difference between females and males. We know that dental caries is one of the most common dental diseases in humankind due to that the infectious diseases leave evidence as dense spots and large cavities on the surface of the tooth (Roberts & Manchester 1995:45). Molar teeth are more exposed to caries because of its morphology of fissures and pits. It is easier for food to get stuck and they can be difficult to keep clean.

Dental caries is caused by acid produced by bacteria in the dental plaque that can break down the enamel and dentine of the tooth. Dental caries is associated with a diet containing sugar or carbohydrates. There is evidence of a rise in dental caries during the middle age, due to the revolution of agriculture (Hillson 1996:283).

The reduction of tooth size has been documented and there are different theories explaining why the teeth became smaller. Some may argue for the change of diet and the development in technology such as pottery (Brace et al 1991), while others argue that the reduction is caused by pressure from dental caries (Calcagno et al 1988). However, dental caries has been studied in medieval materials from Sweden, indicating that caries increased over time (Hillson 1996; Alexandersen 2008; Roberts et al 2012).

The material that has been analyzed is from S:t Clemens cemetery in Lund and is dated to c.990-1050 AD, excavated in 1984. From a total of 3000 graves, a sample of 200 individuals was exanimated with a limitation of only analyze the molar teeth. The measurements that have been taken are mesial-distal and buccal-lingual. The evaluation of caries has been established from a scoring system.

The analysis resulted in that 4 out of 6 molar teeth showed a statistically significant difference, which means that there is a relation between tooth size and dental caries. There is a difference in tooth size between females and males, however, it is the larger teeth in both sexes that are afflicted with caries. Larger teeth have a more complexed morphology while smaller teeth have a more simplified morphology. Due to the increase of agriculture, and the technology of pottery, the food could be heated. This resulted in a stickier consistency that could easily get stuck in the morphology of the teeth. The large teeth would not be advantageous due to the focal infection theory and evolutionary theory.

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Appendix

Measurements in mm. 1 =female, 1? =probably female, 2 =male and 2? =probably male.

M1sup **M1inf**

MD	BL	Caries	Sex	Age	MD	BL	Caries	Sex	Age
10,44	10,37	0	2	Adult	10,32	10,48	0	2	Adult
11,62	10,61	9	2	Adult	9,8	9,74	9	1	Adult
10,77	9,58	0	2	Adult	11,23	11,56	0	2	Adult
11,81	11,01	9	2	Adult	9,82	9,81	0	2	Adult
10,89	10,81	0	2	Adult	11,36	12,24	1	2	Adult
11,44	7,45	9	2	Maturus	9,72	9,32	9	2	Adult
11,11	9,89	9	1?	Adult	10,69	11,05	1	2	Adult
10,71	7,53	9	1?	Maturus	10	9,72	9	1	Adult
10,84	10,13	1	2	Maturus	9,08	8,87	9	2	Maturus
10,96	10,32	0	2	Adult	10,28	10,39	9	1?	Adult
10,27	9,54	0	2?	Adult	9,92	10,43	9	1?	Maturus
11,19	10,4	0	2	Adult	8,51	9,29	9	1?	Maturus
9,65	9,36	0	1	Adult	11,13	10,34	9	2?	Adult
10,73	9,58	0	1	Adult	10,11	9,78	2	2	Maturus
12	10,8	0	1	Adult	10,29	11,49	9	2	Maturus
10,67	10,67	9	1	Adult	9,69	10,5	2	2	Adult
11,1	10,72	0	1	Adult	9,75	11,03	0	2?	Adult
10,69	9,93	0	1	Adult	9,89	10,25	0	1	Adult
11,41	10,88	0	2	Adult	9,7	9,5	2	1	Adult
10,77	10,09	0	2	Adult	11,13	11,77	9	2	Adult
9,9	9,41	0	1	Adult	10,26	10,4	0	2	Adult
10,05	10,44	0	1	Adult	9,7	10,1	0	1	Adult
10,94	9,96	0	1?	Adult	9,74	10,48	2	1	Adult
10,8	10,07	0	1	Adult	11,5	11,2	1	1	Adult
10,77	9,65	0	1	Adult	10,85	11,17	1	1	Adult
10,62	9,74	0	2	Adult	9,52	10,48	0	2	Adult
9,8	9,77	0	2?	Adult	9,89	11,39	0	1	Adult
11,66	9,35	9	1	Adult	11,04	11,75	0	0	Adult
10,16	8,33	0	1	Adult	10,69	10,99	2	2	Adult
10,73	9,78	1	1	Adult	10,47	11,25	0	2	Adult
10,58	10,79	0	1	Adult	10,29	10,63	0	2	Adult
9,6	9,1	0	2	Adult	10,07	10,4	1	1	Adult
10,9	9,99	0	2	Adult	10,29	10,49	9	1	Adult
11,4	10,48	0	2	Adult	10,06	10,79	0	2	Adult
10,34	9,72	0	2?	Adult	10,58	10,99	0	1	Adult
10,49	9,44	0	1	Adult	11,21	11,28	0	2?	Adult
10,76	10,74	0	2	Adult	10,63	11,86	9	2	Adult
10,34	9,5	0	1	Adult	10,19	10,89	9	1?	Adult

11,05	10,57	0	2	Adult	9,88	10,35	1	1	Adult
10,75	9,45	0	2	Maturus	10,46	10,54	0	2	Adult
10,38	9,67	9	2?	Adult	10,06	11,08	0	1	Adult
9,93	10,12	0	2	Adult	10,11	10,86	0	2	Adult
10,43	10,2	1	1	Adult	9,7	9,9	9	1	Adult
9,77	8,81	0	1	Adult	10,01	10,4	0	2?	Adult
12,08	11,51	9	2	Adult	10,17	9,95	9	1	Adult
10,35	10,04	0	1	Adult	9,59	10,34	9	2?	Adult
10,87	10,66	0	2	Adult	10,58	11,98	0	2	Adult
10,58	11,05	1	1	Adult	9,97	10,24	0	1	Adult
11,33	9,38	9	2	Adult	10,41	10,21	9	1	Adult
10,7	10,71	1	2	Adult	10,31	11,17	0	1	Adult
10,65	9,51	9	1	Adult	10,67	11,34	0	2	Adult
11,86	10,71	1	2	Adult	10,33	11	0	2	Maturus
10,26	9,95	0	1	Adult	10,54	10,5	0	2	Adult
10,78	9,95	0	1	Adult	10,55	10,87	0	2	Adult
11,47	10,24	0	2	Adult	10,13	10,39	0	2?	Adult
10,9	10,32	0	0	Adult	9,9	9,96	1	1	Adult
11,07	10,3	0	2	Adult	10,77	11,09	0	2	Adult
11,39	10,09	0	2	Adult	10,57	10,89	9	1	Adult
10,18	10,1	0	1	Adult	9,74	10,92	0	1	Adult
10,48	9,83	1	2	Adult	10,43	10,75	0	2	Adult
10,5	9,6	0	2	Adult	10,44	9,9	9	2	Maturus
11,27	10,62	0	0	Adult	9,85	10,06	9	2?	Adult
10	9,19	0	1	Adult	9,6	10,64	0	2	Adult
10,24	9,61	0	1?	Adult	10,38	10,68	9	1	Adult
10,64	10,03	0	1	Adult	10,32	10,42	0	2?	Adult
10,07	10,37	0	2	Adult	9,1	10,28	1	1	Adult
10,84	9,53	9	1	Adult	11,69	11,79	9	2	Adult
12,1	10,41	1	2	Adult	10,24	11,15	0	1	Adult
10,38	9,77	0	1	Adult	10,66	10,78	1	2	Adult
9,68	9,21	0	1	Adult	9,78	10,07	9	1	Adult
12,08	10,28	0	2	Adult	9,96	10,84	1	1	Adult
10,83	10,16	0	0	Adult	10,05	9,92	0	1	Adult
10,69	8,96	9	1	Maturus	10,77	11,02	1	2	Adult
10,32	10,23	0	1	Adult	11,42	11,73	1	2	Adult
11,4	11,63	0	2	Adult	10,16	10,17	1	1	Adult
10,17	9,66	0	1	Adult	10,1	10,67	0	2	Adult
10,88	10,19	0	1	Maturus	10,47	10,55	9	2	Adult
9,42	9,22	0	1	Adult	10,67	10,66	0	1	Adult
11,3	9,6	1	1	Adult	11,04	11,53	9	2	Adult
10,58	9,22	0	2?	Adult	10,62	11,02	1	0	Adult
9,9	10,2	0	1	Maturus	10,41	11,22	1	2	Adult
10,46	10,53	1	2	Adult	10,38	11,22	0	2	Adult
10,59	9,35	0	1?	Adult	10,91	11,96	0	2	Adult

10,59	10,14	0	1	Adult	9,99	10,86	0	1	Adult
11,04	10,82	1	2	Adult	10,11	10,78	0	2	Adult
10,74	10,01	0	2	Adult	10,24	11,53	0	2	Adult
10,27	10,12	0	1?	Adult	9,83	9,47	2	1	Adult
10,9	10,49	0	2	Adult	9,48	8,79	1	0	Maturus
11,75	9,79	0	2?	Adult	10,05	10,91	0	2	Adult
11,08	9,23	1	2?	Maturus	9,61	9	2	1	Adult
10,68	10,35	0	2	Adult	9,8	10,91	0	1?	Adult
10,89	10	0	1?	Adult	10,14	10,8	1	1	Adult
9,71	10,14	0	2	Adult	10,14	10,17	0	2?	Adult
11,38	11,33	9	2	Adult	10,11	10,78	1	2	Adult
11,1	10,09	9	2	Adult	10,05	9,97	9	1	Adult
11,18	10,07	9	2	Maturus	9,77	10,67	0	1	Adult
10,58	9,48	9	1	Adult	9,84	9,74	0	2?	Maturus
11,3	8,99	9	2	Adult	8,97	9,9	0	1	Adult
10,95	10,08	0	1	Adult	10,66	10,5	2	1	Maturus
10,33	9,76	0	1	Adult	10,26	11,43	0	0	Adult
10,93	10,25	9	1	Adult	10,02	10,14	9	1	Maturus
10,71	9,75	0	1	Adult	10,62	10,8	0	1	Adult
10,62	10,81	0	1	Adult	10,23	9,69	0	2	Maturus
11,61	9,63	0	1	Adult	10,87	12,12	0	2	Adult
10,81	9,85	0	1	Adult?	10,22	9,93	0	1	Adult
9,77	8,29	9	1	Maturus	9,73	9,53	0	1	Adult
11,05	10,59	0	2	Adult	10,61	10,95	0	2	Adult
11,73	10,03	1	2	Adult	10,04	10,3	9	2?	Adult
10,39	10,6	0	1	Adult	10,14	11,04	1	1	Maturus
10,98	10,65	0	2	Adult	10,09	10,36	1	1	Adult
10,91	9,85	0	2?	Adult	10,29	11,08	0	2	Adult
11,06	10,3	0	2	Adult	10,07	10,96	0	2	Adult
11,74	10,66	9	2	Adult	9,81	10,36	0	1?	Adult
10,68	9,16	9	2	Adult	10,16	10,7	0	2	Adult
11,17	10,59	9	2	Adult	10,5	10,73	1	2?	Adult
11,14	10,88	0	2	Adult	10,26	10	0	1	Adult
11,32	10,05	9	2	Adult	10,32	10,43	9	1?	Adult
10,74	9,83	9	1?	Adult	10,16	10,16	0	2	Adult
10,91	9,36	9	1?	Maturus	10,33	10,32	0	0	Adult
10,61	10,19	9	2	Maturus	10,9	10,82	9	2	Adult
11,02	10,07	0	1?	Adult	10,37	10,97	9	2	Adult
10,73	10,47	0	2	Adult	10,27	11,23	1	2	Maturus
11,52	9,61	0	2?	Adult	10,68	12	0	2	Adult
10,59	9,1	9	1	Adult	9,39	9,81	0	2	Adult
11,41	10,66	9	2	Adult	10,19	10,2	9	1	Adult
10,86	10,59	0	2	Adult	10,71	11,73	1	2	Adult
10	9,27	0	1	Adult	9,45	9,5	9	1	Adult
11,13	9,73	0	1	Adult	10,63	11,63	1	0	Adult

12,16	10,6	0	1	Adult	10,23	10,71	9	1	Adult
11,16	10,5	9	1	Adult	10,28	10,76	0	1	Adult
10,95	10,65	0	1	Adult	10,49	10,85	9	1	Adult
10,69	10,04	0	1	Adult	10,76	11,67	1	1	Adult
10,27	10,16	0	2	Adult	10,46	10,66	1	1	Adult
10,76	9,25	0	2?	Adult	11,25	10,86	1	2	Adult
10,85	9,66	2	2	Adult	10,83	10,64	0	2	Adult
10,66	9,74	0	1?	Adult	10,3	10,89	1	1	Adult
10,71	9,88	0	1	Adult	10,33	11,8	0	2	Adult
10,4	9,18	9	2	Adult	10,92	10,91	0	1	Adult
10,67	9,64	0	2	Adult	9,84	10,26	1	1	Adult
10,33	9,56	0	2?	Adult	9,5	9,46	9	1	Maturus
11,11	9,93	9	1	Adult	10	10,52	1	1	Adult
10,44	8,96	0	1	Adult	10,45	11,62	0	2	Adult
10,87	9,65	1	1	Adult	10,35	10,58	1	2	Adult
10,73	10,42	0	1	Adult	10,24	10,7	1	1	Adult
10,08	9,01	0	2	Adult	10,32	11,17	0	2	Adult
10,97	9,9	0	2	Adult	10,4	10,44	0	2?	Adult
11,86	10,05	0	2	Adult	10,16	10,48	0	2	Adult
10,72	9,95	0	2?	Adult	9,66	9,82	9	1	Adult
11,12	10,53	0	2	Adult	12,1	11,58	0	2	Adult
10,52	9,44	0	1	Adult	11,31	11,88	0	2	Adult
10,92	10,02	0	2	Adult	10,29	10,68	1	2	Adult
11,3	9,4	1	2	Adult	8,08	9,03	9	2	Maturus
10,93	9,3	0	2	Maturus	10,32	10,58	9	1?	Adult
10,28	9,68	0	2?	Adult	10,18	9,22	2	1?	Maturus
10,22	10,03	0	2	Adult	9,35	10,32	9	1?	Maturus
10,21	9,89	9	1	Adult	9,12	9,83	0	1	Adult
9,57	8,94	0	1	Adult	10,96	9,99	9	2?	Adult
11,51	10,07	1	2?	Adult	10,03	10,83	9	2	Maturus
12,01	10,98	0	2	Adult	10,32	10,95	0	2	Adult
10,7	9,76	0	1	Adult	9,83	11,06	1	2?	Adult
11,02	10,61	1	2	Adult	9,84	10,11	2	1	Adult
10,7	10,47	1	1	Adult	11,16	12,03	9	2	Adult
11,09	8,88	9	2	Adult	10,25	10,81	0	2	Adult
10,93	10	0	2	Adult	9,67	9,61	0	1	Adult
10,61	9,7	9	1	Adult	9,73	10,46	2	1	Adult
12,25	10,39	1	2	Adult	10,84	11,32	0	1	Adult
10,75	9,9	0	1	Adult	10,92	11,05	0	1	Adult
11,26	9,97	0	1	Adult	10,61	11,11	0	1	Adult
11,67	10,01	2	2	Adult	10,31	10,98	0	1	Adult
10,9	10,39	1	0	Adult	10,35	12,16	0	0	Adult
11,31	10,37	2	2	Adult	10,37	11,11	0	2	Adult
11,37	10,52	0	2	Adult	9,08	10,01	0	1	Adult
10,33	10,03	0	1	Adult	10,13	10,38	9	2?	Adult

11,4	9,97	0	1	Adult	10,23	10,53	0	2	Adult
10,83	9,72	0	2	Maturus	9,85	10,34	9	1	Adult
10,5	9,44	0	2	Adult	10,52	11,31	0	1	Adult
10,81	9,68	2	2	Adult	9,83	10,57	9	2	Adult
10,49	9,5	0	1	Adult	10,06	11,3	0	2?	Adult
10,83	9,62	1	1?	Adult	11	11,78	0	2	Adult
10,69	10,3	0	1	Adult	10,16	11,04	2	1?	Adult
10,93	9,45	1	2?	Adult	9,6	10,41	1	1	Adult
10,7	10,37	0	2	Adult	10,85	10,43	0	2	Adult
11,08	10,27	1	1	Adult	10,2	10,59	0	1	Adult
10,09	9,95	0	1	Adult	9,92	11,2	9	2	Adult
10,04	9,26	0	1	Adult	10,18	10,33	0	2	Adult
11,11	9,7	0	2	Adult	10,12	10,66	0	1	Adult
11,04	10,05	0	0	Adult	10,45	9,35	9	1	Adult
10,03	9,41	9	1	Maturus	10,23	10,59	0	2?	Adult
10,29	10,05	0	1	Adult	10,14	10,08	9	0	Adult
11,81	11,3	0	2	Adult	11,04	12,08	0	1	Adult
10,75	9,34	0	1	Maturus	10,99	11,52	0	2	Adult
9,76	9,05	0	1	Adult	9,55	10,5	9	2?	Adult
10,93	9,13	0	2?	Adult	10,55	9,98	1	2	Adult
9,86	9,94	0	1	Maturus	9,72	9,35	0	1	Adult
10,55	10,1	1	2	Adult	10,28	11,07	0	1	Adult
10,73	9,14	0	1?	Adult	10,51	11,72	0	2	Adult
12,23	10,26	2	1	Maturus	10,36	10,43	0	2	Maturus
10,74	9,79	0	1	Adult	9,87	10,27	9	2	Maturus
11,28	10,46	0	2	Adult	10,16	10,76	0	2	Adult
11,46	10,12	0	2	Adult	10,6	10,7	0	2	Adult
10,38	9,87	0	1?	Adult	9,78	10,04	1	1	Adult
11,07	9,83	0	2	Adult	10,73	10,63	0	2	Adult
11,44	8,5	9	2?	Maturus	10,69	10,4	9	1	Adult
10,81	9,82	0	2	Adult	9,85	10,72	0	1	Adult
11,34	10	0	1?	Adult	10,63	11,02	0	2	Adult
10,49	10,09	0	2	Adult	10,06	8,82	9	2	Maturus
11,56	9,83	0	2	Adult	9,62	10,48	0	2?	Adult
11,05	10,16	1	2	Maturus	9,63	10,03	0	2	Adult
10,53	9,35	9	1	Adult	9,9	11,11	9	1	Adult
11,61	10,04	0	1	Adult	10,58	10,59	9	2?	Adult
11,03	10,5	9	1	Adult	9,17	9,95	0	1	Adult
11,95	10,09	0	1	Adult	11,47	11,57	1	2	Adult
10,72	9,7	1	1	Adult	10,23	10,62	0	1	Adult
11,5	10,54	0	1	Adult	10,62	11,26	1	2	Adult
11,46	9,72	0	1	Adult	10	9,89	9	1	Adult
10,75	9,68	0	1	Adult?	9,81	10,82	1	1	Adult
10,39	8,56	9	1	Maturus	9,89	9,26	0	1	Adult
11,57	10,21	0	2	Adult	10,57	11,07	1	2	Adult

11,7	9,84	0	2	Adult	11,24	11,5	9	2	Adult
10,5	11	0	1	Adult	9,84	10,7	1	1	Adult
11,12	10,1	0	2	Adult	9,94	10,96	1	2	Adult
10,65	11,23	0	1?	Maturus	9,89	10,69	9	2	Adult
12,1	10,41	1	2	Adult	11,18	11,44	1	2	Adult
10,69	10,47	0	1	Adult	10,28	10,44	0	0	Adult
11,05	10,04	0	1	Adult	10,47	11,05	0	2	Adult
					10,31	10,81	0	2	Adult
					10,94	11,79	1	2	Adult
					9,66	10,42	0	1	Adult
					9,89	10,74	0	1	Adult
					9,8	10,53	0	2	Adult
					10,41	11,64	0	0	Adult
					10,16	10,55	0	2	Adult
					10,14	11,2	9	2	Adult
					10,09	9,96	9	0	Maturus
					9,88	10,8	0	2	Adult
					9,97	10,7	0	1?	Adult
					10,11	11,2	1	1	Adult
					9,93	10,15	0	2?	Adult
					10,1	10,7	1	2	Adult
					9,83	10,77	0	1	Adult
					9,07	9,85	1	1	Adult
					10,11	11,18	0	0	Adult
					10	9,64	9	1	Maturus
					9,39	9,41	1	2	Adult
					10,44	10,8	0	1	Adult
					9,75	9,96	9	2	Maturus
					10,8	12,37	0	2	Adult
					9,81	9,51	0	1	Adult
					9,55	9,58	0	1	Adult
					10,53	10,02	9	2	Adult
					9,44	10,6	9	2?	Adult
					9,78	10,92	0	1	Maturus
					10,82	11,16	9	1	Maturus
					10,43	9,48	1	0	Adult
					10,13	10,92	0	1	Adult
					10,24	11	1	2	Adult
					10,35	10,89	0	2	Adult
					9,55	10,25	0	1?	Adult
					10,15	11,09	0	2	Adult
					10,59	11,01	0	2?	Adult
					10,29	10,71	0	1	Adult
					9,68	9,01	9	2?	Maturus
					10,33	10,48	1	1?	Adult

					10,17	10,03	0	2	Adult
					11	9,41	1	2	Maturus
					10,09	10,58	1	0	Adult
					10,93	11,14	1	2	Adult
					10,36	10,95	9	2	Adult
					10,16	11,02	0	2	Maturus
					11,22	12,31	0	2	Adult
					9,49	10,23	0	2	Adult
					9,98	10,34	1	1	Adult
					11	11,32	0	2	Adult
					9,04	9,61	0	1	Adult
					10,78	12,05	1	0	Adult
					10,22	10,42	9	1	Adult
					10,17	11,22	0	1	Adult
					10,15	11,33	9	1	Adult
					10,3	10,79	0	1	Adult
					10,97	11,66	1	2	Adult
					10,29	10,88	0	2	Adult
					10,6	11,07	1	1	Adult
					10,28	11,82	0	2	Adult
					10,9	11	0	1	Adult
					10,58	10,72	9	2	Adult
					9,84	11,12	0	1	Adult
					9,73	10,6	1	1	Adult
					9,64	9,51	9	1	Maturus
					9,77	10,27	1	1	Adult
					10,33	11,3	0	2	Adult
					10,4	10,22	1	2	Adult
					10,22	10,9	1	1	Adult
					10,12	11,16	0	2	Adult
					10,13	9,2	0	2?	Adult
					9,82	10,03	0	1	Adult
					10	10,32	0	1	Adult
					11,24	11,35	1	2	Adult
					11,19	11,33	1	2	Adult
					10,73	10,6	0	1	Adult
					10,33	10,73	0	1	Adult

M2sup

MD	BL	Caries	Sex	Age
10,71	9,55	0	2	Adult
11,2	9,97	1	2	Adult
10,25	10,42	9	2	Adult
10,46	9,03	0	2	Adult
12,68	10,4	1	2	Adult
10,03	8,48	0	2	Adult
10,55	9,05	9	2	Maturus
10,57	9,48	1	2	Adult
11,88	10,14	0	1?	Adult
10,33	9,3	9	1?	Maturus
10,5	8,06	9	1?	Maturus
11,12	9,5	9	2?	Adult
10,51	8,83	1	2	Maturus
10,91	9,1	0	1?	Adult
10,56	9,74	0	2	Adult
10,31	9,15	0	1	Adult
11,65	9,47	0	2	Adult
10,23	9,3	0	1	Adult
11,87	9,46	0	1	Adult
10,58	9,02	0	1	Adult
11,28	10,47	0	1	Adult
11,25	8,53	0	1	Adult
11,13	9,75	1	2	Adult
10,93	10,08	0	2	Adult
9,46	8	0	1	Adult
10,38	7,72	0	1	Adult
10,19	8,84	1	1?	Adult
10,82	8,46	2	2	Adult
10,92	8,79	0	1	Adult
10,25	8,95	0	2?	Adult
10,64	8,82	9	1	Adult
9,76	8,33	0	1	Adult
9,83	8,02	1	1	Adult
10,9	10,08	0	1	Adult
10,77	9,72	0	2	Adult
9,47	9,25	0	2	Adult
12,28	7,73	0	2	Maturus
11,34	9,28	0	2	Adult
10,46	7,24	0	2?	Adult

M2inf

MD	BL	Caries	Sex	Age
10,71	9,55	0	2	Adult
11,2	9,97	1	2	Adult
10,25	10,42	9	2	Adult
10,46	9,03	0	2	Adult
12,68	10,4	1	2	Adult
10,03	8,48	0	2	Adult
10,55	9,05	9	2	Maturus
10,57	9,48	1	2	Adult
11,88	10,14	0	1?	Adult
10,33	9,3	9	1?	Maturus
10,5	8,06	9	1?	Maturus
11,12	9,5	9	2?	Adult
10,51	8,83	1	2	Maturus
10,91	9,1	0	1?	Adult
10,56	9,74	0	2	Adult
10,31	9,15	0	1	Adult
11,65	9,47	0	2	Adult
10,23	9,3	0	1	Adult
11,87	9,46	0	1	Adult
10,58	9,02	0	1	Adult
11,28	10,47	0	1	Adult
11,25	8,53	0	1	Adult
11,13	9,75	1	2	Adult
10,93	10,08	0	2	Adult
9,46	8	0	1	Adult
10,38	7,72	0	1	Adult
10,19	8,84	1	1?	Adult
10,82	8,46	2	2	Adult
10,92	8,79	0	1	Adult
10,25	8,95	0	2?	Adult
10,64	8,82	9	1	Adult
9,76	8,33	0	1	Adult
9,83	8,02	1	1	Adult
10,9	10,08	0	1	Adult
10,77	9,72	0	2	Adult
9,47	9,25	0	2	Adult
12,28	7,73	0	2	Maturus
11,34	9,28	0	2	Adult
10,46	7,24	0	2?	Adult

11,47	8,94	2	1	Adult	11,47	8,94	2	1	Adult
11,47	9,15	0	2	Adult	11,47	9,15	0	2	Adult
10,61	9,58	0	2	Adult	10,61	9,58	0	2	Adult
10,33	8,63	0	2	Adult	10,33	8,63	0	2	Adult
10,51	9,4	0	2?	Adult	10,51	9,4	0	2?	Adult
10,32	9,67	0	2	Adult	10,32	9,67	0	2	Adult
10,23	9,1	1	1	Adult	10,23	9,1	1	1	Adult
10,23	8,79	1	1	Adult	10,23	8,79	1	1	Adult
12,13	10	1	2	Adult	12,13	10	1	2	Adult
10,03	9,29	0	1	Adult	10,03	9,29	0	1	Adult
10,3	9,07	0	2	Adult	10,3	9,07	0	2	Adult
10,38	8,45	0	1	Adult	10,38	8,45	0	1	Adult
10,49	9,5	0	2	Adult	10,49	9,5	0	2	Adult
10,92	9,36	1	1	Adult	10,92	9,36	1	1	Adult
12,15	8,86	0	2	Adult	12,15	8,86	0	2	Adult
9,88	9,46	0	1	Adult	9,88	9,46	0	1	Adult
11,69	9,49	1	2	Adult	11,69	9,49	1	2	Adult
10,53	8,85	0	1	Maturus	10,53	8,85	0	1	Maturus
10,12	8,6	0	1	Adult	10,12	8,6	0	1	Adult
11,32	8,73	0	2	Adult	11,32	8,73	0	2	Adult
10,31	9,09	1	0	Adult	10,31	9,09	1	0	Adult
10,82	9,25	0	2	Adult	10,82	9,25	0	2	Adult
9,82	9,28	0	1	Adult	9,82	9,28	0	1	Adult
10,44	9,15	1	2	Adult	10,44	9,15	1	2	Adult
10,2	8,98	0	2	Adult	10,2	8,98	0	2	Adult
11,06	9,77	0	0	Adult	11,06	9,77	0	0	Adult
9,88	9,14	2	1	Adult	9,88	9,14	2	1	Adult
10,39	9,06	0	1?	Adult	10,39	9,06	0	1?	Adult
11,11	8,66	0	1	Adult	11,11	8,66	0	1	Adult
11,11	9,45	0	2	Maturus	11,11	9,45	0	2	Maturus
10,32	7,92	1	2	Adult	10,32	7,92	1	2	Adult
10,04	8,3	0	1	Adult	10,04	8,3	0	1	Adult
9,83	7,5	0	1	Adult	9,83	7,5	0	1	Adult
11,78	8,49	0	2	Adult	11,78	8,49	0	2	Adult
10,77	9,24	0	0	Adult	10,77	9,24	0	0	Adult
11,14	9,01	1	1	Maturus	11,14	9,01	1	1	Maturus
10,84	8,61	0	1	Adult	10,84	8,61	0	1	Adult
11,2	9,42	0	2	Adult	11,2	9,42	0	2	Adult
11,02	8,98	0	1	Maturus	11,02	8,98	0	1	Maturus
8,93	8,26	0	1	Adult	8,93	8,26	0	1	Adult
11,2	9,3	0	1	Adult	11,2	9,3	0	1	Adult
10,5	9,44	0	2?	Adult	10,5	9,44	0	2?	Adult
9,8	9,4	0	1	Maturus	9,8	9,4	0	1	Maturus
10,72	9,47	0	2	Adult	10,72	9,47	0	2	Adult
11,08	9,15	0	2	Adult	11,08	9,15	0	2	Adult

11,89	8,33	0	2	Adult	11,89	8,33	0	2	Adult
9,8	9,3	0	1?	Adult	9,8	9,3	0	1?	Adult
10,79	9,34	0	2	Adult	10,79	9,34	0	2	Adult
11,3	9,75	1	2?	Adult	11,3	9,75	1	2?	Adult
11,31	9,23	1	2?	Maturus	11,31	9,23	1	2?	Maturus
10,76	9,78	0	2	Adult	10,76	9,78	0	2	Adult
10,23	9,14	2	1?	Adult	10,23	9,14	2	1?	Adult
10,62	8,34	0	2	Adult	10,62	8,34	0	2	Adult
9,58	8,72	0	2	Adult	9,58	8,72	0	2	Adult
11,61	11,13	1	2	Adult	11,61	11,13	1	2	Adult
11,4	9,06	0	2	Adult	11,4	9,06	0	2	Adult
11,59	9,49	1	2	Maturus	11,59	9,49	1	2	Maturus
10,8	8,13	9	1	Adult	10,8	8,13	9	1	Adult
11,87	10,22	0	2	Adult	11,87	10,22	0	2	Adult
10,7	9,41	0	1	Adult	10,7	9,41	0	1	Adult
10,27	8,45	1	1	Adult	10,27	8,45	1	1	Adult
10,43	9,22	0	1	Adult	10,43	9,22	0	1	Adult
11,8	9,55	9	2	Adult	11,8	9,55	9	2	Adult
9,93	9,79	0	1	Adult	9,93	9,79	0	1	Adult
11,52	10,57	0	2	Adult	11,52	10,57	0	2	Adult
9,92	8,2	0	1?	Maturus	9,92	8,2	0	1?	Maturus
11,25	10,5	0	1	Adult	11,25	10,5	0	1	Adult
11,17	9,68	0	1	Adult	11,17	9,68	0	1	Adult
10,55	9,31	2	1	Maturus	10,55	9,31	2	1	Maturus
10,46	9,36	0	1	Adult?	10,46	9,36	0	1	Adult?
10,15	8,32	0	1	Maturus	10,15	8,32	0	1	Maturus
11,63	10,52	0	2	Adult	11,63	10,52	0	2	Adult
11,16	9,64	1	1	Adult	11,16	9,64	1	1	Adult
10,87	9,55	0	2	Adult	10,87	9,55	0	2	Adult
10,33	9,23	0	2?	Adult	10,33	9,23	0	2?	Adult
10,71	9,55	0	2	Adult	10,71	9,55	0	2	Adult
11,2	9,97	1	2	Adult	11,2	9,97	1	2	Adult
10,25	10,42	9	2	Adult	10,25	10,42	9	2	Adult
10,46	9,03	0	2	Adult	10,46	9,03	0	2	Adult
12,68	10,4	1	2	Adult	12,68	10,4	1	2	Adult
10,03	8,48	0	2	Adult	10,03	8,48	0	2	Adult
10,55	9,05	9	2	Maturus	10,55	9,05	9	2	Maturus
10,57	9,48	1	2	Adult	10,57	9,48	1	2	Adult
11,88	10,14	0	1?	Adult	11,88	10,14	0	1?	Adult
10,33	9,3	9	1?	Maturus	10,33	9,3	9	1?	Maturus
10,5	8,06	9	1?	Maturus	10,5	8,06	9	1?	Maturus
11,12	9,5	9	2?	Adult	11,12	9,5	9	2?	Adult
10,51	8,83	1	2	Maturus	10,51	8,83	1	2	Maturus
10,91	9,1	0	1?	Adult	10,91	9,1	0	1?	Adult
10,56	9,74	0	2	Adult	10,56	9,74	0	2	Adult

10,31	9,15	0	1	Adult	10,31	9,15	0	1	Adult
11,65	9,47	0	2	Adult	11,65	9,47	0	2	Adult
10,23	9,3	0	1	Adult	10,23	9,3	0	1	Adult
11,87	9,46	0	1	Adult	11,87	9,46	0	1	Adult
10,58	9,02	0	1	Adult	10,58	9,02	0	1	Adult
11,28	10,47	0	1	Adult	11,28	10,47	0	1	Adult
11,25	8,53	0	1	Adult	11,25	8,53	0	1	Adult
11,13	9,75	1	2	Adult	11,13	9,75	1	2	Adult
10,93	10,08	0	2	Adult	10,93	10,08	0	2	Adult
9,46	8	0	1	Adult	9,46	8	0	1	Adult
10,38	7,72	0	1	Adult	10,38	7,72	0	1	Adult
10,19	8,84	1	1?	Adult	10,19	8,84	1	1?	Adult
10,82	8,46	2	2	Adult	10,82	8,46	2	2	Adult
10,92	8,79	0	1	Adult	10,92	8,79	0	1	Adult
10,25	8,95	0	2?	Adult	10,25	8,95	0	2?	Adult
10,64	8,82	9	1	Adult	10,64	8,82	9	1	Adult
11,32	8,75	0	0	?	11,32	8,75	0	0	?
9,76	8,33	0	1	Adult	9,76	8,33	0	1	Adult
9,83	8,02	1	1	Adult	9,83	8,02	1	1	Adult
10,9	10,08	0	1	Adult	10,9	10,08	0	1	Adult
10,77	9,72	0	2	Adult	10,77	9,72	0	2	Adult
9,47	9,25	0	2	Adult	9,47	9,25	0	2	Adult
12,28	7,73	0	2	Maturus	12,28	7,73	0	2	Maturus
11,34	9,28	0	2	Adult	11,34	9,28	0	2	Adult
10,46	7,24	0	2?	Adult	10,46	7,24	0	2?	Adult
11,47	8,94	2	1	Adult	11,47	8,94	2	1	Adult
11,47	9,15	0	2	Adult	11,47	9,15	0	2	Adult
10,61	9,58	0	2	Adult	10,61	9,58	0	2	Adult
10,33	8,63	0	2	Adult	10,33	8,63	0	2	Adult
10,51	9,4	0	2?	Adult	10,51	9,4	0	2?	Adult
10,32	9,67	0	2	Adult	10,32	9,67	0	2	Adult
10,23	9,1	1	1	Adult	10,23	9,1	1	1	Adult
10,23	8,79	1	1	Adult	10,23	8,79	1	1	Adult
12,13	10	1	2	Adult	12,13	10	1	2	Adult
10,03	9,29	0	1	Adult	10,03	9,29	0	1	Adult
10,3	9,07	0	2	Adult	10,3	9,07	0	2	Adult
10,38	8,45	0	1	Adult	10,38	8,45	0	1	Adult
10,49	9,5	0	2	Adult	10,49	9,5	0	2	Adult
10,92	9,36	1	1	Adult	10,92	9,36	1	1	Adult
12,15	8,86	0	2	Adult	12,15	8,86	0	2	Adult
9,88	9,46	0	1	Adult	9,88	9,46	0	1	Adult
11,69	9,49	1	2	Adult	11,69	9,49	1	2	Adult
10,53	8,85	0	1	Maturus	10,53	8,85	0	1	Maturus
10,12	8,6	0	1	Adult	10,12	8,6	0	1	Adult
11,32	8,73	0	2	Adult	11,32	8,73	0	2	Adult

10,31	9,09	1	0	Adult	10,31	9,09	1	0	Adult
10,82	9,25	0	2	Adult	10,82	9,25	0	2	Adult
9,82	9,28	0	1	Adult	9,82	9,28	0	1	Adult
10,44	9,15	1	2	Adult	10,44	9,15	1	2	Adult
10,2	8,98	0	2	Adult	10,2	8,98	0	2	Adult
11,06	9,77	0	0	Adult	11,06	9,77	0	0	Adult
9,88	9,14	2	1	Adult	9,88	9,14	2	1	Adult
10,39	9,06	0	1?	Adult	10,39	9,06	0	1?	Adult
11,11	8,66	0	1	Adult	11,11	8,66	0	1	Adult
11,11	9,45	0	2	Maturus	11,11	9,45	0	2	Maturus
10,32	7,92	1	2	Adult	10,32	7,92	1	2	Adult
10,04	8,3	0	1	Adult	10,04	8,3	0	1	Adult
9,83	7,5	0	1	Adult	9,83	7,5	0	1	Adult
11,78	8,49	0	2	Adult	11,78	8,49	0	2	Adult
10,77	9,24	0	0	Adult	10,77	9,24	0	0	Adult
11,14	9,01	1	1	Maturus	11,14	9,01	1	1	Maturus
10,84	8,61	0	1	Adult	10,84	8,61	0	1	Adult
11,2	9,42	0	2	Adult	11,2	9,42	0	2	Adult
11,02	8,98	0	1	Maturus	11,02	8,98	0	1	Maturus
8,93	8,26	0	1	Adult	8,93	8,26	0	1	Adult
11,2	9,3	0	1	Adult	11,2	9,3	0	1	Adult
10,5	9,44	0	2?	Adult	10,5	9,44	0	2?	Adult
9,8	9,4	0	1	Maturus	9,8	9,4	0	1	Maturus
10,72	9,47	0	2	Adult	10,72	9,47	0	2	Adult
11,08	9,15	0	2	Adult	11,08	9,15	0	2	Adult
11,89	8,33	0	2	Adult	11,89	8,33	0	2	Adult
9,8	9,3	0	1?	Adult	9,8	9,3	0	1?	Adult
10,79	9,34	0	2	Adult	10,79	9,34	0	2	Adult
11,3	9,75	1	2?	Adult	11,3	9,75	1	2?	Adult
11,31	9,23	1	2?	Maturus	11,31	9,23	1	2?	Maturus
10,76	9,78	0	2	Adult	10,76	9,78	0	2	Adult
10,23	9,14	2	1?	Adult	10,23	9,14	2	1?	Adult
10,62	8,34	0	2	Adult	10,62	8,34	0	2	Adult
9,58	8,72	0	2	Adult	9,58	8,72	0	2	Adult
11,61	11,13	1	2	Adult	11,61	11,13	1	2	Adult
11,4	9,06	0	2	Adult	11,4	9,06	0	2	Adult
11,59	9,49	1	2	Maturus	11,59	9,49	1	2	Maturus
10,8	8,13	9	1	Adult	10,8	8,13	9	1	Adult
11,87	10,22	0	2	Adult	11,87	10,22	0	2	Adult
10,7	9,41	0	1	Adult	10,7	9,41	0	1	Adult
10,27	8,45	1	1	Adult	10,27	8,45	1	1	Adult
10,43	9,22	0	1	Adult	10,43	9,22	0	1	Adult
11,8	9,55	9	2	Adult	11,8	9,55	9	2	Adult
9,93	9,79	0	1	Adult	9,93	9,79	0	1	Adult
11,52	10,57	0	2	Adult	11,52	10,57	0	2	Adult

9,92	8,2	0	1?	Maturus	9,92	8,2	0	1?	Maturus
11,25	10,5	0	1	Adult	11,25	10,5	0	1	Adult
11,17	9,68	0	1	Adult	11,17	9,68	0	1	Adult
10,55	9,31	2	1	Maturus	10,55	9,31	2	1	Maturus
10,46	9,36	0	1	Adult?	10,46	9,36	0	1	Adult?
10,15	8,32	0	1	Maturus	10,15	8,32	0	1	Maturus
11,63	10,52	0	2	Adult	11,63	10,52	0	2	Adult
11,16	9,64	1	1	Adult	11,16	9,64	1	1	Adult
10,87	9,55	0	2	Adult	10,87	9,55	0	2	Adult
10,33	9,23	0	2?	Adult	10,33	9,23	0	2?	Adult

M3sup **M3inf**

MD	BL	Caries3	Sex	Age	MD	BL	Caries	Sex	Age
11,28	8,8	1	2	Adult	9,8	10,17	0	2	Adult
10,17	9	0	2	Adult	9,02	10,01	0	1	Adult
10,77	8,69	0	2	Adult	10,23	10,26	1	2	Adult
11,17	9,38	1	2	Adult	10,55	11,53	1	2	Adult
10,08	8,77	0	2	Maturus	9,35	11,04	1	2	Adult
10,12	9,31	0	1?	Maturus	9,18	10,02	2	1	Adult
10,67	9,36	1	2	Maturus	9,97	10,29	9	2	Maturus
9,63	7,37	0	2	Adult	9,87	10,48	0	2	Adult
11,41	9,48	0	2	Adult	9,26	10,47	0	1?	Adult
10,57	7,65	0	1	Adult	10	11	0	2?	Adult
11,66	8,65	0	1	Adult	8,95	10,8	0	2	Maturus
10,29	7,97	0	1	Adult	9,75	10,21	2	2	Maturus
10,93	10,19	0	2	Adult	10,05	11,19	0	2	Adult
10,76	7,5	0	2	Adult	9,39	10,68	0	2?	Adult
9,75	8,02	0	2	Adult	9,56	10,11	0	2	Adult
10,27	8,09	0	1	Adult	9,93	11,37	0	2	Adult
9,31	7,67	0	2?	Adult	9,56	9,23	0	1	Adult
9,93	8,55	1	1	Adult	9,16	10,06	2	1	Adult
8,87	8,74	1	1	Adult	8,63	10,24	0	1	Adult
11,27	8,8	0	1	Adult	9,64	10,88	0	1	Adult
10,39	8,03	0	2	Adult	9,5	10,21	0	2	Adult
10,82	9,6	0	2	Adult	9,07	11,83	0	1	Adult
9,78	8,77	0	2?	Adult	10,21	10,83	1	2	Adult
11,42	9,25	1	2	Adult	9,66	11,1	0	2	Adult
10,12	9,38	0	2?	Adult	9,08	10,1	0	2	Adult
10,53	9,36	1	1	Adult	9,37	8,69	0	1	Adult
8,24	7,46	0	1	Adult	9,73	10,51	0	1	Adult
13,11	8,1	1	2	Adult	8,84	10	0	2	Adult
10,74	9,44	1	2	Adult	9,66	10,53	0	2	Adult
10,11	8,44	0	2	Adult	9,4	10,95	0	2?	Adult
9,9	8,19	0	1	Adult	9,73	9,97	0	2	Adult

9,28	9,28	1	1	Adult	9,19	9,76	0	1	Adult
10,99	9,52	1	2	Adult	10,07	11,22	0	2	Maturus
8,11	9,93	0	1	Maturus	8,15	9,23	0	2	Adult
10,08	8,73	0	1	Adult	10,05	10,47	0	1	Adult
11,16	9,11	0	2	Adult	8,9	9,85	0	1	Adult
10,86	9,43	0	0	Adult	9,46	9,81	0	2?	Adult
11,13	8,42	0	0	Adult	10,26	9,7	1	1	Adult
9,07	8,63	2	1	Adult	8,99	10,58	0	2?	Adult
10,16	9,42	0	1?	Adult	8,57	10,05	0	1	Adult
10,91	8,48	0	1	Adult	9,5	10,06	1	1	Adult
9,82	7,69	0	1	Adult	9,64	10,64	0	1	Adult
9,18	8,38	0	1	Adult	9,66	11,23	0	2	Adult
8,48	7,67	0	1	Adult	10,6	11,16	1	2	Adult
9,05	7,96	1	1	Maturus	9,44	11,06	0	2	Maturus
9,91	8,16	0	1	Adult	8,6	9,66	0	2	Adult
10,21	8,73	0	1	Maturus	9,97	10,69	0	2	Maturus
9,46	7,79	0	1	Adult	10,73	11,02	0	2	Adult
9,28	7,11	0	1	Adult	9,45	9,55	0	2?	Adult
11,32	9,19	0	1	Maturus	9,18	10,12	1	1	Adult
12,09	10,45	2	1	Maturus	10,4	11,99	1	2	Adult
10,08	7,65	0	2	Adult	9,74	10,54	1	1	Adult
10,41	7,3	0	2	Adult	9,56	9,67	1	2	Maturus
10	8,87	0	2	Adult	8,9	9,73	1	1	Adult
10	8,38	2	1?	Adult	9,63	10,85	0	2	Adult
11,58	10,05	9	2	Maturus	9,23	10,01	0	2	Adult
10,18	8,31	0	1	Adult	9,5	10,63	1	2?	Adult
9,97	8,11	0	1	Adult	8,85	10,28	1	1	Adult
10,13	8,76	0	1	Adult	9,55	10,54	0	2?	Adult
10,21	8,96	0	1	Adult	8,04	9,37	0	1	Adult
10,55	10,32	1	1?	Maturus	10,37	12,5	1	2	Adult
10,85	9	0	1	Adult	9,24	10,92	0	1	Adult
10,44	8,42	1	1	Adult	9,97	11,46	1	2	Adult
9,94	8,64	0	1	Adult?	9,46	10,2	0	1	Adult
9,75	7,5	0	1	Adult	8,88	10,5	0	1	Adult
9,4	8,3	0	2?	Adult	9,74	10,5	1	2	Adult
11,28	8,86	1	2	Adult	9,63	9,25	1	1	Adult
12,35	8,36	0	2	Adult	9,7	10,27	0	1	Adult
10,15	8,9	0	2	Adult	9,66	10,88	0	2	Adult
12,04	9,36	1	2	Adult	10,28	10,99	1	2	Adult
9,85	9,17	0	2	Adult	9,27	9,05	0	1	Maturus
10,72	7,69	0	2	Maturus	10,89	11,69	0	2	Adult
10,56	8,88	0	2	Maturus	10,44	11,52	1	2	Adult
10,47	8,48	0	2	Adult	10,28	10,66	0	2	Maturus
10,86	9,14	0	2	Adult	10,07	10,98	1	1	Adult
10,22	8,56	0	2?	Adult	9,21	10,21	0	2	Maturus

10,76	7,68	0	1	Adult	9,66	11,82	1	2	Adult
10,05	9,33	0	1	Adult	9,28	10,05	1	0	Maturus
9,99	8,33	0	1	Adult	9,43	10,24	1	2	Adult
8,92	7,94	0	1	Adult	8,08	9,4	0	1	Adult
10,45	8,17	0	2	Adult	8,35	10,24	1	1?	Adult
11,62	9,5	1	2	Adult	9,3	11,14	1	1	Adult
10	8,82	0	2?	Adult	8,83	9,05	0	2?	Adult
11,26	8,79	0	2	Adult	9,29	9,62	1	1	Adult
9,39	6,39	0	1	Adult	8,94	10,04	0	1	Adult
9,31	9,01	0	2	Adult	8,42	8,92	0	1	Adult
10,26	8,03	0	2	Maturus	8,97	9,49	0	1	Maturus
10,3	8,69	0	2?	Adult	9,34	11,11	0	1	Adult
10,15	9,09	0	1	Adult	8,3	9,56	1	2	Maturus
12,18	9,98	1	2?	Adult	9,91	11,43	1	2	Adult
9,81	9,02	0	1	Adult	9,43	9,99	0	1	Adult
10,6	9,51	1	2	Adult	10,26	10,55	0	1	Maturus
10,49	9,33	0	1	Adult	9,54	9,85	0	1	Adult
10,44	7,9	0	2	Adult	9,56	9,33	0	1	Adult
8,94	7,42	1	1	Adult	8,81	10,38	0	2?	Adult
9,47	8,5	1	1	Adult	9,2	9,74	1	1	Maturus
11,65	9,41	0	2	Adult	10,34	11,23	1	1	Maturus
10,53	9,08	0	0	Adult	8,49	9,1	0	0	Adult
10,18	8,42	0	2	Adult	9,37	10,43	1	2	Adult
10,13	8,97	0	2	Maturus	9,27	10,33	0	2	Adult
9,72	8,69	0	1	Adult	9,13	10	0	1	Adult
10,57	8,1	1	1	Adult	9,31	7,91	0	1?	Adult
9,38	8,17	0	2	Maturus	8,87	8,77	0	2	Adult
9,55	8,05	0	1	Adult	9,67	11,51	0	2	Maturus
10,83	9,09	0	1	Adult	8,92	9,71	0	0	Adult
9,42	8,2	1	1	Adult	9,58	10,03	0	2	Adult
9,08	7,73	0	1	Maturus	10,23	12,12	1	2	Maturus
9,63	8,53	0	1	Adult	8,89	9,31	1	2	Adult
11,68	9,18	0	2	Adult	8,68	10,2	9	1	Adult
10,7	8,2	0	1	Maturus	10,48	11,32	0	2	Adult
9,04	7,63	0	1	Adult	9,14	10,22	0	1	Adult
10,68	8,7	0	2?	Adult	10,7	11,72	1	0	Adult
11,02	8,79	0	1	Maturus	9,03	9,92	0	1	Adult
9,54	7	0	1?	Adult	7,98	9,98	0	1	Maturus
11,24	10,74	0	1	Maturus	9,45	10,05	0	1	Adult
9,52	8,12	1	1?	Adult	8,75	9,92	0	1	Adult
10,62	8,49	0	2	Adult	11,46	12,5	0	1	Adult
11,28	9,72	9	2	Adult	10,12	10,56	1	1	Adult
11,43	9,46	1	2	Maturus	9,9	11,3	1	1	Adult
10,02	7,96	1	1	Adult	9,49	7,88	0	2	Adult
11,22	10,5	0	2	Adult	10,85	11,41	1	2	Adult

10,44	9,02	0	1?	Maturus	9,45	10,37	1	1?	Maturus
10,8	8,16	0	1	Adult	8,9	10,15	1	1	Adult
10,02	8	0	1	Adult?	8,79	9,85	0	2	Adult
9,6	8,06	0	1	Adult	9,88	10,8	1	1	Adult
					8,96	10	1	1	Adult
					8,29	8,14	0	1	Maturus
					9,86	10,76	1	1	Adult
					9,85	10,28	0	2	Adult
					8,73	9,5	1	1	Adult
					9,14	9,65	0	2	Adult
					8,99	9,9	0	2?	Adult
					10,16	10,48	0	2	Adult
					9,66	9,82	9	1	Adult
					12,1	11,58	0	2	Adult
					11,31	11,88	0	2	Adult
					10,29	10,68	1	2	Adult
					8,08	9,03	9	2	Maturus
					10,32	10,58	9	1?	Adult
					10,18	9,22	2	1?	Maturus
					9,35	10,32	9	1?	Maturus
					9,12	9,83	0	1	Adult
					10,96	9,99	9	2?	Adult
					10,03	10,83	9	2	Maturus
					10,32	10,95	0	2	Adult
					9,83	11,06	1	2?	Adult
					9,84	10,11	2	1	Adult
					11,16	12,03	9	2	Adult
					10,25	10,81	0	2	Adult
					9,67	9,61	0	1	Adult
					9,73	10,46	2	1	Adult
					10,84	11,32	0	1	Adult
					10,92	11,05	0	1	Adult
					10,61	11,11	0	1	Adult
					10,31	10,98	0	1	Adult
					10,35	12,16	0	0	Adult
					10,37	11,11	0	2	Adult
					9,08	10,01	0	1	Adult
					10,13	10,38	9	2?	Adult
					10,23	10,53	0	2	Adult
					9,85	10,34	9	1	Adult
					10,52	11,31	0	1	Adult
					9,83	10,57	9	2	Adult
					10,06	11,3	0	2?	Adult
					11	11,78	0	2	Adult
					10,16	11,04	2	1?	Adult

					9,6	10,41	1	1	Adult
					10,85	10,43	0	2	Adult
					10,2	10,59	0	1	Adult
					9,92	11,2	9	2	Adult
					10,18	10,33	0	2	Adult
					10,12	10,66	0	1	Adult
					10,45	9,35	9	1	Adult
					10,23	10,59	0	2?	Adult
					10,14	10,08	9	0	Adult
					11,04	12,08	0	1	Adult
					10,99	11,52	0	2	Adult
					9,55	10,5	9	2?	Adult
					10,55	9,98	1	2	Adult
					9,72	9,35	0	1	Adult
					10,28	11,07	0	1	Adult
					10,51	11,72	0	2	Adult
					10,36	10,43	0	2	Maturus
					9,87	10,27	9	2	Maturus
					10,16	10,76	0	2	Adult
					10,6	10,7	0	2	Adult
					9,78	10,04	1	1	Adult
					10,73	10,63	0	2	Adult
					10,69	10,4	9	1	Adult
					9,85	10,72	0	1	Adult
					10,63	11,02	0	2	Adult
					10,06	8,82	9	2	Maturus
					9,62	10,48	0	2?	Adult
					9,63	10,03	0	2	Adult
					9,9	11,11	9	1	Adult
					10,58	10,59	9	2?	Adult
					9,17	9,95	0	1	Adult
					11,47	11,57	1	2	Adult
					10,23	10,62	0	1	Adult
					10,62	11,26	1	2	Adult
					10	9,89	9	1	Adult
					9,81	10,82	1	1	Adult
					9,89	9,26	0	1	Adult
					10,57	11,07	1	2	Adult
					11,24	11,5	9	2	Adult
					9,84	10,7	1	1	Adult
					9,94	10,96	1	2	Adult
					9,89	10,69	9	2	Adult
					11,18	11,44	1	2	Adult
					10,28	10,44	0	0	Adult
					10,47	11,05	0	2	Adult

					10,31	10,81	0	2	Adult
					10,94	11,79	1	2	Adult
					9,66	10,42	0	1	Adult
					9,89	10,74	0	1	Adult
					9,8	10,53	0	2	Adult
					10,41	11,64	0	0	Adult
					10,16	10,55	0	2	Adult
					10,14	11,2	9	2	Adult
					10,09	9,96	9	0	Maturus
					9,88	10,8	0	2	Adult
					9,97	10,7	0	1?	Adult
					10,11	11,2	1	1	Adult
					9,93	10,15	0	2?	Adult
					10,1	10,7	1	2	Adult
					9,83	10,77	0	1	Adult
					9,07	9,85	1	1	Adult
					10,11	11,18	0	0	Adult
					10	9,64	9	1	Maturus
					9,39	9,41	1	2	Adult
					10,44	10,8	0	1	Adult
					9,75	9,96	9	2	Maturus
					10,8	12,37	0	2	Adult
					9,81	9,51	0	1	Adult
					9,55	9,58	0	1	Adult
					10,53	10,02	9	2	Adult
					9,44	10,6	9	2?	Adult
					9,78	10,92	0	1	Maturus
					10,82	11,16	9	1	Maturus
					10,43	9,48	1	0	Adult
					10,13	10,92	0	1	Adult
					10,24	11	1	2	Adult
					10,35	10,89	0	2	Adult
					9,55	10,25	0	1?	Adult
					10,15	11,09	0	2	Adult
					10,59	11,01	0	2?	Adult
					10,29	10,71	0	1	Adult
					9,68	9,01	9	2?	Maturus
					10,33	10,48	1	1?	Adult
					10,17	10,03	0	2	Adult
					11	9,41	1	2	Maturus
					10,09	10,58	1	0	Adult
					10,93	11,14	1	2	Adult
					10,36	10,95	9	2	Adult
					10,16	11,02	0	2	Maturus
					11,22	12,31	0	2	Adult

					9,49	10,23	0	2	Adult
					9,98	10,34	1	1	Adult
					11	11,32	0	2	Adult
					9,04	9,61	0	1	Adult
					10,78	12,05	1	0	Adult
					10,22	10,42	9	1	Adult
					10,17	11,22	0	1	Adult
					10,15	11,33	9	1	Adult
					10,3	10,79	0	1	Adult
					10,97	11,66	1	2	Adult
					10,33	10,73	0	1	Adult
					10,29	10,88	0	2	Adult
					11,19	11,33	1	2	Adult
					10,6	11,07	1	1	Adult
					10,28	11,82	0	2	Adult
					10	10,32	0	1	Adult
					10,9	11	0	1	Adult
					10,58	10,72	9	2	Adult
					9,84	11,12	0	1	Adult
					9,73	10,6	1	1	Adult
					9,64	9,51	9	1	Maturus
					9,77	10,27	1	1	Adult
					10,33	11,3	0	2	Adult
					10,4	10,22	1	2	Adult
					10,22	10,9	1	1	Adult
					10,12	11,16	0	2	Adult
					10,13	9,2	0	2?	Adult