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Skeletal Preservation in All Saints Church, Fishergate, York

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Abstract

The site of All Saints Church, Fishergate have the potential to provide information about skeletal preservation as an issue in human taphonomy. Recent excavations undertaken on this site have unearthed a great number of skeletal remains. By employing methods of frequencies and anatomical preservation index scores it is possible to obtain information about well presented and well preserved skeletal elements, as well as obtaining information of how the factors of location, periods, and age categories relate to the state of preservation of the skeletal elements. Moreover, the obtained results may lead to the interpretation of what sort of factors might have caused the conditions.

The results of analysis from this research show that long limb bones such as tibia and fibula bear a higher level of taphonomical strength which is necessary in order to survive any taphonomical threats. This condition may happen due to the structure of long limb bones as they are more resistant to the threats compared to smaller bones such as hyoid, carpal, and tarsal bones. The state of preservation appears to be related to factors such as location, grave depth (i.e. information of assigned periods, in this research), and age categories. Results show that the remains buried inside the church present a higher state of preservation compared to the remains buried outside the church. The individuals taken as sample in this research show that the remains originated from Roman period also present a higher state of preservation, which is due to the depth of burials of these remains. Lastly, the comparison of adult and juvenile skeletal elements shows that the remains of adult were preserved highly better compared to the juvenile remains. This research has only covered a small part over the broad issues of human taphonomy and further or more detailed researches are highly possible to be established.

Acknowledgement

The author would like to acknowledge Pia Nystrom, Andrew Chamberlain, Lauren McIntyre (University of Sheffield), and Graham Bruce (On Site Archaeology) for their great amount of help and support on the process of this dissertation research, and to the author's parents, sister, and Ingrid H.E. Pojoh for the help with suggestions and support throughout the writing process of this dissertation.

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Chapter 1. Introduction

Taphonomy refers to a sub-discipline of palaeontology which studies the processes occur on organic remains after time of death and is now more commonly applied into archaeological contexts (Bonnichsen, 1989; Micozzi, 1991; White & Folkens, 2005). On another occasion, taphonomy is also known as a branch study of paleoecology and is defined as "the study of relationships between ancient organisms and their environments, the death of organisms, and their burial and post burial history in the geologica past, based on fossil faunas and their stratigraphic position" (Glossary of Geology, 1980 in Marshall, 1989: 8). Taphonomy is the term presented by the Russian palaeontologist, I.A. Efremov (1940) on describing the 'transition of remains from the biosphere into the lithosphere or the processes of "fossilization" from death to diagenesis' (Martin, 1999: 1). The definition of taphonomy was then reviewed by Behrensmeyer and Kidwell (1985 in Bonnichsen, 1989: 2) as "the study of processes of preservation and how they affect information in the fossil record." Taphonomy sometimes is also referred to as the "law of burial", originated from the Greek words of *taphos* (meaning "burial") and *nomos* (meaning "law").

Taphonomy has become gradually important in reconstructing the past as one of the goal of archaeology, although taphonomical methods were not commonly applied as a field of scientific study until the 1970s (Nawrocki, 1995). The implementation of taphonomy in archaeology concerns with the issues on how to determine plants, animals, or human remains accumulate and preserve differentially within its archaeological contexts. In some issues, it is even important to determine whether the changes occur within the context are associated with human activities. In general, some archaeological remains may have survived better than other materials throughout the time. The objectives of studying issues of taphonomy are to determine the causes of transformations on artefacts as well as ecofacts, and to identify whether these transformations are caused by natural or cultural forces. By understanding the reasons of taphonomical transformation, one is expected to explain the phenomenon occurred to the human remains as archaeological evidence after time of death and also explain how these factors will affect the interpretation in an archaeological context.

The transformation in archaeological data may be affected by factors such as the size of the object buried, the depth of the burials, climates of the site in question, as well as the soil condition in which the burials occur (Grant, *et al.,* 2001: 115). As the objects were buried in the soil, it would experience various depositional processes along with any possible disturbances which may have been caused by bacteria, acid, water, erosion, ice, worms, roots, sunlight, gnawing, thawing, and oxidisation (see also White & Folkens, 2005). In the meantime, activities such as looting, grave robbing, shelling, mining, reuse of land/soil, trampling, as well as the excavation itself are known as disturbances caused by cultural forces which are normally done by human (Grant, *et al.,* 2001: 114). Furthermore, Nawrocki (1995) had divided the factors in taphonomical processes into three factors which are environmental, individual, and cultural. Environmental factors considered to have affected the taphonomical processes of skeletal remains are those of biotic and abiotic factors.

Large carnivores such as dogs may be responsible on scavenging human remains and may also inflict the condition of the skeletal elements. Even if such scenario may not happen in a cemetery, the role of disturbance of large rodents may as well occur and cause such preservation conditions of the skeletal remains. On the other hand, smaller organisms, such as fungi and bacteria may as well involve in the process of decomposition of a buried human remains. Plant activities are also considered to have great effects on the state of skeletal preservation. Root movements may have taken its role on pushing over artefacts as well as shifting the position of the skeletal elements. Furthermore, Nawrocki mentioned that the factors considered as abiotic environmental cause of taphonomic processes include the temperature and climate, area exposure to water and sunlight, soil acidity, and burial depth below the ground surface. The second factor is the individual factors which include the bone shape, size, and condition on each skeletal element, as well as pathological condition experienced by the human during their lifetime. Some pathological conditions are considered to have great contributions on skeletal preservation when buried. The last factor is cultural factors which include burial preparation, rituals, burial treatments, as well as a more recent human activities such as construction conduct within the site area and certainly, archaeological excavation itself. These factors may have affected the state of skeletal preservation especially in those burial treatment where the living included accessories made of metals which can cause stain the surfaces of skeletal elements (see also Janaway, 1987).

In an almost similar manner, Bello *et al.* (2006) divided these taphonomical factors into two categories which are extrinsic and intrinsic factors. Extrinsic factors include the geographical and geological condition of the site, the nature of vegetation and faunal condition of the site, as well as the human activities in the surrounding area of the site or on the site (see also Henderson, 1987). In their opinion, it is rather difficult to distinguish the indicators between human activities which involve in a ritual of a burial or activities of human related to the maintenance of the area surrounding or on the site. On the other hand, the intrinsic factors that is assumed to have taken role on taphonomical processes are the conditions in which each skeletal remain possess, such as bone mineralization and bone density.

1.1. Background

Human taphonomy refers to a more specific issue within the grand scheme of taphonomy, which refers to studies of post-mortem processes thought to have affected human skeletal remains (Bello & Andrews, 2006: 1; Lieverse, *et al.,* 2006: 1141). One of the issues in human taphonomy studies is of the preservation of skeletal elements, as every part of the bones which are found in an excavation may be in a different state of preservation which might have been caused by these taphonomical processes, including human modifications such as funerary practices, removal from their contexts, the excavation activity, or even the storage techniques applied to the skeletal remains collection (Bello & Andrews, 2006: 1).

Methods in human taphonomy are used in researches such as the taphonomic history of fossil assemblage (Boaz & Behrensmeyer, 1976), skeletal conditions in Khuzir-Nuge XIV, Siberia (Lieverse, *et al.*, 2006), skeletal preservations in medieval cemeteries (Bello & Andrews, 2006), a study of human skeletal remains decay processes in the 13th century charnel house (bone crypt) located underneath the church of the Holy Trinity in Rothwell (Garland, *et al.*, 1988), or in a much later archaeological site of Oneida Burial, New York (Nawrocki, 1995).

The research done by Bello & Andrews (2006) analysed skeletal remains from three medieval and three post-medieval sites in order to determine the specific anatomical patterns of preservation in bones. These sites are St. Estève Le Pont, Hauture, St. Maximin, Fédons, Observance, and Spitalfields. The total numbers of the samples employed are over than 900 skeletons. The result of this research proved that sub-adult skeletons are less well-preserved compared to adult skeletons. It also proved that state of preservation of skeletal elements increases proportionally according to the individual age, and another result in this research shows that among the sub-adults age group observed, female skeletal remains are generally less well-preserved compared to the male ones (p. 3-10). Another research employing similar methods was undertaken by Bello *et al.* (2006) upon obtaining information about age and sex bias in the past population structures.

Every changes in the soil during excavation have great effects for further analytic process, therefore burial data recording should be made by careful observation and accurate documentation. Standard documentations need to be completed on the process of recording burial data are notes on burial characteristics, which include burial integrity, body positioning and skeletal orientation, dimensions of burial, and effects of cremation (if any) (Lieverse, *et al.*, 2006: 1144). A well-planned excavation and skills of osteological material recognition is mandatory in order to gather more detailed evidence by minimising the probability of discarding or removing important material of skeletal elements. The excavated skeletal remains from archaeological sites may vary in condition of bone preservation from very poorly to a very well preserved bone (Henderson, 1987: 43). These explanations become the base of interest upon commencing a research for dissertation about how is the preservation of skeletal remains in the selected site of All Saints Church of Fishergate, York. The skeletal assemblage found in this site is considered to have the potential on providing information about preservation of the skeletal remains, as this assemblage was recently excavated.

1.2. Aims and Objectives

The aim of this research is to identify the difference of skeletal surface preservation from the skeletal assemblage, to understand the form and pattern of skeletal surface preservation present found in All Saints Church of Fishergate, York, as well as providing additional information about the cemetery. The specific questions addressed are:

a. What level of preservation can be observed in the skeletal remains from the site of All Saints Church of Fishergate, York?
b. Which skeletal element is well represented and from which category do they originated and how is this condition explained?
c. Does the skeletal preservation in this site vary between the categories of age groups and of assigned estimated periods?
d. Does the skeletal preservation vary with the location in which the skeletal assemblage was found (inside and outside the church’s wall)?

e. What are the possible factors in this site which may cause the differences in state of preservation among the skeletal remains?

1.3. Dissertation Structure

The first chapter of this dissertation consists of definition of taphonomy and human taphonomy, its origin, as well as explanation on factors which caused the occurence of taphonomy on archaeological materials or objects in an area or site. Several examples of application of taphonomical methods are also explained in this chapter, to provide illustration on how these methods may help on answering questions regarding taphonomical issues. Another part of this chapter also described several questions which are expected to help explaining the problems in question as well as to gain information related to the aims and objectives of this research.

The second chapter of this dissertation incorporates description of All Saints Church of Fishergate, York, as the site where all the materials were obtained and the materials utilized on this research. Explanations of methods used in this research can also be found within this chapter.

The third chapter of this dissertation includes the results of analytical processes done with methods explained on the previous chapter. These results were presented in a systematic way starting with the analysis results of sample frequencies for each skeletal element in the sample, results from well preserved bones analysis, and results from comparing and correlating the anatomical preservation indices with three variables of location, assigned periods, and age categories, as well as results of related statistical tests ran on these variables.

The discussion explained on the fourth and final chapter of this dissertation will be addressed in order to interpret the results of analyses done the in the previous chapter as well as to form conclusions which are expected to answer the questions addressed within the range of aims and objectives of the research and provided suggestions for possible further studies about the subject of taphonomy.

Chapter 2. Materials and Methods

2.1. All Saints Church of Fishergate

The excavation undertaken to discover the remains of All Saints Church of Fishergate was located at the junction of Kent Street and Fawcett Street, York. There were previous evaluations in 1987 and in 2003 related to the development of the Barbican Centre which reported occurrence of burials from medieval dates (Bruce & McIntyre, 2008). The latest excavation in the location of All Saints Church of Fishergate was held between June 2007 and February 2008 by On Site Archaeology. This excavation covered the church area as well as its surrounding cemetery. Archaeological evidence found within the site suggested that activities upon this site dated back to the Roman period, which continued to be used until the medieval period.

The historical background of this church is considered to be very little as there were few of documentary evidence that mentioned the existence of this church. According to the earliest documentary evidence which relates the church to the years between 1091 and 1095, All Saints Church of Fishergate was noted to be a part of Whitby Abbey’s cell. A city plan of York, engraved by John Speed in 1610, shows an unmarked building on the eastern part of Fishergate which may have represented the location of this church. Meanwhile, maps or city plans of the late 17th and 18th century did not show any marks of the location of this church, in which by this time the maps and plans showed the area as parts of agricultural land. The location of this church was then covered by the cattle market during the early 19th century. On the

First Edition Ordnance Survey map published in 1852, the location of the church is shown with the area limits of the cattle market, which was located on the northeast side of today's site (Bruce & McIntyre, 2008; McIntyre & Chamberlain, 2008).

The unpublished article written by Bruce and McIntyre (2008) mentioned some interesting findings on the site which vary from the evidence of Roman activities, which includes clay and gravel quarry as well as burials, to the timber structure found and was considered to be the a part of the early church's structure. Of all the findings, the most interesting finds are the number of mass graves unearthed on this site. These mass graves were recorded to vary in size, from the smallest ones containing six or seven individuals, to the largest ones containing up to eighteen individuals. The organisation of these graves was recorded to follow a similar pattern with orientation of the head to the west and feet to the east. Some of these skeletal remains were positioned laying on their back, to their sides, or even buried face down.

The numbers of excavated skeletal remains in All Saints Church of Fishergate are approximately 580 individuals. This assemblage of skeletal remains presents the characteristics of medieval period (as well as early Medieval and late Medieval period) and Romano-British period (with one skeletal remain noted as originated from early Roman period). When this site was first discovered, the skeletal remains excavated were thought to be the victims of one of the episodes of the plague recorded in the early 17th century York, which was severely impact the city on the years of 1604 and 1631 (Bruce & McIntyre, 2008). It is noted that the population represented in the more recent excavation is dominated by males from a young age to middle age.

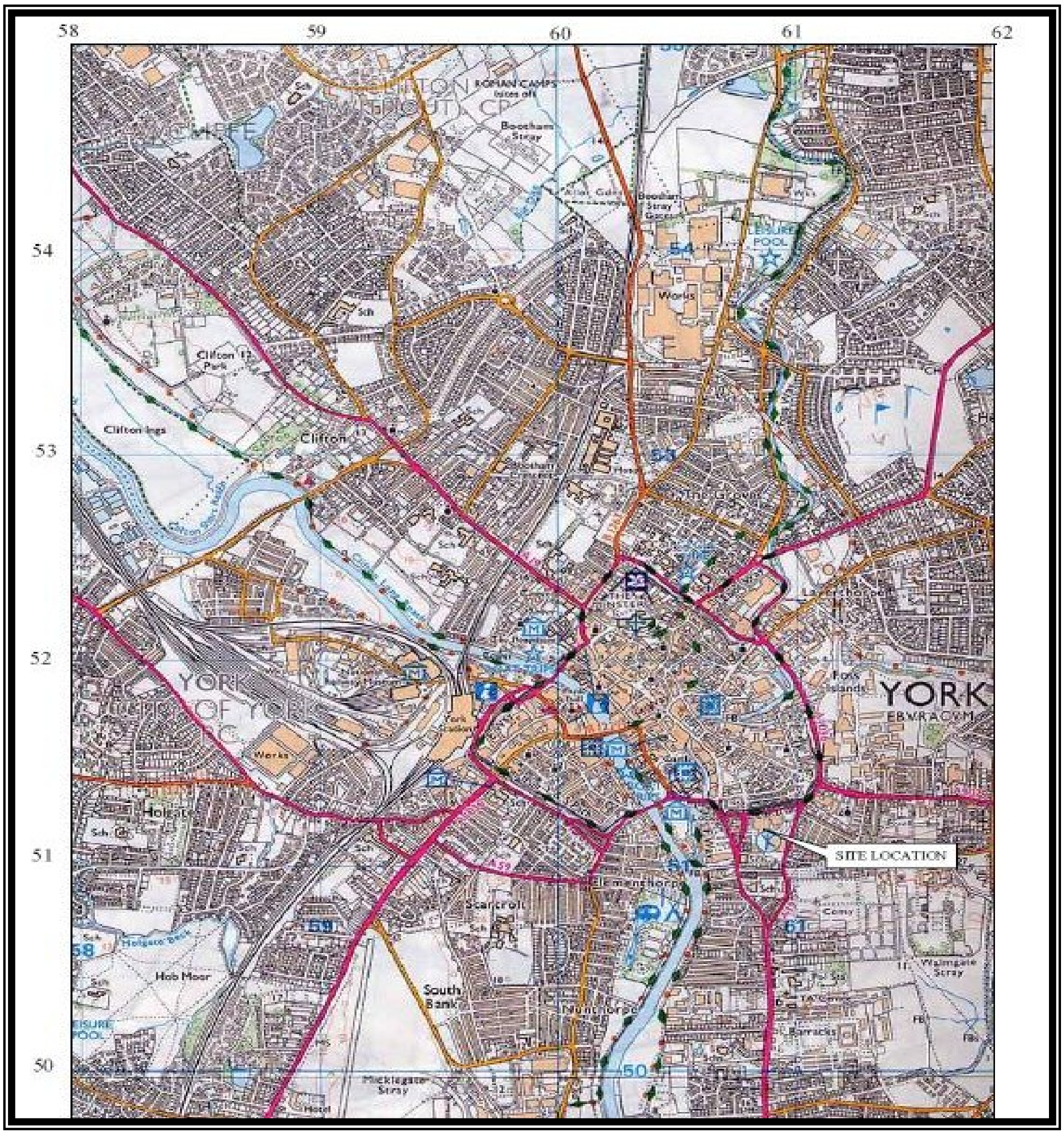

Figure 1. Location of All Saints Church Fishergate excavation site. Not to scale. (taken from Barbican Reports, 2003).

2.2. Materials

Sampling method is used in this research in order to get a smaller sample of skeletal remains from all of the data. The sample chosen for this research is expected to represent the overall condition of the skeletal remains found within the site. The total number of the data used in this research is of 100 individuals complimented with information obtained from a database of results from preliminary studies done in University of Sheffield. The database created by Lauren McIntyre contains information such as age estimation, sex determination, as well as the periods of which skeletal remain is thought to be originated from. These information from the database are used throughout the research.

In general, the assemblage of the skeletal remains is divided into two locations, skeletal remains found inside the church's wall and skeletal remains found outside the church's wall. The skeletal assemblage from this site was recorded to a site plan made on Adobe Illustrator which contains information of the skeletal catalogue numbers as well as the location and position of the skeletal remains. By using this site plan, it is possible to obtain the location of each skeletal remains against the ruins of All Saints Church and its surrounding cemetery. Sampling technique was done by taking random skeletal catalogue numbers from both locations, inside and outside the church. The obtained skeletal numbers and locations were then matched with period, sex, and age information available from the database.

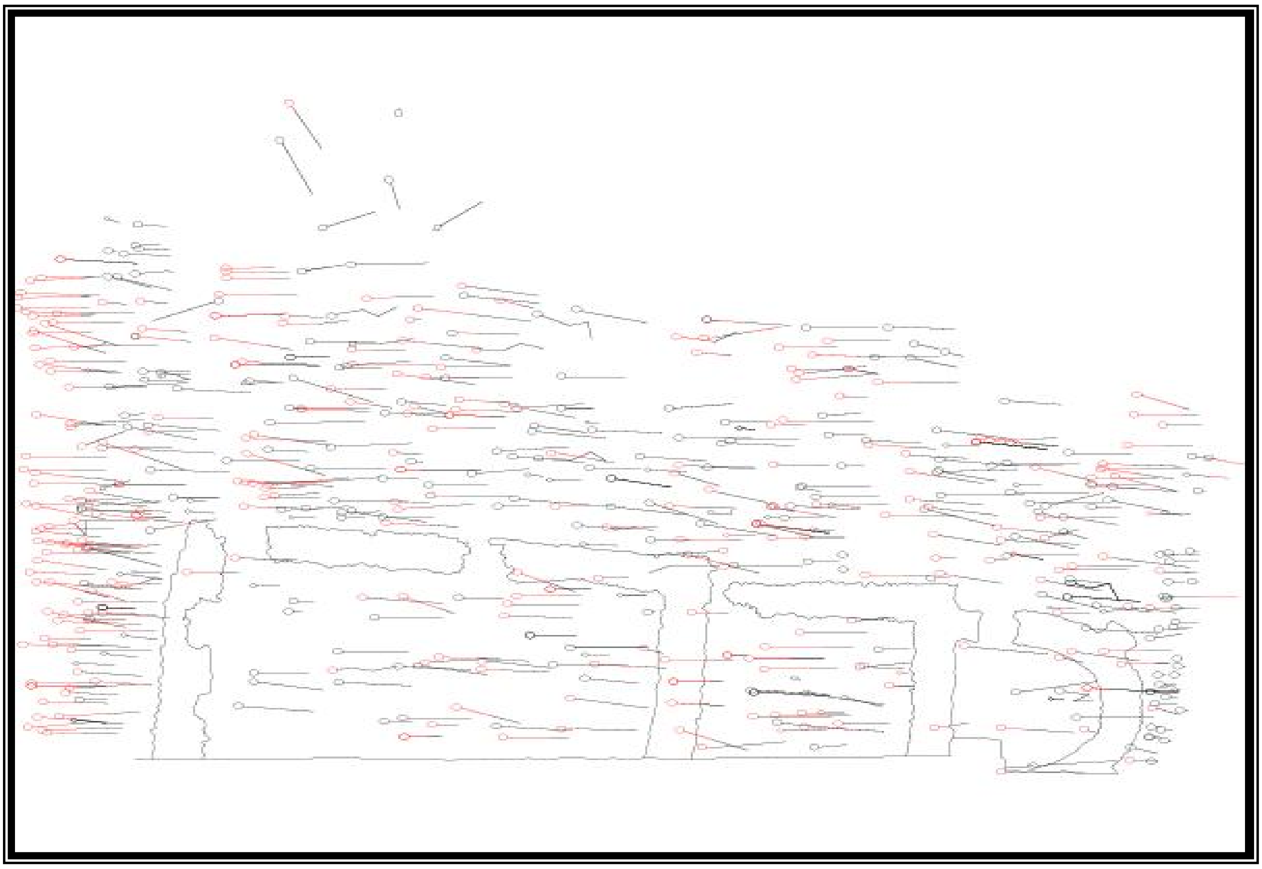

Figure 2. All Saints Church, Fishergate Cemetery Plan.
On Site Archaeology, 2007. Unpublished digital drawing.

The excavated skeletons were divided into three periodical groups, Roman, Medieval, and post-Medieval. This categorization was done by observing the phasing of the graves on site during the process of excavation. Roman skeletons were recognized by their different positions than the rest of the skeletal remains, their different orientation in the cemetery, and were also recognized from associated ceramic finds (Bruce, pers. comm., 2009). The early medieval skeletons were differentiated by their conditions which were cut by the foundation of the medieval church. As for the post medieval skeletons were distinguished by their positions which cut the church and therefore these burials noted to exist later than the timeframe when the church was demolished (McIntyre, pers. comm., 2009). Overall, there are 6 individuals assigned as those of Roman period, 7 individuals from early medieval period, and 87 individuals from medieval period.

Age categories used in this study are obtained from the database of the preliminary studies of the skeletal remains in the All Saints Church of Fishergate. Methods used on ageing estimation of the collection are by observing the features of the sternal ends of the ribs (Iscan & Loth, 1986), observing the features of the auricular surface (Lovejoy, *et al.*, 1985; Buckberry & Chamberlain, 2002), and observing the dental occlusal surface wear (Miles, 1962). To simplify the analytical process, the age categories will be divided as juveniles and adults without using the actual age range assigned on the database. Blank space is used to refer to unknown age categories. There are 18 juveniles, 79 adults, and 3 of unknown age category used in this sample.

Sex categories used in this research were also based on the database from the preliminary studies, which was done by assigning sex determination using methods proposed by Brooks and Suchey (1990) as well as using sex diagnostic based on the morphological characters of the skeletal remains depending on which skeletal element observed (McIntrye, pers. comm., 2009). In some of the skeletal remains, sex determination and age estimation may not be assigned if the required skeletal elements are not present. Blank space is used to refer to unknown or indeterminate sex categories. There are 35 females, 33 males, and 32 individuals of unknown sex within this sample.

Other sources of data used to assist this research are found in forms of books, articles with related issues of preservation on skeletal remains and taphonomic processes in cemeteries, as well as related site reports.

2.1. Methods

The selected sample of All Saints Church Fishergate was observed and calculated based on the presence of each skeletal elements. The elements being observed are skull, mandible, maxilla, hyoid, ribs, sternum, vertebrae (cervical, thoracic, lumbar), sacrum, hip bones, upper limbs (scapula, clavicle, humerus, radius, ulna, carpal bones, metacarpals, and hand phalanges), and lower limbs (femur, tibia, fibula, patella, tarsal bones, metatarsals, and foot phalanges). Carpal (scaphoid, lunate, hamate, capitates, trapezoid, trapezium, pisiform, and triquetral) and tarsal (talus, calcaneus, cuboid, navicular, and three cuneiforms) bones were also counted specifically by observing the presence of each element. Although several elements such as skull, mandible, maxilla, hyoid, hip bones, and sacrum were found to be fragmented, these elements were counted as one skeletal element. Skeletal elements of ribs were mainly found in fragments and were counted by observing its sternal ends for both sides. Upper and lower limb skeletal elements were counted altogether, disregarding the anatomical siding.

This research project also employed the analytical methods used by Bello & Andrews (2006) in their research of skeletal preservation in the medieval and post medieval cemeteries of St. Estève le Pont, Hauture, Fédons, Observance, St. Maximin, and Spitalfields, such as scores of anatomical preservation index and scores of well preserved bones. Anatomical preservation index is a score of preservation used to assess the quantity of skeletal material present in a collection or sample. Anatomical preservation index refers to the 'ratio between the score of preservation and the skeleton's total anatomical number of bones' (Bello & Andrews, 2006: 2). This index score portrays the preservation scores in assessing the quantity of the bones present and will also shows which skeletal element that is more preserved or less preserved than other bones. The calculation was done by dividing the sum of skeletal elements present in a skeletal remain by the expected number present and the result was multiplied by 100 in order to get percentage value. By assessing the scores of anatomical preservation index it is possible to distinguish the skeletal elements into classes of well preserved bone (stated in percentage), which are (1) class 1; assigned to the bones which are not preserved (value of 0% preservation), (2) class 2 assigned to the skeletal remains with 1-24% of its bones preserved; (3) class 3 assigned to the skeletal remains with 25-49% of its bones preserved; (4) class 4 assigned to the skeletal remains with 50-74% of its bones preserved; (5) class 5 assigned to the skeletal remains with 75-99% of its bones preserved; (6) class 6 assigned to the skeletal remains with all of its bones preserved (100% preservation) (Bello, et al., 2006; Bello & Andrews, 2006). By categorizing the skeletal elements into these classes, it is possible to conclude which skeletal remains present the preservation score more than 50% (indicating well-preserved bone value) or less which indicates the otherwise.

Simple statistical methods are required in order to provide a result regarding the data recorded using the methods explained previously. Statistical methods were carried out by using Microsoft Excel 2007 and Statistical Package for Social Science (SPSS) software. These softwares will help to explore the data statistically and also analyse the distribution and frequencies of the data. Results of this analysis process are presented according to the anatomical preservation as well as presenting the individual preservation of the skeletal remains.

Calculations of frequencies of skeletal elements in the sample were done by employing Microsoft Excel and several series of t-tests were done in order to observe the level of significant differences on each variable. These results were to be correlated to locations of where the skeletal remains were found, their estimated periods, and their assigned age categories. Figures and charts are included to illustrate the results of each analysis.

Chapter 3. Results

The number of skeletal elements observed in this research include 180 elements in total, which includes mandible (1 element), maxilla (1 element), hyoid (1 element), ribs (24 elements), sternum (1 element), skull (was counted as 1 element), cervical (7 elements), thoracic (12 elements), lumbar (5 elements), hip bones (counted as 2 elements of both sides), and sacrum (1 elements). In addition, skeletal elements of upper and lower limbs are counted by combining the elements from right and left sides. These skeletal elements consist of scapula (2 elements), clavicle (2 elements), humerus (2 elements), radius (2 elements), ulna (2 elements), femur (2 elements), tibia (2 elements), fibula (2 elements), patella (2 elements), tarsal (calcaneus, talus, navicular, cuboid, cuneiforms/14 elements), metatarsals (10 elements), foot phalanges (28 elements), carpals (scaphoid, lunate, hamate, pisiform, trapezoid, trapezium, capitates, triquetral/16 elements), metacarpal (10 elements), and hand phalanges (28 elements).

3.1. Frequencies of Skeletal Elements

The first set of analysis done was calculating the frequency of each bone recorded from each skeletal remains. This analysis is expected to answer the questions regarding which of the skeletal elements are in the condition of well preserved and well presented within the sample, by assuming logically that a skeletal element which preserved better may turn up more frequently in a sample. In this process the skeletal elements were divided into six categories, which are cranial bones (including skull, maxilla and mandible), hyoid and vertebrae, thorax bones (ribs and sternum), upper limb bones (shoulder girdles, arms, hands), pelvic girdle (hip bones and sacrum), and lower limb bones (legs and feet). The description of analyses results will be written according to the anatomical sequence as mentioned.

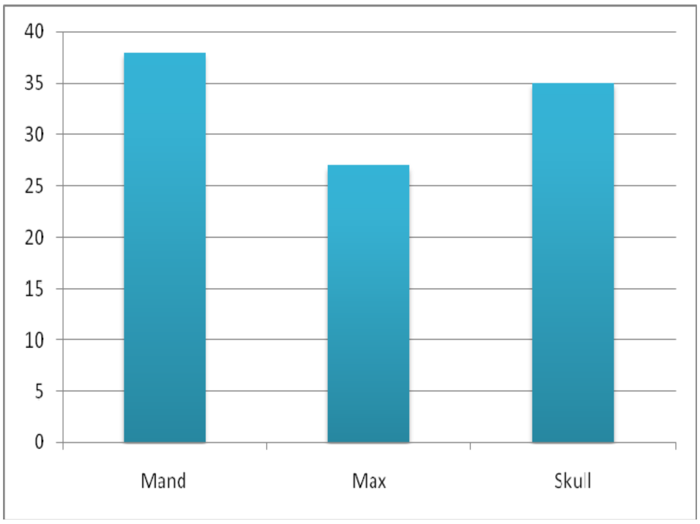

Figure 3. Frequency of cranial bones

Based on the calculation, the frequency of mandible and skull appear did not differ greatly in general, although compared to maxilla, these two skeletal element appear more frequent in the sample. Frequency calculation result of the cranial bones shows that mandible was the most skeletal element found in the sample (n= 38), followed by skull (n= 35), and maxilla (n= 27). This indicates that the state of preservation of mandibles in the sample is higher than skulls and maxillae (Figure 3), although these skeletal elements might have been found in fragments.

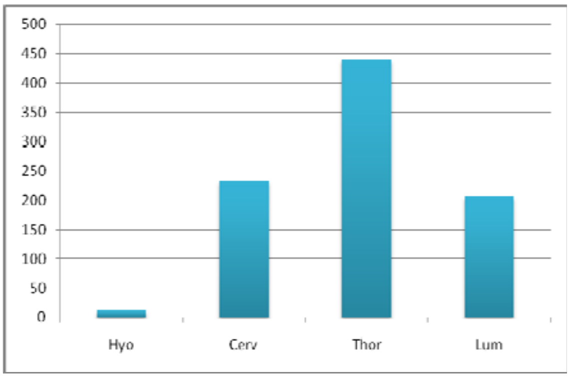

Figure 4. Frequency of hyoid and cervical, thoracic, and lumbar

The frequency chart on Figure 4 shows that the total number of each skeletal element varies greatly. Hyoid (n= 13) appear to be the least skeletal element to be found in the sample. As for the vertebral bones, thoracic (n= 441) seems to be the most frequent skeletal element appearing in the sample, followed by cervical bones (n= 233) and lumbar (n= 206). This indicates that the state of preservation of thoracic in the sample is higher than cervical, lumbar, and hyoid.

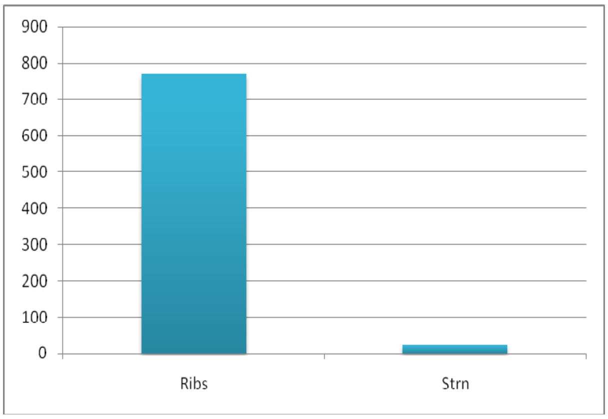

Figure 5. Frequency of ribs and sternum

Figure 5 shows the overall frequency of ribs and sternum present in the sample. The total number of ribs (n= 770) is inevitably higher than the total number of sternum (n= 24) found in the sample. This indicates that the state of preservation of ribs in the sample is better than sternum, even though ribs were commonly found in fragments, but sternum did not seem to be preserved well enough to last until the time of excavation.

As mentioned previously, each skeletal elements included in the category of upper limb bones were counted from both sides of the body to calculate the frequencies. The frequency of upper limb bones did not show any difference from each skeletal element (Figure 5). Both radius (n =90) and ulna (n= 91) are the most dominant skeletal element found in the sample, followed by clavicle (n= 81), scapula (n= 79), and humerus (n= 68). This means that the score of preservation of both radius and ulna are higher than the rest of the bones in this category. The chart also shows that there is no significant difference in frequency of radius, ulna, scapula, and clavicle, although the frequency of humerus appeared not as much as the rest of the skeletal element.

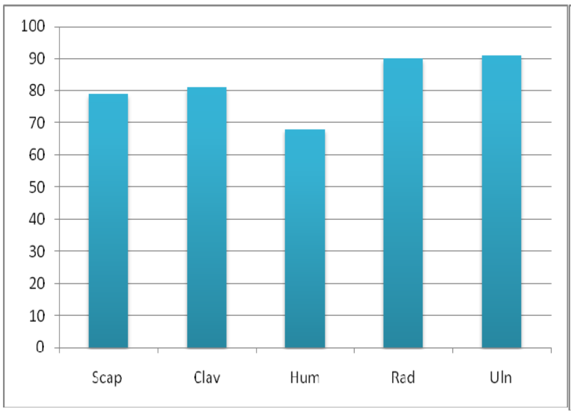

Figure 6. Frequency of Upper Limb Bones

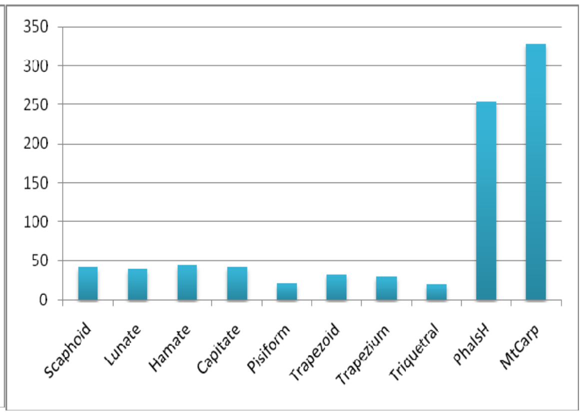

Figure 7. Frequency of carpals, metacarpals, and hand phalanges

As for carpals, metacarpals, and hand phalanges in the sample, Figure 6 shows that metacarpals are the most dominant skeletal element found (n= 328), followed by phalanges (n= 254) and carpal bones (n=242). Either of the carpals, metacarpals, and hand phalanges bones was found in a complete set or incomplete set on each individual observed. In a more specific frequency calculation, it appear that hamate (n= 45), capitates (n= 42), scaphoid (n= 42), and lunate (n= 40) are the most dominant skeletal elements found in the sample. On the other hand, pisiform (n= 22) and triquetral (n= 20) seem to be the least dominant skeletal element found.

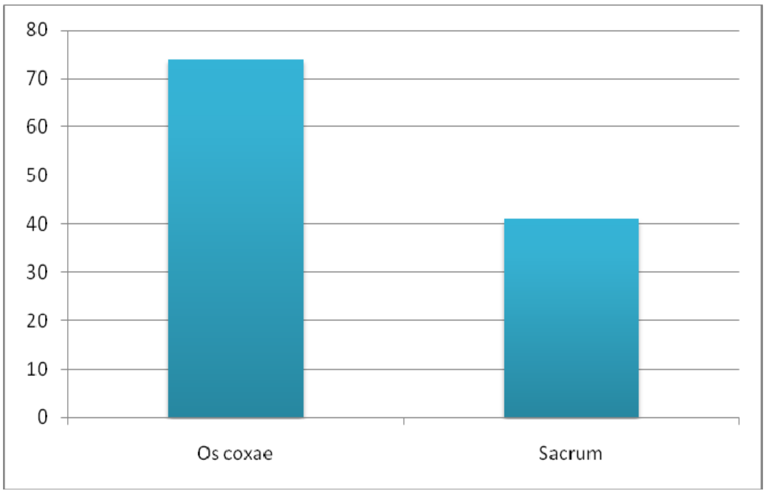

Figure 8. Frequency of pelvic girdle bones

Based on the calculation, the frequency of hip bones and sacrum differ greatly in general. Hip bones (n= 74) tend to be the more frequent skeletal element to appear in the sample compared to sacrum (n= 41). This indicates that the state of preservation of hip bones in the sample is better than sacrum (Figure 8), although these skeletal elements might have been found in fragments.

The frequency of the long bones in the category of lower limb skeletal element did not show any significant difference (Figure 6), especially between tibia and fibula. Both tibia (n =136) and fibula (n= 134) seem to be the most dominant skeletal element found in the sample, followed by the frequency of femur (n= 117).

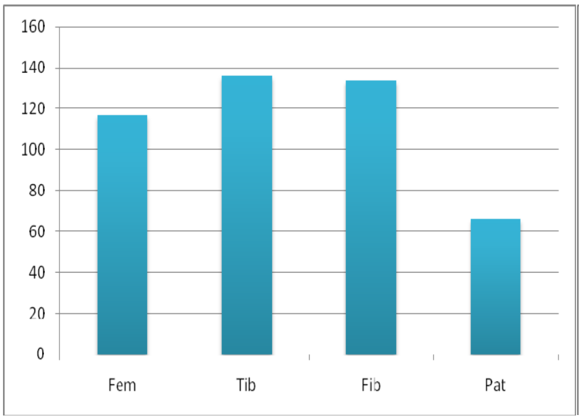

Figure 9. Frequency of Lower Limb Bones

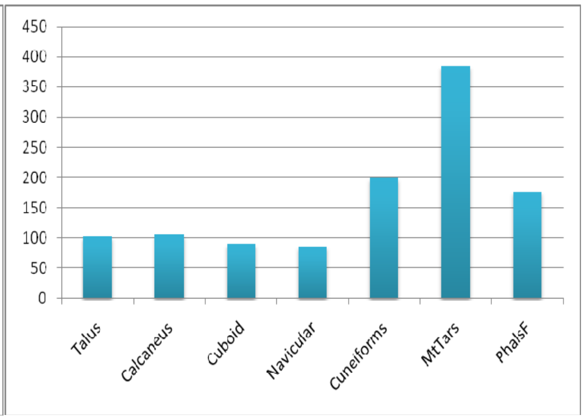

Figure 10. Frequency of tarsals, metatarsals, and foot phalanges.

Meanwhile the frequency of patella (n= 66) seems to be the least dominant skeletal element in this category. This means that the score of preservation of both tibia and fibula are higher than the rest of the bones in this category, followed by the score of preservation of femur. The frequencies of femur, tibia, and fibula did not differ greatly, although the frequency of femur appeared not as much as the tibia and fibula.

3.2. Well Preserved Bone

The next set of analysis is to calculate the scores of well preserved bone. Well preserved bone scores are calculated by dividing the sum of each skeletal remains by the sum of observed skeletal elements (180 elements) multiplied by 100. It is basically done to calculate the percentage of skeletal preservation score for each skeletal sample. The results from this calculation can then be assigned into one of the six classes of well preserved bones as used by Bello and Andrews (2006: 3).

Figure 11 shows the results of well preserved bones analysis and it shows that most of the skeletal remains in the sample belong to the category of Class 2 (as much as 51 individuals) with 1-24% of their bones preserved. This followed with the skeletal remains belong to the category of Class 3 of well preserved bones (36 individuals), skeletal remains assigned to the category Class 4 (12 individuals), and a skeletal remain assigned to the category of Class 5 (SK 3557). Figure 12 shows the examples of skeletal remains assigned to Class 2 (SK 3540) and Class 5 (SK 3557).

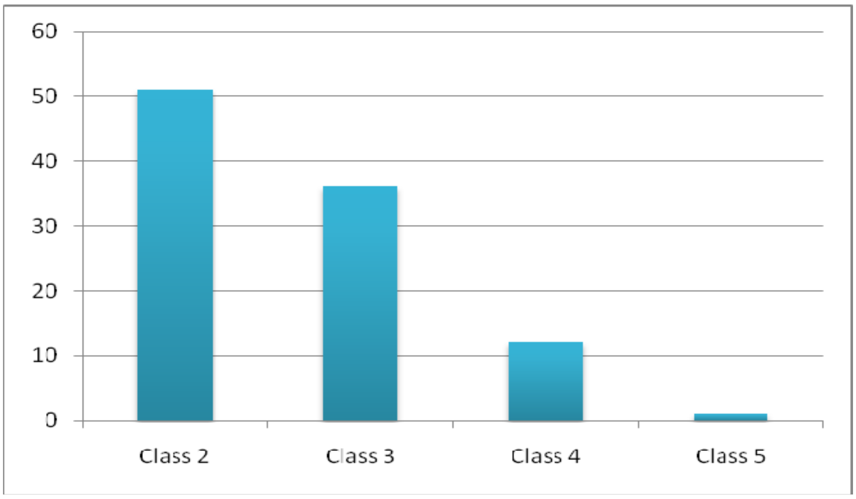

Figure 11. Classes of well-preserved bones in All Saints Fishergate sample

SK 3540 SK 3557

Figure 12. Examples of Class 2 skeletal remains (SK 3540) and Class 5 skeletal remains (SK 3557), On Site Archaeology Ltd.

3.3. Anatomical Preservation Index

The next set of analysis done was to calculate the anatomical preservation index of each skeletal element. In this part of analysis all of the six skeletal elements categories used previously were correlated with variables of the location where the skeletal remain was found, their assigned periods, and assigned age categories.

3.3.1. Anatomical Preservation Index by Location

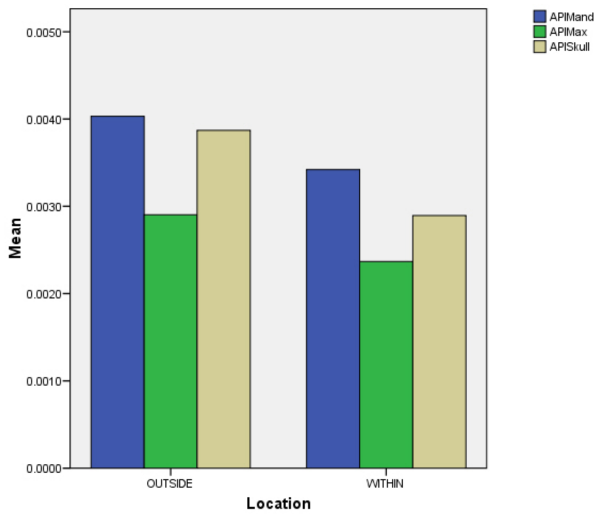

Figure 13. Anatomical Preservation Index of cranial bones based on the location of skeletal remains

The chart above shows the frequency of cranial skeletal elements found in two locations, inside the church's wall and outside the church's wall. The chart also illustrates that the variable of mandible has the highest value of preservation index in both locations, but the highest on the samples found outside the church. It is followed by the mean of anatomical preservation index of skull. It is without a doubt that this anatomical preservation index chart shows that the cranial skeletal elements found inside the church have less preservation index value compared to the cranial skeletal elements found outside the church. But in general, the distribution of these skeletal elements did not show any difference if compared by the locations. Both of the histograms showing the anatomical preservation index on each location have mandible as the variable with the highest index score of preservation, followed by skull, and maxilla as the variable with the lowest index score of preservation. These results seem to be in conformity with the results of t-test done which provide the t-value for mandible (Sig. 2-tailed= .562), maxilla (Sig. 2-tailed= .582), and skull (Sig. 2-tailed= .352) as these values did not show significant difference between these skeletal elements according to the locations in which the skeletal remains were found as illustrated on the chart.

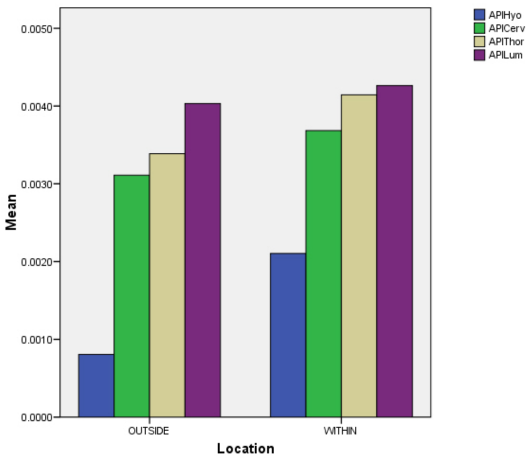

Figure 14. Anatomical Preservation Index of Hyoid, Cervical, Thoracic, and Lumbar based on the location of skeletal remains

In general, Figure 14 shows that the distribution of anatomical preservation index scores on skeletal elements of hyoid, cervical, thoracic, and lumbar on both observed locations are similar. The anatomical preservation index of lumbar shows the highest score compared to the other elements either located inside or outside the church. This is consistent with the t-test result which did not show any significant difference of the same skeletal element (Sig. 2-tailed= .801). The significance level of cervical and thoracic on the chart also did not show any significance level of difference. The anatomical preservation index of hyoid appears as the lowest score if compared to the other three skeletal elements and even between the locations, this skeletal element shows a very significant difference (Sig. 2-tailed= .062).

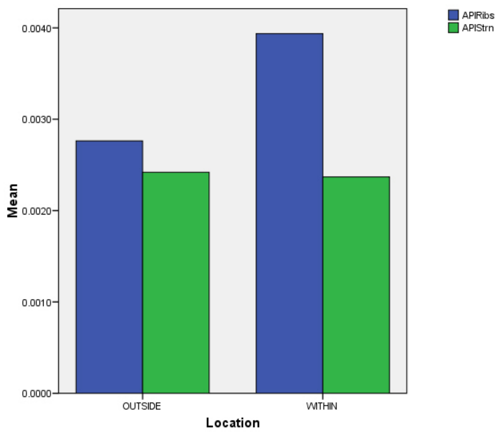

Figure 15. Anatomical Preservation Index of Ribs and Sternum based on the location of skeletal remains

The score of anatomical preservation index of ribs is highest on the sample found inside the church, compared to the same variable found outside the church (t= 1.694). On the other hand, the score of anatomical preservation index of sternum did not show any significant difference between each location (t= -.057), as it appears to have a quite similar score of preservation index.

In general, the skeletal elements of upper limb bones found inside the church seem to have higher preservation index scores than the skeletal elements found outside the church, although the anatomical preservation index of humerus found inside the church appear to be lesser than the anatomical preservation index of the same element found outside the church and show a significance of difference (Sig 2-tailed= .482). The anatomical preservation index of scapula found inside the church tends to be fairly significant with the anatomical preservation index scor for scapula found outside the church (Sig. 2-tailed= .233).

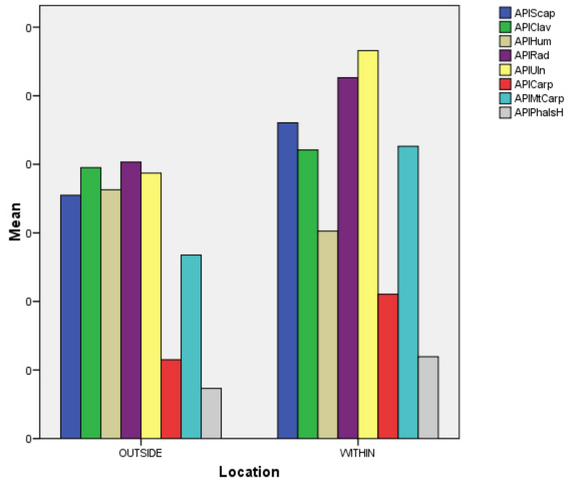

Figure 16. Anatomical Preservation Index of Upper Limb Bones, Carpal, Metacarpal, and Hand Phalanges based on the location of skeletal remains

The anatomical preservation index of clavicle in both locations did not show any significant difference (Sig. 2-tailed= .86). Radius' anatomical preservation index scores in both location show significant difference (Sig. 2-tailed=.177), as the anatomical preservation index score of radius found inside the church is higher than the score of radius found outside the church. The anatomical preservation index score for the skeletal elements of ulna found inside the church appear to have the highest value among other upper limbs skeletal elements, either found inside or outside the church. The anatomical preservation index of carpal bones found inside the church is significantly higher than the anatomical preservation score of the same skeletal element which were found outside the church (Sig. 2-tailed= .076). The following score of anatomical preservation index of metacarpals found inside the church appear significantly higher as well, if compared to the anatomical preservation index of the same skeletal element found outside the church (Sig. 2-tailed= .044). As for the element of hand phalanges, the anatomical preservation index scored of both locations seem to have the lowest score if compared to the rest of the skeletal elements of upper limbs. The anatomical preservation index of hand phalanges found outside the church appear to have significant difference with the score of hand phalanges found inside the church (Sig. 2-tailed= .075).

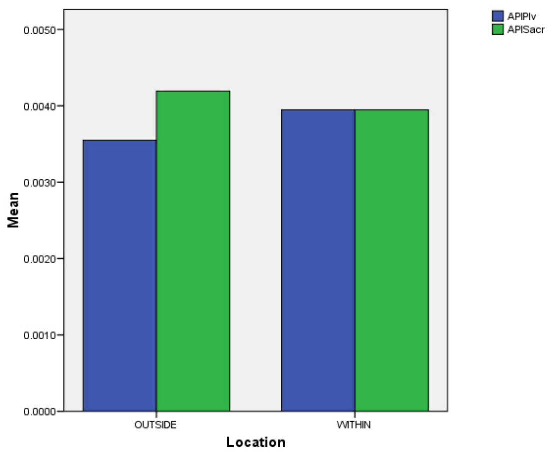

Figure 17. Anatomical Preservation Index of Hip bones and Sacrum based on the location of skeletal remains

From the sample of skeletal remains found outside the church, sacrum tends to be the skeletal element which has a well preserved condition, compared to those found inside the church. While the skeletal element of hip bones is rather less preserved when found outside the church, rather than found inside the church. In spite of this result, the difference between the overall anatomical preservation index scores of hip bones and sacrum did not appear to be highly significant. This shows that the scores of preservation of each skeletal element found on each location are nearly at an equal level. Although, the anatomical preservation index for sacrum indeed appeared to have a higher score compared to the same skeletal element found inside the church (Sig. 2-tailed= .081).

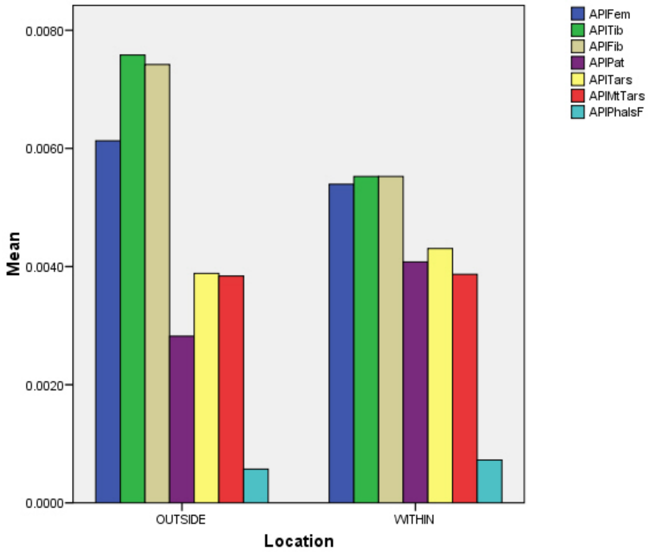

Figure 18. Anatomical Preservation Index of Lower Limb Bones, Tarsal, Metatarsal, and Foot Phalanges based on the location of skeletal remains

The preservation index score of lower limbs showed on the chart varied greatly. The anatomical preservation indices of femur, tibia, and fibula found outside the church seem to be significantly different if compared to the same skeletal elements which were found inside the church. Preservation score of patella also appear to have significant difference, as seen on the chart that the score of patella found inside the church tend to be in a better state of preservation compared to the patella found outside the church (Sig. 2-tailed= .215). The anatomical preservation indices of tarsals, metatarsals, and foot phalanges found on both locations did not show any significant differences (Sig. 2-tailed = .615; .972; .401 respectively).

3.3.2. Anatomical Preservation Index by Periods

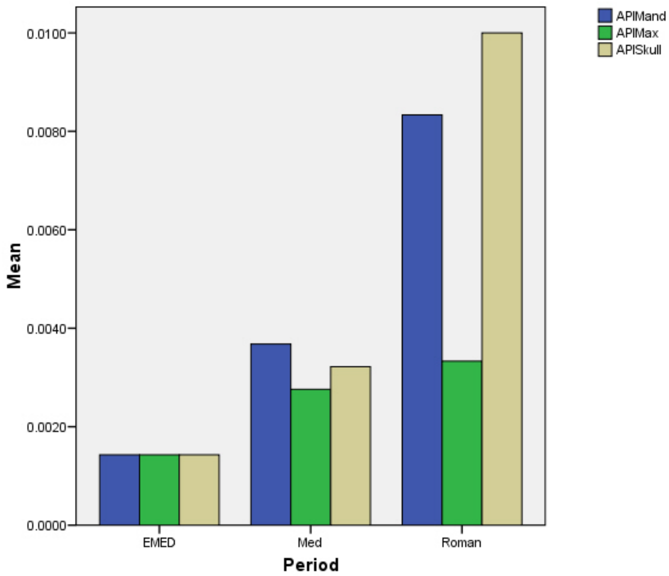

Figure 19. Anatomical Preservation Index of Cranial Bones based on the Assigned Periods

Figure 19 illustrate that skull and mandible in the Roman samples are of those with high preservation index score compared to the same skeletal elements from early medieval and medieval periods. From the seven individuals of early medieval skeletal remains in the sample, they seem to show uniformity in anatomical preservation index for cranial skeletal elements. On the other hand, the skeletal remains from medieval samples show that mandibles from this sample have the highest preservation index score compared to skeletal elements of skull and maxilla. These results is seem to be consistent with the results of t-test done which provide the significance value for mandible (Sig. 2-tailed= .023), maxilla (Sig. 2-tailed= .734), and skull (Sig. 2-tailed= .000) as these values show significant difference between these skeletal elements according to the periods in which the skeletal remains were assigned to.

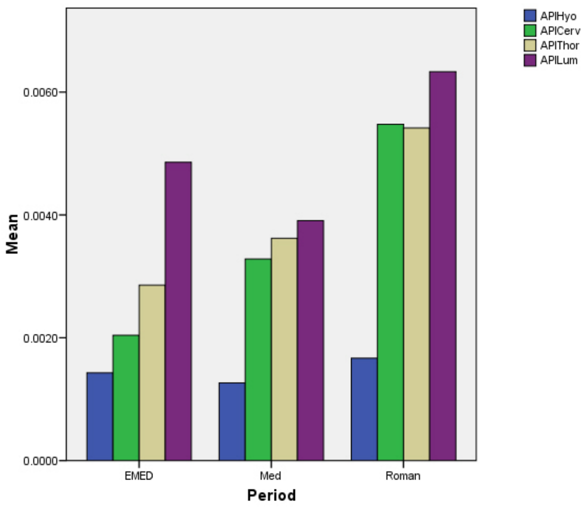

Figure 20. Anatomical Preservation Index of Hyoid, Cervical, Thoracic, and Lumbar based on the Assigned Periods

The chart shows that the Roman samples have the overall highest anatomical preservation indices for skeletal elements of lumbar, thoracic, cervical, and hyoid, if compared to the samples from other periods. The anatomical preservation index of hyoid from all of the assigned periods did not show any significant differences (Sig. 2-tailed= .786). Meanwhile, the anatomical preservation index for cervical and thoracic seems to have a pattern where the preservation becomes better as the sample appears to be chronologically older. The difference in the preservation of cervical and thoracic of the Roman sample is significant compared to the samples of early medieval and medieval. In general, lumbar is the only skeletal element with the highest score pf anatomical preservation index on every sample from different periods.

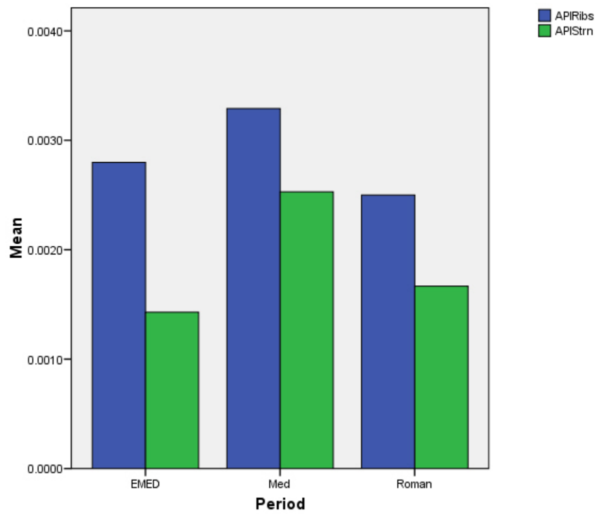

Figure 21. Anatomical Preservation Index of Ribs and Sternum based on the Assigned Periods

Figure 21 shows that ribs are the most commonly found skeletal elements on every sample from different periods and the difference of its anatomical preservation index is not significant (Sig. 2-tailed= .601). This condition also implies to the skeletal element of sternum as the differences between samples from each periods did not show any significance (Sig. 2-tailed= .668). In general, medieval samples do have better scores of preservation if compared to the other two samples of early medieval and Roman.

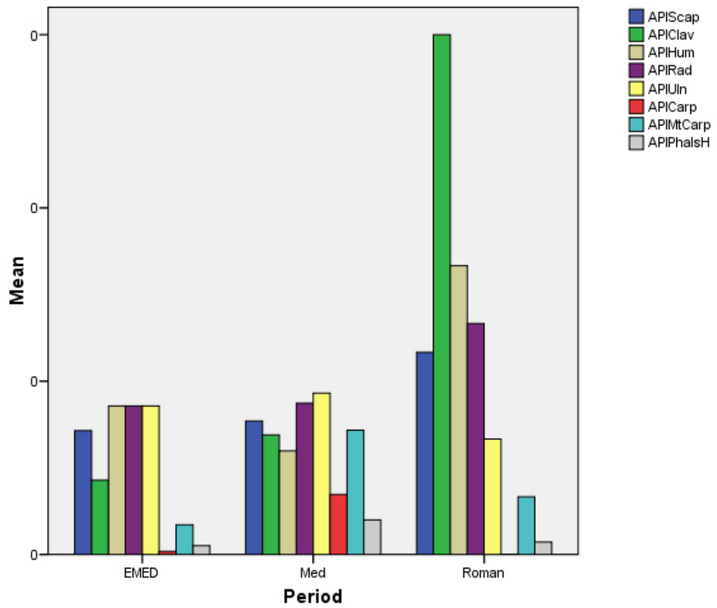

Figure 22. Anatomical Preservation Index of Upper Limb Bones, Carpal, Metacarpal, and Hand Phalanges based on the Assigned Periods

Figure 22 illustrate that clavicle from Roman samples have the highest score of preservation amongst the skeletal elements of upper limbs observed. This is consistent with the t-test result done to the variables (Sig. 2-tailed= .000) which shows a highly significance of difference with other variables in the sample. The next skeletal element which also has a high value of significance is humerus. The humeri from the Roman samples appear to have the highest score of anatomical preservation index if compared to the same elements from other periods. This is also consistent with the t-test result done (Sig. 2-tailed= .002) which obviously shows significant difference. Once more, this analysis shows that the skeletal elements observed present a high score of preservation index when the sample is of the Romans. The chart shows that there are differences between the score of anatomical preservation indices of radius (Sig. 2-tailed= .216) and ulna (Sig. 2-tailed= .492), although the result of t-tests did not say as well. Carpal bones appear to be poorly preserved on both samples of Roman and early medieval, although these skeletal elements appear in a small number within the medieval sample (Sig. 2-tailed= .145), but the difference between these three categories is not significant. The similar condition also applies to the skeletal elements of metacarpal (Sig. 2-tailed= .291) and hand phalanges (Sig. 2-tailed= .272).

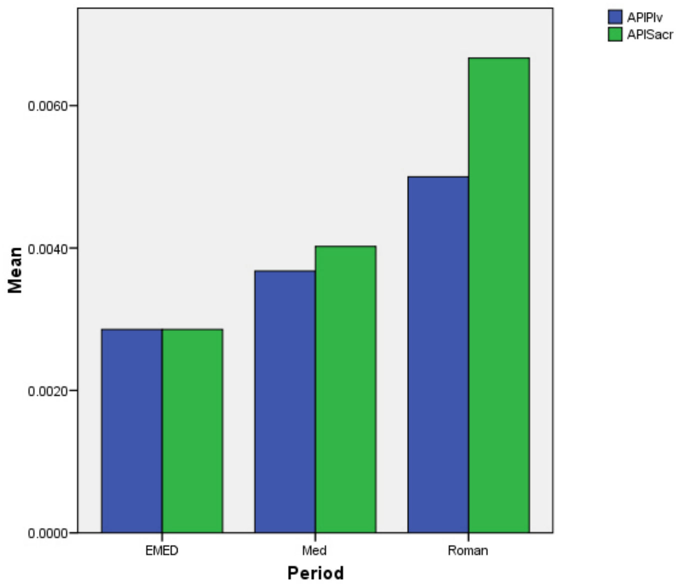

Figure 23. Anatomical Preservation Index of Hip bones and Sacrum based on the Assigned Periods

Figure 23 illustrate that the skeletal elements of hip bones and sacrum from the Roman sample were preserved better than the same skeletal elements of early medieval and medieval samples. The score of anatomical preservation index of sacrum appear to be highest within the Roman sample, as well as the anatomical preservation index of hip bones within the same sample. The early medieval sample appears to have the least preserved hip bones and sacrum, even if compared to the medieval ones.

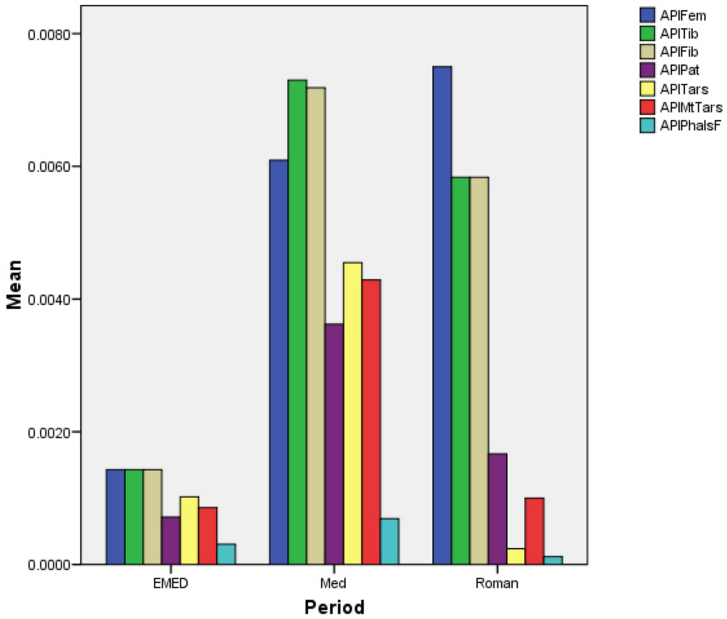

Figure 24. Anatomical Preservation Index of Lower Limb Bones, Tarsal, Metatarsal, and Foot Phalanges based on the Assigned Periods

The scores of anatomical preservation on these skeletal elements from Roman, early medieval, and medieval samples varied greatly. The highest anatomical preservation index can be found on the femur element in Roman sample. This followed by the anatomical preservation indices of tibia and fibula from the medieval samples. T-test was used to observe the significance of these skeletal elements, and the result shows that from the skeletal elements of femur (Sig. 2-tailed= .031), tibia (Sig. 2-tailed= .005), and fibula (Sig. 2-tailed= .006), which shows some significant difference between these periods. Another significant difference can be observed on the skeletal element of tarsal (Sig. 2-tailed= .009) and metatarsal (Sig. 2-tailed= .038), which also visible on the chart where the skeletal elements of tarsal and metatarsal within the medieval sample have the highest score of preservation if compared to the same skeletal elements in other category.

3.3.3. Anatomical Preservation Index by Age Categories

Figure 25 illustrate that the cranial skeletal elements on the juvenile sample appear to show a higher anatomical preservation index if compared to the adult sample, in exception for the element of maxilla. The assumption which can be made according to this chart is that the cranial skeletal elements of the juvenile sample present a higher scale of preservation than the cranial skeletal elements of the adult sample.

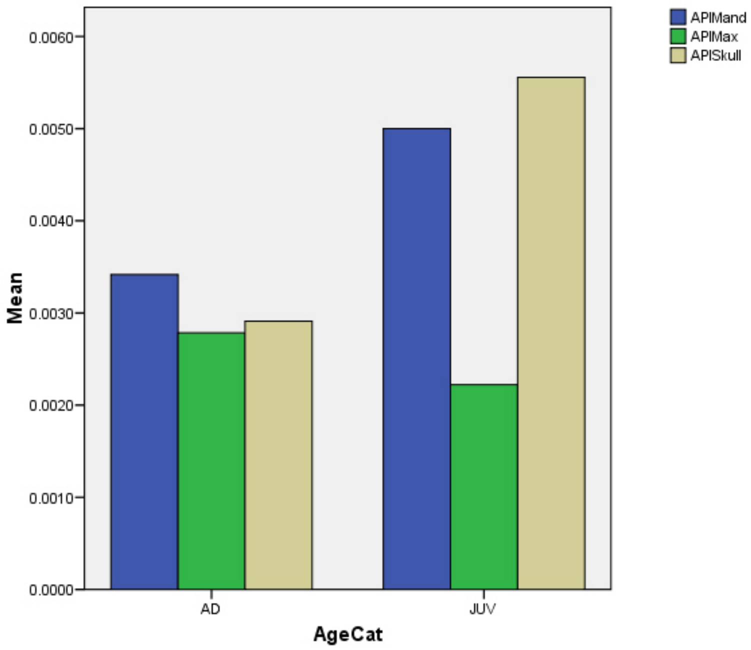

Figure 25. Anatomical Preservation Index of Cranial Bones based on Age Categories

In addition, the results of t-test done which provide the significance value for mandible (Sig. 2-tailed= .234), maxilla (Sig. 2-tailed= .648) show no significant difference between these skeletal elements according to the age categories in which the skeletal remains were assigned to. However, the skull variable (Sig. 2-tailed= .033) did indeed show significant difference.

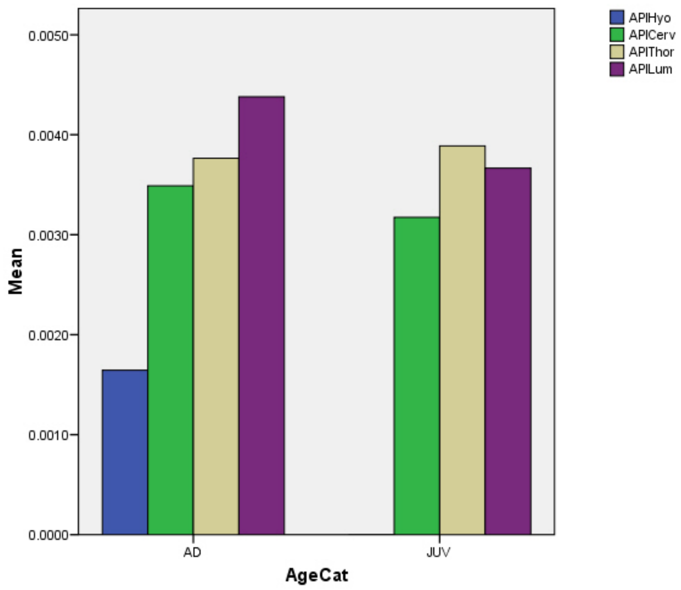

Figure 26. Anatomical Preservation Index of Hyoid, Cervical, Thoracic, and Lumbar based on Age Categories

Figure 26 shows that the anatomical preservation index of lumbar in adult sample has the highest score compared to lumbar in juvenile sample, as well as compared to other skeletal elements in this analysis. The elements of cervical (Sig. 2-tailed= .780) and thoracic (Sig. 2-tailed= .905) did not show any significant difference between the samples of adult or juvenile. On the other hand, hyoid (Sig.

2-tailed= .065) were only found on the adult sample and this evidently shows a significant difference as there were no hyoid found in the juvenile sample.

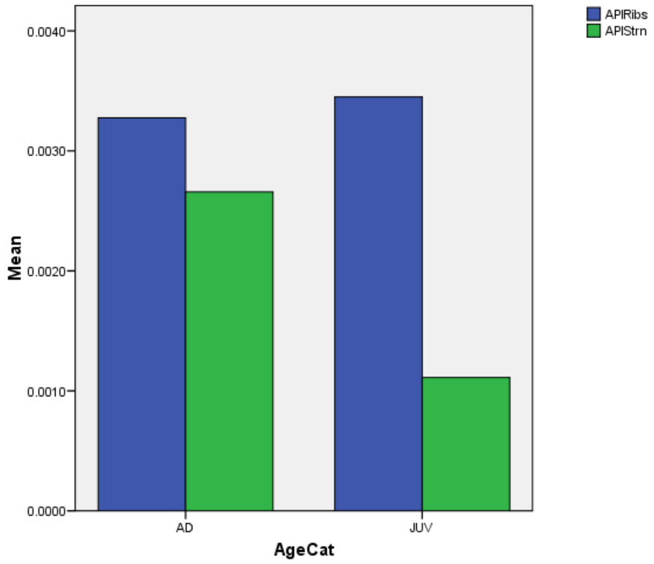

Figure 27. Anatomical Preservation Index of Ribs and Sternum based on Age Categories

The chart on Figure 27 shows that ribs appear to be the most commonly found elements in both of the adult and juvenile samples. As for the skeletal element of sternum, it is more common to be found on the adult sample, rather than in the juvenile ones. For these samples, there is no significant difference for the skeletal elements of ribs (Sig. 2-tailed= .846), but there is a greater significant difference for the element of sternum (Sig. 2-tailed= .167).

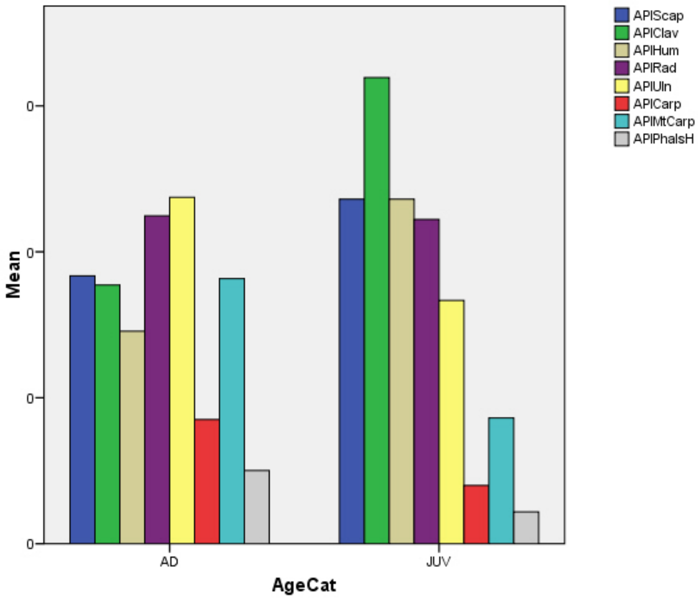

Figure 28. Anatomical Preservation Index of Upper Limb Bones, Carpal, Metacarpal, and Hand Phalanges based on Age Categories

As seen on Figure 28, the adult sample the skeletal element of ulna appears to be the highest score of anatomical preservation index, followed by radius, clavicle and metacarpal, and scapula. Meanwhile, the anatomical preservation indices for carpals and hand phalanges in the adult sample appear to be the least preserved skeletal elements. On the other hand, the juvenile sample shows that clavicle has the highest preservation score, followed by scapula and humerus, radius, and ulna. While the anatomical preservation indices for carpals, metacarpals, and hand phalanges appear to be the least preserved skeletal elements in the juvenile sample. The siginificant differences on this analysis can be seen from the elements of clavicle (Sig. 2-tailed= .129), humerus (Sig. 2-tailed= .090), metacarpals (Sig.= .056), and hand phalanges (Sig. 2-tailed= .081). In general, the adult sample has better preservation condition compared to the juvenile sample, although as mentioned previously, the score of clavicle's preservation is at its highest on the juvenile sample.

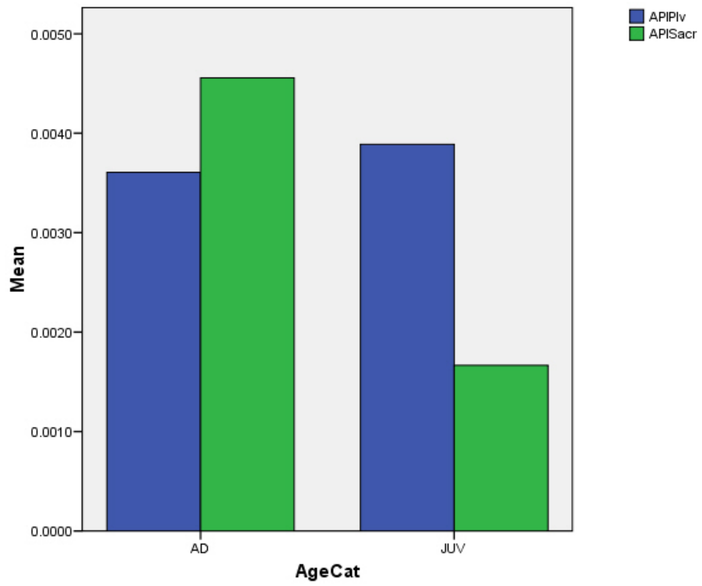

Figure 29. Anatomical Preservation Index of Hip bones and Sacrum based on Age Categories

The adult sample shows that sacrum is more common to be in a well preserved condition rather than hip bones, while the juvenile sample shows the otherwise. It is evident that hip bones are more common to be in well preserved condition than sacrum in the adult sample. Based on the t-test ran for these skeletal elements, there was no significant difference between the skeletal element of hip bones (Sig. 2-tailed= .765) in the samples of adult and juveniles. But there was a significant difference between the sacrum (Sig. 2-tailed= .024) in the adult and juvenile samples.

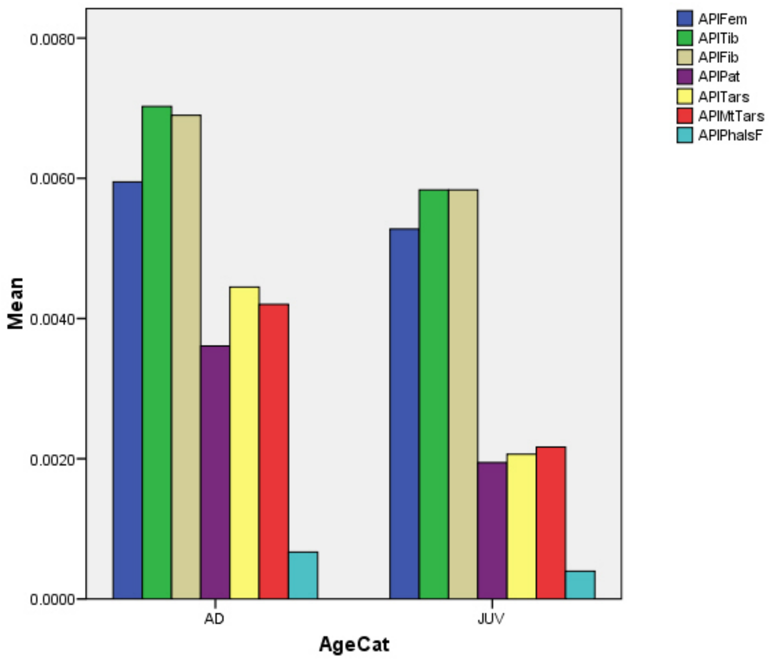

Figure 31. Anatomical Preservation Index of Lower Limb Bones, Tarsal, Metatarsal, and Foot Phalanges based on Age Categories

For the lower limb skeletal elements, the adult sample shows that the tibia has the highest score of preservation, followed by fibula, femur, tarsal and metatarsal, and patella. While the lowest score of anatomical preservation index in this sample is shown on the phalanges. The juvenile sample shows that the highest score of preservation can be seen on the skeletal elements of tibia and fibula, followed by femur, metatarsal, tarsal, and patella. Almost similar to the adult sample, in juvenile sample the phalanges appear to be the skeletal element with the lowest score of preservation. Based on t-tests ran on these skeletal elements significant difference are found on tarsal (Sig. 2-tailed= .023), metatarsal (Sig. 2-tailed= .0.57), and patella (Sig. 2-tailed= .107) as these three elements show great significance between adult and juvenile samples.

Chapter 4. Discussion & Conclusion

4.1 Discussion

The overall results of analyses explained on the previous chapter show that there are several skeletal element which present high score of preservations. The skeletal elements with the highest score of preservation in this sample are mandible, thoracic vertebrae, ribs, radius and ulna, metacarpal, several carpal bones (scaphoid, lunate, and hamate), hip bones, tibia and fibula, metatarsal, and cuneiforms. On the other hand, skeletal elements which were assigned with the lowest scores of preservation include the maxilla, hyoid, sternum, humerus, carpal bones (pisiform and triquetral), sacrum, femur, and several tarsal bones (cuboid and navicular). Skeletal elements such as scapula, clavicle, radius, ulna, cervical, thoracic, lumbar, sacrum, and skull appear to have a fair score of preservation and were also fairly presented in the sample, although not dominant in frequencies. Factors which can cause these skeletal elements to be preserved better than the other skeletal elements might be related to the extrinsic and intrinsic factors.

The result of skeletal elements frequencies of the sample shows that the most well presented element is the tibia and fibula. This is consistent to the expected result as these long limb bones have skeletal structures with high proportion of cortical bones, which are more durable from the extrinsic and intrinsic factors. On the other hand, other long bones such as femur and humerus, which are also expected to be well presented, appear to have lower levels of presentation. The structure and size of humerus and femur as long bones were the factors assumed to enable these skeletal elements to preserve better than the smaller and more fragile bones such as radius, ulna, and fibula. The poorer state of preservation shown in the skeletal elements of femur and humerus might be caused by factors of taphonomic processes of truncation, disturbance from the later period's burials, fragmentation or soil pressure in specific area of the burials which can affect the loss of these skeletal elements. Smaller bones such as hyoid, phalanges, carpal bone, and tarsal bones indeed appear to have lower presentation as these trabecular bones are more susceptible to the taphonomic processes. Smaller sized bones tend to be easier to be moved by worms or rodents actions, and these bones may also undergo faster process of destruction. Moreover, any soil disturbance caused by land usage, maintenance, recent development, and excavation process may as well cause the disappearance of these smaller bones. Several reports mentioned about the discoveries of human skeletal remains in the area of All Saints Church of Fishergate dated back to 1724 when a city Sheriff, William Hutton, and his workmen dug up the field and found a number of bones, complete skeletons, as well as stone coffins. The next discovery was reported in 1987 when the construction of the Barbican Centre was about to commence (Bruce, 2008). These human related activities proved to be one of the causes of possible truncation and skeletal element removal.

Based on the analysis results explained on the previous chapter, the skeletal sample of All Saints Church, Fishergate were mainly assigned to the category of Class 2, which shows that the bones of these skeletal remains were 1-24% preserved. On the other hand, from the sample taken for this research, only one skeletal remain assigned as Class 5 of well preserved bones with 75% of its bones preserved (SK

3557). This condition may be related to the fact that the area of All Saints Church had experienced several area modifications especially after the church was abandoned and then demolished. Fragmentation of skeletal remains was assumed to be caused by either from the conditions of overlapping burials during which time the site was used (continuously), or by more recent human activities, such as what has been noted, the establishment of Cattle Market as well as the development of Barbican Centre.

Based on the analysis comparing the skeletal element preservation with the location where these skeletal remains were found, it appears that the remains which were found inside the church's wall present higher frequencies rather than the skeletal remains found outside the church. The skeletal elements with high frequencies found inside the church's wall are ribs, thoracic, cervical, lumbar, tarsal, metatarsal, carpal, metacarpal, and hand phalanges. On the other hand, skeletal elements with high frequencies found outside the church are ribs, thoracic, tarsal, metatarsal, and metacarpal. These general results show that the location inside the church might have better soil condition to support the preservation of skeletal elements rather than the soil condition outside the church. Other factors which may be considered to have caused the different state of preservation for skeletal elements between these two locations are natural causes such as root movements, availability of water, and faunal activities. The effect of any forms of vegetation to buried human remains may vary greatly although this may not always appear evidently (Nawrocki, 1991). The movements of roots on plants may affect the position of any artefacts, and in this case ecofacts such as skeletal remains. The larger the root and the more rapid its movement may cause in bone modification, disposition, or even destruction of the skeletal elements (see also Henderson, 1987). The skeletal remains buried inside the church might not face the threat of this factor as much as the skeletal remains buried outside the church. Vegetation from a more recent time which grows around the area of this church may caused a far greater disturbance for the skeletal remains buried outside the church, instead of those buried inside. The high frequency of skeletal elements found inside the church might as well caused by the fact that the majority of mass graves unearthed on this site were found inside the church. As the state of preservation of skeletal remains buried inside the church is better than those buried outside, it is highly possible that the frequency of each skeletal element is also better represented.

Logically, the risk of skeletal elements buried inside the church to be destroyed is expected to be lessened, unless there is human interference in altering the soil deposition which inevitably will also cause damages to the skeletal remains. For instance, some of the skeletal remains inside the church were indeed found truncated as the burials were cut by the foundation of the church itself. Other skeletons have also been found truncated which might be caused by a more recent disturbance, such as when the area of the church was transformed into Cattle Market in the early 19th century. In exception, the preservation of Roman skeletal elements in the sample appeared to be well preserved although these remains were found buried outside the church. Another factor which might be influencing the state of preservation of these skeletal remains is the size of the graves. As mentioned before, the mass graves found on the site vary greatly in sizes, from small ones to large ones. The size of the graves might also affect upon trampling and overlapping positions of the skeletons, especially in mass graves.

The sample of medieval period may show a more significant level of presentation and this is probably caused by the amount of sample taken from each periods. The total number of medieval sample is obviously greater than the total number of early medieval and Roman samples. However, based on the analysis comparing the anatomical preservation indices with the assigned period of the sample, it appears that Roman samples are far more well preserved than the samples from early medieval and medieval. The latter analysis result may be more sensible as Roman samples were buried in graves with depth greater than the early medieval or medieval (Nawrocki, 1995). In general, skeletal preservation may vary according to the depth of the graves. If the depth of the grave is more shallow and closer to the ground surface, it is almost possible that the scale of skeletal preservation can be assigned as poorly preserved. The conditions of poorly preserved bones may appear as being highly fragmented, fragile, and anatomically incomplete. On the contrary, burials situated at a greater depth are often found in a rather well preserved condition. It is indeed possible to analyse the relationship between grave depth and skeletal preservation (Nawrocki, 1995: 58). Unfortunately the majority of the grave cuts could not be seen during the excavation, as the soils appear to be homogenous. Furthermore, the grave cuts were truncated by burials of the later period, so the information about the grave depth in the site tends to be arbitrary (McIntyre, pers. comm., 2009). There are also indications which suggested that the wall of the church was still partially standing when these graves were dug up as some of the skeletal remains were found directly overlying the church's foundation.

The adult skeletal elements are indeed appeared to be well presented if compared to the juvenile sample. This result is consistent with the comparison of anatomical preservation indices with age categories. The analysis shows that skeletal elements of the adult sample are well preserved compared to the juvenile sample. The nature of juvenile skeletal structure is known to be smaller in size and less dense than the skeletal structure of an adult. It is indeed easier to recognize and differentiate the skeletal elements of adults rather than of juveniles, because the size of adult bones are generally larger and more robust. These aspects might be the reasons for juvenile skeletal elements are often appear to be under represented if compared to adult skeletal elements. In addition, the smaller size of juvenile skeletal elements made it more susceptible to the activities of burrowing animals, root movements, and worms (Buckberry, 2000). Skills on recognizing small and unfused juvenile skeletal elements are also necessary, because the deficiency on these skills may also be responsible to the cause of under representation of juvenile skeletal elements during the excavation process (see also Scheuer & Black, 2000). In their studies, Gordon & Buikstra (1981) concluded that the preservation of juvenile skeletal remain decline rapidly according to the soil acidity in which the burial was situated, compared to the skeletal remains of adults. As in the sample of All Saints Church of Fishergate several skeletal elements of the juvenile remains appear to be more well preserved than those of the adult sample, therefore it is probable that the soil acidity within the area of the cemetery is less callous thus causing this condition.

4.2. Conclusion

Taphonomical changes in archaeological evidence can be caused by natural and cultural factors. By recognizing these factors one will be able in determining how and why they affect the state of preservation on the archaeological evidence. Human taphonomy, by focusing to the skeletal remains as archaeological evidence aimed to answers questions related to the issue of buried skeletal preservation. The great number of skeletal remains unearthed in the site of All Saints Church of Fishergate is considered interesting to provide information about the pattern of skeletal preservation. Samples were taken and series of analyses were done in order to identify the skeletal preservation as well as to illustrate the possible factors causing taphonomic occurrences on the site.

In conclusion, to answer the questions addressed for this research, the sample of skeletal remains in the site of All Saints Fishergate is classified into the level of moderately preserved (class 2) as most of the sample was found outside the church which affects the state of preservation because the possibility of disturbances are higher. Tibia and fibula appear to be the most presented bones in the sample due to its cortical structure which allows these skeletal elements to preserve better than other elements. On the other hand, small bones such as hyoid, phalanges, carpal and tarsal bones were under represented in frequency due to the trabecular structure which enabled these elements to degrade faster than other elements with a m ore dense structure. Moreover, the size of these bones also made it possible for them to be mistaken as small stones or even accidentally discarded during the process of excavation.

The analyses results show that there is a correlation between location where the skeletal remains were discovered and the state of skeletal preservation. The remains buried outside the church obviously faced more severe taphonomical threats which will affect the state of skeletal preservation. On the other hand, the remains buried inside the church might have faced lesser threats. Even though the skeletal remains buried inside the church also faced the threats of being truncated by church's foundation building activities (i.e. during redevelopment), but the remains buried outside the church had to deal with other factors such as vegetation and faunal activities, water intrusion, and temperature.

Based on the site phasing according to the period in which these skeletal remains were assigned to, the state of skeletal preservation of the Roman samples appeared to be in a better preservation compared to the sampled from early medieval and medieval skeletal remains. The factor of grave depths in Roman burials may contribute to this result, as generally Roman burials are tend to be situated in a greater depth compared to the burials of later periods (i.e. early medieval and medieval). Other factors such as burial preservation and burial treatments during each period may as well contribute to the skeletal preservation on human remains. A more detailed observation and analysis need to be done regarding to this issue as the majority of the grave cuts appeared to be truncated by burials of later periods.

Age categories seemed to be influential to the state of preservation of the skeletal elements in the sample. The adult skeletal elements are well presented in frequency and seem to have a better state of preservation as well, if compared to the juvenile skeletal sample. Due to its smaller and more fragile structure or composition of the bones, skeletal elements in the juvenile sample tend to have more threats of not being preserved as well as the adult skeletal elements. Even in a carefully planned excavation, elements of juvenile are susceptible to be lost or removed.

Of all the taphonomical factors contributed to the state of preservations of skeletal remains in this site, the factor mostly responsible is probably the continuous land usage for development and construction. The area of All Saints Church of Fishergate was noted not only once to have undergone area development which dated back even far before the more recent ones. The process of modern area developments caused the relocation or destruction of the site, as well as the archaeological evidence hidden beneath them. The preliminary process of site development may as well cause truncation and removal of random skeletal elements from its archaeological context. This, of course, is inevitable but still contributes to a great extent on the state of preservation of the skeletal remains.

Further researches are still yet to be done to address the broad aspects of taphonomy. Pathological conditions during the lifetime of an individual are also considered to contribute such skeletal condition which may also cause the structure of the bone to degrade. This was recognized as an individual factor which can alter the state of skeletal preservation. Therefore, further studies regarding this topic might be interesting to be undertaken on the skeletal remains in this site. A more in-depth research regarding the effect of soil condition between the two locations where the skeletal remains were found can be establish in order to gain more information about the pattern of skeletal preservation in the assemblage in All Saints Church Fishergate. Another possible further research that can be established regarding the issue of taphonomy is by focusing on the pattern of fragmentation on the skeletal remains found in this site, remembering the continuous areal disturbance occurred on the site may as well contribute to the state of fragmentation within the assemblage.

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