Dental Wear in Determining the Age at Death for the Santa Catalina de Guale Population: Methodology

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by
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Clark Larsen called to say that this is a piece of solid, original work.
Thecla.

St. Catherines Island, Georgia, has been an area of archaeological investigations since the mid-nineteenth century. Since then a number of scholars have examined both prehistoric and historic sites on the island, as well as completing ethnohistorical studies. These previous studies indicate that the island was occupied by the Guale Indians approximately 4000 years ago until its abandonment in 1693. During this time, there was a period of Euorpean contact with the native population, from 1526 to 1683, which had both biological and demographic impacts on the native Americans (Thomas et al. 1978). Figure 1 illustrates the location of historic Guale settlement.

The focus of this paper is to describe the methodology utilized for the investigation. The methodology used in this study involves examining the dental wear in order to determine age at death. The basis of this study is the archaeologically recovered human remains from an early contact period involving the Spanish mission, Santa Catalina de Guale, on St. Catherines Island. Following is a brief discussion of the history of St. Catherines Island and a detailed discussion of the methodology utilized for the study.

HISTORY OF ST. CATHERINES ISLAND

St. Catherines Island is one of the barrier Sea Islands along the Atlantic coast of the Southeastern United States (see Figure 2). The island was formed between the late Pleistocene and Holocene periods; however, it was not until 4000 years ago that the Guale came to inhabit the area (Thomas 1978).

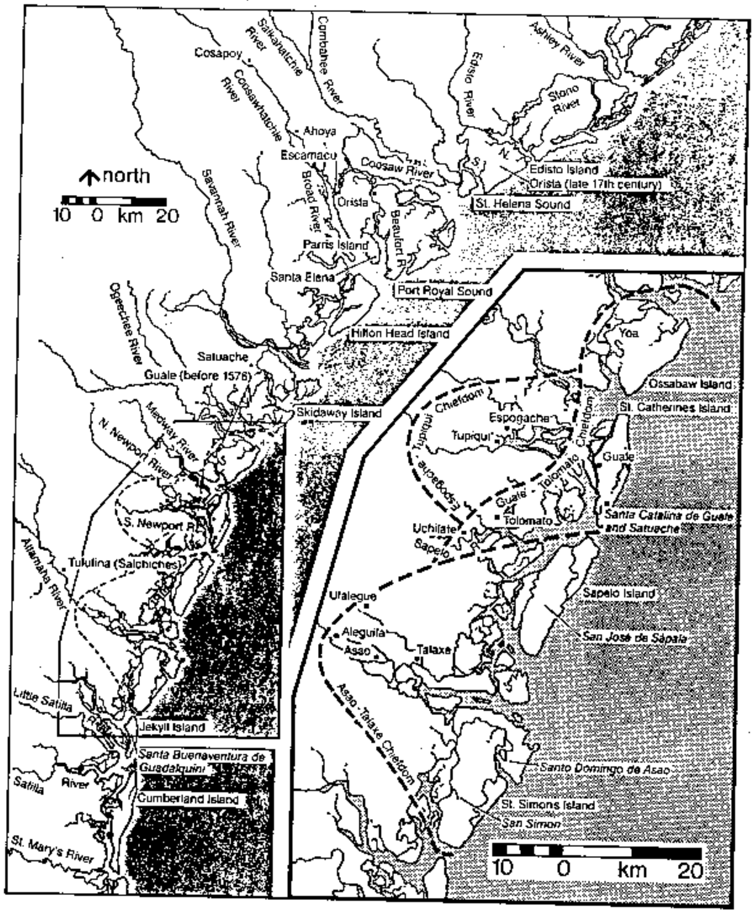


FIGURE 1: Location of Historic Guale Settlement
(from Thomas et al. 1978)

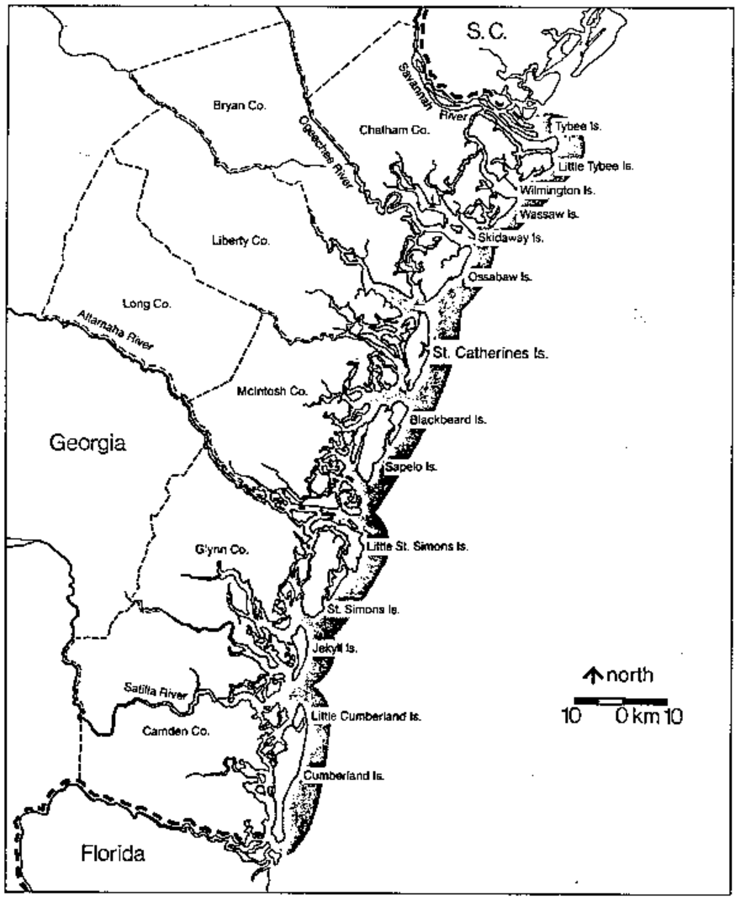


FIGURE 2: Location of St. Catherines Island, Georgia (from Thomas et al. 1978)

The archaeological data indicate that since its first occupation up until A.D. 1150, the natives hunted, gathered, and fished as their modes of subsistence. During this period, the populations were widely scattered in small settlements, probably reflecting the nuclear family occupation of small seasonal camps. Then after A.D. 1150, changes in their subsistence and settlement patterns took place: in addition to hunting and gathering, the domestication of plants (particularly maize) was adopted, and evidence of an increase in population and a more sedentary lifestyle became apparent. Another major change in their lifeway occurred in 1526, when the Guale populations first came in contact with the Eurepeans. The above changes in the lifestyles of the Guale have been studied in detail, both archaeologically and ethnohistorically (see Jones 1978; Larsen 1982, 1983, 1984). The following briefly discusses those previous studies on St. Catherines Island.

Prehistory: Preagricultural - Agricultural Periods

The archaeological investigations of the preagricultural and agricultural populations have concentrated mainly in the effects of the adoption of agriculture on the human skeleton and dentition. St. Catherines Island provided excellent data for these studies because the island had been continuously occupied for over 2300 years, and therefore it contained burial mounds from both preagricultural and agricultural periods. Through the comparison of the human remains from the two types of mounds, the impact of agriculture was observed (Larsen 1982).

The comparative analysis of the human remains from the two periods indicates that there was a change in the status of health among the Guales. As a result of the domestication of plants, the population became more sedentary, nucleated, and increased in size. This in turn produced a higher frequency of infectious disease, evident in the skeletal materials by the presence of periosteal reactions. Periosteal reactions occur when the cortical(outer) bone has been affected by an infection. Also, due to the heavy consumption of maize, a plant high in carbohydrate, the frequency of dental caries increased. The changes in the skeletal and dental remains involve a reduction in the facial and masticatory complex size, posterior tooth size, the postcranial size, and stature. Also due to the increase in sedentism, less mechanical stress on the skeleton was applied. Therefore, there was a decrease in the frequency of degenerative joint diseases (Larsen 1982, 1984).

In sum, the effects of the adoption of agriculture by the natives of St. Catherines Island has been studied in detail. The comparative analysis of the preagricultural and agricultural populations indicate that the latter had an increase in the frequency of infectious diseases, a decrease in degenerative disease, and an alteration of skeletal size from that of the preagricultural population.

Protohistoric Context

The first Europeans to arrive at the Guale coast were members of a Spanish slaving party in 1526. Then in 1562, French Hugenots arrived on the coast to establish their colony, which would be abandoned in 1563 (Jones 1978).

The colonization by the Spanish had the most significant effect on the Guale. The Spanish established missions, and the Indians associated with the missions provided the labor for the colony. The Guale, in return, were treated with contempt and were forced to pay food tribute to the centralized villages. Responding to such treatment, the Indians revoltted, beginning in 1576, and the rebellions intensified as time progressed. Consequently, many of the Indians were killed and many fled, causing a decrease in population. In addition, because the Old World diseases were brought to the virgin soil - Guale coast by the Europeans, the natives were struck with epidemics such as smallpox, measles, bubonic plague, scarlet fever, whooping cough, malaria, typus, dipteria, cholera, and influenza. With epidemics and with increasing attacks from the English occupied Carolina settlement, the population size drastically reduced, and the island was eventually abandoned in 1683 (Jones 1978).

From 1977 through 1979, an archaeological survey of the island was conducted by the Edward John Noble Foundation and the American Museum of Natural History. Through the survey, the site of the Spanish mission, Santa Catalina de Guale, have been located. The mission area included the church structure, village deposits, and a well. The church structure is constructed of three daub walls and a fourth wall probably constructed of wood. Beneath the church floor human burials were confined in the mortuary pattern of sixteenth - seventeenth century mission cemeteries. The individuals were buried in shallow pits parallel to the long axis of the structure, in supine position, heads oriented toward the southeast, and hands crossed over the chest (see Figure 3). The artifacts were religious medallions, copper bells, and crucifixes (Larsen 1983; Hutchinson 1986).

The human remains from this cemetery have been subject to research concerning the quality of health within the context of changing lifeways. Hutchinson(1986) studied the implication of biological stress by the analysis of the dental remains. In his study, Hutchinson noted that the population during the mission period experienced more biological, nutritional stress than the precontact period, as indicated by a high frequency in the appearance of hypoplasia in the dental remains. Hypoplasia is a deficiency in enamel thickness, which results in leaving a linear groove on the crown of a tooth. This defect occurs during the calcification of a tooth when the individual experiences nutritional stress, and therefore the development of the tooth discontiues for the period of stress.

In sum, the previous studies show that during the prehistoric period the Guale shifted in their subsistence pattern from hunting, gathering, and fishing, to an agriculturally based life. The consequences of such a shift are evident in the skeletal remains: increase in frequency of infectious diseases and a decrease in the frequency of degenerative joint diseases. Thus far, the historical data, in addition to archaeological

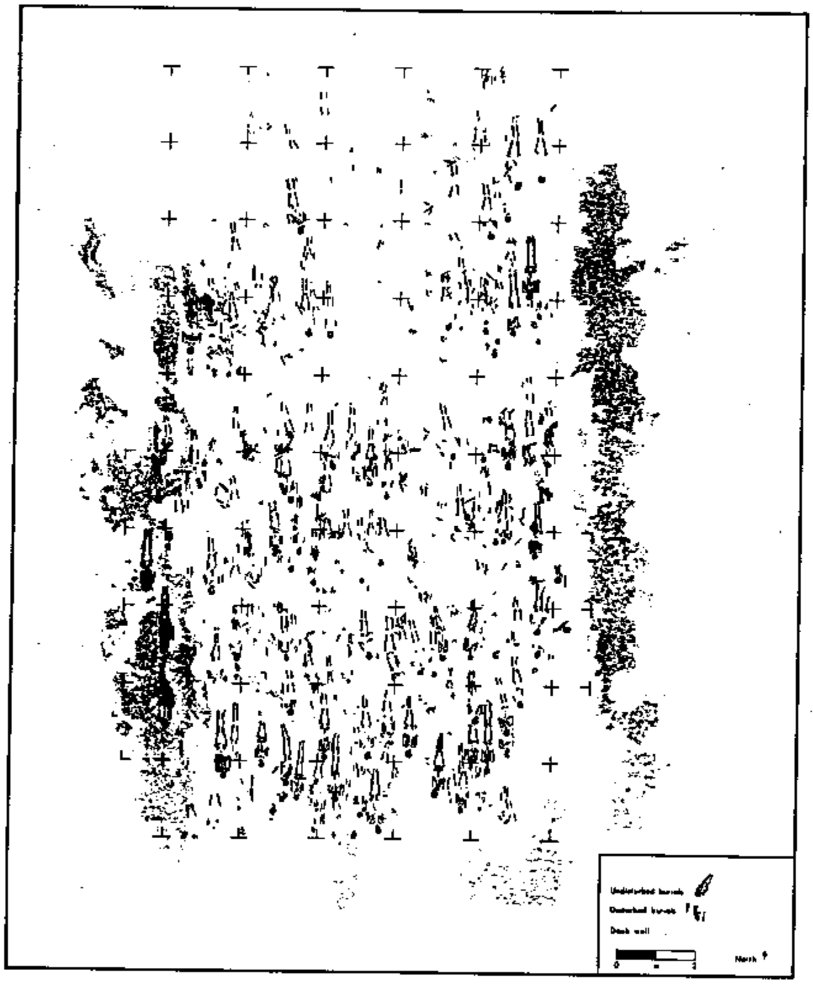


FIGURE 3: Santa Catalina de Guale: Location of Burials

data of the priod, indicate the impact that European contact had on the native Indians. The recent analysis of the dental remains of the historic mission population implies an increase in the amount of nutrition and disease stress experienced by the Guale.

METHODOLOGY

Determing the age at death of archaeologically recovered individuals is an essential component in demographic study. Using various parts of human skeleton, many authors have developed different methods for the assessment of the age at death. These methods utilize features such as: suture closure, ossification of bone, pubic symphasis, auricular surface, dental calcification and eruption, and dental wear (see Gilbert and McKern and Stewart 1973; Jackes 1985; McKern and Stewart 1957; Lovejoy 1985; Lovejoy et al. 1985; Miles 1963 and 1978; Smith 1984; Swardstedt 1966, and Ubelacker 1984). Most of these authour utilized just one of these features to determine the age. Lovejoy et al. (1985), however, noted that using the multifactorial method (utilizing suture closure, auricular surface, radiographs of proximal femur, pubic symphaseal face, and dental wear as the principal components) results in more accurate outcome than using any single indicator.

In this study, only the dental remains, 199 mandibular dentitions, of the Santa Catalina de Guale population is used. Although Lovejoy et al. (1985) discussed the superiority of the multifactorial method, due to the poor preservation of the skeletal remains from the mission cemetery, the principal components used in their method could not be applied. As the hardest substance of skeletal material, only the dental remains were preserved well enough to be studied in detail. When possible, however, individuals were aged by measurements of the long bones, particularly the pre-adults. In all those cases, the age derived from the dentalanalysis corresponded with the age derived from the other age indicators.

The principal methods used for the determination of age of the Santa Catalina de Guale population are those described by Ubelaker (1984) and Miles (1963 and 1978). For assigning the ages for the young individuals (less than 19 years of age), Ubelaker's method of age estimations based on calcification and eruption of teeth was used. Then, to estimate the ages for the adult group, Miles' method of age assessment based on the functional occusal wear of molars was used. The following sections discuss the methods more in detail as they were utilized in this study.

The current study involved 199 mandibular dentition, of which 87 were pre-adults. In defining a set of teeth as a dentition, two criteria had to be met: 1) a dentition had to have at least three teeth, and 2) at least one of the three had to be a molar. The first criterion allowed to justify consistency in wear within the dentition. Since Miles' method requires analysis of occlusal wear of molars in order for individuals, particularly the adults, to be assigned an age at death, presence of at least one molar was required. The second criterion, however, was not critical for aging the pre-adulats up to about twelve years of age. Observing the formation and eruption of permanent and deciduous teeth and root provided the information needed for determining the age at death; therefore, the presence of molars was not essential.

During the excavation of the mission cemetery, isolated teeth belonging to different individuals were bagged separately. If the teeth belonging to several individuals were found in a cluster, then the whole cluster was bagged together. Those teeth then were carefully studied in the laboratory to be separated as individuals, and to see whether or not any of them belonged to dentitions of individuals buried nearby. The coloration and the size of teeth, and the matching of the mesial and distal facets between the teeth, were used as factors to determine whether or not the teeth found in clusters belonged to another nearby indivicual , or if the teeth belonged to each other within the cluster. In the laboratory, each of the isolated dentitions were placed in petri dishes filled with sand. The purpose of using sand was to hold the teeth in their articulating positions.

Before the individuals were assigned to specific ages, the dentitions were placed in seriation according to their calcification, eruption, and wear level. Then, using the methods described by Ubelaker and Miles, the age at death of the individuals was determined.

Pre-Adult Age Determination

Ubelaker's study (1984) on the development of teeth in American Indians provided the basis for aging the pre-adults from the mission population. From various authors, Ubelaker collected data on rate of eruption of permanent teeth among American Indians. For the calcification of permanent teeth, and the calcification and eruption of deciduous teeth, he gathered data from non-Indian populations, mainly white Americans. Figure 4 is a summarization of the data collected by Ubelaker from Ubelaker 1984). He noted that some studies indicate that teeth of Indians form and erupt earlier than those of white Americans, therefore, he used data from the "early" end of the published variation in preparing the chart. Since his study provided an approximate chronology of dental development, each of the stages in the sequence is accompanied by a plus or minus range of months to allow for vaiability.

Using the chart provided by Ubelaker, individuals up to age twelve were aged according to calcification and eruption of teeth. Beginning with the teeth formation at five - month utero, he had an interval of a year or less between the stages up to the age twelve. Then his sequence skip to age fifteen, then to age twentyone. Due to the larger intervals towards the latter stages of the sequence, the individuals between the ages twelve and fifteen, and fifteen and twenty-one, could not be aged using the chart. Therefore, using the method described by Miles, the intervals between the stages twelve to fifteen and fifteen to twenty-one were reduced to intervals of one year

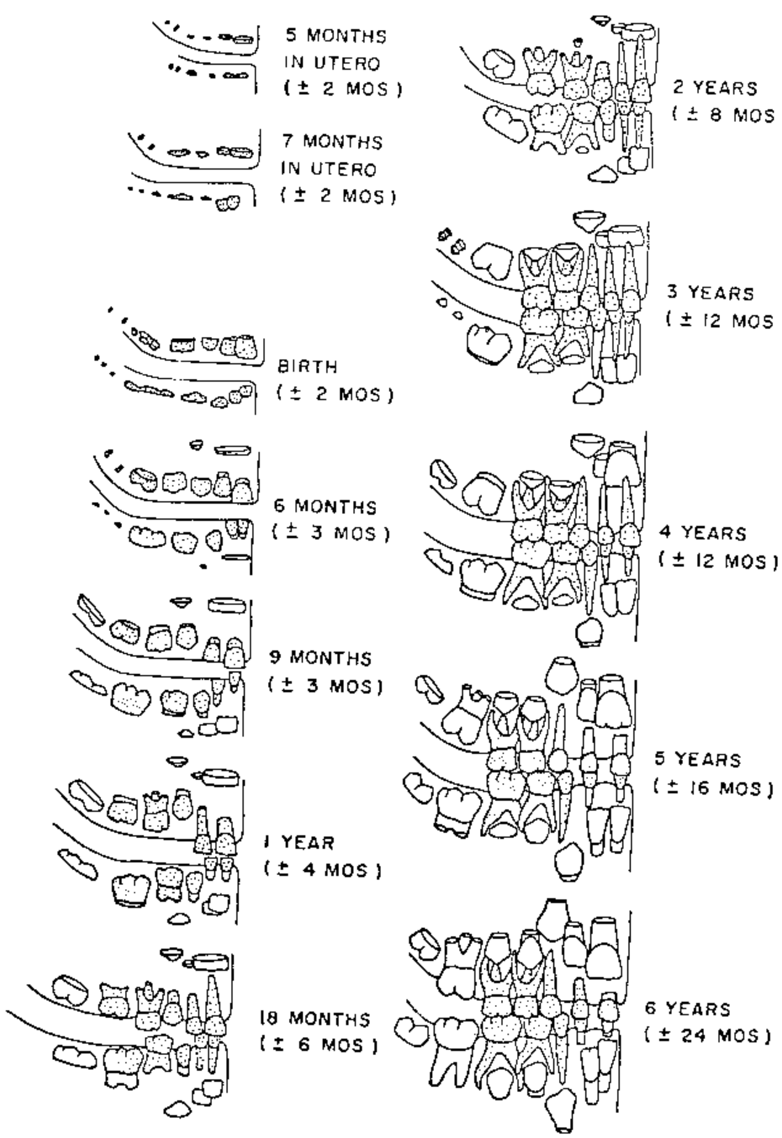
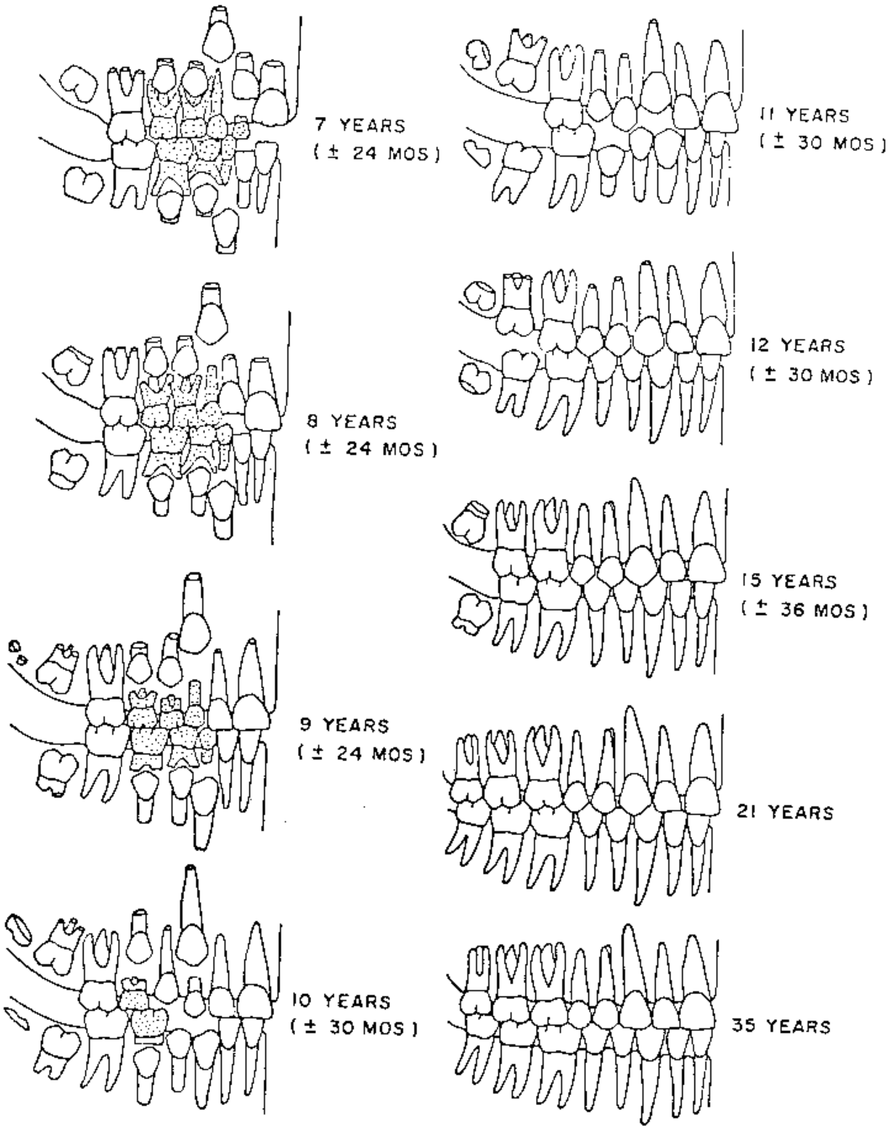


FIGURE 4: The sequence of formation and eruption of teeth among American Indians (from Ubelaker 1984)


7 YEARS
(± 24 MOS)
8 YEARS
(± 24 MOS)
9 YEARS
(± 24 MOS)
10 YEARS
(± 30 MOS)
11 YEARS
(± 30 MOS)
12 YEARS
(± 30 MOS)
15 YEARS
(± 36 MOS)
21 YEARS
35 YEARS

by establishing additional stages between them.

Miles' method in determining the age at death involves estimating the number of years the teeth have been functionally used. This method is based on a generalization that the permanent maxillary and mandibular first, second, and third molars (M1, M2, M3) erupt at ages 6, 12, and 18 respectively.

When Miles (1963) explained his method for determining the age by utilizing M3, he noted that M3 erupted by age 18, and by age 19, the M3 was in full occlusion. Throughout this study it was generalized that all teeth required one year from the initial eruption period to reach full occlusion. Thus, in this study, the term "eruption" was used to mean that a tooth had just passed through the stage of initial emergence from its cript, and that the eruption began immediately when an individual turned 6, 12, and 18 depending on which molar. The calcification and eruption sequence of permanent molars provided by Ubelaker also confirm this. Then, by the beginning of ages 7, 13, and 19, the molars would reach full occlusion, and by the beginning of ages 8, 14, and 20, each molars would have one year of functional wear. Therefore, when X = age at death, (X-7), (X-13), and (X-19) would equal the functional ages for M1, M2, and M3 respectively. Using this standard then, we could say that an individual who is fourteen years of age has seven years of functional wear on M1 and one year of functional wear on M2. Then, an M2 of a person who is fourteen years old should have an equivalent amount of wear as an M1 of a person aged eight years (both M1 and M2 have functional wear of one year). Below is a clarification of the concept used.

M3 wear at =	M2 wear at =	M1 wear at =	Functional wear in years
18 years	12 years	6 years	Begin to erupt
19	13	7	0 years of wear
20	14	8	1
	15	9	2
	16	10	3
	17	11	4
	18	12	5

Once the ages were assigned to the individuals between 12 and 15, and 15 and 21 throught the comparison of occlusal wear, the stages of root development of the molars were noted. In the Ubelaker sequence, the relationship between the development of crown and root of a tooth, and its position in maxilla and mandible before and after eruption of a tooth is clearly illustrated. Therefore, using that as the basis, the position of a tooth before and after the eruption was estimated. Using all this information (years of functional wear, root formation, and position of a tooth), it was possible to establish chronological stages of tooth development between the ages 12 to 15, and 15 to 21, each stage representing one year. Figure 5 is a chart illustrating the result of the information discussed above.

It must be noted, however, that although the generalization that M3 comes in occlustion at age 18, many researchers stated

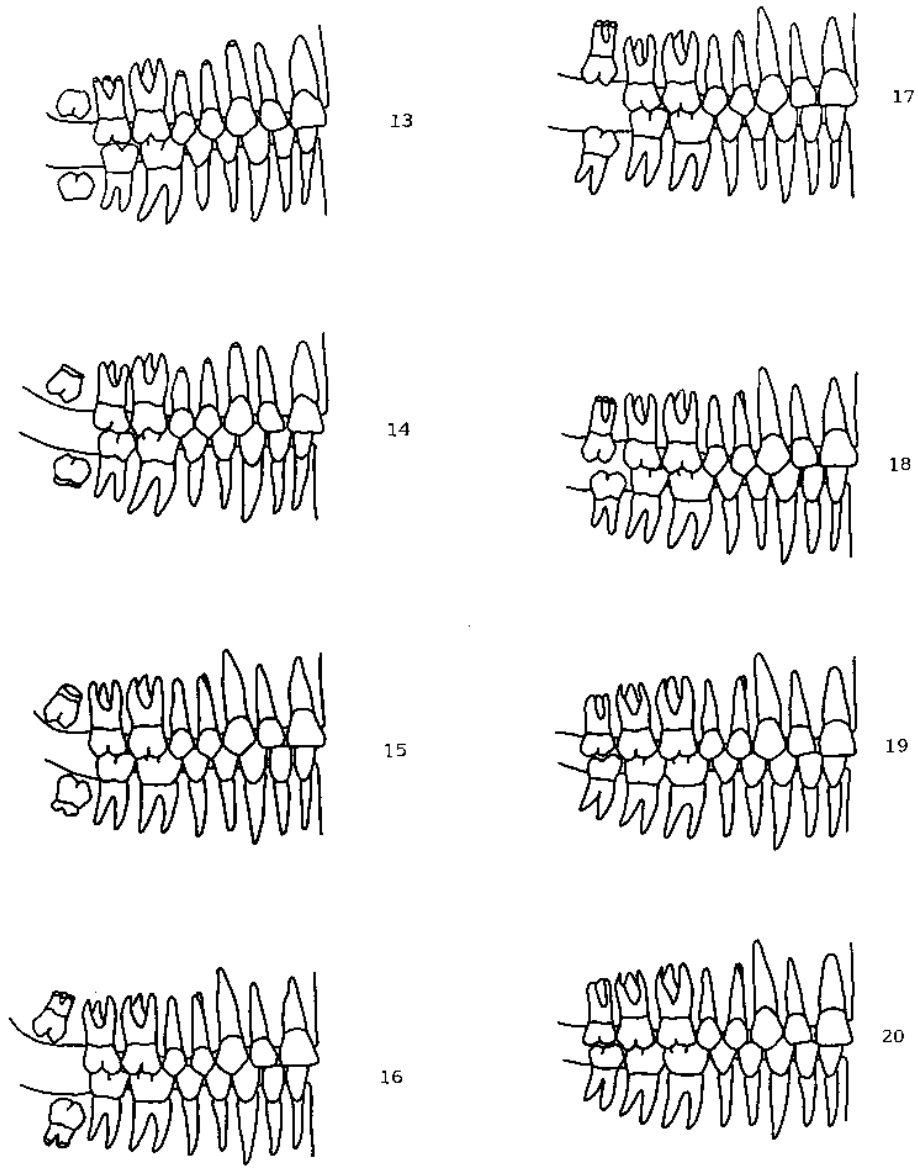


FIGURE 5: An addition to Ubelaker 1984

there is a wide variation in formation and eruption of M3. This was also apparent in this study (see Figure 7). This generalization was still utilized, but the relationship between M3 and other molars, in terms of wear, was also considered (i.e. If M1 had a functional wear of 21 years and M3 had a wear of a year, the individual was not aged as a 19 year old, but rather as a 31 year old individual. In this case it was assumed that M3 erupted later than the generalized year, or that individual had lost the maxillary M3 few years after the eruption).

In sum, using the chronological sequence of dental development compiled by Ubelaker, the pre-adults of the Santa Catalina de Guale population were assigned an age at death. Because Ubelaker had a larger interval between his stages of dental development, from 12 to 15 and 15 to 21, it was necessary to establish additional stages, each representing one year, to reduce the size of the interval between those years and to assign ages to individuals between 12 to 15 and 15 to 21. This was accomplished partly by utilizing Miles' method of determining the years of functional wear on the occlusal surface of the molars, observing the root formation, and determining the position of teeth before and after the eruption.

Adult Age Determination

Determining the age at death for the adult population was based on the method developed by A.E.W. Miles (1963 and 1978) from his study of 190 dentitions from an Anglo Saxon cemetery in England. In addition to the Miles' method, the methods of scoring the degree of wear and calculating the rate of wear (regression coefficient) were adopted by Smith (1984) and Swarstedt (1966) respectively.

Miles' method involves first estimating the age at death of the pre-adults by using calcification and eruption of the teeth, and then extimating the number of years that individual tooth has been in functional occlusion. Once the dentitions of the pre-adult are assigned ages, those are used as the basis in determining the functional age of the adults. For instance, if an M3 of an individual has approximately an equal amount of wear as an M1 of a 19 year old, then the first individual would be 31 years old. The calculation involves adding the number of function years for the teeth and the age when the tooth reaches full occlusion (12 years of functional wear + 19 = 31 years).

During his analysis, however, Miles noticed that the rate of wear on the three molars was not uniform. He noticed that M1, M2, and M3, all of the same functional age had a different degree of wear: M3 appeared to have a smaller degree of wear compared to M2, and M2 compared to M1. It was evident that the rate of wear diminishes as the tooth row reaches toward the posterior of the teeth row. Miles explained the cause by reasoning that as the number of molars increase, the amount of work required by the dentition is shared between the molars. Therefore, with the presence of M1 and M2, M3 would wear at a slower rate than M2 before the eruption of M3; and M2 would wear at a slower rate compared to M1 prior to the eruption of M2 and M3. Miles expressed this wear relationship by using the ratio 6: 6.5: 7. This ratio means that when it takes 6 years for M1 to reach a stage of wear, it would take M2 and M3 6.5 and 7 years respectively, to reach that same stage of wear. Using this ratio, then, we see that if an M2 has an equivalent amount of wear as an M1 of 43 years in functional age, then M2 actuqlly is 47 years old in functional age. Although the rate of wear between the 3 molars varies, Miles concluded that the rate of wear for the M1 is not slowed down by the emergence of the M2, however M2 does wear at a slightly slower rate than M1. The calculation is shown below.

$$\frac{43}{6} = \frac{X}{6.5}$$, where X=Functional age of M2

$X = 46.7 \doteq 47$ years in functional age.

By adding the functional age and the age when M2 erupts, the age of the indificual can be determined.

47 + 12(age when M2 erupts) = 59 years

Due to the difference in ratio, the age obtained from the calculation would vary depending on which one of the three molars was used for the calculation. Therefore, Miles calculated the ages by using all the molars of an individual, then took the mean of the values to derive at the age of an individual.

EXAMPLE FROM MILES'S SAMPLE

M2 wear = 43 years of M1 wear

X = Years of M2 wear

$$\frac{43}{6} = \frac{X}{6.5} \; ; \; X = 46.6 \doteq 47$$

age = 47 + 12 = 59 years

M3 wear = 33 years of M1 wear

X = Years of M3 wear

$$\frac{33}{6} = \frac{X}{7} \; ; \; X = 38.5 \doteq 39$$

age = 39 + 18 = 57 years

M3 wear = 30 years of M2 wear

X = Years of M3 wear

$$\frac{30}{6.5} = \frac{X}{7} \; ; \; X = 32.3 \doteq 32$$

age = 32 + 18 = 50 years

Estimated Age of the Individual:

$$(59 + 57 + 50)/3 = 55.3 \doteq 55 \text{ years}$$

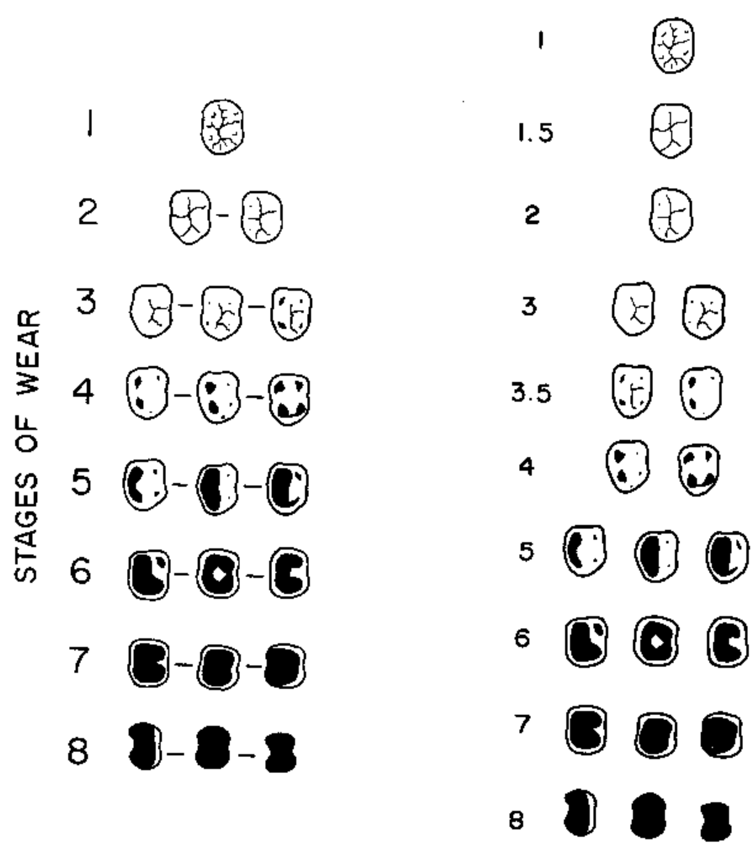
It must be mentioned that Miles' method is based on the assumption that the rate of wear of the molars and the ratio of 6: 6.5: 7 remain constant throughout the life of dentition.

Our preliminary analysis did not support the use of such a ratio. In the Santa Catalin de Guale sample, we could not assure that wear was a constant function. Also, we could not assure that M1, M2, and M3 maintained the same ratio of wear rates throughout the age classes. Although we were forced to assure linearity in wear, we believed that the ratio seemed only to further skew the data. Therefore, although the assumption that the rate of wear remains constant was used, the ratio 6: 6.5: 7 was not used in this study.

In order to check the consistency in the rate of wear, each molar from the Santa Catalina sample was scored: using the scoring system developed by Smith (1984); each tooth was scored according to the degree of its wear. The scale provided by Smith was adopted for this study instead of the scale used by Miles. Both populations used in Smith's study and this current study are American Indians who practiced agriculture, where the population used by Miles was Anglo-Saxon. Therefore it was the similarity in the population samples which determined the scale used. The scale by Smith, however, was modified in this study. The original scale consisted of stages of wear, each stage represented by a whole number from 1 - 7, which 1 being little or no wear and 7 being severe wear. The modification of this original scale resulted in inserting the intermediate stages of 1.5 and 3.5. Both the original and modified Smith's scale are shown on figures 6A and 6B.

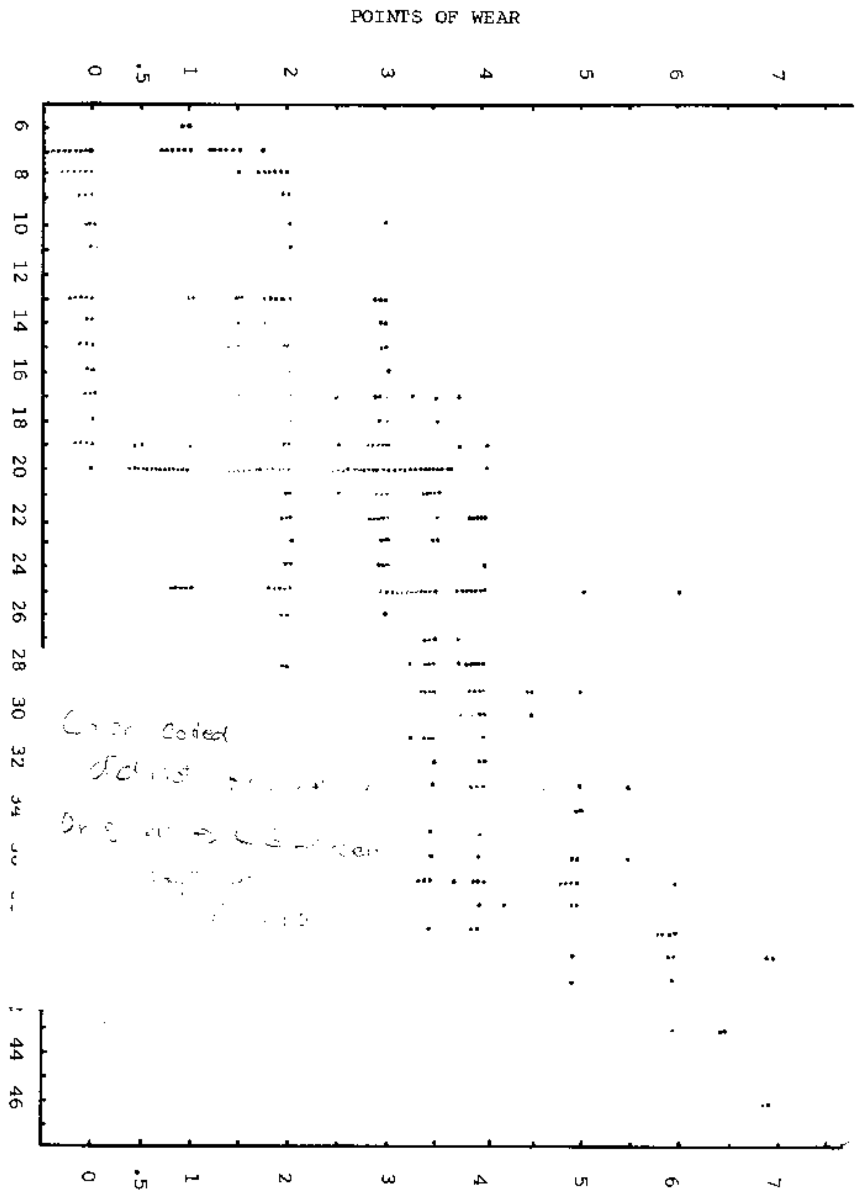
Using the modified Smith scale, each permanent molar was scored according to the wear. An assumption was made that each stage represented an even interval and that an equal amount of time is involved in each stage of wear (except for stages 1.5 and 3.5, half of the period required by the other stages is represented).

To illustrate the relationship between the age and the level of wear (the abrasion point assigned to each tooth), a graph was plotted. The results are shown on Figure 7. The figure illustrates a linear relationwhip that the degree of



A B

FIGURE 6: (A) Diagram of crown surface used to score stages of tooth wear (from Smith 1984).
(B) a modification of Smith 1984.



M1
M2
M3

AGE

FIGURE 7

wear increased with increasing age at a constant rate. This evidence of linearity, however, could be a result of the earlier assumptions: Miles' method assumed linearity, thus while assigning the functional ages to the individuals, it was assumed that the rate of wear was constant. The scoring system developed by Smith also assumes that the intervals between the stages of wear are even. Since the whole procedure began with these assumptions, the graph may be a mere reflection of those. However, the Figure 7 does show that there is a consistent relationship between dental wear and age for the children (less than 19) whose age was not determined by wear, but instead by the independent procedures of eruption and calcification

To mathmatically show the rate of wear, regression coefficient (k) was calculated for the sub-adults using the basic linear equation. The calculation requires the abrasion point of a tooth and its functional age. Regression coefficient represents the amount a tooth wears per year (the number of abrasion point per year), and the inverse value 1/k, represents the number of years it takes for a tooth to wear to a certain degree (the number of years per abrasion point).

x = age at death

y = abrasion points

(x-7) = functional age for M1

(x-13)= functional age for M2

From $y = r(x-7)$, $k = \frac{\Sigma y}{(x-7)}$ = points/year for M1

From $y = r(x-13)$, $k = \frac{\Sigma y}{(x-13)}$ = points/year for M2

This equation has been slightly modified in this study: instead of using (x-6) and (x-12) as Swardstedt suggested, (x-7) and (x-13) were used in calculating the functional ages for the M1 and M2 for the reason discussed earlier in the paper.

1) k for M1 before M2 eruption

   subset: 7-11 year old with at least one M1 in occlusion (when both left and right teeth were present, the average of the left and right sides was used when available).

   $N = 26,\ \Sigma y = 43.5,\ \Sigma(x-7) = 47$

   $k = \frac{43.5}{47} = .93$; $1/k = 1{,}08$ years/point

2) k for M2 with M1 in occlusion

   subset: 13-19 year old individuals with both M1 and M2 in occlusion.

   $N = 23;\ \Sigma y = 46;\ \Sigma(x-13) = 98$

   $k = \frac{46}{98} = .47$; $1/k - 2.13$ years/point

3) k for M1 with M2 in occlusion

   subset: 13-19 year old individuals with both M1 and M2 in occlusion.

   $N = 23;\ \Sigma y = 74.5;\ \Sigma(x-7) = 212$

   $k = \frac{74.5}{212} = .33$; $1/k - 2.85$ years/point

4) k for MI from the complete sample

   subset: 7-19 year old

   $N = 51;\ \Sigma y = 122.5;\ \Sigma(x-7) = 300$

$$k = \frac{122.5}{300} = .41 \quad ; \quad 1/k = 2.45 \text{ years/point}$$

5) k for M2 from the complete sample

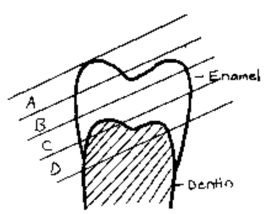
subset: ages from 13-19 year old

$N = 27; \Sigma y = 54.25; \Sigma(x-13) = 116$

$$k = \frac{54.25}{116} = .47 \quad ; \quad 1/k - 2.14 \text{ years /point}$$

From the calculations #1-3, it is clear that M1 before the eruption of M2 wears at a faster rate than M2 with M1 in occlusion, and that M1 wears faster before M2 eruption than after M2 is in occlusion. Although Miles concluded that the rate of wear for M1 is not slowed down by the emergence of M2 but that M2 does wear at a slightly slower rate than M1, our result shows that M1 does slow down after the eruption of M2 as a result of M1 sharing the work load with M2. How long this difference in rate of wear is sustained is not completely understood.

Also, comparing the results of calculations #4 and 5, above show a disagreement with Miles' proposal. According to Miles, M2 should wear at a slower rate than M1, however the calculations seem to indicate otherwise. The reason for this, as Swarstedt noted, is due to greater number of M1 represented in the sample than M2. The manner in which a tooth wears should also be considered.



A: Initial cusp removal

B: Most cusp removal

C: Complete cusp removal with some dentin exposure

D: Full dentin exposure

Figure 8: Stages of Wear

During the period of initial cusp removal (area A), the level of occlusal wear is easier to detect and thus to measure (see Figure 8). However, once the cusps are more completely removed (area B), the degree of wear becomes more difficult to measure since the occlusal view of the crown becomes uniform until the crown of the tooth is completely removed. Once dentin exposure begins (area C) the wear is easier to measure again until complete dentin exposure has occurred (area D). Therefore, when the tooth is in the stages of wear of areas A and C, the abrasion level is more easily scored than in area B where the depth of wear cannot be gaiged with any accuracy. Likewise, the rate of wear of a tooth with complete cusp removed and full dentin exposure cannot be determined. Thus, the mathmetical result indicates that molars during the initial periods of abrasion (A) seem to wear at a faster rate than during the later periods of abrasion (B).

This concept was illustrated in Santa Catalina de Guale sample. As mentioned earlier, the calculation of regression coefficient indicated that M1 slows down in its rate of wear from the time before M2 eruption to after M2 eruption. Then using the concept explained above, we could reason that it is because by the time M2 erupts, the initial cusps of M1 have already been removed. Hence, the rate appears to slow down after M2 eruption. Also, the regression coefficients of M1 and M2 from the complete sample indicate that M2 wears at a faster rate than M1 - opposing Miles and the expected pattern. It is clear that rates of wear are extremely variable and that the rate is related to several variables: what stage of wear the tooth is in (A,B,C,D), how many teeth are sharing the occlusal load, and how wear is measured. The subsets used for the calculation of regression coefficient for M1 and M2 were indificuals between the ages 7-19 for M1, and 13-19 for M2. The greater number of individuals were represented in the subset for M1 than for M2, and the subset for M1 had a wider range of ages than M2. As a result, the older individuals of the first subset already had the cusps removed and even some dentin exposed on their M1, whereas the individuals of M2 subset were still in the stage of cusp removal on their M2. Since the initial cusp removed is more easily scored than the later cusp removal stage, the rate of wear for M2 from the whole sample appeared to be faster than the M1 from the complete sample. This complication suggests that Swardstedt's method of calculating the rate of wear in adults using regression coefficient based on pre-adults is not plausible for the Santa Catalina de Guale sample.

In sum, the age at death of the adults from the Santa Catalina de Guale population was determined by using the Miles' method. This method involves determining the functional age of the dentitions in order to calculate the age at death. The assumptions made in this method are: 1) M1, M2, and M3 erupt at ages 6,12, and 18 respectively, and 2) that the rate of wear is constant. Additionally Miles established a ratio of 6: 6.5: 7 to express the relationship of rate of wear between the three molars. This ratio tells us that M1 wears faster than M2, and M2 faster than M3. This ratio,however, was not used in this study because the degree of wear between three molars of the same functional age could not be accurately measured. Then, using the wear scoring technique provided by Smith, each tooth was scored according to the level of wear. The scoring sustem allowed plotting the relationship between the degree of wear and age. The graph suggested that the pre-adult teeth wear in a constant rate - the degree of wear increases as the age increases. This evidence of linearity probably is a result of the earlier assumption of linearity prior to aging and scoring. Lastly, to determine the rate of wear, the regression coefficient was calculated using the linear regression model. The values suggested by the calculations are equivocal. However, the process is useful in determining a general relationship between dental wear and age: namely, that there is a loose correlation between increasing wear and chronological age. The data from Santa Catalina de Guale question the assumptions that the relationship is eitherlinear or consistent, yet there is a reason to believe that the ages assigned to individuals based on the analysis shall be provisionaly called "dental age", and that when the whole sample is considered, the margins of error shall be such that provisional demographic reconstruction is possible from the sample

The age distribution resulted from the study is shown below. This distribution, however, may not be a true representation of the total population. Among the dentitions from the mission population are a sample mandibles without the molars, apparently belonging to old individuals. Since the methodology requires presence of at least one molar, such individuals could not be used in the analysis. In addition, the mission sample contains a large number of unidentifiable tooth fragments. Although some fragments are results of a greakage during the excavation, some are the results of a tooth "falling apart" after the complete dentin exposure. The molars of older individuals have domplete dentine exposere with remaining enamel loosly attached aroun it. Once this enamel becomes loose, the teeth cannot be used in the sample to be aged. Thus, because a few jaws and tooth fragments which may have belonged to the older individuals could not be used, the older indificuals could be under represented. There may also be artificial under representation of the young individuals. Some mission populations do not bury their children if the children were not baptised prior to the death. The Santa Catalina de Guale has very few youg individuals. Although there is no proof for this hypothesis yet, there is a possibility that the mission also practiced this custom. In spite of these possibilities, the age distribution of the mission population seems reasonable, perhaps close to representing the tru population.

AGE DISTRIBUTION

Age Group	Number of Individuals
0 - 5	22
6 - 10	31
11 - 15	10
16 - 20	44
21 - 25	29
26 - 30	27
31 - 35	13
36 - 40	19
41 - 45	2
46 - 50	1

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