Reading the dental record : a dental anthropological approach to foodways, health and disease, and crafting in the pre-Columbian Caribbean

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Chapter 6 Results

6.1 Introduction

The results presented in this chapter are organized into data pertaining to dental wear, dental pathology, and dental defects. Within these main categories, each individual subject is discussed at sample, site, and intra-site levels. Intra-site sex-based and chronological differences are discussed for those sites with at least four adult individuals of known sex.[7] This minimum number has been arbitrarily chosen, to include as many sites and individuals in the statistical analyses as possible. Rate and type of wear and frequencies of pathology at the different sites – such as caries and AMTL – are compared with each other and, in Chapter 7, with published results from studies across the globe. Next to the assessment of chronological differences on an individual site basis, differentiating between different phases of occupation per site (intra-site), broad scale comparisons over time throughout the region are made (section 6.6), based on the division of the sample into two main groups (Early and Late Ceramic Age) as explained in Chapter 5 (section 5.4).

6.2 Preservation and Completeness

The state of preservation and the completeness of the dental material influence collection of the data, statistical analysis, and interpretation of the results. Table 6.1 shows the completeness of the individual assemblages as a ratio between the prevalence of teeth that are accounted for (i.e., observed, or ante mortem loss) and teeth

Site	Observed + AMTL	Missing + PMTL	Ratio
Buccament West	30	2	0.07
Esperanza	18	2	0.11
El Cabo	53	11	0.21
La Caleta	25	7	0.28
Heywoods	69	24	0.35
Higuey	23	9	0.39
Spring Bay 1c	14	6	0.43
La Mina	21	11	0.52
St. Kitts	41	23	0.56
Argyle 2	61	35	0.57
Chorro de Maíta	1430	830	0.58
Mamora Bay	80	48	0.60
Malmok	78	50	0.64

7 Intra-site chronological comparisons are made based on the time periods established by the author in Chapter 5 using calibrated radiocarbon dates of the skeletal individuals. For Maisabel and Tutu, early and late phases are compared. At Punta Candelero, three phases are distinguished, however in all calculations in this chapter only middle and late are compared, since the number of individuals dated to the early period is too small to allow for reliable testing with statistical analyses. For Lavoutte and Manzanilla numbers in one or more occupation phases were too small to reliably test for differences using statistical analyses.

Site	Observed + AMTL	Missing + PMTL	Ratio
Hacienda Grande	37	27	0.73
Anse à la Gourde	1164	960	0.82
Manzanilla	305	254	0.83
Tanki Flip	34	30	0.88
Kelbey's Ridge 2	93	86	0.92
Maisabel	492	463	0.94
Point de Caille	66	62	0.94
Lavoutte	476	457	0.96
Punta Candelero	856	827	0.97
Escape	398	390	0.98
Argyle	31	33	1.06
Tutu	381	404	1.06
St. Croix, USVI	15	17	1.13
Savanne Suazey	68	80	1.18
Santa Cruz	81	99	1.22
Savaneta	94	120	1.28
Monserrate	28	36	1.29
Santa Elena	22	29	1.32
Collores	22	30	1.36
Punta Macao	233	316	1.36
Canashito	52	74	1.42
Wemyss Bight cave	13	19	1.46
Diale 1	59	142	2.41
Saladero	27	69	2.56
Manigat cave	25	71	2.84
Juan Dolio	52	156	3.00
Tocorón	44	148	3.36
Clarence town cave	14	50	3.57
Gordon Hill caves	11	53	4.82
Cañas	15	81	5.40
Coto	5	27	5.40
Indian Creek	5	27	5.40
Yauco 1	4	28	7.00
Simon Beach	3	29	9.67
María de la Cruz	1	31	31.00
Santa Isabel	1	31	31.00
Total	**7170**	**6814**	**0.95**

Table 6.1 The completeness ratios of the individual assemblages as a ratio between the prevalence of observed + AMTL and missing + PMTL, displayed in order of completeness (high to low).

that are unaccounted for (i.e., missing [absent, no socket observed] and post mortem loss [empty socket observed]). As can be seen in this table, the completeness of the different assemblages varies considerably. The completeness ratios for the entire assemblage ranges between 0.07 (Buccament West) and 31.00 (Santa Isabel). The completeness ratios for the larger sites range between 0.58 (Chorro de Maíta) and 1.36 (Punta Macao), and therefore represent intermediate complete-

ness within this sample.
The state of preservation of the teeth at the individual sites differs considerably (Figure 6.1). Anse à la Gourde, for example, is relatively poorly preserved, most likely due to soil conditions at the site (soft sandy substrate). Many teeth are fragmented, with large parts of the enamel cracked or broken off completely. Root surfaces often appear cracked or fragmented, or the outer surface appears exfoliated, perhaps due to soil acidity. Punta Candelero and Chorro de Maíta are in exceptionally good condition; tooth crowns are rarely cracked or damaged in other ways, root surfaces are intact, and the alveolar bone is generally intact.
The most poorly preserved teeth in the sample are from Argyle. During excavations here and at neighbouring Escape and Argyle 2, almost no faunal remains were recovered. It appears that soil conditions (acidity) are not conducive to the preservation of organic materials, something which is often the case in volcanic substrates. Many dental remains at Escape, Argyle, and Argyle 2 consist only of (fragmented) enamel caps.
Other factors that influence the condition of the material and the ability to document dental wear and pathology are storage conditions, cleaning techniques, and restorative work. Air humidity after excavation greatly influences the condition of particularly the enamel cap of tooth crowns. This part of the tooth, due to its

Figure 6.1 State of preservation of the dental material. Left to right: good preservation of teeth and alveolar bone (Chorro de Maíta 51); post-deposition and post-excavation cracking and fragmenting of teeth and roots due to changing humidity conditions (Anse à la Gourde 450); very poor preservation of teeth with only fragmented enamel caps preserved (Argyle F42-15).

hardness and brittle nature, is highly susceptible to changes in humidity in the environment. The result is cracking, chipping and flaking of the enamel, as it expands and contracts at a different rate than the underlying dentine. This is also the reason that teeth sometimes crack or split as soon as they have been excavated; the change from the relatively moist, cool surroundings in the soil to the much dryer (and hotter) air causes the enamel to break. Cleaning techniques involving water may damage teeth for the same reasons; the introduction of moisture onto a dry tooth causes breakage. Other cleaning techniques, both during and after excavation, may damage dental material when inappropriately hard (tooth) brushes or non-wooden (i.e., metal) picks are used. Such cleaning often results in the loss of dental calculus, a valuable source of microremains of plants and other foods. Another common reason for the loss of calculus is the fact that it is mistaken for dirt adhering to the tooth, and subsequently removed (Roberts 2009; Williams 2001). Restorative work on skeletal and dental material may include gluing various fragmented elements together, and painting numbers and letters onto material with nail varnish, typo correction fluid, and permanent markers. Gluing material sometimes obstructs analysis of the material when teeth are glued into sockets, or, rarely, when jaws are glued together in occlusion. Fortunately only a very small number of individuals incorporated into this study have been subject to such restorative work.

6.3 Dental wear

6.3.1 Macrowear

Rate of wear

As discussed in Chapter 2, food consistency and food preparation techniques strongly influence the abrasivity of foods and as such significantly affect occlusal dental wear. The degree of dental wear is also known to be strongly associated with age. In order to compare the rate of dental wear for different groups, this relationship between age and degree of wear must be taken into account. Any comparisons

Site	**M1**	**M2**
Anse à la Gourde	(*t*= 1.16, p= 0.27)	(*t*= 1.48, p= 0.17)
Chorro de Maíta	(*t*= 0.29, p= 0.77)	(*t*= 1.73, p= 0.10)
Diale 1	-	-
Escape	(*t*= 0.21, p= 0.84)	(*t*= 0.00, p= 1.00)
Juan Dolio	-	-
Lavoutte	(*t*= -0.82, p= 0.43)	(*t*= 0.43, p= 0.68)
Maisabel	(*t*= -0.80, p= 0.45)	(*t*= 0.43, p= 0.68)
Malmok	-	-
Manzanilla	(*t*= 0.00, p= 1.00)	(*t*= -1.00, p= 0.37)
Punta Candelero	(*t*= 0.62, p= 0.54)	(*t*= 0.33, p= 0.75)
Punta Macao	-	-
Santa Cruz	-	-
Savaneta	-	-
Tutu	(*t*= -1.53, p= 0.17)	(*t*= 0.00, p= 1.00)
All sites	**(t= = -1.38, p= 0.17)**	**(t= 0.54, p= 0.59)**

Table 6.2 The results of paired samples t-test comparisons of mean degree of wear of right and left mandibular first and second molars. The sample sizes at Diale 1, Juan Dolio, Malmok, Punta Macao, Santa Cruz, and Savaneta were too small to allow for comparison.

must be based on factors that can be assessed independently of estimated ranges of age-at-death, and independently of group age profiles, which may differ significantly (see also Chapter 4).

The adult age distributions of the sites with at least four aged adults can be found in Appendix B. As can be seen in Appendix B, some sites clearly differ with regards to their age distribution. For example, the site of Diale 1, with predominantly young adult individuals, and the site of Tutu, with predominantly old adult individuals, show quite different age distributions. For these reasons, this study compares intra-individual rates of wear, measured using the difference in degree of wear between the adjacent permanent molars.

This is possible due to the fact that these teeth erupt at approximately 6-year intervals in all humans, which means inter-individual and inter-group comparisons can be made (Bernal et al. 2007; Chattah and Smith 2006; Hillson 1996; Scott and Turner 1988; Smith 1972; Watson et al. 2011). Although some studies have used both adjacent M1–M2 and adjacent M2–M3 comparisons, this study is restricted to only adjacent M1–M2 comparisons (see Chapter 4, section 4.2.2).

The degree of occlusal surface wear was recorded for all teeth of the adult maxillary and mandibular dentition in the sample according to the dental wear scoring method devised by Molnar (1971), but only the left mandibular first and second molars were used in this analysis. Potential differences in degree of wear of the right and left mandibular first and second molars was assessed by comparing mean wear scores to identify if gross differences in wear exist between the right and left mandibular dentition. This method can be used for general comparisons (Watson et al. 2011). No significant differences in mean degree of wear were observed between right and left dentitions using a dependent (or paired) samples t-test (Table 6.2). For this reason, if a left first or second molar was absent, it was substituted by its antimere.

A total of 159 adjacent first and second mandibular molars (n= 318) was selected to assess potential differences in the rate of occlusal surface wear between sites using principle axis analysis. The equations of principal axes were calculated for adjacent first and second left mandibular molars. To compare wear rates, the principle axis equation was determined by plotting the wear score of M1 on the Y1 (X) axis, and

Site	B	Principle Axis Equation	CL (95%)
Punta Candelero	0.835	1.726 + 0.835Y	0.443 < b < 1.475
Tutu	0.874	1.116 + 0.874Y	0.631 < b < 1.193
Lavoutte	1.016	0.706 + 1.016	0.676 < b < 1.532
Maisabel	1.094	0.370 + 1.094Y	0.861 < b < 1.396
Chorro de Maíta	1.302	-0.548 + 1.302Y	0.696 < b < 2.760
Escape	1.551	-0.381 + 1.551Y	0.987 < b < 2.710
Anse à la Gourde	1.669	0.062 + 1.669Y	0.951 < b < 3.625

Table 6.3 Principle axis slope (b), equation, and 95% confidence limits per site.

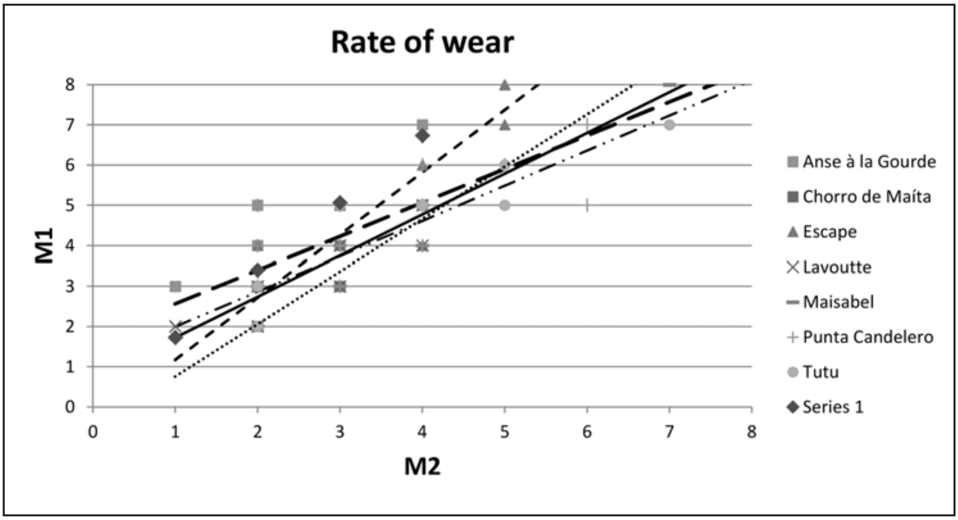

Figure 6.2 Scatterplot of M1–M2 wear scores by site, shown with principle axes. Note differences in slope steepness.

M2 on the Y2 (Y) axis (Sokal and Rohlf 1981:594–601). A steep principle axis slope (b) indicates a rapid rate of wear, whereas a gentle principle axis slope indicates a slow rate of wear. Since this method avoids the effects of age on the degree of dental wear, significant differences between the rate of wear (the principle axis slopes) of different sites can be taken to indicate differences in food consistency or food preparation techniques. Rapid rates of wear are usually associated with tough, abrasive diets (often hunter-gatherer or hunter-fisher diets). Slower rates of wear are more often associated with refined, less abrasive diets (processed agricultural produce) (Smith 1984; Larsen 1997; Lukacs 1996; Watson et al. 2011). Principle axis analysis was performed for the seven largest assemblages in the sample, which included at least ten adults with observed adjacent first and second left mandibular molars. The slopes, equation and confidence limits of the principle axis analyses can be found in Table 6.3. As can be seen in this table, the gradients of the slopes differ, reflecting differences in the rate of wear at each site. This suggests that food consistency and/or food preparation techniques differed per site. At some sites, the rate of wear was clearly more rapid than at other sites. For example, the sites of Anse à la Gourde, Chorro de Maíta, and Escape show relatively high rates of wear, with principle axis slopes of 1.302 and above. The remaining sites show lower rates of wear, with slopes of 1.094 and below.

As discussed by Scott (1979a), who compared the results of both the Scott (1979b) and Molnar (1971) dental wear scoring methods when used in principle axis analysis, the use of the 8 category Molnar method may lead to (greater) overlap in the confidence limits for the different groups in the comparison (see also Chapter 4 section 4.2.2). The results in Table 6.3 show that the slopes (b) for Lavoutte, Maisabel, Punta Candelero, and Tutu do indeed fall within the confidence limits for all seven sites in the sample. However, the slope (b) for Chorro de Maíta is distinct

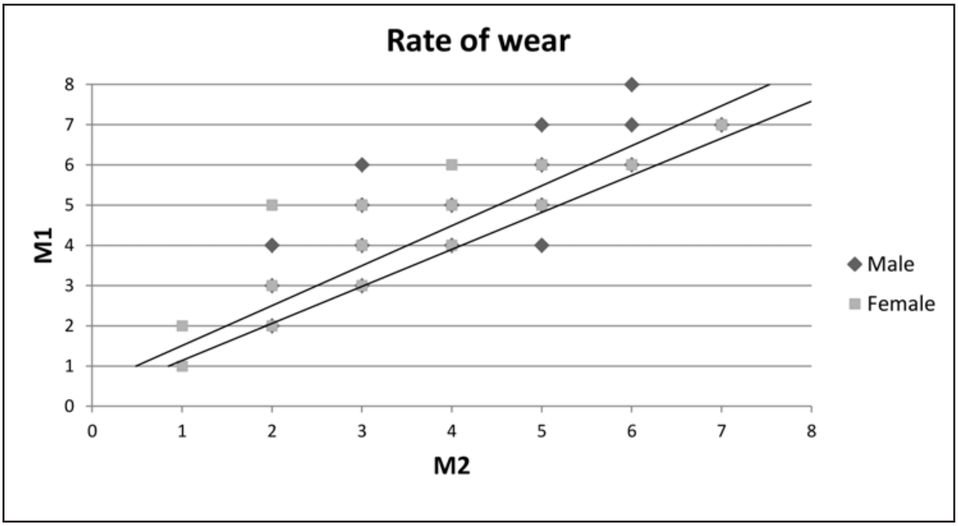

Figure 6.3 Scatterplot of M1–M2 wear scores by sex, shown with principle axes. Note the very slight difference in slope steepness.

(i.e., higher) from the highest confidence limit for Tutu. The slopes (b) for Anse à la Gourde and Escape are distinct (i.e., higher) from the highest confidence limits for Lavoutte, Maisabel, Punta Candelero, and Tutu. The use of the Molnar (1971) dental wear scoring system in principle axis analysis has thus revealed distinct differences in rate of wear in different groups; these differences are visualized in Figure 6.2. This figure shows the principle axis slopes for these seven sites, together with the plotted wear scores of adjacent first and second molars (M2 on the x-axis, and corresponding M1 on the y-axis), and thus visually displays the differences in rate of wear at these seven sites. Note in particular the differences in slope steepness, which indicate variation in rate of wear.

Chronological comparisons
Sample sizes of the separate occupation phases defined at some of the sites were deemed too small to make reliable comparisons regarding rate of wear.

Sex-based comparisons
Principle axis analysis was performed for the total of males and females in the sample. The slopes, equation and confidence limits of the principle axis analyses for males are: 1.087; 0.240 + 1.087Y; $0.7643 < b < 1.563$. The slopes, equation and confidence limits of the principle axis analyses for females are: 1.007; 0.5208 + 1,007Y; $0.708 < b < 1.433$.
The gradients of the slopes differ very slightly, reflecting differences in the rate of wear between males and females (Figure 6.3). Males have a very slightly higher rate of wear than females overall. This could indicate that food consistency and/or food preparation techniques differed by sex, or that differences in robusticity between the sexes contributed to the higher rate of wear in males.

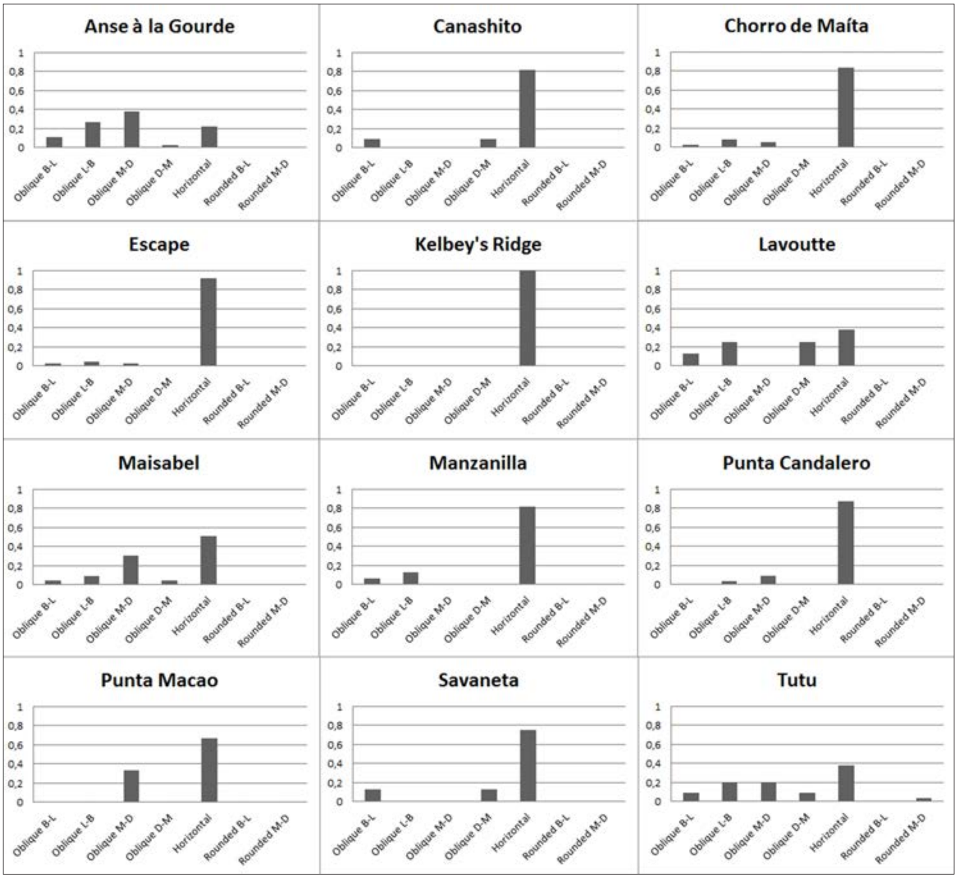

Figure 6.4 Bar charts depicting the proportion of molars by direction of wear, for each site with at least 16 molars graded in categories 2–8. Category 1, which represents the natural tooth shape and generally only occurs in unworn teeth, is excluded.

Sample sizes of adults of known sex at each site were deemed too small to make reliable comparisons regarding rate of wear.

Direction of wear

The direction of wear, which is related to the consistency (abrasiveness) and preparation methods of food, is measured in eight categories. Since category 1 represents the natural tooth shape, which generally only occurs in unworn teeth, this category is excluded from the calculations here. Figure 6.4 shows a number of bar charts for each site with at least 16 molars graded in categories 2–8 of direction of surface wear. The sites not included either have less than four adults in the assemblage, or have retained their natural molar shape overall.

Examination of the frequency distributions of the direction of wear categories shows that there are two distinct 'types' of sites in the entire sample. The first type consists of sites that are characterized by predominantly horizontal molar wear, in some cases with a very small component of obliquely worn molars. The sites of Canashito, Chorro de Maíta, Escape, Kelbey's Ridge 2, Manzanilla, Punta Candelero, Punta Macao, and Savaneta belong to this type. The second type consists of sites in which the four different categories of obliquely worn teeth together

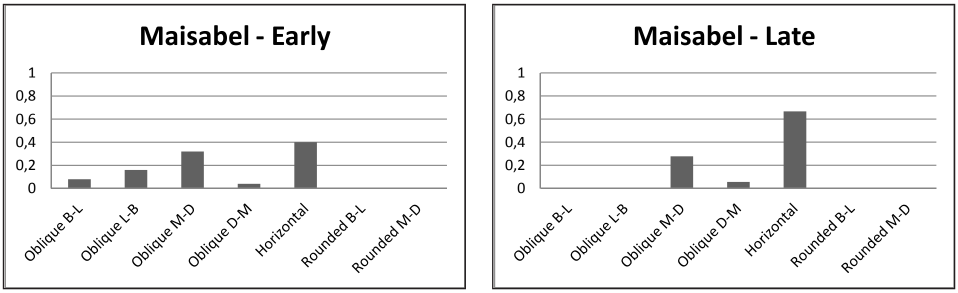

Figure 6.5 Proportions of direction of molar wear Maisabel: Early/Late.

outnumber the number of horizontally worn teeth. Anse à la Gourde, Lavoutte, Maisabel, and Tutu belong to this type.

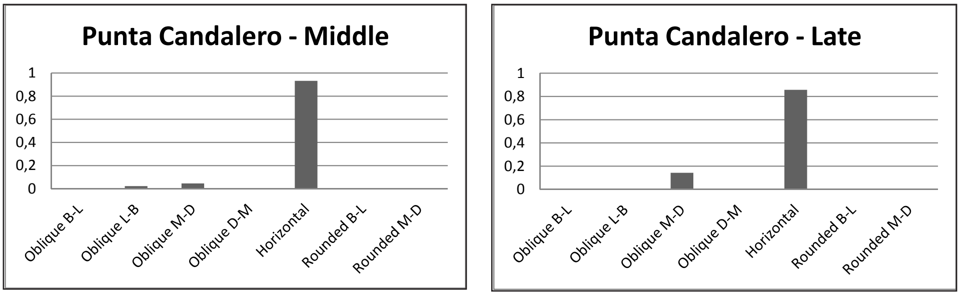

Figure 6.6 Proportions of direction of molar wear Punta Candelero: Middle/Late.

Chronological comparisons

Maisabel –As the bar charts in Figure 6.5 shows, the proportion of horizontally worn molars increases in the late phase, while the proportion of obliquely worn molars both drops and shows less variation in types. A chi-square test shows the difference is not statistically significant ($\chi 2(1, N=63)= 2.98, p= 0.12$).

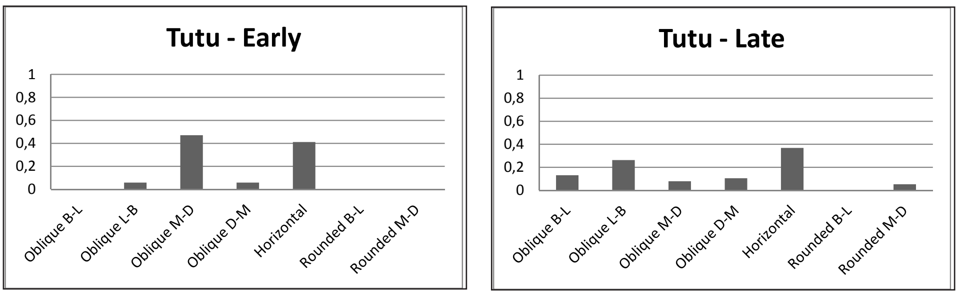

Figure 6.7 Proportions of direction of molar wear Tutu: Early/Late.

Punta Candelero – No significant differences were found between the middle and late phases of occupation ($\chi^2(1, N= 99)= 2.64, p= 0.17$). As the bar charts in Figure

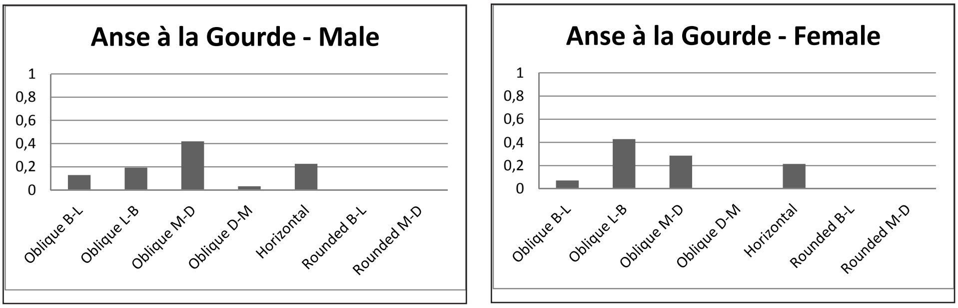

Figure 6.8 Proportions of direction of molar wear Anse à la Gourde: Male/Female.

6.6 show, the distribution of numbers across the categories of wear stays almost the same, notably with horizontal wear as the most common category.

Tutu – While the proportions of horizontally and obliquely worn molars in the early and late phases of occupation, do not differ significantly ($\chi^2(1, N= 53)= 0.15$,

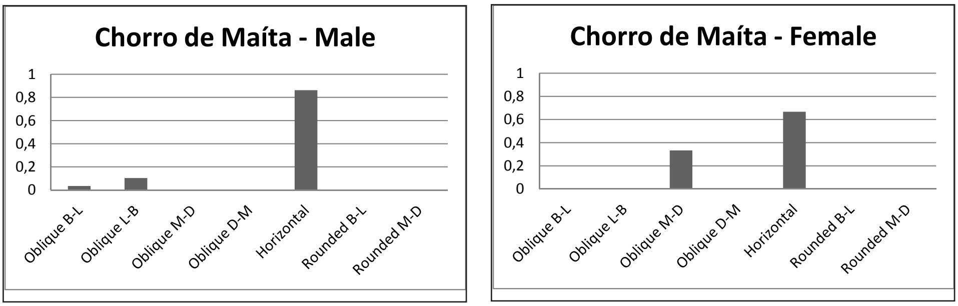

Figure 6.9 Proportions of direction of molar wear Chorro de Maíta: Male/Female.

$p= 0.70$), the composition of the obliquely worn group does clearly differ. As the bar charts in Figure 6.7 show, in the early phase mesial-distal oblique wear predominates. In the late phase lingual-buccal oblique wear is most prevalent, al-

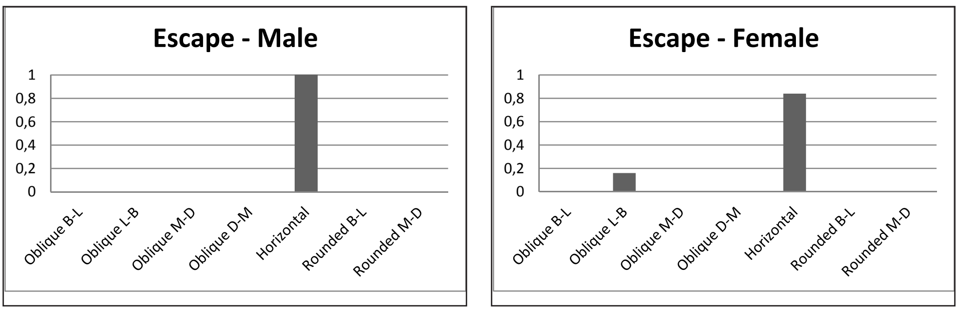

Figure 6.10 Proportions of direction of molar wear Escape: Male/Female.

though the margin of difference is smaller. A chi-square test shows this difference is statistically significant ($\chi^2(4, N= 53)= 5.12, p= 0.28$).

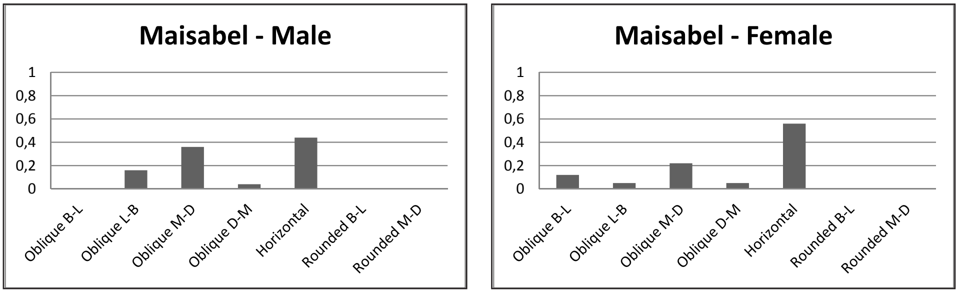

Figure 6.11 Proportions of direction of molar wear Maisabel: Male/Female.

Sex-based comparisons

Anse à la Gourde – As can be seen in Figure 6.8, the frequencies of the categories of direction of molar wear differ slightly between males and females. While the proportions of oblique versus horizontal are practically equal, within the obliquely worn group males have a higher frequency of mesial-distal wear, whereas females

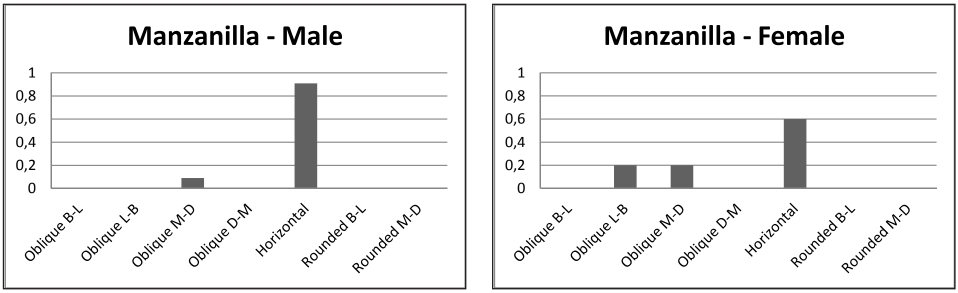

Figure 6.12 Proportions of direction of molar wear Manzanilla: Male/Female.

have a higher frequency of lingual-buccal wear. The difference is not statistically significant based on the results of a chi-square test ($\chi^2(4, N= 55)= 3.20, p= 0.53$). Chorro de Maíta – Figure 6.9 shows that males have a greater proportion of hori-

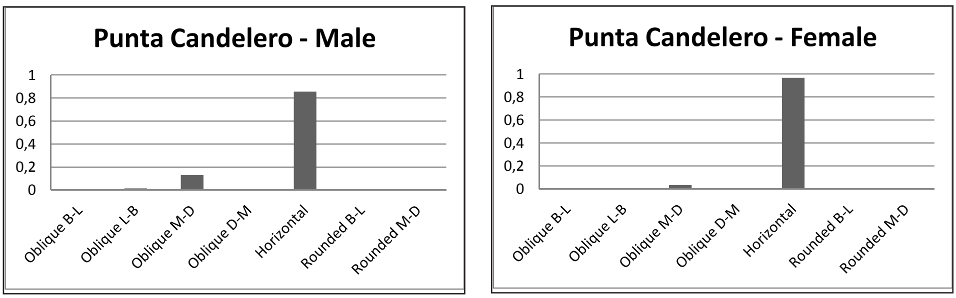

Figure 6.13 Proportions of direction of molar wear Punta Candelero: Male/Female.

zontally worn molars, and females a greater proportion of obliquely worn molars (in particular mesial-distal). The difference is not statistically significant (χ^2(1, N= 35)= 1.34, p= 0.27), most likely due to the small sample size.
Escape – Although Figure 6.10 suggests a small difference between males and females with regards to the proportion between oblique and horizontal surface shape, this is most likely the result of the very small number of males is the assemblage.
Lavoutte – Since most teeth have retained their natural shape, numbers are too small at Lavoutte to reliably test differences between males and females (n= 8).
Maisabel – Slight differences in the frequencies of the oblique categories of wear are present, although the proportion of oblique and horizontal direction of wear is almost equal in both sexes (Figure 6.11).
Manzanilla – In both males and females horizontal wear is clearly the predominant direction of wear (Figure 6.12), but numbers were too small to reliably test for

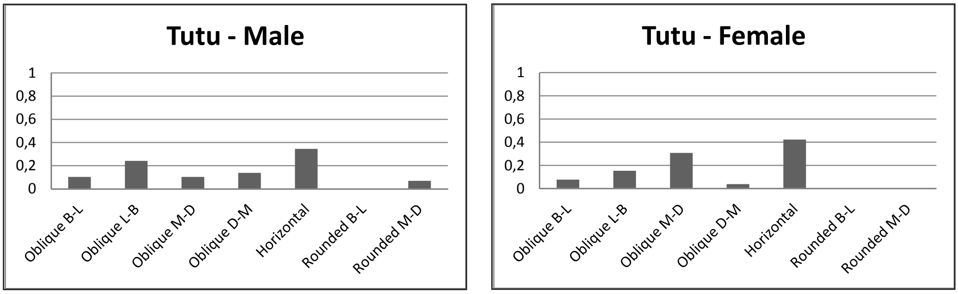

Figure 6.14 Proportions of direction of molar wear Tutu: Male/Female.

significant differences (n= 16).
Punta Candelero – Figure 6.13 shows that both males and females have predominantly horizontally worn molars. Although males have a very slightly larger proportion of oblique mesial-distal molar wear, the difference is very subtle, and is not statistically significant (χ^2(1, N= 65)= 0.95, p= 0.38).
Punta Macao – Since most teeth have retained their natural shape, numbers are too small to reliably test differences between males and females (n= 6).
Tutu – Figure 6.14 shows that the proportion of oblique and horizontal molar wear is very similar for both sexes, however the composition of the group of obliquely worn teeth differs slightly. In males, most obliquely worn molars slant lingual-buccal, whereas in females the most common type of oblique wear is mesial-distal. The difference is only slight, however, and is not statistically significant (χ^2(4, N= 53)= 5.12, p= 0.28).
For the sites of Canashito, Diale 1, Juan Dolio, Kelbey's Ridge 2, Malmok, Point de Caille, Santa Cruz, Savaneta, Savanne Suazey and Tocorón numbers are too small to reliably test differences between males and females. For Mamora Bay there is no information available on biological sex, meaning no comparisons could be made

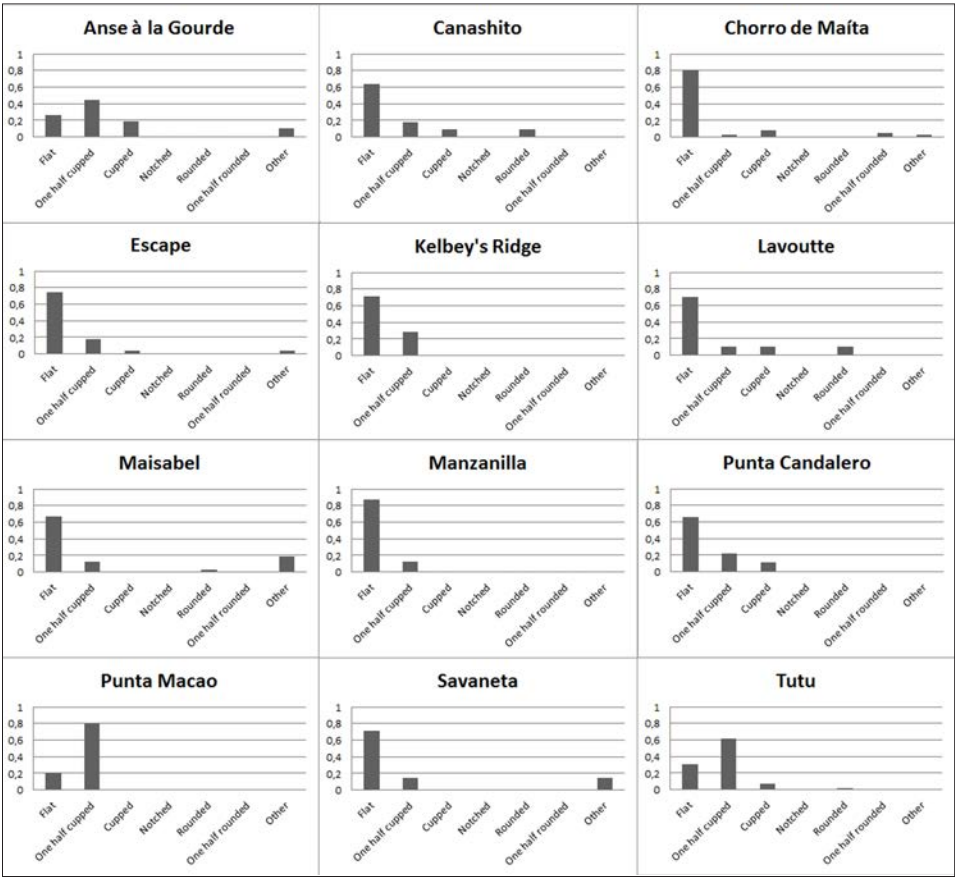

Figure 6.15 Bar charts depicting the proportion of molars by occlusal surface shape, for each site with at least 16 molars graded in categories 2–7. Category 1, which represents the natural tooth shape and generally only occurs in unworn teeth, is excluded.

between males and females.

Occlusal surface shape

The occlusal surface shape is similarly related to the consistency (abrasiveness) and preparation methods of food, and is measured in seven different categories. Since category 1 represents the natural tooth shape, which generally only occurs in unworn teeth, this category is excluded from the calculations here. Figure 6.15 shows a number of bar charts for each site with at least 16 molars graded in categories 2–7 of occlusal surface shape. The sites not included either have less than four adults in the assemblage, or have retained their natural occlusal surface shape overall.

The frequency distributions of the occlusal surface shape categories similarly show two 'types' of sites. The first type consists of sites that are characterized by predominantly flat molar wear, in some cases with a small component of cupped or half cupped molars. The sites of Canashito, Chorro de Maíta, Escape, Kelbey's Ridge 2, Lavoutte, Maisabel, Manzanilla, Punta Candelero, and Savaneta belong to this type. The second type consists of sites in which the two different categories denoting cupped occlusal surfaces together outnumber the number of horizontally

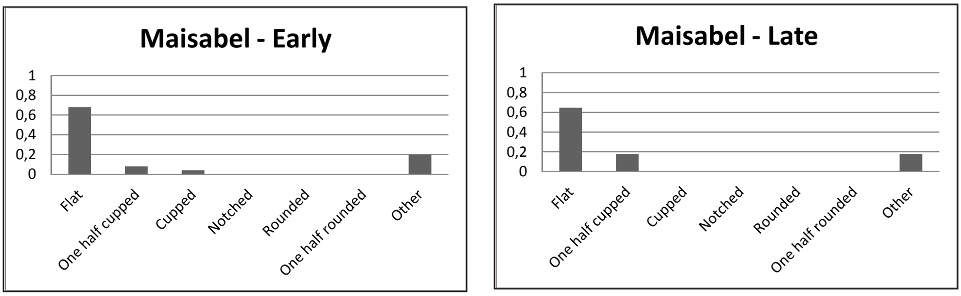

Figure 6.16 Proportions of molar occlusal surface shape Maisabel: Early/Late.

worn teeth. Anse à la Gourde, Punta Macao, and Tutu belong to this type.

Chronological comparisons
Maisabel – Figure 6.16 shows that the frequencies of occlusal surface shapes are

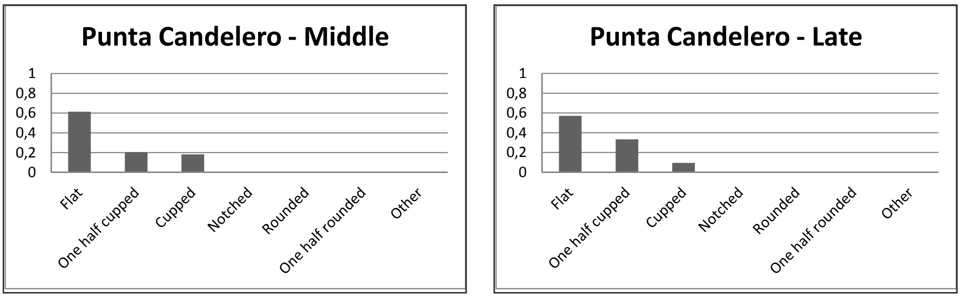

Figure 6.17 Proportions of molar occlusal surface shape Punta Candelero: Middle/Late.

almost identical for the early and late phase of occupation.
Punta Candelero – As can be seen in Figure 6.17, the frequencies of occlusal surface shapes are practically the same for the middle and late phase of occupation.
Tutu – The proportion of flat wear rises slightly in the late phase of occupation

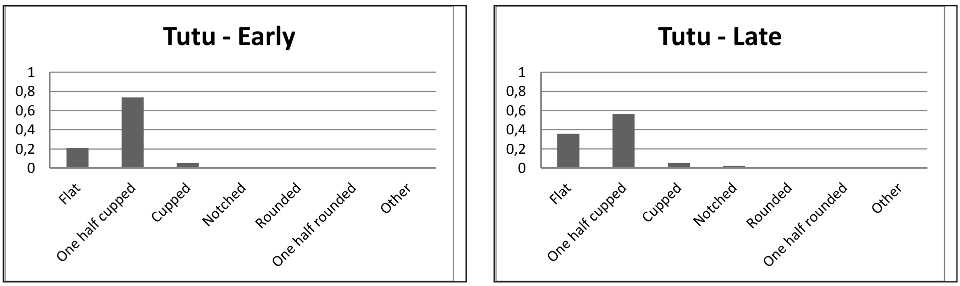

Figure 6.18 Proportions of molar occlusal surface shape Tutu: Early/Late.

(Figure 6.18), although the difference is not statistically significant ($\chi^2(1, N= 58)= 1.32, p= 0.25$).

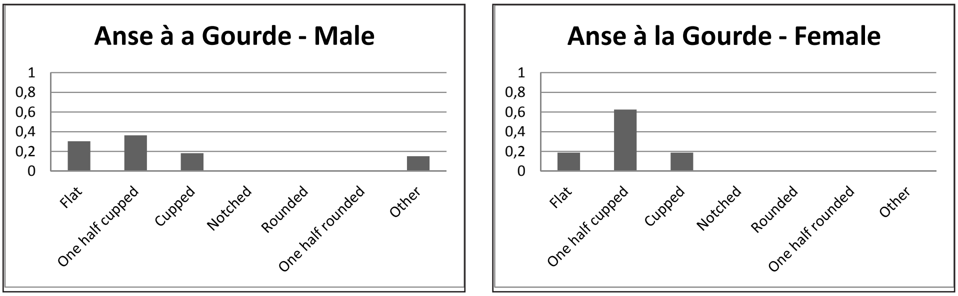

Figure 6.19 Proportions of molar occlusal surface shape Anse à a Gourde: Male/Female.

Sex-based comparisons

Anse à la Gourde – As can be seen in Figure 6.19, the proportion of cupped molar wear is somewhat higher in females than in males, however, the difference is not statistically significant ($\chi^2(1, N= 49)= 0.39, p= 0.50$).

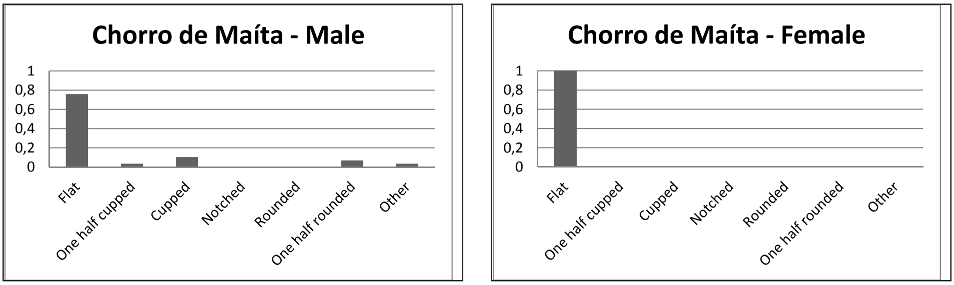

Figure 6.20 Proportions of molar occlusal surface shape Chorro de Maíta: Male/Female.

Chorro de Maíta – Figure 6.20 shows that while females have exclusively flatly worn molars, males also have a small proportion of cupped and rounded molars. The difference is most likely the result of the small number of female teeth in the sample, however, since most female teeth retain their natural shape.

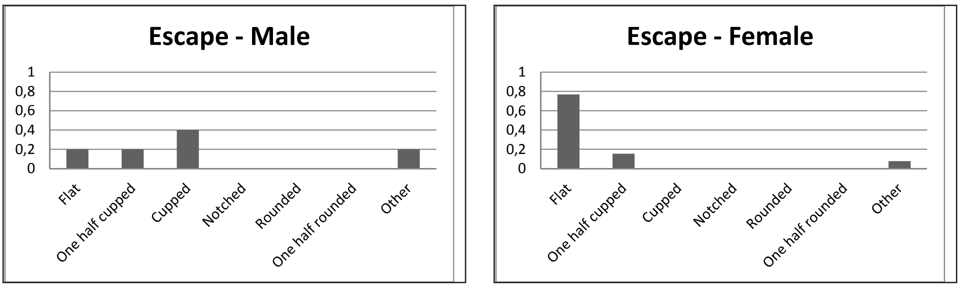

Figure 6.21 Proportions of molar occlusal surface shape Escape: Male/Female.

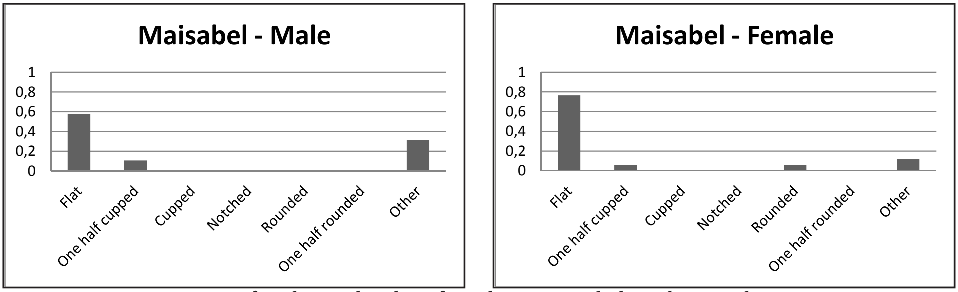

Figure 6.22 Proportions of molar occlusal surface shape Maisabel: Male/Female.

Escape – The proportion of flatly worn molars is clearly larger in females than in males. In males, cupped wear is most common (Figure 6.21). Numbers are too small to reliably test for significant differences, however (n= 18).
Lavoutte – Since most teeth have retained their natural shape, numbers are too small at Lavoutte to reliably test differences between males and females.

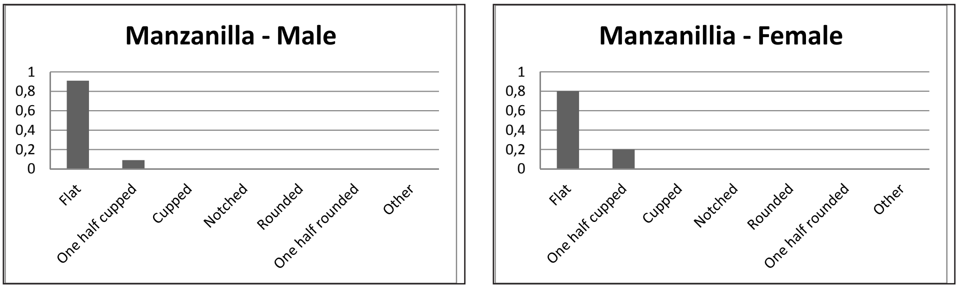

Figure 6.23 Proportions of molar occlusal surface shape Manzanilla: Male/Female.

Maisabel – The proportion between cupped and flat wear in both males and females is near enough the same (Figure 6.22). Males have a slightly larger number of teeth graded as 'other' than females, however the difference is not statistically significant ($\chi^2(1, N= 46)= 3.399, p= 0.334$).
Manzanilla – As Figure 6.23 demonstrates, the proportions of flat and cupped

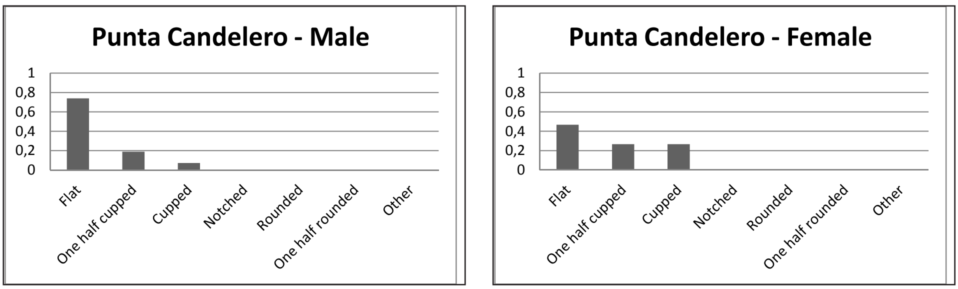

Figure 6.24 Proportions of molar occlusal surface shape Punta Candelero: Male/Female.

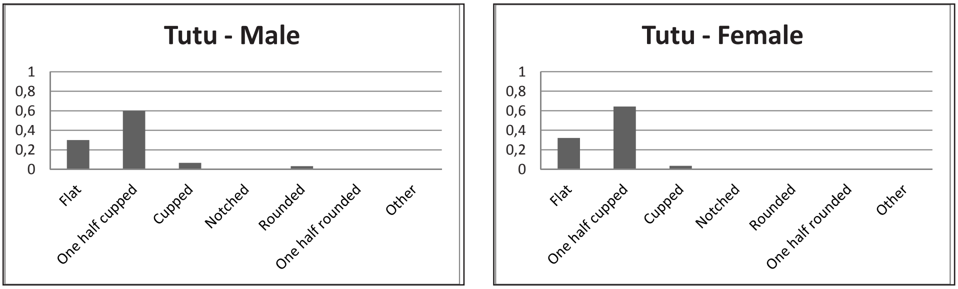

Figure 6.25 Proportions of molar occlusal surface shape Tutu: Male/Female.

wear in males and females are almost equal.
Punta Candelero – In males the flat occlusal surface shape clearly outnumbers the categories of cupped wear. In females, while flat wear in the most common surface shape, the categories of cupped wear together outnumber flat wear (Figure 6.24). The difference between males and females is statistically significant as demonstrated by a chi-square test ($\chi^2(1, N= 99)= 6.88, p= 0.01$).
Punta Macao – Since most teeth have retained their natural shape, numbers are too small to reliably test differences between males and females.
Tutu – Both males and females are practically equally affected by flat and cupped molar surface shapes (Figure 6.25).
For the sites of Diale 1, Juan Dolio, Kelbey's Ridge 2, Malmok, Point de Caille, Santa Cruz, Savaneta, Savanne Suazey and Tocorón numbers are too small to reliably test differences between males and females. For Mamora Bay there is no information available on biological sex, meaning no comparisons could be made between males and females.

Extremely flat and horizontal wear
The combination of horizontal direction of wear and flat occlusal surface shape occurs more frequently than other combinations of wear patterns. At the sites of Chorro de Maíta and Punta Candelero extremely horizontally flattened and polished wear is frequently seen (Figure 6.26). This particular type of wear is rare or absent in the other sites.

Juvenile dental wear
The inclusion of a considerable number of juveniles (n= 69) in the dataset (although the numbers are relatively small at the individual sites), allowed for the tackling of a subject rarely dealt with in dental anthropology, or osteoarchaeology in general: juvenile dental wear, i.e., wear of the deciduous teeth (Clement and Freyne 2012). Preliminary observations of the degree of dental wear in very young (infant)

Figure 6.26 Punta Candelero 6. Oblique occlusal/lingual view of the right mandibular molars, showing very flat and horizontal wear. Note in particular, the flattened surface of the third molar. The first molar is slightly cupped, but this is to be expected considering the degree of wear and dentine exposure.

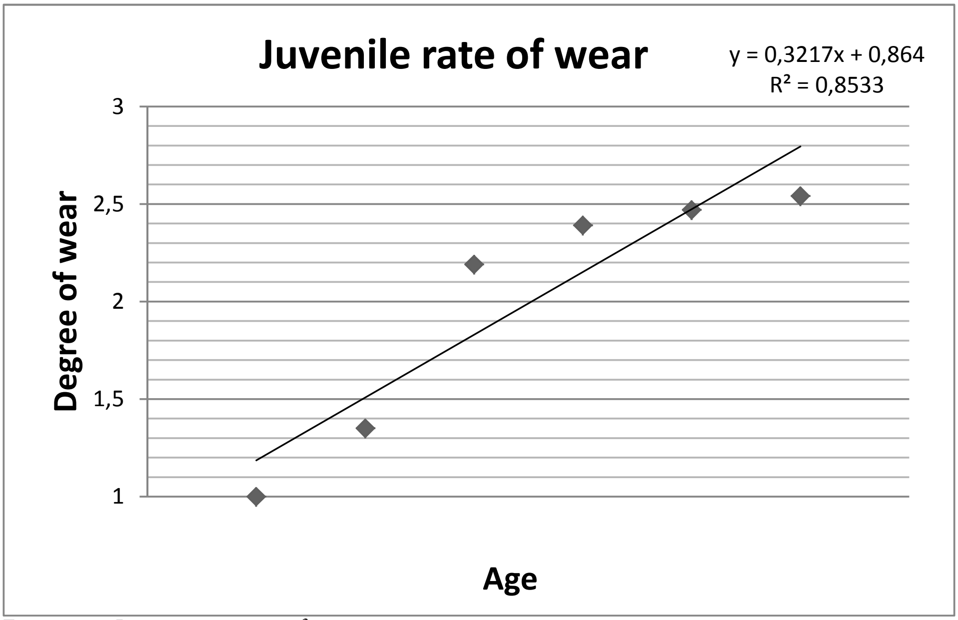

Figure 6.27 Linear regression of mean wear scores against age.

individuals led me to explore this data as a potential avenue for determining the role of juveniles in food consumption, and possible weaning age and duration. Dental wear in juveniles is caused by extrinsic abrasives (food), and tooth on tooth wear (attrition), as is the case in adults. Just as in adults, the type and degree of dental wear is partly influenced by physical aspects of the enamel. The enamel of deciduous teeth is generally less resilient than that of the permanent dentition as it is much thinner, and the deciduous dentition is generally much smaller (Hillson 1996), however, dental wear in the deciduous dentition has not been intensively studied. In part it seems this is because age estimation in juveniles uses the eruption sequence, which is much more accurate than degree of wear. Also, since the deciduous dentition is shed relatively rapidly it is generally assumed that little wear will have accumulated. The presence of even very slight deciduous dental wear in itself is highly interesting, as it indicates that the dentition was in occlusion and solid foods were being consumed – on a regular basis (Lewis 2007).
Table 6.4 and Figure 6.27 display the mean degree of dental wear of the deciduous teeth per age category and the rate of wear (regression line) for the total number of juveniles represented in the samples (n= 54). Age categories were defined by the author to represent the shortest time intervals possible with the available data on age of the individuals. Degree of dental wear is evaluated using Molnar's (1971) method, which is broadly comparable to those of Smith (1984) and Murphy (1959), on a scale of 1 to 8 in which 1 represents the category 'unworn' and 8 represents 'roots functioning in occlusion'. Figure 6.27 shows that in this group of 54 children, dental wear is present from the age of 1–2 years onward. In juveniles aged 0–1 no dental wear was observed. Degree of dental wear rises sharply at the age of

3–4, perhaps related to children being completely weaned at this age.
At 5–6 years there is only a slight rise in the mean degree of wear, probably due to the eruption of the permanent first molars and replacement of the deciduous central incisors with permanent elements around this age, which would also have taken some of the masticatory load off the rest of the dentition. Mean degree of dental wear continues to rise only very slightly at the age of 7–9 years, and 10–11, again probably due to the replacement of a number of deciduous elements by permanent teeth which take the masticatory load off the remaining deciduous teeth.

Site comparisons
Numbers of juvenile individuals per site are too small to be able to make comparisons between mean degrees of wear for the juvenile age groups.

Age	Site	Feature	Individual Age	Mean degree of wear
<1	Anse à la Gourde	1922	0.5–1	1
	Punta Macao	20	0.3–0.5	
1–2	Chorro de Maíta	17	1.5–2	1.35
	Diale 1	155	1.5–2.5	
	Maisabel	3	1–2	
	Maisabel	24	1–1.5	
	Maisabel	27	1.5–2	
3–4	Anse à la Gourde	377	2–3	2.19
	Anse à la Gourde	1413	3–4	
	Chorro de Maíta	10	2–3	
	Chorro de Maíta	84	3–5	
	Collores	162	3	
	Kelbey's Ridge 2	337	2–3	
	Maisabel	8	2–3	
	Maisabel	31	2–4	
	Punta Candelero	40	3–5	
	Punta Candelero	112	2–3	
	Punta Macao	21	2–4	
	Santa Elena	153	3–4	
	Savanne Suazey	2	2.5–3.5	
	Spring Bay 1c	1	2–4	

Age	Site	Feature	Individual Age	Mean degree of wear
5–6	Anse à la Gourde	195	4–5	2.39
	Anse à la Gourde	1944	5–7	
	Chorro de Maíta	12	5–6	
	Chorro de Maíta	13	4–5	
	Chorro de Maíta	18	5–6	
	Escape	25	6	
	Lavoutte	9	4–5	
	Lavoutte	14	4–5	
	Maisabel	16	4–5	
	Punta Candelero	113	5–7	
	Punta Candelero	114	4–5	
	Punta Macao	7	4–5	
	Punta Macao	10	4–5	
	Santa Cruz	6	4–5	
	Sistema sanitaria	2	4–5	
	Tutu	6	5.5–7	
	Tutu	22	4–5	
	Tutu	32	5	
7–9	Anse à la Gourde	291	4–9	2.47
	Chorro de Maíta	6	6–9	
	Chorro de Maíta	7	7–9	
	Chorro de Maíta	14	6–8	
	Chorro de Maíta	32	7–8	
	Chorro de Maíta	69	6–8	
	Punta Candelero	14	7–8	
	Punta Candelero	2 (B4)	6–7	
	Savaneta	Urn	7	
	Tutu	39	8	
10–11	Chorro de Maíta	64	10–12	2.54
	Chorro de Maíta	94	9–11	
	Diale 1	150	9–10	
	Tutu	20	9	

Table 6.4 The degree of dental wear per juvenile and mean degree of wear per age category for juveniles per site.

Intentional Dental Modification

A female individual (72B) aged 18–25 years from the site of Chorro de Maíta presents a clear case of intentional dental modification. The dental modification affects the upper incisors and canines, with the central incisors most prominently modified. All upper incisors and both upper canines appear to have been filed extensively, considerably reducing the crown height and leaving the occlusal surfaces extremely smooth and flattened. The central incisors have a further modification of the occlusal surfaces at both the mesial and distal margins, in the form of buccolingual grooves which extend across the entire occlusal surface. The grooves are 1.50–2.00 mm wide and 1.5 mm deep. In frontal view, the grooves appear to be semi-circular in shape, however the pits of the grooves are in actual fact almost completely flat (Figure 6.28). The other teeth in the dentition are unmodified and only very slightly worn. There is no corresponding wear on the lower anterior teeth, most likely excluding a masticatory activity as the cause. Moreover, the strik

Site	Chipping frequency (tooth count) %	Male	Female	Unknown
Monserrate	0.00	0.00	-	0.00
Tanki Flip	0.00	-	-	0.00
Savaneta	1.43	4.00	0.00	-
Point de Caille	1.52	0.00	3.00	-
Santa Cruz	3.03	0.00	0.00	5.00
Tocorón	3.13	0.00	8.00	0.00
Chorro de Maíta	5.48	7.00	3.00	2.00
Diale 1	6.00	6.00	6.00	-
Heywoods	6.06	-	5.00	6.52
Canashito	6.38	10.53	0.00	11.11
Escape	7.97	0.00	12.00	8.00
Argyle 2	9.43	11.90	-	0.00
Gordon Hill cave	10.00	0.00	-	50.00
Savanne Suazey	10.53	10.00	11.00	-
Lavoutte	10.74	13.00	8.00	5.00
Saladero	11.11	-	-	11.11
Punta Candelero	11.82	25.00	31.00	24.00
Manzanilla	14.21	16.00	18.00	0.00
Mamora Bay	15.00	-	-	15.00
St. Kitts	17.07	26.92	-	0.00
El Cabo	19.05	20.00	17.65	-
Maisabel	21.02	16.00	30.00	13.00
Punta Macao	26.98	26.00	28.00	2.00
Anse à la Gourde	28.69	37.11	22.01	25.00
Juan Dolio	30.77	33.00	29.00	-
Malmok	32.26	47.00	8.00	15.00
Canas	33.33	-	0.00	37.50
Manigat cave	34.62	25.00	-	36.36
Clarence town cave	38.46	33.33	100.00	-
Kelbey's Ridge 2	40.00	67.00	37.00	-
Tutu	41.08	57.00	31.00	0.00
Hacienda Grande	72.22	100.00	16.67	-

Table 6.5 The frequency of chipped teeth by site and sex.

ing symmetry and precision of the grooves and flattened occlusal surfaces indicate that the modification must have been intentional as opposed to activity-induced.

Figure 6.28 Chorro de Maíta individual 72B. Intentional Dental Modification of the upper incisors and canines. Labial view.

6.3.2 Dental chipping

Chipping is prevalent throughout the entire sample, although some significant differences were found between the sites. In total 1,032 chipped teeth were recorded in the adult population, amounting to 21.01% of the teeth in which preservation and pathological condition of the tooth (e.g., the presence of large carious lesions) allowed for assessment of chipping (n= 4,912). In the total sample, 235 adult individuals with at least one chipped tooth were observed, amounting to 60.41% of the entire adult population (n= 389). Of the total population, 247 individuals with at least one chipped tooth were observed, amounting to 53.93% of the entire population (n= 458).

		High							**Low**												
		AAG	**JD**	**KR**	**MB**	**MK**	**PM**	**TT**	**CAN**	**CM**	**DIA**	**ESC**	**LAV**	**MMB**	**MZ**	**PdC**	**PC**	**SAV**	**SC**	**SS**	**TOC**
High	**AAG**	-	0.76	0.22	**0.01**	0.15	**0.04**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	JD	0.76	-	0.47	0.07	0.22	0.19	0.22	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**0.05**	**0.01**	**0.00**	**0.01**	**0.00**	**0.00**	**0.02**	**0.00**
	KR	0.22	0.47	-	**0.02**	0.06	0.06	1.00	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	MB	**0.01**	0.07	**0.02**	-	0.88	0.73	**0.00**	**0.03**	**0.00**	**0.05**	**0.00**	**0.00**	0.42	0.13	**0.00**	0.10	**0.00**	**0.00**	0.14	**0.02**
	MK	0.15	0.22	0.06	0.88	-	1.00	**0.00**	**0.04**	**0.00**	0.08	**0.00**	**0.01**	0.40	0.21	**0.00**	0.25	**0.00**	**0.00**	0.16	**0.02**
	PM	**0.04**	0.19	0.06	0.73	1.00	-	**0.00**	0.18	**0.00**	**0.04**	**0.00**	**0.00**	0.29	0.12	**0.00**	0.08	**0.00**	**0.00**	0.11	**0.01**
	TT	**0.00**	0.22	1.00	**0.00**	**0.00**	**0.00**	-	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Low	**CAN**	**0.00**	**0.00**	**0.00**	**0.03**	**0.04**	0.18	**0.00**	-	0.73	1.00	1.00	0.60	0.24	0.22	0.31	0.13	0.30	0.34	0.51	0.64
	CM	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	0.73	-	0.33	**0.04**	**0.00**	**0.00**	**0.00**	0.37	**0.00**	0.25	0.51	0.12	1.00
	DIA	**0.00**	**0.01**	**0.00**	**0.05**	0.08	**0.04**	**0.00**	1.00	0.33	-	1.00	1.00	0.40	0.34	0.16	0.22	0.16	0.20	0.75	0.64
	ESC	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	1.00	**0.04**	1.00	-	0.45	0.08	**0.03**	0.07	**0.00**	**0.04**	0.16	0.61	0.50
	LAV	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	0.60	**0.00**	1.00	0.45	-	0.22	0.12	**0.03**	**0.01**	**0.02**	0.07	0.81	0.35
	MMB	**0.01**	**0.05**	**0.01**	0.42	0.40	0.29	**0.00**	0.24	**0.00**	0.40	0.08	0.22	-	1.00	**0.01**	1.00	**0.01**	**0.02**	0.60	0.10
	MZ	**0.00**	**0.01**	**0.00**	0.13	0.21	0.12	**0.00**	0.22	**0.00**	0.34	**0.03**	0.12	1.00	-	**0.00**	0.73	**0.00**	**0.01**	0.66	0.09
	PdC	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	0.31	0.37	0.16	0.07	**0.03**	**0.01**	**0.00**	-	**0.00**	1.00	1.00	**0.05**	1.00
	PC	**0.00**	**0.01**	**0.00**	0.10	0.25	0.08	**0.00**	0.13	**0.00**	0.22	**0.00**	**0.01**	1.00	0.73	**0.00**	-	**0.00**	**0.00**	0.44	**0.05**
	SAV	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	0.30	0.25	0.16	**0.04**	**0.02**	**0.01**	**0.00**	1.00	**0.00**	-	1.00	**0.05**	0.55
	SC	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	0.34	0.51	0.20	0.16	0.07	**0.02**	**0.01**	1.00	**0.00**	1.00	-	0.12	1.00
	SS	**0.00**	**0.02**	**0.00**	0.14	0.16	0.11	**0.00**	0.51	0.12	0.75	0.61	0.81	0.60	0.66	**0.05**	0.44	**0.05**	0.12	-	0.25
	TOC	**0.00**	**0.00**	**0.00**	**0.02**	**0.02**	**0.01**	**0.00**	0.64	1.00	0.64	0.50	0.35	0.10	0.09	1.00	**0.05**	0.55	1.00	0.25	-

Table 6.6 Chi-square values and p-values for the post-hoc chi-square tests of chipping frequencies per site. Only sites with four or more adult individuals are included. Statistically significant differences are marked in bold. AAG= Anse à la Gourde, JD= Juan Dolio, KR= Kelbey's Ridge 2, MB= Maisabel, MK= Malmok, PM= Punta Macao, TT= Tutu, CAN= Canashito, CM= Chorro de Maíta, DIA= Diale 1, ES= Escape, LAV= Lavoutte, MMB= Mamora Bay, MZ= Manzanilla, PdC= Point de Caille, PC= Punta Candelero, SAV= Savaneta, SC= Santa Cruz, SS= Savanne Suazey, TOC= Tocorón.

Chipping prevalence

One aim of this study is to assess differences in chipping rates between the individual sites. A preliminary investigation of chipping rates based on simple tooth count and individual count methods was performed, in order to gain an insight into the potential differences between the sites. Only sites with at least four adult individuals were included in these analyses. The caries rates based on the tooth count method per site and by sex, can be found in Table 6.5. As can be seen in this table, there appear to be considerable differences in the rate of caries per site. The statistical significance of these differences was tested using a chi-square test. This

Site	Chipping frequency (individual count) %	Male	Female	Unknown
Monserrate	0.00	0.00	-	0.00
Tanki Flip	0.00	-	-	0.00
Tocorón	16.67	0.00	100.00	0.00
Savaneta	20.00	50.00	0.00	-
Point de Caille	25.00	0.00	50.00	-
Santa Cruz	25.00	0.00	0.00	50.00
Cañas	33.33	-	0.00	50.00
Heywoods	33.33	-	100.00	0.00
Kelbey's Ridge 2	33.33	0.00	50.00	-
Saladero	33.33	-	-	33.33
Chorro de Maíta	40.00	46.15	30.77	66.67
Escape	40.00	0.00	66.67	37.50
Gordon Hill cave	50.00	0.00	-	100.00
Mamora Bay	50.00	-	-	50.00
St. Kitts	50.00	100.00	-	0.00
Lavoutte	51.85	80.00	40.00	28.57
Diale 1	60.00	50.00	66.67	-
Argyle 2	66.67	100.00	-	0.00
Maisabel	69.23	60.00	87.50	66.67
Manzanilla	71.43	70.00	75.00	-
Punta Macao	73.33	83.33	62.50	100.00
Punta Candelero	73.47	84.21	81.82	57.89
Canashito	75.00	100.00	0.00	100.00
Savanne Suazey	75.00	100.00	50.00	-
Anse à la Gourde	78.69	91.67	64.71	33.33
Tutu	80.95	100.00	78.57	0.00
Juan Dolio	85.71	100.00	75.00	-
Clarence town cave	100.00	100.00	100.00	0.00
El Cabo	100.00	100.00	100.00	0.00
Hacienda Grande	100.00	100.00	100.00	0.00
Malmok	100.00	100.00	100.00	100.00
Manigat cave	100.00	100.00	-	100.00

Table 6.7 The frequency of individuals affected by chipping by site and sex.

test determined a significant difference between at least two of the sites (χ^2(19, N=4912) = 420.94, p= 0.00).
Table 6.6 displays the χ^2 values and p-values of the post-hoc (chi-square) com-

Site		18–25		26–35		36–45		46+	
		Ant.	Post.	Ant.	Post.	Ant.	Post.	Ant.	Post.
Chorro de Maíta	**M**	13.21 (53)	0.00 (76)	6.90 (87)	9.09 (132)	7.14 (14)	8.70 (23)	6.45 (31)	4.17 (24)
	F	0.00 (77)	2.63 (114)	3.33 (30)	3.23 (31)	0.00 (13)	50.00 (14)	0.00 (8)	14.29 (7)
Escape	**M**	0.00 (8)	0.00 (19)	-	-	0.00 (8)	0.00 (12)	-	-
	F	0.00 (8)	40.00 (15)	14.29 (14)	0.00 (28)	0.00 (5)	14.29 (7)	0.00 (2)	20.00 (10)
Lavoutte	**M**	-	-	16.13 (31)	13.79 (58)	13.64 (22)	14.71 (34)	0.00 (16)	8.70 (23)
	F	0.00 (6)	5.26 (19)	0.00 (13)	0.00 (17)	0.00 (16)	13.33 (15)	30.00 (10)	26.67 (15)
Punta Candelero	**M**	0.00 (20)	22.22 (36)	8.00 (25)	50.00 (38)	23.81 (21)	29.41 (34)	17.86 (28)	58.97 (39)
	F	16.67 (12)	33.33 (15)	11.54 (26)	52.08 (48)	0.00 (11)	38.46 (13)	0.00 (8)	57.14 (14)
Manzanilla	**M**	23.08 (13)	21.74 (23)	5.26 (19)	12.12 (33)	-	50.00 (4)	0.00 (7)	42.86 (7)
	F	0.00 (8)	41.18 (17)	-	-	-	-	0.00 (9)	10.00 (10)
Maisabel	**M**	15.00 (20)	21.62 (37)	16.67 (36)	8.93 (56)	-	-	16.00 (25)	18.75 (32)
	F	-	-	-	-	39.13 (23)	32.50 (40)	24.14 (29)	15.38 (26)
Punta Macao	**M**	0.00 (2)	0.00 (8)	27.27 (11)	30.00 (10)	17.65 (17)	33.33 (12)	0.00 (1)	0.00 (2)
	F	14.29 (7)	36.36 (11)	0.00 (8)	29.41 (17)	-	-	30.77 (13)	37.50 (8)
Anse à la Gourde	**M**	44.00 (25)	18.42 (38)	27.66 (94)	35.71 (98)	57.14 (28)	38.24 (34)	46.67 (30)	55.00 (20)
	F	14.29 (63)	6.93 (101)	27.96 (93)	28.41 (88)	47.06 (34)	17.86 (28)	29.41 (17)	30.00 (10)
Tutu	**M**	-	-	-	-	42.86 (21)	52.63 (38)	38.89 (18)	73.81 (42)
	F	50.00 (18)	10.71 (28)	-	-	21.05 (19)	58.62 (29)	29.55 (44)	30.00 (60)

Table 6.8 Chipping rates for males and females per site, by age group and anterior/posterior teeth. The number of observed teeth is indicated between the brackets.

parisons of each individual site to the others in order to establish the cause of the significant difference demonstrated by the chi-square test extended to more than 2 groups. Post-hoc comparisons of each individual site with the others revealed that, as expected, the sites within the higher and ranges show significant differences with sites in the lower chipping range, and vice versa. Based on the significant differences found between the sites, two groups can be defined: one representing a low chipping range (Table 6.6).
The individual count assesses the proportion of individuals in the population who have at least one chipped tooth. Of the total adult populations (n= 389), 60.41% has at least one chipped tooth (n= 235). The proportion of adult individuals affected by chipping per site and by sex is presented in Table 6.7. A chi-square test for independence of variables demonstrates that at least two sites differ significantly from each other with regards to the proportion of adults affected by chipping (χ^2(19, N=342) = 46.57, p= 0.00). Post-hoc comparisons showed that a significantly higher proportion of the adult population of Anse à la Gourde is affected by dental chipping than the adult populations of Chorro de Maíta (χ^2(1, N=116) = 14.94, p= 0.00), Escape (χ^2(1, N=85) = 7.77, p= 0.01), and Tocorón (χ^2(1, N=67) = 8.28, p= 0.01). Likewise, at Tutu a significantly higher proportion of the adult population is affected by dental chipping than the adult populations of Chorro de Maíta (χ^2(1, N=76) = 11.12, p=0.00), Escape (χ^2(1, N=45) = 7.20, p= 0.01), and Tocorón (χ^2(1, N=27) = 8.68, p= 0.01). No other significant differences were revealed.
The preliminary assessments above indicate significant differences in chipping rates between the individual sites in the sample. However, chipping like all dental wear is related to age, and is known to affect the anterior and posterior teeth in different ways. Therefore, when comparing chipping rates between groups, the effects of age, differential preservation of individual dental elements, and differential susceptibility of individual dental elements must be taken into account. The differences demonstrated above using the simple tooth count and individual count methods could (partly) result from differing age profiles and differentially preserved/affected dental elements. Table 6.8 presents the chipping rates per site by age group (18–25, 26–35, 36–45, and 46+), and by anterior and posterior teeth.

Chronological comparisons

Maisabel – A very slight increase is seen in the frequency of chipped teeth (tooth count) from the early to late period, although this is not statistically significant.

Maisabel	Tooth count	Individual count
Early	0.16	0.64
Late	0.17	0.73
	χ^2(1, N=400)= 0.13, p= 0.72	χ^2(1, N=26)= 0.28, p= 0.60

Table 6.9 Chipping frequencies (tooth count and individual count) for Maisabel per period.

The proportion of affected individuals (individual count) also rises from the early to late period. This difference is also not statistically significant (Table 6.9).
Punta Candelero – The frequency of chipped teeth (tooth count) is the same for the middle and the late period. The proportion of affected individuals (individual count) also drops from the middle to late period. This difference is also not statistically significant (Table 6.10).

Punta Candelero	Tooth count	Individual count
Middle	0.26	0.70
Late	0.26	0.60
	$\chi^2(1, N=336)= 0.00, p= 1.00$	$\chi^2(1, N=25)= 0.18, p= 0.67$

Table 6.10 Chipping frequencies (tooth count and individual count) for Punta Candelero per period.

Tutu – The frequency of chipped teeth (tooth count) shows a statistically significant increase from the early to late period. The proportion of affected individuals (individual count) drops somewhat from the early to late period, although the difference is not significant (Table 6.11).

Tutu	Tooth count	Individual count
Early	0.33 (42/127)	0.89 (8/9)
Late	0.47 (90/192)	0.75 (9/12)
	$\chi^2(1, N=319)= 6.01, p= 0.01$	$\chi^2(1, N=21)= 0.64, p= 0.60$

Table 6.11 Chipping frequencies (tooth count and individual count) for Tutu per period.

Sex-based comparisons

In the total sample 69.28% of males (n= 106) and 60.81% of females (n= 90) are affected by dental chipping. While a greater proportion of males are affected by chipping than females, a chi-square test shows that this difference is not statistically significant ($\chi^2(1, N= 301)= 2.38, p = 0.15$). The proportion of teeth affected in males is 20.59%, while in females the proportion is 16.64%. A chi-square test shows this difference is statistically significant ($\chi^2(1, N= 4,572)= 11.65, p= 0.00$), showing males have a greater proportion of chipped teeth overall than females.
Sex differences were investigated at the individual sites. Based on the results presented in Table 6.8, at most of the larger sites, males tend to have higher chipping rates in all age groups and in both anterior and posterior teeth than females. Below, the sites with a large enough assemblage of males and females to use in comparative statistical analyses are discussed in more detail. Frequencies of dental chipping based on the tooth count method and on the individual count method per site and by sex can be found in Table 6.5 and Table 6.7 respectively. The frequency of dental chipping (tooth count) by sex and anterior and posterior dentition for all sites with four or more adults can be found in Table 6.12.

Intra-site comparisons

Anse à la Gourde – A chi-square test demonstrates that a significantly larger proportion of males (91.67%) is affected by chipping than females (64.71%) (χ^2(1, N= 58)= 5.59, p= 0.03). Furthermore, in males (35.22%) a significantly greater proportion of the teeth is chipped than in females (19.09%) (χ^2(1, N= 935)= 30.98, p= 0.00). This difference is mainly due to the greater proportion of posterior chipping in males than in females. In males the anterior dentition is significantly more frequently affected than the posterior dentition (χ^2(1, N= 380)= 51.99, p= 0.00). In females, while the anterior dentition is more frequently affected than the posterior dentition, difference is not statistically significant (χ^2(1, N= 477)= 1.82, p= 0.19). A Mann-Whitney U test shows that males have significantly larger chips than females (*U* = 76880.50, p= 0.00).

Frequency of chipping	Male			Female			Unknown			Child		
	Ant.	Post.	Total	Ant.	Post.	Total	Ant.	Post.	Total	Ant.	Post.	Total
Anse à la Gourde	0.49	0.25	0.37	0.27	0.17	0.22	0.50	0.00	0.25	0.09	0.03	0.08
Canashito	0.00	0.17	0.11	0.00	0.00	0.00	0.20	0.00	0.11	-	-	-
Chorro de Maíta	0.09	0.06	0.07	0.01	0.05	0.03	0.02	0.03	0.02	0.01	0.00	0.00
Diale 1	0.00	0.10	0.06	0.14	0.04	0.06	-	-	-	0.00	0.50	0.50
Escape	0.00	0.00	0.00	0.07	0.14	0.12	0.01	0.12	0.08	0.00	0.00	0.00
Juan Dolio	0.14	0.41	0.33	0.14	0.33	0.29	-	-	-	-	-	-
Kelbey's Ridge	1.00	0.50	0.67	0.38	0.36	0.37	0.00	0.00	0.00	0.00	0.03	0.02
Lavoutte	0.12	0.13	0.13	0.05	0.10	0.08	0.03	0.07	0.05	0.00	0.00	0.00
Maisabel	0.16	0.16	0.16	0.31	0.29	0.30	0.09	0.17	0.13	0.00	0.00	0.00
Malmok	0.00	0.50	0.47	0.00	0.14	0.08	0.16	0.14	0.15	-	-	-
Mamora Bay	-	-	-	-	-	-	0.03	0.22	0.15	-	-	-
Manzanilla	0.12	0.19	0.16	0.00	0.30	0.18	0.00	0.00	0.00	0.00	0.14	0.18
Point de Caille	0.00	0.00	0.00	0.00	0.06	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Punta Candelero	0.11	0.34	0.25	0.11	0.43	0.31	0.14	0.29	0.24	0.00	0.18	0.10
Punta Macao	0.23	0.29	0.26	0.19	0.35	0.28	0.05	0.00	0.02	0.00	0.00	0.00
Santa Cruz	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.05	0.00	0.00	0.00
Savaneta	0.00	0.06	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Savanne Suazey	0.00	0.15	0.10	0.00	0.15	0.11	-	-	-	0.00	0.00	0.00
Tocorón	0.00	0.00	0.00	0.00	0.13	0.08	0.00	0.00	0.00	0.00	0.00	0.00
Tutu	0.43	0.64	0.57	0.30	0.33	0.31	0.00	0.00	0.00	0.00	0.33	0.15

Table 6.12 Frequency of dental chipping anterior vs. posterior (tooth count). Only sites with more than four adults included.

Chorro de Maíta – A chi-square test shows there is no significant difference between the proportion of males (53.85%) and females (69.23%) affected by chipping (χ^2(1, N= 52)= 1.30, p= 0.39). While the proportion of chipped teeth in males (6.77%) and females (3.99%) at Chorro de Maíta does not differ significantly (χ^2(1, N= 859)= 3.19, p= 0.10), a Mann-Whitney U test shows that males have significantly larger chips than females (U = 77108.00, p= 0.05). A chi-square test confirmed there are no significant differences between the proportion of chipped male anterior (6.53%) and posterior teeth (8.11%) (χ^2(1, N= 425)= 0.50, p= 0.57). In females, the anterior teeth (1.21%) are far less frequently affected than the posterior teeth (5.16%). This difference was found to be statistically significant using a chi-square test (χ^2(1, N= 378)= 4.37, p= 0.05).
Diale 1 – Numbers are too small to compare differences in individual count between males and females. No significant differences were apparent in the proportion of chipped teeth between males (6.25%) and females (5.88%) (χ^2(1, N= 50)= 0.00, p= 1.00).
Escape – Numbers of sexed adults are too small to compare differences in individual count between males and females. The tooth count, however, demonstrated that there is a significant difference in the proportion of teeth affected by dental chipping between males (0.00%) and females (11.58%) (χ^2(1, N= 142)= 5.90, p= 0.02). Females show a significantly larger proportion of chipped teeth than males. Nonetheless, this difference is likely to be the result of poor preservation of the material and the much smaller number of males than females.
Juan Dolio – Numbers are too small to compare differences in individual count between males and females. No significant differences were apparent in the proportion of affected teeth between males (33.33%) and females (28.57%) (χ^2(1, N= 52)= 0.14, p= 0.77).
Kelbey's Ridge 2 – Numbers are too small to compare differences in individual count between males and females. No significant differences were apparent in the proportion of affected teeth between males (66.67%) and females (37.04) (χ^2(1, N= 30)= 0.99, p= 0.55).
Lavoutte – The individual count suggests that females (20.00%) are less frequently affected by dental chipping than males (100.00%); a chi-square test revealed difference is statistically significant (χ^2(1, N= 20)= 13.33, p= 0.00). The tooth count similarly suggests that females (8.45%) are slightly less frequently affected by dental chipping than males (12.50%), however this difference is not statistically significant (χ^2(1, N= 326)= 1.37, p= 0.28). Although in both sexes, the posterior dentition appears more frequently affected than the anterior dentition, no significant differences were found in the proportion of anterior (11.59%) versus posterior teeth (13.04%) affected by chipping in males (χ^2(1, N= 184)= 0.08, p= 0.82) or in the proportion of anterior (5.36%) versus posterior (10.47%) dentition in females (χ^2(1, N= 142)= 1.14, p= 0.37). A Mann-Whitney U test found no significant differences between males and females regarding chip size (U = 11479.00, p= 0.21).
Maisabel – The individual count does not show a significant difference between

the proportion of males (60.00%) and females (87.50%) affected by chipping (χ^2(1, N= 23)= 1.86, p= 0.35). However, the tooth count reveals that females (29.82%) have a significantly higher proportion of chipped teeth than males (16.00%) (χ^2(1, N= 314)= 8.36, p= 0.01). Furthermore, a Mann-Whitney U test shows that females have significantly larger chips than males (*U* = 9511.50, p= 0.02). The proportions of anterior and posterior teeth affected in both males (and females are near enough the same.

Malmok – Numbers are too small to compare differences in individual count between males and females. Despite the small number of individuals (and teeth) from Malmok, a chi-square test shows a significant difference in the proportion of posterior dental chipping between males (47.37%) and females (8.33%) (χ^2(1, N= 31)= 5.13, p= 0.05). Anterior chipping is absent in both sexes.

Mamora Bay – Since there is no information available on biological sex at Mamora Bay, no comparison could be made between males and females.

Manzanilla – The individual count revealed no significant difference between the proportion of males (70.00%) and females (75.00%) affected by chipping (χ^2(1, N= 14)= 0.35, p= 1.00). The tooth count similarly showed no significant differences between the proportion of teeth affected by chipping in males (15.57%) and in females (18.18%) (χ^2(1, N= 166)= 0.16, p= 0.81). A Mann-Whitney U test found no significant differences between males and females regarding chip size (*U* = 2344.00, p= 0.74).

Point de Caille – Numbers are too small to compare differences in individual count between males and females. For the tooth count, a chi-square test revealed there are no significant differences in the proportion of chipped teeth between males (0.00%) and females (3.23%) (χ^2(1, N= 66)= 1.15, p= 0.47).

Punta Candelero – A chi-square test revealed there are no significant differences between the proportion of males (84.21%) and females (81.82%) affected by chipping (χ^2(1, N= 30)= 0.03, p= 1.00). Furthermore, no significant differences were found in the proportion of chipped teeth between males (24.64%) and females (30.06%) at Punta Candelero (χ^2(1, N= 518)= 1.74, p= 0.21). In both males (χ^2(1, N= 335)= 21.15, p= 0.00) and females (χ^2(1, N= 164)= 18.25, p= 0.00) the posterior (male: 33.81%, female: 43.14%) dentition is significantly more frequently chipped than the anterior dentition (male 11.20%, female: 11.29%). Although females appear to be affected by larger chips overall, a Mann-Whitney U test found no significant differences between males and females regarding chip size (*U* = 24327.50, p= 0.13).

Punta Macao – A chi-square test found no significant difference between the proportion of males (62.50%) and females (83.33%) affected by chipping (χ^2(1, N= 14)= 0.73, p= 0.58). No significant difference was apparent in the proportion of affected teeth between males (19.77%) and females (26.56%) (χ^2(1, N= 150)= 0.97, p= 0.33). In both males (χ^2(1, N= 66)= 0.33, p= 0.59) and females (χ^2(1, N= 60)= 1.87, p= 0.25), no significant differences were found between the proportions of the anterior (male: 22.86%, female: 19.23%) and posterior (male: 29.03%, female:

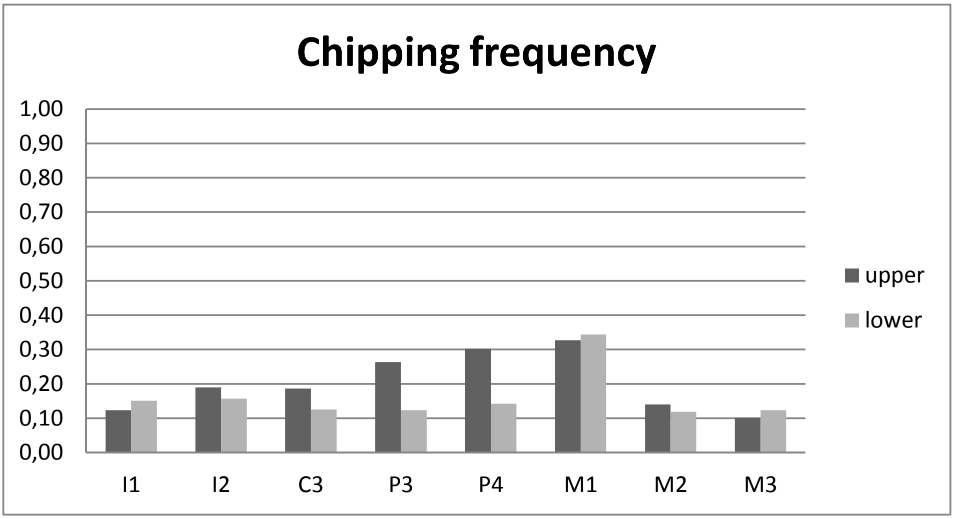

Figure 6.29 The frequency of chipping per dental element.

35.29%) dentitions affected by chipping. A Mann-Whitney U test found no significant difference in chip size between males and females (U = 2141.50, p= 0.37).
Santa Cruz – None of the individuals of known sex have dental chipping.
Savanne Suazey – Numbers are too small to compare differences in individual count between males and females. No significant differences were apparent in proportion of affected teeth between males (9.52%) and females (11.11%) (χ^2(1, N= 57)= 0.04, p= 1.00).
Savaneta – Numbers are too small to compare differences in individual count between males and females. No significant differences were apparent in proportion of affected teeth between males (3.70%) and females (0.00%) (χ^2(1, N= 70)= 1.62, p= 0.39).

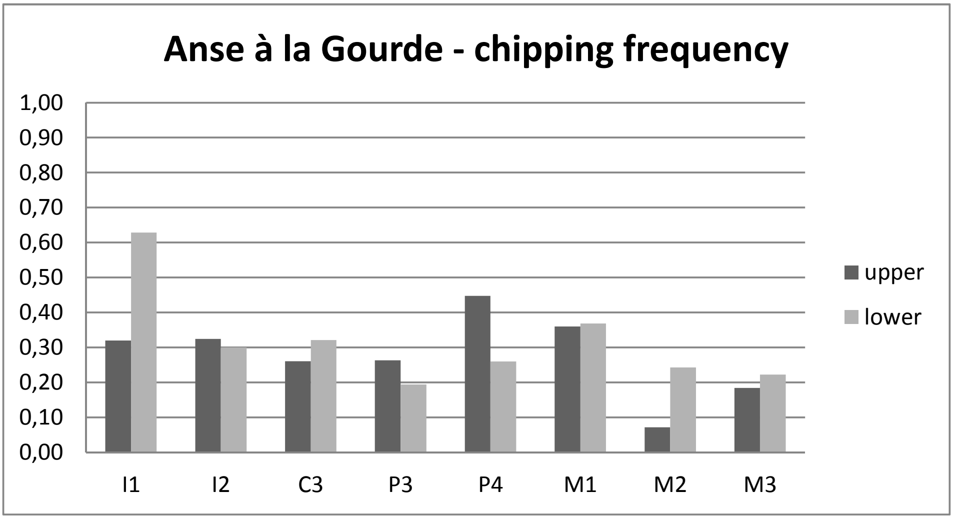

Figure 6.30 The frequency of chipping per dental element for Anse à la Gourde.

Tocorón – Numbers are too small to compare differences in individual count between males and females. No significant differences were apparent in proportion of affected teeth between males (0.00%) and females (8.33%) (χ^2(1, N= 32)= 1.72, p= 0.38).
Tutu – In both males and females, the posterior dentition (male: 55.00%, female: 41.91%) is more frequently affected than the anterior dentition (male: 43.24%, female: 20.69%). In females, however, the difference is more pronounced than in males. This difference is statistically significant in females (χ^2(1, N= 197)= 15.21, p= 0.00), but not in males (χ^2(1, N= 117)= 1.40, p= 0.32). A chi-square test demonstrates that the proportion of teeth affected by chipping is significantly greater in males (42.74%) than in females (19.29%) (χ^2(1, N= 314)= 22.23, p= 0.00). However, the proportion of male individuals (100.00%) and female individuals (78.57%) affected by chipping does not differ significantly (χ^2(1, N= 20)= 1.51, p= 0.52). A Mann-Whitney U test shows that males have significantly larger chips than females (*U* = 8077.50, p= 0.00).

Chipping location

Dental arch
For all sites combined, we see that the frequency of chipping is higher in the maxillary teeth than in the mandibular teeth. This difference is mainly due to the much higher number of chipped upper canines and premolars (see Figure 6.29). Furthermore, the lower central incisors are slightly more frequently affected than the upper central incisors. No correlations were found between the location of the chip on the tooth crown and the location of chip in the dental arch. The most frequently chipped teeth for both the upper and lower dentition are the first mo-

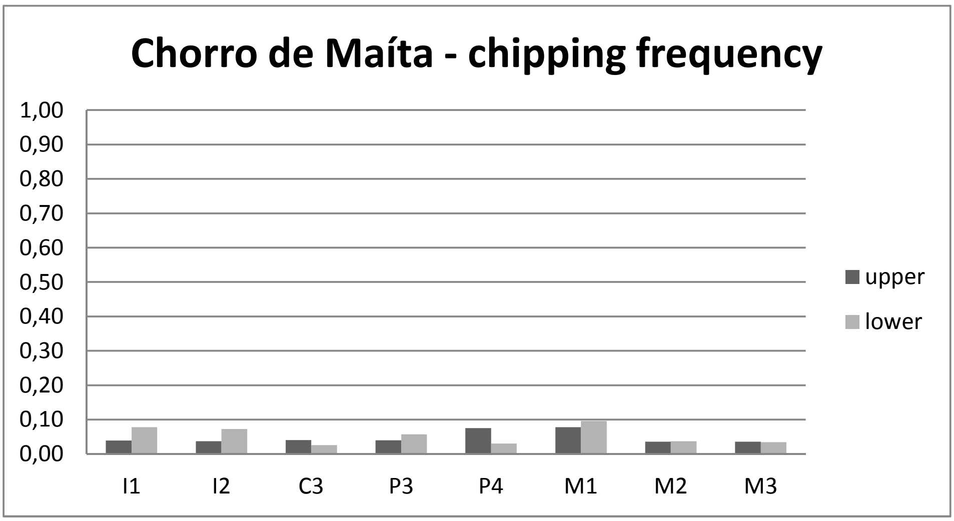

Figure 6.31 The frequency of chipping per dental element for Chorro de Maíta.

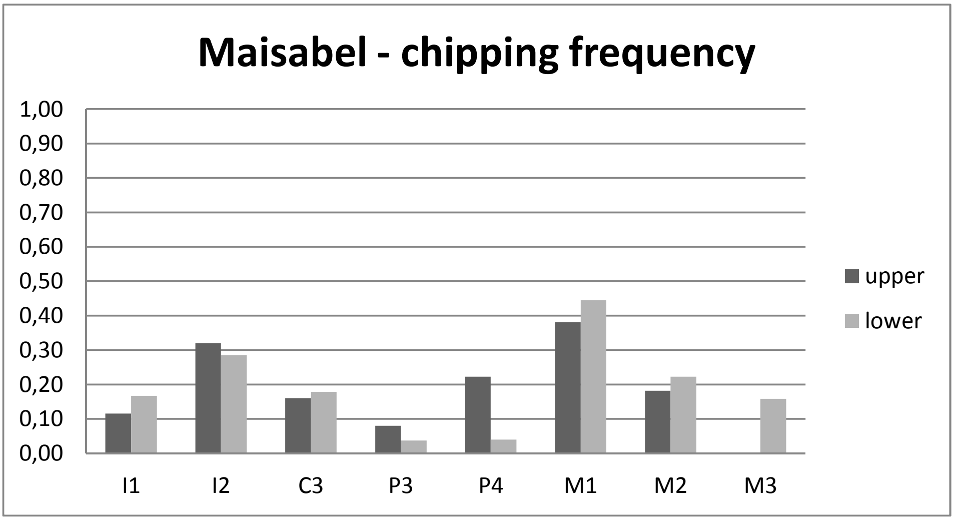

Figure 6.32 The frequency of chipping per dental element for Maisabel.

lars, most likely because of the long period they spend in functional occlusion (eruption at around 6 years of age), and their important role in the mastication of tougher foodstuffs. The individual sites mirror the distribution of chips throughout the dental arch seen in Figure 6.29, except Anse à la Gourde, Chorro de Maíta, and Maisabel (see Figures 6.30, 6.31, and 6.32). At Anse à la Gourde, particularly the lower central incisors are more frequently affected by chipping. At Chorro de Maíta the lower central and lateral incisors are very frequently affected. At Maisabel chipping is particularly frequent in the lateral incisors (upper and lower).

In the total sample, the frequency of chipping is higher in the posterior dentition than in the anterior dentition. A chi-square test shows that the posterior dentition is significantly more frequently affected by chipping than the anterior dentition

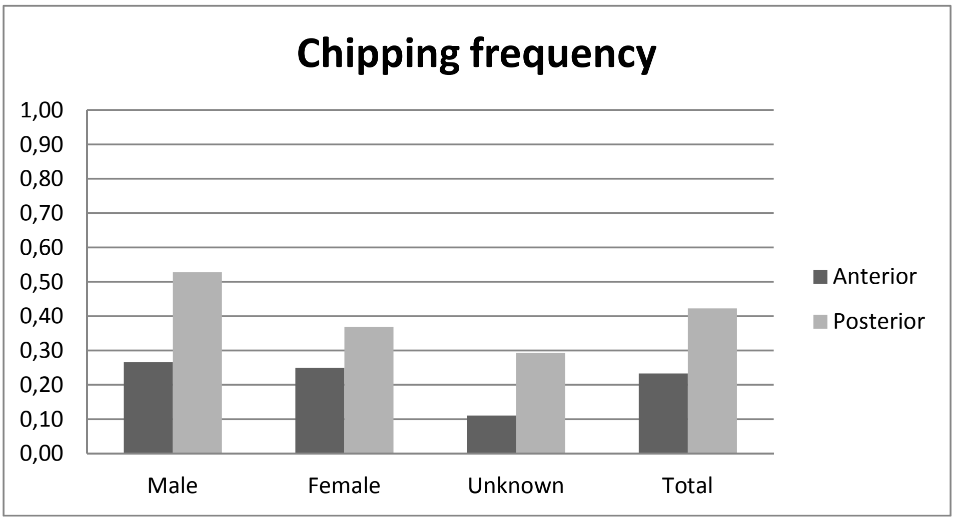

Figure 6.33 The frequency of chipping by anterior/posterior dentition.

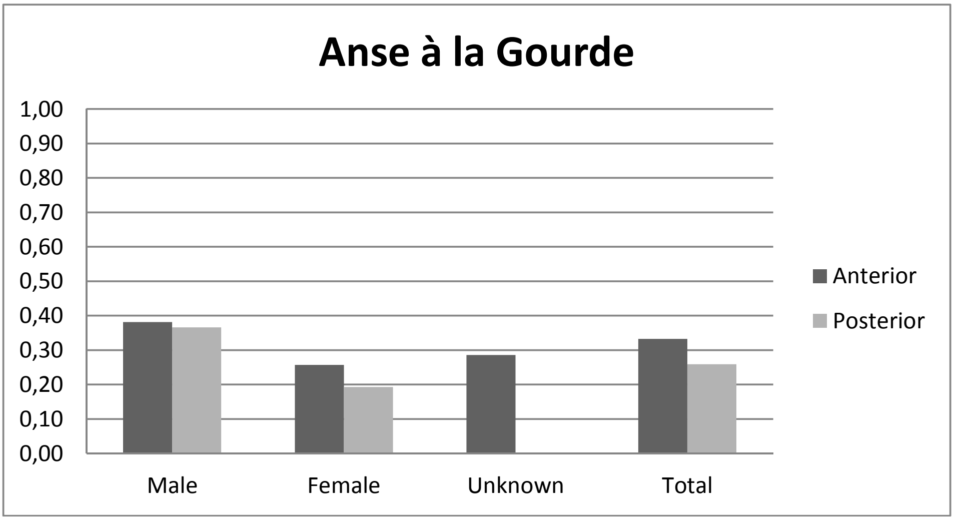

Figure 6.34 The frequency of chipping by anterior/posterior dentition for Anse à la Gourde.

(χ^2(1, N= 5191)= 197.25, p= 0.00).

Most sites in the sample show a similar difference between anterior and posterior chipping to that seen in Figure 6.33, except Chorro de Maíta and Maisabel (see Figures 6.35 and 6.36). At Anse à la Gourde anterior chipping frequency is greater in both males and females than posterior chipping frequency (Figure 6.34). At Chorro de Maíta anterior chipping is greater in males, but not in females. At Maisabel, the frequency of anterior and posterior chipping is the same (see also section 6.3.2 Dental Chipping – Sex-based comparisons).

Tooth crown

Next to the location of chipping throughout the dental arch, discussed in the sections above, the location of the chip(s) on the tooth crown was also recorded, potentially giving insight into different non-alimentary uses of the teeth or different dietary factors contributing to dental chipping. Comparison of the different sites, however, shows a consistent tendency for chips to be located along the buccal edge of the occlusal surface. This tendency was observed in both the anterior and posterior dentitions, and is present regardless of other differences in the proportion of the anterior and posterior dentitions affected by chipping, or difference between the sexes. The second most frequently affected location on the tooth is the interproximal edges of the occlusal surface, either mesial or distal. This type of dental chipping is slightly more frequently found in the posterior dentition, although the anterior dentition is certainly not unaffected by it, and at Punta Macao is even more frequently affected than the posterior dentition. Figure 6.37 shows the frequencies in which the nine different chipping locations were observed for the larger sites in the sample.

Degree of chipping

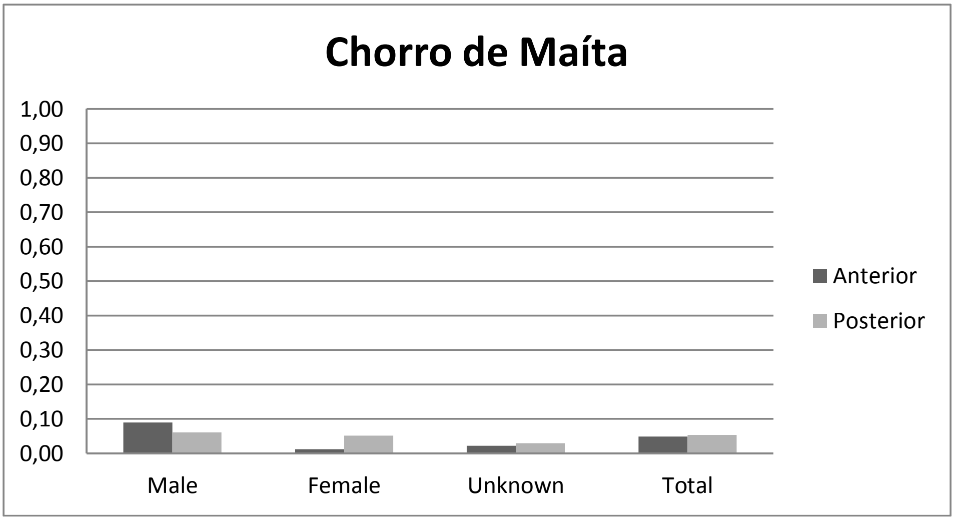

Figure 6.35 The frequency of chipping by anterior/posterior dentition for Chorro de Maíta.

The degree of chipping was measured according to an ordinal scale (0= none, 1= slight [0.5 mm or larger but superficial], 2= medium [1 mm with the enamel more deeply involved], 3= large [>1 mm involving enamel and dentine]) (Bonfiglioli et al. 2004).

For all sites combined, we see that the mean degree of chipping is higher in the maxillary teeth ($\overline{X} = 0.39$) than in the mandibular teeth ($\overline{X} = 0.31$). The difference can mainly be attributed to the much higher mean degree of chipping in the upper canines and premolars (Figure 6.38). Furthermore, the lower second and third molars are more severely affected than their upper counterparts. The lower central incisors are similarly more severely affected than the upper central incisors.

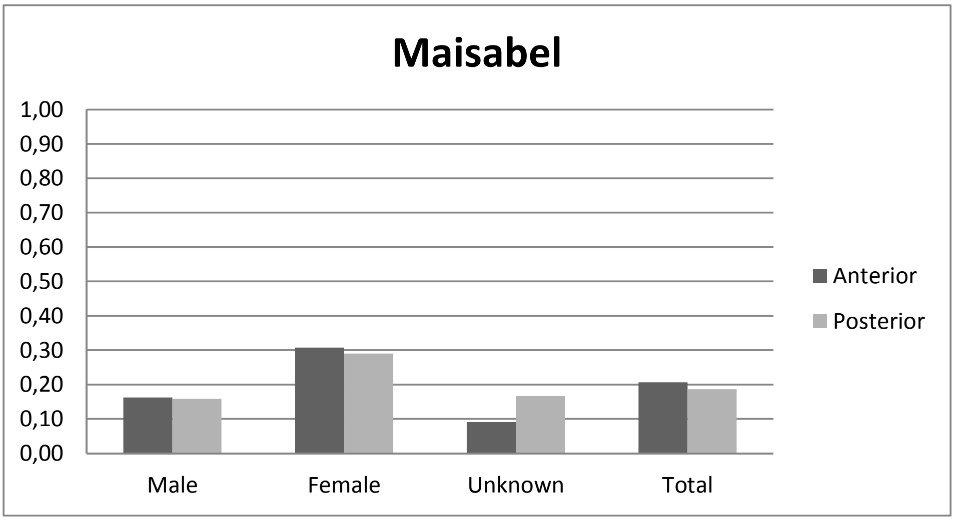

Figure 6.36 The frequency of chipping by anterior/posterior dentition for Maisabel.

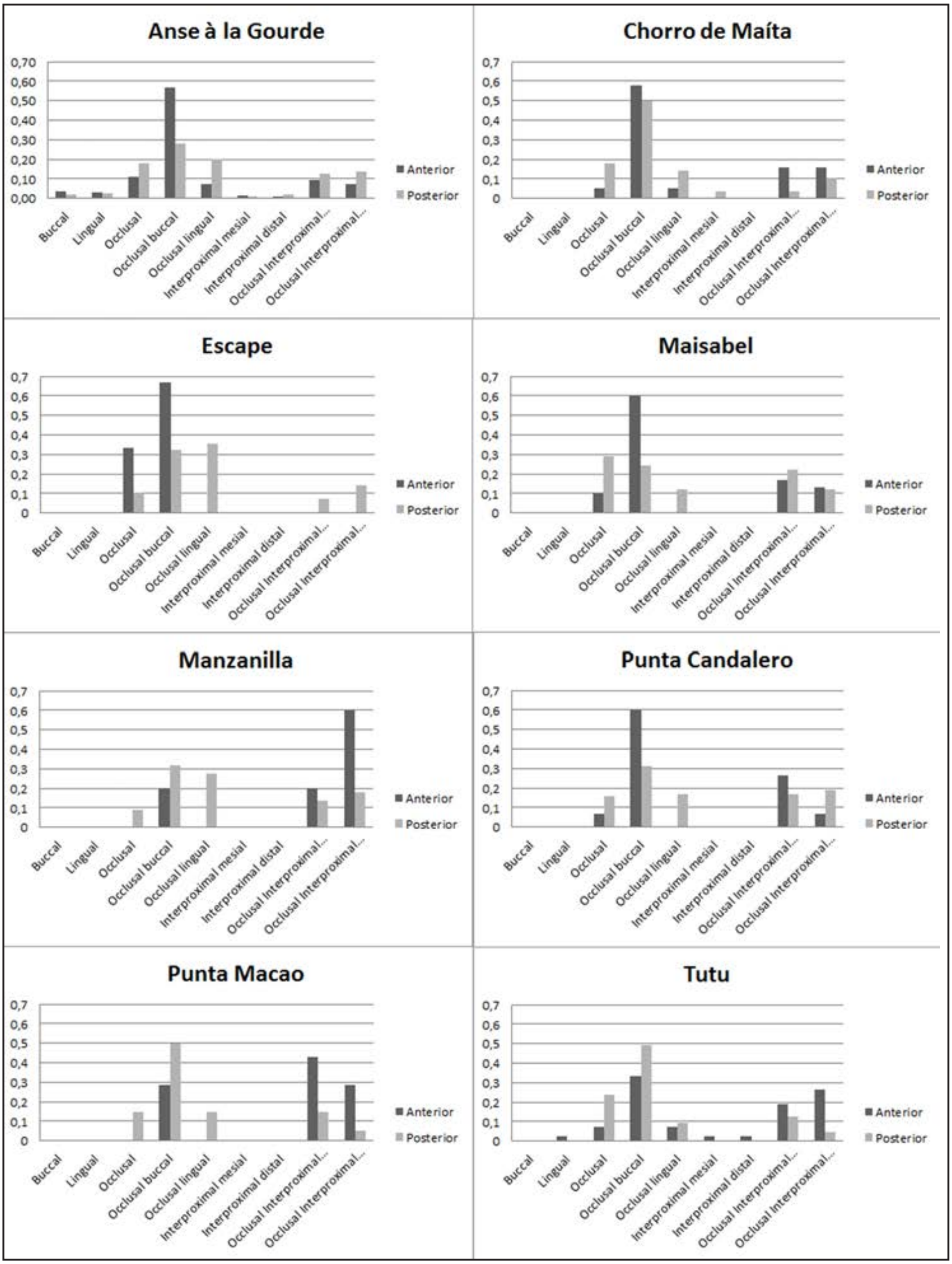

Figure 6.37 Bar charts depicting the frequencies of chipping locations (tooth crown) per site.

Even so, no differences were apparent in the location of the chipping on the tooth crown between upper and lower dentitions. The most severely chipped teeth for both the upper and lower dentition are the first molars, most likely because of their early eruption (at around 6 years of age), and important role in the mastication of tougher foodstuffs.

For all sites combined, we see that the mean degree of chipping is lower in the anterior teeth ($\overline{X}$ = 0.23) than in the posterior teeth ($\overline{X}$ = 0.43). Similar differences between the anterior and posterior dentition are seen in both males and females (Figure 6.39 and Table 6.13), and at all individual sites except Anse à la Gourde, Diale 1, and Kelbey's Ridge 2, where in females the anterior teeth have a very slightly higher mean degree of chipping than the posterior teeth.
The results of a Kruskal-Wallis test show there is a statistically significant difference between the degree of chipping recorded in the different sites ($H(18)$= 365.06, p= 0.00). Post-hoc testing of the individual sites two by two produced the results

Mean degree of chipping	**Male**			**Female**			**Unknown**		
	Ant.	**Post.**	**Total**	**Ant.**	**Post.**	**Total**	**Ant.**	**Post.**	**Total**
Anse à la Gourde	0.57	0.90	0.73	0.43	0.37	0.40	1.50	0.00	0.75
Canashito	0.00	0.33	0.21	0.00	0.00	0.00	0.20	0.00	0.11
Chorro de Maíta	0.11	0.13	0.12	0.02	0.15	0.09	0.08	0.16	0.13
Diale 1	0.00	0.13	0.09	0.14	0.04	0.06	-	-	-
Escape	0.00	0.00	0.00	0.07	0.23	0.18	0.01	0.24	0.16
Juan Dolio	0.14	0.86	0.57	0.14	0.48	0.39	-	-	-
Kelbey's Ridge 2	2.00	3.00	2.50	0.38	0.36	0.37	-	-	-
Lavoutte	0.14	0.31	0.24	0.07	0.24	0.17	0.03	0.08	0.05
Maisabel	0.20	0.27	0.24	0.34	0.39	0.37	0.14	0.25	0.20
Malmok	0.00	0.78	0.74	0.00	0.14	0.08	0.16	0.14	0.15
Mamora Bay	-	-	-	-	-	-	0.07	0.46	0.30
Manzanilla	0.16	0.28	0.24	0.00	0.59	0.36	0.00	0.00	0.00
Point de Caille	0.00	0.00	0.00	0.00	0.06	0.03	-	-	-
Punta Candelero	0.15	0.68	0.48	0.22	0.78	0.59	0.16	0.52	0.41
Punta Macao	0.28	0.53	0.46	0.32	0.82	0.60	0.09	0.00	0.04
Santa Cruz	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.11
Savaneta	0.00	0.06	0.04	0.00	0.00	0.00	0.00	0.00	0.00
Savanne Suazey	0.00	0.25	0.20	0.00	0.23	0.17	-	-	-
Tocorón	0.00	0.00	0.00	0.00	0.38	0.25	0.00	0.00	0.00
Tutu	0.81	1.55	1.32	0.52	0.67	0.61	0.00	0.00	0.00

Table 6.13 The mean degree of chipping by site, sex, and anterior/posterior dentition.

presented in Table 6.14, which displays the significance (p) values for each individual site compared with each other individual site. Based on shared significant differences, and the degree of chipping, two groups could be distinguished: one represents sites with a high degree of chipping ($\overline{X}$ = 0.45–0.86), and the other represents sites with a (relatively) low degree of chipping ($\overline{X}$ = 0.01–0.29).

Gross localized chipping
Eight dentitions showed a particular pattern of very severe dental chipping confined to the buccal surfaces of a small number of teeth (Figures 6.40 and 6.41;

Table 6.15). The chipping is graded 3 according to Bonfiglioli et al. (2004), but its severity is remarkable, with large parts of the tooth crown having been lost. Often there is considerable rounding and smoothing of the chipped area showing the teeth were in functional occlusion long after the damage occurred. Considerable localized force would have been necessary to cause such damage, and since in all cases the damaged areas are located on the buccal edge of the tooth crown, the use of the

Figure 6.41 Punta Candelero 1 (B4). Gross localized chipping of the third and fourth lower left premolars. Note the considerable rounding and smoothing of the break surface due to continued use after damage.

		High						Low												
		AAG	**JD**	**KR**	**PC**	**PM**	**TT**	**CAN**	**CM**	**DIA**	**LAV**	**MB**	**MMB**	**MK**	**MZ**	**PdC**	**SAV**	**SC**	**SS**	**TOC**
High	**AAG**	-	1.00	1.00	1.00	1.00	**0.00**	1.00	**0.00**	**0.00**	**0.00**	**0.00**	0.81	0.22	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.05**
	JD	1.00	-	1.00	1.00	1.00	0.29	1.00	0.37	0.15	0.94	1.00	1.00	1.00	1.00	**0.03**	**0.02**	0.08	0.99	0.96
	KR	1.00	1.00	-	1.00	1.00	1.00	1.00	0.35	0.21	0.63	0.95	0.99	0.98	0.96	0.11	0.11	0.16	0.68	0.51
	PC	1.00	1.00	1.00	-	1.00	**0.00**	1.00	**0.00**	**0.00**	**0.00**	**0.00**	1.00	0.89	0.17	**0.00**	**0.00**	**0.00**	**0.02**	0.20
	PM	1.00	1.00	1.00	1.00	-	**0.01**	1.00	**0.00**	**0.00**	0.19	1.00	1.00	1.00	1.00	**0.00**	**0.00**	**0.00**	0.71	0.79
	TT	**0.00**	0.29	1.00	**0.00**	**0.01**	-	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Low	**CAN**	1.00	1.00	0.10	1.00	1.00	**0.01**	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	CM	**0.00**	0.37	0.35	**0.00**	**0.00**	**0.00**	1.00	-	1.00	1.00	**0.00**	1.00	1.00	0.64	**0.01**	**0.00**	1.00	1.00	1.00
	DIA	**0.00**	0.15	0.21	**0.00**	**0.00**	**0.00**	1.00	1.00	-	0.94	**0.01**	0.98	0.86	0.23	1.00	1.00	1.00	1.00	1.00
	LAV	**0.00**	0.94	0.63	**0.00**	0.19	**0.00**	1.00	1.00	0.94	-	1.00	1.00	1.00	1.00	**0.00**	**0.00**	0.53	1.00	1.00
	MB	**0.00**	1.00	0.95	**0.00**	1.00	**0.00**	1.00	**0.00**	**0.01**	1.00	-	1.00	1.00	1.00	**0.00**	**0.00**	**0.00**	1.00	1.00
	MMB	0.81	1.00	0.99	1.00	1.00	**0.00**	1.00	1.00	0.98	1.00	1.00	-	1.00	1.00	0.42	0.41	0.84	1.00	1.00
	MK	0.22	1.00	0.98	0.89	1.00	**0.00**	1.00	1.00	0.86	1.00	1.00	1.00	-	1.00	0.13	0.12	0.56	1.00	1.00
	MZ	**0.00**	1.00	0.96	0.17	1.00	**0.00**	1.00	0.64	0.23	1.00	1.00	1.00	1.00	-	**0.00**	**0.00**	0.07	1.00	1.00
	PdC	**0.00**	**0.03**	0.11	**0.00**	**0.00**	**0.00**	1.00	**0.01**	1.00	**0.00**	**0.00**	0.42	0.13	**0.00**	-	1.00	1.00	0.98	1.00
	SAV	**0.00**	**0.02**	0.11	**0.00**	**0.00**	**0.00**	1.00	**0.00**	1.00	**0.00**	**0.00**	0.41	0.12	**0.00**	1.00	-	1.00	0.98	1.00
	SC	**0.00**	0.08	0.16	**0.00**	**0.00**	**0.00**	1.00	1.00	1.00	0.53	**0.00**	0.84	0.56	0.07	1.00	1.00	-	1.00	1.00
	SS	**0.00**	0.99	0.68	**0.02**	0.71	**0.00**	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.98	1.00	-	1.00
	TOC	**0.05**	0.96	0.51	0.11	0.79	**0.00**	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-

Table 6.14 Significance (p) values for comparisons of degree of chipping per site based on the post-hoc testing of sites two by two after a Kruskal-Wallis test revealed significant differences were present ($H(18) = 365.06$, $p = 0.00$). Note that Escape is excluded from the calculations due to poor preservation. AAG= Anse à la Gourde, JD= Juan Dolio, KR= Kelbey's Ridge 2, PC= Punta Candelero, PM= Punta Macao, TT= Tutu, CAN= Canashito, CM= Chorro de Maíta, DIA= Diale 1, LAV= Lavoutte, MB= Maisabel, MMB= Mamora Bay, MK= Malmok, MZ= Manzanilla, PdC= Point de Caille, SAV= Savaneta, SC= Santa Cruz, SS= Savanne Suazey, TOC= Tocorón.

teeth in some sort of non-alimentary activity is the most likely cause. Trauma is thought to be an unlikely explanation for this pattern of wear, since a forceful blow to this area of the face would more likely result in complete loss of the elements.

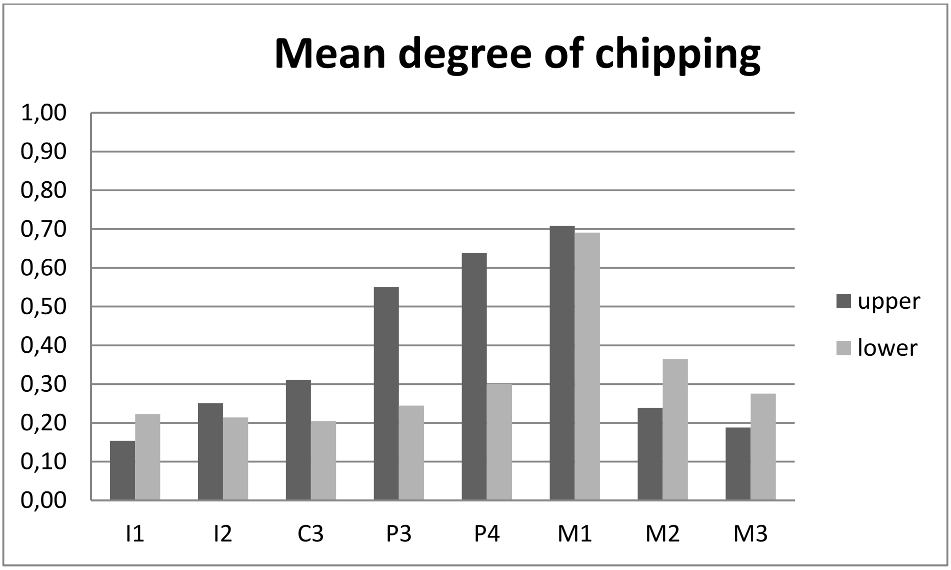

Figure 6.38 The mean degree of chipping per dental element.

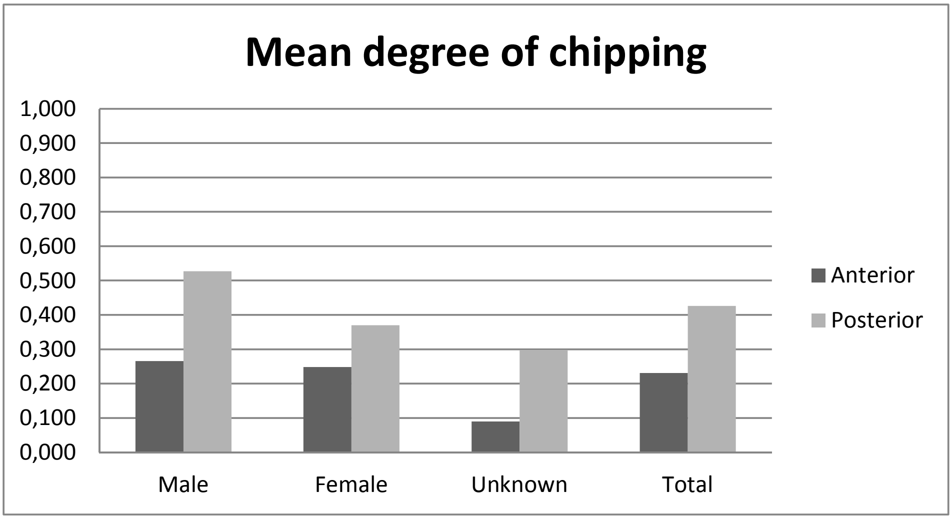

Figure 6.39 The mean degree of chipping by anterior/posterior dentition.

Site	Individual	Affected teeth
La Caleta	190	2.3, 2.4, 2.5
Punta Candelero	1 (B4)	3.4, 3.5, 3.6
Punta Candelero	1 (Y)	1.4
Punta Candelero	3 (B3)	1.4, 1.5, 2.4
Punta Candelero	13 (Huecoid)	1.3, 1.4, 1.6, 1.7
Punta Candelero	59 (B5)	1.3, 1.4, 1.5
Punta Macao	25	1.4, 2.4, 2.5
Savanne Suazey	5	1.4

Table 6.15 Individuals affected by gross localized chipping.

6.3.3 LSAMAT

Figure 6.40 Punta Macao 25. Gross localized chipping of the third and fourth upper left premolars.

As described in Chapter 4, the presence of LSAMAT (lingual surface attrition of the maxillary anterior teeth) was documented according to guidelines established by Turner and Machado (1983). They describe LSAMAT as "the occurrence of progressive wearing with age of upper anterior lingual tooth surfaces without corresponding lingual or labial surface wear on any lower teeth. It is not the result of any manner of occlusal overbite, overjet, malocclusion, or other normal or abnormal anatomical consideration" (Turner and Machado 1983:126). They also note a correlation between LSAMAT and a high rate of caries. According to a number of previous studies, lingual surface enamel of teeth affected by LSAMAT is worn away, often leaving the dentine exposed, and the remaining structure tends to have a polished appearance (Irish and Turner 1997; Robb et al. 1991; Turner and Machado 1983; Turner et al. 1991).

Figure 6.42 Type 1 LSAMAT (Chorro de Maíta 45).

While adhering closely to the described appearance of LSAMAT for its diagnosis in this study, I noticed a degree of variation in the appearance of LSAMAT in the sample. This variation is partly the result of different stages of LSAMAT wear. Especially the early stages of LSAMAT may be hard to distinguish. Mostly, these are characterized by lingual polishing and slight loss of enamel but no dentine exposure. Apart from differences due to the stage of the wear, however, there appear to be two different types of LSAMAT present in the material used in this study, both of which fit the original description of LSAMAT as set out by Turner and Machado (1983).

Figure 6.43 Type 1 LSAMAT (Higuey).

Type 1

The lingual surfaces of the central incisors are unevenly affected by wear, especially in the early stages. The most severe wear is located on the central incisors, on the projecting area of the cingulum, close to the cement-enamel junction. Here, the enamel is generally worn away, exposing a considerable portion of the dentine. The lateral incisors and canines ap-

Figure 6.44 Type 1 LSAMAT. Left: Punta Candelero 1 (B4); Right: Chorro de Maíta 34.

pear to be worn more evenly across the lingual surfaces, although the cingulum and the area closest to the cement-enamel junctions are also most severely affected. In the early stages, the wear facets are circular in shape, and tend to be very slightly cupped. The remainder of the lingual surfaces appears not to be worn, but in some cases has a polished appearance. Later, the central incisors in particular may become severely worn across the entire lingual surface (but mostly around the cingulum), with considerable loss of crown height. Type 1 LSAMAT is also characterized by lingual wear of the premolars, and in a few cases even the first molar. Lingual wear of the premolars tends to be relatively severe, exposing a moderately sized, highly cupped dentine patch.

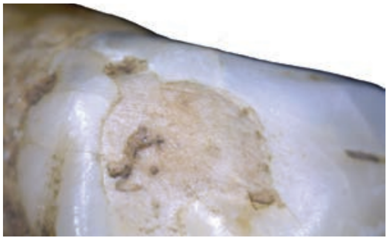

Figure 6.45 Manzanilla 267B (oblique view).

The photo example of an individual affected by LSAMAT given by Irish and Turner (1997) closely fits the appearance of Type 1 LSAMAT. Figures 6.42, 6.43, and 6.44 show examples of Type 1 LSAMAT from this study.

Type 2

The lingual wear of the incisors tends to affect the entire surface, and is generally flattened and angled in an oblique (downward-labial) direction (Figures 6.45 and 6.46). In early stages of wear, this type closely resembles Type 1 LSAMAT, as due to its naturally raised relief, the cingulum is worn first. However, early Type 2 can be distinguished from Type 1 by wear and / or polishing of other parts of the lingual surface, especially the part closest to the incisal edge. Furthermore, the lingual surface is always worn flat and often displays macroscopically observable labio-lingual striations. The central incisors are often the most severely affected, followed by the lateral incisors and then the canines. These teeth are similarly affected by flattened wear which extends across the entire lingual surface. Premolars are not involved.

Figure 6.46 Type 2 LSAMAT. El Cabo 85-34-06.

Surface striations

The lingual surfaces of teeth affected by both Type 1 and Type 2 LSAMAT were assessed macroscopically and microscopically. Microscopic examination revealed that both types of LSAMAT are associated with lingual striations. In both types of LSAMAT, these striations are most prevalent on the central incisors, followed by the lateral incisors and the canines (i.e., the teeth most severely affected by LSAMAT). In both types, the striations are predominantly oriented in linguo-labial direction. Type 1 LSAMAT, however, tends to have finer striations overall, and a

more diffuse pattern of direction. This type is more strongly associated with lingual polishing. Type 2 LSAMAT presents with larger and coarser striations with a clearer directionality.
The lingual surface wear of a small number of teeth with LSAMAT was assessed with a Scanning Electron Microscope. The results hereof are discussed in detail in section 6.3.5.

LSAMAT frequency
Of the total sample, 42.14% is affected by LSAMAT (n= 193). Of the total group of males, 48.37% (n= 74) is affected by LSAMAT. Of the females, 49.32% (n= 73) is affected by LSAMAT. The proportion of males and females affected by LSAMAT is more or less equal. Table 6.16 displays the percentages of individuals affected by LSAMAT per site and by sex. At the individual sites, some slight differences are apparent between the sexes. Most are not statistically significant however, except at Chorro de Maíta, where males are significantly more frequently affected by LSAMAT than females ($\chi^2(1, N= 52)= 6.32, p= 0.03$).

% individuals affected							
Site	**Male**	**Female**	**Unknown**	**Juvenile**	**Adults**	**Total**	**Sex-based difference**
Anse à la Gourde	54.17	47.06	40.00	12.50	49.18	44.93	No
Canashito	0.00	0.00	100.00	-	25.00	25.00	No
Chorro de Maíta	73.08	38.46	40.00	18.75	54.39	46.58	Yes: male > female ($\chi^2(1, N= 52)= 6.32, p= 0.03$)
Diale 1	50.00	33.33	-	0.00	40.00	28.57	No
Escape	50.00	50.00	25.00	0.00	33.33	32.00	No
Juan Dolio	33.33	25.00	-	-	28.57	28.57	No
Kelbey's Ridge 2	100.00	50.00	-	0.00	66.67	33.33	No
Lavoutte	50.00	60.00	42.86	0.00	51.85	46.67	No
Maisabel	33.33	25.00	33.33	0.00	30.78	25.00	No
Malmok	100.00	100.00	100.00	-	100.00	100.00	No
Mamora Bay	-	-	75.00	-	75.00	75.00	n.a.
Manzanilla	22.22	50.00	0.00	0.00	28.57	23.53	No
Point de Caille	50.00	50.00	-	-	50.00	50.00	No
Punta Candelero	47.36	63.64	47.39	16.67	52.00	48.21	No
Punta Macao	33.33	50.00	33.33	0.00	40.00	31.58	No
Santa Cruz	100.00	100.00	50.00	0.00	75.00	50.00	No
Savaneta	0.00	0.00	-	0.00	0.00	0.00	No
Savanne Suazey	0.00	50.00	-	0.00	25.00	20.00	No
Tocorón	0.00	0.00	0.00	-	0.00	0.00	No
Tutu	83.33	85.71	100.00	40.00	85.71	76.92	No

Table 6.16 Frequency of individuals affected by LSAMAT by site and sex/age. Statistically significant differences between the proportions of affected males and females are given.

Next to those incorporated into Table 6.16, a number of sites with less than four individuals also showed LSAMAT wear: Argyle 2, Buccament West, Canas, Ceru Noka, El Cabo, Esperanza, Heywoods, Hacienda Grande, Higuey, La Mina, Manigat cave, Saladero, Spring Bay 1c, St. Kitts (unknown site).

Frequency per type

Of the total adult population (N= 389), 6.94% (n= 27) is affected by Type 1 LSAMAT, and 40.10% (n= 156) is affected by Type 2 LSAMAT. This clear difference in proportions is statistically significant as demonstrated by a chi-square test (χ2(1, N= 389)= 118.90, p= 0.00).

Table 6.17 displays the numbers of individuals and the corresponding percentages affected by the two different types of LSAMAT (by sex and age), of the total group of individuals with LSAMAT wear. As already shown, Type 1 LSAMAT occurs much less frequently than Type 2 LSAMAT. A binomial test for goodness of fit shows that there is a significant difference between the expected ratio (0.5) and the sample ratio (0.85, 0.15; p= 0.000). Similarly, the difference is statistically significant for males (0.81, 0.19; p= 0.00), females (0.86, 0.14; p= 0.00), individuals of unknown sex (0.92, 0.08; p= 0.00) and juveniles (0.90, 0.10; p= 0.02). Overall, no association is apparent between the type of LSAMAT and age or sex.

	Male %	N	Female %	N	Unknown %	N	Child %	N	Total %	N
Type 1	18.92	14	13.70	10	8.33	3	10.00	1	14.51	28
Type 2	81.08	60	86.30	63	91.67	33	90.00	9	85.49	165
Total	100.00	74	100.00	73	100.00	36	100.00	10	100.00	193

Table 6.17 The frequency of LSAMAT types.

Table 6.18 shows the numbers of individuals per site (by sex and age) affected by the two types of LSAMAT. This table does not include sites with less than 4 individuals. Smaller assemblages in which both types of LSAMAT are found are: El Cabo and Heywoods. The single individual representing an unknown site close to the modern day city of Higuey was found to have Type 1 LSAMAT. Of all sites, none appear to show any association between sex and LSAMAT type, except for Chorro de Maíta. Here it seems that Type 1 LSAMAT is more strongly associated with males than with females. A chi-square tests shows that the difference is statistically significant (χ^2(2, N= 52)= 8.20, p= 0.02).

LSAMAT	Individuals affected (N)						
	Type	Male	Female	Unknown	Juvenile	Adults	Total
Anse à la Gourde	1	0	1	0	0	1	1
	2	13	16	0	1	29	30
Chorro de Maíta	1	9	2	0	0	11	11
	2	10	8	1	4	19	23

LSAMAT	Individuals affected (N)						
	Type	Male	Female	Unknown	Juvenile	Adults	Total
Lavoutte	1	1	0	0	0	1	1
	2	4	6	3	0	13	13
Manzanilla	1	0	2	0	0	2	2
	2	3	1	0	0	0	4
Punta Candelero	1	2	2	2	1	6	7
	2	5	8	7	0	20	20
Punta Macao	1	0	1	0	0	1	1
	2	2	2	1	0	5	5
Tutu	1	1	0	0	0	1	1
	2	4	12	1	2	17	19

Table 6.18 The number of LSAMAT types per site and sex/age. Only sites with both types of LSAMAT are displayed.

LSAMAT and caries rate

The total caries rate in the group of individuals affected by LSAMAT is 13.77%. The overall population of adults without any type of LSAMAT shows a caries rate of 10.48%. The difference is statistically significant according to the results of a chi-square test (χ^2(1, N= 5580)= 13.70, p= 0.00). The group affected by LSAMAT also shows a significantly higher mean number of caries per individual (2.37) than the group not affected by LSAMAT (1.26) (t(383)= 5.12, p= 0.00). Therefore, there appears to be an association between caries rate and LSAMAT: adult individuals with LSAMAT have a higher rate of caries overall than those without LSAMAT. There is some evidence, however, that this association may be influenced by the age distributions of both groups: the non-LSAMAT group is generally younger than the LSAMAT group (Appendix B). Since both dental wear (including non-masticatory wear) and caries are age-related the greater caries rate in the LSAMAT groups could be (partially) related to age.

The adult individuals affected by Type 1 LSAMAT show a caries rate of 12.75%. The adult individuals affected by Type 2 LSAMAT show a caries rate of 13.96%. No significant difference was found between the caries rates of both groups (χ^2(1, N= 3138)= 0.51, p= 0.52). The Type 1 LSAMAT group (χ^2(1, N= 2936)= 2.19, p= 0.15) does not show a significantly high caries rate than the non-LSAMAT group. The Type 2 LSAMAT group (χ^2(1, N= 5086)= 14.21, p= 0.00) does show a significantly higher caries rate than the non-LSAMAT group.

Site	Total sample (N)	Affected (N)	Male	Female	Unknown	Juvenile	Affected %
Anse à la Gourde	69	14	4	9	0	1	20.29
Argyle 2	3	1	1	0	0	0	33.33
Chorro de Maíta	73	7	5	2	0	0	9.59
Coto	1	1	0	0	1	0	100.00
El Cabo	2	1	1	0	0	0	50.00
Escape	25	3	1	2	0	0	12.00
Esperanza	2	1	0	0	0	1	50.00
Higuey	1	1	1	0	0	0	100.00
Indian Creek	1	1	0	0	1	0	100.00
Juan Dolio	7	2	2	0	0	0	28.57
Kelbey's Ridge 2	6	2	1	1	0	0	33.33
La Caleta	1	1	1	0	0	0	100.00
Lavoutte	31	1	1	0	0	0	3.23
Maisabel	35	4	2	2	0	0	11.43
Manigat Cave	3	1	0	0	1	0	33.33
Manzanilla	18	1	1	0	0	0	5.55
Punta Candelero	56	13	6	3	3	1	23.21
Punta Macao	19	4	3	1	0	0	21.05
Savanne Suazey	5	1	1	0	0	0	20.00
St. Croix	1	1	1	0	0	0	100
St. Kitts	1	1	0	0	1	0	100
Tutu	26	4	3	1	0	0	15.38

Table 6.19 The number and proportion of individuals affected by non-alimentary dental wear per site by sex/age.

Chronological comparisons

Maisabel – in the early phase of occupation 30.77% of the population is affected by LSAMAT. In the late period this drops to 21.05%. A chi-square test shows the difference is not significant ($\chi^2(1, N= 32)= 0.39, p= 0.68$).

Punta Candelero – in the middle phase of occupation 47.62 % of the population is affected by LSAMAT. In the late period this rises to 80.00%. The difference is not statistically significant ($\chi^2(1, N= 26)= 1.70, p= 0.33$).

Tutu – in the early phase of occupation 100.00 % of the population is affected by LSAMAT. In the late period this drops to 68.75%. The difference is not statistically significant ($\chi^2(1, N= 25)= 3.52, p= 0.12$).

Sex-based comparisons

As can be seen in Table 6.16, males at Chorro de Maíta are significantly more frequently affected than females. None of the other sites show significant differences in the proportions of males and females affected by LSAMAT.

6.3.4 Non-alimentary tooth use: *teeth as tools*

A total of 66 individuals show evidence of non-alimentary or occupational use of the teeth, amounting to 14.41% of the entire sample. These individuals displayed patterns of dental wear which could not be caused by normal food mastication. The proportion of individuals with such wear in the individual site sample sets varies widely (Table 6.19).

Sex-based comparisons

The number of males (n= 153) and females (n= 148) across the entire sample is more or less equal. The distribution of individuals in the group displaying non-alimentary wear appears different, however (Table 6.20).

	Non-alimentary wear %	N	Population %	N
Male	53.03	35	33.41	153
Female	31.82	21	32.31	148
Unknown	10.61	7	19.21	88
Child	4.55	3	15.07	69
Total	100.00	66	100.00	458

Table 6.20 The proportions of males and females in the entire sample, and the proportions of males and females in the non-alimentary wear group.

An exact binomial test for goodness of fit shows that in the non-alimentary wear group the proportion of males and females using their teeth as tools differs sig-

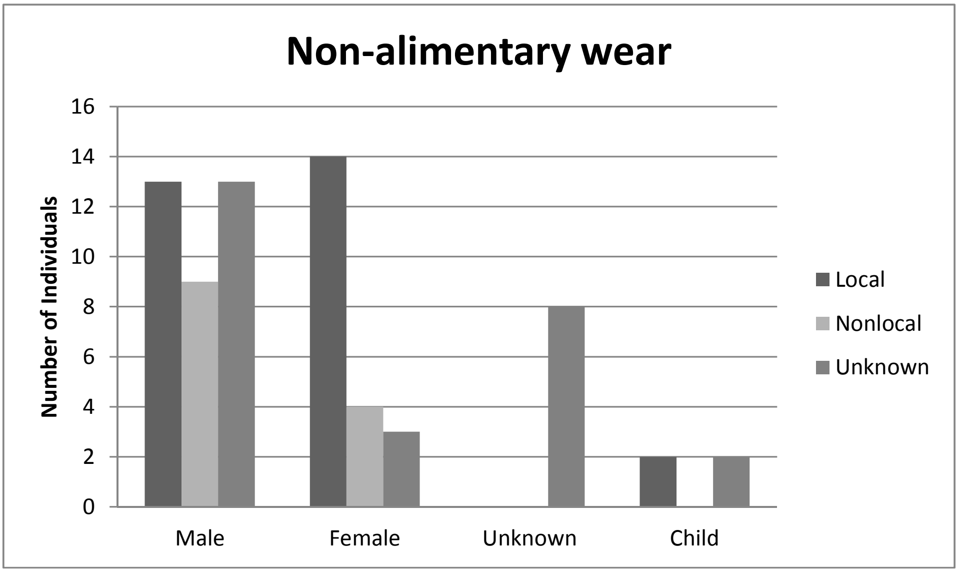

Figure 6.47 The number of nonlocals, locals, and individuals for which provenience is unknown by sex/age.

	Site	Individual	Sex	Age	C14	Origin
Type 1	Anse à la Gourde	139	Male	46+	?	Local
	Anse à la Gourde	207	Female	36–45	?	Local
	Anse à la Gourde	1948	Male	46+	?	Nonlocal
	Kelbey's Ridge 2	68	Male	36–45		Local
	Maisabel	28	Male	46+	Hacienda Grande	Local
	Manigat Cave	264654	Unknown	Adult	?	?
	Punta Candelero	7 (B6)	Male	46+	cal. A.D. 598–871	?
Type 2	Anse à la Gourde	304	Female	26–35	?	Local
	Argyle 2	1	Male	36–45	?	?
	Chorro de Maíta	25	Male	26–35		Local
	Chorro de Maíta	92	Male	36–45	Contact period	Nonlocal
	El Cabo	F85-34-06	Male	26–35	?	?
	Juan Dolio	8	Male	26–35	?	?
	Kelbey's Ridge 2	132	Female	46+		Local
	Lavoutte	68-04	Male	26–35	cal. A.D. 1304–1422	Local
	Maisabel	7	Male	46+	cal. A.D. 932–1162	Nonlocal
	Manzanilla	119	Male	46+	Late Palo Seco	Local
	Punta Candelero	1A (D1)	Female	46+	cal. A.D. 680–942	?
	Punta Candelero	3 (B3)	Unknown	Adult	?	?
	Punta Candelero	4 (B3)	Female	26–35	?	?
	Punta Candelero	9 (B3)	Female	36–45	cal. A.D. 468–663	?
	Punta Macao	1	Female	36–45	Late?	Local
	Punta Macao	11	Male	26–35	Late?	Local
	Punta Macao	13	Male	36–45	Late?	Local
2a	Anse à la Gourde	706	Male	26–35	?	Local
	Anse à la Gourde	2212	Female	46+	cal. A.D. 1218–1388	Local
	La Caleta	190	Male	36–45	?	?
2b	Anse à la Gourde	452	Female	26–35	?	Local
	Anse à la Gourde	1948	Male	46+	?	Nonlocal
	Chorro de Maíta	65	Male	18–25		Local
	Higuey	Dario Yune	Male	26–35	?	?
	Punta Candelero	ass. w. 1 (C3)	Unknown	Adult	?	?
Type 3	Anse à la Gourde	50	Female	Adult	?	Local
	Anse à la Gourde	159	Female	18–25	?	Local
	Anse à la Gourde	238B	Female	26–35	?	Local
	Anse à la Gourde	450	Male	26–35	cal. A.D. 1264–1317	Nonlocal
	Anse à la Gourde	452	Female	26–35	?	Local
	Anse à la Gourde	2213	Female	46+	cal. A.D. 1273–1382	Nonlocal
	Argyle 2	1	Male	36–45	?	?
	Chorro de Maíta	65	Male	18–25		Local
	Coto	266173	Unknown	Adult	?	?
	El Cabo	F85-34-06	Male	26–35	?	?
	Higuey	Dario Yune	Male	26–35	?	?

	Site	Individual	Sex	Age	C14	Origin
Type 3	Maisabel	10	Female	46+	cal. A.D. 606–785	Local
	Maisabel	23	Female	46+	cal. A.D. 1057–1277	Nonlocal
	Punta Candelero	A3	Unknown	Adult	cal. A.D. 622–773	?
	Punta Candelero	1 (B6)	Male	46+	?	?
	Punta Candelero	1 (F4)	Unknown	Adult	?	?
	Punta Candelero	1A (D1)	Female	46+	cal. A.D. 680–942	?
	Punta Candelero	40	Child	3–5	?	?
	Punta Candelero	59 (B5)	Male	Adult	?	?
	Punta Macao	12	Male	36–45	Late?	Local
	Tutu	30	Male	36–45	Late	Local
	Tutu	31	Female	36–45	Late	Nonlocal
Type 4	Anse à la Gourde	1945	Female	26–35	?	Local
	Chorro de Maíta	47	Male	26–35		Nonlocal
	Chorro de Maíta	68	Female	18–25		Local
	Chorro de Maíta	87A	Female	26–35		Nonlocal
	Chorro de Maíta	89	Male	46+		Nonlocal
	Esperanza	2	Child	4–5	?	?
	Indian Creek	254343	Unknown	Adult	?	?
	Juan Dolio	69	Male	Adult	?	?
	Punta Candelero	29 (A3)	Male	26–35	cal. A.D. 591–769	?
	Punta Macao	1	Female	46+	Late?	Local
	Savanne Suazey	5	Male	Adult		?
	Tutu	33	Male	36–45	Late	Local
	Tutu	38	Male	46+	Late	Nonlocal
	Tutu	39	Child	8	Late	Local
Type 5	Anse à la Gourde	219	Child	9–11	?	Local
	Anse à la Gourde	1945	Female	26–35	?	Local
	Escape	2	Female	36–45	?	Local
	Escape	24	Female	26–35	?	Local
	Escape	36	Male	36–45	?	Nonlocal
	Punta Candelero	1 (B4)	Male	46+	cal. A.D. 553–666	?
	St. Croix	496	Male	26–35	?	?
	St. Kitts	511	Unknown	Adult	?	?
	Tutu	38	Male	46+	cal. A.D. 1170–1400	Nonlocal

Table 6.21 Individuals affected by the different types of non-alimentary wear by sex/age, dating, and provenience (Laffoon and de Vos 2011; Laffoon 2012; Hoogland personal communication 2012; Pestle 2011; Siegel 1992, 1996, 1999).

nificantly from the expected ratio (0.5) and the sample ratio (0.62, 0.38; $p= 0.048$). Males are more frequently affected by non-alimentary wear than females. A chi-square test confirms that males are significantly more frequently affected by non-alimentary dental wear than females ($\chi^2(1, N= 301)= 3.75$, $p= 0.05$).

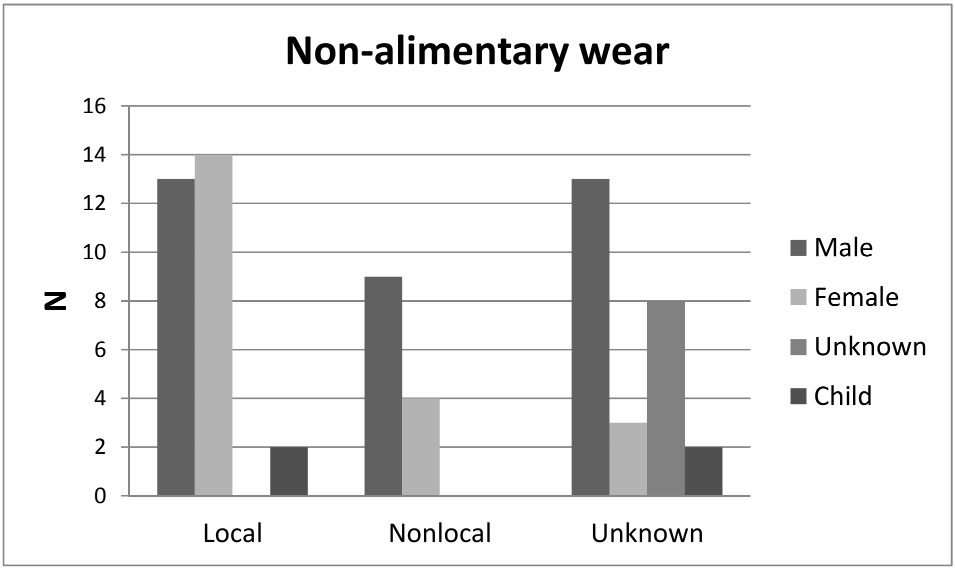

Figure 6.48 The number of males, females, individuals of unknown sex, and juveniles by provenience.

Chronological comparisons

The earliest dated individual showing signs of the use of the teeth as tools is radiocarbon dated to cal. A.D. 553–666, the latest to cal. A.D. 1304–1422 (Table 6.21). Individuals 47, 65, 89, and 92 from Chorro de Maíta probably fall outside of this range, as based on extended (Christian) burial position, and European faunal remains and metals found in the grave sediments, these individuals postdate contact. Individuals 25, 68, and 87 may pertain to the pre-Columbian phase of occupation as there are no indications of contact and they are buried in a typically Amerindian manner. Caution must be applied here, however, since these burial practices may have been in use well into the contact period, and it is possible that Chorro de Maíta was an entire Contact period site (Valcárcel Rojas 2012).

Provenience and non-alimentary wear

A study of human mobility and migration throughout the Caribbean region through Strontium isotope analysis was undertaken simultaneously to the research presented here (Laffoon 2012; Laffoon, Davies, et al. 2012), as a part of the NWO Vici programme 'Communicating Communities' led by Prof. Dr. C.L. Hofman (project no. 277-62-001). Many of the samples used in the isotope study and in this study are derived from the same sites and skeletal individuals. Since the geographical origins of an individual found buried at a particular location are likely to have influenced their social and cultural identity, it is interesting to see whether another aspect of their identity (craft activities, the use of the teeth as tools) is associated in some way with origin.

Figures 6.47 and 6.48 both display the numbers of locals and nonlocals within the non-alimentary tooth use group by sex and age. Both diagrams show that the number of nonlocal females is considerably smaller than the number of local females using their teeth as tools. It is also clear that the number of nonlocal males is much larger than the number of nonlocal females. A chi-square test reveals that although a larger proportion of females using their teeth as tools appear to be of local origin than the proportion of males of local origin there is no statistically significant difference between the sexes ($\chi^2 = 1.58$, $p = 0.21$).

Types of non-alimentary wear

The 66 individuals in the total sample that showed evidence of the use of their teeth as tools are not only of both sexes and varying ages; there is also considerable variation in the type of non-masticatory wear observed in the group. Some patterns of wear are unique to an individual, while in other cases the same (or a very similar) pattern of wear is observed in numerous individuals. Based on the degree of wear, the size and shape of the affected area(s), the location of the wear on the individual dental elements, and its distribution throughout the dentition, a number of types of non-alimentary wear could be identified.

Type 1: lingual wear of the lower incisors

This pattern is characterized by the loss of enamel on the lingual surfaces of the lower anterior teeth, specifically the incisors. Central incisors are generally more severely affected than lateral incisors. Root surfaces are also affected in cases of alveolar bone resorption. This pattern is not associated with malocclusion, or any corresponding wear on the upper anterior teeth.

Figure 6.49 Type 1 non-alimentary wear. Punta Candalero 7 (B6).

Type 2: Disproportionate wear between anterior and posterior teeth

This pattern is characterized predominantly by disproportionate wear between the anterior and posterior teeth. The anterior teeth are more severely worn than the posterior teeth (Figure 6.50). Often, the entire crowns of the anterior teeth are lost, and the surfaces of these elements are worn rounded or flat. In some cases the severe wear of the anterior teeth has resulted in an open bite. In other cases, only the upper or lower teeth are disproportionately worn, with no corresponding wear on the opposite teeth.

Figure 6.50 Type 2 non-alimentary wear. Punta Macao 13.

Type 3: Notching / grooving of the anterior teeth
Notches or grooves on the occlusal surfaces tend to be located in the anterior dentition, as they are generally the result of the use of the teeth as tools, as opposed to for example tooth picking (in which case they are located on the interproximal surfaces). In most individual cases documented here only one or two elements are affected. In one case opposing teeth are notched /grooved, showing they were used to clamp (and possibly pull) a thin strip of material or another object. In many

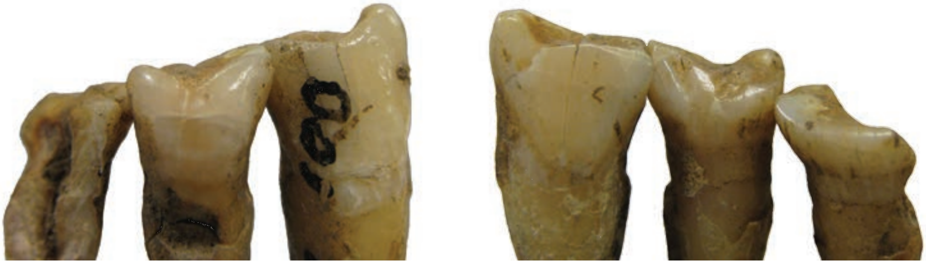

Figure 6.51 Type 3 non-alimentary wear. Coto 266173. Labial/lingual.

other cases opposing teeth are not preserved. The affected dental element, and size and direction of the notch/groove varies. The surface of the notch/groove tends to be polished and display small striations parallel to the notch/groove, indicating the direction of the movement of the material across the tooth.
Six individuals from the sites of Anse à la Gourde, Punta Candelero, and Tutu, display highly similar notches, with regards to size, shape, depth, and orientation of the notches, and with regards to the elements of the dentition that are affected. Five of these individuals are female, perhaps indicating some form of gender-based task differentiation. In all six cases the anterior teeth are affected by notches of approximately 1.5 mm in width, with striations and/or pitting microscopically visible in the groove. The size of the notches, combined with microscopically observed striations and sometimes slight pressure pitting in the grooves, corresponds to those observed in individuals who clamp thin strips of material such as (cotton) thread or plant stems or leaves, perhaps indicating sewing, cordage manufacture, or basketry. Some notches display polishing along the walls and pit of the groove (Figure 6.51), which is consistent with a fine fibrous material, such as cotton thread, being pulled across the surface.

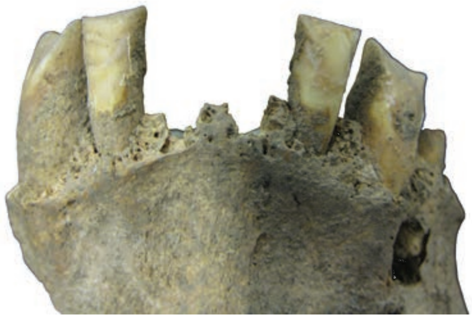

Figure 6.52 Type 4 non-alimentary wear.

Type 4: Buccal wear
This pattern of wear is characterized by the loss of enamel on the buccal/labial surfaces of the teeth. Usually this type of wear affects the anterior teeth, or al-

ternatively the premolars. In a number of cases only the upper central incisors were found to be affected. Wear facets tend to be flat. When the lower incisors or canines are affected the wear is generally flat or slightly curved (rounded), and angled in lingual-labial direction (Figure 6.52). In these cases lingual-labial striations can sometimes be distinguished macroscopically. When the upper (central) incisors are affected, the wear tends to be flat and not angled.

Type 5: Singular cases
Nine individuals displayed patterns of unique non-masticatory wear, perhaps resulting from individual habits or very rare uses of the teeth as tools. These individual cases are described here.

Anse à la Gourde 219
This juvenile aged between 9–11 years shows wear of the upper incisors and premolars that is typical for both Type 1 and Type 2 LSAMAT. The upper incisors are worn flat on the lingual surface, and there is slight dentine exposure. The upper third premolars are also worn flat on the lingual surface, although only the enamel is affected. The lower left premolars and first molar show slight wear on the buccal-occlusal edge, reminiscent of that seen in cases of lingual tilting of the molars, although these teeth have not tilted any more than the normal human helicoidal plane upon eruption of the permanent dentition (Figure 6.53) (Molnar 2011; Reinhardt 1983; Smith 1986). The wear is not severe, however, as is the case in lingual tilting, and no dentine is exposed. No striations were observed on the wear facets either macroscopically of microscopically, although SEM may (in future) reveal patterns of microwear.The wear facets observed in the upper and lower left teeth correspond well, suggesting that they could have been caused by the drawing of an object or material outward and downward between the occluded teeth.


Figure 6.53 Type 5 non-alimentary wear. Anse à la Gourde 219.

Anse à la Gourde 1945
This female aged between 26–35 years shows a unique pattern of wear of the upper incisors and the lower left premolars (Figure 6.54). The wear on the upper incisors is highly symmetrical and very smooth, reminiscent of intentional dental modification. The upper cen-


Figure 6.54 Type 5 non-alimentary wear. Anse à la Gourde 1945.

Figure 6.55 Type 5 non-alimentary wear. Escape 2.

tral incisors are worn on both the lingual and labial surfaces. The lingual wear appears to be Type 2 LSAMAT with dentine exposure. The labial wear is quite severe, with much exposed dentine, and affects the labial-incisal surface of the central incisors. Together in labial view, the upper central incisors form a crescent shape. The lateral incisors, which are much less severely worn, are both notched in occlusal-traversal direction close to the mesial margin of the crown. The remaining lower incisors (left central and lateral) are less severely worn than the upper incisors, but do show signs of incipient occlusal-traversal notching.

The lower left premolars are both very severely worn on the buccal surface, exposing the dentine. The wear facets are very flat and smooth. It seems that these wear facets may have been polished, however, the teeth are poorly preserved, and the wear facets are too damaged to be sure.

The almost perfect symmetry, smoothness, and differential wear between the opposing teeth would suggest this may be a case of intentional dental modification. However, this individual also shows clear signs of the use of the teeth as tools: LSAMAT and the buccal wear of the lower premolars. This, combined with the incipient notching of the lower left incisors, which may indicate some task activity involving the occluding pairs of incisors, suggests that this is more likely a striking case of non-alimentary tooth wear, perhaps associated with cordage manufacture.

Escape 2

This female aged between 36–45 years displays severe irregular wear of the lower left second molar is (Figure 6.55). The mesio-buccal quadrant of the crown is worn away entirely in very oblique lingual-buccal direction. Wear facet is somewhat concave and elongated, resembling a large smooth groove. Some pressure must have been put on the tooth as it is slightly lingually tilted, with the roots becoming detached on the buccal side.

Figure 6.56 Type 5 non-alimentary wear. Escape 24.

Escape 24

This female aged between 26–35 years has extreme wear on the lower right first molar (Figure 6.56). The rest of the dentition is moderately worn, with the other molars assigned no more than 3 or 4 on the degree of wear scale. The lower right first molar is worn to a degree of at least seven on this scale. The surface is very flat, and very slightly angled in lingual-buccal direction. The enamel and crown have

entirely worn away. Sadly, the upper right first molar was not present (it is unclear whether it was lost ante or post mortem), so any corresponding excessive wear of this element could not be assessed.
It seems a highly specific task activity or personal habit was the cause of this pattern of wear, since this is the only case of its kind in the entire sample. It is likely that an object or material was regularly clamped between the upper and lower right first incisors and perhaps moved along the occlusal surfaces. This object or material could be no larger than 1 cm in width, since the adjacent teeth are not affected.

Escape 36
This male individual aged between 36–45 years has a somewhat similar pattern of wear to that of Anse à la Gourde 219, although there are differences. This individual shows clear Type 2 LSAMAT, combined with wear on the buccal-occlusal edges of the lower right premolars. This wear across the surface is slightly rounded, and angled in lingual-buccal direction. Buccal (rounded) wear was also found on the severely worn lower left central incisor (which is merely a root tip functioning in occlusion). The upper right premolars are worn in buccal-lingual direction. It seems this individual manipulated some sort of flexible material (hence the rounded wear) between the occluding upper and lower right teeth, likely in an outward and downward direction.

Punta Candelero 1 (B4)
This male aged 46+ years, discussed above under section 6.3.2 "Gross localized chipping", shows very severe chipping on the buccal surfaces of the mandibular left premolars and first molar. The latter is unique among the individuals affected by gross localized chipping, since in all other cases the maxillary dentition is affected. The chipping is very severe, with large part of the tooth crowns broken off. The chipped area is highly rounded and smooth, showing the teeth were in functional occlusion long after the tooth was damaged. Considerable localized force would have been necessary to cause such damage, probably clamping and pulling a tough or hard material across the buccal-occlusal edges of the lower left premolars and first molar (Figure 6.40).

St. Croix (unknown site) 496
This male aged 26–35 years has what appears to be a pipe notch between the upper left lateral incisor and canine, and the lower left canine (Figure 6.57). The also appears to be a second developing pipe notch between the upper left canine and the third premolar. The shape and size of the notch, the angle toward the frontal exterior, the extreme symmetry and smooth regularity, and the polished surface of

Figure 6.57 Type 5 non-alimentary wear. St. Croix 496.

the notched area are typical characteristics for pipe notches. Also the presence of a second, developing notch is typical for pipe smokers (Van Dijk et al. in press). Naturally, the presence of a true pipe notch would indicate that this individual does not date to the pre-Columbian period, as pipe smoking was not practiced in the Caribbean at that time.

St. Kitts (unknown site) 511
Similar to St. Croix 496, this adult of unknown age and sex displays what in other circumstances may be identified as a pipe notch (Figure 6.58). According to the Peabody Museum of Natural History catalogue, however, the teeth of this individual were found in a Saladoid jar, obviously predating the contact period by hundreds of years. The notch is located on the occluding left canines. The upper canine has a large polished notch along the lingual surface, the bottom of which is concave and very regular. The lower left canine has a crescent-shaped notch on the incisal edge. The possible cause of this pattern of wear is unknown.

Figure 6.58 Type 5 non-alimentary wear. St. Kitts 511. Lingual view.

Tutu 38
This male aged 46+ years shows lingual tilting of a single tooth (the lower right molar). Lingual tilting is characterized by the lingual orientation of the (molar) teeth, exposure of the roots as they come loose of the alveolar bone, and buccal wear which can extend to the exposed roots. This type of wear is usually associated with severe attrition syndrome, but when it occurs in a single tooth (especially without wear of the opposing tooth) is more likely to be the result of the use of the teeth as tools. In this case, some sort of flexible material would have been pulled across the buccal-occlusal surface of the mandibular right molar.

6.3.5 Microwear
To obtain further insight into the precise cause(s) of some non-alimentary wear patterns, a small number of teeth were submitted for study with a scanning electron microscope. Microwear analysis of this kind is usually used to infer dietary practices, in which case molars are the preferred elements for analysis. Microwear

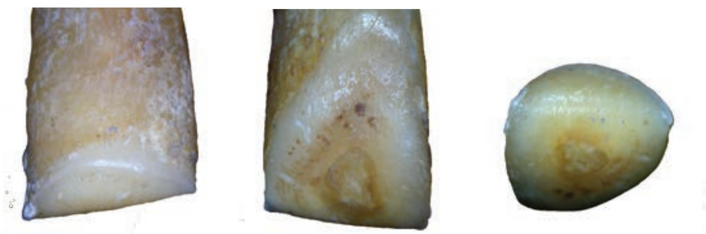

Figure 6.59 Punta Macao 1, upper right central incisor.

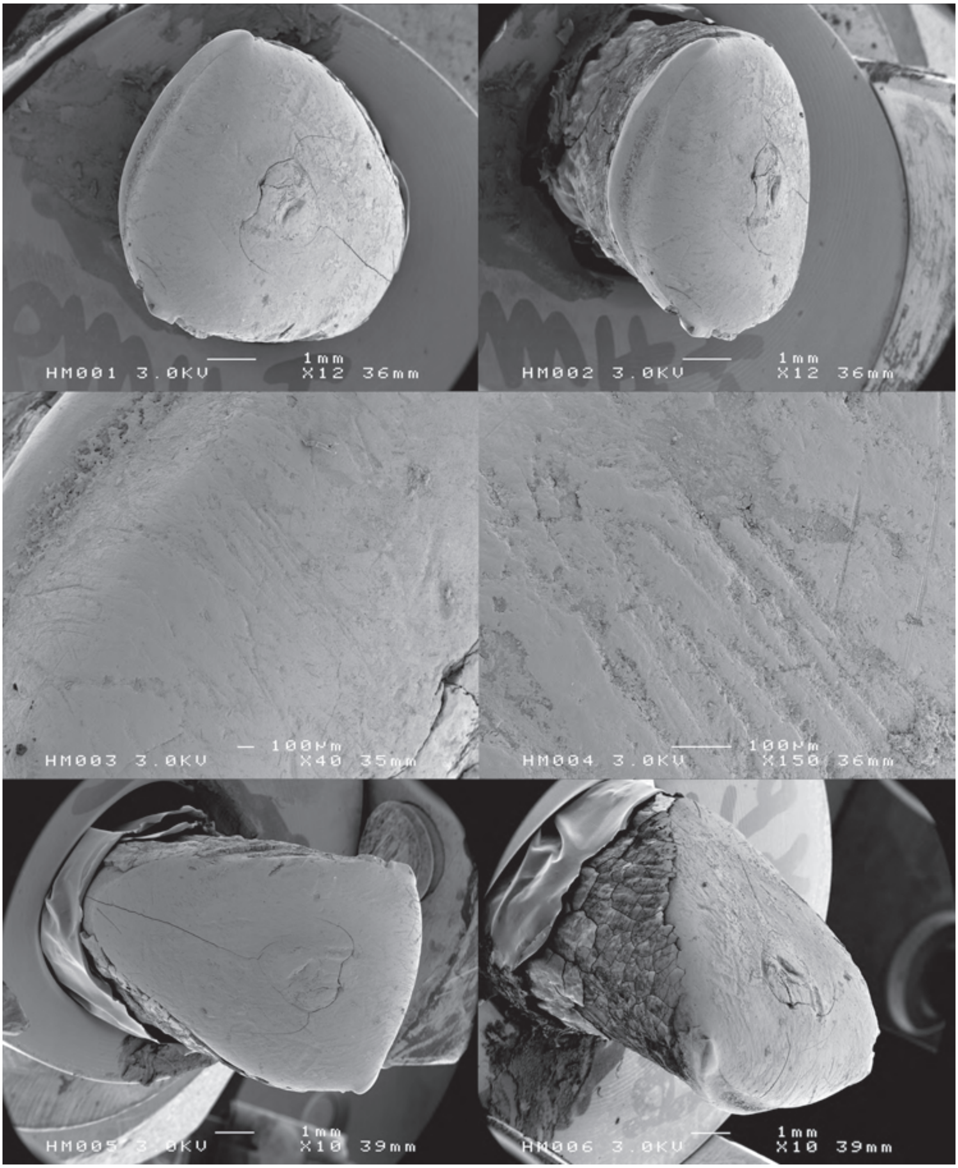

Figure 6.60 Punta Macao 1, upper right central incisor.

studies have infrequently dealt with non-alimentary uses of the teeth, and when they do, they tend to focus on the labial enamel surfaces of the incisors (Krueger and Ungar 2010; Lukacs and Pastor 1988; Ungar and Spencer 1999). Here, the surfaces of anterior teeth which were macroscopically observed to show signs of non-alimentary wear (often the lingual surfaces) are the subject of study. As we will see, the degree of abrasion on these surfaces often means that there is no longer any enamel present. Since dentine and enamel differ in hardness (dentine is softer), we must take into account both materials may be somewhat differently affected by

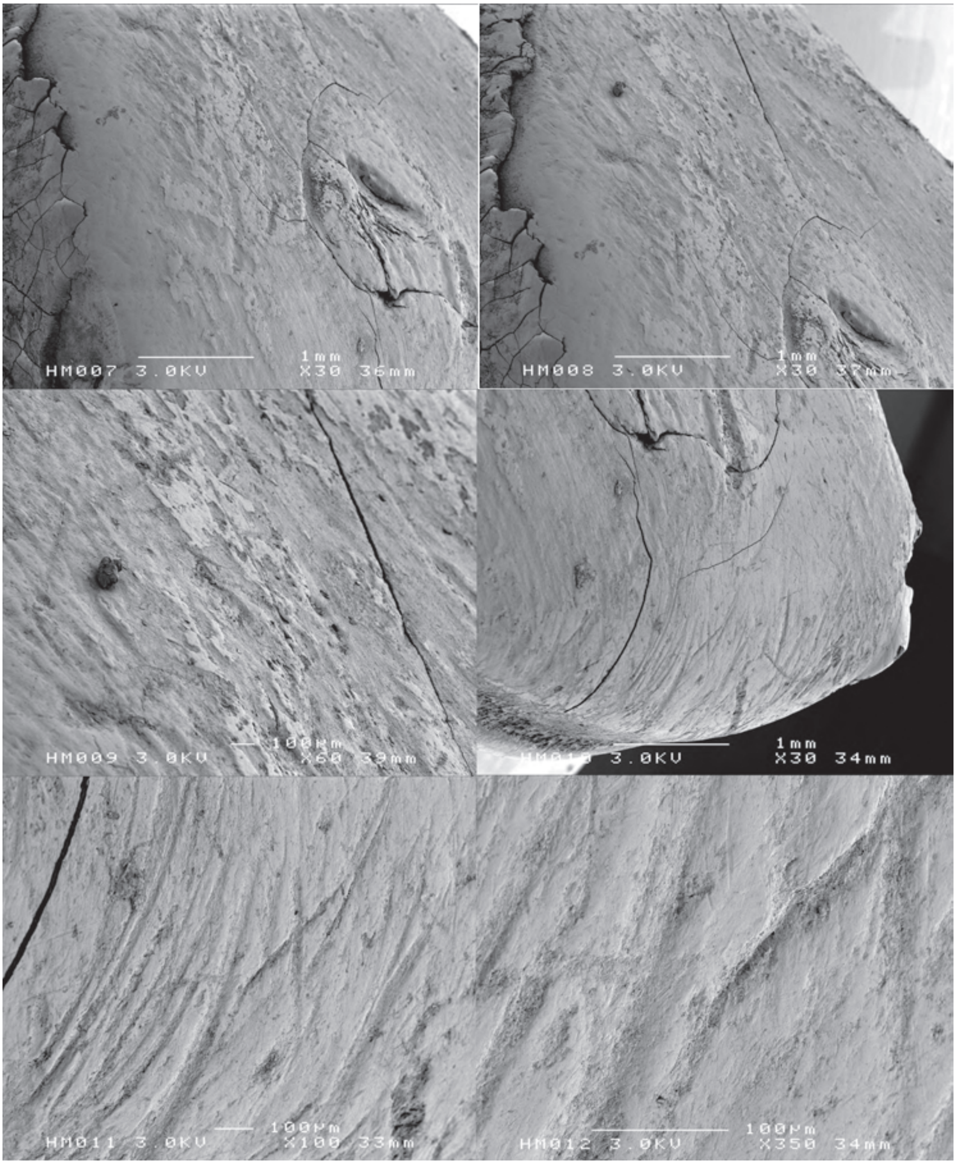

Figure 6.61 Punta Macao 1, upper right central incisor.

pitting, striations and scratches than enamel (Fiorillo 2006, 2008). Furthermore, since this does not concern an analysis of dietary practices, quantification and statistical analyses are not used. Orientation, length, width, starting point, and to a certain extent density, are used to infer potential causes of the wear patterns (Puech 1979; Ryan 1979).

Table 5.4 presents an overview of the samples included in this analysis. The samples were selected based on specific patterns of wear, including Type 2 and Type 4 non-alimentary wear and LSAMAT.

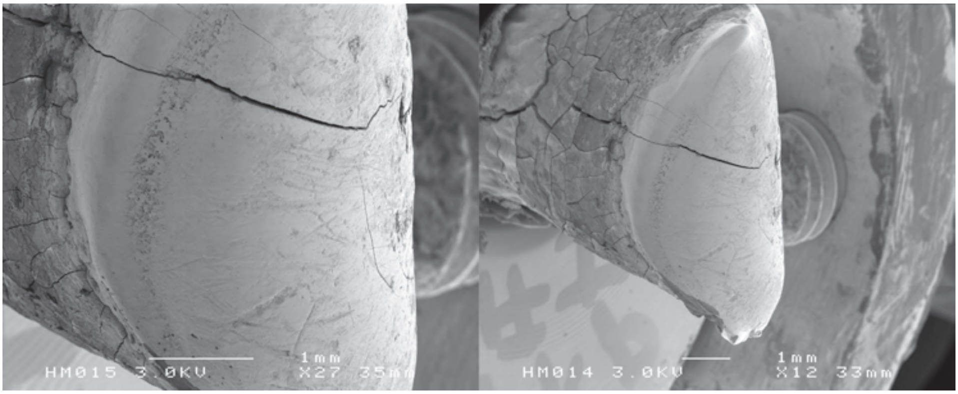

Figure 6.62 Punta Macao 1, upper right central incisor.

Non-alimentary wear

Punta Macao 1

Individual 1 from the site of Punta Macao (female, 46+ years) was selected to represent Type 2 and Type 4 non-alimentary wear. The dental elements 3.1 and 4.2 were chosen for their labial wear (Type 4), and elements 1.1 and 2.2 for their high degree of lingual, and incisal edge abrasion (Type 2).

Since this individual displays lingual abrasion of the upper incisors, and labial abrasion of the lower incisors, the hypothesis is tested that this pattern of wear was caused by the drawing of some kind of thin strip of material in a downwards motion between the upper and lower front teeth (where there is a slight natural overbite). If this was indeed the case, we would expect to find striations of a similar direction, size, and shape on the lingual surfaces of the upper teeth and the labial surfaces of the lower teeth.

Figure 6.63 Punta Macao 1, upper left lateral incisor.

Element 1.1

The upper right central incisor (Figures 6.59–6.62) is worn to the extent that all but

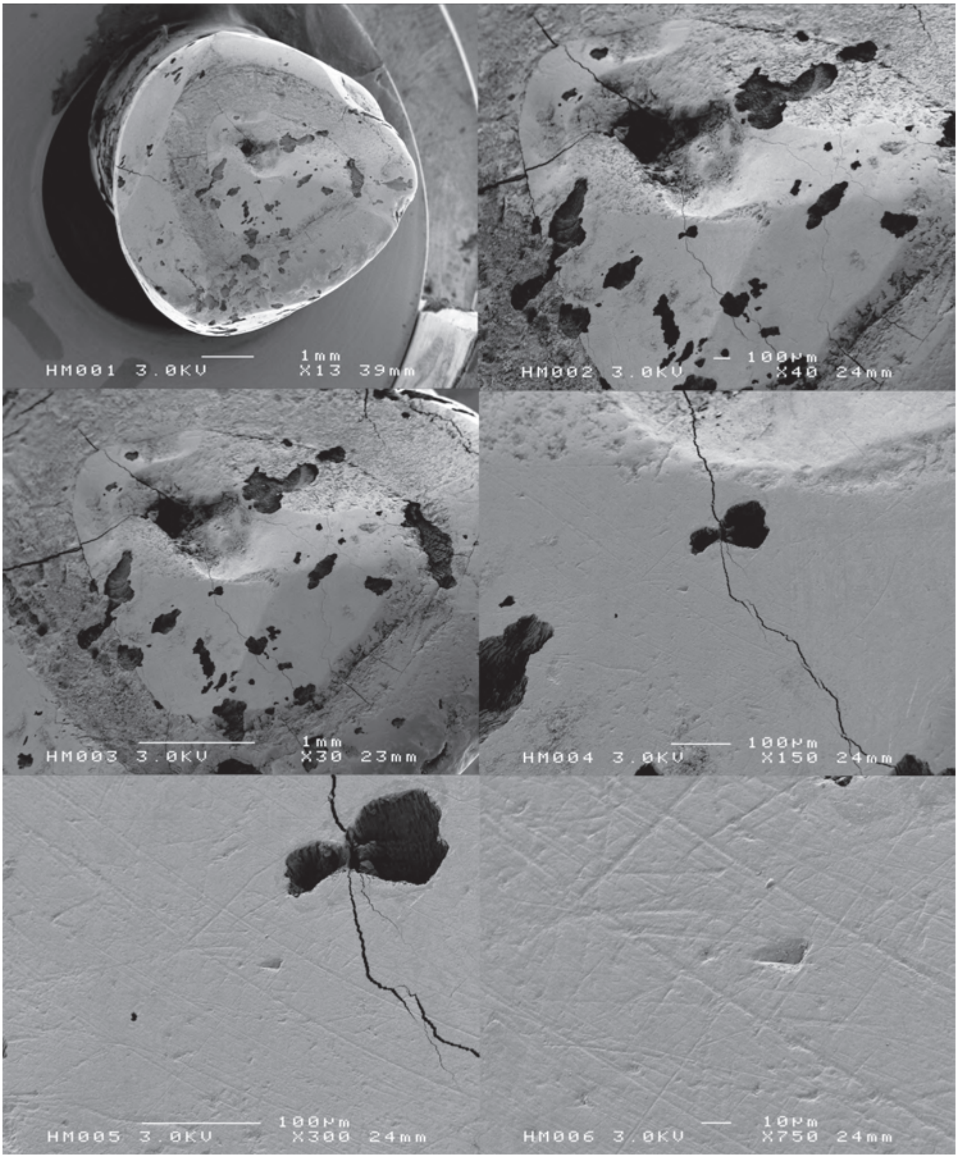

Figure 6.64 Punta Macao 1, upper left lateral incisor.

a tiny strip of enamel is still present on the labial surface. Scratches of various sizes were found in the exposed dentine on the lingual surface and the incisal edge. The highest density of scratches is found along the linguo-incisal edge. The scratches are predominantly oriented in labio-lingual direction, with the starting point labial and the ending point lingual. The latter indicates that the motion of drawing the material across the surface was upward or 'front-to-back' as opposed to the downward motion that is often suggested for similar extreme lingual wear of the upper incisors. Scratches are mostly between 0.50–1.00 mm in length; width varies between 5–50 µm. The pits of the scratches are highly irregular, appearing pitted in some cases and damaged by post-depositional processes in others. The central area of the lingual surface, and the area closer to the cement-enamel junction appear to be damaged by deterioration of the material over time, post-depositional processes, or perhaps acid erosion in life.

Element 2.2

The upper left lateral incisor is much less severely worn than the upper right central incisor (Figures 6.63–6.65). The exposed dentine on the lingual surface is highly

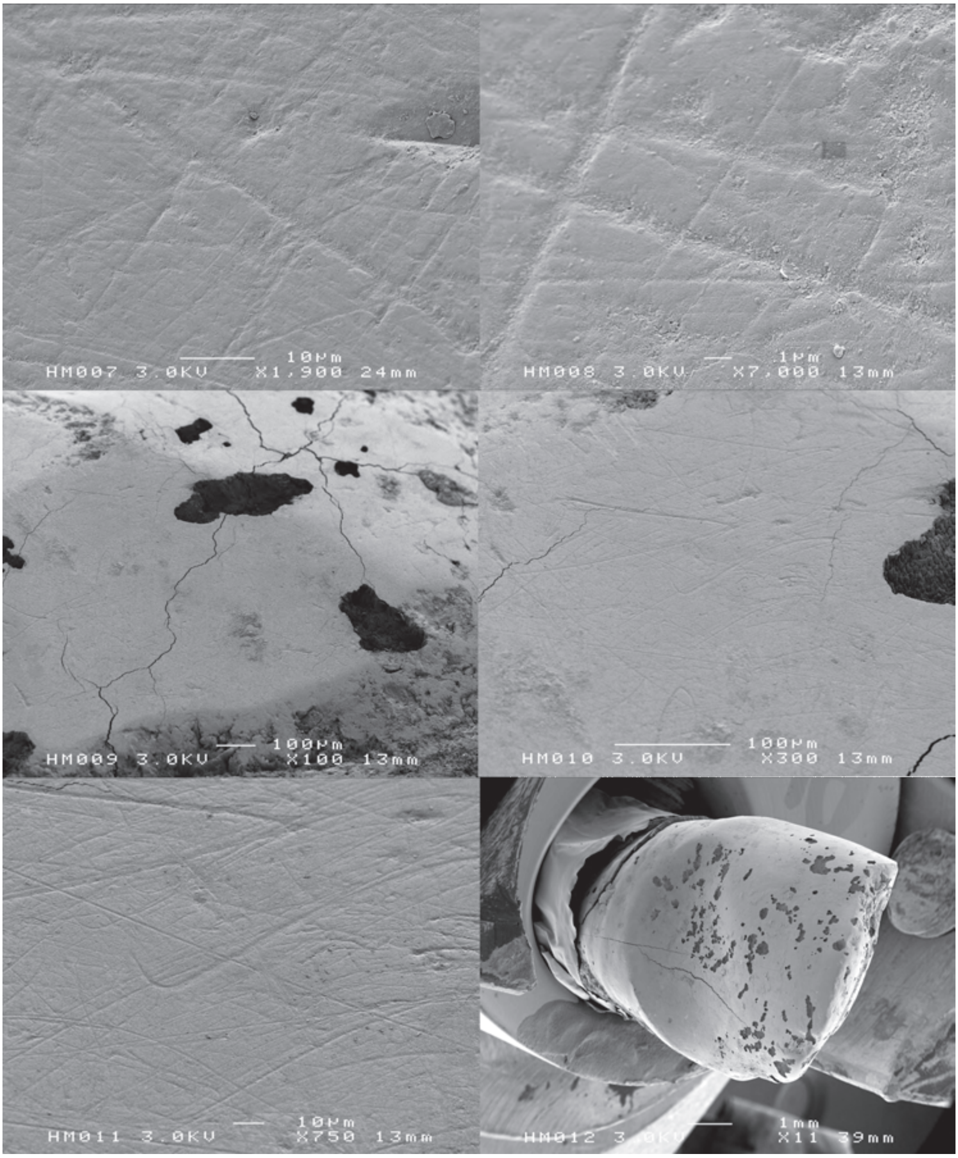

Figure 6.65 Punta Macao 1, upper left lateral incisor.

pitted, appearing damaged by post-depositional processes or perhaps acid erosion in life. Both the enamel and the dentine are damaged by relatively large (up to 0.8 mm) 'pits' or 'holes' (clearly visible as darker patches on the SEM images) on the entire tooth crown, but in particular on the labial enamel surface. It is thought that this is modern damage is due to changing air humidity, which often results in cracking and flaking of

Figure 6.66 Punta Macao 1, lower left central incisor.

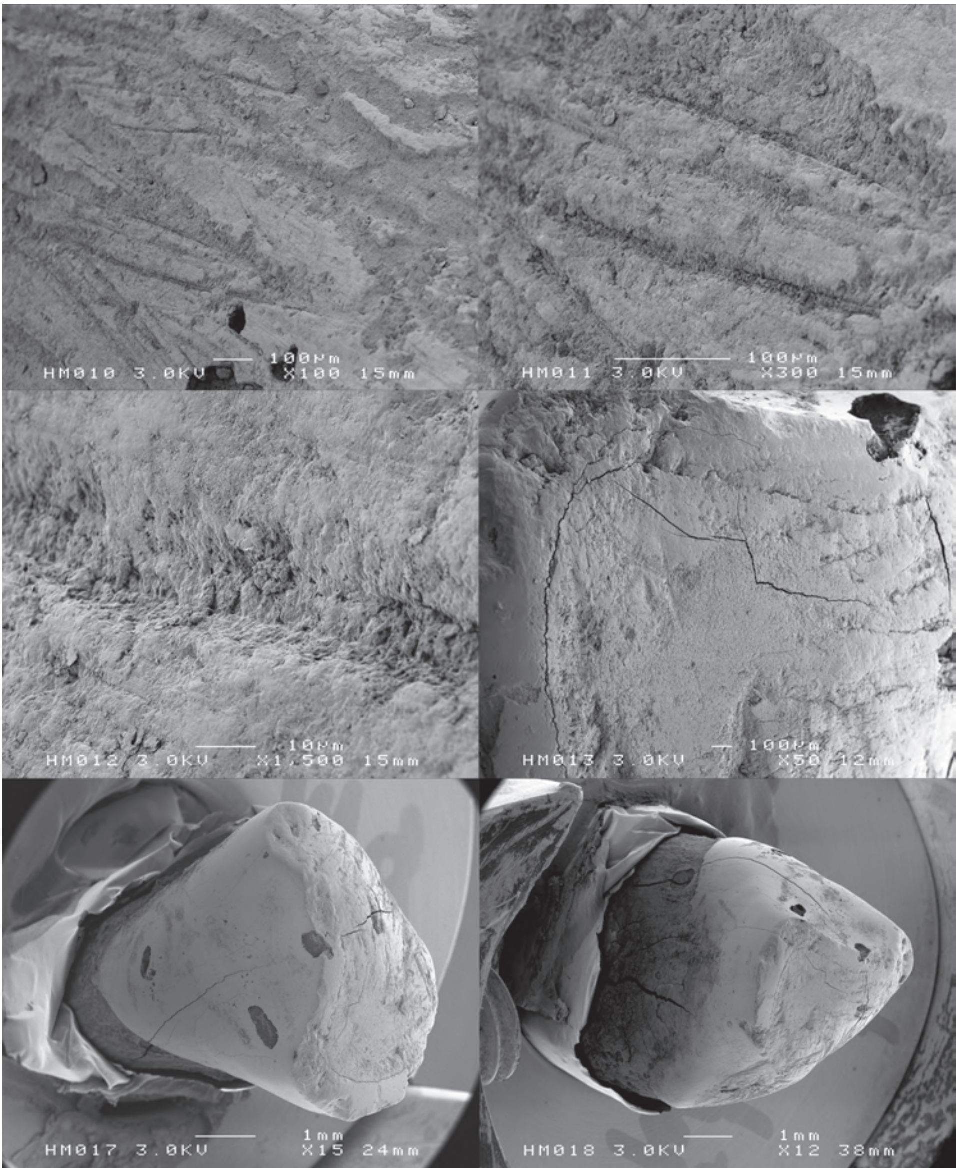

Figure 6.67 Punta Macao 1, lower left central incisor.

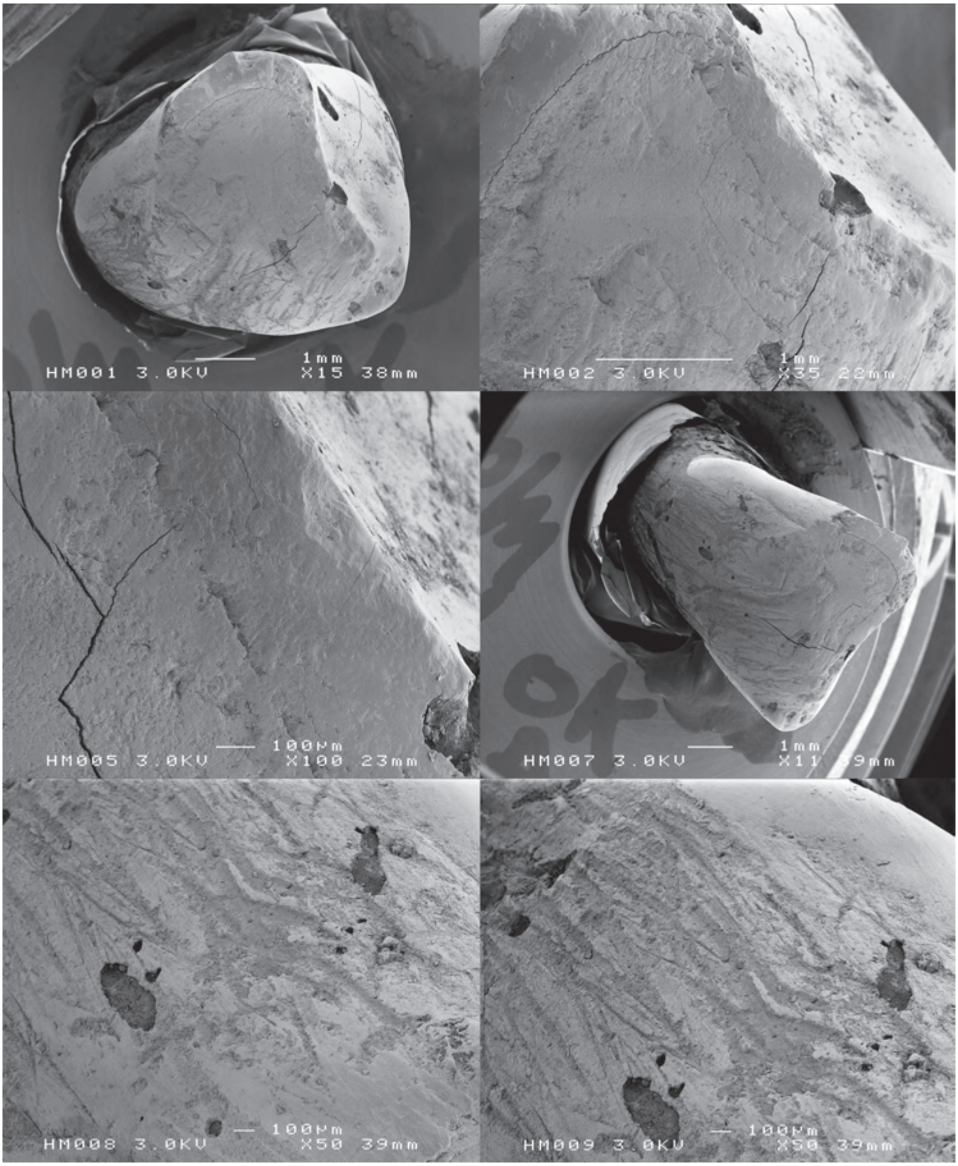

Figure 6.68 Punta Macao 1, lower left central incisor.

particularly the enamel of teeth. The lingual enamel surface was observed macroscopically to be worn in numerous facets, which together form a 'pyramid-shaped' relief. The enamel appears highly polished. Scratches on the lingual enamel range up to around 0.7 mm in length, and between 0.50–1.00 µm in width. Orientation is mostly labio-lingual on the most distally positioned wear facet, although there is considerable cross-hatching. On the facet closest to the linguo-incisal edge, there is no clearly predominant orientation, and scratches are dense, and curved. Many scratches are shorter (up to 200 µm), and mesio-distally oriented scratches are also

present. These scratches are also generally between 0.50–1.00 μm wide. The pits of the scratches are highly irregular, appearing pitted in some cases and damaged by post-depositional processes in others.
The linguo-incisal enamel edge is affected by a series of very small chips which have rounded surface from subsequent wear. The distal portion of this edge is most severely affected.
The labial surface of this tooth was observed macroscopically to have a large obliquely oriented groove, which is highly polished. Since very few striations were found on this surface, and those present were very small and lacked clear orientation, the cause of this groove is still uncertain.

Element 3.1

The lower left central incisor is highly worn, particularly on the labial surface (Figures 6.66–6.68). This surface was observed macroscopically to have large striations on the remaining enamel and on the exposed dentine. Many of these striations are over 1 mm in length, and are up to 100 μm in width. Finer striations surround these larger scratches, and are similarly oriented in labio-lingual direction, with the starting point labial and the end point lingual. The pits of the scratches are highly irregular, appearing pitted in some cases and damaged by post-depositional processes in others.
The incisal edge is worn to a flat surface, with exposed dentine. This surface shows no evidence of scratches, but is densely pitted. The appearance of these pits suggests the surface has been damaged by post-depositional processes or by acid erosion in life. The lingual surface of the tooth did not reveal any significant wear.
The mesial cement-enamel junction revealed a series of highly uniform and parallel striations, covering an area of approximately 1 mm^2 (Figure 6.68). These striations are approximately 10 μm wide, and the pits of the striations are highly irregular, again appearing damaged (weathered) post mortem.

Element 4.2

The lower right lateral incisor was observed macroscopically to be worn on the labial surface, displaying a number of large scratches surrounded by finer striations (Figures 6.69–6.72). The scratches are up to 3 mm in length and up to 50 μm in width. These larger scratches are relatively deep, and the pit of the scratches, although 'weathered' in appearance, is generally V-shaped. The smaller scratches and striations surrounding these are shorter and finer, and are not V-shaped in cross section. Orientation is labio-lingual, with the start labial and the end lingual.
The distal corner of the incisal edge of this tooth is worn rounded in mesio-distal direction, and displays corresponding striations, approximately 30 μm wide. The length and starting point of these striations could not be determined due


Figure 6.69 Punta Macao 1, lower right lateral incisor.

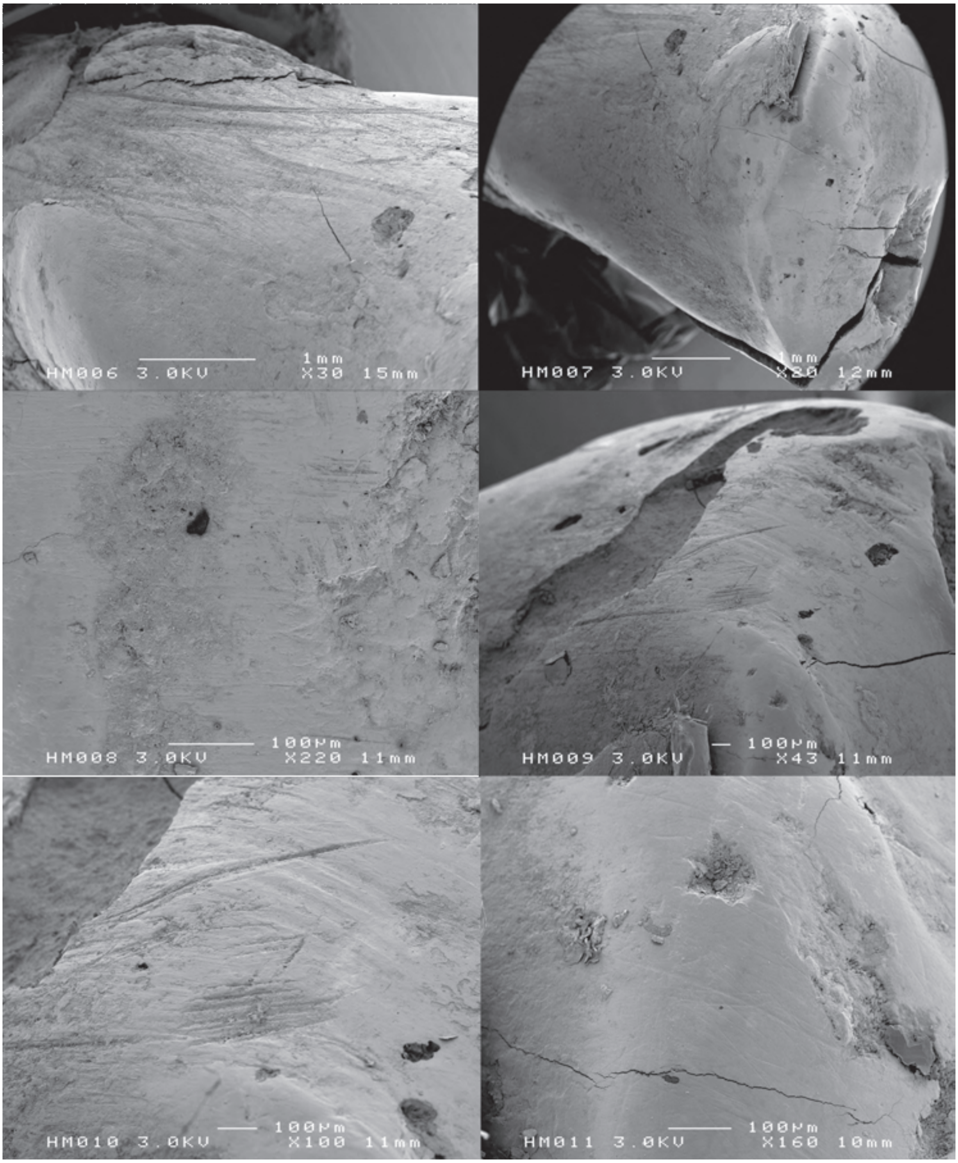

Figure 6.70 Punta Macao 1, lower right lateral incisor.

to modern damage to the enamel, most likely caused by changing humidity or the surroundings of the tooth. On the same portion of the tooth a small patch of highly uniform, dense and parallel striations was observed (Figure 6.71; lower left). Almost 400 µm long and approximately 10 µm wide, these striations are generally mesio-distally oriented, although the starting point is not clear.

The labio-incisal edge has a polished wear facet, which shows very fine and uniformly oriented striations in labio-lingual direction. They are no longer than 80 µm, and around 1 µm in width.

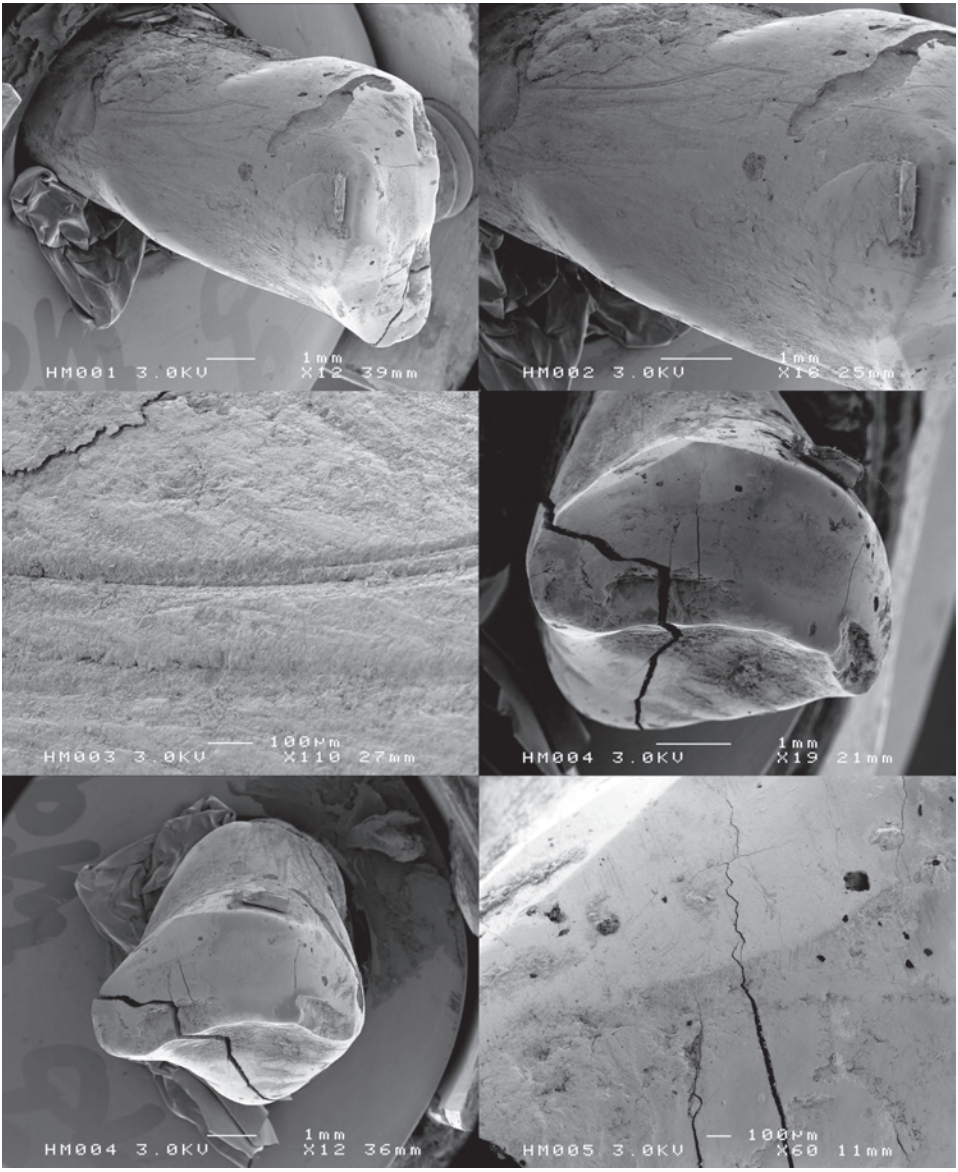

Figure 6.71 Punta Macao 1, lower right lateral incisor.

Punta Macao 11

Individual 11 from the site of Punta Macao (male, 26–35 years) was selected to represent Type 2 non-alimentary wear (disproportionate wear of the anterior teeth). The dental elements 1.1 and 1.2 were used. Element 1.1 displays severe rounded wear of the incisal surface in linguo-labial direction. Element 1.2 is also severely worn, and displays a groove on the labio-incisal edge.

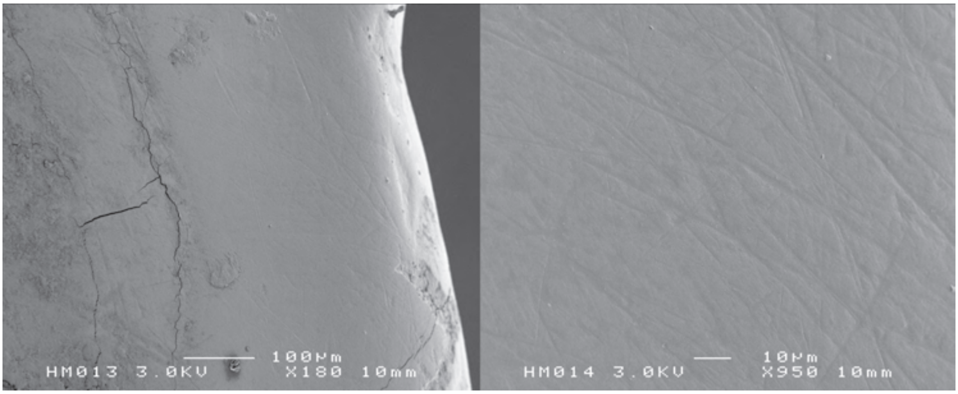

Figure 6.72 Punta Macao 1, lower right lateral incisor.

Element 1.1
The upper right central incisor is severely worn, with all enamel lost (Figures 6.73–6.75). This tooth was observed macroscopically to be worn into a labio-lingually rounded, smooth stump, with striations across the occlusal surface. The densest concentration of scratches is located on the labial portion of the occlusal surface, and here most scratches are oriented in labio-lingual direction (with the starting point labial). Toward the central portion of the occlusal surface, striations are found in both labio-lingual and linguo-labial direction. The scratches are relatively short, considering those seen in Punta Macao individual 1, generally measuring

Figure 6.73 Punta Macao 11, upper right central and lateral incisor.

less than 1 mm in length. Width ranges up to approximately 40 µm, and most scratches are V-shaped in cross section. The pits of the scratches are highly irregular, appearing pitted in some cases and damaged by post-depositional processes in others.
The most central portion of the exposed incisal dentine surface shows some pitting and appears haphazardly scratched and damaged, perhaps indicating pressure damage and lifting of fractured areas.

Element 1.2
The upper right lateral incisor is much less severely worn than its mesial neighbour, as the entire crown is still surrounded by enamel (Figures 6.73 and 6.76–6.77). This tooth was observed macroscopically to be worn flat lingually, and with

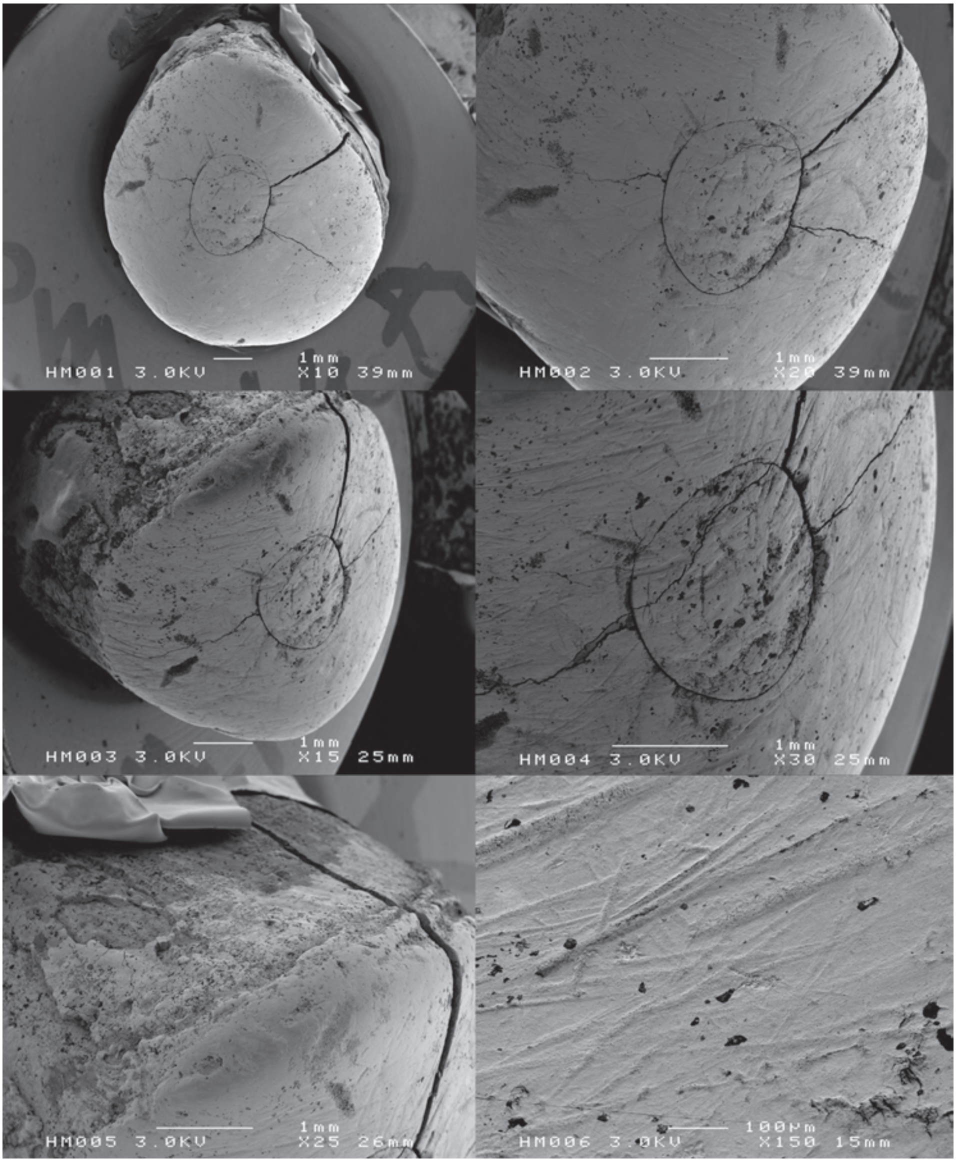

Figure 6.74 Punta Macao 11, upper right central incisor.

considerable loss of crown height, reducing the incisal edge to a flat surface. The mesio-labial edge is particularly worn, resembling an occlusal traversal notch in labial view. However, since the wear does not extend in lingual direction across the entire occlusal surface, this wear was not classed as a notch.

The flat area of the lingual surface, which is highly polished, does not show many striations, and those present are very fine and show no clear orientation. The notch-like area on the mesial corner of the labio-incisal edge also shows relatively few striations. These range up to 0.6 mm in length and 20 μm in width, and are

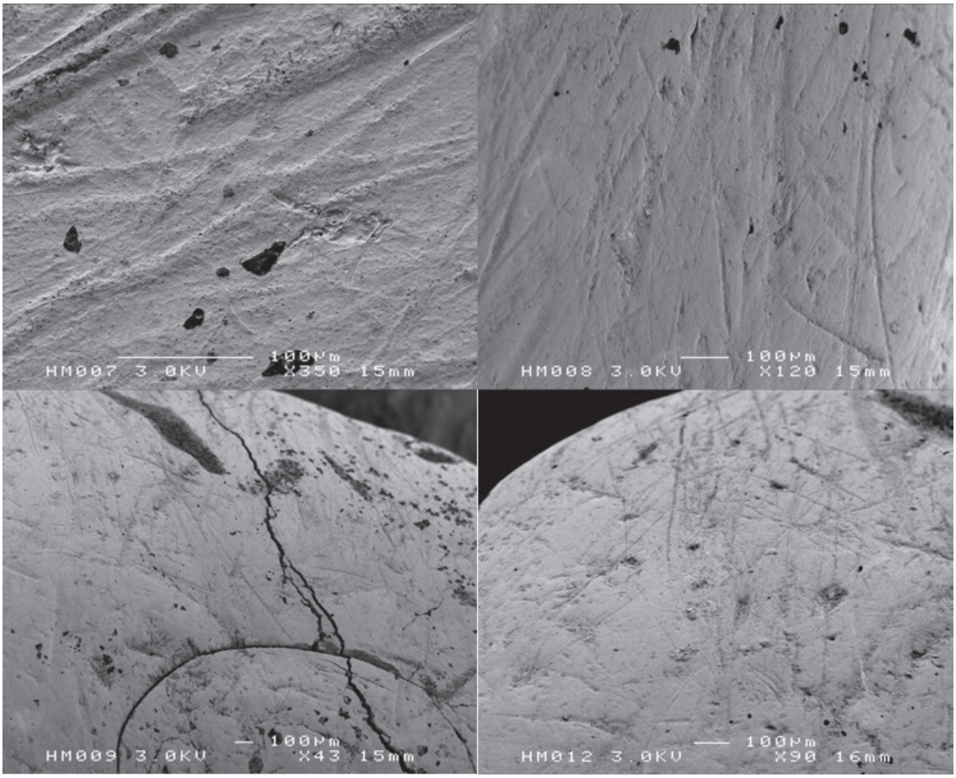

Figure 6.75 Punta Macao 11, upper right central incisor.

oriented in linguo-labial direction, although the starting point is unclear. The exposed incisal dentine surface shows a number of large pits and damaged areas which could be related to the exertion of pressure on the surface and resulting fracturing and lifting of dentine fragments.

Remarkably, the particular wear pattern of both upper right incisors is practically identical to that found in another adult male at Punta Macao (individual 13).

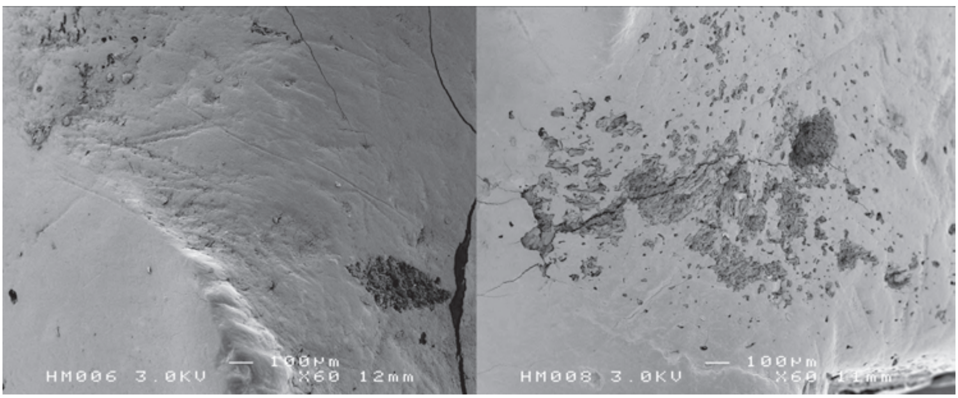

Figure 6.76 Punta Macao 11, upper right lateral incisor.

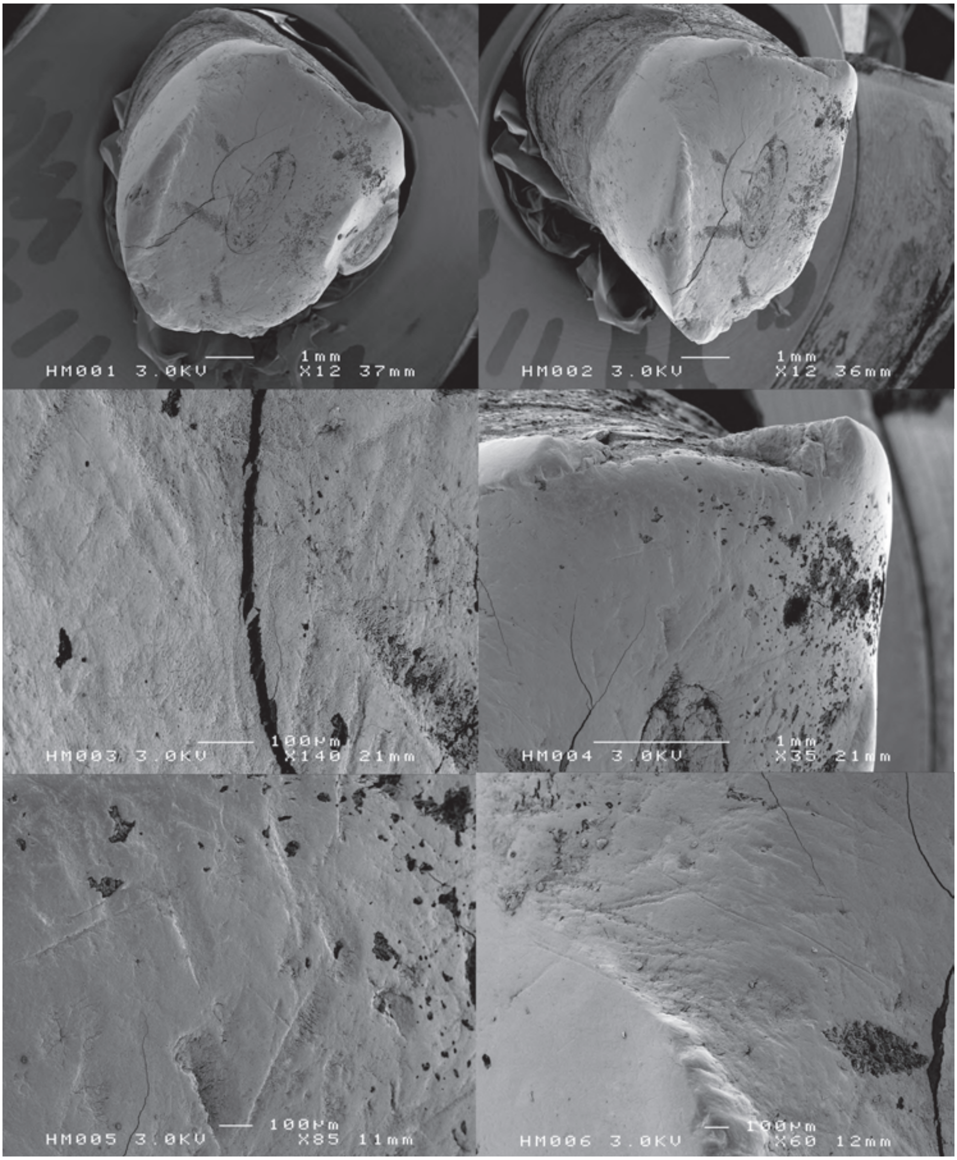

Figure 6.77 Punta Macao 11, upper right lateral incisor.

LSAMAT

Anse à la Gourde 430

The dental elements 1.1 and 1.2 from individual 430 from the site of Anse à la Gourde (female, 26–35 years) were selected to represent Type 1 LSAMAT. Element 1.1 displays dentine exposure on the lingual surface of the tooth, particularly along the raised mesial and distal ridges of the shovel-shaped crown. The most severe wear is located on and around the cingulum, close to the cement-enamel junction. Element 1.2 is less severely worn, with the raised ridges of the shovel shaped surface worn flat, and some dentine exposed. No striations were observed macroscopically on the lingual surface of this tooth.

Figure 6.78 Anse à la Gourde 430, upper central incisor (lingual view).

Element 1.1

The upper right central incisor is worn to the extent that the dentine is exposed on the incisal edge and the lingual surface, particularly on and around the cingulum (Figure 6.78). The exposed dentine and worn enamel show no macroscopically observable striations. Scanning electron microscopy revealed very few striations, and those that are present show no clear directionality, and are exclusively located on the enamel surface. The exposed dentine appears weathered, with an irregular surface relief. The lack of observable microwear patterns is most likely the result of acid erosion of the enamel and dentine surfaces of the tooth. The slightly worn enamel along the lingual side of the incisal edge shows characteristic signs of acid erosion in the form of a uniform honeycomb pattern of enamel prisms (Figures

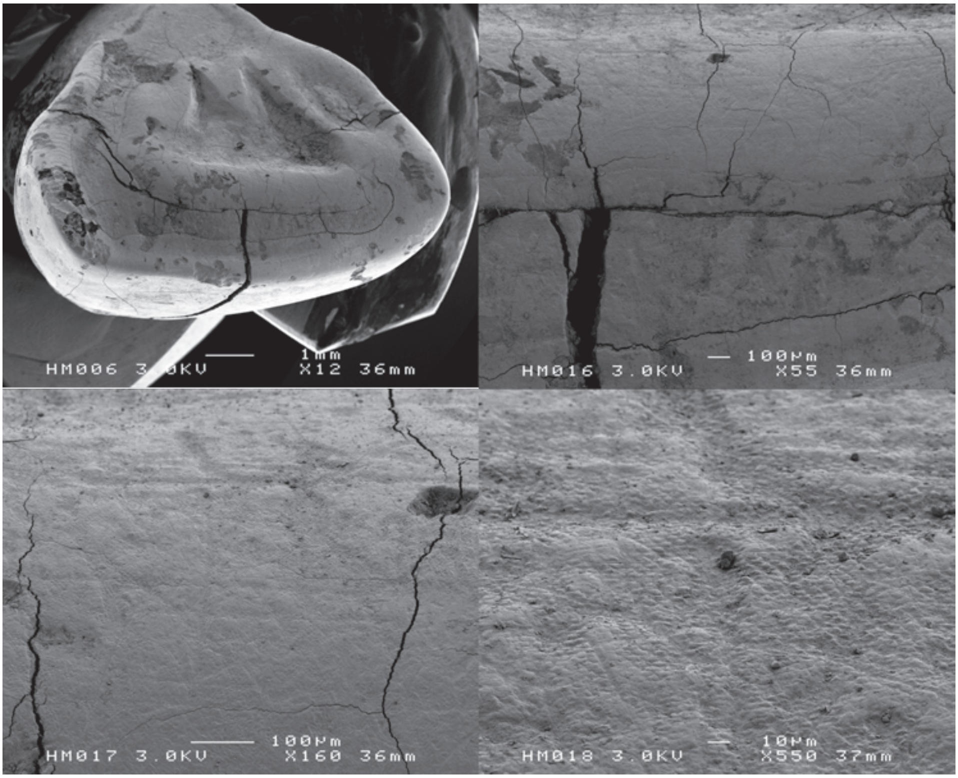

Figure 6.79 Anse à la Gourde 430, upper central incisor.

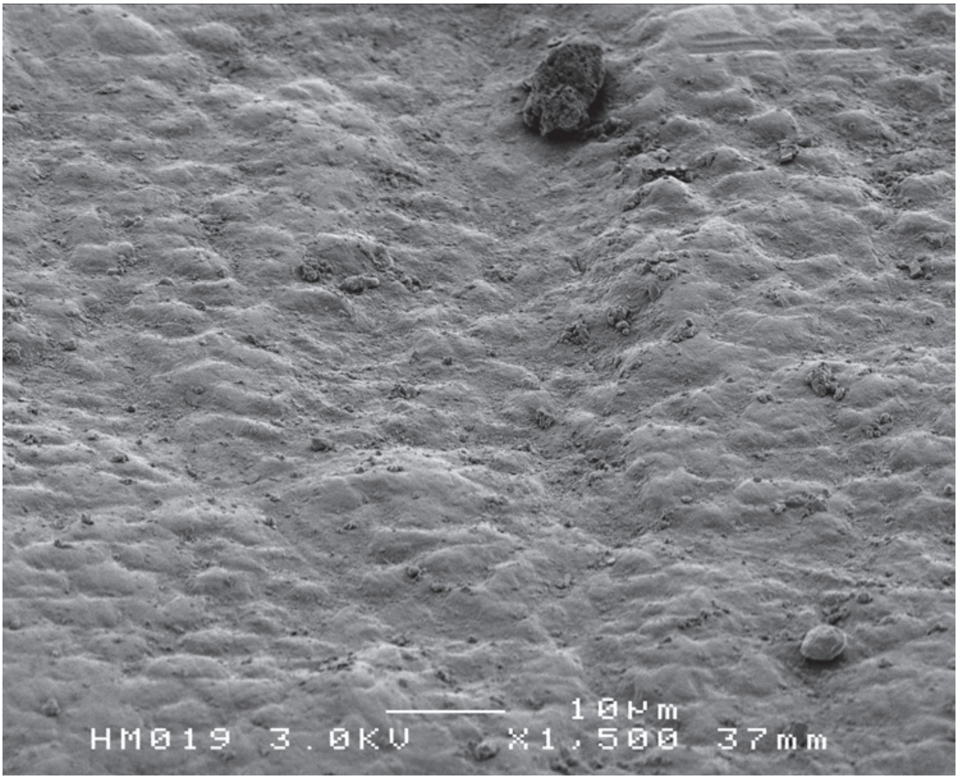

Figure 6.80 Anse à la Gourde, upper central incisor; enamel prisms.

6.79 and 6.80). The distal raised portion of the shovel-shaped crown also displays characteristic signs of acid erosion of the enamel (Figure 6.81). Similarly, the worn area on and around the cingulum shows some enamel prisms and 'weathered', irregular dentine surface (Figure 6.82) (King et al. 1999).

Element 1.2

The upper right lateral incisor is slightly worn, with small patches of enamel lost on the lingual surface (Figure 6.83). No striations were observed macroscopically on the lingual surface. The worn patches are slightly cupped, with some dentine exposure. Scanning electron microscopy revealed very fine labio-lingual striations in the enamel around one of these patches, all measuring less than 0.5 mm in length, with most striations around 40 μm in length. Width ranges between 1–5 μm. The striations are relatively well defined, and the troughs of the scratches show no pitting (Figure 6.84). There is also evidence of acid erosion in this area as shown by the presence of a uniform honeycomb pattern of enamel prisms (Figure 6.85) (King et al. 1999). The central portions of the worn patches show some pitting and damage. It is not clear whether this damage is post-depositional in nature, or whether it is the result of pressure or acid erosion.

The very fine nature of the striations, and the absence of pitting suggests that relatively little pressure was involved in their formation. The length and width of the striations indicates that course, fibrous plant material with adhering grit is highly unlikely to have been the cause.

Anse à la Gourde 2215
The upper left central incisor of individual 2215 from the site of Anse à la Gourde (female, 26–35 years) was selected to represent Type 2 LSAMAT. The tooth is very severely worn, with the lingual surface of the tooth comprising entirely of exposed dentine. Some striations were observed macroscopically on the lingual surface. The incisal edge displays chipping which has become rounded from subsequent wear.

Element 2.1
The area of the lingual surface around the cingulum displays a number of scratches of variable size and generally labio-lingual directionality in the exposed dentine. Some of the larger scratches range up to 2 mm in length and 100 µm in width. The pits of these larger scratches are generally irregular in shape. A series of smaller scratches are also present around the area of the cingulum. These smaller scratches are more sharply defined, and tend to have V-shaped pits. They are of varying

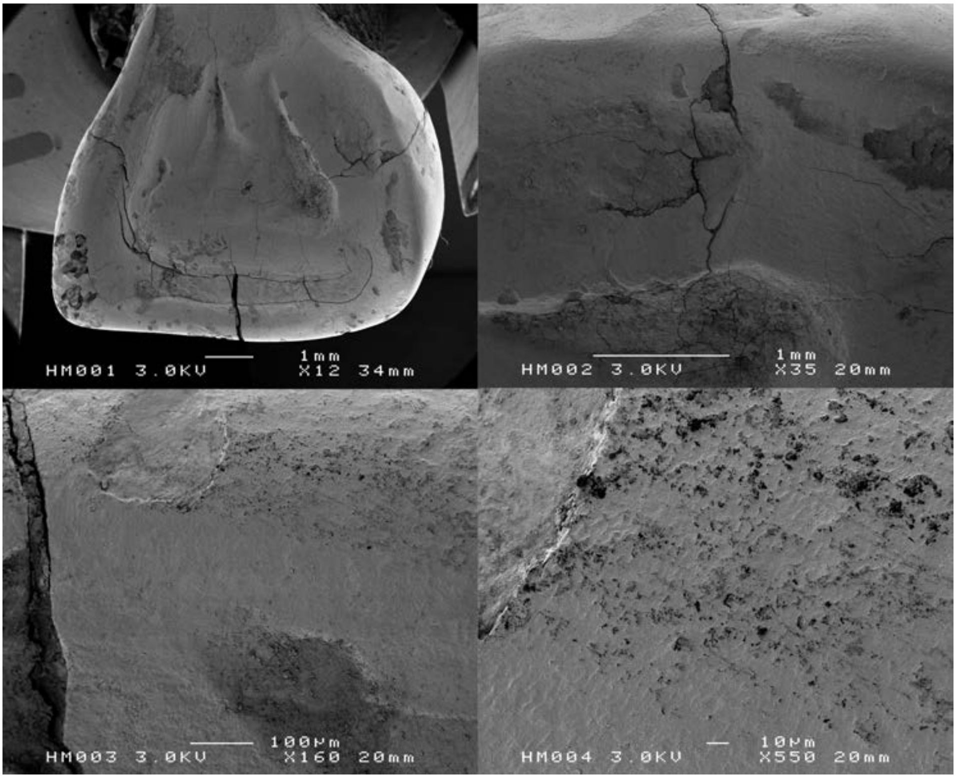

Figure 6.81 Anse à la Gourde, upper central incisor.

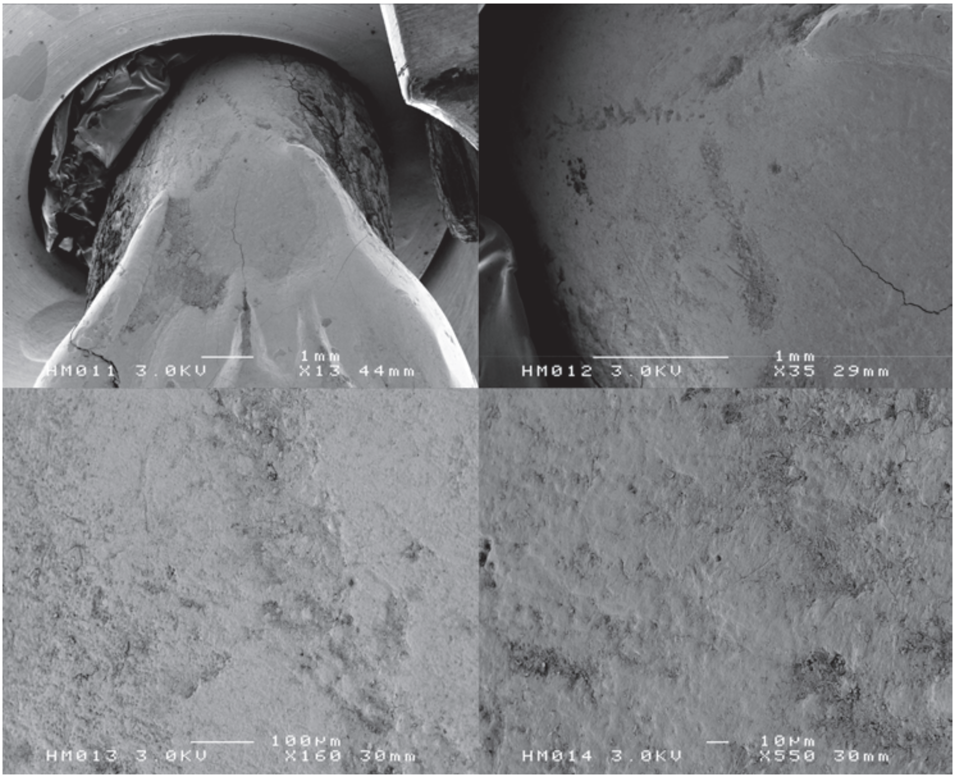

Figure 6.82 Anse à la Gourde, upper central incisor.

length and generally around 10 µm or less in width. The lingual surface shows evidence of pitting and perhaps pressure damage. Due to this damage and taphonomical damage, the starting pints of the scratches were hard to define (Figure 6.86).

Spring Bay 1c individual 1

The upper right deciduous central incisor of individual 1 from the site of Spring Bay 1c (child, 2–4 years) was selected. This tooth shows severe wear with dentine exposure on the incisal edge and across the lingual surface. The projecting area of the cingulum is particularly affected by wear. No striations were observed macroscopically, however the enamel edge surrounding the lingual dentine patch appears chipped and pitted

Figure 6.83 Anse à la Gourde 430, upper right lateral incisor.

Element 5.1

The area of the lingual surface around the cingulum displays an exposed dentine patch with fine linguo-labially oriented scratches. The enamel surrounding this area also shows a series of fine scratches, oriented in labio-lingual direction. The scratches are sharply defined, and tend to

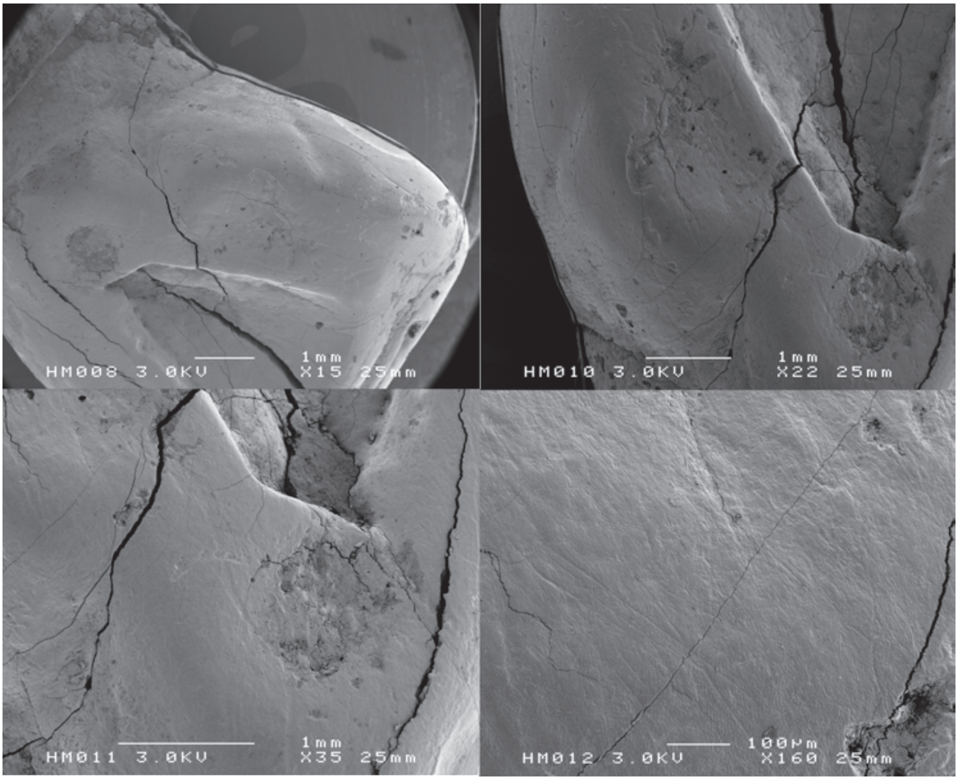

Figure 6.84 Anse à la Gourde, upper right lateral incisor.

have V-shaped pits. They are of varying length and generally around 1–2 μm or less in width. The troughs of the scratches show no pitting. The lingual surface shows

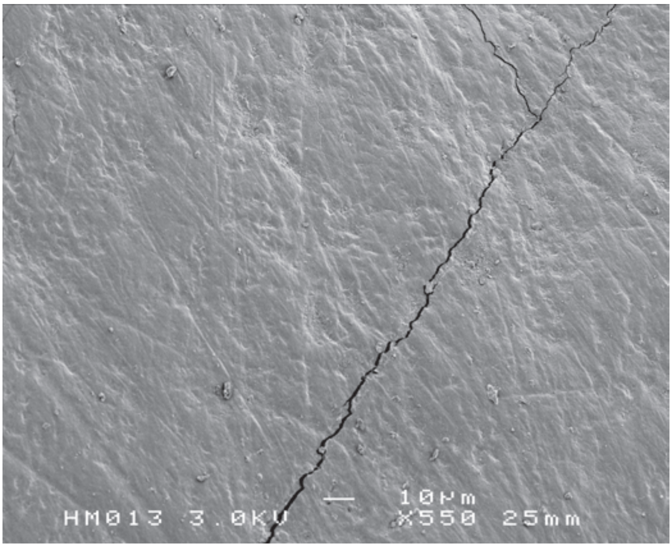

Figure 6.85 Anse à la Gourde, upper right lateral incisor.

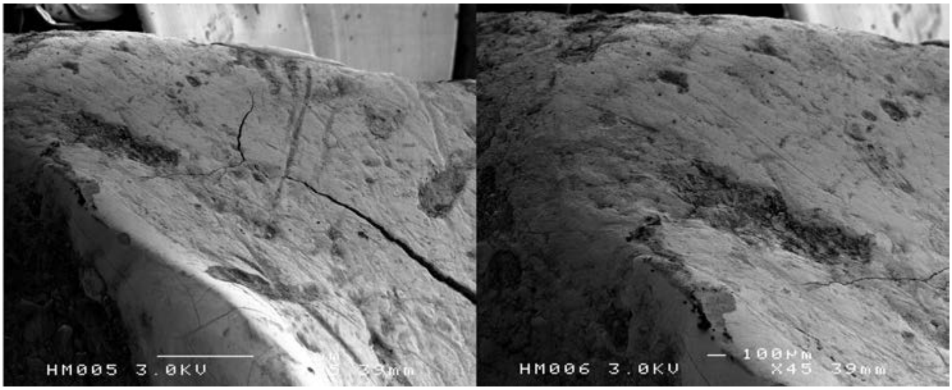

Figure 6.86 Anse à la Gourde 2215, upper left central incisor.

no evidence of pitting or pressure damage. The very fine nature of the striations, and the absence of pitting suggests that relatively little pressure was involved in their formation. The length and width of the striations indicates that tough, fibrous plant material (with adhering grit) is unlikely to have been the cause (Figure 6.87).

6.4 Dental pathology

6.4.1 Caries

Of the 8,144 observable teeth and sockets, 767 teeth (9.42%) were lost ante mortem, and 660 teeth were lost post mortem (8.10%). Anomalous eruption was observed in 5 teeth (third molars only). Complete failure to erupt (due to young age, impaction or agenesis) was recorded in 232 tooth positions (of which 43 third molars). Of the 6,480 fully erupted teeth, 48 were excluded from the present study due to severe postmortem damage that prevented evaluation. Therefore, it has been possible to study caries in 6,432 teeth. Caries are prevalent throughout the entire sample, although significant differences were found between the sites. In total, 687 carious lesions were recorded in the adult population, amounting to 12.29% of the total number of observed teeth (n= 5,592). Of all adults 232 adult individuals with at least one carious lesion were observed, amounting to 59.64% of the entire adult population (n= 389). The mean number of carious lesions per individual for all adults is 1.78.

Caries prevalence

One aim of this study is to assess differences in caries rates between the individual sites, to investigate potential differences in foodways. A preliminary investigation of caries rates based on simple tooth count and individual count methods was performed, in order to gain an insight into the potential differences between the sites. Only sites with at least four adult individuals were included in these analyses. The caries rates based on the tooth count method per site can be found in Table 6.22.

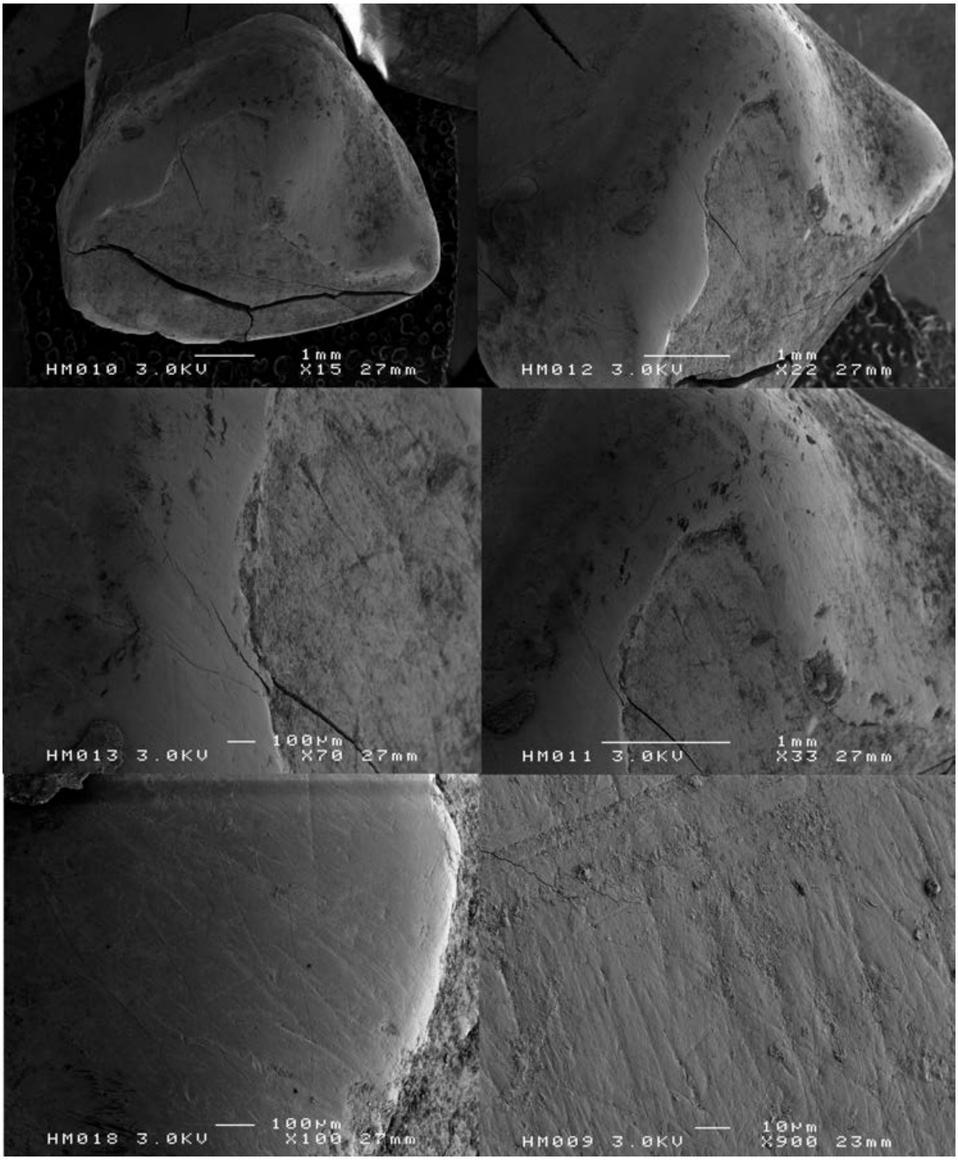

Figure 6.87 Spring Bay 1c individual 1, upper right deciduous central incisor.

As can be seen in this table, there appear to be considerable differences in the rate of caries per site. The statistical significance of these differences was tested using a chi-square test. This test determined a significant difference between at least two of the sites ($\chi^2(19, N= 5039)= 175.01, p= 0.00$).

Post-hoc comparisons of the sites to each other site using chi-square testing revealed that Anse à la Gourde has a significantly greater caries rate than all sites excepting Kelbey's Ridge 2, Punta Macao, Santa Cruz, Savanne Suazey, and Tocorón. Canashito has a significantly lower caries rate than all sites, excepting Diale 1, Escape, Juan Dolio, Malmok, Point de Caille, and Savaneta. Chorro de Maíta has a significantly higher rate of caries than Canashito, Diale 1, Escape, Juan Dolio, Malmok, Point de Caille, Punta Candelero, Savaneta, and a significantly lower rate of caries than Anse à la Gourde, Kelbey's Ridge 2, Santa Cruz, Savanne Suazey, and Tocorón. Diale 1 has a significantly lower caries rate than all sites, excepting

Site	N	Frequency (tooth count)
Canashito	47	0.00
Juan Dolio	51	0.00
Malmok	61	0.00
Savaneta	75	1.33
Escape	388	2.32
Diale 1	54	3.70
Point de Caille	66	4.55
Mamora Bay	75	9.33
Maisabel	400	9.50
Punta Candelero	733	9.82
Lavoutte	397	11.84
Manzanilla	166	12.05
Tutu	319	12.54
Chorro de Maíta	922	13.23
Punta Macao	176	14.77
Anse à la Gourde	940	19.89
Santa Cruz	58	24.14
Savanne Suazey	57	24.56
Kelbey's Ridge 2	39	30.77
Tocorón	34	35.29

Table 6.22 The caries frequency (tooth count) per site.

Escape, Juan Dolio, Malmok, Point de Caille, and Savaneta. Escape has a significantly lower caries rate than Anse à la Gourde, Chorro de Maíta, Kelbey's Ridge 2, Lavoutte, Maisabel, Mamora Bay, Manzanilla, Punta Candelero, Punta Macao, Santa Cruz, Tocorón, and Tutu. Juan Dolio has a significantly lower caries rate than all sites, excepting Canashito, Diale 1, Malmok, Point de Caille, and Savaneta. Kelbey's Ridge 2 has a higher caries rate than all sites, excepting Anse à la Gourde, Santa Cruz, Savanne Suazey, and Tocorón. Lavoutte has a significantly higher caries rate than Canashito, Escape, Malmok, and Savaneta, and a significantly lower caries rate than Anse à la Gourde, Kelbey's Ridge 2, Santa Cruz, Savanne Suazey, and Tocorón. Maisabel has a significantly higher caries rate than Escape, Juan Dolio, Malmok, and Savaneta, and a significantly lower caries rate than Anse à la Gourde, Kelbey's Ridge 2, Santa Cruz, Savanne Suazey, and Tocorón. Malmok has a significantly lower caries rate than all sites, excepting Diale 1, Escape, Juan Dolio, Point de Caille, and Savaneta. Mamora Bay has a significantly higher caries rate than Escape, Juan Dolio, Malmok, and Savaneta, and a significantly lower caries rate than Anse à la Gourde, Kelbey's Ridge 2, Santa Cruz, Savanne Suazey, and Tocorón. Manzanilla has a significantly higher caries rate than Canashito, Escape, Juan Dolio, Malmok, and Savaneta, and a significantly lower caries rate than Kelbey's Ridge 2, Santa Cruz, Savanne Suazey, and Tocorón. Point de Caille has a significantly lower caries rate than Anse à la Gourde, Chorro de Maíta, Kelbey's Ridge 2, Punta Macao, Santa Cruz, Savanne Suazey, and Tocorón. Punta Candelero has

		High					Medium								Low						
		AAG	KR	SS	SC	TOC	CM	LAV	MB	MMB	MZ	PC	PM	TT	CAN	DIA	ES	JD	MK	PdC	SAV
High	AAG	-	0.11	0.39	0.40	0.05	0.00	0.00	0.00	0.02	0.02	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	KR	0.11	-	0.64	0.64	0.80	0.01	0.00	0.00	0.02	0.01	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SS	0.39	0.64	-	1.00	0.34	0.02	0.01	0.00	0.03	0.03	0.00	0.10	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	SC	0.40	0.64	1.00	-	0.34	0.03	0.01	0.00	0.03	0.03	0.00	0.11	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	TOC	0.05	0.80	0.34	0.34	-	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Medium	CM	0.00	0.01	0.02	0.03	0.00	-	0.53	0.07	0.47	0.80	0.04	0.63	0.85	0.03	0.04	0.00	0.00	0.00	0.04	0.00
	LAV	0.00	0.00	0.01	0.01	0.00	0.53	-	0.30	0.69	1.00	0.31	0.34	0.82	0.05	0.10	0.00	0.01	0.00	0.09	0.00
	MB	0.00	0.00	0.00	0.00	0.00	0.07	0.30	-	1.00	0.36	0.92	0.08	0.23	0.10	0.21	0.00	0.01	0.01	0.24	0.02
	MMB	0.02	0.01	0.03	0.03	0.00	0.47	0.69	1.00	-	0.66	1.00	0.31	0.55	0.19	0.30	0.01	0.04	0.02	0.34	0.05
	MZ	0.02	0.01	0.03	0.03	0.00	0.80	1.00	0.36	0.66	-	0.40	0.53	1.00	0.05	0.11	0.00	0.01	0.00	0.09	0.01
	PC	0.00	0.00	0.00	0.00	0.00	0.04	0.31	0.92	1.00	0.40	-	0.08	0.19	0.10	0.22	0.00	0.01	0.00	0.19	0.01
	PM	0.12	0.03	0.10	0.11	0.01	0.63	0.34	0.08	0.31	0.53	0.08	-	0.49	0.02	0.03	0.00	0.00	0.00	0.03	0.00
	TT	0.00	0.01	0.02	0.02	0.02	0.85	0.82	0.23	0.55	1.00	0.19	0.49	-	0.04	0.05	0.00	0.00	0.00	0.08	0.00
Low	CAN	0.00	0.00	0.00	0.00	0.00	0.03	0.05	0.10	0.19	0.05	0.10	0.02	0.04	-	0.53	1.00	1.00	1.00	0.55	1.00
	DIA	0.00	0.00	0.00	0.00	0.00	0.04	0.10	0.21	0.30	0.11	0.22	0.03	0.05	0.53	-	0.63	0.50	0.22	1.00	0.57
	ES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	1.00	0.63	-	0.61	0.62	0.40	1.00
	JD	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.04	0.01	0.01	0.00	0.00	1.00	0.50	0.61	-	1.00	0.26	1.00
	MK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	1.00	0.22	0.62	1.00	-	0.25	1.00
	PdC	0.00	0.00	0.00	0.00	0.00	0.04	0.09	0.24	0.34	0.09	0.19	0.03	0.08	0.55	1.00	0.40	0.26	0.25	-	0.34
	SAV	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05	0.01	0.01	0.00	0.00	1.00	0.57	1.00	1.00	1.00	0.34	-

Table 6.23 Significance (p) values for comparisons of adult caries frequency per site using chi-square testing. Statistically significant values are shown in bold. AAG= Anse à la Gourde, KR= Kelbey's Ridge 2, SS= Savanne Suazey, SC= Santa Cruz, TOC= Tocorón, CM= Chorro de Maíta, LAV= Lavoutte, MB= Maisabel, MMB= Mamora Bay, MZ= Manzanilla, PC= Punta Candelero, PM= Punta Macao, TT= Tutu, CAN= Canashito, DIA= Diale 1, ES= Escape, JD= Juan Dolio, MK= Malmok, PdC= Point de Caille, SAV= Savaneta.

a significantly higher caries rate than Escape, Juan Dolio, Malmok, and Savaneta, and a significantly lower caries rate than Anse à la Gourde, Chorro de Maíta, Kelbey's Ridge 2, Santa Cruz, Savanne Suazey, Tocorón, and Tutu. Punta Macao has a significantly higher caries rate than Canashito, Diale 1, Escape, Juan Dolio Malmok, Point de Caille, and Savaneta, and a significantly lower caries rate than Kelbey's Ridge 2, Tocorón. Santa Cruz has a significantly higher caries rate than all sites, excepting Anse à la Gourde, Kelbey's Ridge 2, Punta Macao, Santa Cruz, Savanne Suazey, and Tocorón. Savaneta has a significantly lower caries rate than all sites, excepting Canashito, Diale 1, Escape, Juan Dolio, Malmok, and Point de Caille. Savanne Suazey has a significantly higher caries rate than all sites, excepting Anse à la Gourde, Kelbey's Ridge 2, Punta Macao, Santa Cruz, Savanne Suazey, and Tocorón. Tocorón has a significantly higher caries rate than all sites, excepting Kelbey's Ridge 2, Santa Cruz, and Savanne Suazey. Tutu has a significantly higher caries rate than Canashito, Diale 1, Escape, Juan Dolio, and Malmok, and a significantly lower caries rate than Anse à la Gourde, Kelbey's Ridge 2, Santa Cruz, Savanne Suazey, and Tocorón.

Table 6.23 presents the significance (p) values of the chi-square test comparing each site with each other site. Grouping of the sites based on shared significant differences with other sites, reveals that there are three distinct groups in the assemblage, representing low, medium, and high caries rates respectively. The low caries rate group represents sites with caries rates between 0.00–4.55%. The medium caries rate group represents sites with caries rates between 9.33–14.77%. The high caries rate group represents sites with caries rates between 19.89–35.29%.

Site	N	Frequency (individual count)
Canashito	4	0.00
Juan Dolio	7	0.00
Malmok	4	0.00
Diale 1	5	20.00
Savaneta	5	20.00
Escape	24	33.33
Maisabel	26	34.62
Manzanilla	14	42.86
Mamora Bay	4	50.00
Point de Caille	4	50.00
Punta Candelero	49	59.18
Punta Macao	15	60.00
Tocorón	6	66.67
Lavoutte	27	70.37
Tutu	21	71.43
Santa Cruz	4	75.00
Savanne Suazey	4	75.00
Chorro de Maíta	55	76.36
Anse à la Gourde	61	80.33
Kelbey's Ridge 2	3	100.00

Table 6.24 The caries frequency (individual count) per site.

These distinct differences in caries rates per group, suggest that foodways, specifically carbohydrate consumption and food preparation techniques, differed per group. Sites in the highest caries rate range represent communities in which soft, sticky, refined carbohydrates would have comprised a large portion of the daily diet, whereas the sites in the lowest caries rate range represent communities in which carbohydrate consumption would have been less important, and foods were likely less soft, sticky, and refined. The sites in the medium caries rate range are intermediate between the two cases.

Table 6.24 shows the caries rates per site based on the individual count method, which assesses the frequency of individuals with at least one carious lesion in each site assemblage. Only sites with at least four adult individuals were included in these analyses. As can be seen in this table, there appear to be considerable differences in the prevalence of caries per site. These differences were tested using a chi-square test. This test determined a significant difference between at least two of the

Site	18–25			26–35			36–45			46+		
	I+C	PM	M	I+C	PM	M	I+C	PM	M	I+C	PM	M
Canashito	-	-	-	0.00 (6)	0.00 (6)	0.00 (7)	0.00 (5)	0.00 (3)	0.00 (2)	-	-	-
Juan Dolio	0.00 (8)	0.00 (8)	0.00 (11)	0.00 (1)	0.00 (2)	0.00 (3)	-	-	-	-	-	-
Malmok	-	-	-	0.00 (8)	0.00 (9)	0.00 (19)	0.00 (17)	0.00 (9)	0.00 (16)	-	-	-
Savaneta	0.00 (9)	0.00 (9)	0.00 (6)	0.00 (20)	9.09 (11)	0.00 (13)	-	-	-	-	-	-
Escape	0.00 (34)	0.00 (34)	4.17 (48)	0.00 (45)	0.00 (30)	0.00 (47)	10.00 (20)	12.50 (16)	0.00 (14)	10.0 (10)	0.00 (12)	5.88 (17)
Diale 1	0.00 (1)	0.00 (5)	0.00 (12)	-	-	-	-	-	-	-	-	-
Point de Caille	0.00 (16)	0.00 (10)	0.00 (8)	-	-	-	-	-	-	11.1 (9)	16.67 (6)	0.00 (12)
Mamora Bay	-	-	-	-	-	-	-	-	-	-	-	-
Maisabel	0.00 (25)	0.00 (17)	2.94 (34)	0.00 (36)	0.00 (26)	0.00 (30)	0.00 (22)	0.00 (14)	0.00 (26)	3.03 (66)	20.00 (30)	48.39 (31)
Punta Candelero	0.00 (51)	0.00 (42)	13.46 (52)	9.09 (44)	2.63 (38)	17.39 (46)	0.00 (32)	0.00 (22)	24.00 (25)	2.78 (36)	3.85 (26)	28.00 (25)
Lavoutte	0.00 (6)	0.00 (7)	25.00 (12)	0.00 (44)	12.9 (31)	20.54 (44)	6.12 (49)	16.67 (30)	18.52 (27)	0.00 (26)	5.88 (17)	30.00 (20)
Manza-nilla	0.00 (21)	11.76 (17)	0.00 (23)	10.53 (19)	15.4 (13)	10.00 (20)	-	0.00 (1)	0.00 (3)	0.00 (15)	22.22 (9)	37.50 (8)
Tutu	0.00 (18)	23.08 (13)	6.67 (15)	-	-	-	10.53 (38)	26.83 (41)	32.00 (25)	0.00 (64)	7.02 (57)	20.51 (39)
Chorro de Maíta	1.55 (129)	0.00 (81)	18.95 (95)	4.27 (117)	7.14 (70)	20.48 (83)	0.00 (24)	25.00 (20)	6.25 (16)	19.4 (36)	45.45 (11)	50.00 (12)
Punta Macao	0.00 (20)	0.00 (11)	9.52 (21)	0.00 (19)	4.17 (12)	5.83 (12)	11.76 (17)	28.57 (7)	33.33 (3)	8.33 (12)	0.00 (5)	0.00 (3)
Anse à la Gourde	2.33 (86)	11.76 (51)	31.76 (85)	2.76 (181)	25.3 (83)	36.05 (86)	11.29 (62)	15.15 (33)	10.34 (29)	0.00 (47)	0.00 (11)	33.33 (15)
Santa Cruz	0.00 (4)	50.00 (4)	6.25 (16)	0.00 (8)	50.0 (4)	25.00 (4)	0.00 (3)	0.00 (3)	50.00 (4)	-	-	-
Savanne Suazey	0.00 (3)	0.00 (5)	0.00 (10)	-	-	-	-	-	-	-	-	-
Kelbey's Ridge 2	-	-	-	-	-	-	0.00 (1)	100.0 (1)	-	16.7 (12)	20.00 (5)	11.11 (9)
Tocorón	-	-	-	-	-	-	-	-	-	-	-	-

Table 6.25 Caries rates per site, by age group and tooth category. The number of observed teeth is indicated between the brackets.

sites (χ^2(19, N= 342)= 67.11, p= 0.00). Post-hoc comparisons of the sites to each other site revealed that Anse à la Gourde and Chorro de Maíta have a significantly larger proportion of adults affected by caries than Escape, Juan Dolio, and Maisabel. Lavoutte and Tutu have a significantly greater proportion of adults affected by caries than Juan Dolio. No other significant differences were found. The preliminary assessments above indicate possible differences in foodways between the individual sites in the sample. However, as discussed in Chapter 4 (section 4.2.3), when comparing caries rates between groups, the effects of age, differential preservation of individual dental elements, and differential susceptibility of individual dental elements to carious lesions must be taken into account (Hillson 2001, 2008b; Wasterlain et al. 2009). The differences demonstrated above using the simple tooth count and individual count methods could (at least in part) result from differing age profiles and differentially preserved/affected dental elements. For this reason, these potential sources of variation must be controlled for in order to assess foodways based on caries prevalence. Table 6.25 presents the caries rates per site by age group (18–25, 26–35, 36–45, and 46+), and by tooth category (incisors and canines, premolars, and molars). As can be seen in Table 6.25 there is a trend for an increase in caries rate with age, which is particularly clear for the larger site assemblages of Anse à la Gourde, Chorro de Maíta, Escape, Manzanilla, Lavoutte, Punta Candelero, and Tutu. At the site of Punta Macao, caries rates rise until the age of 36–45 years, but clearly drop in the age group of 46+ years. Decreases in caries rates in the oldest age categories of populations that show a clear trend for age-related increase in caries rates have previously been noted previously (Wasterlain et al. 2009), and can be related to higher rates of AMTL in older age categories. Although AMTL is known to be caused by a variety of factors (see Chapters 2 and 4; sections 2.2.1 and 4.2.3), an important cause of AMTL is the destructive process of carious lesions, particularly in populations with high caries rates. As such, the drop off in caries rates may be related to high rates of AMTL in older age groups. As can be seen in Table 6.35, AMTL rates at Punta Macao clearly rise sharply in the oldest age groups. Wasterlain et al. (2009) found that increased AMTL of molars in older age groups coincided with an increase in caries rates of the anterior teeth, most likely because, with the loss of the molars, these were the only teeth left in the mouth and exposed to cariogenic factors. An increase in caries rates with age of incisors and canines, and premolars, can be seen at the some of the other larger site assemblages in Table 6.25: Anse à la Gourde, Chorro de Maíta, Punta Candelero, and Tutu. At Anse à la Gourde, caries rates also drop off in the oldest age group; again this may be related to the high AMTL rates in adults of 46+ years, particularly in the premolars and molars (Table 6.35). At Chorro de Maíta and Tutu, both caries and AMTL rates continue to rise with age (Tables 6.25 and 6.35). What is also clear from Table 6.25, is the fact that the molars are generally more frequently affected by caries in all age groups than the incisors and canines, and the premolars. Premolars, in turn, are more frequently affected by caries than incisors and canines. This reflects known differences in susceptibility of the different tooth classes to carious lesions. Molars, due to their intricate fissures tend to retain food remains and dental plaque more easily, leading to carious activity. Similarly, premolars retain food remains and plaque in fissures on the occlusal surface (Hillson 1996, 2001; Wasterlain et al. 2009). High rates of caries in incisors and canines are generally associated with populations consuming very large proportions of cariogenic foods, consisting of soft, sticky carbohydrates. In populations with low carbohydrate intake, the first molars are affected most by caries, with populations with slightly higher carbohydrate intake showing caries on the second and third molars as well as on the premolars (Hillson 2001, 2008b). As shown in Table 6.25, the sites of Anse à la Gourde, Santa Cruz, and Tutu have relatively high caries rates in the younger age groups, with high percentages of incisors and canines and premolars affected throughout. The sites of Chorro de Maíta, Lavoutte, Manzanilla, Punta Candelero, and Punta Macao have intermediate caries rates, with fewer incisors and canines and premolars affected throughout. The sites of Canashito, Diale 1, Escape, Juan Dolio, Malmok, Point de Caille, and Savaneta show a relatively low caries rate throughout, with few affected anterior teeth. However, these sites are represented by very few aged adults, and as such it is difficult to infer the relation between age and caries rates.

Overall, these data support the categories of high, medium, and low caries rates presented above using the simple tooth count method, with the exception of the site of Tutu. Based in the data presented in Table 6.25, Tutu fits the pattern of high carbohydrate intake, since relatively high rates of caries are seen in all age groups and tooth classes. It is possible that this pattern was masked through the use of the tooth count method, in which adults of unknown age were included. Maisabel shows very low caries rates for the younger age groups, and high rates for the oldest group (46+ years). Again, this may be the result of the inclusion of adults of unknown age in the tooth count method. Based on the data shown in Table 6.25, Maisabel shows caries rates that are more befitting of low carbohydrate intake groups.

Chronological comparisons

A preliminary investigation of caries rates based on simple tooth count and individual count methods was performed, in order to gain an insight into the potential differences between the occupation phases at the sites of Maisabel, Punta Can

Occupation phase	18–25			26–35			36–45			46+			Total adults*	Ind. freq. %
	I+C	PM	M	I+C	PM	M	I+C	PM	M	I+C	PM	M		
Early	0.00 (12)	0.00 (4)	0.00 (11)	0.00 (22)	0.00 (15)	0.00 (18)	0.00 (10)	0.00 (2)	0.00 (6)	3.85 (26)	21.43 (14)	55.00 (20)	10.65 (169)	36.36 (11)
Late	0.00 (15)	0.00 (13)	4.35 (23)	0.00 (14)	0.00 (11)	0.00 (12)	0.00 (13)	0.00 (12)	0.00 (20)	2.50 (40)	14.29 (21)	58.82 (17)	8.65 (231)	33.33 (15)
Chi-square													χ^2(1, N=400)= 0.45, p= 0.61	χ^2(1, N=26)= 2.10, p= 0.20

Table 6.26 Caries rates at Maisabel, by age group, tooth category, and phase of occupation. The number of observed teeth/individuals is indicated between the brackets. * Includes adults of unknown age.

delero, and Tutu. No significant differences were found between the occupation phases at these three sites.
Maisabel – The rate of carious teeth drops slightly in the late phase of occupation. The number of affected individuals also drops slightly in the late period. These differences are not statistically significant. Comparison of caries rates per age group reveals no clear differences between the two occupation phases (Table 6.26).
Punta Candelero – The percentage of carious teeth rises slightly in the late phase of occupation, along with the number of affected individuals. These differences are not statistically significant (Table 6.27). Comparison of caries rates per age group reveals that the young middle adult group (26–35 years) in the middle occupation phase shows clearly higher caries rates than that of the late occupation phase. This group also shows substantially higher AMTL rates than the late group in this age category (Table 6.37). Apart from this, there are no clear differences between the two occupation phases (Table 6.27).

Occupation phase	18–25			26–35			36–45			46+			Total adults*	Ind. freq. %
	I+C	PM	M	I+C	PM	M	I+C	PM	M	I+C	PM	M		
Middle	0.00 (23)	0.00 (18)	0.00 (24)	3.57 (28)	8.00 (25)	14.3 (28)	0.00 (18)	0.00 (11)	25.0 (12)	0.00 (9)	14.3 (7)	14.3 (7)	7.17 (251)	50.00 (20)
Late	0.00 (8)	0.00 (8)	75.0 (8)	0.00 (12)	0.00 (6)	0.00 (10)	0.00 (7)	0.00 (5)	12.5 (8)	0.00 (1)	-	-	9.41 (85)	60.00 (5)
Chi-square													χ^2(1, N=336)= 0.45, p= 0.49	χ^2(1, N=25)= 0.16, p= 1.00

Table 6.27 Caries rates at Punta Candelero, by age group, tooth category, and phase of occupation. The number of observed teeth/individuals is indicated between the brackets. * Includes adults of unknown age.

Tutu – The percentage of carious teeth and the number of affected individuals drop somewhat. These differences are not statistically significant (Table 6.28). Comparison of caries rates per age group shows that in the young and old middle adult age groups, the early phase occupation group has higher caries rates, excepting the molars of 36–45 year olds (Table 6.28). The latter may be related to high AMTL rates, particularly for molars, in the early phase group of 36–45 year olds, which may have led to a drop in caries rates (Wasterlain et al. 2009). Similarly, high AMTL rates may have affected the caries in the 46+ age group, effectively reducing the caries rate in the early group (Table 6.38). It seems, therefore, that the difference in caries rates between the early and late occupation phases at Tutu, based on the simple tooth count and individual count methods, may reflect a true difference in foodways, and is not simply an artefact of differing age profiles and preservation of the different categories of teeth.

Sex-based comparisons

A preliminary investigation of caries rates based on simple tooth count and individual count methods was performed, in order to gain an insight into the potential differences between males and females. Of the entire sample, 11.71% (n= 285) of male teeth is affected by carious lesions. In females, 14.73% (n= 315) of teeth is affected. A chi-square test shows that females have a significantly higher caries prevalence (tooth count) than males (χ^2(1, N= 4572)= 9.06, p= 0.00). In total,

Occupation phase	18–25			26–35			36–45			46+			Total adults*	Ind. freq. %
	I+C	PM	M	I+C	PM	M	I+C	PM	M	I+C	PM	M		
Early	0.00 (10)	50.0 (6)	16.67 (6)	-	-	-	11.76 (17)	42.11 (19)	18.18 (11)	0.00 (26)	11.76 (17)	16.67 (12)	15.75 (127)	77.78 (9)
Late	0.00 (8)	0.00 (7)	0.00 (9)	-	-	-	8.70 (23)	13.64 (22)	46.67 (15)	0.00 (38)	4.88 (41)	22.22 (27)	10.94 (192)	75.00 (12)
Chi-square													χ^2(1, N=319)= 1.58, p= 0.23	χ^2(1, N=21)= 0.02, p= 1.00

Table 6.28 Caries rates at Tutu, by age group, tooth category, and phase of occupation. The number of observed teeth/individuals is indicated between the brackets. * Includes adults of unknown age.

62.09% (n= 95) of males has at least one cavity. Of females, 64.19% (n= 95) has at least one cavity. The proportions of males and females affected is near enough the same (χ^2(1, N= 301)= 0.14, p= 0.72). No caries were observed at Canashito and Juan Dolio.

Intra-site comparisons

A preliminary investigation of caries rates based on simple tooth count and individual count methods was performed for each individual site, in order to gain an insight into the potential differences between males and females. The results show statistically significant differences in caries prevalence (tooth count) between males and females at Anse à la Gourde, Maisabel, and Punta Candelero. Numbers are too small at the sites of Canashito, Diale 1, Escape, Kelbey's Ridge 2, Malmok, Mamora Bay, Point de Caille, Santa Cruz, Savaneta, Savanne Suazey, and Tocorón to reliably test for differences between the sexes.

To control for potential sources of variation resulting from differing age profiles and differentially preserved/affected dental elements, differences between the sexes were further investigated by age group (18–25, 26–35, 36–45, and 46+), and by tooth category (incisors and canines, premolars, and molars). Since numbers are too small at Canashito, Diale 1, Escape, Kelbey's Ridge 2, Malmok, Mamora Bay, Point de Caille, Santa Cruz, Savaneta, Savanne Suazey, and Tocorón to reliably test for differences between the sexes, these sites were omitted from these analyses. Caries rates for males and females per age group and tooth category can be found in Table 6.29.

Site		18–25			26–35			36–45			46+		
		I+C	PM	M	I+C	PM	M	I+C	PM	M	I+C	PM	M
Maisabel	**M**	0.00 (19)	0.00 (10)	3.85 (26)	0.00 (36)	0.00 (22)	0.00 (30)	-	-	-	0.00 (25)	5.88 (17)	46.15 (13)
	F	-	-	-	-	-	-	0.00 (22)	0.00 (14)	0.00 (26)	3.45 (29)	50.00 (10)	50.00 (12)
Punta Candelero	**M**	0.00 (20)	0.00 (16)	30.00 (20)	0.00 (24)	0.00 (17)	5.56 (18)	0.00 (21)	0.00 (14)	27.78 (18)	0.00 (28)	0.00 (20)	25.00 (16)
	F	0.00 (12)	0.00 (8)	0.00 (7)	16.67 (24)	5.56 (18)	24.00 (25)	0.00 (11)	0.00 (5)	14.29 (7)	12.50 (8)	16.67 (6)	28.57 (7)
Lavoutte	**M**	-	-	-	0.00 (31)	15.00 (20)	23.53 (34)	0.00 (22)	5.88 (17)	23.53 (17)	0.00 (16)	10.00 (10)	10.00 (10)
	F	0.00 (6)	0.00 (7)	25.00 (12)	0.00 (13)	0.00 (6)	10.00 (10)	18.75 (16)	44.44 (9)	16.67 (6)	0.00 (10)	0.00 (4)	50.00 (10)
Manzanilla	**M**	0.00 (13)	0.00 (8)	0.00 (13)	10.53 (19)	15.38 (13)	10.00 (20)	-	0.00 (1)	0.00 (3)	0.00 (7)	100.00 (2)	40.00 (5)
	F	0.00 (8)	28.57 (7)	0.00 (8)	-	-	-	-	-	-	11.11 (9)	0.00 (7)	33.33 (3)
Tutu	**M**	-	-	-	-	-	-	5.26 (19)	23.81 (21)	40.00 (15)	0.00 (18)	0.00 (21)	15.79 (19)
	F	0.00 (18)	23.08 (13)	6.67 (15)	-	-	-	15.79 (19)	33.33 (15)	20.00 (10)	0.00 (44)	8.57 (35)	25.00 (20)
Chorro de Maíta	**M**	3.77 (53)	0.00 (33)	21.05 (38)	0.00 (87)	5.66 (53)	19.12 (68)	0.00 (14)	44.44 (9)	8.33 (12)	10.00 (30)	42.86 (7)	50.00 (10)
	F	0.00 (76)	0.00 (48)	17.54 (57)	14.29 (28)	11.76 (17)	20.00 (10)	0.00 (8)	12.50 (8)	0.00 (4)	66.67 (6)	50.00 (4)	50.00 (2)
Punta Macao	**M**	0.00 (2)	0.00 (2)	0.00 (6)	0.00 (11)	0.00 (5)	100.0 (4)	11.76 (17)	28.57 (7)	33.33 (3)	0.00 (1)	0.00 (2)	-
	F	0.00 (7)	0.00 (3)	12.50 (8)	0.00 (8)	71.43 (7)	37.50 (8)	-	-	-	9.09 (11)	0.00 (4)	0.00 (3)
Anse à la Gourde	**M**	4.00 (25)	36.36 (11)	50.00 (20)	0.00 (93)	11.76 (34)	31.91 (47)	3.57 (28)	0.00 (15)	5.88 (17)	0.00 (30)	0.00 (6)	35.71 (14)
	F	0.00 (61)	5.71 (35)	26.15 (65)	5.68 (88)	38.24 (34)	41.03 (39	17.65 (34)	35.71 (15)	16.67 (12)	0.00 (17)	0.00 (5)	0.00 (1)

Table 6.29 Caries rates for males and females per site, by age group and tooth category. The number of observed teeth is indicated between the brackets.

Anse à la Gourde – There are clear differences between the sexes with regards to the prevalence of carious lesions in males and females. A chi-square test shows there is a significant difference between male (17.00%) and female (22.12%) caries rates, with females showing a higher caries rate than males (tooth count) (χ^2(1, N= 935)= 3.78, p= 0.05). No significant differences were found in the proportions of affected individuals between males (79.17%) and females (85.29%) (χ^2(1, N= 58)= 0.37, p= 0.73). In the youngest age group, males have higher caries rates than females for all tooth categories. In the young middle and old middle age groups, females show distinctly higher caries rates than males. Considering the small sample size, differences between males and females aged 46+ years, are less clear. However, females in this age group have distinctly higher rates of AMTL than males. Since caries is a major contributing factor to AMTL, it is possible that the trend of higher caries prevalence in females of 26–35 and 36–45 years was continued into the oldest age group at Anse à la Gourde.

Chorro de Maíta – Males (14.19%) show a higher frequency of carious teeth than females (11.72%), however, a chi-square test shows that the difference is not significant ($\chi^2(1, N= 859)= 1.15, p= 0.31$). No significant differences were found between the proportions of affected males (80.77%) and females (69.23%) ($\chi^2(1, N= 52)= 0.92, p= 0.52$). On examination of the data presented in Table 6.29, the difference between male and female caries rates based on the tooth count method is no longer apparent.

Diale 1 – The results of a chi-square test show that there is no significant difference in the frequency of carious lesions between males (12.50%) and females (0.00%) ($\chi^2(1, N= 50)= 4.43, p= 0.10$), with a higher caries frequency in males than in females. Numbers are too small to test for significant differences in proportions of affected males and females.

Escape – A slight difference in caries rates was observed between males (4.26%) and females (3.16%), but a chi-square test demonstrates that this difference is not statistically significant ($\chi^2(1, N= 142)= 0.11, p= 1.00$). No significant difference was found between the proportions of affected males (100.00%) and females (50.00%) ($\chi^2(1, N= 8)= 1.60, p= 0.46$).

Kelbey's Ridge 2 – The results of a chi-square test show there is no significant difference in the frequency of carious lesions between males (57.14%) and females (25.00%) ($\chi^2(1, N= 39)= 2.78, p= 0.17$). Since all males and females are affected by caries, and numbers are very small, comparison for statistically significant differences in individual count is omitted.

Lavoutte – A slight difference in caries rate was observed between the sexes. A chi-square test shows that the difference between male (11.89%) and female (13.79%) caries rates is not significant ($\chi^2(1, N= 330)= 0.27, p= 0.62$). No significant differences were found between the proportions of affected males (80.00%) and females (70.00%) ($\chi^2(1, N= 20)= 0.27, p= 1.00$). Examination of the data presented in Table 6.29, shows that, considering the small sample size, there are no clear differences between males and females when comparing the different tooth classes and age groups.

Maisabel – The results of a chi-square test show there is a significant difference in the frequency of carious lesions between males (5.41%) and females (14.84%) ($\chi^2(1, N= 350)= 8.96, p= 0.01$), with a much higher caries frequency in females than in males. The proportions of affected males (33.33%) and females (37.50%) do not differ much, and a chi-square test found no significant difference between males and females ($\chi^2(1, N= 23)= 0.04, p= 1.00$). Examination of the data presented in Table 6.29, reveals no further evidence of differences between male and female caries rates, since only the oldest age group contains individuals of both sexes for comparison. Since the male group is mostly comprised of young and young middle adults, and the female group is comprised of old middle and old adults, the significant difference in caries based on the tooth count method is likely to be an artefact of differing age profiles between the two groups.

Manzanilla – Females (13.64%) have a slightly higher caries frequency than males (11.48%). A chi-square test reveals that this difference is not significant (χ^2(1, N=

166)= 0.14, p= 0.79). The proportion of females (50.00%) affected by caries is also slightly higher than the proportion of males (40.00%), however, no significant difference was found ($\chi^2(1, N= 14)= 0.12, p= 1.00$). Examination of the data presented in Table 6.29, reveals no further evidence of differences between male and female caries rates, since only the youngest and oldest age groups contain individuals of

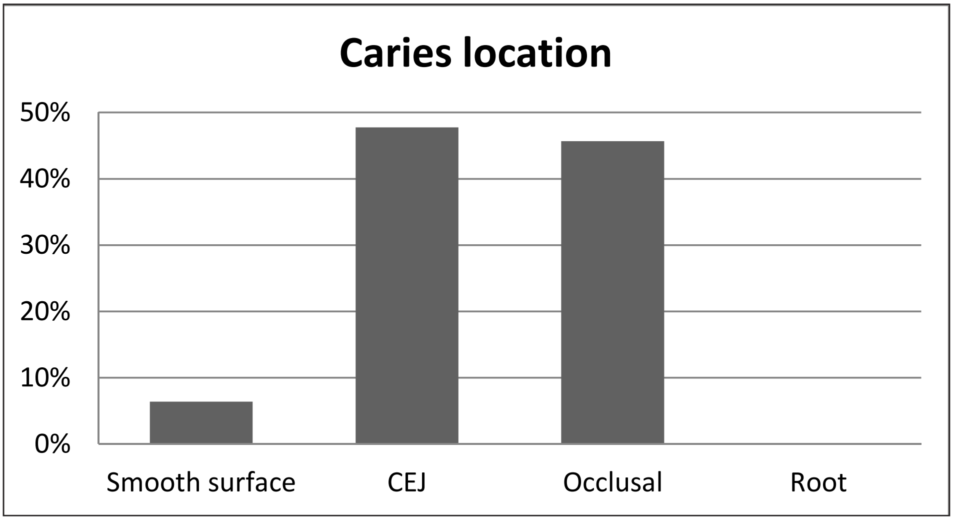

Figure 6.88 Prevalence of caries per location.

both sexes for comparison.

Punta Candelero – Females (13.87%) have a significantly higher caries rate than males (8.70%), as demonstrated by a chi-square test ($\chi^2(1, N= 518)= 3.31, p= 0.05$). No significant differences were found between the proportions of affected males

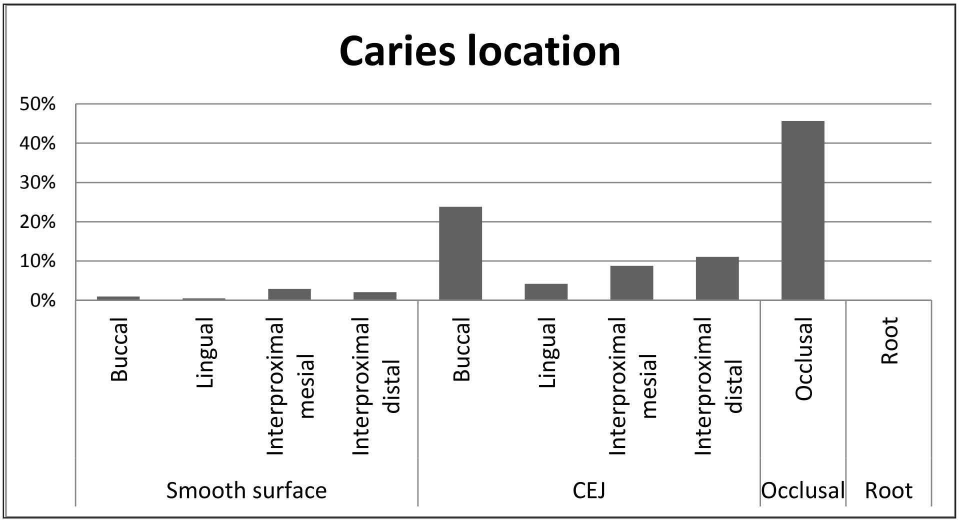

Figure 6.89 Prevalence of caries per location (detailed).

(68.42%) and females (63.64%) (χ^2(1, N= 30)= 0.07, p= 1.00). Examination of the data presented in Table 6.29, reveals that young middle and old female adults have higher caries rates than males. Furthermore, females aged 26–35 years show distinctly higher AMTL rates (Table 6.39), which for a substantial part may have resulted from higher caries rates.

Punta Macao – Even though there is a very large difference between the caries frequency (tooth count) for males (13.95%) and females (20.31%), no statistically significant difference was found with a chi-square test (χ^2(1, N= 150)= 1.07, p= 0.38). Furthermore, no significant difference was found between the proportions of affected males (50.00%) and females (66.67%) (χ^2(1, N= 14)= 0.39, p= 0.63). Due to the small sample size, and the lack of females aged 36–45 years, the difference in caries rate based on tooth count could not be investigated further.

Tutu – No clear difference in caries prevalence between males (12.93%) and females is present (12.56%). This is confirmed by a chi-square test (χ^2(1, N= 315)= 0.05, p= 0.86). A smaller proportion of females (71.43%) appears to be affected by caries than males (83.33%), however this difference is also not statistically significant (χ^2(1, N= 20)= 0.32, p= 1.00). Due to the lack of younger individuals of both sexes for comparison differences in affected tooth classes and between age groups could not be assessed.

Site	Smooth surface %	CEJ %	Occlusal %	Root %
Anse à la Gourde	8.19	41.52	50.29	0.00
Canashito	0.00	0.00	0.00	0.00
Chorro de Maíta	7.63	33.05	58.47	0.85
Diale 1	0.00	100.00	0.00	0.00
Escape	0.00	55.56	44.44	0.00
Juan Dolio	0.00	0.00	0.00	0.00
Kelbey’s Ridge 2	0.00	50.00	50.00	0.00
Lavoutte	4.65	62.79	32.56	0.00
Maisabel	0.00	70.00	30.00	0.00
Malmok	0.00	0.00	0.00	0.00
Mamora Bay	0.00	28.57	71.43	0.00
Manzanilla	6.25	68.75	25.00	0.00
Point de Caille	0.00	66.67	33.33	0.00
Punta Candelero	3.17	49.21	47.62	0.00
Punta Macao	3.85	38.46	57.69	0.00
Santa Cruz	9.10	45.45	45.45	0.00
Savaneta	100.00	0.00	0.00	0.00
Savanne Suazey	0.00	85.71	14.29	0.00
Tocorón	0.00	66.67	33.33	0.00
Tutu	10.00	57.50	32.50	0.00

Table 6.30 Frequencies of caries location per site.

Caries location

Caries location was recorded as smooth surface, cement-enamel junction (CEJ), occlusal, or root surface. These categories are further subdivided into a total of nine locations on the tooth. For the entire sample, CEJ followed by occlusal caries are most prevalent (Figure 6.88). Within the category of CEJ caries, the most frequent location is buccal and interproximal (Figure 6.89).
Table 6.30 displays the percentage of caries per location at the individual sites. These data show that there are substantial differences between the sites. Broadly speaking, the sites can be divided into those with a considerably larger proportion of CEJ caries than occlusal caries (Escape, Lavoutte, Maisabel, Manzanilla, Point de Caille, Savanne Suazey, Tocorón, and Tutu), and those with a considerably larger proportion of occlusal caries than CEJ caries (Anse à la Gourde, Chorro de Maíta, Mamora Bay, and Punta Macao). The remaining sites have a more or less equal proportion of CEJ and occlusal caries (Punta Candelero and Santa Cruz), or no caries at all (Canashito, Diale 1, Juan Dolio, and Malmok). Smooth surface caries occur in some of both major groups.

6.4.2 Dental calculus

The amount of accumulated calculus is, of course, in part related to age, as the older an individual becomes, the more calculus (s)he could potentially accumulate. Conversely, the more the tooth crowns wear away, the more calculus will wear away too. As discussed in Chapter 2 a wide array of other factors influence the rate of calculus deposition and the size of calculus deposits, meaning that small differences in the (mean) size of calculus accretions within or between populations are very difficult to interpret. Nonetheless, the size and type of calculus deposits was documented according to Brothwell (1981) and Hillson (1996).
The distribution of the calculus deposits throughout the dentition is also examined here, because although the formation of dental calculus has been shown to be related to dietary practices, the deposition of supragingival dental calculus throughout the dentition and on the surfaces of individual teeth is known to follow a particular 'natural' pattern in all humans (Bergström 1999; Corbett and Dawes 1998; Jin and Yip 2002; Parfitt 1959; Schroeder 1969; White 1997).
For the site of Tutu, presence and degree of calculus was not systematically recorded, as most deposits appear to have been lost or removed during cleaning prior to examination of the material (see also Larsen et al. 2002). Similarly, at Diale 1, Savaneta, Savanne Suazey, and Tocorón, calculus appears to have been lost during cleaning and/or transportation of the material, or simply due to drying and loss over time in storage.
Overall, calculus was observed in 41 of the 49 sites (83.67%). The frequency of calculus accretions (tooth count and individual count) per site with more than four individuals can be found in Table 6.31. The frequencies vary widely between the sites. A chi-square test ($\chi^2(19, N= 342) = 57.41, p= 0.00$) shows that at least two sites differ significantly from each other with regards to the frequency of

Site	T.C. (n)	%	I.C. (n)	%
Anse à la Gourde	473	50.32	46	75.41
Canashito	6	12.77	2	50.00
Chorro de Maíta	269	29.18	45	81.82
Diale 1	*3*	*6.00*	*1*	*20.00*
Escape	73	18.81	14	58.33
Juan Dolio	23	45.10	5	71.43
Kelbey's Ridge 2	18	46.15	1	33.33
Lavoutte	104	26.33	16	59.26
Maisabel	65	16.25	17	65.38
Malmok	13	21.31	3	75.00
Mamora Bay	9	12.00	2	50.00
Manzanilla	97	58.43	11	78.57
Point de Caille	49	74.24	4	100.00
Punta Candelero	422	58.94	45	91.84
Punta Macao	124	71.26	13	86.67
Santa Cruz	12	20.69	3	75.00
Savaneta	*4*	*5.33*	*1*	*20.00*
Savanne Suazey	*8*	*14.04*	*3*	*75.00*
Tocorón	*7*	*20.59*	*3*	*50.00*
Tutu	*39*	*12.23*	*6*	*28.57*

Table 6.31The frequency of calculus (tooth count and individual count) per site. In italics: sites where calculus was not systematically recorded because of loss due to cleaning or damage.

individuals affected by calculus. Post-hoc comparison of each of the sites reveals that Anse à la Gourde, Chorro de Maíta, Punta Candelero, and Punta Macao have a significantly larger proportion of individuals affected by calculus than Tutu. However, this is most likely an artefact of the non-systematic recording of calculus in the Tutu
assemblage, as discussed above. Punta Candelero also shows a significantly larger proportion of individuals affected by calculus than Diale 1. No other significant differences between the sites were found.

Chronological comparisons

Maisabel – The proportion of affected teeth drops slightly in the late period (16.67%) in comparison to the early period (17.16%). The difference is not statistically significant ($\chi^2(1, N= 385)= 0.02, p= 0.89$). Similarly, the proportion of affected individuals drops from the early to late phase (72.73% and 42.86%, respectively), although the difference is not significant ($\chi^2(1, N= 25)= 2.23, p= 0.23$). The mean degree of calculus deposits also drops in the late phase (1.61) as opposed to the early phase (1.96). A Mann-Whitney U test demonstrates that this difference is not significant (U = 395.00, p= 0.16).

Punta Candelero – The proportion of affected teeth drops slightly in the late period (63.53%) in comparison to the middle period (64.94%). The difference is not statistically significant ($\chi^2(1, N= 336)= 0.06, p= 0.90$). The proportion of affected individuals rises somewhat from the middle (90.00%) to the late (100.00%) phase. The difference is not statistically significant ($\chi^2(1, N= 25)= 0.54, p= 1.00$). Similarly, the mean degree of calculus deposits rises slightly from the middle (1.22) to late (1.30) phase. A Mann-Whitney U test shows that this difference is not significant (U = 4104.00, p= 0.17).
Tutu – The proportion of affected teeth drops slightly in the late period (9.90%) when compared to the early period (15.75%). The difference is not statistically significant ($\chi^2(1, N= 319)= 2.44, p= 0.16$). The proportion of affected individuals also drops somewhat (early: 33.33%, late: 25.00%), as does the mean degree of calculus deposits (early: 1.65, late: 1.56). These differences are also not statistically significant ($\chi^2(1, N= 21)= 0.18, p= 1.00$) and (U = 11576.00, p= 0.23), respectively.

Sex-based comparisons
For the overall sample, the proportion of affected teeth is larger in males (43.76%) than in females (34.27%). The difference is statistically significant according to the results of a chi-square test ($\chi^2(1, N= 4557)= 42.82, p= 0.00$). A Mann-Whitney U test showed that there is a statistically significant difference in the size of calculus deposits between males and females (U = 1772185.00, p= 0.00). Males are affected by larger calculus deposits than females.
Anse à la Gourde – The proportion of affected teeth in males and females is near enough equal; 49.38% of male teeth is affected, and 52.38% of female teeth is affected. When comparing the size of the calculus deposits in males and females, there also appears to be no difference between the sexes. A Mann-Whitney U test showed that there is no statistically significant difference in the size of calculus deposits between males and females (U = 25962.50, p= 0.82).
Chorro de Maíta – A chi-square test shows there is a significant difference between the proportion of teeth affected by calculus deposits in males (32.31%) and females (26.18%), with males more frequently affected than females ($\chi^2(1, N= 859)= 3.87, p= 0.05$). When comparing the size of the calculus deposits in males and females, a Mann-Whitney U test shows that there is no statistically significant difference in the size of calculus deposits between males and females (U = 7395.00, p= 0.17).
Escape – A chi-square test shows there is a significant difference between the proportion of teeth affected by calculus deposits in males (31.91%) and females (12.63%) at Escape, with females more frequently affected than males ($\chi^2(1, N= 142)= 7.59, p= 0.01$). A Mann-Whitney U test shows that males have significantly larger calculus accretions than females (U = 1814.00, p= 0.01).
Lavoutte – A chi-square test shows that the proportion of teeth affected by calculus deposits in males (38.38%) is significantly higher than in females (20.00%) at Lavoutte ($\chi^2(1, N= 330)= 13.00, p= 0.00$). Furthermore, a Mann-Whitney U test shows that males have significantly larger calculus accretions than females (U =

10759.50, p= 0.00).
Maisabel – A chi-square test shows that the proportion of teeth affected by calculus deposits in females (24.22%) is significantly higher than in males (13.53%) at Maisabel (χ^2(1, N= 335)= 6.23, p= 0.02). Furthermore, a Mann-Whitney U test shows that females have significantly larger calculus accretions than males (U = 11200.50, p= 0.00).
Manzanilla – A chi-square test shows that there is no statistically significant difference between the proportion of teeth affected by calculus deposits in males (60.66%) than in females (52.27%) at Manzanilla (χ^2(1, N= 166)= 0.94, p= 0.38). A Mann-Whitney U test shows that there is no statistically significant difference in size of calculus accretions between males and females (U = 2197.50, p= 0.12).
Punta Candelero – A chi-square test shows that the proportion of teeth affected by calculus deposits in males (66.38%) is significantly higher than in females (55.49%) at Punta Candelero (χ^2(1, N= 518)= 5.84, p= 0.02). Furthermore, a Mann-Whitney U test shows that females have significantly larger calculus accretions than males (U = 26340.50, p= 0.05).
Punta Macao – A chi-square test shows that there is no statistically significant difference between the proportion of teeth affected by calculus deposits in males (68.60%) than in females (57.81%) at Punta Macao (χ^2(1, N= 150)= 1.86, p= 0.23). Furthermore, a Mann-Whitney U test shows that there is no significant difference in the size of calculus accretions between males and females (U = 2496.00, p= 0.28).
Tutu – Although male dentitions (13.79%) are slightly more frequently affected by calculus than female dentitions (11.56%), chi-square test shows that there is no statistically significant difference between the proportion of teeth affected by calculus deposits in males than in females (χ^2(1, N= 315)= 0.34, p= 0.60).

Unusual calculus deposits
Eight cases of unusual patterns of dental calculus deposits were identified in the assemblages of Argyle 2, Escape, Manzanilla, Punta Candelero, and Punta Macao. The calculus deposits are extremely large, and differ both in location on the individual teeth and distribution throughout the dental arch from the expected natural pattern of calculus deposition. None of the affected individuals are female. Six are male, and of the remaining two one is of indeterminate sex (due to its young age) and one is of unknown sex (due to poor preservation).

Argyle 2 individual 3
This male aged between 18–25 years shows very large calculus deposits on the lower right mandibular dentition, extending from the canine to the third molar. Of the right maxillary teeth, only the canine is present, and is equally affected by excessive calculus formation. The other upper right teeth were lost ante and post mortem. The deposits are largest on the buccal surfaces, but very heavy calculus accumulations were also found on the occlusal and lingual surfaces. Occlusal calculus

accumulations are rare, as they only form when these surfaces are redundant, or in other words, are not used in food mastication. Normal use of the teeth for mastication of foodstuffs prevents the formation of calculus deposits on the occlusal surfaces, as plaque is removed by the abrasive action of the food across the tooth. Large occlusal calculus deposits in the lower right dentition indicate that these teeth, and therefore also the occluding upper right teeth, were not used in normal food mastication. The ante mortem loss of the occluding upper right teeth could also cause redundancy of the lower teeth, however since some of the upper right teeth were lost post mortem, it is fair to assume that mastication was still possible.

Figure 6.90 Manzanilla 255A, unusual calculus deposits on lower right mandibular teeth.

Calculus deposits are also present on the left side of the dentition on the upper canine and first molar, but these deposits are much smaller and befit the normal pattern of calculus accumulation. No occlusal calculus was found on the left side of the dentition. It is likely that the left part of the dentition was used in all food mastication activities, something which is corroborated by the fact that the left dentition shows a higher mean degree of wear than the right dentition.

Escape 17

This adult of unknown sex aged between 36–45 years shows very large calculus deposits on the right dentition, extending from the upper third premolar to the lower third molar (the upper fourth premolar, upper third molar, and lower second molar are absent). The deposits are largest on the buccal surfaces, but very heavy calculus accumulations were also found on the occlusal and lingual surfaces, indicating that the right side of the dentition was not used in normal food mastication. No calculus was found on the left side of the dentition. It is likely that this side was used in all food mastication activities, as it has a higher mean degree of wear than the right dentition.

Manzanilla 255A

This male aged between 26–35 years was found interred together with the partial remains of a juvenile (255B, secondary interment) aged 2–4 years (Dorst 2008; Weston in prep.).

Very large calculus accumulations are present on the right mandibular dentition, extending from the lateral incisor to the second molar (the third molar, or wisdom tooth, was present, but only partially erupted and impacted)(Figure 6.90). Unfortunately, the right maxillary teeth were lost post mortem, but considering the severity of calculus accumulation in the lower right dentition, it is highly likely that these teeth were also affected by large calculus deposits. Deposits are largest on the buccal surfaces, but heavy calculus accumulations were also found on the occlusal and lingual surfaces. Large occlusal calculus deposits in the lower right dentition show that these teeth and the occluding upper right teeth were not used in normal food mastication. Another explanation for such large calculus deposits on the lower right teeth is the ante mortem loss of the occluding upper right teeth, thus making the lower teeth redundant and susceptible to calculus accumulation. In this case, however, the upper right teeth appear to have been lost post mortem. Calculus deposits are also present on the left side of the dentition and on the lingual surfaces of the lower incisors, but these deposits are much smaller and befit the normal pattern of calculus accumulation. No occlusal calculus was found on the left side of the dentition. It is likely that the left part of the dentition was used in all food mastication activities, since this part of the dentition shows a higher mean degree of wear than the right dentition (Mickleburgh 2012).

Manzanilla 267-269
This possible male aged between 26–35 years was buried on top of another adult individual, with two juvenile individuals later buried at intervals on top (Dorst 2008; Weston in prep.).
Very large calculus accumulations are present on the left side of both the upper and lower dentition from the canines to the second molars (the third molars are absent). The deposits are heaviest on the buccal surfaces, but large accumulations are also present on the occlusal and lingual surfaces. Occlusal calculus is present in both the left upper and lower quadrants, clearly indicating that these teeth were not used in normal mastication.
The right side of the dentition has practically no calculus. The right teeth also show a higher average degree of wear than the left teeth, indicating that this side performed most of the food mastication activities (Mickleburgh 2012).

Manzanilla 291
This individual of indeterminate sex aged between 14–16 years was found buried on the back with the legs flexed toward the torso (Dorst 2008; Weston in prep.).
Heavy calculus deposits were found on the buccal surfaces of the left upper teeth, extending from the canine to the second molar (the third molar is absent). These teeth also show relatively large lingual deposits. Occlusal calculus is present the upper left teeth, on both premolars and the first molar.
Although the lower left teeth lack large buccal calculus deposits, it appears that these may have been lost due to post-depositional processes or cleaning. Both lower premolars and the second molar have considerable occlusal deposits. The presence of occlusal calculus in the left portion of the dentition of this individual again indicates that this side the dentition must have been avoided during masticatory activities (Mickleburgh 2012).

Punta Candelero 54
This adult male shows heavy calculus deposits on the buccal surfaces of the right upper teeth from the lateral incisor to the fourth premolar (the molars are absent), and on the right lower dentition from the lateral incisor to the third molar. The lower molars also have occlusal calculus and the lower third molar also has a large lingual calculus deposit. The left side the dentition has only small calculus deposits befitting the normal pattern of accumulation, and is more severely worn than the right side.

Punta Candelero 56
This male aged between 16–18 years shows heavy calculus deposits on the buccal surfaces of the left teeth from the canines to the lower first and upper second molars. The premolars and the upper first and second molars also have occlusal calculus. The right side the dentition has no calculus deposits, and is slightly more severely worn than the left side.

Punta Macao 2
This male aged between 14–16 years appears to show the same pattern of calculus deposits described above for individuals from Argyle2, Manzanilla, and Punta Candelero. The pattern is less clear in this case, however, as only three teeth on the left side display the large calculus accretions (the other left teeth were absent). Heavy calculus deposits are found on the buccal surfaces of the upper left fourth premolar, upper first molar and the lower first molar. These teeth also have occlusal calculus. The right side the dentition has no calculus deposits. No difference in degree of wear between the left and right side of the dentition was observed, although the young age of this individual means wear would be very slight in any case.

6.4.3 Periapical abscesses
The rate of periapical abscesses (tooth count and individual count) is presented in Table 6.32. No periapical abscesses were found at the other sites in the sample. Overall the rates of periapical abscesses in the sample are not particularly high, but they clearly differ at the individual sites.

Figure 6.91 Cañas, Puerto Rico, periapical abscess.

Site	Periapical abscesses (T.C.) (n)	Frequency %	Periapical abscesses (I.C.) (n)	Frequency %
Chorro de Maíta	2	0.14	2	3.64
Escape	1	0.25	1	4.17
Tutu	1	0.25	1	4.76
Anse à la Gourde	6	0.52	5	8.20

Site	Periapical abscesses (T.C.) (n)	Frequency %	Periapical abscesses (I.C.) (n)	Frequency %
Kelbey's Ridge 2	1	1.08	1	33.33
Punta Macao	3	1.29	2	13.33
Punta Candelero	13	1.52	9	18.00
Diale 1	1	1.69	1	20.00
Canashito	1	1.92	1	25.00
Tocorón	1	2.27	1	16.67
El Cabo	2	3.77	1	50.00
La Caleta	1	4.00	1	100.00
Canas	2	13.33	1	33.33
Clarence Town cave	2	14.29	1	50.00
Indian Creek	3	60.00	1	100.00

Table 6.32 The frequency of periapical abscesses (tooth count and individual count) per site.

Sex-based differences

In the entire sample, 13.07% of males (n= 20) is affected by periapical abscesses. Of females, 3.38% are affected by periapical abscesses (n= 5). A chi-square test shows the difference is statistically significant (χ^2(1, N= 301)= 9.28, p= 0.00).

At most sites the numbers of affected individuals are so small that differences between the sexes cannot be reliably tested. For Anse à la Gourde the results of a chi-square test show that although males (n= 4) appear more frequently affected than females (n= 1), the difference is not statistically significant (χ^2(1, N= 58)= 3.37, p= 0.15). Similarly for Punta Candelero, males (n= 6) appear more frequently affected than females (n= 1), but the difference is not statistically significant (χ^2(1, N= 30)= 1.97, p= 0.22).

6.4.4 AMTL

AMTL is prevalent throughout the entire sample, although some significant differences were found between the different sites. In total 767 cases of AMTL were recorded in the adult population, amounting to 11.06% of the total number of observed tooth positions (n= 6938). In the total sample, 142 adult individuals with at least one ante mortem lost tooth were observed, amounting to 36.50% of the entire adult population (n= 389).

AMTL prevalence

An aim of this study is to assess differences in AMTL rates between the individual sites. A preliminary investigation of AMTL rates based on simple tooth count and individual count methods was performed, in order to gain an insight into the potential differences between the sites. The rate of AMTL (tooth count) is calcu-

lated as follows: number of AMTL / total number of observed tooth positions (= observed teeth + unerupted teeth + AMTL + PMTL) = AMTL rate. The rate of AMTL (individual count) is calculated as follows: number of individuals with at least one ante mortem lost tooth / total number of individuals = AMTL rate.
The AMTL rates based on the tooth count method per site can be found in Table

Site	N	Frequency % (T.C.)
Point de Caille	66	0.00
Savanne Suazey	57	0.00
Escape	394	2.79
Maisabel	432	3.94
Diale 1	88	5.68
Mamora Bay	84	5.95
Savaneta	75	6.67
Lavoutte	448	6.70
Santa Cruz	57	7.02
Punta Candelero	912	7.24
Canashito	52	9.62
Anse à la Gourde	1207	13.01
Punta Macao	257	14.40
Kelbey's Ridge 2	42	16.67
Chorro de Maíta	1296	17.36
Manzanilla	202	19.31
Tocorón	51	19.61
Tutu	443	19.64

Table 6.33 The AMTL frequency per site. Due to the lack (or poor preservation) of alveolar bone, Juan Dolio and Malmok were omitted from the analyses.

6.33. As can be seen in this table, there appear to be considerable differences in the AMTL rates per site. These differences were tested using a chi-square test. This test determined a significant difference between at least two of the sites (χ^2(17, N= 6173)= 199.77, p= 0.00).
Table 6.34 shows the AMTL rates per site based on the individual count method, which assesses the frequency of individuals with at least ante mortem lost tooth in each site assemblage. As can be seen in this table, there appear to be considerable differences in the prevalence of AMTL per site. These differences were tested using a chi-square test. This test determined a significant difference between at least two of the sites (χ^2(17, N= 335)= 42.56, p= 0.00).
The preliminary assessments above indicate differences in AMTL rates between the individual sites in the sample. However, as discussed in Chapters 2 and 4 (sections 2.2.1 and 4.2.3), when comparing AMTL rates between groups, the effects of age, differential preservation of individual dental elements, and differential

Site	N	Frequency (individual count)
Point de Caille	4	0.00
Savanne Suazey	4	0.00
Diale 1	7	14.29
Escape	24	16.67
Savaneta	5	20.00
Maisabel	26	23.08
Canashito	4	25.00
Santa Cruz	4	25.00
Lavoutte	28	28.57
Manzanilla	14	28.57
Tocorón	6	33.33
Punta Candelero	50	34.00
Punta Macao	15	46.67
Mamora Bay	4	50.00
Anse à la Gourde	61	52.46
Chorro de Maíta	55	63.63
Kelbey's Ridge 2	3	66.67
Tutu	21	61.90

Table 6.34 The AMTL frequency (individual count) per site. Due to the lack (or poor preservation) of alveolar bone, Juan Dolio and Malmok were omitted from the analyses.

susceptibility of individual dental elements to ante mortem loss must be taken into account (Hillson 2001, 2008b; Wasterlain et al. 2009). The differences demonstrated above using the simple tooth count and individual count methods could (at least in part) result from differing age profiles and differentially preserved/affected dental elements. For this reason, these potential sources of variation must be controlled for.

Table 6.35 presents the AMTL rates per site by age group (18–25, 26–35, 36–45, and 46+), and by tooth category (incisors and canines, premolars, and molars). As can be seen in this table, individuals in older age groups generally have higher AMTL rates than individuals in younger age groups. However, because age-at-death estimations are not available for all adults, the numbers of individuals representing the different age categories at each site are considerably reduced. In some cases, such as Mamora Bay and Tocorón, none of the adults in the sample could be aged.

This complicates comparisons between the different sites. Nonetheless, as Table 6.35 shows, those sites identified as high AMTL rates based on the simple tooth count method, i.e. Anse à la Gourde, Chorro de Maíta, Manzanilla, Punta Candelero, and Tutu, also show relatively high AMTL rates. The sites of Anse à la Gourde, Chorro de Maíta, and Punta Candelero show relatively high rates in most age groups and tooth categories.

Site	18–25			26–35			36–45			46+		
	I+C	PM	M	I+C	PM	M	I+C	PM	M	I+C	PM	M
Point de Caille	0.00 (16)	0.00 (8)	0.00 (8)	-	-	-	-	-	-	0.00 (11)	0.00 (7)	0.00 (11)
Savanne Suazey	0.00 (4)	0.00 (5)	0.00 (10)	-	-	-	-	-	-	-	-	-
Escape	2.94 (34)	0.00 (31)	1.89 (53)	2.17 (46)	0.00 (46)	0.00 (47)	0.00 (24)	0.00 (20)	22.22 (18)	0.00 (11)	0.00 (12)	19.04 (21)
Maisabel	0.00 (30)	0.00 (17)	0.00 (35)	0.00 (36)	0.00 (26)	0.00 (30)	0.00 (22)	6.67 (15)	5.71 (35)	0.00 (76)	0.00 (32)	26.09 (46)
Diale 1	0.00 (14)	0.00 (13)	0.00 (15)	-	-	-	-	-	-	-	-	-
Mamora Bay	-	-	-	-	-	-	-	-	-	-	-	-
Savaneta	0.00 (9)	0.00 (7)	0.00 (6)	0.00 (20)	8.33 (12)	23.53 (17)	-	-	-	-	-	-
Lavoutte	0.00 (8)	0.00 (7)	0.00 (12)	2.04 (49)	5.88 (34)	8.33 (48)	0.00 (58)	3.33 (30)	31.82 (44)	0.00 (30)	5.00 (20)	16.67 (24)
Santa Cruz	0.00 (4)	40.00 (5)	11.11 (18)	0.00 (8)	0.00 (4)	0.00 (4)	0.00 (3)	0.00 (3)	0.00 (4)	-	-	-
Punta Candelero	0.00 (51)	0.00 (42)	0.00 (56)	12.90 (62)	13.04 (46)	21.21 (66)	2.86 (35)	4.35 (23)	6.67 (30)	8.51 (47)	8.00 (25)	14.81 (54)
Canashito	-	-	-	0.00 (6)	0.00 (6)	0.00 (6)	0.00 (6)	0.00 (3)	71.43 (7)	-	-	-
Anse à la Gourde	0.00 (86)	0.00 (51)	3.37 (89)	1.06 (189)	9.47 (95)	35.46 (141)	0.00 (63)	12.12 (33)	12.82 (39)	0.00 (50)	31.58 (19)	47.06 (51)
Punta Macao	0.00 (25)	0.00 (14)	0.00 (23)	0.00 (32)	9.09 (22)	39.29 (28)	0.00 (18)	25.00 (12)	50.00 (6)	27.27 (22)	18.18 (11)	75.00 (12)
Kelbey's Ridge 2	-	-	-	-	-	-	0.00 (4)	0.00 (4)	100.00 (6)	0.00 (12)	0.00 (8)	10.00 (10)
Chorro de Maíta	0.00 (146)	0.00 (91)	11.21 (116)	3.97 (151)	14.44 (90)	30.15 (136)	14.63 (41)	17.24 (29)	60.00 (40)	34.67 (75)	51.28 (39)	81.69 (71)
Manzanilla	0.00 (21)	0.00 (17)	0.00 (23)	0.00 (19)	0.00 (13)	0.00 (20)	-	0.00 (1)	0.00 (3)	40.00 (30)	46.67 (15)	69.23 (26)
Tocorón	-	-	-	-	-	-	-	-	-	-	-	-
Tutu	0.00 (19)	0.00 (13)	0.00 (22)	-	-	-	0.00 (38)	0.00 (41)	36.59 (41)	13.64 (88)	14.71 (68)	52.08 (96)

Table 6.35 AMTL rates per site, by age group and tooth category. The number of observed tooth positions is indicated between brackets.

Chronological comparisons

Maisabel – A statistically significant rise is seen in the frequency of AMTL in the late phase of occupation (Table 6.36). Although the proportion of affected individuals also rises in the later period, the difference is not statistically significant. These differences do not appear to be the result of differing age profiles of both groups. Half of both the early and late groups are older adults (46+ years). Comparison of AMTL rates per age group reveals that the greatest difference between the two groups comprises the oldest adults (46+ years), with older adults in the late phase of occupation clearly showing higher rates of AMTL that older adults in the early

Occupation phase	18–25			26–35			36–45			46+			Total adults*	Ind. freq. %
	I+C	PM	M	I+C	PM	M	I+C	PM	M	I+C	PM	M		
Early	0.00 (12)	0.00 (4)	0.00 (11)	0.00 (22)	0.00 (15)	0.00 (18)	0.00 (10)	33.33 (3)	9.09 (11)	0.00 (26)	0.00 (14)	0.00 (20)	1.14 (175)	9.09 (11)
Late	0.00 (20)	0.00 (15)	0.00 (24)	0.00 (14)	0.00 (11)	0.00 (12)	0.00 (13)	0.00 (12)	4.17 (24)	0.00 (50)	0.00 (21)	37.5 (32)	5.84 (257)	33.33 (15)
Chi-square													χ^2(1, N=432) = 6.07, p= 0.02	χ^2(1, N=26)= 2.10, p= 0.20

Table 6.36 AMTL rates at Maisabel, by age group, tooth category, and phase of occupation. The number of observed tooth positions/individuals is indicated between brackets. * Includes adults of unknown age.

phase of occupation (Table 6.36). As such, the significant difference between AMTL rates between the early and late phases of occupation at Maisabel based on the simple tooth count method, appears to reflect a true increase in rates, not resulting purely from differing age profiles.
Punta Candelero – A significant drop is seen in the frequency of AMTL in the late

Occupation phase	18–25			26–35			36–45			46+			Total adults*	Ind. freq. %
	I+C	PM	M	I+C	PM	M	I+C	PM	M	I+C	PM	M		
Middle	0.00 (23)	0.00 (16)	0.00 (28)	17.95 (39)	11.4 (35)	18.42 (38)	4.76 (21)	7.14 (14)	7.14 (14)	6.25 (16)	20.0 (10)	41.7 (12)	11.11 (319)	35.00 (20)
Late	0.00 (8)	0.00 (7)	0.00 (8)	0.00 (12)	0.00 (7)	0.00 (11)	0.00 (7)	0.00 (5)	0.00 (9)	0.00 (1)	-	-	0.00 (85)	0.00 (4)
Chi-square													χ^2(1, N= 404)= 10.21, p= 0.00	χ^2(1, N= 24)= 1.98, p= 0.28

Table 6.37 AMTL rates at Punta Candelero, by age group, tooth category, and phase of occupation. The number of observed tooth positions/individuals is indicated between brackets. * Includes adults of unknown age.

phase of occupation (Table 6.37). The proportion of affected individuals also drops in the later period but the difference is not statistically significant. An important factor in this difference may be the fact that the oldest age group (46+ years) is underrepresented in the late group. Nonetheless, as can be seen in Table 6.37, the early group shows clearly higher AMTL rates in the young middle adult and old middle adult age groups (26–35 and 36–45 years, respectively). As such, the difference between the two occupation phases likely represents a true drop in AMTL over time.
Tutu – The frequency of AMTL drops in the late phase of occupation, however the difference is not statistically significant based on the results of a chi-square test. The proportion of affected individuals rises somewhat in the late period, but the difference is not statistically significant (Table 6.38). Comparison of AMTL rates per age group reveals that the greatest difference between the two groups

comprises the oldest adults (46+ years), with older adults in the early phase of occupation clearly showing higher rates of AMTL that older adults in the late phase of occupation (Table 6.38).

Occupation phase	18–25			26–35			36–45			46+			Total adults*	Ind. freq. %
	I+C	PM	M	I+C	PM	M	I+C	PM	M	I+C	PM	M		
Early	0.00 (11)	0.00 (7)	0.00 (12)	-	-	-	0.00 (17)	0.00 (19)	31.25 (16)	20.59 (34)	29.17 (24)	63.64 (33)	23.03	55.56 (9)
Late	0.00 (8)	0.00 (6)	0.00 (10)	-	-	-	0.00 (23)	0.00 (22)	38.46 (26)	9.26 (54)	2.27 (44)	46.03 (63)	17.36	66.67 (12)
Chi-square													χ^2(1, N=443)= 2.17, p= 0.15	χ^2(1, N=21)= 0.27, p= 0.67

Table 6.38 AMTL rates at Tutu, by age group, tooth category, and phase of occupation. The number of observed tooth positions is indicated between brackets. * Includes adults of unknown age.

Sex-based comparisons

A preliminary investigation of AMTL rates based on simple tooth count and individual count methods was performed, in order to gain an insight into the potential differences between males and females. A difference was observed between the prevalence of AMTL (tooth count) in males and females in the total sample. Of the entire sample, 12.03% (n= 336) of observed male tooth positions is affected by carious lesions. In females, 15.76% (n= 396) of observed tooth positions is affected. A chi-square test demonstrates that this difference is statistically significant (χ^2(1, N= 5305)= 15.51, p= 0.00). The proportion of females affected by AMTL (45.27%, n= 67) is almost the same as the proportion of males (45.10%, n= 69) (χ^2(1, N= 301)= 0.00, p= 1.00).

No AMTL was observed at Point de Caille and Savanne Suazey. Due to the lack (or poor preservation) of alveolar bone, Juan Dolio and Malmok were omitted from the analyses.

Intra-site comparisons

A preliminary investigation of AMTL rates based on simple tooth count and individual count methods was performed for each individual site, in order to gain an insight into the potential differences between males and females. The results show statistically significant differences in AMTL rate between males and females at Anse à la Gourde, Manzanilla, and Punta Candelero. At these three sites, females show significantly higher rates of AMTL than males. Numbers are too small at the sites of Canashito, Diale 1, Kelbey's Ridge 2, Mamora Bay, Point de Caille, Santa Cruz, Savaneta, Savanne Suazey, and Tocorón to reliably test for differences between the sexes.

To investigate potential sources of variation resulting from differing age profiles and differentially preserved/affected dental elements, differences between the sexes were further studied by age group (18–25, 26–35, 36–45, and 46+), and by tooth category (incisors and canines, premolars, and molars). Since numbers are too small at Canashito, Diale 1, Kelbey's Ridge 2, Mamora Bay, Point de Caille, Santa Cruz, Savaneta, Savanne Suazey, and Tocorón to reliably test for differences between the sexes, these sites were omitted from these analyses.

Site		18–25			26–35			36–45			46+		
		I+C	PM	M	I+C	PM	M	I+C	PM	M	I+C	PM	M
Escape	**M**	11.11 (9)	0.00 (7)	8.33 (12)	-	-	-	0.00 (8)	0.00 (7)	0.00 (5)	-	-	-
	F	0.00 (8)	0.00 (5)	0.00 (9)	0.00 (14)	0.00 (11)	0.00 (17)	0.00 (5)	0.00 (4)	57.14 (7)	0.00 (2)	0.00 (2)	0.00 (8)
Maisabel	**M**	0.00 (25)	0.00 (12)	0.00 (27)	0.00 (36)	0.00 (26)	0.00 (30)	-	-	-	0.00 (29)	0.00 (21)	36.00 (25)
	F	-	-	-	-	-	-	0.00 (23)	6.67 (15)	5.71 (35)	0.00 (35)	13.33 (15)	18.75 (16)
Lavoutte	**M**	-	-	-	2.78 (36)	7.41 (27)	10.53 (38)	0.00 (28)	14.29 (21)	25.00 (24)	0.00 (18)	7.69 (13)	15.38 (13)
	F	0.00 (8)	0.00 (7)	0.00 (12)	0.00 (13)	0.00 (7)	0.00 (10)	0.00 (18)	10.00 (10)	50.00 (12)	0.00 (12)	0.00 (7)	16.67 (12)
Punta Candelero	**M**	0.00 (20)	0.00 (16)	0.00 (20)	0.00 (29)	0.00 (22)	4.35 (23)	4.17 (24)	5.88 (17)	9.09 (22)	7.89 (38)	12.00 (25)	26.92 (26)
	F	0.00 (12)	0.00 (8)	0.00 (7)	22.22 (36)	23.33 (30)	31.71 (41)	0.00 (11)	0.00 (6)	0.00 (8)	11.11 (9)	0.00 (7)	11.11 (9)
Anse à la Gourde	**M**	0.00 (25)	0.00 (14)	7.69 (26)	0.00 (96)	6.67 (45)	22.54 (71)	0.00 (29)	0.00 (17)	8.00 (25)	0.00 (33)	11.11 (9)	40.00 (25)
	F	0.00 (63)	0.00 (36)	1.47 (68)	2.00 (100)	10.20 (49)	44.74 (76)	0.00 (34)	18.18 (22)	17.65 (17)	0.00 (17)	25.00 (8)	70.00 (20)
Punta Macao	**M**	0.00 (2)	0.00 (2)	0.00 (6)	0.00 (18)	12.50 (8)	60.00 (10)	0.00 (18)	25.00 (12)	42.86 (7)	83.33 (6)	40.00 (5)	100.00 (3)
	F	0.00 (12)	0.00 (8)	0.00 (11)	0.00 (14)	0.00 (11)	27.78 (18)	-	-	-	5.56 (18)	10.00 (10)	66.67 (9)
Chorro de Maíta	**M**	0.00 (55)	0.00 (35)	8.00 (50)	0.00 (110)	7.14 (70)	21.90 (105)	21.43 (28)	26.32 (19)	57.14 (28)	17.31 (52)	33.33 (36)	76.00 (50)
	F	0.00 (92)	0.00 (61)	11.69 (77)	14.63 (41)	26.67 (30)	58.06 (31)	0.00 (13)	0.00 (10)	61.54 (13)	65.38 (26)	70.59 (17)	90.91 (22)
Manzanilla	**M**	0.00 (13)	0.00 (9)	0.00 (14)	0.00 (19)	0.00 (13)	10.00 (20)	-	0.00 (1)	0.00 (3)	46.15 (13)	71.43 (7)	58.33 (12)
	F	0.00 (8)	0.00 (8)	0.00 (9)	-	-	-	-	-	-	35.29 (17)	36.36 (11)	78.57 (14)
Tutu	**M**	-	-	-	-	-	-	0.00 (21)	0.00 (23)	33.33 (24)	18.52 (27)	0.00 (21)	37.50 (32)
	F	0.00 (19)	0.00 (15)	0.00 (22)	-	-	-	0.00 (19)	0.00 (18)	38.89 (18)	11.86 (59)	17.78 (45)	59.38 (64)

Table 6.39 AMTL rates by site, sex, age group, and tooth category. The number of observed tooth positions is indicated between brackets.

Due to the lack (or poor preservation) of alveolar bone, Juan Dolio and Malmok were omitted from the analyses. AMTL rates for males and females per age group and tooth category can be found in Table 6.39. Because both sex and age-at-death estimations are not available for all adults, the numbers of individuals representing the different sex and age categories at each site are further reduced, complicating comparisons between the different sites.

Anse à la Gourde – A significant difference was observed between the rate of AMTL in males (11.35%) and females (16.91%) using a chi-square test. Female dentitions were found to be more frequently affected by AMTL than male dentitions ($\chi^2(1, N= 1082)= 6.62, p= 0.01$). Although a greater proportion of males was found to be affected by AMTL, no significant difference was found in the proportion of affected males or females ($\chi^2(1, N=58)= 0.17$ $p= 0.79$). As can be seen in Table 6.39, AMTL rates in females are distinctly higher overall for all age categories and tooth classes, excepting the 18–25 years age group. AMTL rates of premolars and molars, particularly in the 26–35, 36–45, and 46+ years age groups are clearly higher in females than in males.

Chorro de Maíta – The rate of AMTL in males (18.04%) and females is (18.42%) close to equal. A chi-square test confirms that there is no significant difference ($\chi^2(1, N= 1235)= 0.03, p= 0.88$). No significant difference was found in the proportion of males or females affected ($\chi^2(1, N= 52)= 0.79, p= 0.56$). However, the data presented in Table 6.39 show that in all age groups except 36–45 years, females have substantially higher AMTL rates than males in all tooth classes. In the 36–45 years age group, females have a higher AMTL rate in molars, but males have much higher rates for incisors and canines and premolars. Overall, the pattern shown in Table 6.39 suggests females at Chorro de Maíta suffered more frequently from AMTL than males.

Escape – Results are derived from only a small number of individuals, in part due to the very poor condition of the material, which prevented assessment of the alveolar bone. The available data imply that there is no difference between the frequency (tooth count) of AMTL in males and females.

Lavoutte – There is a slight difference in the rate of AMTL between males (8.72%) and females (5.52%), with males more frequently affected than females. A chi-square test shows this difference is not statistically significant ($\chi^2(1, N= 381)= 1.40, p= 0.32$). No significant difference was found in the proportion of males or females affected ($\chi^2(1, N= 21)= 1.53, p= 0.36$). Based on the data presented in Table 6.39, there is no clear difference between males and females. Since the youngest age group (18–25 years) is represented only by females, this age group could not be assessed for sex-based differences. In the young middle adult age group, males show higher rates for all tooth classes than females. In the oldest two age groups, females have higher AMTL rates in molars, but lower rates in premolars than males.

Maisabel – There is a slight difference in the AMTL rates between males (3.80%) and females (5.56%), with females slightly more frequently affected than males. A chi-square test shows that this difference is not statistically significant ($\chi^2(1, N= 384)= 0.58, p= 0.46$). Although females are clearly more frequently affected by AMTL than males, no significant difference was found in the proportions of affected males or females ($\chi^2(1, N= 23)= 3.64, p= 0.13$). The data in Table 6.39 suggest that the slight differences between males and females may be the result of differing age profiles of the male and female groups at Maisabel. Only the oldest age category is represented by both males and females, and the majority of males

belong to the youngest two age groups, while all females belong to the oldest two age groups.
Manzanilla – Female dentitions (31.34%) were found to have a higher AMTL rate than male dentitions (13.33%) (χ^2(1, N= 202)= 9.32, p= 0.00). No significant difference was found in the proportions of affected males and females (χ^2(1, N= 14)= 1.26 p= 0.52). Due to the lack of females aged 26–35 and 36–45 years, males and females in these age groups could not be compared (Table 6.39). In the youngest age group, no differences are seen, while in the oldest age group, females show higher rates for molars, but males show higher rates for incisors and canines and premolars. As such, the significant difference observed between males and females based on the simple tooth count method appears to be the result of differing preservation of male and female teeth at Manzanilla.
Punta Candelero – A significant difference was observed between the rates of AMTL in males (5.58%) and females (13.70%) using a chi-square test. Female dentitions were found to be more frequently affected by AMTL than male dentitions (χ^2(1, N= 613)= 11.94, p= 0.00). No significant difference was found in the proportion of males or females affected (χ^2(1, N= 31)= 0.22 p= 0.72). On examination of the data presented in Table 6.39, it is clear that females have distinctly higher AMTL rates in the 26–35 age category, but males have higher caries rates in the oldest two age groups (excepting in incisors and canines in the 46+ years category). This, however, may be the result of the fact that there are far fewer females in the older two age classes than males.
Punta Macao – Male dentitions (18.40%) appear to display a higher rate of AMTL than female dentitions (12.28%). This difference is not significant based on a chi-square test (χ^2(1, N= 239)= 1.71, p= 0.21). No significant difference was found in the proportion of males or females affected (χ^2(1, N= 12)= 0.34, p= 1.00). The difference between the sexes, although not statistically significant, is echoed in the results shown in Table 6.39. In the young middle adult and old adult age groups, males have higher AMTL rates than females.
Tutu – Although female dentitions (21.53%) were found to be more frequently affected by AMTL than male dentitions (16.56%), no significant difference was found with a chi-square test (χ^2(1, N= 439)= 1.54, p= 0.26). No significant difference was found in the proportions of males and females affected (χ^2(1, N= 20)= 0.01, p= 1.00). Using the data presented in Table 6.39, only the oldest two age groups could be compared for sex-based differences. These data appear to confirm the tendency for higher AMTL rates in females than in males.

6.4.5 Hypercementosis

Hypercementosis occurs infrequently in all assemblages included in this study. Numbers of individuals affected are low, and the number of teeth affected per in dividual is equally low (Table 6.40). No significant differences were found between

Site	Individual count (N)	Tooth count (N)
Anse à la Gourde	8	11
Canas	1	2
Canashito	0	0
Chorro de Maíta	5	6
Clarence town cave	1	2
Collores	1	5
Diale 1	1	1
El Cabo	2	14
Escape	1	2
Heywoods	2	3
Juan Dolio	0	0
Kelbey's Ridge 2	1	2
La Caleta	1	1
La Mina	1	6
Lavoutte	2	2
Maisabel	1	3
Malmok	2	8
Mamora Bay	0	0
Manigat Cave	1	5
Manzanilla	0	0
Punta Candelero	11	17
Punta Macao	4	7
Santa Cruz	1	2
Savaneta	0	0
Savanne Suazey	0	0
St. Croix (unkn. site)	1	1
St. Kitts (unkn. site)	1	2
Tocorón	1	4
Tutu	0	0

Table 6.40 The frequency of hypercementosis per site.

the sexes of individuals from difference periods of occupation at any of the sites. Of the affected teeth, most belong to the posterior dentition (68.13%). No association was found between non-alimentary use of the teeth and hypercementosis. The mean degree of wear of teeth with hypercementosis ($\overline{X} = 3.38$) is very slightly lower than the mean degree of wear for teeth without hypercementosis ($\overline{X} = 3.47$).

Figure 6.92 Punta Candalero 1 (C3), hypercementosis.

6.4.6 Juvenile pathology

Caries

For the overall juvenile population (n= 69), the caries rate is relatively high, with 4.81% (n= 46) of teeth affected, and 28.99% (n= 20) of individuals affected. Nonetheless, as is generally the case in juveniles, the tooth count and individual count proportions are smaller than in the overall adult population (see section 6.4.1). Table 6.41 shows the juvenile caries rates (tooth count and individual count) per site. At most sites juveniles do not have carious lesions, however the numbers of juvenile individuals are very small. The sites with at least four juveniles tend to show carious lesions, excepting Punta Macao, where the four juveniles present are very young. The percentage of juvenile caries at Anse à la Gourde is extremely high. For the greater part this is due to individual 377, who has an exceptionally high number

Site	N individuals	Prevalence % T.C.	Prevalence % I.C.
Anse à la Gourde	8	22.78/3.80*	37.50
Chorro de Maíta	18	6.09	50.00
Collores	1	0.00	0.00
Diale 1	2	0.00	0.00
Escape	1	0.00	0.00
Esperanza	1	0.00	0.00
Kelbey's Ridge 2	3	0.00	0.00
Lavoutte	3	0.00	0.00
Maisabel	6	1.11	16.67
Manzanilla	4	2.86	50.00
Punta Candelero	6	2.47	33.33
Punta Macao	4	0.00	0.00
Santa Cruz	2	0.00	0.00
Santa Elena	1	0.00	0.00
Savaneta	2	0.00	0.00
Savanne Suazey	1	0.00	0.00
Spring Bay 1C	1	0.00	0.00
Tutu	5	6.49	60.00
Total	69	4.81	28.99

Table 6.41 Juvenile caries frequency (tooth count and individual count) by site. * Respectively with and without individual 377. T.C.= tooth count method, I.C.= individual count method.

of caries. However, this seems to be a unique case of rampant caries (discussed in detail below). At Tutu, the caries rate is relatively high; here the caries prevalence is not driven up by a single anomalous individual. Juveniles at Chorro de Maíta also have a high caries rate, but this is most likely related to the older ages of these juveniles.

Caries Location

As in adults, caries location was recorded as smooth surface, cement-enamel junction (CEJ), occlusal, or root surface, categories which are further subdivided into a total of nine locations on the tooth. For the entire sample of juveniles, occlusal caries are most prevalent (65%). The majority of the remaining caries are located on the smooth surfaces (22.50%). Only 12.50% are located at the CEJ. With the exception of individual 377 from the site of Anse à la Gourde, discussed below, all juveniles affected by caries were over three years of age (3–11 years).

Rampant caries

One juvenile from the site of Anse à la Gourde (377) was found to have an exceptionally high number of carious teeth. This child, estimated at 2–3 years of age, counted 15 carious teeth in a total of 17 observed elements. This appears to be a case of what is known in modern clinical dentistry as Early Childhood Caries (ECC) or rampant caries. ECC is a virulent form of dental caries, which is most likely caused by an infection of Streptococcus mutans. The disease can rapidly destroy the entire deciduous dentition, usually starting with smooth-surface caries on the maxillary incisors, and progressing with smooth surface and occlusal caries of the deciduous premolars and the remaining dentition (Berkowitz 2003; Hallet and O'Rourke 2003).

Dental calculus

A total of 17 juveniles (24.64%) were found to be affected by dental calculus. The mean degree of calculus in these individual is 1.23; overall the calculus deposits are slight, except in Manzanilla individual 291 (discussed in section 6.4.3 for his/her

Site	Affected juveniles (n)
Chorro de Maíta	3
Collores	1
Kelbey's Ridge 2	1
Lavoutte	1
Maisabel	2
Manzanilla	4
Punta Candelero	4
Punta Macao	1

Table 6.42 Juveniles affected by calculus per site.

unusual calculus deposits). No individuals under the ages of 2–4 years were found to have calculus accumulation (Table 6.42).

Periapical abscesses
One abscess was observed in a juvenile (4–5 years) individual (102) from Chorro de Maíta, at the location of element 7.5.

AMTL
Three (4.35%) of the juveniles in the entire sample had lost at least one tooth ante mortem. All three belong to the assemblage of Chorro de Maíta, of which two are close to adolescence. The high rate of juvenile AMTL at Chorro de Maíta (1.79%) is remarkable, and could be associated with the high caries rate in juveniles at the site (Table 6.43).

Chorro de Maíta	Age	Element(s)
41	12–13	4.3
80	14–16	3.6, 4.6
84	3–5	6.1, 6.2

Table 6.43 Juvenile AMTL.

Hypercementosis
No teeth with evidence of hypercementosis were observed in any of the 69 juvenile individuals in the sample.

6.5 Dental defects

6.5.1 Enamel hypoplasia
Enamel hypoplasia in various forms were observed moderately frequently in the entire assemblage (Table 6.44). However, this dental defect was only scored when numerous elements belonging to one individual are affected by the disorder (in the case of pit type hypoplasia), and when at least one tooth crown is affected around the entire or most of the circumference (in the case of linear enamel hypoplasia). Relatively few individuals in the entire sample presented with such patterns of hypoplasia 8.52% (n= 39). In total, 2.10% of teeth are affected by hypoplasia. A total of 7.43% of females is affected (n= 11), and a total of 9.80% of males (n= 15). The majority of observed hypoplasia are linear (75.74%), with a small proportion of pit type hypoplasia (24.26%). Linear enamel hypoplasia (LEH) are more frequently associated with a period of physiological stress, whereas pit type hypoplasia may reflect local-

Figure 6.93 Punta Candelero 4 (B3), linear enamel hypoplasia of the upper left second molar.

ized trauma (Goodman and Rose 1991). Depending on the location of the enamel defect in the dentition and on the tooth crown(s), the age at which the defect occurred can be estimated. The dental elements most frequently affected by LEH are the upper canines. This is followed by the incisors (both central and lateral). A large number of premolar and molars (including third molars) are also affected by LEH. This indicates bouts of physiological stress leading to growth arrest in tooth crown formation were not isolated to the younger years of childhood. The upper canine crowns are generally formed between the ages of six months and six years. The initial bud formation of the third molars starts around nine to ten years of age, with the crowns generally fully formed by the age of fourteen (Langsjoen 1998). Those individuals who are affected by LEH of the second or third molars (Chorro de Maíta 22; Maisabel 14, 18, and 19A; Mamora Bay 1; Punta Candelero 4 (B3), and 32; St. Kitts 511) also show hypoplastic defects of most other elements in the dentition, indicating a long history of physiological stress.

Figure 6.94 Maisabel 14, linear enamel hypoplasia (two separate bands) of the lower right central incisor.

Site	Tooth count %	N	Individual count %	N
Anse à la Gourde	1.08	11	10.14	7
Canashito	0.00	0	0.00	0
Chorro de Maíta	1.83	22	8.22	6
Diale 1	0.00	0	0.00	0
Escape	0.00	0	0.00	0
Juan Dolio	0.00	0	0.00	0
Kelbey's Ridge 2	4.21	4	16.67	1
Maisabel	11.02	54	28.13	9
Malmok	0.00	0	0.00	0
Mamora Bay	1.33	1	25.00	1
Manzanilla	8.49	23	22.22	4
Lavoutte	0.44	2	3.33	1
Punta Candelero	1.76	14	9.09	5
Punta Macao	0.00	0	0.00	0
Point de Caille	0.00	0	0.00	0
Santa Cruz	0.00	0	0.00	0
Savaneta	0.00	0	0.00	0
Savanne Suazey	0.00	0	0.00	0
Tocorón	5.88	2	16.67	1
Tutu	11.00	23	19.23	5

Table 6.44 The frequency of enamel hypoplasia per site.

Chronological comparisons

Maisabel – No significant difference was observed in the prevalence of hypoplasia between the Early group (14.20%) and the Late group (11.69%) ($\chi^2(1, N= 400)= 1.67, p= 0.20$). On examination of the individual count, there appears to be an increase in the numbers of affected individuals in the Late period (n= 6) as opposed to the Early period (n= 2), however this difference is not statistically significant ($\chi^2(1, N= 26)= 1.42, p= 0.40$).

Punta Candelero – Chronological comparisons could not be made for Punta Candelero, since only one individual with enamel hypoplasia could securely be assigned to a period of occupation.

Tutu – No significant difference was observed in the number of teeth affected by enamel hypoplasia between the early phase (1.57%) and the late phase (3.13%) ($\chi^2(1, N= 319)= 0.75, p= 0.49$). No differences were found in the number of affected individuals in the early phase (n= 1) as opposed to the late phase (n= 2) ($\chi^2(1, N= 21)= 0.13, p= 1.00$).

Sex-based comparisons

Of the total sample, 7.19% of males (n= 11) and 10.81% of females (n= 16) are affected by hypoplasia. The slight difference in prevalence is not statistically significant, as demonstrated by a chi-square test ($\chi^2(1, N= 301)= 1.21, p= 0.32$). With regards to the frequency of affected teeth (tooth count) in males (2.55%) and females (2.38%), no statistically significant difference was found ($\chi^2(1, N= 4752)= 0.13, p= 0.78$). Numbers at the individual sites are too small for sex-based comparisons.

Juvenile enamel hypoplasia

A total of seven juveniles (10.14%) of the total juvenile sample were found to be affected by enamel hypoplasia. This includes 3 juveniles from Chorro de Maíta, one from Kelbey's Ridge 2, one from Maisabel, and two from Manzanilla. In all cases, the hypoplasia affect the incisors and premolars of the permanent dentition. No molars or deciduous teeth are affected. Both linear (47.62%) and pit (52.38%) hypoplasia were observed.

6.5.2 Discolouration and Opacities

A total of 36 individuals were found to have at least one tooth (but often more) affected by some form of discolouration (Table 6.45). No difference between the number of males and females affected was observed. A large proportion of those affected (40%) is juvenile.

Figure 6.95 Maisabel 27, symmetrical red-brown staining of the labial surfaces of the deciduous upper central incisors.

Most individuals have red-brown or orange-brown staining on the buccal surfaces of almost all teeth or just the anterior teeth (n= 21). Occlusal, interproximal or lingual surfaces are generally not affected by this type of discolouration. There is some evidence that the staining occurred ante or peri mortem, as the stained area on the crown surface appears to follow the contours of where the gingiva would have been (i.e., it does not reach the cement-enamel junction or the root surface), how

Site	Individual	Sex / age	Discolouration
Anse à la Gourde	219	Child	Staining
Anse à la Gourde	238B	Female	Staining
Anse à la Gourde	349A	Male	Fluorosis
Anse à la Gourde	1126A	Female	Fluorosis
Chorro de Maíta	7A	Child	Staining
Chorro de Maíta	10	Child	Staining
Chorro de Maíta	16A	Male	Staining
Collores	162	Child	Staining
Diale 1	157	Male	Fluorosis
Escape	2	Female	Fluorosis
Escape	23A	Unknown	Residue
Kelbey's Ridge 2	132	Female	Residue
Kelbey's Ridge 2	166	Child	Residue
Kelbey's Ridge 2	313	Child	Staining
Lavoutte	B2	Male	Residue
Lavoutte	57-03	Child	Fluorosis
Lavoutte	67-05	Female	Staining
Lavoutte	67-12	Female	Staining
Lavoutte	67-18	Indet.	Residue
Lavoutte	67-19	Indet.	Residue
Lavoutte	68-11	Female	Fluorosis
Maisabel	1	Indet.	Staining
Maisabel	3	Child	Staining
Maisabel	9	Male	Staining
Maisabel	11	Male	Staining
Maisabel	15	Male	Fluorosis
Maisabel	19A	Female	Staining
Maisabel	24	Child	Staining
Maisabel	27	Child	Staining
Monserrate	163	Male	Staining
Punta Candelero	1 (N5)	Child	Staining
Punta Macao	6.2	Child	Staining
Spring Bay 1c	1	Child	Staining
Santa Cruz	1	Unknown	Residue
Santa Elena	2	Child	Staining
St. Kitts	511	Unknown	Fluorosis

Table 6.45 Discolouration per site and type.

ever it is not clear whether the staining was caused by intrinsic or extrinsic factors (Figure 6.95). A further 8 individuals showed signs of dental fluorosis, in the form of white and/or grey opaqueness of the enamel and white, grey, or yellow-brown mottling (Figure 6.96).

The discolouration in the final 7 individuals was caused by a layer of black or brown-black residue on the teeth (Figure 6.97). The residue resembles a tar or bitumen-like substance, and is generally deposited on only a small number of adjacent teeth. Conclusive identification of the black substance awaits further analysis.

Figure 6.96 Maisabel 9, grey-brown mottling of the occlusal surface of the upper left second molar; most likely dental fluorosis.

6.6 Chronological comparisons

The broad chronological comparisons between the Early Ceramic Age and the Late Ceramic Age are based on categorization of individual site assemblages and periods of occupation at individual sites as discussed in Chapter 5 (section 5.4). The Early Ceramic Age group comprises 79 adult individuals (female= 23, male= 21); the Late Ceramic Age group consists of 258 adults (female= 113, male= 114). The adult age distributions for the two groups are somewhat different (Appendix B). The adult age categories in the Early Ceramic Age are almost equally represented, however in the Late Ceramic Age young adults and young middle adults are slightly more common than old middle adults and mature adults.

Figure 6.97 Lavoutte 67-19, black residue on the buccal surface of the upper right third premolar; not to be confused with adhering soil (light brown).

The chronological comparisons between the Early Ceramic Age and the Late Ceramic Age in the Lesser and Southern Antilles are also based on the categorization discussed in Chapter 5 (section 5.4). The Early Ceramic Age group comprises 40 adult individuals (female= 8, male= 10); the Late Ceramic Age group consists of 147 adults (female= 57, male= 48). The adult age distributions for the two groups are similar (Appendix B).

6.6.1 Early Ceramic Age versus Late Ceramic Age

Dental wear

Rate of wear

A total of 148 adjacent first and second mandibular molars (n= 296) was selected to assess potential differences in the rate of occlusal surface wear between the Early Ceramic Age group and the Late Ceramic Age group using principle axis analysis.

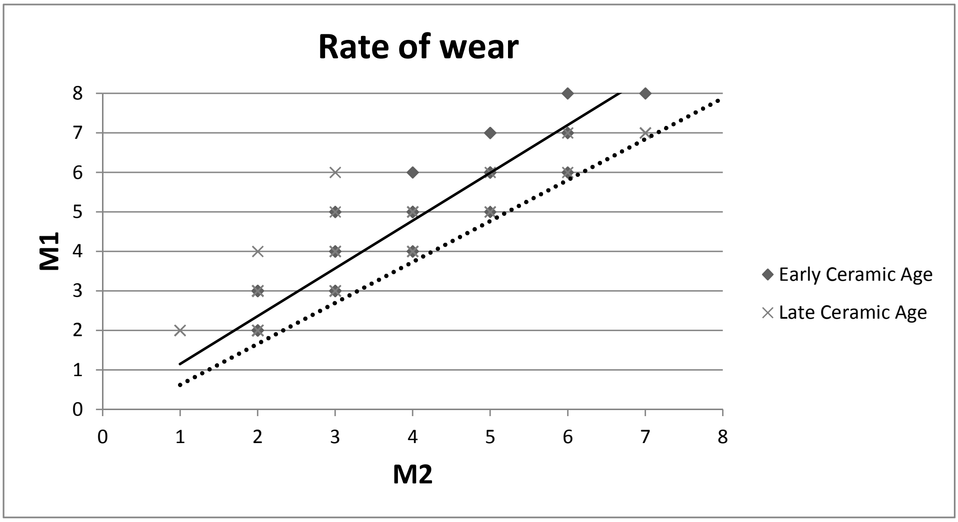

Figure 6.98 Scatterplot of M1–M2 wear scores by period, shown with principle axes. Note differences in slope steepness.

The equations of principal axes were calculated for adjacent first and second left mandibular molars. To compare wear rates, the principle axis equation was determined by plotting the wear score of M1 on the Y1 (X) axis, and M2 on the Y2 (Y) axis (Sokal and Rohlf 1981:594–601). A steep principle axis slope (b) indicates a rapid rate of wear, whereas a gentle principle axis slope indicates a slow rate of wear. Since this method avoids the effects of age on the degree of dental wear, significant differences between the rate of wear (the principle axis slopes) of different sites can be taken to indicate differences in food consistency or food preparation techniques. Rapid rates of wear are usually associated with tough, abrasive diets (often hunter-gatherer or hunter-fisher diets). Slower rates of wear are more often associated with refined, less abrasive diets (processed agricultural produce) (Smith 1982, 1984; Larsen 1997; Lukacs 1996; Sciulli 1997; Kieser et al. 2001; Fujita and Ogura 2009).

Period	b	Principle Axis Equation	CL (95%)
Early Ceramic Age	1.210	0.063 + 1.210Y	0.936 < b < 1.586
Late Ceramic Age	1.037	0.418 + 1.037Y	0.753 < b < 1.434

Table 6.46 Principle axis slope (b), equation, and 95% confidence limits: Early and Late Ceramic Age.

Principle axis analysis was performed using those adults in the Early and Late Ceramic Age groups with observed adjacent first and second left mandibular molars. The slopes, equation and confidence limits of the principle axis analyses can be found in Table 6.46. As can be seen in this table, the gradients of the slopes of the two periods differ, reflecting differences in the rate of wear at each site. This suggests that food consistency and/or food preparation techniques differed per pe-

riod. In the Early Ceramic Age, the rate of wear (slope (b)= 1.210) was more rapid than in the Late Ceramic Age (slope (b)= 1.037).
As discussed by Scott (1979a), who compared the results of both the Scott (1979b) and Molnar (1971) dental wear scoring methods when used in principle axis analysis, the use of the 8 category Molnar method may lead to (greater) overlap in the confidence limits for the different groups in the comparison (see also Chapter 4 section 4.2.2). The results in Table 6.46 show that the slopes (b) for the Early and Late Ceramic Age groups do indeed fall within the confidence limits for both groups. However, both the slopes (b) and confidence limits for the Early Ceramic Age group are higher than those for the Late Ceramic Age group. As such, principle axis analysis using the Molnar (1971) dental wear scoring system has revealed differences in rate of wear in the two groups; these differences are visualized in Figure 6.98. This figure shows the principle axis slopes for both groups, together with the plotted wear scores of adjacent first and second molars (M2 on the x-axis, and corresponding M1 on the y-axis), and thus visually displays the differences in rate of wear in both periods. Note in particular the differences in slope steepness, which indicate variation in rate of wear.
These results suggest that food consistency and food preparation techniques in the Early Ceramic Age were more abrasive to the dentition than those of the Late Ceramic Age.

Direction of wear
In both groups, the most frequently observed direction of molar wear – with the exception of the natural form – is horizontal. In the Early Ceramic Age group 78.53% is worn horizontally. In the Late Ceramic Age groups 57.99% is worn horizontally. The proportion of obliquely worn molars is greater in the Late Ceramic Age group (37.90%) than the Early Ceramic Age group (19.77%).

Occlusal surface shape
In both groups, the most frequently observed occlusal surface shape – with the exception of the natural form – is flat, followed by cupped. In the Early Ceramic Age group flat wear is very slightly more prevalent than in the Late Ceramic Age group (57.99% and 52.63%, respectively). In the Late Ceramic Age group cupped wear is very slightly more prevalent than in the Early Ceramic Age group (33.54% and 38.60%, respectively).

Dental chipping
The frequency of dental chipping (tooth count) is lower in the Early Ceramic Age group (9.55%, n= 114) than in the Late Ceramic Age group (17.94%, n= 634). The difference is statistically significant as demonstrated by a chi-square test (χ^2(1, N= 4728)= 47.20, p= 0.00). The frequency of individuals affected by dental chipping (individual count) is similar for both groups: 60.76% in the Early Ceramic Age group (n= 48) and 58.91% in the Late Ceramic Age group (n= 152). A chi-square

test confirms there is no significant difference ($\chi^2(1, N= 337)= 0.09, p= 0.80$).

In both groups, chipping is most frequently found in the occlusal interproximal surfaces followed by the occlusal buccal surface. No differences were apparent between the groups with regards to the frequency of maxillary or mandibular chipping.

In the Early Ceramic Age group, the posterior dentition (38.62%) is more frequently affected by chipping than the anterior dentition (15.81%). This difference is statistically significant ($\chi^2(1, N= 1168)= 66.70, p= 0.00$). In the Late Ceramic Age group, the posterior dentition (41.42%) is also significantly more frequently affected by chipping than the anterior dentition (25.58%) ($\chi^2(1, N= 3449)= 93.23, p= 0.00$), although the difference between the anterior and posterior teeth is smaller.

A comparison of the overall frequencies of both anterior and posterior chipping of the Early Ceramic Age group and the Late Ceramic Age groups, shows a significant difference between the two, with the latter group far more frequently affected and with a greater proportion of anterior chipping than the early group ($\chi^2(2, N= 4617)= 155.59, p= 0.00$).

LSAMAT

The proportion of individuals affected by LSAMAT in both groups is almost equal. Of the Early Ceramic Age group 49.37% of the individuals (n= 39) is affected by LSAMAT. Of the Late Ceramic Age group 49.22% (n= 127) is affected by LSAMAT. A chi-square test confirms that there is no statistically significant difference between the caries rates in the Early and Late Ceramic Ages ($\chi^2(1, N= 337)= 0.00, p= 1.00$).

All individuals found to have Type 1 LSAMAT belong to the Late Ceramic Age group. Type 2 LSAMAT was observed in both groups.

Non-alimentary tooth use: teeth as tools

Of the individuals showing non-alimentary dental wear who could be assigned to one of the two groups (n= 57), 19.30% belong to the Early Ceramic Age group (n= 11), and 80.70% belong to the Late Ceramic Age group (n= 46). This difference appears large, however, of the total number of individuals in the Early Ceramic Age group, only 13.92% displayed non-alimentary dental wear. Of the total number of individuals in the Late Ceramic Age group, 17.83% showed non-alimentary wear. While the proportion of individuals affected by non-alimentary dental wear is still slightly larger in the Late Ceramic Age, a chi-square test revealed no significant difference in proportion of individuals affected by non-alimentary dental wear between the two periods ($\chi^2(1, N= 337)= 0.66, p= 0.50$).

Dental Pathology

Caries

In the Early Ceramic Age group, 78 carious lesions were recorded in the adult population, amounting to 6.53% of the total number of observed permanent teeth (n= 1,194). Of all adults, 34 individuals with at least one carious lesion were observed, amounting to 43.04% of the entire adult population (n= 79). Males (7.13%) in the Early Ceramic Age groups are less frequently affected by caries than females (9.23%), however, the difference is not statistically significant ($\chi^2(1, N=800)= 1.19, p= 0.30$).

In the Late Ceramic Age group, 524 carious lesions were recorded in the adult population, amounting to 14.83% of the total number of observed permanent teeth (n= 3,534). Of all adults, 183 individuals with at least one carious lesion were observed, amounting to 70.93% of the entire adult population (n= 258). Males (13.03%) in the Late Ceramic Age groups are less frequently affected by caries than females (13.64%), however, the difference is very slight and is not statistically significant ($\chi^2(1, N=3,302)= 0.26, p= 0.61$).

One aim of this study is to assess differences in caries rates between the two main Ceramic Age periods, to investigate potential differences in foodways. A preliminary investigation of caries rates based on simple tooth count and individual count methods was performed, in order to gain an insight into the potential differences between the two. The rate of caries based on the tooth count method in the Late Ceramic Age appears to be distinctly higher than that of the Early Ceramic Age. The statistical significance of this difference was tested using a chi-square test. This test determined a significant difference between the Early and Late Ceramic Age ($\chi^2(1, N=4,728)= 55.26, p= 0.00$). The frequency of individuals affected

ECA		**MALE**		**FEMALE**		**TOTAL**	
Age	Tooth category	N	% Carious	N	% Carious	N	% Carious
18–25	Incisors & Canines	36	0.00	30	0.00	66	0.00
	Premolars	62	4.84 (3)	20	15.00 (3)	82	7.32
	Molars	38	5.13 (2)	22	13.64 (3)	60	8.33
26–35	Incisors & Canines	59	5.08 (3)	13	0.00	72	4.17
	Premolars	46	0.00	25	0.04 (1)	71	1.41
	Molars	57	5.26 (3)	33	6.06 (2)	90	5.56
36–45	Incisors & Canines	41	2.44 (1)	40	2.50 (1)	81	2.47
	Premolars	33	15.15 (5)	27	14.81 (4)	60	15.00
	Molars	22	22.73 (5)	28	7.14 (2)	50	14.00
46+	Incisors & Canines	21	0.00	47	2.13 (1)	68	1.47
	Premolars	12	16.67 (2)	29	13.79 (4)	41	14.63
	Molars	19	36.84 (7)	32	28.13 (9)	51	31.37

Table 6.47 Early Ceramic Age caries rates by sex/age, and tooth category. Numbers of observed caries are given between brackets.

by caries also differs significantly, with the Late Ceramic Age group far more frequently affected than the Early Ceramic Age group ($\chi^2(1, N=337)= 20.52, p= 0.00$). The preliminary assessments above indicate possible differences in foodways between the two periods. However, as discussed in Chapter 4 (section 4.2.3), when comparing caries rates between groups, the effects of age, differential preservation of individual dental elements, and differential susceptibility of individual dental elements to carious lesions must be taken into account (Hillson 2001, 2008b; Wasterlain et al. 2009). The differences demonstrated above using the simple tooth count and individual count methods could (at least in part) result from differing age profiles and differentially preserved/affected dental elements. These potential sources of variation must be controlled for in order to assess foodways based on caries prevalence. Table 6.47 and Table 6.49 present the caries rates by age group (18–25, 26–35, 36–45, and 46+), by sex, and by tooth category (incisors and canines, premolars, and molars), for the Early Ceramic Age and the Late Ceramic Age, respectively.

As can be seen in Table 6.47, in males, the frequency of caries clearly increases with age, particularly in the molars and premolars. In females, the increase in caries rates with age is also clear, although the young middle adult (26–35 years) group shows slightly lower rates than the young adult (18–25 years). This may be related to the much higher rate of AMTL in females in this age group (Table 6.51) (Wasterlain et al. 2009).

The fact that the frequency of carious lesions is associated with age is similarly reflected in Table 6.48, which shows an increase in caries frequency per age category. This table combines all teeth for males and females. Interestingly, the frequency of caries drops slightly in the age group 26–35 years, but this is most likely the result of the small number of individuals in the sample and the fact that one female individual (Burial 4, Tutu) in age group 18–25 years has a relatively large number of carious lesions (4 cavities), thus inflating the frequency for this age group.

Caries rate %	18–25	26–35	36–45	46+
Male	3.06	3.70	11.46	17.31
Female	8.33	3.70	7.37	12.96
Total	5.29	3.70	9.42	14.38

Table 6.48 Early Ceramic Age caries rates by sex/age.

Overall, in both males and females, the molars are more frequently affected by caries than the premolars and incisors and canines. Premolars also tend to be more frequently affected than incisors and canines, although this is less apparent for the younger middle adult age group (26–35 years). These differences reflect differential susceptibility of the different tooth classes to carious lesions (Hillson 1996, 2001; Wasterlain et al. 2009).

In the youngest age group (18–25 years), females have higher caries rates than males for premolars and molars. In the young middle age group (26–35 years), females show very slightly higher rate for molars and premolars than males, but not for incisors and canines. In the middle adult age group (36–45 years), males have higher caries frequency rates in premolars and molars than females, while the rates for incisors and canines are similar. In the old adult age group (46+ years) males again show very slightly higher rates than females for premolars and molars, but not for incisors and canines. In this oldest age group females have distinctly higher AMTL rates (Table 6.51), which may be related to the lower caries rates observed in this group. Although using the tooth count method a slight (non-significant) differences was observed between male and female caries rates in the Early Ceramic Age, the assessment of caries rates by age and tooth class reveals no clear differences between the sexes.

LCA		MALE		FEMALE		TOTAL	
Age	**Tooth category**	**N**	**% Carious**	**N**	**% Carious**	**N**	**% Carious**
	Incisors & Canines	115	2.61 (3)	200	1.00 (2)	315	1.59
	Premolars	85	4.71 (4)	143	6.99 (10)	228	6.14
18–25	Molars	110	22.73 (25)	213	17.84 (38)	323	19.50
	Incisors & Canines	291	0.34 (1)	177	9.04 (16)	468	3.63
	Premolars	192	15.10 (29)	102	31.37 (32)	294	20.75
26–35	Molars	235	20.85 (49)	90	25.56 (23)	325	22.15
	Incisors & Canines	114	2.63 (3)	91	13.19 (12)	205	7.32
	Premolars	83	13.25 (11)	55	23.64 (13)	138	17.39
36–45	Molars	79	18.99 (15)	48	21.08 (5)	127	15.75
	Incisors & Canines	126	3.17 (4)	104	11.54 (12)	230	6.96
	Premolars	76	14.47 (11)	66	16.67 (11)	142	15.49
46+	Molars	72	23.61 (17)	43	32.56 (14)	115	26.96

Table 6.49 displays caries rates of the Late Ceramic Age group by sex and age group

Table 6.49 Late Ceramic Age caries rates by sex/age, and tooth category. Numbers of observed caries are given between brackets.

and tooth class. As can be seen in this table, the frequency of caries increases with age, particularly in the premolars. In both sexes, the increase in caries rates with age is most clear in the young and young middle adult age groups (18–25 and 26–35 years). In the oldest two age groups, the increase in caries is less prominent, and in some tooth classes a slight decrease is seen in comparison to the 26–35 years group. The latter could be related to increasing AMTL rates in these age groups (Table 6.52), which in part would have been caused by caries (Wasterlain et al. 2009).

The fact that the frequency of carious lesions is associated with age is similarly reflected in Table 6.50, which shows an increase in caries frequency per age category.

Caries rate %	18–25	26–35	36–45	46+
Male	10.32	11.00	10.51	11.68
Female	8.99	19.24	15.46	17.37
Total	9.47	13.80	12.55	14.17

Table 6.50 Late Ceramic Age caries rates by sex/age.

This table combines all teeth for males and females. Interestingly, the frequency of caries drops slightly in the age group 36–45 years, but this could be related to the rising AMTL rates with age (Table 6.52).

In general, in both males and females, the molars are more frequently affected by caries than the premolars and incisors and canines, although with age the frequencies of carious premolars increase and (in females) sometimes outweigh the molar frequencies. The latter is likely correlated with the increase in AMTL in molars in the older age categories (Table 6.49). Premolars are also more frequently affected than incisors and canines. These differences again reflect differential susceptibility of the different tooth classes to carious lesions (Hillson 1996, 2001; Wasterlain et al. 2009).

In the youngest age group (18–25 years), males have higher caries rates than females for incisors and canines and molars. In the oldest three age groups, females show very clearly higher caries rates than males in all tooth classes. Females also show distinctly higher AMTL rates overall. Despite the fact that using the tooth count method no differences were observed between males and females, the assessment of caries rates by age and tooth class, while taking into account the relation between caries and AMTL, indicates that foodways differed between males and females in the Late Ceramic Age.

Comparison of caries rates between the Early and Late Ceramic Age groups based on the data presented in Tables 6.47 and 6.49 reveals distinct differences. In general, caries rates in the Late Ceramic Age group are much higher for all age groups and tooth classes. The Late Ceramic Age group shows distinctly higher caries rates in incisors and canines and premolars, for all age groups. For example, in the youngest age group (18–25 years), no caries were observed in incisors and canines of the Early Ceramic Age group, although low caries rates were observed for this age category of the Late Ceramic Age. High rates of caries in incisors and canines are commonly associated with populations consuming very large proportions of cariogenic foods, consisting of soft, sticky carbohydrates. In populations with low carbohydrate intake, the first molars are affected most by caries, and in populations with slightly higher carbohydrate intake caries are seen more frequently on the second and third molars. With increasing caries rates, the premolars are also affected (Hillson 2001, 2008b). The distinctly higher rates of caries, in particular in the incisors and canines and premolars, of the Late Ceramic Age group, suggest that foodways differed between the two periods. A far greater proportion of cariogenic foods, possibly combined with more refined processing techniques, would have been consumed in the later period.

AMTL

In the Early Ceramic Age group, 108 ante mortem lost teeth were recorded in the adult population, amounting to 7.68% of the total number of observed tooth positions (n= 1,406). Of all adults, 24 individuals with at least ante mortem lost tooth were observed, amounting to 30.38% of the entire adult population (n= 79). Males (7.41%) in the Early Ceramic Age groups are statistically significantly less frequently affected by AMTL than females (12.91%) ($\chi^2(1, N=943)= 7.87, p= 0.01$). In the Late Ceramic Age group, 616 ante mortem lost teeth were recorded in the adult population, amounting to 12.84% of the total number of observed tooth positions (n= 4,798). Of all adults, 121 individuals with at least one ante mortem lost tooth were observed, amounting to 46.90% of the entire adult population (n= 258). Males (12.76%) in the Late Ceramic Age groups are less frequently affected by AMTL than females (14.76%), however, the difference is just shy of statistical significance ($\chi^2(1, N=4,394)= 3.70, p= 0.06$).

One aim of this study is to assess differences in AMTL rates between the two main Ceramic Age periods. A preliminary investigation of AMTL rates based on simple tooth count and individual count methods was performed, in order to gain an insight into the potential differences. The rate of AMTL based on the tooth count method in the Late Ceramic Age appears to be distinctly higher than that of the Early Ceramic Age. The statistical significance of this difference was tested using a chi-square test. This test determined a significant difference between the Early and Late Ceramic Age ($\chi^2(1, N=6,204)= 28.06, p= 0.00$). The frequency of individuals affected by AMTL also differs significantly, with the Late Ceramic Age group far more frequently affected than the Early Ceramic Age group ($\chi^2(1, N=337)= 6.73, p= 0.01$).

ECA		MALE		FEMALE		TOTAL	
Age	**Tooth category**	**N**	**% AMTL**	**N**	**% AMTL**	**N**	**% AMTL**
18–25	Incisors & Canines	46	2.17 (1)	31	0.00 (0)	77	1.30 (1)
	Premolars	22	0.00 (0)	19	0.00 (0)	31	0.00 (0)
	Molars	44	13.64 (6)	28	0.00 (0)	72	8.33 (6)
26–35	Incisors & Canines	64	0.00 (0)	30	23.33 (7)	94	7.45 (7)
	Premolars	49	0.00 (0)	30	13.33 (4)	79	5.06 (4)
	Molars	62	1.61 (1)	41	14.63 (6)	103	6.80 (7)
36–45	Incisors & Canines	45	2.22 (1)	42	0.00 (0)	97	1.03 (1)
	Premolars	35	2.86 (1)	28	3.57 (1)	63	3.17 (2)
	Molars	37	40.54 (15)	38	13.16 (5)	75	26.67 (20)
46+	Incisors & Canines	28	3.57 (1)	55	12.73 (7)	83	9.64 (8)
	Premolars	17	17.65 (3)	38	21.05 (8)	55	20.00 (11)
	Molars	27	25.93 (7)	53	39.62 (21)	80	35.00 (28)

Table 6.51 Early Ceramic Age AMTL rates by sex/age, and tooth category. Numbers of observed ante mortem lost teeth are given between brackets.

As can be seen in Table 6.51, the frequency of AMTL is generally higher in the older age categories, showing its relation with age. In females, the increase in caries rates with age is also clear, although the young middle adult (26–35 years) group shows somewhat higher rates than the young adults and old middle adults (18–25 and 36–45 years).
A significant difference between AMTL rate in males and females was found in the Early Ceramic Age group using the tooth count method. Examination of the data presented in Table 6.51 indicates that overall, females in all age groups (excepting the youngest) tend to have higher AMTL rates. The difference is particularly apparent in the oldest age group.
The rate of AMTL is clearly associated with age, as much higher rates are seen in the older age categories than the younger age groups (Table 6.52). Although the difference in AMTL rates between males and females in the Late Ceramic Age based on the tooth count method was found to be just shy of statistical significance, examination of the data presented in Table 6.52 indicates that overall, females in all age groups tend to have higher AMTL rates.

LCA		MALE		FEMALE		TOTAL	
Age	**Tooth category**	**N**	**% AMTL**	**N**	**% AMTL**	**N**	**% AMTL**
18–25	Incisors & Canines	112	0.00 (0)	232	0.00 (0)	344	0.00 (0)
	Premolars	94	0.00 (0)	166	1.20 (2)	260	0.77 (2)
	Molars	135	4.44 (6)	240	5.00 (12)	375	4.80 (18)
26–35	Incisors & Canines	341	0.29 (1)	207	3.86 (8)	548	1.64 (9)
	Premolars	218	6.88 (15)	131	12.98 (17)	349	9.17 (32)
	Molars	302	16.89 (51)	172	38.95 (67)	474	24.89 (118)
36–45	Incisors & Canines	139	4.32 (6)	98	0.00 (0)	237	2.53 (6)
	Premolars	101	10.89 (11)	64	9.38 (6)	165	10.30 (17)
	Molars	127	30.71 (39)	81	34.57 (38)	208	37.02 (77)
46+	Incisors & Canines	176	14.20 (25)	154	16.23 (25)	330	15.15 (50)
	Premolars	115	18.26 (21)	100	25.00 (25)	215	21.40 (46)
	Molars	157	50.32 (79)	130	60.00 (78)	287	54.70 (157)

Table 6.52 Late Ceramic Age AMTL rates by sex/age, and tooth category. Numbers of observed ante mortem lost teeth are given between brackets.

Comparison of AMTL rates between the Early and Late Ceramic Age groups based on the data presented in Tables 6.51 and 6.52 reveals distinct differences. In general, AMTL rates in the Late Ceramic Age group are much higher for all age groups and tooth classes.
The rate of AMTL is clearly associated with age, as much higher rates are seen in the older age categories than the younger age groups (Table 6.52). Although the difference in AMTL rates between males and females in the Late Ceramic Age based on the tooth count method was found to be just shy of statistical significance, examination of the data presented in Table 6.52 indicates that overall, fe-

males in all age groups tend to have higher AMTL rates.
Comparison of AMTL rates between the Early and Late Ceramic Age groups based on the data presented in Tables 6.51 and 6.52 reveals distinct differences. In general, AMTL rates in the Late Ceramic Age group are much higher for all age groups and tooth classes.

Other

Other forms of dental pathology were also assessed for potential differences between the Early and Late Ceramic Age. A chi-square test demonstrates that there is a statistically significant difference in the prevalence of calculus between the Early and Late Ceramic Ages (Table 6.53); the prevalence is higher in the Late Ceramic Age. The Late Ceramic Age group has a slightly lower prevalence of periapical abscesses, however the difference is not significant. Likewise, the Late Ceramic Age group shows a lower hypercementosis prevalence, which is also not statistically significant.

Pathology T.C. %	Abscess	N	Calculus	N	Hypercementosis	N
ECA	0.75 (9)	1206	29.82 (356)	1206	2.40 (29)	1206
LCA	0.43 (16)	3748	36.71 (1376)	3748	1.79 (67)	3748
Chi-square	χ^2(1, N=4728)= 1.54, p= 0.25		χ^2(1, N=4728)= 31.98, p= 0.00		χ^2(1, N=4728)= 1.27, p= 0.29	

Table 6.53 The frequency of pathology (tooth count) in the Early Ceramic Age and Late Ceramic Age groups.

The frequency of individuals affected by periapical abscesses and calculus is near enough the same for both groups. The proportion of individuals affected by hypercementosis is slightly smaller in the Late Ceramic Age group, however the difference between the two groups is not significant (Table 6.54).

Pathology I.C. %	Abscess	N	Calculus	N	Hypercementosis	N
ECA	6.33 (5)	79	65.82 (52)	79	15.19 (12)	79
LCA	7.75 (20)	258	68.22 (176)	258	12.02 (31)	258
Chi-square	χ^2(1, N=337)= 0.18, p= 0.81		χ^2(1, N=337)= 0.16, p= 0.68		χ^2(1, N=337)= 0.36, p= 0.56	

Table 6.54 The frequency of pathology (individual count) in the Early Ceramic Age and Late Ceramic Age groups.

Dental Defects

Enamel hypoplasia

The prevalence of linear enamel hypoplasia (tooth count) in the Early Ceramic

Age group is 0.75% (n= 9). In the Late Ceramic Age groups the prevalence is 2.21% (n= 78). A chi-square test shows the difference is statistically significant (χ^2(1, N= 4728)= 10.44, p= 0.00). The proportion of individuals affected by linear enamel hypoplasia in the Early Ceramic Age group is 3.80% (n= 3). The proportion of individuals affected by linear enamel hypoplasia in the Late Ceramic Age group is 9.69% (n= 25). Despite the apparent large difference, a chi-square test did not reveal statistical significance (χ^2(1, N= 337)= 2.76, p= 0.11).

Discolouration and Opacities
Discolouration of all kinds is slightly more frequent in the Late Ceramic Age group (5.04%, n= 13) than the Early Ceramic Age group (3.80%, n= 3). The difference is not significant (χ^2(1, N= 337)= 0.21, p= 0.77).

6.6.2 Lesser and Southern Antilles: Early Ceramic Age versus Late Ceramic Age

Dental wear

Rate of wear
A total of 68 adjacent first and second mandibular molars (n= 136) was selected to assess potential differences in the rate of occlusal surface wear between the Early Ceramic Age group and the Late Ceramic Age group using principle axis analysis. The equations of principal axes were calculated for adjacent first and second left mandibular molars. To compare wear rates, the principle axis equation was determined by plotting the wear score of M1 on the Y1 (X) axis, and M2 on the Y2 (Y) axis (Sokal and Rohlf 1981:594–601). A steep principle axis slope (b) indicates a rapid rate of wear, whereas a gentle principle axis slope indicates a slow rate of wear. Since this method avoids the effects of age on the degree of dental wear, significant differences between the rate of wear (the principle axis slopes) of different sites can be taken to indicate differences in food consistency or food preparation techniques. Rapid rates of wear are usually associated with tough, abrasive diets (often hunter-gatherer or hunter-fisher diets). Slower rates of wear are more often associated with refined, less abrasive diets (processed agricultural produce) (Smith 1982, 1984; Larsen 1997; Lukacs 1996; Sciulli 1997; Kieser et al. 2001; Fujita and Ogura 2009).
Principle axis analysis was performed using those adults in the Early and Late

Period	b	Principle Axis Equation	CL (95%)
Early Ceramic Age	1.219	0.023 + 1.219Y	0.967 < b < 1.552
Late Ceramic Age	0.955	0.669 + 0.955Y	0.654 < b < 1.385

Table 6.55 Principle axis slope (b), equation, and 95% confidence limits: Early and Late Ceramic Age (Lesser and Southern Antilles).

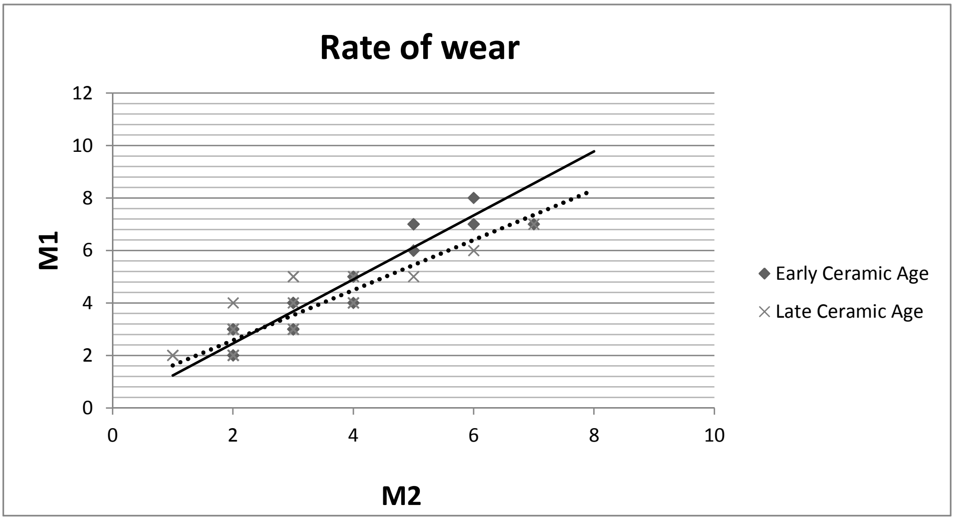

Figure 6.99 Scatterplot of M1–M2 wear scores by period, shown with principle axes. Note differences in slope steepness.

Ceramic Age groups with observed adjacent first and second left mandibular molars. The slopes, equation and confidence limits of the principle axis analyses can be found in Table 6.55. As can be seen in this table, the gradients of the slopes of the two periods differ, reflecting differences in the rate of wear at each site. This suggests that food consistency and/or food preparation techniques differed per period. In the Early Ceramic Age, the rate of wear (slope (b)= 1.219) was more rapid than in the Late Ceramic Age (slope (b)= 0.955).

As discussed by Scott (1979a), who compared the results of both the Scott (1979b) and Molnar (1971) dental wear scoring methods when used in principle axis analysis, the use of the 8 category Molnar method may lead to (greater) overlap in the confidence limits for the different groups in the comparison (see also Chapter 4 section 4.2.2). The results in Table 6.55 show that the slopes (b) for the Early and Late Ceramic Age groups do indeed fall within the confidence limits for both groups. However, both the slopes (b) and confidence limits for the Early Ceramic Age group are higher than those for the Late Ceramic Age group. As such, principle axis analysis using the Molnar (1971) dental wear scoring system has revealed differences in rate of wear in the two groups; these differences are visualized in Figure 6.99. This figure shows the principle axis slopes for both groups, together with the plotted wear scores of adjacent first and second molars (M2 on the x-axis, and corresponding M1 on the y-axis), and thus visually displays the differences in rate of wear in both periods. Note in particular the differences in slope steepness, which indicate variation in rate of wear.

These results suggest that food consistency and food preparation techniques in the Early Ceramic Age were more abrasive to the dentition than those of the Late Ceramic Age.

Direction of wear

In the Early Ceramic Age the most frequently observed direction of wear is horizontal (79.81%), followed by oblique (20.19%). In the Late Ceramic Age the most frequently observed direction of wear is oblique (56.96%), followed by horizontal (43.04%).

Occlusal surface shape

In the Early Ceramic Age the most frequently observed occlusal surface shape is flat (59.62%), followed by cupped (36.54%). In the Late Ceramic Age the most frequently observed direction of wear is cupped (48.81%), followed by flat (41.66%).

Dental chipping

The frequency of dental chipping (tooth count) is twice as great in the Late Ceramic Age (18.59%, n= 339) than the Early Ceramic Age (9.27%, n= 56). The difference is statistically significant, as demonstrated by a chi-square test (χ^2(1, N= 2428)= 28.90, p= 0.00). The frequency of individuals affected by dental chipping (individual count) is higher in the Late Ceramic (61.22%, n= 90) than in the Early Ceramic Age (47.50%, n= 19). A chi-square test shows this difference is not statistically significant (χ^2(1, N= 187)= 2.44, p= 0.15).

In both groups, chipping is most frequently found in the occlusal buccal and lingual surfaces, followed by the interproximal surfaces. No differences were apparent between the groups with regards to the frequency of maxillary or mandibular chipping.

In the Early Ceramic Age group, the posterior dentition (24.60%) is more frequently affected by chipping than the anterior dentition (4.31%). This difference is statistically significant (χ^2(1, N= 587)= 38.62, p= 0.00). In the Late Ceramic Age group, the posterior dentition (41.24%) is also significantly more frequently affected by chipping than the anterior dentition (32.43%) (χ^2(1, N= 1707)= 14.05, p= 0.00), although the difference between the anterior and posterior teeth is smaller.

A comparison of the overall frequencies of both anterior and posterior chipping of the Early Ceramic Age group and the Late Ceramic Age group, shows a significant difference between the two, with the late group far more frequently affected and with a greater proportion of anterior chipping than the early group (χ^2(2, N= 2294)= 101.56, p= 0.00).

LSAMAT

The proportion of individuals affected by LSAMAT in both groups differs little. In the Early Ceramic Age 37.50% of the individuals (n= 15) is affected by LSAMAT. In the Late Ceramic Age 40.14% (n= 59) is affected by LSAMAT. A chi-square test demonstrates that there is no statistically significant difference between the caries rates in the Early and Late Ceramic Ages (χ^2(1, N= 187)= 0.09, p= 0.86).

All individuals found to have Type 1 LSAMAT belong to the Late Ceramic Age group. Type 2 LSAMAT was observed in both groups.

Non-alimentary tooth use: teeth as tools
Of the individuals showing non-alimentary dental wear from sites in the Lesser Antilles and southern Caribbean Islands (n= 24), 20.83% belong to the Early Ceramic Age group (n= 5), and 79.17% belong to the Late Ceramic Age group (n= 19). This difference appears large, however, of the total number of individuals in the Early Ceramic Age group, only 12.50% displayed non-alimentary dental wear. Of the total number of individuals in the Late Ceramic Age group, 12.92% showed non-alimentary wear. While the proportion of individuals affected by non-alimentary dental wear is still slightly larger in the Late Ceramic Age, the difference is clearly very small. A chi-square confirms that there is no significant difference in the proportion of individuals affected by non-alimentary dental wear between the two periods (χ^2(1, N= 187)= 0.01, p= 1.00).

Dental Pathology

Caries
In the Early Ceramic Age group, 22 carious lesions were recorded in the adult population, amounting to 3.64% of the total number of observed permanent teeth (n= 605). Of all adults, 12 individuals with at least one carious lesion were observed, amounting to 30.00% of the entire adult population (n= 40). Males (6.98%) in the Early Ceramic Age groups are more frequently affected by caries than females (2.46%), however, the difference is not statistically significant (χ^2(1, N=294)= 3.01, p= 0.11).
In the Late Ceramic Age group, 292 carious lesions were recorded in the adult population, amounting to 14.83% of the total number of observed permanent teeth (n= 1,824). Of all adults, 90 individuals with at least one carious lesion were observed, amounting to 61.22% of the entire adult population (n= 147). Males (14.53%) in the Late Ceramic Age groups are less frequently affected by caries than females (16.39%), however, the difference is not statistically significant (χ^2(1, N=1,592)= 1.20, p= 0.30).
A preliminary investigation of caries rates based on simple tooth count and individual count methods was performed, in order to gain an insight into the potential differences between the Early and Late Ceramic Age groups. The rate of caries based on the tooth count method in the Late Ceramic Age appears to be distinctly higher than that of the Early Ceramic Age. The statistical significance of this difference was tested using a chi-square test. This test determined a significant difference between the Early and Late Ceramic Age (χ^2(1, N= 2,428)= 61.63, p= 0.00). The frequency of individuals affected by caries also differs significantly, with the Late Ceramic Age group far more frequently affected than the Early Ceramic Age group (χ^2(1, N= 187)= 12.37, p= 0.00).
The preliminary assessments above indicate possible differences in foodways between the two periods. However, these differences could (at least in part) result from differing age profiles and differentially preserved/affected dental elements.

Table 6.56 and Table 6.58 present the caries rates by age group, by sex, and by tooth, for the Early Ceramic Age and the Late Ceramic Age in the Lesser and Southern Antilles.

In general, in both males and females, the molars are more frequently affected by caries than the premolars and incisors and canines. This reflects known differences in the susceptibility of the different tooth classes to caries (Hillson 1996, 2001; Wasterlain et al. 2009).

ECA		MALE		FEMALE		TOTAL	
Age	**Tooth category**	**N**	**% Carious**	**N**	**% Carious**	**N**	**% Carious**
18–25	Incisors & Canines	20	0.00 (0)	8	0.00 (0)	28	0.00 (0)
	Premolars	11	9.09 (1)	5	0.00 (0)	16	6.25 (1)
	Molars	17	11.76 (2)	9	11.11 (1)	26	11.54 (3)
26–35	Incisors & Canines	13	15.38 (2)	20	0.00 (0)	33	6.06 (2)
	Premolars	12	0.00 (0)	17	0.00 (0)	29	0.00 (0)
	Molars	21	9.52 (2)	24	0.00 (0)	45	4.44 (2)
36–45	Incisors & Canines	25	0.00 (0)	10	10.00 (1)	35	2.86 (1)
	Premolars	15	6.67 (1)	6	0.00 (0)	21	4.76 (1)
	Molars	12	0.00 (0)	7	0.00 (0)	19	0.00 (0)
46+	Incisors & Canines	7	0.00 (0)	2	0.00 (0)	9	0.00 (0)
	Premolars	2	100.00 (2)	2	0.00 (0)	4	50.00 (2)
	Molars	5	40.00 (2)	8	12.50 (1)	13	23.08 (3)

Table 6.56 Early Ceramic Age caries rates by sex/age, and tooth category (Lesser and Southern Antilles). Numbers of observed caries are given between brackets.

Although the oldest age category has the highest caries rates in both males and females (Table 6.56), there is no clear relation between caries and age; the young middle and old middle adults have lower rates than the young and old adults. The dip in caries rates in the middle two age groups can also be seen in Table 6.57. This table combines all teeth for males and females. In part this dip may be related to the large proportion of ante mortem lost molars in the 36–45 years category (Table 6.60).

Caries rate %	**18–25**	**26–35**	**36–45**	**46+**
Male	6.25	8.70	1.92	28.57
Female	4.55	0.00	4.35	8.33
Total	5.71	3.74	2.67	19.23

Table 6.57 Early Ceramic Age caries rates by sex/age (Lesser and Southern Antilles).

In females, the rate of caries is relatively low overall, and lesions are restricted to molars only. Males also show caries in the incisors and canines, and premolars. This difference could indicate that males consumed larger amounts of cariogenic foods, since higher rates of caries in incisors and canines and premolars are commonly associated with populations consuming larger proportions of cariogenic foods, consisting of soft, sticky carbohydrates. In populations with low carbohydrate intake, the first molars are affected most by caries, and in populations with slightly higher carbohydrate intake caries are seen more frequently on the second and third molars (Hillson 2001, 2008b; Wasterlain et al. 2009).

Table 6.58 displays caries rates of the Late Ceramic Age group by sex and age group and tooth class. High rates of caries are already seen in the youngest age group. In females, caries rates for all tooth classes clearly increase, with very high rates in all teeth in the 26–35 age group. A dip in female rates is seen for all tooth classes in

LCA		**MALE**		**FEMALE**		**TOTAL**	
Age	**Tooth Category**	**N**	**% Carious**	**N**	**% Carious**	**N**	**% Carious**
	Incisors & Canines	41	2.44 (1)	103	0.97 (1)	144	1.39 (2)
	Premolars	26	23.08 (6)	64	7.81 (5)	90	12.22 (11)
18–25	**Molars**	39	33.33 (13)	119	19.33 (23)	158	22.78 (36)
	Incisors & Canines	149	0.67 (1)	118	8.47 (10)	267	4.12 (11)
	Premolars	89	22.47 (20)	61	36.07 (22)	150	28.00 (42)
26–35	**Molars**	106	26.42 (28)	57	31.59 (18)	163	28.22 (46)
	Incisors & Canines	51	1.96 (1)	50	18.00 (9)	101	9.90 (10)
	Premolars	37	8.11 (3)	25	36.00 (9)	62	19.35 (12)
36–45	**Molars**	39	12.82 (5)	18	16.67 (3)	57	14.04 (8)
	Incisors & Canines	55	0.00 (0)	51	7.84 (4)	106	3.77 (4)
	Premolars	23	4.35 (1)	25	12.00 (3)	48	8.33 (4)
46+	**Molars**	37	18.92 (7)	26	34.62 (9)	63	25.40 (16)

Table 6.58 Late Ceramic Age caries rates by sex/age, and tooth category (Lesser and Southern Antilles). Numbers of observed caries are given between brackets.

the 36–45 age group, followed by an increase in molar rates only in the oldest age group. In males, there is a trend for decreasing caries rates with age. In particular, premolar and molar rates dip in the 36–45 age group. In the oldest age group a slight increase is seen in the rate of molar caries, but incisors and canines and premolars show lower rates than the old middle adult age group. These trends in male and female caries rates in relation to age are also apparent in Table 6.59, which combines all teeth for males and females.

Caries rate	**18–25**	**26–35**	**36–45**	**46+**
Male	18.87	14.24	7.09	6.96
Female	10.14	21.19	22.58	15.69
Total	12.50	17.07	13.64	11.06

Table 6.59 Late Ceramic Age caries rates by sex/age (Lesser and Southern Antilles).

In general, in both males and females, the molars are more frequently affected by caries than the premolars and incisors and canines, although with age the frequencies of carious premolars increase and (in females) sometimes outweigh the molar frequencies. The latter is likely correlated with the increase in AMTL in molars in the older age categories (Table 6.61). Premolars are also more frequently affected than incisors and canines. These differences again reflect differential susceptibility of the different tooth classes to carious lesions (Hillson 1996, 2001; Wasterlain et al. 2009).

In the youngest age group (18–25 years), males have higher caries rates than females in all tooth classes. In the oldest three age groups, females show clearly higher caries rates than males in all tooth classes. Females also show distinctly higher AMTL rates overall. Despite the fact that using the tooth count method no significant difference in caries rate was observed between males and females, the assessment of caries rates by age and tooth class, indicates that foodways likely differed between males and females in the Late Ceramic Age in the Lesser and Southern Antilles.

Comparison of caries rates between the Early and Late Ceramic Age groups based on the data presented in Tables 6.56 and 6.58 reveals distinct differences. In general, caries rates in the Late Ceramic Age group are much higher for all age groups and tooth classes. The Late Ceramic Age group shows distinctly higher caries rates in incisors and canines and premolars, for both males and females and all age groups. High rates of caries in incisors and canines are generally associated with the consumption of large proportions of cariogenic foods, consisting of soft, sticky carbohydrates. In populations with low carbohydrate intake, the first molars are affected most by caries, and in populations with slightly higher carbohydrate intake caries are seen more frequently on the second and third molars. With increasing caries rates, the premolars are also affected (Hillson 2001, 2008b). The distinctly higher rates of caries overall, and in particular in the incisors and canines and premolars, of the Late Ceramic Age group, suggest that foodways differed between the two periods. A far greater proportion of cariogenic foods, possibly combined with more refined processing techniques, would have been consumed in the later period.

AMTL

In the Early Ceramic Age group, 27 ante mortem lost teeth were recorded in the adult population, amounting to 4.17% of the total number of observed tooth positions (n= 647). Of all adults, 8 individuals with at least ante mortem lost tooth were observed, amounting to 20.00% of the entire adult population (n= 40). Males (9.47%) in the Early Ceramic Age groups are statistically significantly more frequently affected by AMTL than females (3.13%) ($\chi^2(1, N=318)= 4.79$, $p= 0.04$).

In the Late Ceramic Age group, 249 ante mortem lost teeth were recorded in the adult population, amounting to 11.62% of the total number of observed tooth positions (n= 2,143). Of all adults, 50 individuals with at least one ante mortem lost tooth were observed, amounting to 34.01% of the entire adult population (n= 147). Males (10.37%) in the Late Ceramic Age groups are significantly less frequently affected by AMTL than females (14.33%) (χ^2(1, N=1.930)= 6.89, p= 0.01).

ECA		MALE		FEMALE		TOTAL	
Age	Tooth category	N	% AMTL	N	% AMTL	N	% AMTL
18–25	Incisors & Canines	22	4.55 (1)	8	0.00 (0)	30	3.33 (1)
	Premolars	13	0.00 (0)	6	0.00 (0)	19	0.00 (0)
	Molars	23	26.09 (6)	9	0.00 (0)	32	18.75 (6)
26–35	Incisors & Canines	13	0.00 (0)	20	0.00 (0)	33	0.00 (0)
	Premolars	11	0.00 (0)	14	0.00 (0)	25	0.00 (0)
	Molars	21	0.00 (0)	26	0.00 (0)	47	0.00 (0)
36–45	Incisors & Canines	25	0.00 (0)	10	0.00 (0)	35	0.00 (0)
	Premolars	18	0.00 (0)	7	0.00 (0)	25	0.00 (0)
	Molars	20	40.00 (8)	11	36.36 (4)	31	38.71 (12)
46+	Incisors & Canines	7	0.00 (0)	2	0.00 (0)	9	0.00 (0)
	Premolars	3	33.33 (1)	2	0.00 (0)	5	20.00 (1)
	Molars	7	28.57 (2)	8	0.00 (0)	15	13.33 (2)

Table 6.60 Early Ceramic Age AMTL rates by sex/age, and tooth category (Lesser and Southern Antilles). Numbers of observed ante mortem lost teeth are given between brackets.

A preliminary investigation of AMTL rates based on simple tooth count and individual count methods was performed, in order to gain an insight into the potential differences. The rate of AMTL based on the tooth count method in the Late Ceramic Age appears to be distinctly higher than that of the Early Ceramic Age. The statistical significance of this difference was tested using a chi-square test. This test determined a significant difference between the Early and Late Ceramic Age (χ^2(1, N=2.790)= 30.91, p= 0.00). The frequency of individuals affected by AMTL does not differ significantly, although the Late Ceramic Age group is more frequently affected than the Early Ceramic Age group (χ^2(1, N=187)= 2.89, p= 0.12).

LCA		MALE		FEMALE		TOTAL	
Age	Tooth category	N	% AMTL	N	% AMTL	N	% AMTL
18–25	Incisors & Canines	41	0.00 (0)	105	0.00 (0)	149	0.00 (0)
	Premolars	27	0.00 (0)	67	2.99 (2)	94	2.13 (2)
	Molars	42	4.76 (2)	123	2.44 (3)	167	2.99 (5)
26–35	Incisors & Canines	156	0.64 (1)	125	1.60 (2)	281	1.07 (3)
	Premolars	83	6.02 (5)	62	9.68 (6)	145	7.59 (11)
	Molars	130	15.38 (20)	97	39.18 (38)	227	25.55 (58)
36–45	Incisors & Canines	61	0.00 (0)	52	0.00 (0)	113	0.00 (0)
	Premolars	37	2.70 (1)	28	14.29 (4)	65	7.69 (5)
	Molars	58	24.14 (14)	29	31.03 (9)	87	28.74 (25)

LCA		MALE		FEMALE		TOTAL	
Age	**Tooth category**	**N**	**% AMTL**	**N**	**% AMTL**	**N**	**% AMTL**
46+	**Incisors & Canines**	66	9.09 (6)	61	9.84 (6)	127	9.45 (12)
	Premolars	27	18.52 (5)	29	17.24 (5)	56	17.86 (10)
	Molars	55	30.91 (17)	56	50.00 (28)	111	40.54 (45)

Table 6.61 Late Ceramic Age AMTL rates by sex/age, and tooth category (Lesser and Southern Antilles). Numbers of observed ante mortem lost teeth are given between brackets.

Although there is not a very clear trend of increasing AMTL rates with age, the rates observed in the older age groups are generally higher than in the younger age groups (Table 6.60). Overall, males are more frequently affected than females. Female AMTL is restricted to the molars in the 36–45 years age group. In males, incisors and canines are affected the 18–25 years age group, and premolars are affected in the 46+ years age group. These data appear to support the statistically significant difference found using a simple tooth count method, where males have higher AMTL rates than females.

The rate of AMTL is clearly associated with age, as much higher rates are seen in the older age categories than the younger age groups (Table 6.61). Examination of the data presented in Table 6.61 confirms the significant difference between males and females found using the tooth count method, with females in all age groups showing higher AMTL rates.

Based on the data presented in Tables 6.60 and 6.61, there are distinct differences between the Early and Late Ceramic Age groups. In general, AMTL rates in the Late Ceramic Age group are much higher for all age groups and tooth classes.

Other

A chi-square test shows that there is a statistically significant difference in calculus prevalence between the Early and Late Ceramic Age in the Lesser and Southern Antilles (Table 6.62). The Late Ceramic Age group has a

Pathology T.C. %	Abscess	N	Calculus	N	Hypercementosis	N
ECA	0.50 (3)	605	22.64 (137)	605	1.65 (10)	605
LCA	0.33 (6)	1824	41.61 (759)	1824	0.93 (17)	1824
Chi-square	χ^2(1, N= 2428)= 0.35, p= 0.70		χ^2(1, N= 2428)= 69.83, p= 0.00		χ^2(1, N= 2428)= 2.16, p= 0.18	

Table 6.62 The frequency of pathology (tooth count) in the Lesser and Southern Antilles: Early Ceramic Age versus Late Ceramic Age.

slightly lower prevalence of periapical abscesses, however the difference is not significant. Likewise, the Late Ceramic Age group shows a lower hypercementosis prevalence, which is again not statistically significant. Comparisons based on the individual count method found no significant differences. The percentage of individuals affected by periapical abscesses is slightly lower in the Late Ceramic Age group (Table 6.63).

Pathology I.C. %	Abscess	N	Calculus	N	Hypercementosis	N
ECA	7.50 (3)	40	62.50 (25)	40	7.50 (3)	40
LCA	4.08 (6)	147	60.54 (89)	147	8.16 (12)	147
Chi-square	χ^2(1, N= 187)= 0.80, p= 0.41		χ^2(1, N= 187)= 0.05, p= 0.86		χ^2(1, N=187)= 0.02, p= 1.00	

Table 6.63 The frequency of pathology (individual count) in the Lesser and Southern Antilles: Early Ceramic Age versus Late Ceramic Age.

Dental Defects

Enamel hypoplasia

None of the Early Ceramic Age individuals have linear enamel hypoplasia. In the Late Ceramic Age the prevalence (tooth count) is 1.37% (n= 25). A chi-square test shows the difference is statistically significant (χ^2(1, N= 2428)= 8.36, p= 0.00). The proportion of individuals affected by linear enamel hypoplasia in the Late Ceramic Age group is 7.48% (n= 11). Despite the apparent large difference, a chi-square test did not reveal statistical significance (χ^2(1, N= 187)= 3.18, p= 0.12).

Discolouration and Opacities

Discolouration of all kinds is slightly more frequent in the Late Ceramic Age individuals (7.48%, n= 11) than the Early Ceramic Age individuals (5.00%, n= 2). The difference is not significant (χ^2(1, N= 187)= 0.30, p= 0.74).