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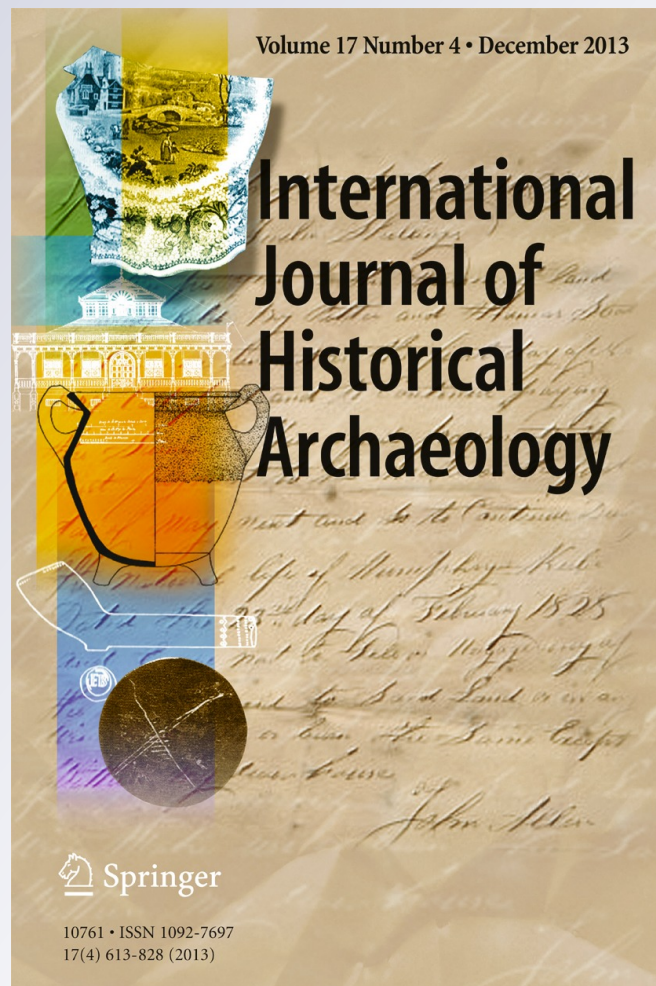
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Health Consequences of Contact on Two Seventeenth-Century Native Groups from the Mid-Atlantic Region of Maryland

Sara K. Becker

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Abstract This study examined the skeletal remains of two different native groups, the Piscataway (Algonquian) and the Susquehannock (Iroquoian), who resided in close geographic proximity in the Tidewater-Potomac region of Maryland in order to understand their health during the 1,600 s CE. Both groups had differing interactions with colonial settlers and numerous historic accounts of violence. The results show some evidence of infectious disease and no types of interpersonal violence on the skeletal remains of either group. Other health disparities found were associated more with cultural and behavioral differences between these two ethnic groups than with direct colonial involvement.

Keywords Bioarchaeology · European contact · Treponemal infection · St. Mary's City · Bacon's rebellion

Introduction

Investigations into European interactions in the New World (e.g., Alchon 2003; King and Chaney 2004; Loren 2008; Silliman 2005) have dispelled the idea that early colonial encounters with Native Americans were uniform. Many of these early interactions varied because of the national origin of colonists, the proximity of Native American communities to colonial settlements, as well as the interpersonal and political relationships between natives and colonists (Alchon 2003; Loren 2008). One way to evaluate the consequences of European contact on different Native American groups involved in early colonial encounters is through changes in skeletal health. In order to understand the differing effects of the contact experience, I evaluated the skeletal remains of two ethnically and linguistically different native groups, the Piscataway (Algonquian) and the Susquehannock (Iroquoian), who

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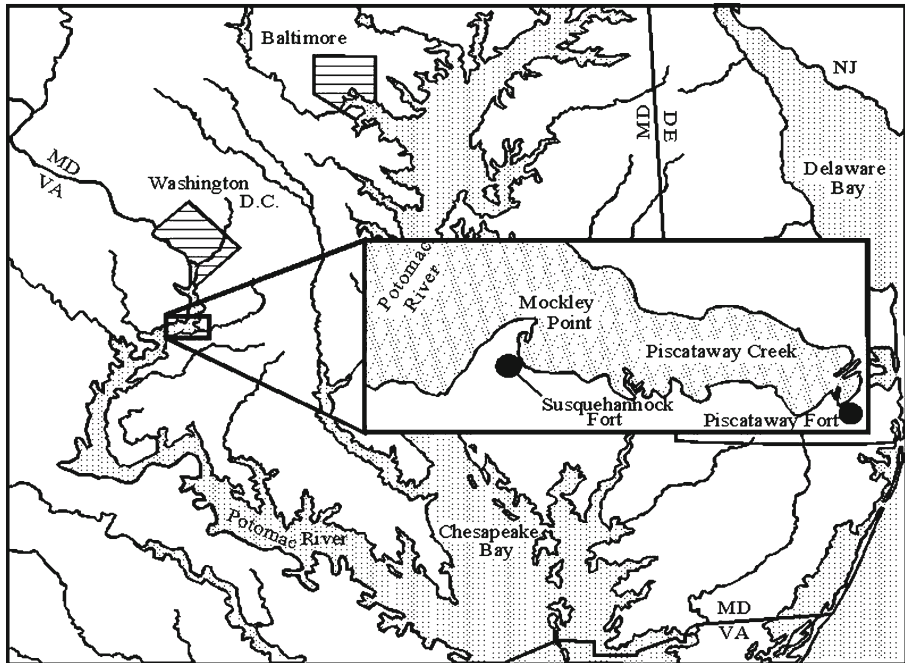


Fig. 1 Map of Mid-Atlantic and study sites

resided in close geographic proximity on Piscataway Creek in the Tidewater-Potomac area of Maryland (Fig. 1). While both groups were in contact with colonists during the 1,600 s CE, each had differing access to local resources, recorded ethnohistoric accounts of violence, as well as relationships with colonial settlers.

Historic and ethnohistoric accounts of colonial interactions in this area describe a longer history of disadvantageous circumstances for the Susquehannock people, such as village decimation from disease and intertribal warfare (Axelrod 1993; Gagnon 2004b; Jennings 1966, 1968, 1978, 1984; Simon 2003; Simon and Gagnon 2005; Webb 1995). These accounts also note fewer problems among the Piscataway peoples who may have been considered a “client” tribe (i.e., a trusted friendly tribe and trading partner) of the Maryland colony (Axelrod 1993; Jennings 1984; Porter 1979; Potter 1993; Simon 2003; Simon and Gagnon 2005; Webb 1995). In addition, these Maryland colonists, who had had come from an England embroiled in bitter conflicts between Protestants and Catholics, did not focus on proselytizing local aboriginal groups (Alchon 2003; Ferguson and Ferguson 1960; Hall 1910; Kellock 1962; Land 1981; Maniez 1994; Menard and Carr 1982; Porter 1979; Potter 1993; Toogood 1969). Instead, they placed importance on religious tolerance, keeping peaceful relations with local native groups, and using friendlier tribes as a buffer to more hostile ones as they acquired land. This “land-centered” contact policy by the Maryland colonists may have also had an impact on the health of the Piscataway and Susquehannock. Hence, my research documents the contact experience of these two native groups with the expectation that while these two groups lived in close spatial proximity in the Mid-Atlantic region, the Susquehannock skeletal remains should show more dramatic negative health consequences through greater prevalence

of (1) disease, (2) skeletal stressors, and (3) evidence of trauma on the bones of these people.

Cultural and Historical Context

According to Porter (1979:ix), at the time of European contact, many Native American tribes in the Mid-Atlantic had a sophisticated political organization with a centralized authority. Tribes that resided in villages on the east side of the Potomac River were members of the Piscataway Alliance, part of the Algonquian linguistic group, whose material culture included construction of longhouses as permanent dwellings, circular palisaded villages, and ossuary burials (Kellock 1962; Land 1981; Potter 1993; Ubelaker 1974). The Piscataway used a combination of hunting, gathering, fishing, and agriculture for subsistence (Ferguson and Ferguson 1960; Porter 1979; Potter 1993). Early European visitors to the Chesapeake Bay area noted that these native peoples had a seasonal subsistence strategy in which marine resources, animals, nuts, berries, and agricultural products such as maize, beans, pumpkins, squash, and green wheat were utilized (Porter 1979, pp. 9, 27).

At the time of initial contact by British Captain John Smith in 1608, the Susquehannock resided near the head of the Chesapeake Bay, living in palisaded villages with multifamily longhouse dwellings (Gallatin 1973 [1836]; Kent 1984; Porter 1979). Food remains excavated from Susquehannock protohistoric villages included domesticated plants, such as maize, pumpkin, and squash, as well as wild animal, plant, and fish resources (Brashler 1987; Guilday et al. 1962), indicating a diet and subsistence strategy similar to the Piscataway. In addition, isotopic dietary reconstruction studies performed on skeletal remains indicate that maize was an important dietary component for the Susquehannock (Buikstra 1992; Vogel and Van Der Merwe 1977).

Preliminary contact with Captain Smith led to years of peaceful interactions between British traders and the Piscataway and the Susquehannock, respectively. These relationships changed after British settlers, escaping the religious problems and persecution in England, settled in St. Mary's City, Maryland in 1634 on land provided by the Piscataway (Kellock 1962; Peasley 1910 [1635]; Toogood 1969). While the Maryland colonists and the Piscataway formed an alliance in which colonists used the Piscataway as a buffer against various Iroquois groups to the north, colonial relations with the Susquehannock deteriorated (Jennings 1982; Maniez 1994; Porter 1979; Toogood 1969). The Susquehannock, assaulted by the Iroquois tribes to the north, began to raid both the Piscataway tribes and the colonists. By 1652, the Susquehannock asked the colonial Maryland government for protection from the other groups to the north and a treaty of friendship, including peaceable relations with the Piscataway tribes, was established (Toogood 1969). In return for this colonial support, the Susquehannock waged war against the Iroquois Confederacy for an additional 20 years (Gallatin 1973 [1836]; Jennings 1968, 1982; Webb 1995).

Decimated by the continued warfare, in 1673 the Susquehannock asked the colonial Maryland government for land and were invited to settle north of present-day Washington, D.C. It is unclear if there was a miscommunication between the Susquehannock and Maryland government or if the proffered land was unacceptable,

but in February of 1674 the Susquehannock instead settled 18mi (29 km) south of present-day Washington, DC near the Piscataway people on Piscataway Creek, Maryland (Ferguson 1941; Maniez 1994; Toogood 1969). Historians (Land 1981; Maniez 1994; Toogood 1969) are uncertain if the Susquehannock would have been permitted to continue living in this area if not for a series of incidents with a group of Doeg Native Americans during the latter half of 1675. The Doeg, an Algonquian-speaking group, had been living farther north of Piscataway Creek in Maryland and Virginia. A few Doegs became involved in a dispute with a wealthy Virginia colonist named Thomas Mathew over trade goods, ending with a Doeg raid in which Virginia colonists were killed and the colonial militia was raised in retribution. After these events, historical accounts of Doeg and Susquehannock involvement vary (Axelrod 1993; Jennings 1968, 1978, 1982, 1984; Porter 1979). The Doeg may have fled to the Piscataway Creek area where the Susquehannocks provided protection for them. It was also possible that the Susquehannock did not help the Doegs, but that the Susquehannock were mistakenly thought to be the same native group by the colonial militia. Either way, this incident with the Doeg initiated a siege of the Susquehannock fort by Virginia and Maryland colonial militia that lasted 6 to 7 weeks. After the militia killed five Susquehannock hostages during negotiations in September 1675, the siege ended when the remaining Susquehannock men, women, and children fled the fort, killing as many as ten of the encamped militia in the process (Axelrod 1993; Ferguson 1941; Kellock 1962; Toogood 1969; Webb 1995).

The siege of the Susquehannock in Maryland had larger political consequences for the region. The remaining Susquehannocks retaliated for the five slain hostages by hassling and possibly killing a few local Virginia colonists. The Susquehannocks then offered a treaty of peaceable relations to the Virginia governor, Sir William Berkeley. Governor Berkeley rejected the treaty, but did not pursue a reprisal against the Susquehannock, thus adding to growing anger among colonists who feared attack by Native American groups in the area (Axelrod 1993; Jennings 1978, 1984). In part, this siege and lack of action against the Susquehannocks by Governor Berkeley helped another Virginia colonist, Nathaniel Bacon, and his followers incite a rebellion (i.e., Bacon's Rebellion) during 1676–77, which ousted the governor from colonial Virginia and caused destruction to the settlement of Jamestown.

The unrest between colonists and natives that followed the siege of the Susquehannock fort, as well as the resulting colonial unease, strained relations with the "client" Piscataway tribes who now felt that they were under direct threat of local militia justice (Webb 1995). By 1678, relations between Piscataway and Maryland colonists reached a low point with accusations of Piscataway murdering colonists, and colonists taking two Piscataway lives in reprisal (Toogood 1969). In addition, historians (Axelrod 1993; Land 1981; Toogood 1969) note that the Piscataway may have supported the militia in the siege on the Susquehannock fort. As such, the deterioration of colonial relationships, continued Iroquois raiding, and fear of a revenge plot by the Susquehannock caused the Piscataway to flee the Piscataway Creek area by 1680 (Kellock 1962; Toogood 1969).

From this archaeological and historical background information, it could be estimated that the Piscataway and Susquehannock had similar levels of interaction with the colonial settlers in the area because neither group had daily contact with or was under the direct control of local colonists. In addition, both groups had similar

diets with access to local cultivated and wild food resources. These data suggest that the impact of European contact on Piscataway and Susquehannock health may have been analogous. However, with the history of warfare and violence among these Susquehannock peoples during the 1,600 s, I would expect that there had been many disruptions to their traditional way of life. These could have included fewer opportunities for a varied diet, harsher living conditions, and more negative colonial interactions, resulting in poorer Susquehannock health, as shown by evidence of disease and skeletal health stressors. Thus, my expectations were that the Susquehannock skeletal remains should show significant and negative health consequences when compared to the Piscataway, with higher rates of infection, skeletal stressors, and evidence of trauma.

Materials and Methods

The well-preserved Piscataway and Susquehannock skeletal collections used in this study are curated at the National Museum of Natural History (NMNH), Washington DC and primarily consist of crania. These two collections do have associated post-crania; however, these bones were comingled post-excavation, possibly during their donation to the NMNH. Thus, the comingled post-crania were examined, but due to the loss of provenience, the focus in this research was on the crania and dentition with known provenience in order to address health changes between these two groups. Overall, all skeletal remains were estimated as adults using standard methods, and sex was estimated from these remains based on cranial morphology (Bass 1981; Buikstra and Ubelaker 1994; Steele and Branblett 1988; White 1991). Table 1 provides a summary of the minimum number of individuals (MNI) and sex distribution.

The Piscataway sample was excavated from a palisaded village/fort (18PG40-A1) in 1939 by avocational archaeologist Alice L. Ferguson. This site is believed to be the principal location of the Piscataway after moving in 1623 from their village of Moyaone and represents a typical Algonquian palisaded village of the era (Curry 1999; Potter 1980; Stephenson et al. 1963). The burials consisted of a small ossuary of adult remains ($n=93$), likely representing a time span of approximately 50 years or less in the Piscataway Creek area because of the short lifespan of the village (i.e., 1623–80) (Curry 1999).

Prior skeletal analyses were performed on these Piscataway burials by Stewart, assistant curator for physical anthropology at the NMNH at the time. He collected information over cranial size and nonmetric traits and used this data to show potential

Table 1 Minimum Number of Individuals (MNI) and distribution by sex

	Adults (% of Total)	Males	Females	Indeterminate sex
Susquehannock	40 (30 %)	17 (13 %)	15 (11 %)	8 (6 %)
Piscataway	93 (70 %)	49 (37 %)	30 (23 %)	14 (10 %)
Total Individuals	133	66	45	22

familial relatedness and compared the Piscataway burials to other ossuary samples in the area (Ferguson and Stewart 1940). He also noted the presence of some pathological conditions including: dental carious lesions (cavities), generalized periosteal reaction (new bone growth on the outer table of long bones), and three fractures from two femora and one tibia. While these trauma were noted in Stewart's study, I only found the fractured and well-healed tibia, likely caused by accidental trauma, in the current collection at the NMNH (Simon 2003).

The Susquehannock sample was excavated by Ferguson in 1940. The remains from this site come from a square palisaded fort (18PR8) (a building style adopted by the Susquehannock after various colonial interactions) and inhabited during 1674–75 (Axelrod 1993; Ferguson 1941; Jennings 1968, 1978, 1982; Potter 1993; Toogood 1969). Within the fort, Ferguson (1941) excavated a pit containing the complete remains of multiple adults ($n=40$), which likely represent the culmination of 2-year occupation of the fort and subsequent siege-related deaths. In addition, Ferguson (1941) noted four adults with advanced signs of treponemal infection, which I found three in the NMNH collections (Simon 2003).

As bioarchaeological studies often use the evidence of infection, dietary and metabolic skeletal stressors, and trauma as a way to measure the impact of European interactions on Native Americans, the examination of skeletal remains in this study was analogous to prior European contact studies (e.g. Baker and Kealhofer 1996; Larsen 2001; Larsen and Milner 1994). To evaluate the health effects on the Piscataway and Susquehannock peoples, I collected three types of data: (1) specific evidence of skeletal infection (e.g. treponemal infection), (2) skeletal stressors involving diet (i.e. dental carious lesions, antemortem tooth loss (AMTL), dental alveolar abscesses) and metabolism (i.e. dental linear enamel hypoplasia (LEH), porotic hyperostosis, and cribra orbitalia), as well as evidence of (3) trauma (i.e. accidental and interpersonal).

Each skeletal element was examined macroscopically for the presence or absence of a pathological condition following traditional bioarchaeological methods (Bass 1981; Buikstra and Ubelaker 1994; Larsen 1997; Ortner 2003; Ortner and Putschar 1985; Steinbock 1976). Conditions were noted either for an individual (i.e. infectious disease, porotic hyperostosis, cribra orbitalia, and trauma) or for an individual's dentition on a per tooth basis (i.e. dental caries, AMTL, dental abscess, and LEH) and then these data were combined into tooth types (i.e. incisors, canines, premolars, molars). Evidence of infection on the crania was recorded if it fit the patterning and location used to reconstruct known types of skeletal infectious disease. Dental caries were examined by using a macroscopic and microscopic examination, noted as present if a lesion perforated the enamel on an otherwise intact tooth, and no data was taken from damaged teeth or teeth with damaged enamel. For AMTL, only maxillary or mandibular remodeling with healing was listed as present for this condition since teeth may have fallen out or been lost due to problems during excavation and/or museum curation. Dental abscessing was noted as present when the alveolar wall of the maxilla or mandible was perforated, and showed bony reaction indicative of response to the infection. Dental LEH scored as present if lines of disruption in the enamel were noted. Porotic hyperostosis and cribra

orbitalia were each only noted as present if there was bilateral porosity on crania. Evidence of trauma, if present, was recorded for each skeletal element and noted as healed, partially healed, or unhealed.

Analyses of data collected by individual for cranial evidence of infectious disease, porotic hyperostosis, cribra orbitalia, and trauma were performed using a two-by-two contingency table comparison with the chi-square statistic for significance ($p > .05$). Generalized estimating equations (GEE), a type of logistic regression with nested sampling, was used to compare dental information from each individual. GEE is an appropriate statistical analysis for the dentition because of the scalar issues involved in choosing between individuals (only one score of present/absent) or teeth (possibly as many as 32 per person) as the unit of comparison (Becker 2012; Gagnon 2004a, 2006; Gagnon and Wiesen 2011; Liang and Scott 1986). Dental data comparisons performed only by individual may result in loss of very specific pathology data, as well as have insufficient results to address research questions. However, if the condition is calculated on a per tooth basis, one individual with multiple affected teeth may result in inaccurate statistical results and violate the independence of data required for many statistical tests (e.g. two-by-two chi-square comparison). GEE addresses these issues, retaining the categorical dependent variable (presence or absence of a dental condition) while keeping the teeth of an individual linked. It also adjusts for scalar issues of sample-effects using model estimates of population parameters by weighting the value of each dental pathology per tooth type (i.e. incisors, canines, premolars, molars, and all categories combined) according to how much information is provided about the individual.

These dental data results were calculated in SAS 9.2 with the Wald test to see if there was a statistically significant relationship ($p > .05$) with a dependent variable (Liang and Scott 1986). Using these methods, the program generated frequency estimates between each population, as well as between the sexes, using model-based combinations of model parameter estimates. Then comparisons were performed between each skeletal collection, Piscataway or Susquehannock, using differences in the prevalence of cranial infection, skeletal stressors (dental caries, AMTL, dental abscess, LEH, porotic hyperostosis, and cribra orbitalia), and evidence of trauma (accidental and interpersonal from crania and dentition) with the chi-square statistic testing for significance at a .05 level or greater.

Results

Individuals as well as the dentition from individuals were compared for any significant differences ($p > .05$). Table 2 shows the result of the comparison between each native group.

While not significant, evidence of infectious disease (e.g. treponemal infection) rates were higher in the Susquehannock group. AMTL rates in the premolar sample were the only statistically significant results ($p = .01$), with a higher frequency of tooth loss among the Piscataway sample in premolar teeth (24 %) than in the Susquehannock premolar sample (7 %). While the combined sample showed no

Table 2 Pathology prevalence: all Susquehannock and Piscataway

Pathology	Susquehannock % affected/total	Piscataway % affected/total	χ^2 significant ($p \leq 0.05$), $df=1$
Infectious disease	8 (3/40)	0 (0/93)	no
Dental caries	19 (73/375)	18 (72/403)	no
Incisors	2 (1/56)	10 (6/60)	no
Canines	12 (6/52)	12 (7/57)	no
Premolars	15 (17/114)	10 (13/124)	no
Molars	32 (49/153)	28 (46/162)	no
AMTL	24 (112/465)	33 (191/571)	no
Incisors	16 (10/61)	23 (18/79)	no
Canines	8 (4/52)	22 (14/65)	no
Premolars	7 (8/123)	24 (39/163)	yes, $\chi^2=7$, $p=0.01$
Molars	39 (90/229)	45 (120/264)	no
Dental abscess	5 (23/463)	4 (22/558)	no
Incisors	3 (2/61)	4 (3/80)	no
Canines	10 (5/52)	8 (5/63)	no
Premolars	1 (1/122)	3 (5/156)	no
Molars	7 (15/228)	3 (9/259)	no
LEH	7 (24/329)	15 (49/327)	no
Incisors	9 (5/53)	9 (5/52)	no
Canines	22 (10/45)	28 (14/50)	no
Premolars	7 (7/95)	18 (17/96)	no
Molars	2 (3/152)	10 (13/129)	no
Porotic hyperostosis	3 (1/31)	0 (0/75)	no
Cribra orbitalia	8 (2/25)	0 (0/64)	no
Trauma (cranial)	0 (0/16)	0 (0/58)	no
Trauma (dental)	0 (0/343)	0 (0/360)	no

other significant differences, there were similar rates of dental caries and dental abscesses; however, rates for AMTL and LEH were higher in the Piscataway population. Also not significant, porotic hyperostosis and cribra orbitalia were found in greater frequency among the Susquehannock (3 % and 8 % of individuals respectively) than the Piscataway (no cases of either condition). Additionally, there were no cases of dental or cranial trauma among the Susquehannock or Piscataway.

Susquehannock and Piscataway females (Table 3) showed no significant differences, but generally higher pathology rates among Piscataway females. Dental caries rates were comparable between the two groups and dental abscesses were slightly higher (3 %) among Susquehannock females. The prevalence of AMTL and LEH was much higher among Piscataway females, 8 % and 24 % respectively. In addition, only females from the Susquehannock sample showed evidence of cribra orbitalia, and there was no evidence of cranial or dental trauma.

Table 3 Pathology prevalence: Susquehannock and Piscataway females

Pathology	Susquehannock % affected/total	Piscataway % affected/total	χ^2 significant ($p \leq 0.05$, $df=1$)
Infectious disease	0 (0/15)	0 (0/31)	no
Dental caries	23 (35/150)	23 (27/117)	no
Incisors	0 (0/25)	25 (4/16)	a
Canines	11 (2/19)	13 (2/15)	no
Premolars	24 (11/45)	21 (8/38)	no
Molars	35 (22/62)	27 (13/48)	no
AMTL	28 (52/186)	35 (55/158)	no
Incisors	20 (5/25)	23 (5/22)	no
Canines	6 (1/18)	20 (3/15)	no
Premolars	4 (2/46)	26 (12/46)	no
Molars	45 (44/79)	47 (35/75)	no
Dental abscess	5 (10/184)	2 (3/151)	no
Incisors	0 (0/25)	4 (1/22)	a
Canines	11 (2/18)	5 (1/14)	no
Premolars	2 (1/145)	3 (1/42)	no
Molars	7 (7/96)	3 (0/73)	no
LEH	6 (8/134)	30 (28/92)	no
Incisors	0 (0/24)	9 (1/11)	a
Canines	22 (4/18)	46 (6/13)	no
Premolars	11 (4/37)	41 (12/29)	no
Molars	0 (0/55)	23 (9/39)	a
Porotic hyperostosis	0 (0/14)	0 (0/26)	no
Cribra orbitalia	22 (2/9)	0 (0/23)	no
Trauma (cranial)	0 (0/15)	0 (0/30)	no
Trauma (dental)	0 (0/142)	0 (0/90)	no

^a Significance could not be determined

A comparison of the males (Table 4) indicated significant cranial evidence of infectious disease, with 18 % prevalence in Susquehannock males and no cases among Piscataway males.

This evidence supports Ferguson's (1941) initial description of treponemal infection on Susquehannock skeletal remains. These Susquehannock males showed evidence of caries sicca over 50 % percent of their skulls (Fig. 2). Caries sicca is observed skeletally in cases of treponemal infection, often in cases of tertiary venereal syphilis (Aufderheide and Rodriguez-Martin 1998; Ortner and Putschar 1985; Steinbock 1976). Cranial involvement with treponemal infection begins in the form of a gumma or gummatous lesion that necroses the outer table of bone and diploe and inner table perforations occur occasionally in the final stage of lesion formation (Fig. 3) (Aufderheide and Rodriguez-Martin 1998; Ortner and Putschar 1985; Steinbock 1976). While the destructive process is ongoing within the center

Table 4 Pathology prevalence: Susquehannock and Piscataway males

Pathology	Susquehannock % affected/total	Piscataway % affected/total	χ^2 significant ($p \leq 0.05$), df=1
Infectious disease	18 (3/17)	0 (0/49)	yes, $\chi^2=9$, Fisher's, $p=.01$
Dental caries	15 (30/194)	16 (29/177)	no
Incisors	4 (1/26)	4 (1/28)	no
Canines	14(4/28)	8 (2/26)	no
Premolars	10 (6/62)	8 (4/52)	no
Molars	24 (19/78)	31 (22/71)	no
AMTL	28 (54/245)	42 (129/307)	no
Incisors	17 (5/30)	28 (11/40)	no
Canines	7 (2/29)	30 (11/37)	no
Premolars	6 (4/68)	31 (26/84)	yes, $\chi^2=6$, $p=.01$
Molars	35 (41/118)	55 (81/146)	no
Dental abscess	4 (10/245)	4 (13/301)	no
Incisors	7 (2/30)	3 (1/141)	no
Canines	7 (2/29)	8 (3/36)	no
Premolars	0 (0/68)	3 (2/81)	^a
Molars	5 (6/118)	5 (7/143)	no
LEH	8 (13/167)	12 (17/137)	no
Incisors	17 (4/23)	16 (4/25)	no
Canines	27 (6/22)	29 (7/24)	no
Premolars	6 (3/52)	11 (4/37)	no
Molars	0 (0/70)	4 (2/51)	^a
Porotic hyperostosis	7 (1/14)	0 (0/45)	no
Cribriform orbitalia	0 (0/16)	0 (0/39)	no
Trauma (cranial)	0 (0/17)	0 (0/31)	no
Trauma (dental)	0 (0/175)	0 (0/161)	no

^a significance could not be determined

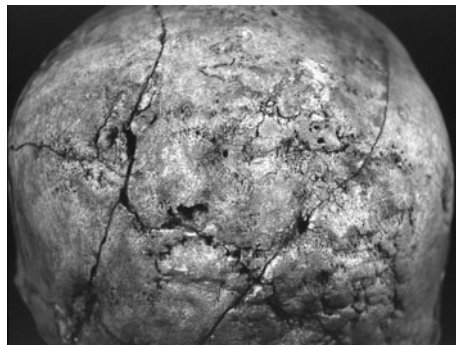


Fig. 2 Susquehannock male (NMNH no. 383662) with caries sicca, posterior view

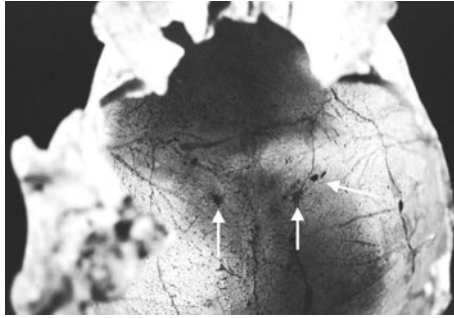


Fig. 3 Susquehannock male (NMNH no. 383662), *arrows point to perforations of the inner table of the cranium due to caries sicca, inferior view*

depression of the gumma, healing usually occurs around the outer perimeter, and multiple healed and reactive lesions scar the cranium and produce the “worm-eaten” appearance (Ortner 2003).

In addition to the evidence of cranial infection, Piscataway males had significantly higher rates of AMTL in premolars (31 %) than Susquehannock males (6 %), similar to the sample not divided by sex. While other dental conditions were not significant, rates for dental caries and dental abscesses were comparable between males from the two groups. As was also noted in the female sample, AMTL and LEH had higher rates among Piscataway males. There was also one case of porotic hyperostosis from a Susquehannock male and no evidence of trauma in either group of males.

Discussion

Skeletal indicators of disease, stress, and trauma can be used to map differences in the contact experience (Baker 1994; Baker and Kealhofer 1996; Gagnon 2004b; Larsen 1991, 2001; Larsen and Milner 1994; Ramenofsky 1987; Simon and Gagnon 2005; Verano and Ubelaker 1992). This study evaluated the idea that due to cultural, behavioral, and contact differences, there should be significantly higher rates of disease, dietary and metabolic skeletal pathologic responses, and trauma for the Susquehannock than for the Piscataway. The anticipated higher rates of infection were found in the Susquehannock population, with significant evidence of infectious disease among males with three of 17 Susquehannock males showing infection and no cases in Piscataway males. The source of infection among the Susquehannock is treponemal infection, probably venereal syphilis with caries sicca evident on the crania. These data also support historic reports which indicated that the Susquehannock were victims of and a source of infection during the 1,600 s to other tribes, especially the Iroquois (Alchon 2003).

Historians (Kellock 1962; Toogood 1969) noted no specific reports of the Piscataway suffering any infectious disease outbreaks, which is consistent with the skeletal evidence. It is possible that the Piscataway suffered acute infectious diseases, which did not manifest on the skeletal remains (Wood et al. 1992). However, with the lack of skeletal data as well as historic evidence (Ferguson 1941; Ferguson and Ferguson 1960; Gallatin 1973 [1836]; Jennings 1966, 1968, 1978, 1982; Kent

1984; Land 1981; Maniez 1994; Porter 1979; Potter 1993; Toogood 1969), it was unlikely that there was any major disease outbreak for the Piscataway during the 1,600 s.

With the dietary skeletal stressors (i.e. dental caries, AMTL, dental abscesses), the results were not what would be expected if the Susquehannock were under dietary constrictions accompanied by a harsher way of life with warfare and the stresses of European contact. The only significant results noted were for AMTL in premolars in the combined sample as well as among males with higher rates in both cases among the Piscataway. It is possible that cultural differences in activity (e.g. Larsen 1985; Milner and Larsen 1991) may account for the significant premolar AMTL differences. With 25 % higher rates of premolar tooth loss in Piscataway males than Susquehannock males, and with dental caries and dental abscess rates approximately equal, tooth loss may be explained by greater use of tobacco (*Nicotana rustica*) among the Piscataway than the Susquehannock (Winter 2001a, 2001b). The placement of a plug of shredded tobacco (activated with the mineral lime) in the mouth near premolar dentition may have helped induce higher rates of tooth loss (Miner 1939). Evidence of brown staining on dentition of these peoples also supports the possibility of tobacco use (Simon 2003). While tobacco farming is not specifically established historically or in the archaeological record for either the Piscataway or the Susquehannock, Captain John Smith (1986 [1624]) reported its cultivation and use by Algonquians in Virginia. Additionally, tobacco growing was widespread across this region, including by Virginia colonists who exported as much as 20,000lbs (9,072 kg) to England in 1612 (Winter 2001a, p. 3). Thus, the difference in tooth loss may be from tobacco use, perhaps as chewing tobacco, which was not unheard of among Native American groups (Winter 2001a, 2001b), and the AMTL differences could reflect this behavioral difference among males from these Algonquian Piscataway and Iroquoian Susquehannock cultures.

While differences in metabolic skeletal responses were identified, they were not statistically significant. Interestingly, the rates of LEH were greater among the Piscataway and especially among Piscataway females. Because LEH represent a growth interruption in the enamel formation caused by some kind of systemic physiological stress (Larsen 1997), it is possible that the Piscataway weathered a period or regular periods of stress, possibly caused by malnutrition. In addition, the greater rates of LEH among Piscataway females may represent behavior differences, where male children had access to better foodstuffs and were treated preferentially when compared to female children, as has been noted among other populations with this type of LEH evidence (Goodman et al. 1991). Additionally, because the differences in LEH for the Susquehannock were only 2 % higher, and males had the greater rates, there does not seem to be any kind of sex difference in access to food resources among this Iroquoian group. Overall, this LEH evidence may represent another cultural difference between the Piscataway and the Susquehannock.

There were also no cases of cribra orbitalia or porotic hyperostosis, both types of metabolic skeletal stressors, for Piscataway individuals, although there were three cases among the Susquehannock. One explanation for the occurrence of porotic hyperostosis and cribra orbitalia (associated in the New World with iron deficiency anemia) among only the Susquehannock may be dietary differences. As previously noted, maize was an important dietary component for the Susquehannock (Buikstra

1992; Vogel and Van Der Merwe 1977). Because of the iron-binding effect of phytates in maize, the consumption of this as a staple food may have caused or increased rates of iron deficiency (Loren 2008), resulting in the evidence porotic hyperostosis and cribra orbitalia on Susquehannock skeletal remains. In addition, the diet of the Piscataway may have included a higher component of marine resources, such as oysters and fish, which are iron-rich and combated any iron deficiency problems commonly seen in populations with maize as a dietary staple (Loren 2008). Potter (1993) discussed evidence of intensified oyster gathering and production after 1,300 in Algonquian archaeological sites from the Tidewater-Potomac area. He noted these camps showed evidence that oysters, which would have been an easily procured food source in this area, were harvested with the intention of being dried for storage. MEDLINE (2001) and the National Institutes of Health (2002) list oysters as a food containing a high bioavailability of iron (six oysters contain 25 % of the recommended daily value of iron). A modern study by Layrisse et al. (1968) described cases of low iron intake with maize that were raised significantly by the introduction of saltwater fish (300 % greater) to the diet. Thus, even if maize was a dietary staple to the Piscataway people, the inclusion of high iron foods would have helped to combat any problems that could result in iron deficiency anemia.

In addition, iron deficiency anemia with the skeletal evidence of porotic hyperostosis and/or cribra orbitalia can be found in cases of parasitic, viral, or bacterial infections associated with sedentism. Previous studies (Larsen et al. 2001; Reinhard 1992; Walker 1986) describe limited and contaminated water resources as one of the likely sources of parasitic infection and eventual skeletal manifestations of porotic hyperostosis and cribra orbitalia. The Piscataway were located next to multiple freshwater sources, and the absence of cases among the Piscataway may be due to this. Cases of porotic hyperostosis and cribra orbitalia among the Susquehannock may not have been caused by an absence of freshwater sources, but instead, availability problems. Before migrating, the Susquehannock requested protection from the Maryland government against the Iroquois, with whom they were at war. Due to this, the Susquehannock may not have been easily able to collect clean water or harvest marine resources (Gagnon 2004b; Simon and Gagnon 2005). In addition, a study by Simon and Gagnon (2005) showed Susquehannock health improved with the move to the Piscataway Creek area.

The last measure of health was evidence of trauma, both accidental and interpersonal. Contrary to the expected results, there was a complete lack of trauma in both the crania and dentition of the Susquehannock and Piscataway populations. In addition, while post-crania were not formally included in this study due to the loss of provenience, I observed only one account of trauma, the aforementioned broken and healed tibia, which likely resulted from accidental trauma (Ferguson and Stewart 1940; Simon 2003). Historic records indicate palisaded villages, conflicts, and raiding that took place, as well as siege of the Susquehannock by colonial forces and murder of both Piscataway and Susquehannock native peoples. As evidence for interpersonal violence is commonly found on crania (Frayser 1997; Lambert 1994; Larsen 1997), and the samples in this research are composed of crania, it is puzzling that no cranial trauma was noted in these samples.

Excavation techniques from the 1930s by avocational archaeologist Alice Ferguson could be one explanation for the absence of trauma notated. However, as

Stewart (Ferguson and Stewart 1940) reviewed the Piscataway sample, and all of the crania are present at NMNH from the original excavation of the Susquehannock settlement (Simon 2003), this cannot adequately explain the absence of cranial trauma. Potter (1993) argued that there was increasing evidence of interpersonal violence in these groups due to the palisaded villages found at the sites in this study. However, Larsen (1997) pointed out that these site characteristics (i.e., fortifications) only identify the threat of violence, and not the actual outcome. In this study, the absence of trauma may be interpreted as just that, an absence of violent trauma. Hostile interactions may not have resulted in interpersonal violence readily apparent on skeletal remains. In addition, the bodies of Susquehannock hostages killed at the start of the siege may not have been retrieved for burial within the fort. Thus, while the history of the area suggests violent interactions, the skeletal remains from this study do not show evidence of repeated conflicts.

Conclusions

The purpose of my investigation was to understand the health impacts of European contact on the Piscataway (Algonquian) and the Susquehannock (Iroquoian) in the Tidewater Potomac Mid-Atlantic region during the 1,600 s. Overall, I expected that Susquehannock health would have been worse because of greater accounts of violence and disruptions to their traditional way of life. My findings were not the straightforward pattern expected. Susquehannock and Piscataway cultural and behavioral diversity, as well as the nature of European contact in this region, may provide some explanations.

Overall, the Susquehannock showed the expected significant evidence of chronic disease with cranial treponemal infection, likely caused by tertiary venereal syphilis. They also had some kind of systemic condition and/or iron deficiency anemia with skeletal evidence of metabolic stress (i.e. porotic hyperostosis and cribra orbitalia), albeit not significantly different from the Piscataway. Contrary to expectations, the Piscataway had significantly higher rates of dietary stressors (i.e. AMTL) and higher, but not significant, rates of dental metabolic stress (i.e. LEH), especially among females. In addition, both groups had similar rates of dental caries and dental abscess.

These data support the historical accounts that the Susquehannock had health problems, in part due to contact with Europeans (i.e. treponemal infection) as well as some change in lifestyle that caused evidence of metabolic stress (i.e. porotic hyperostosis, cribra orbitalia). As both groups had similar rates of dental caries and dental abscess, and the archaeological and historic data suggest they had similar diets, the significant evidence of tooth loss among the Piscataway may be explained by masticatory behavior differences, such as the use of chewing tobacco. In addition, the greater rates of LEH in the dentition among Piscataway peoples indicate a systemic stress, such as a period of starvation, which was harsh enough to cause a lack of dental enamel formation. While not significant, these rates were higher among Piscataway females and may indicate that males were treated preferentially in resource distribution.

In addition, the most puzzling of the results was the lack of interpersonal violence on any of the skeletal remains in this study. Historic accounts of conflicts during the

1,600 s in the Piscataway Creek area were not reflected in the skeletal samples from this study. Although there were definite reports of murder and hostility at the Susquehannock fort (Ferguson 1941; Toogood 1969), the remains buried there do not seem to be direct victims of violence. In addition, evidence of violent raiding by other tribes and trauma on the Piscataway groups caused by colonists was not found on their skeletal remains.

We know that the impacts of European contact on the health of native groups depended upon the particular history, nature, and frequency of that contact. Considering that the Piscataway were a “client” tribe of the Maryland government and had a history of good relations with colonists at the St. Mary’s City settlement in Maryland, it was surprising that the biological evidence demonstrated few significant health differences between the Piscataway and the Susquehannock. Unlike some of their European colonial counterparts, Alchon (2003, p. 133) described British contact policy through the lens of commercial opportunities, with immigration and permanent settlement of the New World to own land and control land resources. In addition, the policy of “liberty of conscience,” which included the freedom to worship and no official faith, was a tenant of the St. Mary’s City colony (Krugler 2004). In this region, it was possible that local religious tolerance and a focus on land acquisition, and not on the native peoples, may have contributed to fewer negative contact experience impacts on these two native groups.

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