

# Linear Enamel Hypoplasia in a Commingled Archaeological Sample From Newton Plantation, Barbados

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## Abstract

Bioarchaeological research of Linear Enamel Hypoplasia analysis at Newton Plantation Burying Ground (ca. 1660-1820) has revealed ample evidence for early life stressors such as malnourishment and weaning. Following my previous research on this site, the current study examines enamel growth defects in the form of Linear Enamel Hypoplasia and their timing of disruption within a subset of commingled dental remains from the Newton Plantation. Bilateral maxillary and mandibular first molars, canines, and central incisors were evaluated without magnification and then inspected using a Dinolite W-20 digital microscope at 20x as well as a hand lens at 10x. Measurements of identified growth defects were taken using Mitutoyo digital needle-point calipers calibrated to 0.01 mm from the defect's center to the cemento-enamel junction. Of the 173 teeth that were scored, 26 teeth showed the presence of LEH. Based on regression formulae by Rose and Goodman (1991), the LEH age at disruption ranged from 0.3846 to 2.87 years. Such data suggest stress began during early childhood for the Barbadian enslaved. Although the remains were commingled during the 1970s by archaeologists working at the site, the high presence of Linear Enamel Hypoplasia in this collection contributes further data to more than 40 years of bioarchaeological research on childhood stress at Newton Plantation, as well as commingled remains analysis.

**Key Words:** Newton Plantation Burying Ground, Barbados, Linear Enamel Hypoplasia, malnourishment, weaning, environmental stressors, bioarchaeology, dental anthropology.

## Introduction

During the mid-17th century, Newton Plantation in

Barbados, West Indies, as many as 45,000 people were enslaved and forcibly relocated by the British from Africa to serve as labor for the production of sugar, rum, and other commodities. Archaeological excavations and craniodental studies performed by Jerome Handler and Robert Corruccini (Shuler 2019) on the plantation in the early 1970s revealed a total of 104 skeletons. Such studies and results provided over 40 years of bioarchaeological insight into the health and livelihood of the enslaved people living on the plantation (Shuler et al. 2019).

Dental evidence provided insight into early childhood dental growth arrest. Specifically, Linear Enamel Hypoplasia (LEH), which is a type of enamel defect that appears as macroscopic grooves and/or pitting on the labial enamel surface of the tooth. Defects such as these are linked to a variety of stressors, including malnutrition and infectious diseases, often resulting in the disruption of enamel formation during one's childhood (Franklin et al., 2022, 223). These defects are often referred to as "nonspecific" due to their incomplete nature; although they can reveal evidence of some form of physiological stress occurring during childhood, it is difficult to ascertain what specifically causes their eruption (Steinberg et al., 2015, 452). Weaning has also been noted as a possible stressor for enslaved individuals during this period, but such has not yet been proven within a single population (Corruccini et al. 1985, 706). Previous studies, including my former undergraduate study, reported modest rates of LEH (20% Corruccini et al., 1985; 19% Ritter, 1991; and 17% Shuler, 2005) based on clearly palpable enamel defects measured by specific methods (Shuler et al., 2019, 273). For this sequential study, LEH prevalence was assessed and recorded within a commingled sample of dental remains exca-

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vated from Newton Plantation. Unlike the articulated collection, LEH assessment and age-at-disruption have yet to be recorded within the commingled set of dental remains. Although commingled and having seemingly little to no other historical data for the collection, much data and insight can still be gathered for further bioarchaeological studies surrounding Newton Plantation. References to my former study concerning early childhood stressors and environmental impacts within the population are also addressed in this article. The measurement of LEH frequency and age-at-disruption within the commingled dental sample from Newton Plantation can offer further bioarchaeological insight for understanding the lives and health of past individuals living upon Newton Plantation, as well as enslaved precolonial Caribbean populations.

## Methods

In this study, a commingled sample of dental remains recovered during the 1997–1998 excavation was assessed for the presence or absence of LEH. The teeth are believed to have been originally excavated and subsequently reburied by archaeologists in the 1970s, resulting in the disarticulation and commingling of individuals.

In this study, the commingled dental remains were assessed for the presence or absence of LEH. Given the nature of the remains, certain methods concerning proper research analyses of commingled collections were used. Because there is no formal itemized list concerning the dental remains, the first step was to create a dental inventory categorized by tooth type, number, and side (RM1) following procedures outlined in Beck et al. (2019). This included dividing the dental remains by tooth type rather than burial type on the Excel spreadsheet.

All permanent, bilateral maxillary and mandibular central incisors, canines, and first molars in the commingled sample were assessed by me for LEH presence. A total of 173 teeth in the sample could be scored for at least one of the aforementioned tooth types. The teeth were inspected under oblique lighting, and any identified LEH defect was further examined using both a Dinolite W-20 digital microscope at 20x and a separate 10x hand lens. Using Mitutoyo digital needle-point calipers calibrated to .01mm, measurements of LEH were taken

from the defect's center to the cemento-enamel junction (CEJ). All data was recorded in an Excel spreadsheet, organized by tooth number and LEH presence or absence. Age at development for each enamel defect in the sample was calculated using regression formulae from Rose and Goodman (1991, 288–289).

## Results

In total, 173 teeth were identified and analyzed for the presence of LEH under oblique lighting and using 20x and 10x magnification. Of the 173 teeth, a mix of 26 bilateral maxillary and mandibular first molars, canines, and central incisors showed defect evidence of LEH. Measurements for the LEH were taken using the Mitutoyo calipers and later used to calculate age-at-disruption with the age-regression formulae from Rose and Goodman (1990). Being a commingled sample, burial numbers cannot be noted, so tooth types and their associative numbers were used to specify which remains showed signs of LEH and those which did not.

**Age at formation = age at crown completion – [(years of formation/crown height) x defect height (from CEJ)]**

LEH defects were not found on all tooth types; specifically, left maxillary first molars, right mandibular first molars, right mandibular canines, left mandibular central incisors, and left mandibular first molars were found to be absent of LEH presence during data collection. A higher frequency was shown in bilateral maxillary and mandibular canines (3/8). The second-highest frequency of LEH was found in the central incisors (1/8). The total frequency of individuals who showed the presence of LEH and were able to be scored was 1/7, or .15. The range for LEH age at disruption was found to be between 0.384 and 2.87 years.

For each tooth type, their age at disruption ranges were:

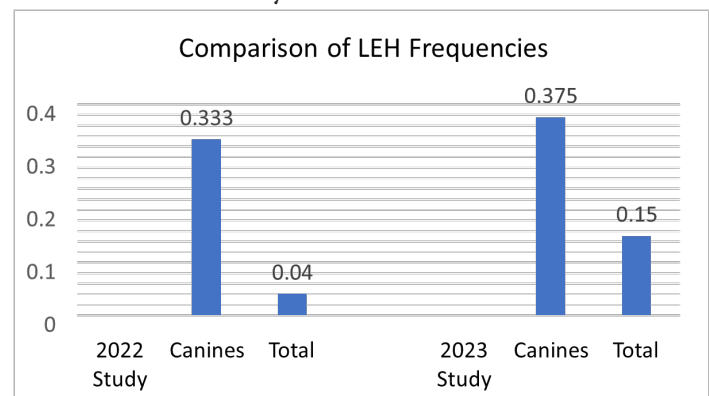
- First molars range = 0.3846 years
- Central incisors = 0.8081–2.8735 years
- Canines = 0.6250–2.1568 years

## Discussion and Conclusion

Malnutrition, environmental impacts, weaning, and other factors are archaeologically commonly found

within the bioarchaeological contexts of the Barbadian enslaved, particularly in studies at the Newton Plantation. Such was also shown to be true in my former undergraduate research study; here I found that LEH presence in individuals with multi-isotopic signatures of Barbadian birthplace supports former predictions of significantly higher levels of early childhood stress for those born into enslavement, including exposure to toxins such as lead (Schroeder et al. 2013) and, potentially, to ethanol from rum intake (Shuler and Schroeder 2013). The results from this study of the measurements of LEH presence in the commingled collection of remains show that children as early as 0.3 years of age were continuously impacted by this severe level of stress up until 3 years of age. Researchers estimation of age at disruption has been repeatedly argued for its validity; according to Hillson and Bond (1997), this measurement shows an “expression of the pattern of enamel layers” rather than the exact timing of a stress episode the individual encountered in their lifetime. Although isotopic data are unable to be taken within this sample, one can easily conclude that many of these individuals experienced severe stress in their early childhood. This therefore results in the development of LEH defects on the enamel surface of the labial teeth (Shuler et al. 2019). Higher frequencies in canines and central incisors are also congruent with the results of my former study. Studies of dental asymmetry trends are congruent with field theory, which entails that “key” teeth, which tend to be the most mesial tooth in each class, tend to show less asymmetry than others. These teeth, however, are more likely to display minor environmental and genetic defects than others (Townsend et al. 2015). Figure 1 depicts a comparison of the frequency of LEH results within canines from both my former and current research studies. Although weaning and other research arguments have not provided sufficient evidence of such, it is reasonable to assume that such is one of the reasons for higher mortality in non-adults during these periods, and therefore it could be possible to assume the eruption of dental enamel and hypoplasia prevalence later on in life (Wasterlain et al. 2018). Understanding the impacts of childhood within a bioarchaeological context is essential, as it “should be contextualized within cultural understandings of the trajectory of the entire life course from conception to death” (Mays et al. 2017). LEH as a whole is an essential piece of a bioarchaeologist’s toolkit for

discovering not only the lifestyle of an individual but also the environmental impacts resulting from these physiological stressors. Analysis of LEH has been used within several contexts of bioarchaeological studies, ranging from forensics, primatology, and archaeological analysis (Steinberg et al. 2015, 458). An example of this is a study looking at the changes in health due to transitions from hunting and gathering societies to agriculture at Dickson Mounds (Steinberg et al. 2015, 457). Results showed that there was an increase in LEH presence during the population transition to subsistence (Steinberg et al., 2015, 457). The study of LEH and other enamel defects is essential to bioarchaeology and biological anthropology as a whole. Through LEH analysis, one can answer critical questions surrounding the health and lifestyle of human populations and primates, as well as transitions in agriculture and subsistence practices (Steinberg et al. 2015, 461). The findings from this study, along with former research, are undoubtedly accredited with 40 years of former bioarchaeological research surrounding the Newton Plantation. The data found offers new opportunities for bioarchaeological dental research and LEH analysis within commingled dental samples. Therefore, providing a platform for studies of Barbadian enslaved peoples and trans-Atlantic slavery.



**Figure 1.** Chart depicting the comparison of LEH frequencies of canines, and the total number of teeth observed in my former 2022 fellowship study versus my current fellowship study.

### Statement of Research Advisor

This is Katie’s second undergraduate research project with dental anthropology and bioarchaeology on the Newton Plantation site. She expanded and did an excellent job in planning and carrying out this second project largely on her own. Through extensive time in

the lab, Katie has been improving her skills at tooth identification and analysis. She has also expanded her knowledge of both dental development and archaeology of the African Diaspora through more in depth reading of the scholarship that serves to contextualize this study. Katie's work will contribute valuable new data on early childhood stress experiences of enslaved individuals who lived on a 17th-18th century plantation in the Caribbean.

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## Authors Biography



Katie E. Smith is a senior-year student pursuing a B.S. degree in Anthropology at Auburn University. She is the assistant bioarchaeology lab director under Dr. Kristrina Shuler and an intern in Auburn's NAG-PRA lab. Her primary research focus has been studying dental morphology and linear enamel hypoplasia's upon a pre-colonial enslaved population from Barbados.



Kristrina A. Shuler is an associate professor in the department of Sociology, Anthropology, and Social Work at Auburn's College of Liberal Arts. She is a biological anthropologist (bioarchaeologist) whose primary focus is upon health and nutrition in early colonial populations from the Caribbean, Southeastern U.S., and Latin America.