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ANALYSIS OF ENAMEL HYPOPLASIA IN OPOSSUMS (*DIDELPHIS VIRGINIANA*), BALDWIN COUNTY, GEORIGA

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ABSTRACT

Characterized by pits, furrows, or swales on the surface of teeth, enamel hypoplasia is a permanent record of disturbances that hinder the development of ameloblasts (cells responsible for enamel deposition). These defects develop in response to physiological stressors that disrupt the typical formation of enamel. In this study, the mandibles of fifty-seven Virginia opossums (*Didelphis virginiana*) collected from Baldwin County, Georgia, were inspected for enamel hypoplasia. Swales, pits, and/or linear furrows were noted on the lower molars of 60% of the opossums. No difference in the rate of occurrence was observed between males and females. Within the subset of individuals exhibiting enamel hypoplasia, the defects were observed more frequently on the second (68%), first (45%), and third (36%) lower molars, and less frequently on the fourth (3%). Analysis of the order of tooth formation in this species indicates that the first and second lower molars were developing at the time of weaning. This pattern of hypoplasia suggests that weaning is a time of severe physiological stress in young opossums.

Key words: Enamel hypoplasia, Virginia opossum, *Didelphis virginiana*

INTRODUCTION

In mammals, the visible enamel surface of a tooth is typically white, smooth, and semi-transparent (Fig. 1A). The enamel, formed by a coat of ameloblasts, surrounds the crown with a mineralized layer produced in a two stage process: matrix secretion and maturation (1). The enamel matrix is the underlying mineral structure of dental enamel. During the secretion stage, ameloblasts release proteins that are mineralized by enzymes. In the maturation stage, ameloblasts transfer compounds used for the final mineralization process. If the ameloblasts are disturbed during tooth development, dental enamel may acquire certain defects. Enamel is not remodeled during the life of the organism and therefore serves as a permanent record of disturbances affecting the ameloblasts' functions.

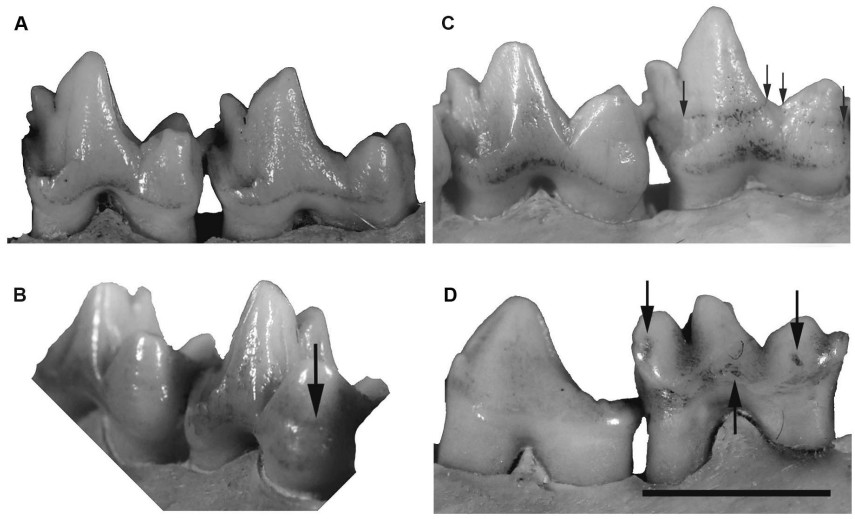

Figure 1. Lower molars of *Didelphis virginiana* from Baldwin County, Georgia, exhibiting smooth, normally formed enamel (A; buccal view, left m3-m4, GCM 2340), plane or swale-type enamel hypoplasia (B; buccal view, left m2-m3, GCM 2362), furrow-type enamel hypoplasia (C; buccal view, left m1-m2, GCM 2345), and pit-type enamel hypoplasia (D; lingual view, right p3-m1, GCM 2337). Anterior is towards left side of images. Scale equals approximately 5 mm.

Enamel hypoplasia (EH) is a deficiency of enamel thickness or enamel mineralization that occurs during tooth crown formation. Most hypoplastic defects occur as a band around the circumference of the crown, representing episodic disruptions to matrix secretions during tooth development. The defects vary widely in form. Berten (2) describes three types of defects that remain the basic classification of enamel hypoplasia: plane or swale-type (Fig. 1 B), furrow-type (Fig. 1 C), and isolated pit-type (Fig. 1 D). Plane or swale defects are characterized as an irregular sloping around the cusp tips of cheek teeth and the incisor edges of anterior teeth. The defect is often followed immediately by perfectly normal enamel; this type of EH indicates that there was a disturbance of short duration that prompted the minor disturbance of enamel development (3). Furrow defects are the most easily recognized (4), and are most often referred to as Linear Enamel Hypoplasia (LEH). In humans LEH is mainly prominent on the sides of anterior tooth crowns. It has been suggested that this type of EH results from an interference in the usual ameloblastic activity during the appositional phase of enamel development; this hindrance in turn results in an area of disturbed matrix formation (5). Pit defects can be seen on the cusps of cheek teeth or incisive edges of anterior teeth, in which small pits occur on the crown surface of a tooth. Pits are the

result of abrupt and permanent interruption of matrix secretion by compact clusters of ameloblasts.

Most studies have interpreted hypoplastic defects as indicators of physiological stress (4). Stressors may be biotic or abiotic factors that induce an interruption to any normal physiological growth. Since enamel is not subject to remodeling following initial formation, and because of the ring-like nature of enamel development, the location of these defects can indicate the age of an individual at the time of stress (6). Thus, dental defects are good indicators of stress occurring during an organism's enamel developmental period.

Didelphis virginiana, the Virginia opossum, is the only native marsupial found within the United States (7). This species utilizes a wide-variety of habitats including deciduous forests, open woods and farmlands. Its range extends from east of the Rocky Mountains south into Central America and north into Canada. Also, opossums are found in isolated locations on the Pacific coast. Common throughout Georgia, *D. virginiana* is a relatively easy species to collect due to its abundance and the frequency with which specimens are found dead on roadways. The purpose of this paper is to report the occurrence of EH in *D. virginiana* from Baldwin County, Georgia and to identify possible stressors associated with the defect.

MATERIALS AND METHODS

During the winter months of 2002 and 2004, fifty-seven road kill opossums were collected in Baldwin County, Georgia. As part of a prior morphological study, the specimens were skeletonized and catalogued (8). The teeth were examined for EH using a dissecting microscope. All skeletal material is housed in the Georgia College Mammal Collection (GCM).

RESULTS

Enamel hypoplasia was observed on the buccal and/or lingual sides of the mandibular molars of thirty-four of the fifty-seven individuals (60%). The defects were found in males (27/43: 63%), females (6/12: 50%), and sex undetermined specimens (1/2: 50%). Overall, a total of seventy-five occurrences of enamel hypoplasia were recorded. Of those defects, 55%, 45%, and 23% were plane or swale, pit, and linear type, respectively. For individuals exhibiting EH, the defect was observed on 45% of the first, 68% of the second, 36% of the third, and 3% of the fourth lower molars. Enamel hypoplasia occasionally appeared on more than one tooth within an individual's lower dentition. For individuals exhibiting EH, 38% had EH on the first and second molars, 19% on the second and third molars, and 3% on the third and fourth molars.

DISCUSSION

The possible stressors that induce EH in *Didelphis virginiana* can be seen as either non-random or random. Non-random stressors would include disruptions in nutrient availability associated with weaning, dispersal, or the

organism's first winter. Random stressors could be associated with disease or injury. The high frequency of EH on the first and second lower molars suggests that the EH in this population is associated with a non-random stressor. As previously indicated, defects in enamel are permanent markers; consequently, the location of EH can be correlated to the age at which an individual sustained the defect.

According to Gardner and Sunquist (9), the first lower molar erupts between the 3rd and 4th month of life; the second lower molar between the 4th and 5th month; the third lower molar between the 5th and 6th month; and the fourth lower molar between the 6th and 7th month. Tooth development precedes eruption by roughly four to six weeks. Weaning in *Didelphis virginiana* occurs at approximately 3 months (Day 87 – 106), coinciding with the development of the 1st and 2nd molars. Individual dispersal occurs at approximately 5 months (Day 120 – 150), coinciding with the development of the 3rd and 4th molars. The first winter occurs at approximately 9 months at which time all teeth have fully developed. The high frequency of EH on the first and second molars suggests that weaning is a period of significant nutritional stress for young Virginia opossums, and the frequency of EH on the third molar suggests that dispersal may be a physiologically stressful time period as well.

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