

Neonatal line: Importance in Birth Identification

Running title: The importance of Neonatal line in Birth Identification: A pilot study

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Abstract

Objective: To identify the Neonatal line in extracted deciduous teeth.

Material and method: A total of 5 extracted deciduous teeth were obtained from the Department of Pediatric and Preventive dentistry. The samples selected were unaffected by caries. These were then mounted on self-cure acrylic resin and sectioned in a microtome to a thickness of 0.5mm. The tooth sections were further ground on an Arkansas stone till paper thin. The samples were then placed on a slide and observed under three types of microscopes- Light, Polarized and Stereomicroscope under 4x and 10x magnification. **Results:** Among the three types of microscopes, it was found that the polarized microscope produced the clearest sharpest images of the Neonatal line. The images formed in the stereomicroscope and the light microscope were less defined. **Conclusion:** The Neonatal line is an important tool in distinguishing live birth from stillbirth. It can be used in medicolegal cases of female infanticide.

Keywords: Forensic odontology, Neonatal line, Incremental lines of Retzius, retained deciduous teeth, female infanticide

Introduction:

Forensic odontology, according to the FDI, is the branch of dentistry that deals with handling and examination of dental evidence and providing results of those findings in interest of justice (I). Forensic odontology plays a significant role in criminal, marital, monetary, social, burial disputes and in the identification of individuals missing for a prolonged period of time (II). In spite of the evolution of man, violence, natural calamities and disasters affect the lives of a numerous number of individuals every day. The identification of the deceased at the site of crime or at disaster hit areas have been carried out by dentists with the usage of dental records. These have been proved helpful during investigations (III).

Due to the fact that soft tissues get decomposed easily, the identification and estimation of the age of individuals becomes difficult. The soft tissues become putrefied very quickly due to the breakdown of proteins leading to the loss of cohesiveness between the tissues. By the time the bodies are discovered, they would have been severely decomposed, making the identification of bodies difficult (IV). Human dentition is a hard tissue alternative to fingerprints (V). The identification of remains by forensic odontology is doable as hard tissues are preserved even after death as they can withstand high temperatures up to 1600 degree celsius, with no loss of the overall structure. Teeth are resilient and wear resistant, hence they are valuable evidence in identifying and estimating the age of the individual (VI). The information derived from the teeth can be used in the identification and estimation of the age of the deceased individuals when comparing the current dental status to previous dental records or ante mortem photographs (VII).

The act of female infanticide is a menace and practiced in various areas across India and the world. Infanticide is the unlawful killing of very young children and is prevalent in various cultures all across the world. Female infanticide is the deliberate killing of newborn girl children, and it is more commonly seen in India and China.

A method of distinguishing stillbirth from live birth is by studying the cross section of the teeth and identifying the Neonatal line. These lines are produced due to the enamel deposition which is initiated by the ameloblasts which is an intermittent process following formation and rest (VIII). As the ameloblasts deposit enamel rhythmically in an incremental pattern, dark bands are formed which are known as Incremental lines of Retzius (IX). The line most prominent is the Neonatal line which is associated with live birth. This can be used in medicolegal cases in identifying the occurrence of female infanticide (X).

Material and method:

This present study was done in a private dental college, Chennai. The study was approved by the Institutional review board with an IRB approval number SRB/SDC/SSE/2020/0119-0720. The samples that were collected from the department were retained deciduous teeth, unaffected by caries. The teeth were extracted using a sharp periosteal elevator and placed in a sterile container. Since the samples were very brittle and could break easily, they were placed in self cure acrylic. Once the acrylic set, thin sections were prepared of 0.5 mm thickness in the mesiodistal and buccolingual planes. The samples were further ground on an Arkansas stone till paper thin. The samples were then placed on a slide and observed by a single investigator under three types of microscopes- Light, Polarized and Stereomicroscope under 4x and 10x magnification. Ethical clearance was granted by the institutional board with an ethical clearance number: **IHEC/SDC/PEDO-2004/21/42.**

Results

The neonatal line was visualized in all samples. Under the light microscope with a magnification of 4x and 10x, the neonatal line was seen as a distinct dark line, closer to the outer surface of the enamel and running as a vertical line throughout the surface of the enamel. The neonatal line could also be visualized under stereomicroscopy at a magnification of 10x, but it was not well defined. The line was best visualized under a polarized microscope as a birefringent band especially in the ground section of a molar sample in the buccolingual direction.

Discussion

Edwin Saunders was the first person to introduce age estimation by teeth, the reason being that dental hard tissues were more accurate compared to other skeletal structures (I). In children it can be used to estimate the period of death as the skeletal structures are not fully mineralized.

The neonatal line is a hypo mineralized dark band seen in the enamel. It extends from the surface of the enamel obliquely to the dentinoenamel junction. It is formed due to the metabolic changes seen in an infant due the change in the environment and stress during the delivery. It can be used to distinguish live birth from stillbirth. The thickness of the band is seen to be dependent on the type of delivery (X).

Eli et al found that the bands were thicker in infants that had undergone a difficult delivery when compared to normal delivery. The placement of bands was observed to be located more cervical if the gestation is prolonged. The bands could not be properly visualized in infants who underwent caesarean, the reason for this was because the ameloblasts are highly sensitive when undergoing stress or harmful stimuli. This is seen in the birthing process where there is a sudden change in the deposition of the enamel matrix that occurs temporarily as a structural disturbance. The formation and calcification of all primary teeth as well as the first permanent molar occurs from the 20th week in utero. The neonatal line can be visualized on any of the primary teeth and even on the first molar if the infant survives for at least a period of 7-10 days.

This is the optimal time for visualizing NNL as a distinct band between pre and post natal enamel (IX). Another alternate reason for the formation of NNL is due to the decreased calcium levels during the first 24 hours of birth (XI).

Contradicting this, a study conducted found that the width of the neonatal line was inversely proportional to the duration of the delivery, where in a longer period of delivery, the line could not be appreciated (XII).

A study by Janardhanan et al was done in an infant who died six days after birth due to respiratory distress. The developing tooth germs were extracted and sectioned. The results were similar to our study where the neonatal line was better visualized under polarized microscope (XIII).

The stereomicroscope is an optical microscope functional for visualizing low magnifications of a particular sample. The method of image formation is by using light reflected from the surface of an object rather than transmitted through it. The image formed is magnified between 10x-40x.

Light microscope is an instrument that uses visible light to detect and detect very small objects. The two types of light microscopes are Simple and Compound microscope, depending on the type and number of lenses required by it.

Polarized light microscope is mainly used in the qualitative assessment of different areas. The neonatal line is a line that is hypo mineralized and due to this it is better visualized using a polarized microscope. This is due to the fact that it produces a clear distinction between a demineralized layer and a mineralized surface, giving rise to either a radiolucent layer or a radio opaque surface.

In cases where the child was still born, as there were no environmental changes, the neonatal line cannot be appreciated. This tells us that just the presence of the neonatal line indicates live birth.

The limitations of the study are that it is done on retained deciduous teeth and not in infants. The width of the lines was not taken into consideration. The sample size was small. In the future a larger sample size is required.

Conclusion:

The Neonatal line is an important tool in distinguishing live birth from stillbirth. It can be used in medicolegal cases of female infanticide. The neonatal line can be visualized as a distinct dark line lying closer to the outer surface of the enamel and running as a vertical line closer to the outer surface of the enamel and further running throughout the surface of the enamel. The best instrument to visualize it is under a polarized microscope.

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Nil

Conflicts of interest:

The authors had no conflicts of interest.

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Legends:

Fig1: Extracted retained deciduous teeth



Fig 2: Samples embedded in self cure acrylic

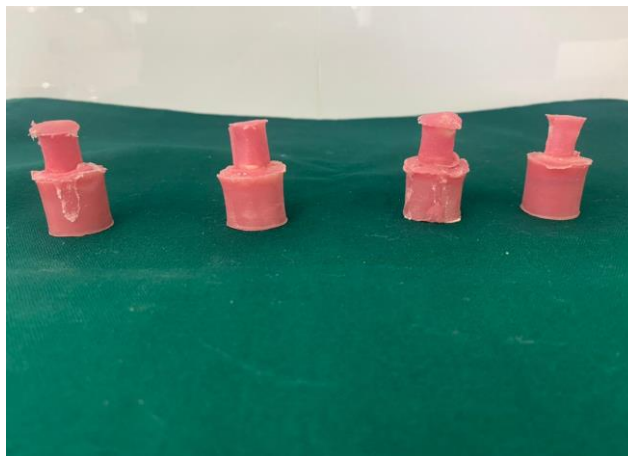


Fig 3: Ground sections of the samples



Fig 4: Neonatal line observed under Stereo Microscope under 10x magnification.

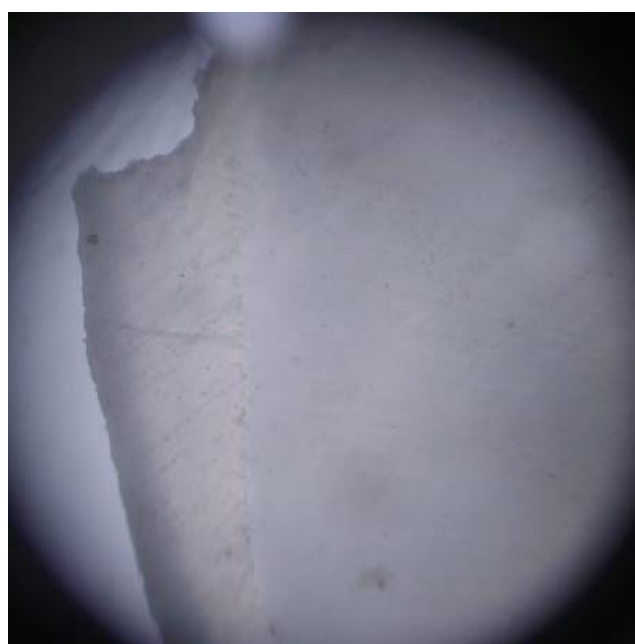


Fig 5: NNL observed under a light microscope with 10x magnification.

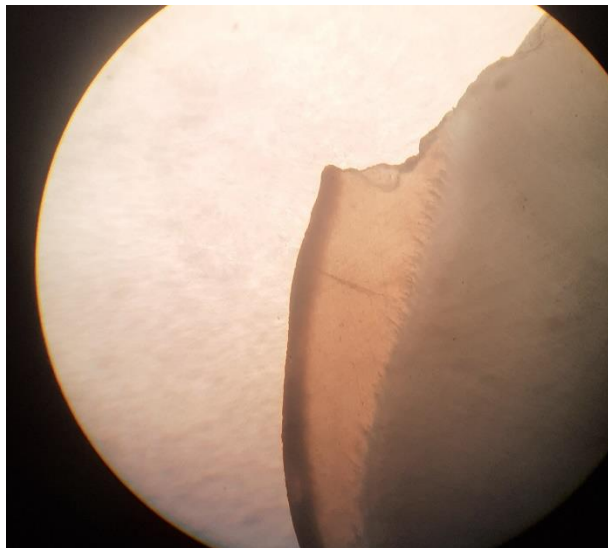


Fig6: NNL observed in polarized microscope under 10x magnification.

