

Scanning Electron Microscopic Examination of Root Canal Walls of Deciduous Molars with Necrotic Pulp

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ABSTRACT

The root canal walls of twenty-five deciduous molar teeth with exposed and necrotic pulps were examined using the scanning electron microscope. Immediately after extraction, all teeth were fixed in Karnosky's solution. The coronal portion of the tooth was sectioned at about 2mm above the enamel cemental junction. The mesial and distal roots were separated and either split in the mesio-distal or bucco-lingual direction. All specimens were prepared for SEM. Observations showed that all roots were infected with organisms consisting of cocci and short rods. Some of the cocci had penetrated the dentine layer. However, the distribution of organisms is not uniform throughout the canals. Bacterial invasion is most in the coronal region and reduces towards the apical region. Accompanying bacterial invasion is root canal walls deterioration. The odontoblastic processes are the first to deteriorate followed by the predentine layer.

Key Words: *Deciduous teeth, Root canal, SEM.*

INTRODUCTION

Pulpal dentine reaction to dental caries in deciduous teeth was described as similar to that of the permanent teeth (1). This was disputed by Rayner and Southam who concluded that the primary tooth pulp responded more rapidly to dental caries than that of permanent teeth (2). Clinical observations showed that the development of intra alveolar pathosis always occurred in the interradicular region of deciduous molars and at the apical region of permanent molars.

Interradicular or periapical pathosis is very often associated with an infected pulp. Endodontic microbiology had shown that the main causative factors in pulpal and periapical infection were bacterial in origin (3-6). The primary microorganism causing pulpal or periapical pathosis is difficult to determine. Advances in culture techniques have provided more information on the microflora in the infected canals (7-9). Predominance of gram-negative anaerobes in root canal infection had been demonstrated (4,10-11).

Bacteriologic studies of infected, open and unfilled deciduous molars have shown the presence of large numbers of cocci and bacteroides and to a lesser extent spirochaetes, yeasts and fibrils (12-14). Most of these organisms were anaerobic and only a few were aerobic. Similar studies on permanent teeth had also demonstrated the presence of a complex system of microorganism. However, the bacteroides appeared to predominate (8,11,15).

An association was also found to exist between the presence of bacteria in the dentinal tubules and pulpal inflammation (16-18). Pulpal inflammation was thought to be due to toxins produced by bacteria that had penetrated and remained in the tubules. These bacteria can remain in the tubules even after mechanical clearing and irrigation of the root canals (19).

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Limited information about canal wall changes in deciduous teeth following pulp necrosis is available. Previous studies only used light microscopy and offers limited information. The purpose of this study is to examine the root canal wall of deciduous teeth with carious exposure and necrotic pulps.

MATERIALS AND METHOD

Twenty-five human deciduous molars with open, untreated and necrotic pulps were selected for this study. Prior to extraction, the area around the tooth was examined for any soft tissue inflammation, swelling or sinus. Teeth were examined for any exposure and necrosis of pulpal tissue. Only teeth with obvious pulpal exposure and necrosis and/or soft tissue pathology were included in this study. No radiographs were taken.

Immediately after extraction, all teeth were washed under running tap water and later soaked in Karnosky's solution (2.0% paraformaldehyde and 2% glutaraldehyde in 0.02M sodium cacodylate) for one week. After fixation, the coronal portion of the tooth was sectioned with a diamond bur under water spray at about 2mm above the enamel cemental junction. The mesial and distal roots were separated by grooving the furcation area. The separated roots were labeled. One root was grooved longitudinally on the buccal aspect and the other on the lateral aspect with a diamond bur under water spray. The roots were split with a chisel and a mallet.

The specimens were then washed in distilled water, dehydrated in varying grades of ethanol and critical dried with carbon dioxide. The dried specimens were sputter coated with 200-300° A of gold and examined under a scanning electron microscope.

Longitudinal splitting of the mesial and distal roots of each tooth resulted in 100 specimens. Each specimen

was examined from the coronal end towards the apical end and from the pulpal surface towards the cemental surface.

RESULTS

Coronal third

Complete destruction of pulp tissue was evident (Figure 1. a). The canal walls also show some degree of deterioration. Most of the odontoblastic layer was destroyed. Remains of the reticular fibers of the predentine region was observed. In some specimens, intact spiral nerve fibers on the pulpal surface of the root canals were also observed. Circumpulpal dentine was observed to be made up of evenly distributed dentinal tubules. However, the diameter of the tubules varied from 3-5 microns. Microorganisms were

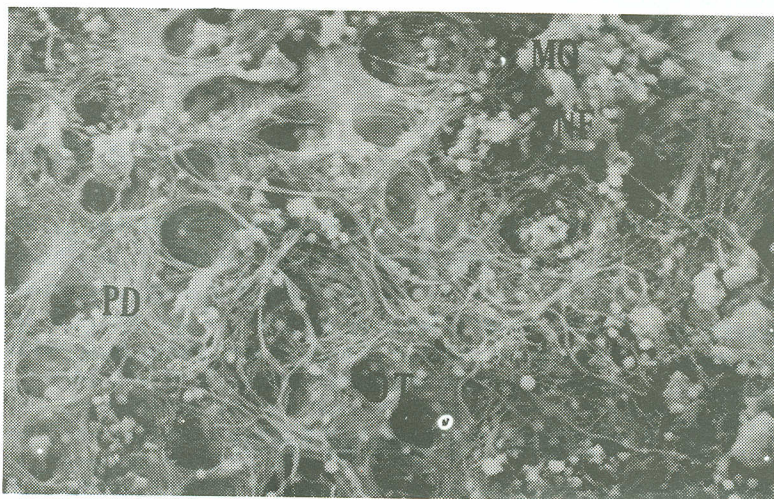


Figure 1.a. Coronal third of root canal showing deterioration of walls. Remains of predentine seen as a lacy network of fibrils (PD) and neural fibers (NF). Exposed and uniformly distributed dentinal tubules (DT) were observed. Microorganisms had infiltrated the lacy network and the dentinal tubules (MO). Cocci appeared to predominate.

observed on the walls of all specimens. Colonies of microorganisms were scattered on the pulpal surface, embedded in the reticular fibers or forming aggregates of colonies occluding the dentinal tubules. The colonies were dominated by cocci. Some rods were also present. No spirochaetes nor filamentous organisms were observed.

Invasion of bacteria deeper into the dentinal layer was evident up to the mid dentine layer (Figure 1.b). They occupied the dentinal tubules as well as the peritubular area. The tubules and peritubular areas were observed to be invaded by cocci only.

Middle third

Though there was complete destruction of pulp tissue, a few red blood cells were observed in pockets on the walls. Deterioration of the pulp wall was to a lesser degree. In some areas, the odontoblastic processes were intact. Collagen fibers, small vascular elements

and neural sheaths form a lacy network on the walls. Though the number of microorganisms was reduced, the organisms were similar.

Invasion of organisms into the dentine layer was also observed. However, the depth of penetration is less; up to one-third of dentine thickness. An interesting observation is that invasion of organisms into dentine is confined to the tubules only. No organisms were observed to have invaded the peritubular region (Figure 2.b).

Apical third

As in the coronal and middle third region of the root canals, the pulp tissue was completely destroyed. Minimal deterioration of the pulp wall was observed (Figure 3.a) The odontoblastic processes were intact. In some cases the odontoblastic processes were flattened and folded over the dentinal tubules. The number of microorganisms were very much reduced. Only a few cocci were observed scattered on the walls.

No invasion of organisms into the dentine layer was observed (Figure 3.b)

Discussion

Light microscopy had been used to analyze bacterial invasion in the radicular pulp of primary teeth (2,13). Due to its limitations it could not provide information on the bacterial topography and systemic examination of the root canals was not possible. Scanning electron microscopy was used in this study for it has been shown to overcome the limitations of light microscopy especially in identifying bacterial types, location and distribution (10,19-21). Another advantage of SEM is that it allows detection of organisms that are difficult to culture.

In this study, attention was focused on the root canal walls of deciduous teeth with necrotic pulp. Necrosis of pulpal tissue was observed throughout the entire canal. Related to the pulpal necrosis were the



Figure 1.b. Dentine layer in the coronal third showing invasion of microorganisms into the dentinal tubules (DT) and peritubular areas (PT)

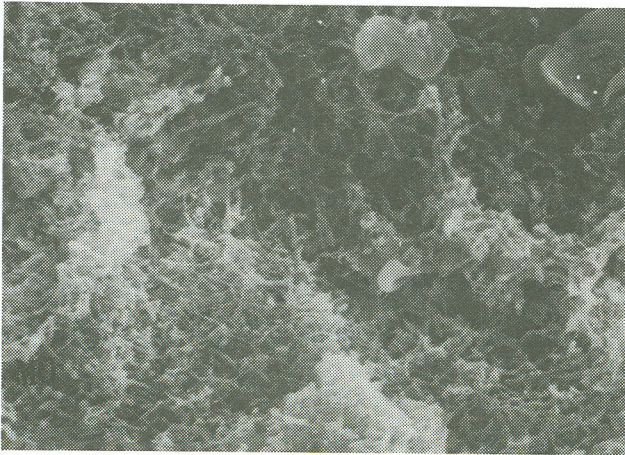


Figure 2.a. Middle third of root canal wall showing lesser deterioration. The odontoblastic layer is fairly well preserved. Microorganisms (MO) were reduced in number.

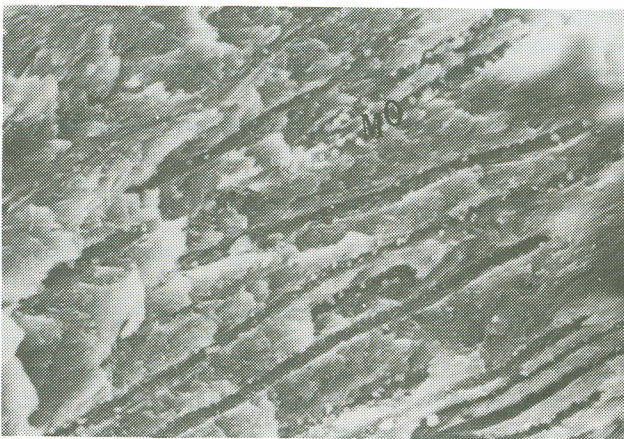


Figure 2.b. Dentine layer in middle third of root region showing microorganisms (MO) confined to the intra-tubular region.

presence of microorganisms throughout the canals. The organisms detected were complex consisting of cocci and a few short rods. This is in accordance with the findings of Cohen et al (11). No spirochaetes and filamentous organisms were observed. Tronstad et al (10) attributed this to the lacy nature of the remains of the predentine layer masking the presence of rods and spirochaetes. Distribution of organisms throughout the canal was not uniform. The coronal third was densely infiltrated, the middle third moderately while the apical third was sparingly infiltrated by organisms. This is in accordance with the findings of Quiott et al (20). It could be explained by the pattern of infection originating from the coronal region. Unlike the findings of Tronstad et al (10), no extracellular substance was observed.

Bacterial invasion was however not limited to the pulpal surface of the canal walls but continued into the dentine layer. The pattern of bacterial invasion follows the same pattern as that in the root canals. Deeper penetration was observed in the coronal third. In this region penetration into the peritubular region was also observed. The number of organisms and the depth of penetration into the dentine layer reduces towards the apical region. It thus appear that bacterial invasion into dentine layer was via the dentinal tubules and into the peritubular dentine.

Accompanying pulp necrosis and bacterial invasion was deterioration of the canal walls. The first to be destroyed was the odontoblastic layer followed by the predentine layer. Destruction of the odontoblastic layer was related to the bacterial invasion of the dentine layer. The greater the destruction of the odontoblastic layer, the greater the invasion of bacteria into the dentine. It thus appears that the odontoblastic layer offers some resistance to bacterial invasion. It further suggests that in the treatment of deciduous teeth with necrotic pulp, not only necessitates the mechanical preparation of the root canals but also the use of volatile medicaments to eliminate the organisms that had penetrated the dentin layer.

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Figure 3.a. Root canal wall in apical third region showing minimal deterioration. Odontoblastic processes were well preserved (OP). Some were seen to be stretched and flattened over the dentinal tubules. Number of microorganisms were minimal.

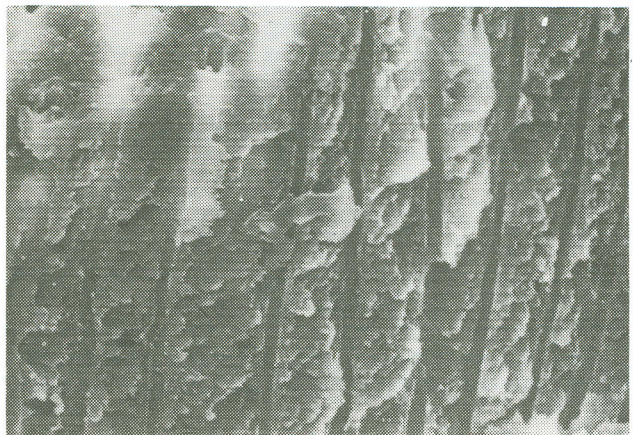


Figure 3.b. Dentine layer free from bacterial invasion.

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