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Evaluation of the Dentinal Bridge after Pulpotomy and Calcium Hydroxide Dressing

Evaluacion del Puente Dentinario Despues de la Pulpotomia y Recubrimiento con Hidroxido de Calcio

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The characteristics of the hard tissue bridge formed after pulpotomies and the dressing of the pulpal wound with a calcium hydroxide-camphorated *p*-monochlorophenol paste was evaluated in 13 young premolars with the use of a scanning electron microscope and methylene blue dye.

The coronal surface of the bridge showed the presence of crystals of different sizes and shapes. The pulpal surface of the bridge was formed by the coalescence of calcospherites, showing the existence of numerous circular or oval holes of 20 to 250 μm diameter approximately. The permeability of the bridge was evaluated with the use of 2% methylene blue dye, showing an intense filtration of the dye through the aforementioned orifices.

Fueron evaluadas con el uso del SEM y azul de metileno como colorante las caracteristicas del puente de tejido duro formado despues de pulpotomías y recubrimiento de la herida pulpar con una pasta a base de hidróxido de calcio-paramonoclorofenol alcanforado en 13 premolares jóvenes. La superficie coronaria del puente mostró la presencia de cristales de variadas formas y tamaños. La superficie pulpar del puente se formó por la coalescencia de calcosferitas, mostrando la existencia de numerosos orificios circulares u ovales de 20 a 250 micrones de diámetro aproximadamente. La permeabilidad del puente fue evaluada con el uso del colorante azul de metileno al 2% mostrando una filtración intensa del colorante a traves de los orificios antes mencionados.

Calcium hydroxide applied on the vital pulpal remanent tissue after pulpotomy stimulates the formation of a calcified bridge. This hard tissue bridge has been studied by different investigators, most of whom have found structural defects that increases its permeability (1–4).

The clinical importance of this situation creates a controversy. The object of this study is to evaluate, with the aid of scanning electron microscopy, the structural characteristics of the bridge, analyzing its permeability with methylene blue dye.

MATERIALS AND METHODS

This study was performed on 13 young and clinically intact premolars that were extracted for orthodontic reasons. After anesthesia and isolation with rubber dam, the coronal enamel was eliminated at high speed with diamond round burs. The dentin was removed by layers with round carbide burs under water spray until access to the pulp was obtained.

The coronal pulp tissue was eliminated with a sharp curette and the wound was washed with a solution of calcium hydroxide in distilled water, dried with sterile cotton pellets, dressed with a calcium hydroxide-camphorated *p*-monochlorophenol paste and covered with IRM, zinc phosphate cement, and amalgam. After 3 to 8 months the teeth were extracted and radiographs were taken mesiodistally and buccolingually. They were then cut horizontally at two levels, one coronal and the other apical to the bridge. The middle third was submerged in 5% sodium hypochlorite to eliminate the organic material and to be able to visualize the dentinal bridge, both from its coronal and apical surfaces (Fig. 1).

The sections were mounted on specimen holders with silver conductive paint. They were placed in a vacuum and covered with a layer of carbon and another of gold to a total thickness of 200 Å. A JEOL U3 scanning electron microscope (SEM) was used in this study. In four cases the permeability of the dentinal bridge was evaluated using methylene blue dye. In these cases and prior to the SEM processing, two drops of the dye were put in the coronal cavity of the middle third, checking after 72 h for any indications of leakage on the apical surface of the bridge.

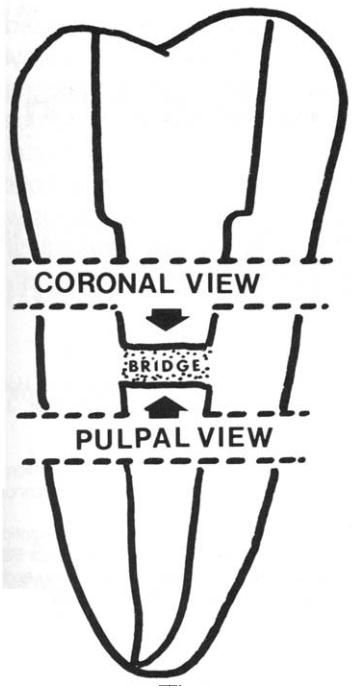

FIG 1. Diagram showing specimen preparation for SEM and permeability studies.

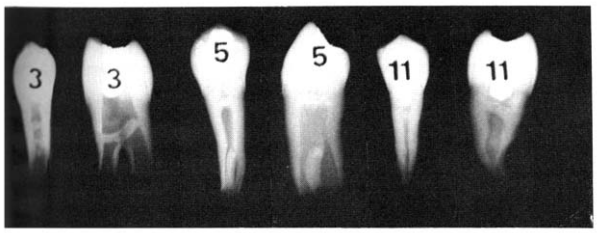

FIG 2. Postextraction radiographs of three different cases showing the hard tissue bridge in mesiodistal and buccolingual views.

RESULTS

The radiographs of every extracted case showed the presence of the hard tissue bridge as a radiopaque zone of variable thickness (Fig. 2). The SEM study showed crystals of different shapes, sizes, and dispositions on the coronal surfaces of the dentinal bridge (Fig. 3). On the pulpal view of the bridge, the surfaces were generally formed by the coalescence of calcospherites and a great number of holes, either oval or circular, of a diameter between 20 and 250 μm were seen (Figs. 4 and 5). There were no important structural differences between cases of 3 or 8 months postoperatively. The leakage analysis showed the invariable passage of the blue methylene dye through the holes in the dentinal bridge.

DISCUSSION

The structure, integrity, and reliability of the dentinal bridge has been studied and discussed in different papers. Langeland et al. (1) maintain that in spite of the radiographic integrity that the bridge may show, perforations and dead tracts are found histologically. Ulmansky et al. (2) found, in a SEM study, the presence of circular or eliptic defects, although smaller than those found in the present study. For these investigators, these defects communicate the coronal and apical surfaces of the dentinal bridge, just as we observed in our permeability study with the aid of methylene blue dye.

The shape and caliber of these perforations made us think that they belong to the blood vessels that remain

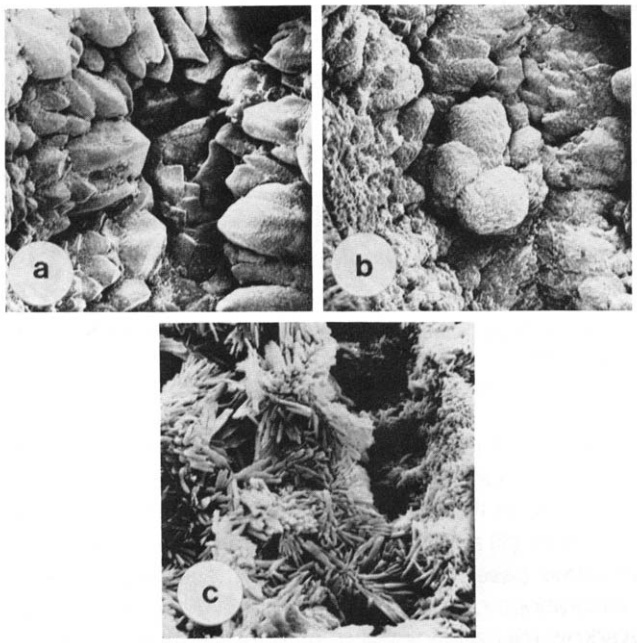

FIG 3. Coronal surfaces of different dentinal bridges. Union of crystals of different shapes, sizes, and dispositions were observed. Original magnification: *a*, ×400; *b*, ×400; *c*, ×3000.

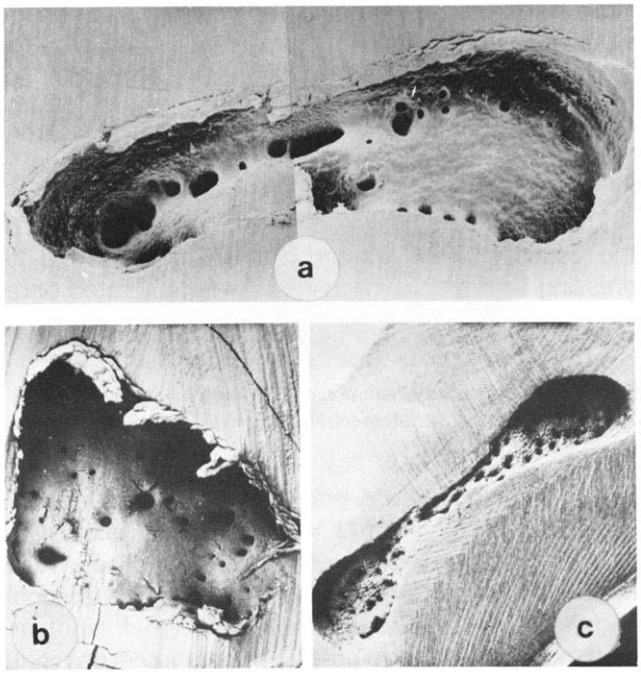

FIG 4. Pulpal surfaces of various dentinal bridges showing the presence of holes. Original magnification: *a*, ×60; *b*, ×40; *c*, ×20.

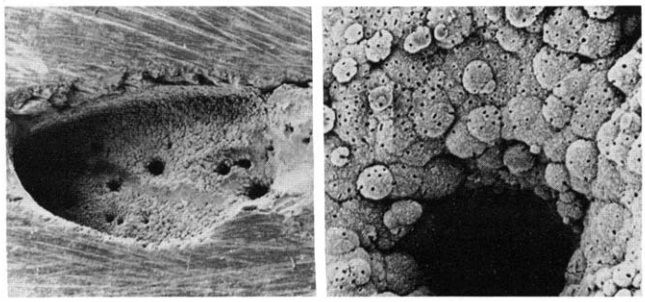

FIG 5. *Left*, Hard tissue bridge showing the presence of holes and the coalescence of calcospherites (original magnification ×60). *Right*, Higher magnification (original magnification ×600).

trapped during the calcification of the bridge. Bernick (5) points out the great amount of blood vessels that are found in the coronal pulp of a young tooth. Langeland et al. (1) and Schroder and Granath (3) have found, in some cases, the presence of these vessels in the perforations of the dentinal bridge. Although Berk and Karkow (6) and Holland et al. (7) insist that the permeability of the dentinal bridge does not compromise the result of the treatment, we consider that under certain clinical circumstances (marginal leakage of coronal fillings, residual caries, coronal fractures, etc.) the bridge would remain exposed to the oral environment, allowing the penetration of bacteria or its toxins that could affect the remaining vital pulp tissue.

SUMMARY

The structural characteristics and the permeability of the dentinal bridge formed after pulpotomy and its dressing with a calcium hydroxide-camphorated paramonochlorophenol paste were analyzed in 13 intact premolars with the aid of SEM and methylene blue dye. The hard tissue bridge that was radiographically found in every case showed an irregular structure in its coronal surface formed by numerous crystals. The pulpar surface showed a great number of holes of between 20 and 250 μm in diameter. The analysis with methylene blue dye showed an intense leakage through these holes, which confirms the porosity of the dentinal bridge.

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