

SCANNING ELECTRON MICROSCOPIC INVESTIGATION OF DENTINAL TUBULES IN *Cebus apella* DENTIN

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ABSTRACT

The aim of the study was to investigate the number and diameter of the *Cebus apella* dentinal tubules. The roots of the *Cebus apella* teeth were examined in specific tooth locations: the apical, middle and cervical dentin. The calculations were based on the scanning electron microscope photographs of the fractured surfaces. The results showed that the average number of dentinal tubules for each

location was: 74,800 tubules/mm² for apical root dentin, 90,000 tubules/mm² for mid-root dentin, 91,600 tubules/mm² for cervical root dentin. The average diameter was the following: apical root dentin, 4,30µm; mid-root dentin, 4,37µm; cervical root dentin, 5,23µm. These findings demonstrate that *the Cebus apella* teeth are a suitable substitute for human in endodontics studies.

KEY WORDS: Dentin, dentinal tubules, teeth.

RESUMO

MICROSCOPIA ELETRÔNICA DE VARREDURA DOS TÚBULOS DENTINÁRIOS DA DENTINA DE *Cebus apella*

O objetivo deste estudo foi investigar o número e diâmetro de túbulos dentinários em *Cebus apella*. Avaliaram-se as raízes dentais de *Cebus apella* em regiões específicas: terço apical, terço médio e terço cervical. Para os cálculos, baseou-se em micrografias de eletrônicas de varredura das faces internas após fratura. Os resultados mostraram que a média do número de túbulos dentinários por área em cada

região foi de: 74.000 túbulos/mm² no terço apical, 90.000 túbulos/mm² no terço médio, 91.600 túbulos/mm² no terço cervical. A média dos diâmetros foi de 4,30 µm no terço apical, 4,37 µm no terço médio e 5,23 µm no terço cervical. Estes achados demonstram que os dentes do *Cebus apella* são adequados substitutos de dentes humanos em estudos endodônticos.

PALAVRAS-CHAVES: Dente, dentina, túbulos dentinários.

INTRODUCTION

The dentin is a mineralized tissue that surrounds the dental pulp and the odontoblasts processes. On average, the dentin contains approximately 50% of mineral volume

(hydroxyapatite crystals), 30% of organic components (mostly type I collagen), and 20% of fluid (MJÖR et al., 2001).

The main dentin feature is the presence of dentinal tubules, which are the responsible for the dentin permeability. The dentinal tubules allow

a direct communication between the dentin and the pulp, and as a result of this pathway, various therapeutic agents may affect the pulp if they are directly applied to the exposed dentin. The rate of transport and subsequent effect of such agents depend on the number and size of the dentinal tubules.

Although dentin has been examined extensively (SCHILKE et al., 2000; VONGSAVAN et al., 2000; RIFAI et al., 2004), very few studies have compared the dentin in different areas of the root. Thus, the knowledge of the dentinal tubular pattern is extremely important to understand the course of endodontic research.

Considering the limited number of studies on monkey root dentin, the purpose of this study was to investigate the number and diameter of the dentinal tubules in monkey dentine.

MATERIALS AND METHODS

The material consisted of 8 canines with completed root development from adult animals. Two skulls of adult *Cebus apella* were obtained from the postmortem room of the Institute of Research Evandro Chagas (Pará, Belém, Brazil). The extracted teeth were immediately stored in distilled water.

Within 24 hours after extraction, the teeth were sectioned at the cementum-enamel junction with a high-speed handpiece. The crowns were discarded and the roots were fractured mesiodistally. Each specimen was placed in an ultrasonic with 0,5% sodium hypochlorite for 5 min to remove soft tissue debris.

Next, the specimens were placed into a vacuum and the surface was gold sputter-coated. With the use of a scanning electron microscope, the dentin of each specimen was examined in three areas of the root structure (apical, middle and cervical third). A magnification of 3000 was used to facilitate the counting of dentinal tubules and to help differentiate tubules from artifacts.

The number of tubules was calculated according to the following formula:

$$X = 1.000.000 \times n / (l / i)^2$$

Where: X= number of tubules/mm²
 n= number of tubules on the picture
 l = length of side of picture (µm)
 i= magnification

Photomicrographs were taken of each examined surface and the diameter of the tubules was measured on the pictures. Only the tubules that showed an almost circular lumen were selected.

RESULTS AND DISCUSSION

The permeability of dentin in monkey is not fully understood. Therefore, the knowledge of root dentin features is important for the endodontic research development.

The present study calculations, obtained from the measure of the dentinal tubules number, revealed that the average number of the dentinal tubules for each of the three locations was the following: apical root dentin, 74,800 tubules/mm²; mid-root dentin, 90,000 tubules/mm²; cervical root dentin, 91,600 tubules/mm².

The literature provides little information about the distribution of dentine tubules and their diameters in monkey teeth. Two studies concern only the coronal dentin (FORSSELL-AHLBERG et al., 1975; KROON et al., 1986). KROON et al. (1986) observed that the dentinal tubules run continuously from the dentin-enamel junction (DEJ) to the pulp of the tooth. Similar findings are described for human dentine (BRANNSTROM & GARBEROGLIO, 1972; OUTHWAITE et al., 1976; WATERS, 1980).

Referring to the number of tubules, it was noted their decreasing according with the dentin location (Figure 1). MJOR & NORDAHL (1996) related that the density of the tubules at the pulpal level was lowest in the root, especially apically, in human dentin.

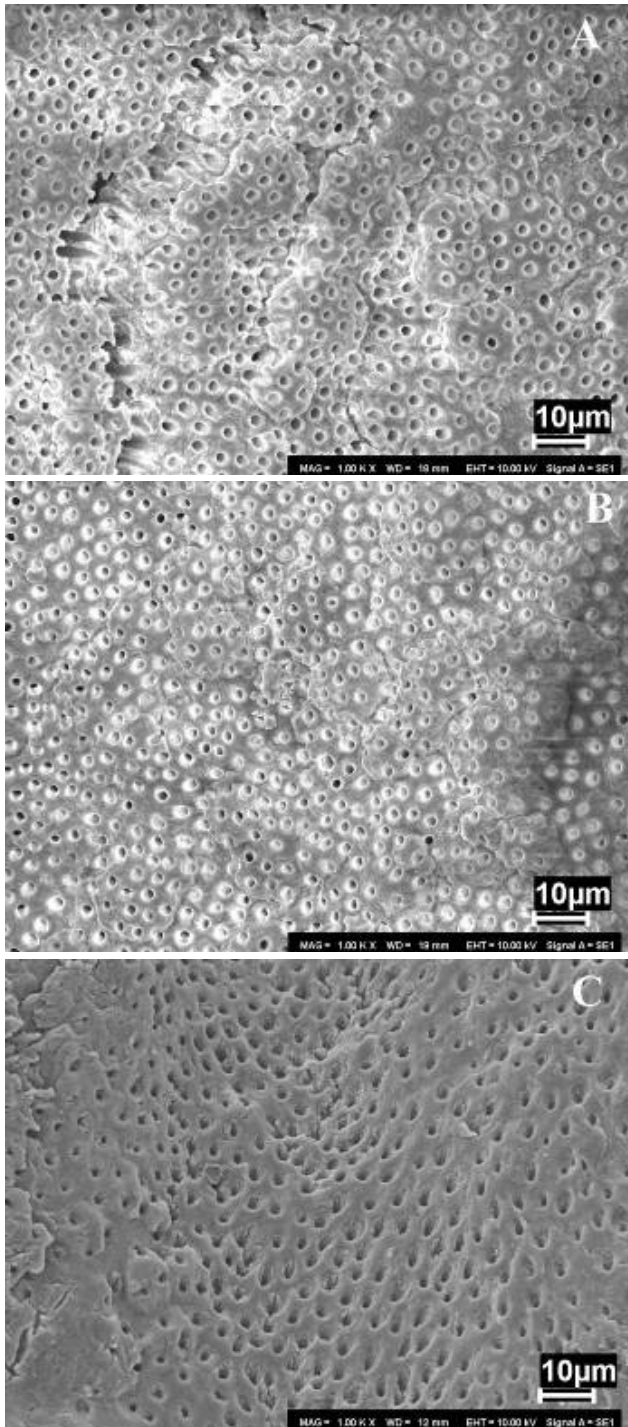


FIGURE 1. Morphologic surface pattern of the dentinal tubules: (A) cervical third, (B) middle third and (C) apical third. 3000 X magnification.

Concerning to the tubular diameter, the average number one each location was the following: apical root dentin, 4,30µm; mid-root dentin, 4,37µm; cervical root dentin, 5,23µm.

In addition, the diameter of the tubules was uniform at the pulpal wall, similar of those reported by FORSELL-AHLBERG et al. (1975).

Furthermore, the permeability of the investigated species dentin do not differ much from the human dentin. Finally, these results suggest that the *Cebus apella* teeth are a suitable substitute for human teeth in endodontics studies. Further studies are required to clarify this animal.

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