

A STUDY OF ROOT CANAL MORPHOLOGY OF *Cebus apella* TEETH

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ABSTRACT

An anatomic study of *Cebus apella* root teeth was performed to analyze the internal anatomy of permanent dentition, normalizing its use as experimental model endodontic research. Twelve adult animals were used in this study. After the removal of the organic tissue, the all teeth were removed, sectioned, analyzed and photographed with a stereomicroscope. The results showed that the anatomy of root canal of this species are similar to human dental anatomy, considering the shape, pathway and number of canals, but with some peculiarities, such as:

the root canal anatomy varied from oval to circular; in the lower canines, the canals are resembled a kidney, reflecting the outside contour of the root; in the upper molars, the mesiobuccal and distobuccal canals are oval, following the general contour of the tooth. The authors conclude that this primate can be applied as models for study of root canal treatment in human beings, in special the upper central and lateral incisors, upper and lower canines and first, second, third lower premolars present single and wide canal with easy access being ideals for endodontic experiments.

KEY WORDS: Anatomy, *Cebus apella*, teeth.

RESUMO

ESTUDO ANATÔMICO DO CANAL RADICULAR DE DENTES DE *Cebus apella*

Realizou-se um estudo anatômico em dentes do *Cebus apella*, para análise da anatomia interna do canal radicular dessa espécie, normatizando seu uso como modelo experimental. Utilizaram-se doze animais adultos. Após a remoção do tecido orgânico, os dentes foram removidos, seccionados e fotografados, sendo analisados com um estereomicroscópio. Os resultados mostraram que os dentes apresentaram características semelhantes às dos seres humanos, mas com algumas peculiaridades, tais como: a

anatomia do canal radicular variou de oval para circular; nos caninos inferiores, os canais são semelhantes a um rim, o que reflete o contorno externo da raiz; nos molares superiores, os canais mesiobucal e distobucal são ovais, seguindo o contorno geral do dente. Os autores concluem que esta espécie pode ser utilizada como modelo em pesquisas odontológicas, principalmente em estudos do tratamento do sistema de canal radicular.

PALAVRAS-CHAVES: Anatomia, dentes, *Cebus apella*.

INTRODUCTION

Researches in the health area usually use small and medium animals, such as rodents, dogs

and cats. In dentistry there is a pertinent literature on the morphological and anatomo-pathological features of these animals' teeth, which are commonly used as experimental models in

endodontic researches (BARKER & LOCKETT, 1971; ORSINI & HENNET, 1992; VONGSAVAN et al., 2000).

GIOSO et al. (1997) examined the non-apical ramifications from the main canal roots of 130 extracted teeth` dogs. They concluded that non-apical root canal ramifications are much less common in dogs compared to humans. VONGSAVAN et al. (2000), investigated *in vitro* and *in vivo* the permeability of incisal surface of a rat incisor and they concluded that the dentine and other tissues that form the incisal surface of a rat incisor are less permeable than cat or human dentine. MASSON et al. (1992) held in 240 teeth from eight different breeds of dogs, and the researcher's internal anatomy apical region, confirming the existence of a complex apical delta, where many ramifications are seen thin, and with an extensive channel summit closed. FORSELL-AHLBERG et al. (1975), in a comparative study in rat, cat, dog and monkey, investigated in commonly used experimental animals the pulpal wall and the dentin with special reference to the number and diameter of the dentinal tubules. In all species examined the dentinal tubules showed a straight course, except in incisors of rat, where local irregularities were seen. STEVEN & HOLMSTRON (1992) reported the probable causes of dental abscess in these animals and proper technique for the treatment of disease, including for reporting that the internal anatomy of the channel. However, the masticatory of all these experimental models appears differs from the human, which hinders the establishment of comparative patterns.

The non-human primates are potential models for biomedical research in the most diverse lines of research because they possess similarities with human beings (BRIGHAM, 1985). The primates are certainly a model animal that became extremely important over the last few decades. One reason is the fact that the man increasingly trying to understand its origin and, as such animals used for the development of biomedical research (WEBER, 2007). Nevertheless, the researchers have been paying little attention to the morphologic features of their teeth and support structures.

Studies are already being made in order to know the anatomy and coronary root of monkeys, particularly in African monkeys (LAVELLE, 1976), however there is no report in the literature about the inner anatomy of root canal teeth of *Cebus apella*. The necessity of studies about permanent dentition of *Cebus apella* approaching several aspects of inner anatomy of pulp chamber and root canal is an indispensable requirement to the procedures on the endodontium as well as it comes to complete the study of these animals' biology and to provide researches on experimental Dentistry

Thus, the objective of this paper was to accomplish a study of the internal anatomy of their root canals, in order to establish comparative patterns with the human teeth anatomy and to evaluate which teeth can be practicable for researches with endodontic instrumentation

MATERIALS AND METHODS

Twelve skulls of adult *Cebus apella* obtained natural postmortem from the Institute of Research Evandro Chagas (Pará, Belém, Brazil) were used in this study. The skulls were cleaned from most soft tissues, and then immersed in a mixture of equal oxygenated water and borax proportions. Then they were put on a hot source for 15 min with the solution in ebullition to dissolve organic tissue and permit the teeth extraction without fracturing the tip of the root. Next, all teeth were removed and each tooth was categorized according to their location within the dental arch.

The extracted teeth were sectioned at the cementum-enamel junction with a high-speed handpiece. The crowns were discarded and the roots were fractured cross sections. After that, the sectioned specimens were photographed with a digital camera (Coolpix 995, Nikon, Japan) and analyzed using a stereomicroscope (Technival Carl Zeiss) at a 1.6x magnification.

RESULTS

The results of the investigation are shown in Tables 1 and 2.

TABLE 1. Cross Sections of the lower teeth adult *Cebus apella*

Lower arch	Cross Sections	Canal	
		Number	Shape
Central incisor	Cervical third	One canal	Oval, mesio-distal flat
	Middle third	Two canals	Oval
	Apical third	Two canals	Oval
Lateral incisor	The description of anatomical features of the lateral incisor is identical to that of the central incisor.		
Canine	Cervical third	One canal	Resembled a kidney
	Middle third	One canal	Resembled a kidney
	Apical third	One canal	Circular
First premolar	Cervical third	One canal	Oval
	Middle third	One canal	Oval
	Apical third	One canal	Circular
Second premolar	The description of anatomical features of the second premolar is identical to that of the first premolar.		
Third premolar	The description is similar to that of the first premolar.		
First molar	Cervical third	Root canal – the mesial and distal root: one canal each	Root canal – the mesial: flat; the distal: oval
	Middle third	Root canal – the mesial: two root canals; the distal: one root canal.	Root canal – the mesial: flat; the distal: circular
	Apical third	Root canal – the mesial: two root canals; the distal: one root canal.	Flat
Second molar	Cervical third	Root canal – the mesial and distal: one root canal each	Root canal – the mesial and distal: circular
	Middle third	Root canal – the mesial and distal: one root canal each	Root canal – the mesial: flat; the distal: circular
	Apical third	Root canal – the mesial and distal: one root canal each	Flat
Third molar	Cervical third	One canal	Circular
	Middle third/ Apical third	Root canal – the mesial and distal: one canal	Root canal – the mesial and distal: circular

TABLE 2. Cross sections of the upper teeth adult *Cebus apella*

Upper Arch	Cross Sections	Number	Canal
Central incisor	Cervical third	One canal	Circular
	Middle third	One canal	Circular
	Apical third	One canal	Oval
Lateral incisor	Cervical third	One canal	Circular
	Middle third	One canal	Circular
	Apical third	One canal	Oval
Canine	Cervical third	One canal	Circular
	Middle third	One canal	Circular
	Apical third	One canal	Oval
First premolar	Cervical third	Two canals	Root canal – the mesial: oval; the distal: flat
	Middle third	Root canal – the buccal and lingual roots: one canal each	Root canal – the buccal: flat; the lingual: circular
	Apical third		Circular
Second premolar	Cervical third	Two canals	Root canal – the mesial: oval; the distal: flat
	Middle third	Root canal – the buccal and lingual: one canal	root canal – the buccal: oval; the lingual: circular
	Apical third		Circular
	Cervical third	Two canals	Root canal – the mesial: oval; the distal: flat
Third premolar	Middle third	Root canal – the buccal and lingual: one canal	Root canal – the buccal: flat; the lingual: circular
	Apical third		Root canal – the buccal: oval; the lingual: circular
	Cervical third	Root canal – The DistoBuccal, Lingual and Mesiobuccal: one canal	Root canal – The DistoBuccal and Mesiobuccal: oval; The Lingual: circular
First molar	Middle third	Root canal – the distobuccal, lingual and mesiobuccal: one canal	Root canal – the distobuccal and mesiobuccal: oval; the lingual: circular
	Apical third	Root canal – the distobuccal, lingual: one canal; the mesiobuccal: two canals	Root canal – the mesiobuccal: oval; the distobuccal and lingual: circular
	Cervical third	All of them	Root canal – the mesiobuccal and distobuccal: oval; The Lingual: circular
Second molar	Middle third	Root canal – the distobuccal, lingual and mesiobuccal: one canal	Root canal – the distobuccal, lingual and mesiobuccal: circular
	Apical third		Root canal – the distobuccal, lingual and mesiobuccal: circular
	Cervical third	All of them	All of them
Third molar	Middle third Apical third	Root canal – The DistoBuccal, Lingual and Mesiobuccal: one canal	Root canal – the distobuccal, lingual and mesiobuccal: oval

DISCUSSION

The knowledge of the morphology of the root canals of *Cebus apella* teeth is useful for the endodontic studies development because there is a similarity between his anatomical structure with that of human oral (with its own particularities of gender), in addition to present oral structures more appropriate, such as minimum length of the teeth and oral opening, when compared to rats, rabbits and dogs, animals also used in dental research.

The need for morphological studies in the teeth of no-human primates the Amazon, covering various aspects anatomic, principally internal anatomy, complements the study of biology of these animals and enable work to search in the area of endodontic research. The *Cebus apella* is known as the New World monkey that inhabits the forests of the South American continent and is distributed geographically almost the entire Brazil. It suits well to life in captivity, where he plays with easy. These animals are omnivores, and most of their diet consists of fruit and a small quantity of insects (TEIXEIRA et al., 2006). Thus, these animals are easier to handle and liable to be related to the cast of lines of research in the area of dentistry.

Several methods were used to investigate the anatomy of the root canals, such as direct observation with the aid of a microscope (SEMPIRA & HARTWELL, 2000); macroscopic sections (VONGSAVAN et al., 2000); filling of canals with inert material; conventional radiography and decalcification (GAMM et al., 1993; GIOSO et al., 1997). Therefore, the morphology understanding is essential for the successful treatment of the root canal. Thus, we used a digital camera in association with a stereomicroscope, which make the methodology practice and easier to be reproducible.

Literature revealed very few studies on monkey teeth (FORSSELL-AHLBERG et al., 1975; KROON et al., 1986) and so far no studies had been done on root canal morphology. In this study, the monkey teeth – *Cebus apella* – exhibit similarities to the dental anatomy of humans, except some morphologic differences in the internal anatomy. In the human teeth, there are

only two upper and lower premolars in each hemi arch, nevertheless, in *Cebus apaella* dentition showed a third premolar in each hemi arch. The cross-sections at various levels revealed that the root canal anatomy varied from oval to circular, showed closest similar to inner human anatomy. In the group of the upper incisors, the human teeth have the same internal configuration, only differing in cervical third, that appear like triangular form with it larger side tower buccal side (LEONARDO et al., 2005). The canine and the upper premolars groups showed the same cross sectional anatomy too. In the upper molars the mesiobuccal and distobuccal canals are oval followed the general contour of the tooth. In these group, the cervical third of mesiobucal canal differs from human internal anatomy (LEONARDO et al., 2005; CLEGHOR et al., 2006). In the lower arch, the group of incisors has the same morphology and cross sectional comparing with human teeth, like the higher mesiodistal flattening. In canine the canals showed be resembled a kidney, differing of human that have a oval form (LEONARDO et al., 2005). In the premolar group the cervical and middle third have the same configuration only differing of human premolar in apical third that have a circular form (CLEGHOR et al., 2007). In molar group the anatomy of mesial canal is mesiodistally flat, reflecting the outside contour of the root.

CONCLUSION

The authors conclude that this primate can be applied as models for study of root canal treatment in human beings, in special the upper central and lateral incisors, upper and lower canines and first, second, third lower premolars present single and wide canal with easy access being ideals for endodontic experiments Additional studies are needed to examine the dentin, pulp and periapical tissues.

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