Accessory foramina in the furcation area of primary molars. A SEM investigation

**ABSTRACT**

**Aim** The accessory canals in the furcation of primary molars can explain the frequent presence of radiolucency in the furcation area in case of pulpitis and necrosis of teeth. In fact these canals can represent a communication between periodontium and pulp tissue allowing bacteria to enter. The aim of this study was to determine the prevalence of foramina in the furcation area of primary molars.

**Materials and methods** The presence of foramina was assessed using extracted deciduous molars examined with Scanning Electron Microscope (SEM) evaluation. Thirty extracted human primary molars (15 upper deciduous molars and 15 lower deciduous molars) were selected to evaluate the presence of extra foramina in their furcation. All teeth were prepared according to Koenigs’ technique: the roots were cut in the furcation area perpendicular to the canals (1.5 mm apical to the external surface of the furcation and 1 mm apical to the cervical line) and then analysed with an electronic scanning microscope.

**Results and conclusion** This study demonstrated that 23 teeth (77% of the samples) had one or more extra foramina near the furcation.

**Keywords** Accessory foramina; Furcation; SEM.

**Introduction**

Pulp therapy in primary teeth is aimed to avoid loss of arch length, to preserve the masticatory function and to remove infection and chronic inflammation of the oral cavity. Literature points out that in spite of a correct treatment (i.e. pulpotomy); some teeth simply do not heal. Treatment failure is often due to the presence of pulpal-periodontal connections that are difficult to treat adequately [Morabito and Defabianis, 1992; Paras et al., 1993a; Paras et al., 1993b; Kramer et al., 2003].

The pulp chamber, as the radicular canals, is quite wide in primary dentition and anomalies of this structure can be noticed quite often. Among these the most common are odd root canals.

In the literature several classifications can be found based on morphology [Yoshida, 1975; Sicher, 1988] or topography [De Deus, 1975] of primary root canals. All authors agree that the presence of a union between pulp chamber and periodontal area could be responsible for the pathological alterations at the interradicular areas frequently found in primary teeth following chronic pulpitis or pulp necrosis. The hypothesis of the formation of accessory root canals is linked to an interruption of the Hertwig’s epithelial root sheath during odontogenesis, resulting in a defect of the dentinal wall of the pulp chamber, in the external furcation, or in any other area of the root [Orban, 1980]. The rupture of Hertwig’s sheath might be due to a high number of pulpar blood vessels [Weinmann, 1940; Scott and Symons, 1982] or to the entrapment of blood vessels deriving from the periodontal plexus into the Hertwig’s membrane [Kovacs, 1967; Cuttright and Baskar, 1969].

The presence of accessory canals in both upper and lower teeth was described for the first time in 1925 by Hess and Zurcher [1925] while the presence of extra canals and foramina was described using different methods [Morabito and Defabianis,1992; Paras et al., 1993a; Paras et al., 1993b; Kramer et al., 2003; Wrbaset al., 1997; Winter, 1962; Moss et al., 1965; Carlson and Andersen, 1966; Simpson, 1973].

The prevalence of extra canals was related to subjects’ gender and age [Woo and Miller, 1981; Ringelstein, 1989] revealing a higher prevalence in males.

The prevalence range of extra canals is very wide Kramer et al., 2003, [Moss, 1965], and this might be due to the different methods used for evaluation.

The aim of this study was to determine the prevalence of foramina in the furcation area of primary molars. The presence of foramina was established using extracted deciduous molars examined by means of SEM.

**Materials and methods**

**Selection of sample**

Among a sample of 126 deciduous molars extracted for orthodontic reasons, 30 teeth (15 upper deciduous molars and 15 lower deciduous molars) were selected, having more of half of their root lengths present; exclusion criteria were the presence of large caries and...
were coated with a golden palladium film with a sputter coater (Edwards S150A) and analysed with a scanning electron microscope, ZEISS DSM 962 (1994). Observations at high (200-500-1500X) and low magnification (15-20X) were performed.

In presence of extra foramina, the diameter was evaluated measuring the main axis using the pointer-cursor of the photo-editor software of the microscope. The foramina measurements were then input into an Excel spreadsheet and range and mean value were calculated.

Finally the Student’s t-test was performed using the statistical software STATA 10.1.

Results

Twenty-three teeth (77% of the samples) showed the presence of one or more extra foramina in the furcation area.

Their diameter varied from a minimum of 4 µm to a maximum of 300 µm with a mean value of 49.23 µm (43.23 µm for the first upper molars and 53.86 µm for the second upper molars); while in the lower molars the minimum value was 5 µm, the maximum was 150 µm and the mean was 36.6 µm (29.6 µm for the first molars and 64.12 µm for the second molars), as described in detail in Table 1.

Three types of foramina were: funnel-shaped, oval or chink-shaped (Fig. 2).

In the deepest area of the foramina wall, covered with a cement-like structure, it was likely to be present the apical end of dentinal tubules. One or more extra foramina could be usually noticed nearby; sometimes extra foramina were noticed inside the wall of larger foramina (Fig. 3). The lumen was often partially covered by debrids.

The observed foramina were distinguished from lacunar images (Fig. 4), which were probably root resorption areas without discontinuity in the cement tissue.
Discussion and conclusion

The presence of foramina in the external furcation of deciduous molars has been studied by different authors with different methods, so it is extremely complex to obtain unambiguous conclusions.

This study has pointed out the presence of a considerable number of foramina in the external furcation of primary teeth, particularly, 96 foramina were found in 30 teeth, with an average of 3 foramina per tooth (without any prevalence for the type of tooth and between maxillary or mandibular site).

The percentage of teeth that showed accessory foramina (77%) could be comparable to the that described by Dammaschke et al. (77%) [Dammaschke et al., 2004], Wrbas et al. (77.5%) [1997], and by
Morabito and Defabianis (70%) [1992], but at the same time it differs from the percentage cited in the studies of Paras et al. (50%) [1993a; 1993b] and Kramer et al. (53.3%) [2003].

One weak point of this paper could be that extra foramina were observed only at the external furcation area.

Different authors like Paras [1993a; 1993b], Kramer [2003] and Wrbas et al. [1997], have analysed both the external furcation and the pulp chamber floor. The different results showed that only some foramina lead to a real canal, or referring to Yoshida [1975] terminology, they can represent false canals entrance, closed, blind and ring-shaped ones.

Several points should be considered during restorative treatment of a decayed deciduous tooth: child age, the proximity of the infected tooth to exfoliation, the importance of the tooth in the future occlusal development, and the presence of the corresponding dental germ [Koch and Poulsen, 2004].

Extra foramina of deciduous molars could directly connect periodontium and pulp tissue (true canals) allowing bacteria in.

The clinical evaluation of the teeth to be treated is very important. Clinical testing (mobility, thermal sensitivity, percussion, palpation) and radiographies (abnormal resorptive processes or interradicular rarefaction) should be evaluated every time before choosing between pulpotomy and extraction.

The presence of structural anomalies in primary molars influences the choice of the therapy, particularly in patients affected by systemic pathologies as cardiopathy, nephropathy and immunodepression (transplanted patients, autoimmune diseases, chemotheraphy), whose general health could be worsened by a possible bacterial disease, caused by the extended infection to the periodontal tissues. In these cases the indication could be represented by the extraction of teeth with pulp pathology, even without an evident interradicular radiolucency.

References