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Differences in the confluence of mesial canals in mandibular molar teeth with three or four root canals

M. Furri
via Campo della Cintura 1 B, Lazise, Verona, Italy

Abstract

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Aim To investigate the correlation between number of root canals and their confluence in mandibular molar teeth.

Methodology A total of 553 first and 383 second mandibular molars were root filled between the beginning of 1997 and the end of 2006. Access cavities were prepared and the pulp chamber floors were carefully inspected with an endodontic explorer under magnification of 4×. After negotiating the root canal system, the 'straightest' canal of each root was instrumented. A gutta-percha cone was placed in the canal and a small file (08 or 10) was inserted to working length and then removed in all other canals. The gutta-percha cone was removed and inspected for notches indicating the presence of confluences. If it was not possible to probe completely one or more canals, the canal confluences were classified as 'not determined' (ND) if there was no sign of confluence; if a notch was present canals were considered confluent. For each tooth, the number of root canals and the presence of confluences were recorded. To test whether there was a difference in frequency of confluences between teeth with three and four root canals the chi-squared analysis with Yates' continuity correction was performed.

Results The frequency of a confluence in mesial canals of first molars was 56% in teeth with three root canals and 34% in teeth with four canals. In second molars, it was 67 and 41%, respectively. Differences in the frequency of confluences in teeth with three and four root canals were statistically significant both in first and in second molars.

Conclusions A greater incidence of confluent canals occurred in teeth with three rather than with four root canals both in first and second mandibular molars.

Keywords: anatomy and histology, mandibular molar, root canal anatomy, root canal morphology.

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Introduction

Knowledge of root canal anatomy is a pre-requisite for root canal treatment. Studies over the years have emphasized the complexity of the root canal system in terms of the number of canals in a root, their length and the presence of anastomoses and isthmuses (Hess 1925, Nielsen *et al.* 1995). Most reports on tooth anatomy are based on *ex vivo* analysis (Vertucci 1984, Caliskan *et al.* 1995, Gulabivala *et al.* 2001, 2002, Wasti *et al.* 2001) and clinical reports have been published only occasionally (Al-Nazhan 1999, Kim *et al.* 2005, Furri *et al.* 2007). From a clinical point of view, the most important parameters of endodontic anatomy seem to be number and length of root canals together with the presence of root canal confluences (Vertucci 2005). Radiographs and the use of apex locators may give reliable information about the length of the root canals whilst their actual number and morphology may

Correspondence: Dr Marco Furri, via Campo della Cintura 1 B, 37017 Lazise, Verona, Italy (Tel.: 0039 045 7580972; fax: 0039 045 7580972; e-mail: mafurri@tin.it).

only be determined by a careful analysis of the pulp chamber floor and an accurate management of the root canals themselves.

Many studies have focused on the description of different root and canal morphologies and various classifications have been suggested (Vertucci 1984, Weine 1996). Some studies correlated gender and ethnic origin with endodontic anatomy (Caliskan *et al.* 1995, Wasti *et al.* 2001, Sert *et al.* 2004, Kim *et al.* 2005, Ahmed *et al.* 2007, Tu *et al.* 2007) but none of the previously published papers have investigated whether a correlation exists between the number and confluence of root canals.

The purpose of this study was to conduct a clinical investigation on this feature of endodontic anatomy.

Materials and methods

All of the mandibular first and second molars consecutively treated by the author between the beginning of 1997 and the end of 2006 were included in the study. The patients were all Caucasian.

For each tooth, the number of canals and the presence of confluences were recorded. The analysis of each tooth was performed as follows: after the pulp chamber was opened, the floor was carefully inspected with the aid of dental loupes and a DG 16 endodontic explorer (Hu-Friedy, Chicago, IL, USA) to determine the number of the canal orifices. Every orifice was considered as a separate root canal. In each root, the straightest canal was instrumented, using sodium hypochlorite and EDTA irrigants. The appropriate size master gutta-percha point was placed in the canal and a small diameter file (08 or 10) was gently inserted and removed at the working length, under apex locator control, in all other canals, the cone was taken out and inspected to check if notches were present indicating that a confluence was present.

If it was not possible to reach one or more apices, the canal confluences were classified as 'not determined' (ND) if there was no sign of confluence; if the confluence occurred coronal to the obstruction, canals were considered confluent.

Exclusion criteria were:

1. Teeth retreated by the same author in the period of data collection (five first and four second molars); in this case, the tooth data were considered only once, and the greatest number of root canals found was considered. For example, if a tooth with three canals was retreated but four root canals were found, the tooth was considered in the four canal group.

2. Teeth extracted before the root canal treatment was completed.

3. Teeth with a number of root canals different from three and four (31 first molars and 27 second molars)

4. Teeth with an evident C-shaped anatomy (four second molars)

5. Teeth where the number of root canals was not determined because:

- root canals not found (one second molar),
- extraction of one of the roots (17 first molars and four second molars) and
- decision to not retreat one root, in the absence of periradicular pathology, because of the presence of a large post or a deep amalgam pin (seven first and two second molars).

The chi-squared analysis with Yates' continuity correction was performed. The null hypothesis being that there was no difference in confluence frequency between the three and four canal teeth.

Level of statistic significance was set at $P < 0.05$.

Results

A total of 936 teeth were included in the study, 576 were primary treatments and 360 were retreatments.

Table 1 describes the distribution between first and second molars and teeth where it was not possible to determine the presence of confluences (ND). In teeth with three canals, the frequency of a confluence was 56% in first molars and 67% in second molars (Tables 2 and 3).

In teeth with four canals, percentages were 34 and 41% in first and second molars, respectively (Tables 2 and 3).

Table 1 Distribution between first and second molars

Tooth	No. of teeth	Not determined	Teeth evaluated
First molars	553	127	426
Second molars	383	65	318

Table 2 Confluences in first molars

First molars	Confluences	Nonconfluences
3 canals* (231 teeth)	56.3% (130/231)	43.7% (101/231)
4 canals* (195 teeth)	33.8% (66/195)	66.2% (129/195)

*$P < 0.01$.

Table 3 Confluences in second molars

Second molars	Confluences	Nonconfluences
3 canals* (296 teeth)	66.9% (198/296)	33.1% (98/296)
4 canals* (22 teeth)	40.9% (9/22)	59.1% (13/22)

*$P < 0.05$.

Differences between teeth with three and four root canals were statistically significant in both first and second molars.

Discussion

The recognition of a confluence is a key factor in performing root canal treatment. Some authors have suggested, when a confluence occurs, to stop the preparation of the confluent canal at the point where the canals merge to avoid procedural errors (Vertucci 2005).

Another consideration is that where confluence occurs the formation of acute angles within the canal may provide an increased risk for the fracture of instruments.

Previous reports on confluences in mesial canals of mandibular molars related the frequency of a confluence to the tooth position, namely first, second or third molar, but failed to investigate whether a correlation between number of root canals and confluence existed (Tables 4 and 5).

In this study, teeth with three and four root canals were considered separately and it has been demonstrated that confluences are more common in teeth with three root canals rather than in teeth with four canals.

Conclusion

The confluence of mesial root canals in first and second mandibular molars was more common in teeth with three rather than four root canals.

Table 4 Distribution of confluences in mesial roots – survey of available studies on first molars

Investigators	Year	No. of teeth	Percentage of confluences
Vertucci	1984	100	63
Caliskan *et al.*	1995	100	50.85
Gulabivala *et al.*	2001	139	69.2
Wasti *et al.*	2001	30	29
Gulabivala *et al.*	2002	118	39.8
Sert *et al.*	2004	200	76
Ahmed *et al.*	2007	100	62
Furri *et al.*	2007	200	51.5

Table 5 Distribution of confluences in mesial roots – survey of available studies on second molars

Investigators	Year	No. of teeth	Percentage of confluences
Vertucci	1984	100	31
Caliskan *et al.*	1995	100	39
Gulabivala *et al.*	2001	134	55.1
Gulabivala *et al.*	2002	60	20.4
Sert *et al.*	2004	200	38
Ahmed *et al.*	2007	100	49
Furri *et al.*	2007	117	74.4

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