ANNALES
UNIVERSITATIS MARIAE CURIE-SKŁODOWSKA
LUBLIN – POLONIA
VOL. LIX, N 1, 10 SECTIO D 2004

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Morphology of root canal cross-sections of resected roots of first and second lower molars

Resection of a tooth apex aims at the creation of optimal healing conditions through tissue regeneration and the forming of a new ligamentous apparatus in the operated area. In order to achieve that, the following steps are taken: the root apex is exposed, tissue damaged by the inflammatory state is removed, the tooth apex is resected, the root canal is filled retrograde and the wound is stitched up (6). A strong prognostic factor determining the success of the procedure of resection is the hermetic sealing of the root canal(s) ostium, which will act as a barrier for the periapical tissue against infection caused by bacteria and toxins. It is also thought that the implementation of the microscope and micro-surgical techniques and the visualization of the intraradicular isthmus and additional canals as well as precise preparation of the canal ostia with ultrasonic tools are the key to obtain better results in the case of tooth apex resection in molars (2, 6), although according to some authors, the preparation of the root canal ostium with the implementation of such tools may in turn lead to the cracking of the root (1, 4). Consequently, the knowledge of root canals topography at the level of the resected tooth root seems to be crucial in the success of the surgical procedure.

The topography of cross-sections of lower molar roots at a height corresponding to root resection has not as yet been researched with the implementation of the resection model, although similar research with the implementation of the model has been conducted by M a u g e r et al. However, it concerned only lower incisors (3) and upper molars (7).

The aim of this work was to research the shape of the transverse cross-sections and the number of root canals in first and second lower molars according to the resection model, that is resected at a height of 3 mm from the root apex and at an angle of 20 deg.

MATERIAL AND METHODS

The research encompassed 100 randomly selected molar teeth, 50 first and 50 second lower molars. After extraction, the teeth were cleaned and stored in a 10% formalin solution for up to two days prior to the microscope research. Next, the root apexes were cut off with a diamond drill of a high-speed turbine at an angle of 20 deg and a height of 3 mm from the apex and then cemented with the implementation of prosthetic wax. The preparations were observed under an electron microscope QX3 (Intel Play), with an enlargement rate of 50x and 100x and digital photographs were taken. Attention was paid to the number of canals, the shape of canal cross-sections, the presence of root canals forking as well as the occurrence of isthmuses between the root canals.

RESULTS

The cross-sections of proximal roots of lower molars observed, were divided into the following categories: one round canal, one oval canal, one elongated canal, one elongated canal with an isthmus between root canals and two canals (Fig. 1–5). The cross-sections of distal roots of lower molars were as follows: one round canal, one oval canal, one elongated canal and one elongated canal with an isthmus between the root canals.

Fig. 1. Cross-section of a round root canal

Fig. 2. Cross-section of an oval root canal

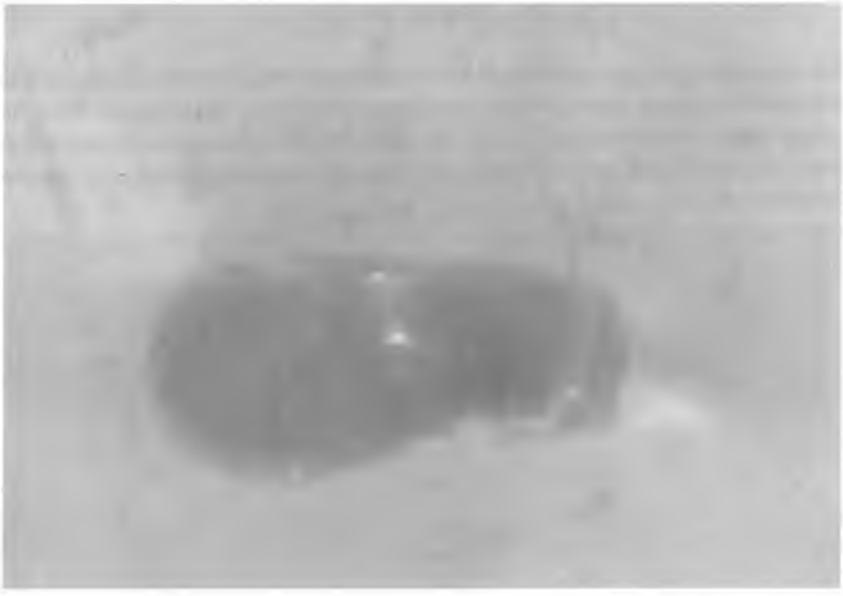

Fig. 3. Cross-section of an elongated root canal

Fig. 4. Cross-section of an elongated root canal with an isthmus

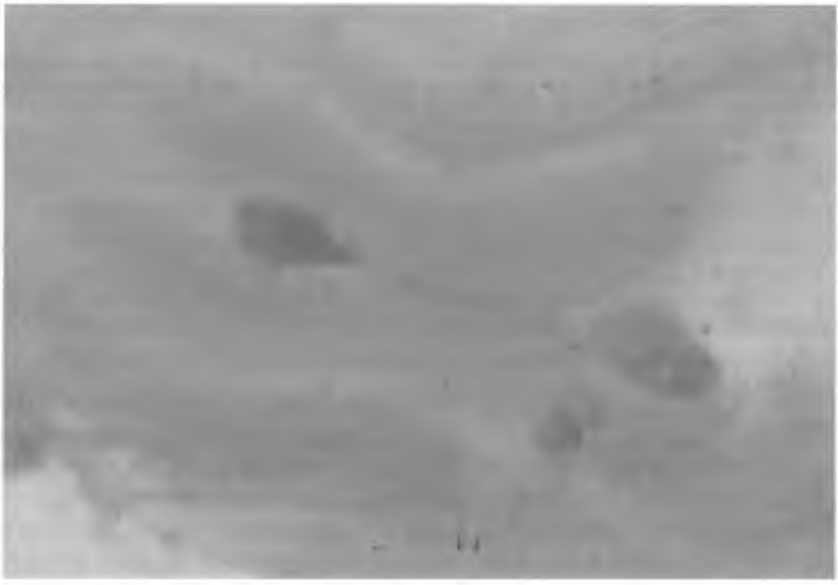

Fig. 5. Cross-section of a root canal forking into two independent root canals

In 20% of first molars, the presence of an isthmus between the canals in the proximal roots was observed; whilst in the group of second molars, an isthmus between the canals of proximal roots occurred in 18% of cases (Tables 1, 2). With regard to distal roots of first and second molars, in 2% and 6%, respectively, an elongated canal with an isthmus was noted.

In the case of distal roots of both first (56%) and second (50%) molars, the incidence of root canals of an oval cross-section was observed most frequently.

Table 1. Cross-sections of proximal roots of lower first and second molars

Shape of the cross-section of the canal(s)	First lower molar, proximal root (number of cases)	Second lower molar, proximal root (number of cases)
1 round canal	6 (12%)	10 (20%)
1 oval canal	11 (22%)	15 (30%)
1 elongated canal	14 (28%)	10 (20%)
1 elongated canal with an isthmus	10 (20%)	9 (18%)
2 canals	9 (18%)	6 (12%)

Table 2. Cross-sections of distal roots of lower first and second molars

Shape of the cross-section of the canal	First lower molar, distal root (number of cases)	Second lower molar, distal root (number of cases)
Round canal	14 (28%)	9 (18%)
Oval canal	28 (56%)	25 (50%)
Elongated canal	7 (14%)	13 (26%)
Elongated canal with an isthmus	1 (2%)	3 (6%)

DISCUSSION

This work utilised an angular method of cutting off a root within 20 deg which ensures excellent access to the root ostium. According to Sauveur et al., cutting off a root during resection perpendicularly to the long axis of the tooth ensures a more beneficial force decomposition between the resected root and the bone as compared with the angular cut. Nevertheless, the angular cut is most frequently implemented in the procedures of resection due to the simplicity of performance and easier access to the root canal ostium (5).

Weston et al. proved in their *in vitro* research that the selection of drill for the cutting off of the root apex during resection has little influence on the process of commencing the production of periodontal attachment by fibroblasts (8). In the research described above, the cut was performed with a high-speed turbine and a diamond drill.

In this research the presence of an isthmus between the canals of first lower molars was detected in 20% of cases in the proximal roots; whilst in the group of second molars the isthmus between canals of proximal roots was present in 18% of cases. With regard to distal roots of first and second lower molars, only in 2% (first molars) and 6% (second molars) of the cases an elongated canal with an isthmus was observed.

Due to a relatively high incidence of an isthmus between canals in proximal roots of lower molars it seems that the resection of such apexes ought to be performed with particular caution. This concerns also endodontic treatment of root canals prior to surgical procedures as well as the retrograde canal filling during resection.

Endodontic treatment is hindered in the case of an isthmus within the canal as it is difficult to demonstrate on a roentgenogram the existence of an isthmus between two root canals even in the case of a photograph taken with endodontic tools in the canals since two proximate canals may join into one through the intraradicular isthmus. Lack of success in endodontic treatment is accounted for precisely by the lack of possibility of correct cleaning and preparing of the periapical area. Resection of the root apex may contribute to the revealing of an isthmus or another canal (3).

In case of uncertainty concerning the correctness of endodontic treatment in tooth root resection, the root canals are filled retrograde. Knowledge of the topography of root canal ostia at the height of the resection level (this work assumed a distance of 3 mm from the root apex) seems to be crucial for the dentist performing the procedure of root resection in lower molars.

CONCLUSIONS

1. In the case of first lower molars in 20% of cases the presence of an isthmus between canals in the proximal roots was observed. In the group of second molars the isthmus between canals of proximal roots occurred in 18% of cases.

2. In distal roots of first and second molars, an elongated canal with an isthmus was observed in 2% and 6% of cases, respectively. With regard to the distal roots of both first (56%) and second (50%) molars, root canals with an oval cross-section were most frequent.

3. It seems that the resection of proximal root apexes in lower molars ought to be performed with particular caution due to potential difficulties connected with their retrograde filling, which is a manifestation of a relatively high incidence of an isthmus between canals.

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SUMMARY

Precise preparation of the root canal ostium with a view to hermetical closing with retrograde root filling is an important prognostic factor determining the success of the procedure of tooth resection. Root canals interconnected with a narrow isthmus may cause problems both in endodontic treatment and in retrograde filling. The aim of this work is the research of the transverse cross-section of root canals of first and second lower molars on the resection model. The research encompasses 100 randomly selected molar teeth: 50 first and 50 second lower molars. The tooth root apexes were cut 3 mm below the apex and examined under an electron microscope, special attention being paid to the shape of root canal cross-sections. In the group of first molar teeth, in 20% the presence of an isthmus between canals in the proximal roots was observed; in the group of second molar teeth an isthmus between the canals of proximal roots occurred in 18% of the cases. It seems that the relatively high percentage (20%–18%) of the occurrence of an isthmus, 3 mm below the root apex, between two elongated

transverse cross-section proximal root canals of first and second molars should encourage particular caution in the retrograde filling of the above-mentioned canals during the procedure of resection.

Morfologia przekrojów kanałów korzeniowych resekowanych korzeni pierwszych i drugich zębów trzonowych dolnych

Precyzyjna preparacja ujść kanałów celem hermetycznego zamknięcia przy wypełnieniu wstecznym kanałów jest ważnym czynnikiem prognostycznym, determinującym powodzenie zabiegu resekcji zębów. Znajomość topografii kanałów korzeniowych na poziomie resekowanego korzenia zęba wydaje się wobec tego istotna we właściwym wykonaniu zabiegu. Kanały korzeniowe połączone wąską cieśnią mogą bowiem sprawiać kłopoty zarówno w leczeniu endodontycznym, jak również przy wypełnieniu wstecznym. Celem pracy było zbadanie kształtu przekrojów poprzecznych kanałów korzeni pierwszych i drugich zębów trzonowych dolnych na modelu resekcyjnym. W badaniu użyto 100 przypadkowo wybranych zębów trzonowych: po 50 pierwszych i drugich zębów trzonowych dolnych. Szczyty korzeni zębów odcinano na wysokości 3 mm od wierzchołka i obserwowano za pomocą mikroskopu elektronowego. Zwracano uwagę na kształt przekrojów kanałów, obecność rozwidlenia kanałów korzeniowych i występowanie cieśni pomiędzy kanałami korzeniowymi. W grupie pierwszych zębów trzonowych w 20% przypadków stwierdzono obecność cieśni między kanałami w korzeniach bliższych, a w grupie drugich zębów trzonowych cieśń pomiędzy kanałami korzeni bliższych występowała w 18% przypadków. Wydaje się, że stosunkowo wysoki odsetek występowania cieśni pomiędzy dwoma wydłużonymi na przekroju poprzecznym kanałami korzeni bliższych pierwszych i drugich zębów trzonowych dolnych na wysokości 3 mm od szczytu korzenia (20–18%) powinien skłonić do szczególnej ostrożności przy wypełnianiu wstecznym tych kanałów w trakcie zabiegu resekcji.