Analysis of Tooth Access Opening by Students Who Have Completed a Course in Endodontic Practice (Part II. Upper Premolars)

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Abstract
Our dental school allocates time to endodontic practicals to 4th-year students who have completed the 3rd-year course in endodontics. In this term, students practice access opening on extracted upper human single root premolars. All of the teeth were donated by students and the effectiveness of this approach for teaching was analyzed. Although all students were able to find the canal orifices of teeth with one root canal orifice, they could correctly find both orifices in 84.6% of teeth with two root canal orifices. Perforation occurred in 9.3% of the upper premolars. Knowledge of tooth anatomy is essential for students studying endodontic practice. Future efforts should be directed at improving endodontic education to ensure that failure does not occur in practice.

Introduction
Graduation from dental school in Japan requires completion of a 6-year course. At Nihon University School of Dentistry at Matsudo, the theory and practice of endodontics are taught to 3rd-year students. Usually, access opening, root canal treatment, and root canal filling of incisors, premolars, and molars are done using extracted human teeth or artificial teeth. However, the curriculum was changed in 2005 and time for endodontic practice is now allocated to 4th-year students who have finished the 3rd-year student course. At this time, practical experience in access opening is gained using extracted human upper premolars. These teeth were donated by students and the effectiveness of this approach has been analyzed. Here we discuss the importance of this approach for endodontic teaching and practice.

Materials and Methods
Extracted upper premolars were obtained by students. Severely damaged teeth, e.g., C3 and C4, checked by instructors, were discarded. X-ray photographs were taken of each extracted tooth from two directions: medial-distal (M-D) and buccal-lingual (B-L). Kodak® X-ray film was used, as in our previous report (1). Students performed tooth access opening while referring to both the tooth and the X-ray photographs. A #1557 carbide bur and #2 and #3 long shank round burs were used for access opening and removal of the pulp horn. After the procedure was completed, the teeth were examined for the effectiveness of this educational approach. X-ray photographs were taken from two directions (M-D and B-L) using a digital X-ray system (Compuray, Trophy Radiologie, Tokyo, Japan) as in our previous report (1). A total of 86 donated teeth were used for analysis following a check by instructors in order to exclude premolars with two roots. A microscope (MANI® IMS22Z) was used for checking the root canal orifice and condition of the preparation. We assessed the numbers of root canal orifices, the success of access opening, the presence of perforation, removal of the pulp horn, pulp floor injury from scraping, and the outline of the cavity preparation in 86 upper premolars.
Table 1. The number of root canal orifice

<table>
<thead>
<tr>
<th>one root canal orifice</th>
<th>two root canal orifices</th>
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<td>34 (39.5%)</td>
<td>52 (60.5%)</td>
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Total 86 teeth

**Results**

**Root canal orifice**

In the X-ray examination of 86 teeth, 52 (60.5%) teeth had two root canal orifices, whereas 34 (39.5%) teeth had one root canal orifice (Table 1).

**Access opening**

In the 52 teeth with two root canal orifices, 44 (84.6%) were shown to have two root canal orifices, although 8 teeth (15.4%) were found to have only one root canal orifice. On the other hand, the 34 teeth with one root canal orifice were found to have exactly one root canal orifice. Typical cases are shown in Figs. 1 and 2.

**Perforation**

Perforation was found in 9.3% (8/86) of upper premolars. On the mesial wall, perforation occurred at the highest frequency of 50% (4/8) among the other walls, *i.e.*, 25% (2/8) on the distal, 12.5% (1/8) on the mesial concurrently with the distal, and 12.5% (1/8) on the palatal wall. In the four cases of mesial wall perforations, three were observed in teeth with two root canal orifices and one was in a tooth with one root. However, in two cases of distal wall perforation, teeth with one and two root canal orifices were perforated equally. Only one tooth with two root canal orifices was perforated on the palatal wall or on the mesial wall concurrently with the distal wall. All perforations were located within a cervical part. Typical cases are shown in Figs. 3 and 4.

**Removal of the pulp horn**

There were 9 teeth (10.5%) from which the pulp horn was removed completely (Fig. 5) and the pulp horn partly remained in 77 teeth (Fig. 6). Pulp horn was removed completely from 8 teeth with two root canal orifices and one tooth with one orifice.
Pulp floor injury from scraping

The pulp floor was scraped in 18 of 52 teeth with two root canal orifices. Typical cases are shown in Figs. 7 and 8.

Outline of the cavity preparation

Cavities were prepared appropriately in 2 of 86 teeth (Fig. 9).
Discussion

Access opening is the most important aspect of endodontic therapy because root canal treatment cannot be done without discovery of the root canal orifice. The number of root canal orifices and root canals differs according to tooth type. For example, upper incisors typically have one root canal orifice and one root canal, whereas upper first premolars have two root canal orifices and two root canals. Knowledge about tooth anatomy is essential for dental treatment, especially endodontic therapy. In previous research (1, 2), investigators have reported that knowledge of tooth anatomy is important in fundamental endodontic practice.

Students have usually learned about tooth anatomy by the time they reach their 2nd year. However, they have no experience in preparing cavities for confirmation of the pulp horn and root canal orifice. Thus, location of the root canal orifice is difficult without a sufficient grasp of the three-dimensional structure of the tooth.

Upper first premolars each have two root canal orifices (3, 4). In the present series of teeth, two root canal orifices were found in 60.5% of upper premolars and one root canal orifice was found in 39.5% of upper premolars. This result suggests that the majority of the teeth obtained from the students were not specifically upper first or second premolars.

Perforation was observed in about 9% of cases. In a previous report, students perforated 20% of upper molars and 13.9% of lower molars (1). Thus, perforation occurred less often in premolars than in molars. Because we did not obtain X-ray photographs before access opening, the reason for this is unclear. However, we speculate that the perforated teeth had an unusual morphology in the pulp horn and pulp floor area. They may have lacked space due to aging (3) and it was very difficult to find the position of the canal orifice. Students sought the root canal orifice with insufficient knowledge of tooth anatomy and prepared the pulp floor excessively. Finally, gouging and perforation occurred. In the future, it will be necessary to give students instruction in anatomical peculiarities of aged teeth to avoid preparation failure in practice. For example, the distance from the cusp to the pulp floor, the size of the root canal orifice, and other features in both aged and young teeth need to be demonstrated. Poor results were also observed for removal of the pulp horn and outline of the cavity preparation.

We intend to change the approach used for theory and practice of endodontics to improve the effectiveness of dental education.

References