Dental Research Journal

A new teaching model with artificial teeth containing simulated pulpal tissue

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ABSTRACT

Background: This study aimed to evaluate the use of artificial teeth for endodontic training for dental students.

Materials and Methods: The following aspects of the artificial teeth were approved by the endodontists in Isfahan University of Medical Science: internal and external anatomy; coronal pulp chambers regarding their size, shape, and canal path; the root canals regarding their size, shape, and position; filling the pulp chamber and root canals by considering the texture, quantity, color, and ease of handling; and resin hardness and visualization of the radiographic image.

Results: The results showed favorable opinions regarding the internal and external anatomy, coronal pulp chamber, root canal (s), handling, and radiographic imaging. The contents of the pulp space and hardness of the teeth were satisfactory.

Conclusion: The artificial teeth tested have the potential to replace the natural teeth in preclinical training.

Key Words: Artificial teeth, dental education, endodontics

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INTRODUCTION

Endodontic materials have recently become an important part of predoctoral and continuing education programs because of the advances in endodontic materials and techniques.[1,2]

In dental education, students require extensive, practical preclinical training before they start to treat a patient for the first time.[3] However, the methods, content, and quantity of endodontic education are still at issue.[1]

For many years, extracted human teeth have been employed either mounted or not mounted on a phantom head[4] for training endodontic procedures as a universal method.[5]

It is difficult to collect sufficient teeth for root canal therapy courses; that is why, it is necessary to search for other alternatives such as "artificial teeth."[6,7]

Not only is the students' access to natural teeth limited but also most of these extracted teeth have anatomical abnormalities, severe curvatures, broken or cracked crowns, etc., These difficulties do not allow dental students to evaluate their individual performance properly.[3]

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Artificial teeth have several benefits in preclinical endodontics training.[1] Today, several types of artificial teeth are available such as three-dimensional printed replicas,[8,9] resin teeth,[3] ceramic, hybrid ceramics, and commercial plastic block root canal simulators.[10,11]

This study aimed to introduce a new artificial tooth model, in which an attempt has been made to simulate pulpal tissue.

We aim to evaluate the features of this teaching model to see whether it can be a suitable alternative to extracted teeth.

MATERIALS AND METHODS

Steps to fabricate the artificial tooth with a simulated pulpal tissue

First, the type of tooth was selected according to its morphology, [Figure 1-7] and then it was simulated. The root and the crown underwent an impression procedure separately. Double silicon impressions were taken for roots, and a single silicone impression was taken for crowns. After tooth impression procedures, the artificial tooth material was prepared. Acrylic resin was used to this end, and the filler was a mixture of barium sulfate and aluminum oxide (at a ratio of 3:2). The filler served as an opacifier as well. Before casting the resin, some space was left for the pulpal tissue. To this end, it was necessary to use a flexible metallic instrument like a dental file. The file was placed in the middle of the tooth; then, the resin was cast. After the resin was set, the file was removed, and the root canal was fabricated. Following the fabrication of the root and the crown, the orifice of the canal was slightly widened with a diamond bur. It was also necessary to prepare a space similar to the pulp chamber on a radiograph. [Figures 8-10] Orifices widened proceeded by placing a coloring agent in the canal. A type of tissue was used, which colors the pulp when it is exposed to the water from the

Figure 1: Maxillary canine (labial view).

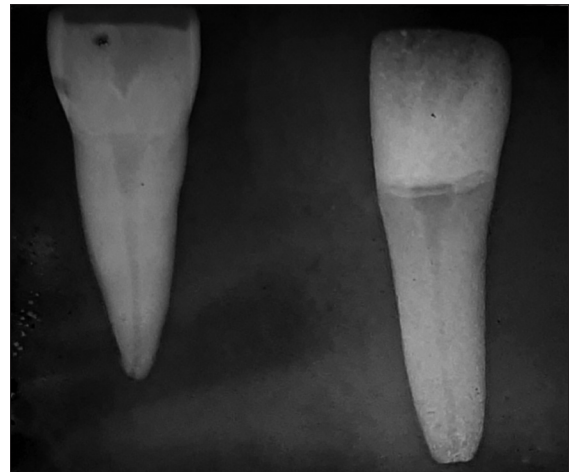**Figure 2:** Maxillary canine (palatal view).

Figure 3: Maxillary central incisor (labial view).

Figure 4: Maxillary central incisor (palatal view).

Figure 5: Mandibular first molar (lingual view).

Figure 6: Mandibular first molar (buccal view).

Figure 7: Mandibular first molar (occlusal view).

Figure 8: Maxillary central incisor radiograph.


Figure 9: Maxillary canine radiograph.

Figure 10: Mandibular first molar radiograph.

high-speed handpiece. The step-by-step preparation process of the model is presented in Figure 11a-f. This reaction simulated the bleeding of the pulp. After placing this tissue within the tooth, the crown and the root were attached with acrylic resin. Then, the tooth was covered with a transparent resin to look like a real tooth with enamel.

The artificial teeth were kept dry and out of reach of water and humidity. Under such a condition, after exposing the pulp chamber, the color change occurs for the first time, similar to bleeding from a vital tooth.
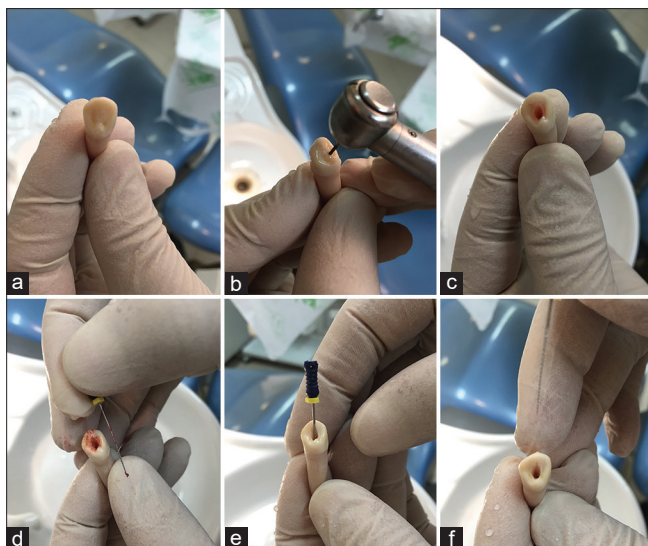
Figure 11: (a-f) The step-by-step preparation process of the model

RESULTS

An easy and inexpensive technique was developed for the fabrication of a model for artificial teeth. The model can be mounted and used easily by the students. They can also be used in association with an apex locator. The cost of the materials is approximately $10 for the model.

DISCUSSION

The principal aim of this study was to develop an improved teaching model that allows the application of modern endodontic techniques in undergraduate and continuing education. Hands-on training and correct guidance are especially necessary to prevent procedural errors and reach a high acceptance rate.

The application of simulated root canals for endodontic courses is widespread in this respect. Evaluation of artificial resin teeth with multiple roots and root canals has been widely accepted by professors in the field of endodontics. Artificial teeth have many favorable properties. Compared to extracted human teeth, they are standardized and easy to obtain in quantity. A particular advantage of artificial teeth is the opportunity of visualization. The teeth can be removed to review any endodontic procedure step by step in three dimensions. Therefore, they improve the understanding of biomechanical root canal preparation as an example. The varieties of errors that can occur throughout endodontic treatment remain, but they can easily be understood. Students can practice under identical conditions, and visual feedback might enhance the learning effect. In addition, for dentists, they are a valuable aid for self-assessment. At the same time, artificial teeth do not pose any risk of infection. Preventing cross-contamination in education is an important factor to be considered. Following the guidelines for infection control, extracted teeth should be heat sterilized before being used in an educational setting.[12]

Since endodontic treatment is one of the most technically sensitive procedures,[13] the teaching approaches should simulate the clinical situations as realistically as possible. Root canal models and artificial teeth do not meet this requirement entirely because they are usually held in hand during their use. Teaching models that can be mounted in a phantom head are more suitable in this respect. An ideal simulation model should enable the use of all the available modern endodontic techniques to comply with the requirements for endodontic treatment on patients.

CONCLUSION

The artificial teeth have the potential to replace the natural teeth in endodontic teaching.

Financial support and sponsorship
Nil.

Conflicts of interest
The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or nonfinancial in this article.

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