Natural Model Training, an Alternative Way to Enhance Learning in Pediatric Dentistry

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Abstract

Objective: Educational teaching of the diagnosis of resorbed root for pulpectomy in deciduous teeth radiography has always been a big challenge in pediatric dentistry.
The purpose of the study was to propose a new practical methodology to improve the quality of learning in students of dentistry.

Materials and Methods: Extracted deciduous teeth were molded in the transparent epoxy resin as their real position in the jawbone. Then, their own pre-extraction radiographs were attached to them. Forty dental students were randomly allocated to the control group of conventional teaching and experimental group of natural model training. All participants were attended in a validated exam and the data were analyzed. A questionnaire was designed with an answer choice in Lickert scale to measure the students' attitude towards the new method and finally the data were reported with descriptive statistics.

Results: The mean of the learning degree in the experimental group was graded 9.2 ± 3.2 and was significantly higher than 5.8 ± 1.1 which belongs to the participants of the conventional method as control ($p= 0.04 <0.05$).

Conclusion: Considering the limitation of this study, using natural models in radiography training will improve the diagnostic competency and the student's educational satisfaction in pediatric dentistry.

Key Words: Pediatric Dentistry; Radiology; Pulpectomy; Medial Education Term

INTRODUCTION

Modern dental education integrates conventional methods and new training policies such as simulation and virtual reality systems [1-3]. The current approach to training of hand skills for dental students involves the use of voxel-based models in order to represent a virtual tooth model [4].

However, it is not easy to resort to simulation with regards to other essential dental competencies such as diagnosis. Dental graduates should have the ability to perform and interpret common radiological examinations in general dental practice. Determination of the disorders on radiographic images needs considerable knowledge of the anatomy.

The most important reason for instruction of the anatomy is to accommodate the kind of education that provides students with spatial-mental models, offering them the appropriate insight for their daily practice. This is especially important in the field of radiology, in which practitioners need to routinely
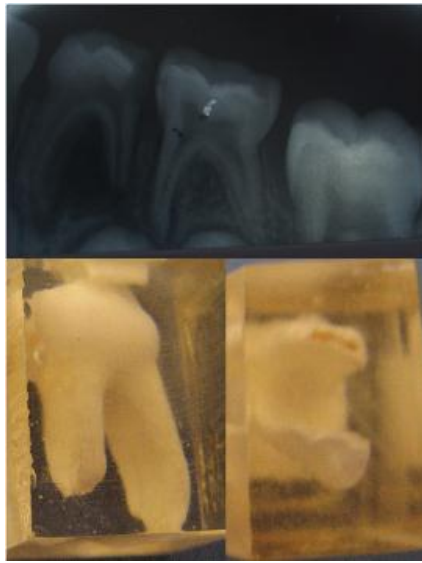
Fig 1. An extracted primary molar and the radiograph

examine radiographic images and to extract a three-dimensional perception from two-dimensional representations of the anatomy [5, 6]. The ability to determine the relative position of objects on radiographs can be described as an ability to mentally integrate 2D spatial information and to perform a transformation of that representation into 3D spatial information [7]. In pediatric dentistry, diagnosis based on radiograph imaging is one of the challenges in the education of dentistry due to overlap of the roots of the deciduous teeth with the buds of the successor permanent teeth as well as the diagnosis of the apex of resorbed roots. Simulator-supported radiology training is a method that offers a great value for students who are likely to fail in regular education methods. Moreover, generating 3D models based on cone beam computed tomography (CBCT) datasets may become another useful technique for demonstrating, planning and teaching. Mass production of these models is possible, but the availability of the computer numerical control (CNC) technology and the cost of model production in this method are existing challenges for developing countries without sufficient economic resources for education [8].

Therefore, alternative, more economical methods are required to help students in dental education to understand the anatomical relations in radiology and to provide additional depth cues. This model needs to have the ability to mimic the characteristics of a real patient and to increase the spatial visualization of deciduous teeth and its resorbed anatomy. The aim of this study was to evaluate the impact of natural model-based training in pediatric dental radiology and to compare its effect on trainees' ability with that of the conventional training method routinely used at the department of pediatric dentistry, Mashhad University of Medical Sciences, Iran.

MATERIALS AND METHODS
To produce the "natural model" for pediatric dentistry, 30 hopeless extracted deciduous molars with relatively intact roots were collected. Selected cases were children between 4 and 10 years of age. All teeth with high-quality preapical radiographies (PA) were cleaned and disinfected by storing in 1% choloramin solution at least for a week. The teeth were mounted in transparent epoxy resin (Khoozestan Petrochemical Co, Iran) as positioned in the jawbone. Every tooth was attached to its pre-extraction radiograph and stored to be used as a "natural model" for pediatric radiography training (Figure 1). Forty fifth-year dental program undergraduates (out of a six-year pre-doctoral curriculum) voluntarily participated in the study (21 males and 19 females) at at Mashhad dental school in 2012. All aspects of the study were approved and performed in accordance with the guidelines of the ethical review process of Mashhad University of Medical Sciences. The design was a simple experimental study organized into three different parts, 1) Random allocation of participants 2) Educating radiographic landmarks used in the pulpectomy procedure in experimental and control groups with an allocated method 3) Proficiency testing after training and completing a questionnaire. A computerized randomization procedure based on the last pediatric dentistry exam results before training allocated participants to either the control or experimental group. The experimental group was assigned a natural model-based training program. The method was based on explaining the

anatomical landmarks on the radiographs along with the presentation of its natural model and apical region. Different types of resorption in the apical and forcation region that might alter the apical foramen and working length in pulpectomy of the primary teeth were discussed with the teeth mounted in transparent resin at sight. The control group received conventional training, namely explanations of the anatomical landmarks on the selected radiographs. Training lasted 30 minutes for both groups. Proficiency testing was then performed immediately after completion of training. All participants were finally assessed on their understanding of radiographic anatomy. The assessment consisted of 10 multiple-choice questions (MCQ) based on the radiographic anatomy as seen on 10 preapical radiographs (PA) taken from upper deciduous molars in patients aged 4 to 10 years old. The MCQ test was provided to each participant in a hard copy format, whereas the PAs corresponding to each question were provided in the form of a PowerPoint (office 2007) presentation on a screen. The total time allocated was 20 minutes (2 minutes per question), and each student had to circle one correct answer (out of three alternatives) on the hard copy sheet provided. The test was designed based on "must-learn" objects in diagnosis during the pulpectomy procedure and validated by the pediatric dentistry department members. The MCQ tests were marked by one of the authors (RS) in a blinded manner, and the score was calculated for each member of the groups. After completion of the intervention phase, each participant received the alternative training (the method used for the other group) and the students were subsequently asked to complete a questionnaire with three questions. The student's impressions were then assessed (in a qualitative term) regarding the effect of the "natural model-training tool" on their learning of pediatric radiographic anatomy. The questionnaire was designed on a four-point Likert scale with the following options: strongly agree, agree, disagree and strongly disagree to determine whether this tool enhanced the quality of learning. Statistical analysis of the groups was performed using the Student's t-test, and statistical significance was accepted at the level of $P < 0.05$. The results of the questionnaire were finally analyzed by descriptive statistics.

RESULTS

Demography of the trial groups are presented in Table 1. The drop-out rate was 5 percent for the control group (one of twenty) and 30 percent (six of twenty) for the experiment group. Proximity of the test with the final courses of the semester on the schedule led to withdrawal of seven of the participants. The mean score of learning from the study was 9.2± 3.2 for the experiment group and higher than 5.8± 1.1 for the conventional method (control) group (P=0.04<0.05). The results of the questionnaire showed that most of the students thought that the new method resulted in more profound learning (96%) and was suitable for learning pediatric radiology (100%) and also that this method can save teaching time (92%) (Table 2).

DISCUSSION

The mean degree of learning in the natural model-training group was higher than the mean degree in the conventional method (control) group. Natural models in radiography training have improved the diagnostic competency in pediatric dentistry with regards to pulpectomy. This may be due to the increased interaction and engagement of the students visualizing the radiographs. Studies have shown that acquired skills can be long-lasting as long as the instruction using medical simulators is designed to involve hands-on practice or when performed on a repeated-practice-and-feedback basis [9-14]. Student's learning is significantly affected by their learning method, with the learning outcomes being strongly influenced by the learning process. The 'deep' approach is therefore, to promote better learning (or 'life-long'), as opposed to the 'surface' approach in which students try to memorize the text [15].

Table 1. Demography of Trial Groups

Group	Man	Woman	Total
Experiment	6	8	14
Control	9	10	19

This was in accordance with the data gained from the questionnaire. Other studies in medical education involving interactive 3D visualizations of anatomical structure showed similar results to those of this study. New methods are becoming increasingly prevalent in medicine for educational purposes, being proposed as an effectively successful alternative to the traditional learning resources [16-18]. Diagnosis and design of appropriate treatment sequences in pulpectomy require comprehensive understanding of the anatomy, especially of the root resorption in deciduous teeth that involves various spatial concepts, such as the shape of anatomical structures, the location of each partition relative to another, and how they are connected. Investigators in comprehension and learning sciences have defined visualization as external help with the potential for increasing or expanding cognition [19].

This method is believed to result in deep learning because of 3D imagination of the radiographs and better integration of radiologic landmarks and anatomy especially in resorbed roots. The other advantage of this method is enabling the rotation of the tooth in any direction, which may further help to improve the 3D visualization [20]. One of the mandatory skills required for each graduate of dentistry is the ability to interpret the common radiological examinations in general dental practice. Radiographic interpretations in medical students appear to be lacking accuracy. Studies have shown that the ability to interpret radiographs is not correlated to the level of medical education, which suggests that more emphasis should be placed on quality, rather than quantity in radiology learning and teaching [21]. It has been reported that simulators are currently used in the health care field for training of responses to cardiovascular emergencies in laparoscopic surgery, the emergency room,

and the operating room [22, 23].

Although the extended use of simulation for training purposes in dentistry is still an object of investigation, especially in the area of preclinical training [7], using anatomic data from patients seems to be an alternative method with a long tradition [4]. Educational simulators demand extended budgets, and that is a process that meets many limitations in developing countries. Thus, simple and technology-independent methods should be investigated to improve student learning.

This is a study with a limited number of individuals enrolled; therefore, a larger randomized study would have provided stronger evidence. One variable not included in this study was the learning style. It is possible that certain types of students may do better in the same study.

CONCLUSION
Despite the limitations of this study, it can be concluded that using natural models in radiography training seems to improve the diagnostic competency as well as the satisfaction of students in pediatric dentistry.

ACKNOWLEDGMENTS

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Table 2. Description of the Results of the Questionnaire

Questions: The new method	Strongly agree	Agree	Disagree	Strongly disagree
Causes more deep learning	92%	4%	4%	_
Is suitable for learning pediatric radiology	92%	8%	_	_
Is time consuming for teaching	4%	4%	8%	84%

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