



THE IMPACT OF SIMULATION-BASED TRAINING OF DENTISTS ON THE FORMATION OF PROFESSIONAL SKILLS IN ORTHODONTICS

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Introduction. The state and dynamic nature of modern society require constant improvement in various areas of healthcare, including dental care. The rapid development and technological advancement of the dental industry set high requirements for the training of future specialists. Outdated training templates for future dentists do not correspond to modern principles of dental clinic operations and do not provide adequate adaptation to everyday professional workload. A frequent problem among young specialists remains the lack of consistency between undergraduate training and the challenges of real professional activity. Despite the systematic efforts of higher medical education institutions to improve the training process of future dentists, the problem of their practical training remains paramount. Increasingly, simulation training and virtual reality tools are used in the training of dentists; however, their implementation in orthodontic training remains insufficient, despite their significant potential and innovation. A number of foreign and domestic studies reflect the positive results of simulation-based training of dentists, but they also highlight several shortcomings.

The aim of this study, based on the analysis of modern foreign and Ukrainian research, is to determine the prospects for the introduction of simulation-based training in the process of training dentists in orthodontics, and to characterize its advantages and disadvantages.

Materials and methods. In the course of the study, a systematic search for publications was conducted in the Scopus and Google Scholar scientometric databases using the keywords “simulation-based training of dentists,” “simulation training tools in orthodontics,” and “dental phantoms” for the period of 2021–2026.

Results. The weak link in the process of training future dentists in orthodontics remains the practical component of professional competencies, especially against the background of a shortage of patients at university clinics, as many prefer private practices. However, higher medical education institutions are faced with the task of preparing specialists who are competent in performing a specific range of dental manipulations. This discrepancy forms a systemic gap between educational objectives and their implementation, the solution of which is of primary importance.

Simulation technologies are a modern and well-founded mechanism for solving the above-mentioned problems in dental education, and they are actively used in higher educational institutions across Europe.

Using the example of training future orthodontists, we highlight the key problems and conceptual principles for solving them through simulation training:

1. The long-term nature of orthodontic treatment outcomes.
2. The wide variety and complexity of orthodontic pathologies.
3. The need for visualization of the impact of orthodontic appliances.

Despite the significant advantages of simulation tools, it is worth noting several disadvantages:

- The high cost of simulation tools, especially high-fidelity simulators;
- The need to train teaching staff to work with advanced simulation equipment;
- The need to organize dedicated space for installing and storing educational equipment;
- The need for constant updates to simulation equipment.

Simulation training tools can be used at each stage of orthodontic training. Plaster models or 3D-printed jaw models are the simplest simulation tools that allow for the visualization of various dental and jaw anomalies and deformations, enabling students to practice diagnostic skills. Such tools remain affordable and do not require complex technical infrastructure. For more realistic visualizations, jaw models capable of simulating tooth movement under the influence of orthodontic appliances can be used. Such simulators are well received by students, providing a clear understanding of the possibilities of orthodontic influence, the reaction of the dento-maxillary apparatus to orthodontic forces, and the correlation between planned and actual movement of teeth.

Another effective tool, especially at the postgraduate level, is the typodont with pre-installed orthodontic elements for practicing clinical manipulations. Such skills are fundamental for everyday orthodontic practice and build confidence for future professional activities.

Conclusions. In conclusion, simulation-based training tools demonstrate significant potential in the orthodontic training of dentists. The level of fidelity of simulation tools should be determined in accordance with specific educational goals. Simulators can be effective as both primary and auxiliary components of training; furthermore, their application scenarios are flexible and can be adapted depending on the topic and level of student proficiency.

Keywords: *simulation-based training; simulation training tools; dental education; orthodontics.*