



**SIMULATION-BASED TRAINING IN THE DEVELOPMENT OF CLINICAL
THINKING AND SURGICAL SKILLS IN THE DIAGNOSIS AND TREATMENT OF
ODONTOGENIC PHLEGMON IN STUDENTS OF THE DENTAL FACULTY
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Abstract.

Odontoid phlegmons are severe purulent-inflammatory diseases of the maxillofacial region that require dental students to have well-developed clinical thinking and practical surgical skills. The aim of the study was to evaluate the effectiveness of simulation-based training using clinical scenarios and a biological model. A comparative analysis of knowledge, clinical thinking, and practical skills before and after training showed a statistically significant improvement in training, increased confidence in performing surgical procedures, and increased motivation to learn. The results of the study demonstrated a statistically significant improvement in the professional training of students, increased confidence in performing surgical procedures, and increased motivation to learn, confirming the high pedagogical effectiveness of the method.

Keywords: simulation training, dental education, odontogenic phlegmons, clinical thinking, surgical skills, biological model, clinical scenarios.

Аннотация. Одонтогенные флегмоны - тяжёлые гнойно-воспалительные заболевания челюстно-лицевой области, требующие от студентов стоматологических факультетов развитого клинического мышления и практических хирургических навыков. Цель исследования - оценить эффективность симуляционно-ориентированного обучения с использованием клинических сценариев и биологической модели. Сравнительный анализ знаний, клинического мышления и практических умений до и после тренинга показал статистически значимое улучшение подготовки, повышение уверенности при выполнении хирургических манипуляций и рост учебной мотивации. Результаты исследования продемонстрировали статистически значимое улучшение профессиональной подготовки студентов, повышение уверенности при выполнении хирургических манипуляций и рост мотивации к обучению, что подтверждает высокую педагогическую эффективность метода.

Ключевые слова: симуляционное обучение, стоматологическое образование, одонтогенные флегмоны, клиническое мышление, хирургические навыки, биологическая модель, клинические сценарии.

Introduction. Odontogenic phlegmons are acute purulent inflammatory processes in the maxillofacial region that can progress rapidly and cause serious complications, including generalised infections and life-threatening conditions. Effective diagnosis and timely surgical intervention require dentists to have a high level of clinical competence, developed clinical thinking, and confident surgical skills.



Traditional forms of training for dental students, which focus mainly on lectures and limited practical experience with patients, do not always prepare future specialists for independent work in real clinical practice. This is especially important when studying severe purulent-inflammatory diseases, such as odontogenic phlegmons, where any mistake can have serious consequences.

In recent years, simulation technologies have been increasingly used in medical education, allowing for the safe modelling of clinical situations, the practice of diagnostic and surgical skills, and the development of clinical thinking in conditions that are as close to reality as possible. The use of biological models, including animal anatomical material, in combination with clinical scenarios makes it possible to reproduce various disease progression scenarios and practise surgical procedures — from incisions and autopsies to drainage of purulent foci — without risk to patients.

Despite the recognised effectiveness of simulation approaches in medical education, systematic studies of their impact on the development of clinical thinking and practical skills of dental students in the treatment of odontogenic phlegmons remain limited.

The relevance of the study is due to the need to introduce modern teaching technologies that can improve the quality of training for future dentists, enhance the level of clinical competence, and reduce the risk of errors when providing emergency care to patients with severe purulent-inflammatory diseases of the maxillofacial region.

Materials and methods. The study was conducted at the simulation centre of the Bukhara State Medical Institute at the Department of Surgical Dentistry among 40 fourth-year students divided into subgroups of 10 people. A pedagogical experiment with simulation-oriented training was used, the purpose of which was to assess the formation of clinical thinking and practical surgical skills. A sheep's head, anatomically similar to a human head, was used as a model, with imitation of various types of odontogenic phlegmon: submucosal, subcutaneous and fascial forms. The training consisted of three stages: a brief theoretical block, analysis of a clinical scenario, and practical work on the model (soft tissue incision, opening of the purulent focus, drainage, wound treatment, and assessment of haemostasis). All actions were assessed using standardised checklists.

Effectiveness was assessed in three areas: theoretical knowledge (pre- and post-testing), clinical reasoning (situational problem solving), and practical skills (objective assessment of actions on a model). The data were processed using descriptive and comparative statistics; paired t-tests or Wilcoxon's criterion were used to assess differences at $p < 0.05$.

Results. Simulation-based training had a significant positive impact on all key indicators of student training. Before the training, the average level of theoretical knowledge was 65.3 ± 5.7 points out of a possible 100, whereas after practical classes using a biological model and clinical scenarios, the average score increased to 85.6 ± 4.2 points, reflecting a statistically significant improvement ($p < 0.001$). This increase indicates a qualitative assimilation of the material and the ability to apply theoretical knowledge in practical situations. The development of clinical thinking also showed significant changes: before the training, students correctly solved an average of $64.2 \pm 6.1\%$ of situational tasks, and after the training, $82.8 \pm 5.4\%$ ($p < 0.001$). The



improvement in clinical thinking indicators reflects an increase in the skills of analysing clinical information, making informed decisions, and choosing the optimal surgical intervention tactics in conditions that are as close as possible to real practice.

Table 1. Assessment of students' practical skills before and after simulation training.

Skill	Before training	After training	p-value
Soft tissue incision	13,1 ± 2,3	20,5 ± 1,7	<0,001
Opening of a purulent focus	11,5 ± 1,9	18,7 ± 2,0	<0,001
Drainage	9,7 ± 1,5	15,3 ± 1,6	<0,001
Antiseptics and safety precautions	7,4 ± 1,2	13,2 ± 1,4	<0,001
Total score	63,7 ± 6,5	81,3 ± 5,8	<0,001

Practical surgical skills were assessed using standardised checklists, including the accuracy of soft tissue incisions, the precision of lesion dissection, the quality of drainage, and compliance with antiseptic and safety techniques. Students performed soft tissue incisions on a sheep's head, opened purulent foci, carefully drained the inflamed areas, and treated the wound, observing all principles of antiseptics and bleeding control. The average total score before training was 63.7 ± 6.5 out of 100, and after training, it was 81.3 ± 5.8 (Table 1).

A detailed analysis of individual components showed significant improvement: the accuracy of soft tissue incisions increased from 13.1 ± 2.3 to 20.5 ± 1.7, the accuracy of opening the focus increased from 11.5 ± 1.9 to 18.7 ± 2.0, drainage efficiency increased from 9.7 ± 1.5 to 15.3 ± 1.6, and compliance with antiseptic and safety techniques increased from 7.4 ± 1.2 to 13.2 ± 1.4 points ($p < 0.001$ for all indicators). These data confirm a significant increase in students' confidence when performing surgical procedures and the formation of stable practical skills.



Figure 1. Preparation of a sheep's head for a simulation exercise, students performing an incision and opening of a purulent focus, as well as draining and treating the wound under the guidance of a teacher.

Overall, the results demonstrate a comprehensive improvement in student training: increased theoretical literacy, the development of clinical thinking and confidence in performing surgical procedures. For a clear presentation of the practical stages of the study, it is recommended to include a photo report reflecting the preparation of the biological model, the performance of incisions, the opening and drainage of purulent foci on the sheep's head, as well as the final control of the performance of all manipulations in compliance with ethical standards and anonymisation of participants (Figure 1).

Discussion and conclusion. Simulation-based training using biological models and clinical scenarios proved highly effective in developing clinical thinking and practical surgical skills in



dental students. After training, the average level of theoretical knowledge increased from 65.3 ± 5.7 to 85.6 ± 4.2 points, the accuracy of solving situational problems increased from $64.2 \pm 6.1\%$ to $82.8 \pm 5.4\%$, and the total score for practical skills rose from 63.7 ± 6.5 to 81.3 ± 5.8 ($p < 0.001$ for all indicators). The effectiveness of the method is explained by the high realism of the biological model, which allows for safe practice of incisions, opening of purulent foci and drainage, as well as the integration of clinical scenarios that promote the development of clinical information analysis and informed decision-making. In addition, an increase in student motivation and engagement has been noted, which strengthens the formation of professional identity and responsibility.

The results are consistent with international data on the benefits of simulation techniques: the use of animal models and highly realistic simulations reduces the number of errors, increases the accuracy of surgical procedures, and improves students' preparation for working with patients in clinical settings. Thus, simulation-based training is an effective tool for improving theoretical training, developing clinical thinking, and developing practical skills. The method can be recommended for implementation in the educational programmes of dental faculties and supplemented with digital simulations and virtual reality to further improve the effectiveness of training.

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