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Research on the Application of Digital Dental Prosthetics in the Teaching of Oral Medical Technology

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Abstract: *Objective*: To explore the application effect and practical significance of digital dental prosthetics technology in the teaching of oral medical technology. *Methods*: Eighty students from the 2024 cohort of the oral medical technology program at a medical college were selected as the research subjects. Using a random number table for group allocation, the 80 students were divided into two independent groups of 40 each. The control group received traditional teaching methods, while the observation group incorporated digital dental prosthetics technology (including CAD/CAM systems, intraoral scanning, 3D printing, virtual simulation training systems, etc.) into their teaching. The theoretical assessment scores, practical skill assessment scores, and teaching satisfaction levels of the two groups were analyzed and compared. *Results*: The observation group scored significantly higher in theoretical assessment (85.67 ± 4.23) compared to the control group (78.45 ± 5.12), and also in practical skill assessment (83.92 ± 4.56) versus (75.38 ± 5.89). Teaching satisfaction was also higher in the observation group (92.50%) compared to the control group (77.50%), with all differences being statistically significant ($P < 0.05$). *Conclusion*: The application of digital dental prosthetics technology significantly enhances the theoretical knowledge and practical skills of oral medical technology students, improving teaching satisfaction and demonstrating practical significance.

Keywords: Digital dental prosthetics technology; Oral medical technology; Teaching reform; CAD/CAM; Virtual simulation

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1. Introduction

With the rapid development of digital technology, the field of oral medicine is undergoing a profound transformation from traditional empirical-based diagnosis and treatment to digital precision medicine [1]. Digital dental prosthetics technology, encompassing computer-aided design and computer-aided

manufacturing (CAD/CAM), intraoral three-dimensional scanning, 3D printing, digital impressions, and virtual simulation training systems, has gradually become a crucial tool in modern dental prosthetics clinical practice [2]. Technological innovation inevitably poses new demands on the training of oral medical technology professionals. Traditional oral medical technology teaching primarily relies on plaster model fabrication, handicraft operations, and apprenticeship models, which suffer from issues such as poor reproducibility, limited teaching resources, and subjective evaluation criteria, making it difficult to meet the industry's urgent need for high-quality technical talent. In recent years, several domestic institutions have begun exploring the integration of digital technology into dental prosthetics teaching, but systematic practice and research on curriculum development, teaching model innovation, and teaching effectiveness evaluation remain lacking [3]. This study systematically incorporates digital dental prosthetics technology into the core curriculum teaching of oral medical technology, evaluating its practical effects in enhancing students' theoretical knowledge, practical skills, and teaching satisfaction through a controlled study, aiming to provide a reference for teaching reform in oral medical technology under the digital backdrop.

2. Materials and methods

2.1. General information

Eighty sophomore undergraduate students from the oral medical technology program at a medical college, enrolled from September 2024 to June 2025, were selected as the research subjects. Using a random number table method, they were divided into an observation group and a control group, with 40 students in each group. In the observation group, there were 18 males and 22 females, aged 20 to 23 years, with an average age of (21.45 ± 0.78) years; their average comprehensive score upon enrollment was (78.32 ± 5.46). In the control group, there were 17 males and 23 females, aged 20 to 24 years, with an average age of (21.52 ± 0.82) years; their average comprehensive score upon enrollment was (78.56 ± 5.23). After comparing the baseline data of the two groups, no significant statistical differences were found in age, gender, or enrollment scores ($P > 0.05$), indicating good comparability. This study was approved by the institution's teaching ethics committee, and all students signed informed consent forms.

2.2. Inclusion and exclusion criteria

Inclusion criteria: (1) Full-time sophomore undergraduate students in the oral medical technology program; (2) Completion of prerequisite courses such as oral anatomy and physiology and oral materials science; (3) Full participation in the courses and assessments involved in this study; (4) Voluntary participation in the study and signing of informed consent forms.

Exclusion criteria: (1) Students missing more than 10% of total class hours due to illness or personal leave during the study period; (2) Students transferring majors or taking a leave of absence midway; (3) Students unwilling to participate or withdrawing midway.

2.3. Methods

Control Group: Traditional teaching methods were implemented. Teaching was based on the oral medical technology professional training program, using core courses such as "Fixed Prosthodontics" and "Removable Partial Denture Prosthodontics" as carriers, and adopting a combination of teacher lectures and plaster model demonstrations. Under teacher guidance, students completed denture fabrication training using traditional models, wax patterns, casting, and other techniques, without incorporating digital dental prosthetics

technology-related content [4].

Observation Group: On the basis of traditional teaching, digital dental prosthetics technology was systematically integrated, including the following:

(1) Digital Equipment and System Configuration: Intraoral three-dimensional scanners, model scanners, CAD/CAM systems, 3D printers, and virtual simulation training systems (Simodont) were introduced. Each group of 4–6 students was equipped with one set of digital equipment operation terminals to ensure orderly practical teaching [5].

(2) Integration of Digital Technology into Curriculum Teaching: In "Fixed Prosthodontics" teaching, modules on "Digital Impression Acquisition and Processing" and "CAD/CAM Crown Design and Fabrication" were added. Students obtained model data using intraoral scanners, completed digital design of single crowns and fixed bridges using CAD/CAM software, and fabricated finished products through milling or 3D printing. In "Complete Denture Prosthodontics" teaching, a digital complete denture design system was introduced, and students completed digital tooth arrangement, base design, and fabrication. In the practical training course of "Oral Prosthodontics", a virtual simulation training module was set up, where students used haptic feedback virtual simulation systems for tooth preparation, tooth arrangement, and other operational training, with the system providing real-time feedback on operational accuracy and supporting repeated practice and self-correction.

(3) Teaching Model and Evaluation Method Reform: A "pre-class guided learning-in-class practical training-post-class extension" blended teaching model was adopted. Pre-class, digital operation videos and task lists were pushed through an online platform; in-class, a combination of "teacher demonstration + student practice + system evaluation" was used, with the digital system automatically recording student operation processes and results to form objective scores; post-class, extension tasks and personalized guidance were provided through the digital platform. A digital operation module was added to the course assessment, accounting for 30% of the total score.

The teaching duration, textbooks, and instructors were consistent for both groups of students, with all instructors having over 5 years of teaching experience in oral medical technology.

2.4. Observation indicators

(1) Theoretical Assessment Scores: At the end of the course, a unified proposition, closed-book examination was conducted to assess students' mastery of theoretical knowledge in oral prosthodontics and the principles of digital technology. The exam paper was worth 100 points, including basic knowledge (40 points), digital principles and applications (30 points), and comprehensive case analysis (30 points). The difficulty coefficient of the questions was uniformly reviewed by the teaching and research office, with an exam duration of 120 minutes. Two teachers independently graded the papers, and the average score was taken.

(2) Practical Skill Assessment Scores: A standardized skill assessment plan was adopted, with each student independently completing single crown wax pattern fabrication (traditional group using wax patterns, observation group completing milling/printing of finished products after digital design) [6]. Three teachers with associate senior or higher titles scored each student on-site based on a unified scoring standard, with scoring dimensions including operational normativity (30 points), prosthesis morphology and accuracy (40 points), and surface quality and seating effect (30 points), out of a total of 100 points.

The average score of the three teachers was taken as the final score.

(3) Teaching Satisfaction Evaluation: A self-designed "Digital Dental Prosthetics Technology Teaching Satisfaction Questionnaire" was distributed at the end of the course, with indicators including very satisfied, satisfied, and dissatisfied.

2.5. Statistical analysis

This study utilized SPSS 26.0 statistical software for data summarization and analysis. Quantitative data (measurement data) were presented as mean ± standard deviation, with *t*-tests used for inter-group comparisons; qualitative indicators (count data) were described using frequency and constituent ratio (%), with chi-square tests used for difference verification. $P < 0.05$ was considered statistically significant.

3. Results

3.1. Analysis of theoretical assessment scores of the two groups of students

As shown in **Table 1**, the observation group scored significantly higher in the theoretical assessment ($P < 0.05$).

Table 1. Analysis of theoretical assessment scores of the two groups of students (*n*=40, points)

Group	Basic Knowledge	Digital Principles and Applications	Comprehensive Case Analysis	Total Score
Control Group	31.56 ± 2.34	18.76 ± 3.12	28.13 ± 2.56	78.45 ± 5.12
Observation Group	32.12 ± 2.18	26.34 ± 2.56	27.21 ± 2.34	85.67 ± 4.23
t	–	–	–	6.982
P	–	–	–	<0.001

3.2. Analysis of skill operation assessment scores of the two groups of students

As indicated by the data in **Table 2**, the observation group scored significantly higher in skill operation assessment ($P < 0.05$).

Table 2. Analysis of theoretical assessment scores of the two groups of students (*n*=40, Mean ± SD points)

Group	Operational Standardization	Morphology and Precision	Surface Quality and Seating Effect	Total Score
Control Group	23.12±2.45	29.45±3.56	22.81±2.67	75.38±5.89
Observation Group	24.56±2.23	35.67±2.89	23.69±2.45	83.92±4.56
t	-	-	-	7.315
P	-	-	-	<0.001

3.3. Analysis of teaching satisfaction among two groups of students

According to the data in **Table 3**, in the overall evaluation of teaching satisfaction, students in the observation group exhibited significantly higher satisfaction with the teaching methods ($P < 0.05$).

Table 3. Analysis of teaching satisfaction among two groups of students (n, %)

Group	Number of Cases	Very Satisfied	Satisfied	Unsatisfied	Total Satisfaction Rate
Control Group	40	16	15	9	31 (77.50)
Observation Group	40	25	12	3	37 (92.50)
x^2	-	-	-	-	5.165
P	-	-	-	-	<0.001

4. Discussion

In recent years, digital technology has been widely applied in the clinical diagnosis and treatment of prosthodontics, driving the transformation of prosthodontic techniques from "empirical manual" to "precise digital" approaches [7]. However, the current teaching of dental technology in China still primarily focuses on traditional plaster model operations and handicraft training, limiting students' exposure to digital equipment and making it difficult for them to quickly adapt to the digital clinical work environment after graduation [8]. Although some institutions have attempted to introduce CAD/CAM or virtual simulation systems, these are mostly offered as elective courses or teaching demonstrations and have not yet been systematically integrated into the curriculum [9]. Therefore, exploring effective pathways for integrating digital prosthodontic technology into professional core courses holds significant implications for teaching reform.

The results of this study show that the total theoretical assessment score of the observation group was (85.67 ± 4.23), significantly higher than that of the control group (78.45 ± 5.12) ($P < 0.05$). In the digital principles and applications module, the observation group scored (26.34 ± 2.56), an increase of 7.58 points compared to the control group's (18.76 ± 3.12), representing the most significant difference. This indicates that integrating digital technology into course teaching helps students establish a systematic understanding of the entire process from digital acquisition and design to fabrication, filling the gap in traditional teaching regarding the application of new technologies [10]. In terms of skill operations, the observation group's total score was (83.92 ± 4.56), while the control group scored (75.38 ± 5.89), with the observation group scoring 8.54 points higher ($P < 0.05$). Particularly in the "shape and precision" dimension, the observation group's score of (35.67 ± 2.89) showed a significant improvement over the control group's (29.45 ± 3.56), likely due to the visual and repeatable characteristics of digital technology. The virtual simulation system enables students to repeatedly practice key operational steps and receive immediate, objective feedback, overcoming the limitation of "one-time operation, difficult error correction" in traditional teaching [11]. The CAD/CAM system presents design ideas as three-dimensional models in real time, helping students intuitively understand the relationship between the shape and function of prostheses and improving operational precision [12]. Additionally, the teaching satisfaction rate in the observation group was 92.50%, significantly higher than the control group's 77.50% ($P < 0.05$), with scores in the teaching methods and learning interest dimensions being 5.11 and 5.31 points higher, respectively. This suggests that the digital teaching mode helps stimulate students' learning interest and enhances classroom interaction and the sense of accomplishment from practice. The immediate feedback and visual effects provided by digital equipment make the learning process more intuitive and engaging, aligning with the cognitive characteristics of contemporary medical students.

In summary, the application of digital prosthodontic technology in the teaching of dental technology

effectively improves students' theoretical knowledge and operational skills while enhancing teaching satisfaction, demonstrating significant practical value and potential for widespread adoption.

Disclosure statement

The author declares no conflict of interest.

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