

Application of Blended Virtual-Real Diversified Teaching Methods in Temporomandibular Joint Disorder Rehabilitation Teaching

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Abstract: Objective To deeply analyze the effects and value of applying blended virtual-real diversified teaching methods in temporomandibular joint disorder rehabilitation teaching. Methods The research subjects were rehabilitation medicine interns. This learning content was one of many rehabilitation internship projects. A total of 60 interns were included, with a time range from January 2024 to December 2025. All interns had a total internship duration of 8-10 months, of which 4 weeks were spent learning temporomandibular joint disorder rehabilitation. All interns were divided into groups according to different teaching plans, forming a control group and an observation group (n=30), respectively adopting conventional teaching methods and blended virtual-real diversified teaching methods, and quantifying the teaching effectiveness of both groups. Results In inter-group comparison, the observation group had higher scores in experimental assignments, experimental examinations, comprehensive scores, and interns' evaluation ratings of teaching methods ($P<0.05$); in inter-group comparison, supervising teachers gave higher evaluation scores for the comprehensive abilities of students in the observation group ($P<0.05$). Conclusion For temporomandibular joint disorder rehabilitation teaching, the blended virtual-real diversified teaching method achieved significant results, which can significantly improve interns' assessment scores, teaching satisfaction, and clinical comprehensive abilities, with greater teaching value.

Keywords: combination of virtual and reality; diversified teaching methods; temporomandibular joint disorder; rehabilitation teaching

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Introduction

Temporomandibular joint disorder is a common disease in oral and maxillofacial surgery, with clinical manifestations mainly including joint pain, limited mouth opening, and clicking sounds, which severely affect patients' masticatory function and quality of life. Its rehabilitation treatment requires integration of anatomical structure, pathological mechanisms, and practical skills, with extremely high requirements for teaching professionalism and practicality^[1]. Rehabilitation teaching, as a core component in cultivating professional talents for temporomandibular joint disorder rehabilitation, directly determines the clinical diagnostic and therapeutic abilities and operational standardization of interns. Currently, conventional teaching methods primarily rely on theoretical lectures and model demonstrations, with problems such as difficulty in visualizing abstract knowledge, limited practical training scenarios, and insufficient active student participation, which fail to meet the actual needs of clinical rehabilitation teaching^[2]. The hybrid virtual-real diversified teaching method integrates virtual simulation technology with traditional teaching advantages, transforming abstract temporomandibular joint anatomical structures and rehabilitation operation procedures into perceptible and practicable teaching scenarios through various forms such as virtual simulation operations, scenario simulations, case analyses, and practical drills, effectively compensating for the shortcomings of traditional teaching^[3]. Currently, research on the application of hybrid virtual-real diversified teaching methods in temporomandibular joint disorder rehabilitation teaching is not yet in-depth. Given this, this paper takes rehabilitation interns with temporomandibular joint disorder as the research subjects to explore the application effectiveness of this teaching method, providing theoretical basis and practical reference for optimizing the rehabilitation teaching model of temporomandibular joint disorder and improving teaching quality.

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1. Information and methodology

1.1 General information

This study involved 60 interns from the Department of Rehabilitation Medicine, with a time range from January 2024 to December 2025. All interns had a total internship duration of 8-10 months, of which 4 weeks were spent learning rehabilitation for temporomandibular joint disorders. All interns were divided into a control group and an observation group (n=30) according to different teaching plans. The specific baseline data for the two groups of interns are as follows:

Control group: Interns aged 19-23 years, with a mean age of (21.20±1.10) years; including 14 male and 16 female students; all undergraduate interns majoring in rehabilitation therapy or related fields; total internship duration of 8-10 months, with 4 weeks devoted to temporomandibular joint disorder rehabilitation learning. Observation group: Interns aged 19-24 years, with a mean age of (21.19±1.11) years; including 16 male and 14 female students; all undergraduate interns majoring in rehabilitation therapy or related fields; total internship duration of 8-10 months, with 4 weeks devoted to temporomandibular joint disorder rehabilitation learning.

Inclusion criteria: ①Interns currently studying rehabilitation therapy for temporomandibular joint disorders; ②Able to participate throughout the teaching intervention and effectiveness evaluation of this study; ③Possess basic medical theoretical foundation without cognitive impairment; ④No history of temporomandibular joint-related diseases or surgical history.

Exclusion criteria: ①Those who cannot complete the full teaching process and evaluation due to leave of absence, departmental transfer, or other reasons during the internship; ② Those with serious physical or mental illness that affects participation in teaching and practical training; ③Those who have previously received specialized training related to temporomandibular joint disorder rehabilitation; ④Those who refuse to cooperate with teaching arrangements and effectiveness assessment.

1.2 Methods

Control group (conventional teaching): Adopted traditional theoretical lectures combined with model demonstration mode, with a total teaching duration of 4 weeks, 2 sessions per week, 90 minutes per session. The teaching instructor explained the pathological mechanisms of temporomandibular joint disorder, rehabilitation principles and operational procedures, while combining model demonstrations of basic techniques. Assignments were given after class, with 30 minutes per week allocated for centralized question-and-answer sessions, and conventional assessment was used to evaluate learning outcomes.

Observation Group(Blended Virtual-Real Multi-Modal Teaching Method): Temporomandibular Joint Disorder Rehabilitation learning duration of 4 weeks, 2 classes per week, 90 minutes per session. Based on conventional teaching, virtual simulation, scenario simulation, and other multi-modal elements were integrated as follows: ① Virtual simulation teaching: Using a temporomandibular joint virtual simulation system, one 40-minute virtual operation training session was scheduled weekly, allowing interns to simulate joint palpation, mouth opening exercises, and other practical operations. The system provided real-time feedback on operational errors, allowing repeated practice until standardization was achieved; ② Scenario simulation teaching: One scenario simulation session was conducted every 2 weeks, with different temporomandibular joint disorder patient consultation scenarios set up. Students were divided into groups to role-play as doctors and patients, completing medical history collection, rehabilitation assessment, and treatment plan formulation. After each group's presentation, the supervising instructor provided feedback and guidance; ③Case analysis teaching: One typical clinical case was selected weekly, with 20 minutes spent guiding interns to analyze case characteristics and develop rehabilitation plans, reinforcing the integration of theory and practice; ④Practical operation reinforcement training: Combined with virtual operation feedback, one 30-minute physical model operation session was scheduled weekly, with the supervising instructor providing one-on-one correction of non-standard operations and simultaneous explanation of operational key points.

During the teaching process, a 15-minute quiz was conducted weekly to promptly understand interns' learning progress and adjust teaching focus, ensuring targeted instruction.

1.3 Observation Indicators

Comparison of experimental assessment scores between the two groups, involving experimental assignment scores, experimental examination scores, and comprehensive scores, all with a full score of 100 points.

Assessment of students' evaluation of teaching methods, using questionnaire survey as the tool (total score 100 points, 5 dimensions: internship satisfaction, improvement in learning motivation, enhancement of clinical thinking, proficiency in clinical skills, and mastery of teaching focus, 20 points per item).

Evaluate the preceptor's assessment of students' comprehensive abilities using the Mini-CEX scale, which consists of 7 dimensions: clinical comprehensive performance, organizational efficiency, communication skills, clinical judgment, professional competence, physical examination, and interview skills. Each dimension is scored 1-9 points using a three-level rating system: excellent (7-9 points), competent (4-6 points), and incompetent (1-3 points).

1.4 Statistical Methods

Data analysis was performed using SPSS 25.0. Measurement data were presented as ($\bar{x} \pm s$), and count data were displayed in [n (%)] format. Comparisons were completed through t-test and chi-square test (χ^2), with $P < 0.05$ indicating statistically significant differences.

2. Results

2.1 Comparison of Experimental Assessment Scores Between Two Groups

As shown in Table 1, in the comparison between groups, the experimental assignment scores, experimental examination scores, and comprehensive scores of the observation group were all higher ($P < 0.05$).

Table 1 Comparison of Experimental Assessment Scores Between Two Groups ($\bar{x} \pm s$, points)

Group	Number of people	Experimental Assignment Grade	Test Examination Scores	Comprehensive Score
Control group	30	90.03±4.90	80.12±5.25	83.25±7.87
Observation group	30	91.24±1.37	88.69±9.85	89.71±6.17
<i>t</i>		1.303	3.224	3.538
<i>P</i>		0.198	0.002	0.001

2.2 Comparison of Student Evaluation of Teaching Methods

As shown in Table 2, in the comparison between groups, the observation group interns gave higher evaluation scores for the teaching method ($P < 0.05$).

Table 2 Comparison of Students' Evaluation of Teaching Methods ($\bar{x} \pm s$, points)

Group	Number of people	Mastery of Key Teaching Points	Clinical skill proficiency	Clinical Thinking Enhancement Status	Degree of Improvement in Learning Motivation	Internship Satisfaction
Control group	30	14.50±0.25	14.50±0.32	16.52±0.29	16.56±0.29	17.78±0.27
Observation group	30	18.13±0.58	18.13±0.60	17.78±0.54	17.92±0.64	18.09±0.54
<i>t</i>		31.480	29.239	2.323	10.602	0.812
<i>P</i>		0.001	0.001	0.024	0.001	0.007

2.3 Comparison of Instructors' Evaluation of Students' Comprehensive Abilities

As shown in Table 3, in the comparison between groups, the teaching instructors gave higher comprehensive ability evaluation scores for the observation group students ($P < 0.05$).

Table 3 Comparison of Mini-CEX Assessment Between Two Groups of Students ($\bar{x} \pm s$, points)

Group	Number of people	Interview Skills	Physical examination	Professional competence	Clinical judgment	Communication Skills	Organizational Effectiveness	Comprehensive Performance
Control group	30	3.75±0.87	4.25±0.73	5.68±0.82	5.72±1.19	4.00±0.72	6.12±0.77	3.83±0.85
Observation group	30	7.03±0.91	7.14±0.72	6.12±0.77	6.91±0.77	7.25±0.77	6.66±0.86	6.10±0.75
t		14.270	15.438	2.142	4.599	16.886	2.562	6.136
P		0.001	0.001	0.036	0.001	0.001	0.013	0.001

3. Discussion

The core of temporomandibular joint disorder rehabilitation teaching is to achieve deep integration of theoretical knowledge and clinical practice. Its foundational knowledge encompasses temporomandibular joint anatomy and physiology, disorder classification, key points of rehabilitation intervention, and practical operation standards, which directly affect interns' acceptance and mastery of subsequent teaching content. Compared to pure theoretical instruction, knowledge transmission methods that align with clinical scenarios can help interns quickly bridge theory and practice, consolidate knowledge foundations, and lay the groundwork for subsequent teaching sessions such as virtual operations and scenario simulations. This is a prerequisite for the blended virtual-real diversified teaching method to exert its advantages [4].

The results of this study showed that in experimental assessment scores, the observation group's experimental assignment scores, experimental exam scores, and comprehensive scores were all significantly higher than the control group ($P < 0.05$). This result is consistent with the research findings of scholar Lu Yunyun [5], indicating that the blended virtual-real diversified teaching method can effectively improve interns' assessment scores. The analysis reveals that the observation group, through repeated practice with virtual simulation and deepened understanding via case analysis, compensated for the disconnect between theory and practice in the control group, and strengthened knowledge retention and application ability [6]. In comparison between the two groups, interns in the observation group gave higher evaluation scores for the teaching method ($P < 0.05$), indicating that this teaching approach better meets interns' learning needs. The reason is that diversified teaching formats enhanced learning interest, one-on-one guidance and real-time feedback strengthened learning satisfaction, and effectively stimulated learning motivation [7]. In comparison between the two groups, preceptors gave higher evaluation scores for the comprehensive ability of students in the observation group ($P < 0.05$), indicating that this teaching method can significantly improve interns' comprehensive clinical competence. The analysis shows that scenario simulation, virtual practice and other components specifically trained interns' communication, clinical judgment, and practical skills, aligning with the core assessment of Mini-CEX, and facilitating interns' smooth transition to clinical positions [8].

In conclusion, the blended virtual-practical diversified teaching method can significantly improve interns' assessment scores, teaching satisfaction, and comprehensive clinical competence, and is worthy of promotion and application.

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