Study on the Application of Big Data Digital Evaluation System in the Teaching of Stomatology Practice

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Abstract. Stomatology requires not only solid basic medical knowledge but also professional and meticulous clinical practice experience. Traditional stomatology teaching often results in teaching effects due to the limitations of subjective and objective factors, which cannot be tailored to the individual. In this article, relying on the big data digital evaluation system, the students of the Hunan University of Medicine were studied, and the actual operation of dental implant resin was performed by groups, and the teaching was scored. The experimental results show that after several rounds of training, the big data digital evaluation system helps to improve the teaching effect of stomatology, and has an advantage over teachers' empirical instruction in terms of details.

Keywords: Application Research · Teaching of Stomatology Practice · Big Data Digital Evaluation System

1 Introduction

Stomatology is a professional discipline with a strong practical and operable nature. Stomatology students need solid theoretical knowledge as well as skilled operational skills and clinical thinking. Only through intensive practical training can students rapidly improve their clinical operational skills, laying a solid foundation for future clinical practice [1, 2].

In traditional stomatology education, teachers use plaster models or simulated cephalometric models to demonstrate operations, while students observe and learn. However, due to the limited number of teachers and time constraints for practical teaching, classroom teaching can only be implemented in the form of one-to-many [3, 4]. In addition, in the evaluation of the effectiveness of tooth preparation, according to the traditional method, most teachers can only grade students' tooth preparation based on their own experience or visual means. This evaluation method is highly subjective, which is not conducive to students' correct and effective access to information and rapid mastery of the essentials and keys of stomatology. The current medical model has changed from a traditional medical model to a medical model that emphasizes biological, social, psychological, and environmental aspects [5, 6]. Stomatology itself is also in a rapid

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development stage, and therefore the requirements for medical students' literacy in stomatology are becoming increasingly stringent. At the same time, the application of digital technology in the stomatology field has gradually penetrated into the teaching and clinical aspects. A dental clinical simulation system that simulates the real clinical operating environment, allows repetitive exercises, guides the operating process, and objectively evaluates the results will contribute to the cultivation and improvement of practical skills of dental students.

This study relies on the big data digital evaluation system, and evaluates the teaching of anterior tooth preparation dentistry in undergraduate pre-service training, aiming to provide a certain theoretical basis for the reform of stomatology teaching.

2 Data and Methods

2.1 Shortcomings of the Old Assessment Method

Traditional stomatology teaching is teacher-oriented, and the teacher talks while doing it. Given the special nature of oral surgery, students on the periphery may not be able to fully see the teacher's operation if they are watching live. Even if a recording system is used, there is a possibility that the picture may be distorted visually due to angle and perspective limitations. This puts the students, as bystanders, in a passive position, and makes them easily confused. In addition, each teacher has different experience and operating habits in group teaching, and their evaluation of subsequent students' operation results can vary. When students' operations deviate, the results obtained will be different since each group refers to different standards. The teacher's score for the whole type of each student after class is based on the teacher's personal subjective consciousness, and there is no objective quantitative standard, so the score cannot be fair and convincing to students.

In dental surgery, most operations performed on the hard tissues of the tooth are invasive and irreversible. The development of a patient-friendly concept is also very important. However, performing operations on isolated teeth or artificial teeth makes it difficult to develop the concept of patient love in students due to the lack of patient feedback. Because there are no quantitative assessment criteria, students are initially afraid to perform operations on isolated or artificial teeth, and later become easily overwhelmed by grinding too sharply and too much.

2.2 Research Objects

96 fourth-year undergraduates majoring in stomatology were selected. Selection criteria: (1) All students have received the theoretical course on maxillary central incisor dental anatomy; (2) All students have received the theoretical course on maxillary central incisor metal porcelain full crown tooth preparation; (3) All Students have watched the teaching video of the preparation on the preparation of maxillary central incisors for full metal porcelain crowns. The 96 students were randomly divided into two groups A and B. The learning of anatomical knowledge and preparation of metal porcelain crowns for maxillary central incisors was examined in these two groups. Both groups of students

scored above 80 (out of 100), and there was no statistically significant difference between the scores of groups A and B. The students in both groups were asked to sculpt the crown shape of the upper right central incisor on the plaster, and a teacher from the Department of Dental Anatomy will score the students' work. Both groups of students scored above 80 (out of 100), and there was no statistically significant difference between the scores of groups A and B.

2.3 Research Methods

An oral prosthetic professional with a faculty title and an attending physician will explain again the main points of the preparation of the maxillary central incisor with reference to the Experimental Course in Prosthodontics, and demonstrate the tooth preparation of left upper central incisors on a simulated cranial model by comparing the experimental and control groups.

Before the formal training, the students in the experimental group and the control group each completed the preparation of a left upper central incisor on their own using the Big Data digital assessment system. The time limit was 30 min, but the computer display screen was turned off. After the preparation was completed and the students left, the display screen was turned on, the score of the final tooth preparation pattern was recorded, the laboratory staff collected and labeled the preparations, and the laboratory staff collect and mark the preparations. If the faculty member does not know the grouping of the preparations, the preparations can be scored. The system score and the teacher's score are regarded as the base score prior to training.

Three left upper central incisors were given to each of the experimental and control groups for tooth preparation exercises. During the training, you can ask questions and ask the faculty member. The experimental group used the practice mode of big data digital evaluation system for anterior tooth preparation, where students can observe the tooth preparation on the screen in real time and receive guidance. The students in the control group prepared the teeth directly on the artificial head model. After the preparation is completed, the faculty will grade and guide them, and then perform the next tooth preparation at the same time as the experimental group until the preparation of three teeth is completed.

All students are assessed with a time limit of 30 min. The tooth preparation is performed during the simulation of the skull model. The display screen is turned off after the tooth preparation is completed. After the assessment, the display screen is turned on to record the systematic assessment results. At the same time, the teacher will be led to score the final dental shape.

Compare the scoring results of the control group and the experimental group, and investigate the trend of the students' overall tooth preparation outcomes under different guidance conditions. Furthermore, a detailed comparison of the results scores of the completion of each part of the student's tooth preparation was carried out through the big data digital evaluation system.

2.4 Statistical Analysis

The data were statistically analyzed using SPSS 22.0. A t-test was used to compare the differences between the scores of tooth preparation and the number of questions per person between the experimental group and the control group. Two paired sample t-tests were used to compare the scores of tooth preparation in the experimental group or the control group before and after training at a test level of $\alpha = 0.05$.

3 Big Data Digital Evaluation System Teaching Evaluation

As shown in Table 1, and Table 2, before the tooth preparation training, the composite scores of all students' tooth preparation morphology were (82.84 ± 2.82) and (74.48 ± 2.85) using the Big Data Digital Evaluation System and the instructors' scores, respectively. Before training, there was no statistically significant difference between the scores of the experimental group and the control group for either the system scores or the instructor scores. After three times of training sessions, the paired t-test results showed that the scores of tooth preparation of the two groups improved after training, and the scores after training were higher than those before training, and the difference was statistically significant. However, the tooth preparation scores of the experimental group were significantly higher than those of the control group after training, and there was a statistically significant difference.

Tooth preparation steps include incisal end preparation, labial preparation, adjacent surface preparation, lingual preparation, and finishing polishing. The main scoring items

Table 1. The scoring results of the left upper incisor preparation by the big data digital evaluation system before and after training.

	Before training	**After training**	***t***	***P***
Test group	82.84 ± 2.82	92.57 ± 1.29	−14.84	0.000001
Control group	82.47 ± 3.02	85.69 ± 3.12	−8.025	0.000087
t	−0.151	−6.012		
P	0.854	0.000029		

Table 2. The teacher's scoring results of the tooth preparation of the upper left anterior tooth before and after training.

	Before training	**After training**	***t***	***P***
Test group	74.48 ± 2.85	91.25 ± 3.37	−22.20	0.000
Control group	75.33 ± 2.88	80.63 ± 2.56	−23.31	0.000
t	−0.340	−2.411		
P	0.756	0.041		

include the following 14 items: incisal end preparation, labial preparation, labial shoulder position, labial shoulder shape, adjacent surface preparation, adjacent surface extension, lingual axial surface preparation, lingual fossa preparation, lingual shoulder position, lingual shoulder shape, undercutting, degree of convergence, line angle and refinement, and gingival damage. The items that lost the most points were line angle and refinement (4.00%), followed by lingual and fossa preparation (2.56%).

Comparing the items that lost points shows that there are statistical differences between the experimental group and the control group: lingual axis surface preparation, lingual fossa preparation, and line angle and refinement. The experimental group outperformed the control group in these three items: lingual axis surface preparation, lingual fossa preparation, line angle, and refinement, and lost fewer points (lingual axis surface preparation: $t = 2.384$, $P = 0.048$; lingual fossa preparation: $t = 2.761$, $P = 0.015$; line angle and refinement: $t = 3.933$, $P = 0.002$).

In terms of questioning, the average number of questions per person in the experimental group was 0.71 ± 0.68 during the three training sessions, and the average number of questions per person in the control group was 3.38 ± 1.01. The number of questions asked per person in the experimental group was significantly lower than that in the control group ($t = 6.183$, $P = 0.000024$).

Digitization is one of the trends in dental education. The dental digital virtual evaluation system can generally be divided into two categories: result evaluation and process evaluation. The result evaluation system is mainly used to evaluate the final tooth preparation morphology through the scanning device and analysis software. The process evaluation system is mostly composed of computers, trackers, and simulated head models, which use infrared tracking systems, video recording systems, etc. to record the movement trajectories of students' heads, fulcrums, mouth mirrors, arms, etc. during the training operation. Real-time monitoring of the cutting pressure of the handpiece and the shape of the prepared body allows for a final comprehensive evaluation. It has the advantages of self-evaluation and objective evaluation and facilitates students to acquire skills quickly. The big data digital evaluation system is a domestic real-time evaluation system that has been used in teaching evaluation for 6 years. Optical positioning, spatial registration, and three-dimensional virtualization are its three major technical principles. The image of the marker point is captured in real time by a high-definition camera, and then the precise coordinates of the marker point are calculated by the computer stereo vision algorithm, and the position of the marker point in the space can be tracked; the space transformation technology is used to compare the virtual space where the tooth is located and the actual object where the jaw is located. A one-to-one correspondence is established in the space; and through three-dimensional simulation is reconstructed to display the dental and instrument models on the screen, reflecting the current preparation in real-time. This study compares the results of practical teaching and training in clinical practice anterior tooth preparation for the first time. Students trained using the big data digital evaluation system scored higher in the final preparation morphology of tooth preparation than the traditional practice teaching method, and significantly fewer problems arose during training.

Stomatology technicians are also a relatively uncommon type of professional practitioner. The calculation of stomatology technicians per thousand population is shown

in formula (1):

$$T = C/N * 1000 \quad (1)$$

Among them, T is the number of stomatology technicians per thousand population, C is the number of stomatology technicians, and N is the population of the region.

Anterior teeth belong to the field of aesthetics, and precise tooth preparation is the basis of anterior restoration. The amount of tooth preparation and surface roughness are the two main aspects to measure the accuracy of tooth preparation. Because the palatal surface of the upper anterior teeth cannot be prepared under direct vision, the use of a mouth mirror is often required. It is often difficult for beginners to control the amount of tooth preparation and the direction of the dental drill, which can easily lead to inadequate or excessive preparation. In the final line angle and refinement, it is difficult for students to grasp the essentials, and they are often afraid to perform the final polishing or polishing is not fine enough for fear of over-preparing the teeth during finishing. Therefore, the preparation of the lingual surface and intensive polishing in the preparation of the anterior teeth has always been a difficult task. This is consistent with the results of this study. Before training, lingual and fossa preparation, line angle, and refinement are the items that lose the most points. However, the students trained with the big data digital evaluation system lost fewer points than the control group in the final dental assessment for three items: lingual axis preparation, lingual fossa preparation, line angel, and refinement. This may be related to the fact that the big data digital evaluation system enables real-time evaluation during the tooth preparation process. Students can observe their own tooth preparation in real time on the computer display screen and can compare it with the standard shape of the tooth preparation displayed on the display screen, so that the difference between the current tooth preparation and the standard shape be evaluated in time to specify the amount of tooth preparation, the direction of the drill, and the adjustment of the body position, which help students to control the final shape of the tooth preparation.

In the process of practical teaching, faculty resources and teaching time are relatively limited. It is difficult to achieve one-on-one guidance within the limited teaching time. After class, the teacher needs to use his spare time to score the students' pre-training, which leads to increased pressure on teachers. This study found that the questioning rate of students using the big data digital evaluation system for training is lower than that of traditional practical teaching, which is consistent with the research results of Cao Yong and others. The big data digital evaluation system has set the operating points and procedures of each session. At the same time, the difference between the shape of the preparation and the final standard shape can be vividly and synchronously observed on the computer monitor during the preparation process. It is more concrete and precise, easy for students to understand and master. In addition, the system can give the corresponding transcript immediately after the training is completed. The transcript shows the content of the process evaluation and the result evaluation. Students can conduct self-assessments based on the transcript and identify their shortcomings in time, which can effectively reduce the questioning rate and ease the teaching burden of teachers. It can display a number of data such as three-dimensional images of standard preparations and student preparations, two-dimensional cross-sectional contours, etc., and can also

superimpose the two-dimensional cross-sectional images of the standard preparation and student preparations with corresponding complete teeth in the backboard, and it can visually show whether the student's preparation is excessive or insufficient, and the difference between points, lines, and angles. According to the preset settings, each student's score can be directly obtained, making the evaluation more objective and reflecting the openness, fairness and impartiality of the score. It is also possible to find out the details of students' preparation mistakes, allowing students to self-evaluate and improve their learning.

However, some shortcomings of the big data digital evaluation system emerged during students' use. For example, the shape and size of the mobile phone configured in the system are different from the actual clinical application. Because the mobile phone in the system is equipped with signal tracking devices, it is larger and heavier than the mobile phone actually used in the clinic, which degrades the user experience. This is also a common problem that needs to be addressed in various real-time dental assessment systems. In addition, the use of digital implementation evaluation systems to evaluate teaching requires higher supplies and funding than traditional teaching methods.

4 Discussion

In this article, relying on the big data digital evaluation system, students of a medical school were studied, and the teaching was graded by the group for the practical operation of resin dental implants. The experimental results show that the use of big data digital real-time evaluation systems is beneficial to rapidly improve the teaching effect of preclinical students' tooth preparation and reduce the teaching burden. Further simulation of this system can better help students adapt to clinical work.

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