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The Effect of Different Teaching Methods on the Quality of Tooth Preparation by Preclinical Students

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Abstract

Background: The success of a restoration in fixed prosthodontics is affected by factors related to the dentist's skills.
Objectives: Given the significance of these factors, this study was conducted to explore the effect of traditional and new teaching methods on the quality of tooth preparation by preclinical students.
Methods: This study was conducted on 58 preclinical students in year three of their program who were divided into two equal groups and were trained on fixed prosthesis preparation. The first group (n = 29) was trained by a new teaching method and the second group (n = 29) by traditional methods. A total of 58 three-unit restorations, including 29 metal-ceramic crowns on the first premolars and 29 metal-ceramic crowns on the first molars, were prepared under testing conditions on mounted typodonts. The finish line was visually evaluated by a clinician.
Results: Most participants in group A were able to make acceptable finish lines. There were significant differences between the groups in terms of the finish line on the buccal and lingual surface of tooth four and six ($P < 0.05$), as the success rate was higher in group A than group B. No significant differences were found between the males and females in these analyses.
Conclusions: It can be concluded that the group receiving the new teaching method was more successful in following the principles of tooth preparation. The use of educational videos can therefore be helpful in learning the principles of tooth preparation.

Keywords: Undercut, Over-Taper, Finish Line, Occlusal Reduction, Teaching

1. Background

In medical education, clinical skills can be acquired in a simulated learning environment (1, 2). A preclinical program is therefore planned to develop and increase the students' clinical skills. Medical students of any discipline can benefit from structured education, which includes a combination of theoretical and practical education in the laboratory on artificial patient models, and acquire the capabilities required for clinical practice (3-5). The main objective of general dentistry curricula is to prepare and empower the students to provide better dental services in their future careers (6).

Prosthetics is a major field of dentistry that is particularly important to master. Dental prosthetic devices include fixed and removable prostheses (7). The success of tooth preparation for fixed prosthesis involves theoretical and practical mastery. The practical aspect depends on motor skills and practice (8). The theoretical aspect is taught through various methods, such as demonstration, PowerPoint presentation, tooth maquette and human samples, each of which can have different advantages in terms of learning.

Dentistry students learn tooth preparation via different educational methods, including traditional and new, such as Virtual Reality, Voxel-Man, DentSimTM, Simodont®, PerioSim® and video projection. Each method has different effects on the students' learning (5, 9). The traditional method is a face-to-face demonstration that delivers the basics of prosthetics to the students, following which the students can work on their own models. To date, this educational protocol has been used for many students; however, it poses many challenges, such as the students' dependence on the teacher, the possible loss of important subjects, the observation of the educational process from one angle only, the unrepeatability of the essential sessions and teaching several complicated techniques in one session. Moreover, the students may experience psychological stress and anxiety, which can affect their learning (7). Other teaching methods have been utilized in recent years, such as educational videos and computer simulations. The question now is how students can be provided with the

possibility of re-using information and relearning the materials (7). Aragon and Zibrowski showed that students who were taught tooth preparation through educational videos and demonstration were better than those taught through demonstration alone (9).

Digital dentistry is currently able to digitally evaluate teeth prepared with a higher accuracy in terms of preparation characteristics. It can also be used for educational purposes (10). Owing to the higher accuracy of the digital scan technique and the objective results obtained compared to clinicians' subjective evaluation and also given the existing visual errors and confounding factors, digital scan is the superior method. Despite all these advantages, few studies have used digital scan systems (10).

2. Objectives

To the best of the researchers' knowledge, no studies have ever evaluated and compared the quality of tooth preparation in single-tooth preparation for crown and fixed prostheses. Moreover, no studies have yet assessed the effect of different teaching methods on the quality of tooth preparation using the CAD/CAM technique. The present study was therefore conducted to evaluate the quality of tooth preparation in preclinical dental students at Kermanshah School of Dentistry focusing on finish line preparation for bridges (11-15).

3. Methods

This randomized educational trial was carried out on 58 randomly-selected third-year preclinical students, who were randomly allocated into two equal groups using a table of random numbers, over a four-year period, from a pool of 100 students. All the 58 students had the same age.

The first group underwent new teaching methods, including PowerPoint presentations, instructor's demonstrations and educational videos (16). Prior to the theoretical session, a PowerPoint file of the materials was given to the students to study, which included pictures, videos and voice-over slides. The teacher then demonstrated the materials. A video was made out of the demonstration and given to the students, and the students were asked to watch it. After 45 days, the teacher held a theoretical session and presented the materials again, and the students were tested on tooth preparation in each practice session.

The second group was taught through the traditional teaching method, including instructor's demonstrations. At the end of the course, 58 three-unit restorations were collected from both groups A and B, including 29 three-unit metal-ceramic restorations on the first premolars and 29 on the first molars. On the test day, the teeth were mounted on a dental generator and the numbers of the teeth to be prepared were put in envelopes for the students to randomly select. After determining the teeth and type of preparation, the students started the tooth preparation process.

The metal-ceramic preparation began from the occlusal surface and was completed after making guide grooves by a round end-taper bur. Functional cusp preparation then began and was completed by a round end-taper bur using the guide grooves made. Then, facial surface grooves were made by a flat-end taper bur in the mesial and distal line angles and mid buccal surface, and were completed afterwards, thus creating a radial shoulder margin. This margin was continued up to the mesial and distal contacts of the proximal surfaces. Next, the proximal surface was opened by a needle bur. Then, guide grooves were made on the lingual surface by a torpedo-shaped bur, and preparation took place using the same bur, which created a chamfer margin in this region, to be coated with metal. The functional cusp was also prepared by this bur after making the guide grooves using a round-end bur. The buccal and lingual surfaces were then prepared by a torpedo-shaped bur after making the guide grooves. In the end, the surfaces were polished by a carbide bur. All the preparations were scanned and digitalized by an optic CAD/CAM scanner (Amann Girrbach Map 400), which requires the teeth to be mounted by scan spray in order to prevent light reflections, since the radiant parts are not scanned well.

To enable a better comparison, the prepared teeth were visually assessed in both groups by two prosthodontics professors blinded to the groupings and the finish lines. To evaluate the finish line, in addition to analyzing the appropriate bur for the finish line depending on the type of crown, factors such as smoothness, finish line, supra gingival margin and adherence to shape were also investigated.

Data were analyzed using descriptive and inferential statistics. For the descriptive statistics, indices of central tendency and dispersion and tables were prepared. For the inferential statistics, the normality of the data was analyzed using the Kolmogorov-Smirnov test. Considering the normality of the data, the independent-sample t-test was used for the between-group comparisons. To analyze the relationship between the qualitative variables, the chi-square test and Fisher's exact test were used. Data were analyzed in SPSS-18 (Chicago, IL, USA). $P \leq 0.5$ was taken as the level of statistical significance.

4. Results

A total of 58 students were divided into two groups (A and B) of 29, including 12 men and 17 women in group B and

16 men and 13 women in group A. The mean age of group B was 23.17 ± 2.51 years, while the mean age of group A was 22.76 ± 1.55 years. There were no significant differences in terms of age between the two groups (P = 0.453 as per the independent sample *t*-test). In group B, 41.4% of the students were male; in group A, 55.2% were male. There were no significant differences in terms of gender distribution between the two groups (P = 0.293 as per the chi-square test).

The frequency and percentage of the finish line on the buccal surface in tooth four in bridge preparation for different groups and genders are determined (Table 1). The chi-square test showed a significant difference between the study groups in terms of the finish line on the buccal surface of tooth four (P = 0.005), as the success rate was higher in group A than group B. Nonetheless, the results of the chi-square test showed no significant differences in finish line on the buccal surface of tooth four by gender in group B (P = 0.876). Fisher's exact test also showed no significant differences between the finish line on the buccal surface of tooth four by gender in group A (P = 0.299).

The frequency and percentage of the finish line on the buccal surface of tooth six in bridge preparation in different groups and genders are calculated (Table 2). The chi-square test revealed a significant difference between the study groups with regard to the finish line on the buccal surface of tooth six (P = 0.014), as the success rate was higher in group A than in B. Nonetheless, the chi-square test revealed no significant differences between the finish line on the buccal surface of tooth six by gender in group B (P = 0.462). Fisher's exact test also showed no significant differences between the finish line on the buccal surface of tooth six by gender in group A (P = 0.299).

The frequency and percentage of finish line on the lingual surface of tooth four in bridge preparation in different groups and genders are presented (Table 3). The results of the chi-square test showed a significant difference between the study groups regarding the finish line on the lingual surface of tooth four (P = 0.016), as the success rate was higher in group A than group B. Nonetheless, the chi-square test showed no significant differences between the finish line on the lingual surface of tooth four by gender in group B (P = 0.774). Fisher's exact test showed no significant differences between the finish line on the lingual surface of tooth four by gender in group A (P = 0.100).

The frequency and percentage of the finish line on the lingual surface of tooth six in bridge preparation in different groups and genders are calculated (Table 4). The chi-square test showed a significant difference between the study groups with respect to the finish line on the lingual surface of tooth six (P = 0.006), as the success rate was higher in group A than group B. The chi-square test revealed no significant differences between the finish line on the lingual surface of tooth six by gender in group B (P = 0.550). Fisher's exact test showed no significant differences between the finish line on the lingual surface of tooth six by gender in group A (P = 0.100).

Table 1. The Frequency and Percentage of the Finish Line on the Buccal Surface of Tooth Four in Bridge Preparation for Different Groups and Genders

Group		Fail		OK		P-Value
		Count	Row, %	Count	Row, %	
B						0.876
	Male	6	50.0	6	50.0	
	Female	8	47.1	9	52.9	
A						0.299
	Male	1	6.3	15	93.8	
	Female	3	23.1	10	76.9	
All						0.005
	B	14	48.3	15	51.47	
	A	4	13.8	25	86.2	
Total		18	31.0	40	69.0	

Table 2. The Frequency and Percentage of the Finish Line on the Buccal Surface of Tooth Six in Bridge Preparation in Different Groups and Genders

Group		Fail		OK		P-Value
		Count	Row, %	Count	Row, %	
B						0.462
	Male	5	41.7	7	58.3	
	Female	10	58.8	7	41.2	
A						0.299
	Male	3	18.8	13	81.3	
	Female	3	23.1	10	76.9	
All						0.014
	B	15	51.7	14	48.3	
	A	6	20.7	23	79.3	
Total		21	36.2	37	63.8	

Table 3. The Frequency and Percentage of the Finish Line on the Lingual Surface of Tooth Four in Bridge Preparation in Different Groups and Genders

Group		Fail		OK		P-Value
		Count	Row, %	Count	Row, %	
B						0.774
	Male	7	58.3	5	41.7	
	Female	9	52.9	8	47.1	
A						0.100
	Male	4	25.0	12	75.0	
	Female	3	23.1	10	76.9	
All						0.016
	B	16	55.2	13	44.8	
	A	7	24.1	22	75.9	
Total		23	39.7	35	60.3	

Table 4. The Frequency and Percentage of the Finish Line on the Lingual Surface of Tooth Six in Bridge Preparation in Different Groups and Genders

Group		Fail		OK		P-Value
		Count	Row, %	Count	Row, %	
B						0.550
	Male	7	58.3	5	41.7	
	Female	8	47.1	9	52.9	
A						0.100
	Male	3	18.8	13	81.3	
	Female	2	15.4	11	84.6	
All						0.006
	B	15	51.7	14	48.3	
	A	5	17.2	24	82.8	
Total		20	34.5	38	65.5	

5. Discussion

This study was conducted to investigate the effect of different teaching methods on the quality of tooth preparation in preclinical students. To this end, the marginal finish line was evaluated in single-crown and fixed prosthesis preparations. Each finish line has its own advantages and disadvantages, which make it suitable for specific crowns. Shoulder finish line is aggressive to the tooth and removes a large part of the tooth structure; however, it is suitable for porcelain owing to its potency. Chamfer finish line removes a smaller part of the tooth, but is suitable for metal because little thickness of metal is located at the margin (12, 17).

Richter and Ueno studied the factors contributing to gingival health by preparing 12 crowns, and half of their margin was above and the other half below the gingiva. They followed up on their patients for three years by annual evaluation and reported no significant differences between the sub-gingival and supra-gingival margins, but suggested that marginal restoration end above the gingiva to the greatest degree possible (18). Eissmann et al. also reported the best results for margins that were smooth and accessible for cleaning (19).

Given the factors noted in different studies for the success of finish lines, this study performed a visual assessment of the software space of the finish lines prepared by the students by considering factors such as smoothness, adherence to gingival contour, placement of finish line above the gingiva and the use of an appropriate bur to make the finish line suitable for a specific crown. The findings showed that most participants in both groups were able to make good finish lines; however, group A outperformed group B, which could be due to the use of the new teaching method in this group.

The present study was mostly similar to the study by Aragon and Zibrowski in terms of the type of teaching method, as Aragon and Zibrowski also used instructor's demonstrations plus educational videos and instructor's demonstrations alone (9), similar to the methods used in the present research. The results of the two studies are therefore similar, as the groups receiving the new teaching method were more successful in following the principles of tooth preparation. In the present research, one group was taught through demonstration along with recorded videos plus the PowerPoint slides of the material, distributed among them before the demonstration. The second group was taught via demonstration alone. Aragon and Zibrowski measured the total score on the practical tests and found that the group receiving educational videos plus instructor's demonstration outperformed the other group in tooth preparation and following its principles.

Nikzad et al. also analyzed two different teaching methods and concluded that educational tools such as VCD and study guides might improve the clinical performance of the students and reduce their stress. To this end, the students filled out questionnaires on stress, self-confidence and knowledge (7).

The present study is different from other studies in that it compared the effects of two different teaching methods on the students' tooth preparation considering experience as a fixed factor affecting the quality of tooth preparation and using the CAD/CAM method. Studies comparing different teaching methods have not digitally evaluated students' tooth preparation and have only compared their scores on practical tests (20).

5.1. Conclusions

It can be concluded that the group receiving the new teaching method was more successful in following the principles of tooth preparation. The use of educational videos and PowerPoint slides along with instructor's demonstrations will be helpful in learning the principles of tooth preparation.

Footnotes

Authors' Contribution: Ladan Jamshidy: data collection and manuscript writing; Hedaiat Moradpoor: performance of the practical sections.

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Patient Consent: The students were told that participation in the study was voluntary and were ensured that nobody but the researcher would access their information. All the participants signed informed consent forms prior to entering the study.

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