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Research Article

Dental students' Performance and Perceived Experience with Magnifying Dental Loupe

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Abstract

Introduction: Magnifying dental loupes have been reported to improve performance and ergonomics among different dental care practitioners. However, there is little evidence to support its use among novice dental students. In this study, we correlated the use of magnifying dental loupes and first-year dental student's performance in preclinical competency assessments. In addition, we evaluated the students' perceived experience with the use of magnifying dental loupes.

Materials and methods: The students' performance and the students' perceived experience with the use of magnifying dental loupes were assessed. To assess the students' performance, we compared the competency assessment scores of the students either using dental magnifying dental loupes or not. A linear mixed-effects model was used to test the effect of magnifying dental loupes on students' performance in cavity preparation classes I, II, and III. To assess the perceived experience with the use of magnifying dental loupes, 109 first-year dental students were surveyed.

Results: Magnifying dental loupes showed a positive and significant correlation with student's increase in performance. Students who used magnifying dental loupes have shown a positive difference of 2.8 points ($p=0.029$). However, as multiple competency assessments were evaluated, the overall students' scores varied despite the fact of using or not magnifying dental loupes. In addition, first-year dental students positively perceived the use of magnifying dental loupes.

Conclusion: Magnifying dental loupes increased first-year performance in classes I, II and III preparation competency assessments.

Introduction

The concept of magnification was introduced to dentistry in a form of an operable microscope in the late '70s [1]. Since then, magnifying dental loupes have been in the market and are widely used to improve visibility during dental procedures [2,3]. Importantly, the use of magnifying dental loupes has been advantageous in field of restorative dentistry [4,5]. Furthermore, the literature suggests that magnified visual acuity of the operating field facilitates diagnosis and treatment of oral diseases [6-8]. In summary, the improvement of visual acuity leads to higher quality dental care, and precision [6-8]. In the '90s, the operating microscope was considered as a necessary part of dental equipment regularly used to diagnose and treat caries lesions, in addition to restorative and surgical procedures [6]. More specifically, in 1997, the Commission on Dental Accreditation republished a position statement requiring the use of magnification in all advanced endodontic residency programs due to the evident benefits [9]. The benefits of using magnifying dental loupes are also related to prevention of occupational injuries in dental practitioners and dental students [10-13]. However, while the perception of magnifying dental loupes among dental practitioners and dental students seems to be positive, whether magnifying improve students' performance in untrained and novice dental students is still controversial [14-15].

Thus, we aimed to assess whether magnifying dental loupes improve performance in preclinical assessments in the simulation laboratory. We measured performance by assessing the scores of the Class I, Class II, and Class III preparation competency assessments. In addition, we aimed to investigate how first-year dental students perceived the experience of using magnifying dental loupes during the competency assessments. We hypothesize that the use magnifying dental loupes will positively impact the performance of first-year dental students' competency assessments and will be well-perceived by dental students.

Materials and Methods

This study was reviewed and considered exempt due to the minimal risks for the subjects by the University of Michigan Institutional Review Board (HUM#00187561). The approved methods are described below.

Subject recruitment

We invited and enrolled 109 first-year dental students to participate in the study. The students' participation required only answering a short 4-question survey through Qualtrics (supplemental material - Table 1). All students who participated in the study were enrolled in the preclinical restorative dentistry course at the University of Michigan School of Dentistry (UMSOD) from August 2020 to April 2021. The scores from the competency assessments (class I, II, III cavity preparations) in the course were retrieved. All course sessions were held in-person at the simulation laboratory at the UMSOD. In the simulation laboratory, each student had their working space assigned at the beginning of August 2020. Each working space (bench) was fully equipped with a dental simulator unit (ADEC), a high-speed handpiece (Bien Air), typodonts (Columbia), high-speed straight cylinder carbide burs 330 and 245 (Brassler), and an examination kit containing dental instruments. The students have individually determined their ergonomic working position according to previous lectures and orientation provided by the same group of instructors. The UMSOD does not require students to use magnifying dental loupes. Therefore, if students choose to do so, the devices are purchased by the students. Consequently, the magnifying dental loupes' brands, light sources, and magnifications could not be controlled once the students choose what they are going to purchase according to their personal preferences.

Study design

The data relating to the use of magnifying dental loupes were collected during each competency assessment in the studied period (August 2020 to April 2021) by a teaching assistant who was not part of the scoring team of faculty experts. To determine the students who used magnifying dental loupes during the competency assessments, the teaching assistant recorded the student's assigned working space number. Later on, the working space numbers were correlated to the earned student's score in each competency assessment evaluated in this study. Therefore, the scoring of the assessments was done by blinded expert assessors who were not aware of the students who were either using magnifying dental loupes or not. Students' competency assessment scores were retrieved from the assessments of classes I, II, and III cavity preparations. Each competency assessment was evaluated and scored by a team of blinded faculty experts. The tooth preparation rubrics are described in supplemental material (Figure 1).

Data analysis

A linear mixed-effects model with and without random effect was used to test the effect of magnifying dental loupes on students' performance in cavity preparation using the competency assessment scores for the comparative analysis. Both models were tested using a random intercept per individual, indicating the average score variation from student to student. The first model used a random intercept for exams, reflecting the possibility that students' average scores could vary from exam to exam. The second model was tested without the random effect for the exam type. The association between the use of magnifying dental loupes and the individual scores from the competency assessment scores were determined with a 95% confidence interval (95% CI) and the level of significance adopted was 5%. To evaluate the perceived performance and adaptability of students using magnifying dental loupes, students were invited to answer a short 4-question survey (Qualtrics) at the end of April 2021. The questions addressed whether students received training before use, the frequency of use, and difficulties found with the use of the dental loupes. In addition, one question addressed how students perceived the use of loupes in relation to their preclinical performance (supplemental material - Table 1).

Results

Students' performance upon using magnifying dental loupes

When the scores of the competency assessments were analyzed by mixed-effects model for the individual scores, students using magnifying dental loupes showed an overall statistically significant improvement in the preclinical competency assessment scores. Specifically, the model without the random effect for the competency assessments showed a significant effect for the use of magnification loupes with an estimated difference of 2.8 (95% confidence interval 0.3 - 5.4, $p = 0.029$). However, the linear mixed effects weren't significant in the model with the random intercept for the competency exams with the estimated difference of 2.6 (95% confidence interval -0.2 - 5.5, $p = 0.08$). These results demonstrate that students' average scores did vary from exam to exam. The analysis of the two models did not show a significant improvement in the model with the random intercept for the exam ($p = 0.64$).

Students perceived experience with the use of magnifying dental loupes

Data were collected from 109 dental students during three tooth preparation preclinical competency assessments in the simulation laboratory. The findings illustrated that only 22.94 % of these students used magnifying dental loupes in the first assessment. In the second assessment, 39.45% of students used magnifying dental loupes during the second assessment, followed by 73.39% in the third assessment (Figure 1). However, 92.66% of students reported in April 2021 that they had used magnifying dental loupes at some point during the studied period while practicing in the simulation laboratory.

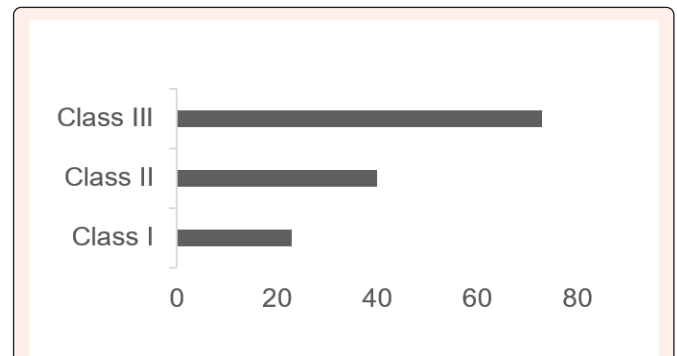


Figure 1: Percentage of students using magnifying dental loupes per preclinical competency assessment increased progressively from the first assessment (class I) to the last assessment (class III) during the study period (August 2020 to April 2021).

When students were asked about the reasons why they either use or did not use magnifying dental loupes, 29% of the students consider the cost as a factor for not purchasing them at the beginning of the course, whereas 16.6% of them considered the weight of the magnifying dental loupes as a mean of discomfort, and 4.1% of these respondents did not use magnifying dental loupes due to eye and vision problems. Alternatively, when the students were asked about the reason why they decided to purchase magnifying dental loupes, 35% of the students responded that they considered the possibility of enhancing viewing ability, 32.6% wanted to improve the quality of their simulation laboratory work, and 30.2% reported that magnifying dental loupes helped them with posture while working in the simulation laboratory. The summary of the reported reasons for choosing or not choosing to use dental loupes can be seen in Table 1.

Table 1: Reasons for choosing or not loupes.

Reasons for choosing NOT to use loupes	Percentage %
Costs too high	29
Loupes are not comfortable	16.6
Eye and vision problems	4.1
Other	50.3
Reasons for choosing to use loupes	
Enhancing viewing ability	35
Improving performance	32.6
Improving posture and ergonomics	30.2
Other	2.2

When asked about training before using magnifying dental loupes in the simulation laboratory, most students (74%) did not receive any training and only a small percentage (6%) reported that they had received training sessions before using the magnifying dental loupes, and 20% of the students reported that they only had a brief demonstration by the vendors before purchasing and using the magnifying dental loupes Table 2.

**Table 2:** Percentage of students who received training before using magnifying dental loupes.

Have you received any training sessions before using your magnifying dental loupes?	Responses %
Yes	6
Yes - Brief Demonstration before purchasing the magnifying dental loupes	20
No	74

In terms of the difficulty of using magnifying dental loupes, 30.8% of students did not find the use of magnifying dental loupes difficult whereas, 23.2% of the students reported difficulties related to adaptability, 16.3% reported eye fatigue, 11.9% of students reported dizziness while using magnifying dental loupes, and 11.9% of students reported headaches. These results are summarized in Table 3.

Table 3: Perceived experience with the use of magnifying dental loupes.

Do you find using magnifying dental loupes difficult? If yes, please describe.	Responses
No	Total 30.8
Yes - Difficult to adapt to the use of magnifying dental loupes	23.2
Yes - Eye Fatigue	16.3
Yes - Dizziness	11.9
Yes - Headache	11.9
Yes - Other	5.9
	Total 69.2
TOTAL	100

Students were also asked about the perception of the quality of their work. For that, 81.3% of the students stated that the quality of their work had improved, and 17.7% of them answered that they were not sure about improving the quality of their work. Only a very small percentage of the students (1%), responded that they did not think that the quality of their work had improved. These results are depicted in Table 4.

Table 4: Quality of work upon using magnifying dental loupes.

Question:	Responses %
How do you perceive the quality of your work upon using magnifying dental loupes?	
The quality of my work has improved	81.3
Not sure the quality of my work has improved	17.7
The quality of my work has not improved	1

Discussion

First-year dental students significantly improved performance in the competency assessments class I, II and III cavity preparations with the use of magnifying dental loupes. However, it is not clear whether this improvement is directly related to a better visual ability due to the magnification of the operatory field or it is related to the constant and progressive training over time. First year dental students are learning to control their hand-eye coordination and fine motors skills. Increasing the operatory field may alone not be enough for an improved ability to deliver a better preparation. On the other hand, an increase the size of the visualized field may allow a better visualization of details that could not be seen before resulting in a better ability to self-assess and correct the preparations. As previously observed, [10,15] we have found that students positively perceived using magnifying dental loupes. Most students in our sample who chose to use magnifying dental loupes perceived that the quality of their work has improved. Like previous studies, we observed significant improvement in the scores of students that used magnifying dental loupes at the end of the studied period [16-18]. In this study, students were not aware of each's other scores. However, at the end of the studied period,

most of students used magnifying dental loupes in the final competency assessment (Figure 1). Therefore, over time, more students may have experience peer influence and decided to purchase and use magnifying dental loupes based on their peer's perceived experience [19]. As observed before, most of our students experienced difficulties while using magnifying dental loupes [17], and reported magnifying-dental-loupes related headaches, eye fatigue and dizziness. Even though students suffer discomfort while using magnifying dental loupes, most of the students positively perceived the magnifying dental loupes regarding increasing the quality of their dental work, enhancing viewing ability, and improving performance and ergonomics.

Because the UMSOD is a public institution and offers affordable tuition compared to private institutions [20], it is possible that many students reported financial obstacles to purchasing magnifying dental loupes. Other authors have also found that the price of magnifying dental loupes may be an obstacle for dental trainers and trainees to adopt its use [21]. However, by the end of April 2021, most of the class (92.66%) reported using magnifying dental loupes at least once in the simulation laboratory. Whether or not students were frequently using magnifying dental loupes is unknown and not an aim of this study. More importantly, it is concerning to know that 69.2% of students reported discomfort while using magnifying dental loupes, which may correlate to the fact that only 26% of the students using magnifying dental loupes reported receiving training before using them, which correlates to a previous study's findings [22]. One limitation of this study was that by the end of our study period, most of students were already using magnifying dental loupes during their competency assessments and the using different types of loupes. However, our data from August 2020 to April 2021, allow us to conclude that even without appropriate magnifying dental loupes training, first-year dental students significantly improve performance in class I, II and III cavity preparations competency assessments.

Conclusion

Based on our findings, we plan to propose the accessibility of magnifying dental loupes for all UMSOD first-year dental students associated with adequate training. A recommended formal training to use and care of dental loupes would be crucial for earlier learners to overcome challenges of using dental loupes and improve their performance.

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