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Comparative evaluation of video-based and face-to-face approaches in suture training for dentistry students an observational comparative study

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ABSTRACT

Aims: This study aims to compare the effectiveness of video-based learning (VBL) and face to face teaching (FFT) in the education of final-year dental students on suturing skills.

Methods: Fifty students were randomized into VBL (n=25) and FFT (n=25) groups. All participants recorded their suturing procedures before (T0) and after (T1) the training. Performances were evaluated using the Objective Structured Assessment of Technical Skills (OSATS). Two blinded evaluators scored each video. Changes in OSATS scores and self-reported confidence were statistically analyzed.

Results: Both groups showed significant improvement after training ($p<0.05$). The VBL group had a significantly higher OSATS score at T1 (13.00±2.16) than the FFT group (11.80±2.04) ($p=0.040$). The increase in OSATS scores was also higher in the VBL group ($p=0.007$). Most participants in both groups reported high satisfaction and willingness to attend similar sessions.

Conclusion: VBL provided greater skill acquisition than FFT for suturing training. These findings support the integration of video-based instruction into dental surgical education.

Keywords: Clinical competence, dental education, suture

INTRODUCTION

Since the COVID-19 pandemic, the changing circumstances have had a significant impact on the social and educational structures of healthcare institutions. These impacts include the disruption of clinical observation and training for students, the interruption of surgical education for oral surgery residents, restrictions on face-to-face interactions, and the delay or reduction of elective surgical procedures.[1]

On the other hand, dental students are expected to acquire fundamental surgical skills during their education and clinical internship periods. These skills are critical for providing safe and effective treatment in clinical practice. The General Medical Council requires that all undergraduate students in the United Kingdom must be able to perform basic wound closure safely under supervision, and dental students are also required to demonstrate competence in basic suturing.[2] However, access to extracurricular surgical skills training remains limited for students and healthcare professionals, and the available alternatives are often insufficient.[3] The available courses and training programs primarily rely on face-to-face teaching (FFT) methods and present several disadvantages, including physical capacity limitations, accessibility challenges due to centralized course locations, long travel times, and high costs associated with transportation and accommodation.[4]

Although some studies have shown that dental students acquire sufficient knowledge and skills during preclinical courses, they also reveal that the educational process involves various challenges and limitations.[5] Unlike other healthcare programs, dental education uniquely combines theoretical learning, laboratory-based practical training, and clinical practice. In dental education, spatial perception and mental visualization skills are considered essential components for the comprehension of theoretical knowledge. However, the development of these skills is not always adequately supported in traditional learning environments.[6,7]

Video-based learning (VBL) is another method used for learning and development of fundamental surgical and clinical skills.[8] In dental education, learning knowledge and clinical skills through videos supports visual and mental imagery while also reducing instructors' workload and the need for a large teaching staff. Thus, it contributes to efficiency in terms of both time and cost.[9] At the same time, it serves as a calibration tool that helps students better understand the subjects. It supports mental preparation processes and contributes to the development of practical skills.[10]

Surgical skills such as suturing are a critical component of motor learning, and through VBL, students can enhance

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their theoretical knowledge prior to hands-on practice by repeatedly watching instructor demonstrations.[11] In this context, investigating the impact of VBL-supported suturing training on the skill development of dental students represents an important area of research for enhancing the effectiveness of educational programs. However, although video recordings are actively used in dental education, their impact on the performance of final-year dental students who are actively involved in patient care has not been sufficiently explored in the literature. Due to limited teaching staff and the increasing number of students each year, video recordings may offer a more feasible alternative to FFT for educating students and surgical trainees in clinical and surgical skills. VBL can also be used to evaluate the training they receive and their performance.[12]

The aim of this study is to comparatively evaluate the effectiveness of VBL versus FFT in providing knowledge and clinical skills in dental education, as well as its impact on clinical performance. The alternative hypothesis (H1) of this study claims that clinical skill outcomes differ between students receiving VBL and those receiving FFT.

METHODS

Ethical Approval

The study was carried out with the permission of the Zonguldak Bülent Ecevit University Non-interventional Clinic Researches Ethics Committee (Date: 16.04.2025, Decision No: 2025/08). We obtained an informed consent form from all participants for procedure. All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Study Desing

This observational randomized controlled study was conducted at the Department of Periodontology, Faculty of Dentistry, Zonguldak Bülent Ecevit University.

Participants

Final-year dental students from the Faculty of Dentistry at Zonguldak Bülent Ecevit University participated in the study.

Evaluators

Two expert periodontists (RC and BAS) from the Department of Periodontology, Faculty of Dentistry, Zonguldak Bülent Ecevit University were included in the study to evaluate suturing skills based on recorded videos using the Objective Structured Assessment of Technical Skills (OSATS) Scale. The OSATS consisted of a 16-item dichotomous checklist, with each item scored as 1 for "yes" and 0 for "no" (**Table 1**).[13]

All participants were informed about the study design, confidentiality issues, objectives, and expectations. They were included in the study after providing written informed consent.

Participants were randomly assigned to sequential groups based on their order of registration. A total of 50 volunteer final-year dental students were randomly sampled and divided into two groups: FFT and VBL. The FFT group was divided into six subgroups, each consisting of 4 to 5 students, and each subgroup received in-person instruction from the same instructor. The instructor-to-student ratio was 1:4, which has been shown to optimize the educational benefit of FFT in suturing training.[14]

Table 1. The OSATS mark sheet used by the trial outcome adjudicators

Empty cell	OSAT point
1.	Safe removal of suture from pack
2.	Safe mounting on needle holder
3.	Appropriate mounting and orientation of needle in jaws
4.	Counter traction by tissue on forceps
5.	Appropriate suture bite size
6.	Appropriate trajectory of needle through tissue
7.	Appropriate formation of each throw of knot
8.	Appropriate crossing of hands with each throw
9.	Appropriate number of throws for suture material used
10.	Correct suture tension: not pulled too tight
11.	Correct suture tension: not pulled too loose
12.	Correct cut/length between suture
13.	Correct distance between sutures
14.	Avoided handling needle
15.	Safe put-down/disposal of needle
16.	Completed task with suture length provided

OSATS: Objective Structured Assessment of Technical Skill

The VBL group received instruction from the same instructor as the other group, through a video demonstrating three simple sutures using hand-tied knots.[13] The participants watched the video once.

The instructors followed a standardized curriculum during both the VBL and FFT sessions. The structure of our teaching sessions is based on Peytons '4 stage approach' as below:[15]

- **Demonstration:** Demonstration of skill by teacher, in real time without commentary
- **Discussion:** Demonstration of skill by teacher, whilst providing explanation and discussing with students
- **Comprehension:** Demonstration of skill by teacher, with instructions and explanation provided by students
- **Execution:** Demonstration of skill by student, with commentary and instructions from other students

The training video demonstrated the correct technique by segmenting the fundamental maneuvers into individual steps.

Before (T0) and after (T1) the FFT and VBL sessions, participants recorded themselves performing the assigned task using two smartphones (48 MP iPhone 15 Pro Max camera; Apple Inc.) mounted on tripods, ensuring identical direction, angle, and distance. Personal data were protected by ensuring that only the participants' hands and the needle movements on the silicone model were visible in the videos. The anonymized video recordings were retrospectively evaluated by two expert researchers using the OSATS score, and the results were recorded as the primary outcome. The

total score was defined as the average of the scores given by the two evaluators. The difference in total OSATS scores between T0 and T1 was considered as the learning gain.[15,16]

Secondary outcomes revealed through the questionnaires included subjective confidence in suturing and knot-tying (before and after the intervention) and perceptions of intervention quality, which were assessed using five-point Likert Scale items.[15]

Sample Size

The sample size calculation for the study was performed using the G*power 3.1.9.7 software (Franz Faul, University of Kiel, Germany). In the calculation, the study conducted by Nathan et al.[15] reported a statistically significant difference of 1.73±0.41 (mean±standard deviation) between the groups, and based on these data, the effect size (Cohen's d) was calculated as 0.907. ased on this effect size, a power analysis with a significance level of 5% (α=0.05) and a power of 90% (1-β=0.90) indicated that a minimum of 22 participants per group, totaling 44 participants, was required [Noncentrality parameter (NCP): 3.01; critical t: 1.68]. A 10% over-sampling was applied to accommodate potential dropouts, and 25 participants were assigned to each group, resulting in a total of 50 participants completing the study.

Statistical Analysis

Statistical analyses of the data obtained in the study were performed using SPSS 27.0 for Windows (Statistical Package for the Social Sciences, Chicago, USA). The normality assumption of the variables was assessed using the Shapiro-Wilk test, which showed that only the difference scores between baseline and post-intervention measurements followed a normal distribution (p>0.05). For continuous variables that followed a normal distribution, an independent student's T test was used to compare the groups, while the Mann-Whitney U test was applied for those that did not meet the normality assumption. Paired samples T test was used to evaluate time-dependent changes within the groups. The reliability of OSATS measurements taken two weeks apart was assessed in 25% of randomly selected samples using Cronbach's α and two-way mixed-effects intraclass correlation coefficients (ICC). The level of statistical significance was set at p<0.05 with a 95% confidence level in this study.

RESULTS

The intraclass correlation coefficients (ICCs) for repeated measurements of the total OSATS score were found to be 0.923 for BAS and 0.942 for RC. These values indicated excellent intra-observer reliability.

Population

Among the participants who took part in the training, 33 (66%) were female and 17 (34%) were male, resulting in a total of 50 individuals. The number of participants was equal in each intervention group, with 25 students assigned to the VBL module and 25 to the FFT group (Table 1). The mean age was 23.4±0.851 years. The baseline characteristics of the two groups are presented in Table 2, and the distribution of these characteristics was similar between both groups.

Table 2. Sample baseline characteristics

Descriptives		FFT (n=25)	VBL (n=25)
Age in years (mean±SD)		23.3±0.822	23.4±0.941
Gender n (%)	Male	n=9 (36%)	n=8 (32%)
	Female	n=16 (64%)	n=17 (68%)
Subjective confidence at baseline n (%)	Not at all confident	3 (12%)	4 (16%)
	Not so confident	8 (32%)	14 (56%)
	Somewhat confident	10 (40%)	1 (4%)
	Very confident	4 (16%)	5 (20%)
	Extremely confident	0	1 (4%)
Subjective confidence at post-intervention n (%)	Not at all confident	0	1 (4%)
	Not so confident	1 (4%)	0
	Somewhat confident	11 (44%)	8 (8%)
	Very confident	7 (28%)	11 (44%)
	Extremely confident	3 (12%)	5 (20%)

FFT: Face to face learning, VBL: Video-based learning, SD: Standard devation

Evaluation of Suturing Skills Before and After Instruction

At baseline (T0) and post-intervention (T1) time points, students' suturing skills were assessed using the validated OSATS scale, which employs a scoring system ranging from 0 to 16. The scale consists of 16 items, each scored as 0 (no) or 1 (yes), and the evaluation is based on the total score [17] Repeated measurements showed a statistically significant increase in OSATS scores regardless of training type, with the mean baseline score rising from 9.54±2.49 to 12.40±2.17 at post-intervention. The difference in OSATS scores between T0 and T1 was compared within each group. Additionally, the differences in T0-T1 OSATS scores were compared between the FFT and VBL groups. The mean OSATS score at T0 was 9.12±2.04 in the VBL group and 9.96±2.70 in the FFT group. There was no statistically significant difference between the baseline scores of the two groups (p=0.237).

The mean OSATS score at T1 was 11.80±2.24 in the FFT group and 13.00±2.16 in the VBL group. A statistically significant difference was observed between T0 and T1 OSATS scores within both the FFT and VBL groups (p=0.002 and p<0.001, respectively) (Figure).

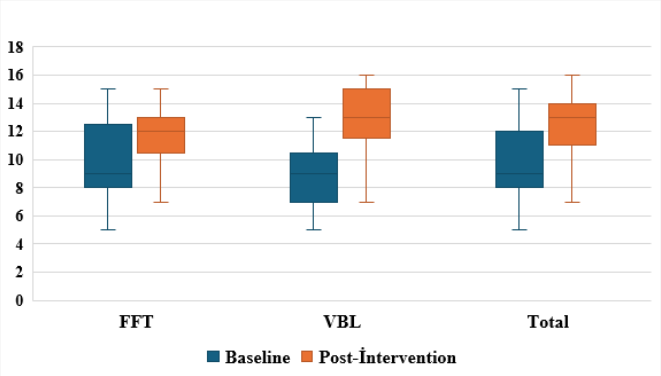

Figure. Mean OSATS scores by group

OSATS: Objective Structured Assessment of Technical Skills, FFT: Face to face learning, VBL: Video-based learning

The OSATS score in the VBL group at T1 was significantly higher than that in the FFT group (p=0.040) (Table 3).

Differences between T0 and T1 OSATS scores were analyzed in both intervention groups. The mean T0-T1 score difference was 1.84±2.7 in the FFT group and 3.88±2.3 in the VBL group. The improvement in OSATS scores was significantly higher in the VBL group compared to the FFT group (p=0.007) (Table 3).

Subjective Confidence and Perceptions

The instructional outcomes and students' perceptions regarding suturing skills, based on self-reported data, are presented in Table 4.

80% of the FFT group and 76% of the VBL group reported that they greatly enjoyed the training. Additionally, 88% of the FFT group and 92% of the VBL group expressed willingness to participate in a similar training method in the future (Table 4).

DISCUSSION

During the COVID-19 pandemic, many schools and higher education institutions adopted online learning formats, such as web-based learning and e-learning, to ensure continuity in education.[17,18] This shift has influenced educational practices across various disciplines, including dental education.[19] However, the shift to online platforms may have considerable implications for dental training, which traditionally depends on practical experience and ongoing patient interaction.[20,21] In particular, acquiring surgical competencies an essential component of dental curricula requires both psychomotor and cognitive skills. Consequently, conventional face-to-face training (FFT), which offers immediate feedback, remains essential for effective learning in this context.[22] In recent years, VBL has emerged as a promising educational tool in dentistry. By providing high-resolution, close-up recordings of clinical procedures, VBL enhances instructional delivery and enriches student learning experiences.[23] It enables the presentation and dissemination of clinical case scenarios, supports standardized teaching, and contributes to the structured nature of dental education.[24] Traditional surgical and clinical skills programmes aim not only to provide patient care but also to nurture the development of professional competencies among dental and surgical trainees.[25,26]

This observational randomized controlled study aimed to evaluate the effect of VBL compared to FFT on suturing

Table 3. Intra and inter-group comparisons of OSATS scores at baseline (T0), post-intervention (T1), and the change scores (T0-T1) in FFT and VBL groups

	FFT (n=25)		VBL (n=25)		p
	Mean±SD (median)	95% CI	Mean±SD (median)	95% CI	
Baseline (T0)	9.96±2.70 (9)	8.85-11.1	9.12±2.24 (9)	8.19-10	0.237[t]
Post-intervention (T1)	11.8±2.04 (12)	11-12.6	13±2.16 (13)	12.1-13.9	0.040[u]
Change scores (T0-T1)	1.84±2.7 (2)	0.724-2.96	3.88±2.37 (4)	2.9-4.86	0.007[t]
p	0.002[p]		<.001[p]		

[t]: Independent samples T test, [u]: Mann-Whitney U test, [p]: Paired samples T test. Statistical significance was set at p<0.05, CI: Conficence interval, FFT: Face to face learning, VBL: Video-based learning, SD: Standard devation

Table 4. Post-intervention subjective confidence levels and participants views on the instruction session

		Intervention group	
Question/statement	Response	FFT (n=25)	VBL (n=25)
How confident do you feel placing an interrupted suture with a hand-tied knot? n (%)	Not at all confident	0	1 (4%)
	Not so confident	2 (8%)	2 (8%)
	Somewhat confident	14 (56%)	8 (32%)
	Very confident	9 (36%)	14 (56%)
	Extremely confident	0	0
I enjoyed the training session n (%)	Strongly disagree	0	0
	Disagree	0	0
	Neither agree nor	0	0
	Agree	5 (20%)	6 (24%)
	Strongly agree	20 (80%)	19 (76%)
I would like to attend another training session of the same format n (%)	Strongly disagree	0	0
	Disagree	0	0
	Neither agree nor	0	0
	Agree	3 (12%)	2 (8%)
	Strongly agree	22 (88%)	23 (92%)

FFT: Face to face learning, VBL: Video-based learning

and knot-tying skills among dental students. The OSATS scale was used to assess these skills as the primary outcome. Regardless of the training method, OSATS scores improved significantly from the pre-training to the post-training period. However, the post-training OSATS scores in the VBL group were significantly higher than those in the FFT group. Furthermore, the improvement in OSATS scores-interpreted as learning gain-was greater in the VBL group compared to the FFT group. Based on these findings, the H1 hypothesis was accepted.

In this study, we used the OSATS, which has proven accuracy and validity, adopting a dichotomous response format, with excellent intra-examiner agreement[15] However, variations of the OSATS differ, such as the inclusion of Likert-Type Scales and the need for subjective judgements by the assessor.[27] Our use of an objective performance measure allowed for a higher level of standardization in assessment and greater generalizability of the findings.[28]

In a multicentre study involving 55 participants, similar to our study, an increase in OSATS score from T0 to T1 was observed in both VBL and FFT groups; however, no evaluation was made regarding T0-T1 score differences.[16] Nathan et al.[15] evaluated the effects of three different training methods, including VBL and FFT, on the suturing and basic surgical skills of medical students in a design comparable to our own. In their study, the VBL and FFT groups were contrasted with the virtual classroom training (VCT) method, which is based on creating an interactive virtual classroom. The educational contribution of the VBL and FFT groups was found to be significantly higher than that of VCT, while no significant difference was identified between VBL and FFT. They concluded that VBL and FFT are good alternatives to VCT because VBL and FFT demonstrate similar results in terms of training contribution, and VBL is more economical and easier to access. The advantages of three-dimensional visualisation in the application of basic surgical procedures are recognised.[29]

The potential limitations of two-dimensional VBL were considered during the study design, and this limitation was minimized by taking video recordings from two different angles and orientations during both training and assessment. A consistent objective competence assessment method was used to identify differences that may occur post-intervention. Al-Jundi et al.[30] compared remote feedback delivered via video communication with FFT, concluding that both methods were equally effective in improving basic surgical skills. Niaz et al.[16] compared traditional FFT with VBL in the operating theater training of 60 surgical residents. An increase in OSATS score was noted in both groups, though the OSATS score was higher in the FFT group after training. Despite this, the learning gain was found to be greater in the VBL group. In line with existing studies, the fact that VBL yields similar or superior results compared to FFT in terms of learning gain supports its consideration as a reliable training tool for integrated feedback and evaluation of basic surgical and clinical applications in the future. Additionally, due to its benefits such as reinforcing learning, repeatability, and adaptability to individual learning speeds, VBL can be regarded as an effective method in surgical skills training.

There are a limited number of studies on the subject in the literature. In the existing studies, limitations such as calibration deficiencies and biased behaviour are observed.[15,16] In our study, students were randomly assigned to consecutive groups based on the order of participation. Randomization was conducted by an independent individual who was not involved in the study procedures. In this way, more homogeneous groups were formed. Double blinding was applied to minimize biases concerning participants and evaluators. Participants were not provided with any information about the group they were in prior to the training. During the evaluation phase, the researchers scored the participants without knowing which group they belonged to.

Limitations

Secondary outcome measures in our study, based on participants' subjective reports, were also sensitive to various mechanisms of response bias. The methods used by the trainers may show individual differences. These can be interpreted as limitations of our study. In order to minimize the risk of bias that may arise from these situations, the same instructor was in charge of both VBL and FFT sessions and all sessions were conducted using standardized curriculum content. The majority of the 50 students who participated in our study were female. This unequal distribution may have limited the examination of the effect of gender on learning outcome. This can be interpreted as a limitation of our study.

CONCLUSION

The results obtained within the limitations of this study showed that the VBL group was higher than the FFT group in terms of both post-training OSATS scores and educational gain (T0-T1). In this respect, VBL can be considered as a reliable educational tool for integrated feedback with the evaluation of basic surgery and clinical practices. In addition to its contribution to suture education, recording videos of basic and advanced surgical operations with patient consent can make significant contributions to the learning of students and candidate surgeons. Studies in the literature, including our study, evaluate clinical performance immediately after training. Studies evaluating clinical performance in the medium-long term after training will be important in terms of evaluating the time-dependent effectiveness of educational models. This situation can contribute to the development of curricula in the health field.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Zonguldak Bülent Ecevit University Non-interventional Clinic Researches Ethics Committee (Date: 16.04.2025, Decision No: 2025/08).

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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