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ORIGINAL ARTICLE

The application of an intraoral banana peel suturing model in surgical training of dental students

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Abstract

Objectives: This study investigated the application of an intraoral banana peel suturing model in helping students to acquire intraoral surgical techniques.

Methods: This is a self-control study conducted from January 2021 to March 2021. An intraoral banana peel suturing model was implemented to provide oral suture experience for undergraduates majoring in stomatology. The sutures students placed in the model were photographed and evaluated blindly by a professional team using an established scoring system. Training scores were recorded before (training 1) and after 2 months of training (training 2). Linear regression was used to examine factors related to the scores. Suturing training was conducted in the School and Hospital of Stomatology at Peking University. A total of eighty-two students in Peking University School and Hospital of Stomatology were in their fourth pre-clinical year and followed a workshop on surgical sutures according to the curriculum. All students who should take this course were included, and the response rate was 100%.

Results: The mean training 2 score (23.04 ± 3.83) was higher than the mean training 1 score (13.94 ± 3.15). The training 1 score was not significantly correlated with any of the students' general characteristics. The training 2 score was correlated with the training 1 score and the cumulative duration of practice outside of class.

Conclusion: The intraoral banana peel suturing model can be used for suture training, and dental students' suture ability was improved after using the banana peel for suture practice.

KEYWORDS
dental education, dental model, suture techniques, teaching materials

1 | INTRODUCTION

Suture training is one of the most difficult aspects of dental surgery education. Intraoral sutures are manipulated in a limited space, deep within the oral cavity; they are considerably challenging for dental students. Before clinical practice, students require a long duration of extensive practice to acquire suture technique.[1,2] Continuous practice involves efforts both inside and outside of the classroom. Thus, there is a need for a model that can be used repeatedly, which allows students to frequently perform suture exercises both inside and outside of the classroom.

In the past, materials used for suture education and training have included animal tissues and artificial materials,[3,4] which are expensive and have limited space for suture application; such materials cannot provide students with repeated, large-scale training opportunities.

In recent years, many medical educators have been revising the concepts of ideal medical training models. Some educators have designed a reproducible training model that allows ultrasound-based diagnosis of thyroid lesions.[5] Stanford University School of Medicine uses grapes as a training model for otolaryngology microsurgery; the use of this model has significantly improved incision and suturing skills among students.[6] Some educators have experimented with the use of banana peels for suture exercises.[7,8] Banana peels are rich in fiber and have an appropriate thickness of around 2–3 mm; they can be separated to form simulated incisions, which can then be sutured. Bananas are common fruits worldwide; they are inexpensive, environmentally friendly, and easily obtained. Thus, the use of bananas offers numerous and long simulated incisions for suture training. Our research has confirmed that in the external oral suture, the suturing ability of the students has been significantly improved after the banana peel model suture training.[9]

Bananas can be fixed within the jaws of the dental simulator and intraoral suturing can be conducted; this arrangement constitutes an intraoral banana peel suturing model. Here, we hypothesized that dental students' suturing ability can be improved after using the intraoral banana peel suturing model for suture practice because it provides sufficient training practice both inside and outside of class. Therefore, we established a scoring system and performed a blinded quantitative evaluation of the efficacy of suture training with an intraoral banana peel suturing model.

2 | MATERIAL AND METHODS

This project was exempt from ethics review by the Institutional Review Board of Peking University School and Hospital of Stomatology as all scores are de-identified, and there is no identifiable risk to participation.

In total, 82 fourth-year dental undergraduates at Peking University participated in this study. Instructors provided a theoretical explanation and demonstration. Each student was given an intraoral banana peel suturing model, which comprised a banana fixed within the jaws of the manikin head (Nissin Dental Products Inc., Japan) (Figure 1). Students conducted suture training on the intraoral banana peel suturing model (Figure 2) for 20 min. The sutured bananas were numbered and photographed to ensure blinded assessment (i.e., without student names) (training 1). All suturing results were carefully analyzed; the strengths and weaknesses were discussed in detail.

Students were encouraged to practice outside of class and record the cumulative duration of practice. Two months later, the same 20-minute suture training with an intraoral banana peel suturing model was conducted; the bananas were numbered and photographed as previously described (training 2).

A scoring system for the evaluation of suture training performance was established. The maxillofacial surgery professionals were invited to develop the scoring system, which consisted of seven scoring items: suture length, suture spacing, knot quality, wound closure, tissue injury, esthetics, and suture number. Most items were evaluated and scored on a scale of 1–5 points; knot quality was scored on a scale of 1–2 points. If the thread knot demonstrated no obvious looseness and the thread length was appropriate, the knot quality was given a score of 2 points; otherwise, it was given a score of 1 point. The full score was 32 points, with a higher score indicating better performance (Table 1). Seven instructors in the oral and maxillofacial surgery education group were asked to participate in the blinded scoring project. Questionnaire surveys were used to record the students' general characteristics. The institutional edu-

FIGURE 1 The intraoral banana peel suturing model (left). Students using the intraoral banana peel suturing model (right).

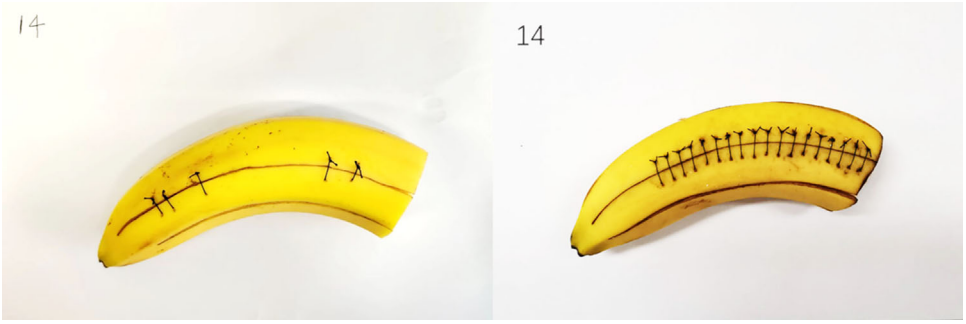

FIGURE 2 Suture results were photographed and numbered to ensure blinded assessment (i.e., without student names). Training 1 (left) by student No. 14; training 2 (right) by the same student, performed 2 months later.

TABLE 1 The scoring system for evaluation of suture training performance.

Item	Points				
	1	2	3	4	5
Suture length	Too long or too short		Occasionally too long or too short		Appropriate length
Suture spacing	Too wide or too narrow		Occasionally too wide or too narrow		Appropriate space
Knot quality	The knot was loose	The knot was tight	–	–	–
Wound closure	Wound dehiscence		Wound partially dehiscence		Wound closed
Tissue injury	Frequently caused tissue damage		Occasionally caused tissue damage		Carefully protected tissue
Esthetics	Inaesthetic		Moderate level		The stitches were neat and even
Suture number	1–5 stitches	6–8 stitches	9–11 stitches	12–14 stitches	15 stitches and more

cation office provided each student's course grade, which was based on the sum of all scores in the course; the full course score was 100 points.

Statistical analyses were performed using SPSS software (IBM SPSS Statistics, Version 22.0. Armonk, NY: IBM Corp. USA). The Kolmogorov–Smirnov test was used to assess the normality of the data; Cronbach's α was used for reliability analysis, while the Kaiser–Meyer–Olkin test and Bartlett's test were used for validity analysis. Scores were compared between groups. Multifactor linear regression was used to examine the relationships of various factors with suture results. $P < 0.05$ was considered to indicate statistical significance.

3 | RESULTS

In total, 82 students participated in the study. All students completed both training sessions and the questionnaire survey. Their general characteristics are shown in Table 2.

The mean scores of training 1 and 2 exhibited a normal distribution. The results showed that the training 2 score (23.04 ± 3.83) was significantly higher than the training 1 score (13.94 ± 3.15). The Cronbach's α reliability coefficient was 0.887, the Kaiser–Meyer–Olkin validity value was 0.902, and Bartlett's sphericity p-value was < 0.01.

TABLE 2 General characteristics of 82 dental students.

		Number	(%)
Sex	Female	52	63.41
	Male	30	36.59
Avocational interests	calligraphy	7	8.54
	physical education	12	14.63
	manual	13	15.85
	painting	14	17.07
	music	27	32.93
	other	9	10.98
Extracurricular practice time (hours)	0-10	59	71.95
	11-20	17	20.73
	21-30	4	4.88
	31-60	2	2.44
Course grade (points)	70-80	10	12.20
	81-90	67	81.70
	91-100	5	6.10

TABLE 3 Results of multifactor linear regression with the training 2 scores as the dependent variable ($n = 82$).

	Unstandardized coefficients		Standardized coefficients			
	B	**Standard error**	***Beta***	***t***	***p***	**VIF**
Constant	13.130	9.697	–	1.354	0.180	–
Training 1 scores	0.325	0.125	0.267	2.588	0.012	1.033
Sex	1.198	0.880	0.152	1.361	0.178	1.202
Practice time	0.114	0.043	0.278	2.645	0.010	1.068
The full course grade	0.027	0.121	0.025	0.222	0.825	1.219
R^2	0.205					
Adjusted R^2	0.164					
F	$F(4,77) = 4.977$, $p = 0.001$					
D-W	1.572					

TABLE 4 Results of multifactor linear regression with the (training 2-training 1) scores as the dependent variable ($n = 82$).

	Unstandardized coefficients		Standardized coefficients			
	B	**Standard error**	***Beta***	***t***	***p***	**VIF**
Constant	15.233	2.100	–	7.255	<0.001	–
Training 1 scores	−0.671	0.123	−0.503	−5.441	<0.001	1.010
Sex	1.266	0.821	0.146	1.541	0.127	1.059
Practice time	0.115	0.042	0.256	2.716	0.008	1.048
*R*2	0.341					
Adjusted R^2	0.316					
F	$F(3,78) = 13.477$, $p < 0.001$					
D-W	1.570					

Univariate linear regression revealed that the training 1 score was not significantly correlated with any of the students' general characteristics. Multifactor linear regression showed that the training 2 score was correlated with training 1 and the cumulative duration of practice outside of class. The model formula was training 2 = 13.13 + 0.325* training 1 score + 0.114 * practice time; the model's R^2 value was 0.164 (Table 3).

Linear regression analysis was performed with the cumulative practice time as the independent variable and the (training 2-training 1) score as the dependent variable. The model formula was (training 2 - training 1) = 15.233 − 0.671 × training 1 score + 0.115 × practice time; the model's R^2 value was 0.316 (Table 4).

4 | DISCUSSION

This study used an intraoral banana peel suturing model to help dental students acquire the intraoral suture technique. The scoring system in this study facilitated the assessment of efficacy in a blinded and quantitative manner. After education and practice, the students exhibited significant improvement in the suture technique.

To provide clearly defined goals for the students, we developed an objective assessment of the suture technique, which consisted of seven scoring items: suture length, suture spacing, knot quality, wound closure, tissue injury, esthetics, and suture number. Our testing approach confirmed that this scoring method was reliable and effective. Three types of suture evaluation methods have been described in the literature. First, an objective structured assessment of technical skills has been proposed by Martin and colleagues.[10] This evaluation method uses global rating scales, which include the concepts of time and action, equipment holding, equipment selection, assistant cooperation, proficiency, and relevant knowledge of specific steps. This method is appropriate for the standardized assessment of multiple items in surgery; it has a broad focus. Second, self-evaluation scales (e.g., the Likert scale) can be used for subjective self-assessment. Third, questionnaires can be prepared by the Delphi expert consultation method. For example, Lee[1] performed a study in which experts discussed seven components of

evaluation: needle holding method, interrupted suture, vertical mattress suture, horizontal mattress suture, subcutaneous suture, suture removal, and sharps handling. Similar to our approach, Gonzalez-Navarro[4] used an evaluation method in which five components were assessed: needle entry and exit points on the same plane, appropriate suture length, appropriate suture spacing, appropriate knot tightness, and sufficient suture tension. Our scoring method combined the strengths of the above methods; it also evaluated the suture number and tissue strain, which are two important considerations in clinical practice. Additionally, our scoring method used blinded assessment to ensure objectivity.

In addition to clear criteria, an appropriate model is needed. In this study, we demonstrated the strengths of an intraoral banana peel suturing model for suture training. This model aids in student awareness, perception, and control of suture distance; it can adequately show the suture length, spacing, wound margin closure, and tissue strain. Additionally, the banana has an arc shape similar to the dental arch; it can be placed in the mouth of a manikin head to simulate incisions and sutures in various areas of the alveolar ridge (e.g., anterior tooth and molar areas). During our study, a few students complained that some banana peels were soft and fragile. We recommend the use of immature bananas during early practice. However, softness and fragility are not limitations of the banana peel suturing model because many types of wound tissues must be sutured in clinical practice; for example, gingival tissue tears easily when subjected to excessive tension. Therefore, after students have acquired some suturing experience, they can practice with more mature bananas to enhance their control of suture tension.

Because it is conducted in a confined and deep cavity, intraoral suturing is more difficult than skin suturing. However, the use of an intraoral banana peel suturing model demonstrated that the training 2 score was higher than the training 1 score. The training 2 score was positively correlated with the training 1 score. The higher the training 1 score, the better the student's suturing skill foundation, so the training 2 score is higher. The training 2 score and the improved score were both significantly correlated with the training time. This is consistent with published findings.[11] Shah reported that mastery of intraoral sutures was achieved after 80 cases of intraoral sutures.[12] Medical educators have generally agreed that a single session of suture training is insufficient to achieve good results; students should perform repeated exercises outside of class to improve their suture technique,[1,13–16] then practice regularly to maintain their suturing skills.[17,18] In this study, the good practice model and mastery of suturing requirements on the basis of our scoring standards enabled students to achieve sufficient and effective practice outside of class. These aspects compensate for the limited class time and inadequate practice provided by existing educational methods.

There were some limitations in this study. First, because of the need for blinded scoring, students were not scored while they performed the suturing technique. However, we provided detailed explanations prior to the in-class practice session; we also corrected students individually as they performed the technique (e.g., by modifying the needle-holding method, suturing method, and instrument placement). Second, it is difficult to fix bananas in the oral cavity of a manikin head; this approach cannot simulate suturing of the upper jaw. Third, this was a single-center study with small sample size and non-uniform preparation of bananas, which may have influenced the suturing results. These areas should be improved in future education research. In addition, in future studies, we will compare the intraoral banana peel suturing model with other suturing models to determine their efficacy.

5 | CONCLUSION

In summary, an intraoral banana peel suturing model can be used for helping dental students to acquire intraoral suture techniques. This model can be used for guidance in class and training outside of class; it can be assessed in a blinded and quantitative manner, thus improving intraoral suture technique among dental students.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

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