

Complications and Dental Students' Perceptions Regarding Student-to-Student Local Anesthesia Administration in Oral Surgery Clinic: Descriptive Research

Ağız Cerrahisi Kliniğinde Öğrenciden-Öğrenciye Lokal Anestezi Uygulamasına İlişkin Komplikasyonlar ve Öğrenci Algısı: Tanımlayıcı Araştırma

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ABSTRACT Objective: Student-to-student practice is the one of the most common preclinical training method for local anesthesia education in dentistry. However, the complications in this modality are relatively less known. This study aimed to evaluate the rate and types of complications and the perception of student-to-student local anesthesia education during dental education. **Material and Methods:** This prospective, single-center study was conducted on fourth-year dental students. As part of their clinical education, students performed inferior alveolar block anesthesia on each other at the oral surgery department. Two days after the training, local and systemic complications linked to local anesthesia were assessed. Overall perception and satisfaction level of the students related to the practice and education modality were also evaluated. **Results:** The study included 44 participants [median age, 22 years; female, 26 (59%)]. The rate of any local complication was 72.7%. Pain and burning on the injection site (65.9%) and trismus (15.9%) were the most common complications. Hematoma, soft tissue injury, facial paralysis, subluxation, and syncope were also observed (2.3%). All participants recommended the practice for future applications, while 88.6% were willing to access advanced educational modalities such as simulation. Also, 97.7% agreed that the student-to-student local anesthesia education improved their empathy level toward patients. The overall satisfaction level was 87.5% (70%-90%). **Conclusion:** Local complications were common after student-to-student inferior alveolar block anesthesia. On the other hand, the students were overall satisfied by this unique educational practice.

ÖZET Amaç: Diş hekimliğinde lokal anestezi eğitimi için öğrenciden-öğrenciye anestezi uygulaması en yaygın klinik öncesi eğitim yöntemlerinden biridir. Bununla birlikte, bu eğitim modeline ilişkin komplikasyon oranları literatürde belirsizdir. Bu çalışma, diş hekimliği eğitimi sırasında öğrenciden-öğrenciye lokal anestezi uygulamasının komplikasyon oranları ile öğrencilere yönelik algı ve memnuniyet oranlarını değerlendirmeyi amaçlamaktadır. **Gereç ve Yöntemler:** Bu prospektif, tek merkezli çalışma, diş hekimliği fakültesi 4. sınıf öğrencileri üzerinde yürütülmüştür. Öğrenciler, klinik eğitimlerinin bir parçası olarak ağız diş ve çene cerrahisi bölümünde klinik uygulamalara başlamadan önce birbirlerine inferior alveolar blok anestezi uygulamışlardır. Eğitimden 2 gün sonra uygulanan anket formları aracılığıyla lokal anesteziye bağlı gelişmesi muhtemel lokal ve sistemik komplikasyonlar, öğrencilerin eğitim modeline ilişkin genel algı ve memnuniyet düzeyleri değerlendirilmiştir. **Bulgular:** Çalışmaya 44 [ortalama yaş 22, kadın, 26 (%59)] katılımcı dâhil edilmiştir. Herhangi bir lokal komplikasyon gelişme oranı %72,7 olarak belirlenmiştir. Enjeksiyon yerinde ağrı/yanma (%65,9) ve trismus (%15,9) en sık belirlenen komplikasyonlar olup; hematoma, yumuşak doku yaralanması, fasiyal paraliz, subluksasyon ve senkop da gelişen diğer komplikasyonlar olarak saptanmıştır (%2,3). Tüm katılımcılar uygulamayı gelecekteki öğrenciler için tavsiye ederken, katılımcıların %88,6'sı simülasyon gibi gelişmiş eğitim yöntemlerine erişim konusunda istekli olduklarını bildirmişlerdir. Ayrıca katılımcıların %97,7'si öğrenciden-öğrenciye lokal anestezi eğitiminin hastalara karşı empati düzeyini geliştirdiğini ifade etmiştir. Uygulamaya yönelik genel memnuniyet seviyesi %87,5 (%70-90) olarak saptanmıştır. **Sonuç:** Öğrenciden-öğrenciye inferior alveolar blok anestezi uygulaması sonrası lokal komplikasyonlar yaygın olarak izlenmiştir. Bununla birlikte, öğrenciler bu benzersiz eğitim uygulamasından genel olarak memnun kalmıştır.

Keywords: Local anesthesia; complications; dentistry; education; informed consent

Anahtar Kelimeler: Lokal anestezi, komplikasyonlar, diş hekimliği; eğitim; bildirilmiştir onam

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Administering safe and effective local anesthesia is an essential skill for pain-free dentistry and a prerequisite for most dental procedures.^{1,2} Adequate local anesthesia enables painless treatment, optimizes patients' comfort/cooperation, and improves the performance of the clinician. Therefore, gaining experience in local anesthesia administration is an important part of dental education. The result of a survey that aimed to investigate the structure of the local anesthesia education in European dental schools revealed that the theoretical part of the education mostly started during the first half of the third year, and the first injection, usually administered to a schoolmate, was mostly supervised by an oral and maxillofacial surgeon.³ In Türkiye, similar to the European dental schools, local anesthesia education begins in the first half of the third year, and the first injection in humans, usually to a fellow student or schoolmate, is generally supervised by an oral and maxillofacial surgeon.⁴

Various teaching methods have been defined for local anesthesia education. Manikin simulation, instructional videos, and preclinical training models have proven beneficial for local anesthesia education in dentistry.⁵⁻⁷ However, besides lectures and textbook instructions, student-to-student practice is the traditional and most common preclinical training method.^{1,5} Although the importance of this teaching methodology is broadly accepted, information regarding complication rates and students' perceptions is relatively lacking. The majority of dental schools worldwide do not obtain prior written consent from students receiving oral injections from fellow students. Although the perception of the administration of local anesthesia is considered a safe procedure, legal and ethical issues should still be taken into consideration. The main aim of this study was to evaluate the rate and types of complications and the perception of student-to-student local anesthesia during dental education.

MATERIAL AND METHODS

This prospective, single-center study was conducted on fourth-year dental students of the University of Health Sciences, Gülhane Faculty of Dentistry and approved by the University of Health Sciences/Gül-

hane Scientific Research Ethics Committee (date: March 25, 2021, no: 2021/133). It was carried out on March 2021 and was performed in accordance with the guidelines of the Declaration of Helsinki. Before starting clinical procedures, students applied student-to-student inferior alveolar block anesthesia (IABA) at the oral and maxillofacial surgery department as a part of their formal curriculum. On the day of training, students were informed about the study protocol, and informed consent was obtained. Concerning the 27th article of the Helsinki Declaration about dependent relationship with the physician, support was obtained from a clinic administrative staff for obtaining informed consent. Students not willing to participate in the study were informed that their education would not be affected. Students who had administered intraoral local anesthetic injection previously and were not willing to participate in this study were excluded.

Before the application, a brief instruction about IABA was given which included the anatomical landmarks, the technique, insertion point of the needle, and potential complications on solid models. After the presentation, the students were sorted into 2 groups and switched their role as practitioners and patients onwards. They applied IABA through a direct approach. A 2-mL solution containing articaine was applied (40 mg/mL articaine, 0.01 mg/mL epinephrine, Maxicaine fort 2 mL; Vem İlaç, Ankara, Türkiye). The students were monitored by Gurkan Rasit Bayar and Metin Sencimen when the local anesthesia was administered. After the anesthesia application, the students were requested to wait for half an hour before leaving the clinic. After 2 days of the local anesthetic training, the students filled out questionnaires that included the following items: age, sex, local/systemic complications related to local anesthesia procedures, and questions to evaluate the perception and satisfaction level of students regarding this education modality.

Local complications were questioned in terms of pain/burning on injection, trismus, hematoma, infection, emphysema, facial paralysis, soft tissue injury, prolongation of anesthesia, failure of anesthesia, needle fracture, ophthalmological complications, necrosis, and others. Systemic complications were

TABLE 1: Items to evaluate students' perception and satisfaction level.

Questions that aim to evaluate students' perception		Frequency	Percent
Do you recommend this education modality to prospective students?	Yes	44	100.0
	No	0	0
Do you want to access advanced educational modalities as simulation besides the conventional education approach?	Yes	39	88.6
	No	5	11.4
Does student-to-student local anesthesia education improve your empathy levels toward patients?	Yes	43	97.7
	No	1	2.3
Satisfaction level (%)		Median (Q1-Q3)	
Please mark your satisfaction level regarding the student-to-student local anesthesia model as an educational tool.		87.5 (70.0-90.0)	
(0-100 point VAS was used, with 0 indicating the lowest satisfaction level, and 100 the highest satisfaction level)			

VAS: Visual Analogue Scale.

questioned in terms of syncope, systemic toxicity, allergy, methemoglobinemia, and others. The questions that aimed to evaluate perception are presented in [Table 1](#). These questions were designed according to previous studies conducted on dental students.^{1,2,5-7} For evaluating the satisfaction level, a Visual Analogue Scale (VAS) was inserted below the question asking the satisfaction level regarding the student-to-student local anesthesia model as an educational tool.⁸

The statistical analyses were performed using version 23 of IBM-SPSS for Windows (SPSS Inc, IL, USA). Normality of distribution of scale variables was analyzed using the Shapiro-Wilk normality test and graphical methods (histogram, Q-Q plot). Non-normally distributed data were reported as median and 1st-3rd quartiles. Categorical variables were reported as frequency and percentage. Comparisons between 2 independent groups were performed using the Mann-Whitney U test or the chi-square test where appropriate.

RESULTS

A total of 44 [median age, 22; female, 26 (59%)] dental students were included. [Table 2](#) displays the characteristics of the participants. Of the students, 25% did not report any local or systemic complications. The rate of local complications among dental students was 72.7%. Pain and burning on injection (65.9%) and trismus (15.9%) were the most common complications. Hematoma (2.3%), soft tissue injury (2.3%), facial paralysis (2.3%), and subluxation (2.3%) were

also observed. Syncope was reported in one student in as a systemic complication. Complications were observed in 73.1% of women and 76.5% of men. The overall satisfaction level was 80% (70%-90%) among women and 90% (70%-100%) among men. No significant difference was found between the sexes in terms of satisfaction levels and complication rates ($p=0.569$, $p=0.999$). All complications reported by students are presented in [Table 3](#).

Perceptions and satisfaction levels related to training are presented in [Table 1](#). The overall satisfaction level was 87.5% (70%-90%). All students recommended this education modality for prospective students. Around 90% of the participants were willing to access advanced educational modalities, such as simulation besides conventional education approach. Most students (97.7%) agreed that student-to-student local anesthesia education improved their empathy levels towards patients.

TABLE 2: Participants' characteristics.

Median (Q1-Q3)	22.0 (21.0-23.0)
Age, year	
Sex, n (%)	
Male	18 (40.9)
Female	26 (59.1)
Complications, n (%)	
No local or systemic complication	11 (25)
Local complication	32 (72.7)
Systemic complication	1 (2.3)
Local and systemic complication	0

TABLE 3: Complications reported by students.

Complications (L: Local, S: Systemic)	Frequency (n)	Percent (%)
L-Pain/burning on injection	29	65.9
L-Trismus	7	15.9
L-Hematoma	1	2.3
L-Facial paralysis	1	2.3
L-Subluxation	1	2.3
L-Soft tissue injury	1	2.3
S-Syncope	1	2.3
L-Needle fracture	0	0.0
L-Infection	0	0.0
L-Failure of anesthesia	0	0.0
L-Prolonged anesthesia	0	0.0
L-Emphysema	0	0.0
L-Ophthalmological complications	0	0.0
L-Necrosis	0	0.0
S-Systemic toxicity	0	0.0
S-Allergy	0	0.0
S-Methemoglobinemia	0	0.0

DISCUSSION

Theoretical knowledge and local injection skills are among the most important parts of local anesthesia education.¹ Textbooks, lectures, peer-assisted injections, and anatomic models have been defined as the main training techniques for preclinical local anesthesia education in dental schools. Brand et al. reported that the use of preclinical training models in local anesthesia education might have positive impacts in terms of confidence and pain perception.⁶ Peer-assisted learning is an influential method for teaching surgical skills, and student-to-student administration of the first local anesthetic injection has been a conventional method for preclinical training.^{1,9} It remains a suitable method for creating a real-world experience that improves the confidence of students.¹⁰

Identifying the students' perception about their dental education is an important aspect of education.¹¹ Students' attitudes towards local anesthesia have been examined in previous studies in terms of anxiety and sex differences.^{12,13} Meechan reported that female students were more anxious about giving and receiving local anesthetic injections than male students.¹² However, Sánchez-Garcés et al. stated that sex was not associated with anxiety during student-

to-student local anaesthesia administration.¹⁰ In different European dental schools, 17-81% of students reported that they feel insufficiency before the first injection in a human being.¹⁴ Wong et al. reported that student-to-student dental local anesthetic pre-clinical training had a beneficial effect on confidence.¹ Kuscü et al. reported that student-to-student local anesthesia administration improved dental students' perceptions about the potentiality of pain-free injections.¹⁵ Reyes-Acuca et al. reported that 100% of the students who participated in their study stated that the student-to-student training method should continue in the course of dental anesthesia.¹⁶ In the present study, the overall satisfaction level regarding student-to-student local anesthesia administration as an educational tool was 87.5%, and sex was not related to the satisfaction level. Further, 100% of students recommended this education modality to prospective students. Most students agreed that student-to-student local anesthesia education improved their empathy levels toward patients. In conclusion, student-to-student local anesthesia application was associated with beneficial effects on students' perception. Besides the positive effects of the student-to-student local anesthesia for education, new techniques also exist that help in improving learning outcomes. Corrêa et al. showed that the virtual reality simulator was considered satisfactory for the anesthesia training in terms of needle insertion and perception of the tissues during inferior alveolar nerve block.¹⁷ Mladenovic et al. reported a shorter period of time for performing local anesthesia and higher anaesthetic success rate in teaching inferior alveolar block anaesthesia among students with the reality mobile simulator combined with education, compared with the conventional educational methods.¹⁸ Reyes-Acuca et al. emphasized the positive effect of dental anesthesia simulation models on the students, like increased confidence and shorter anesthesia time.¹⁶ Zafar et al. reported that a virtual reality simulator as an adjunct educational tool in local anesthetic training could improve students' perception and learning process in pediatric dentistry by improving the understanding of anatomical landmarks and optimizing the learning environment.¹⁹ Lee et al. reported that practicing the simulation model before

the first-time IABA resulted in fewer post-injection complications and might be beneficial for enhancing dental students' level of comfort.²⁰ Compared with the classroom lecture format, simulation-based local anesthesia teaching was reported to be more effective in improving the theoretical knowledge among students.²¹

Besides the aforementioned research, it was shown that model performance did not correlate with the performance on the patient and was significantly lower than that has been objectified with the pain and thermal sensitivity nerve tester.²² In the present study, around 90% of the participants were willing to access advanced educational modalities, such as simulation, besides the conventional education approach. The students who did not want to have access to advanced simulation technologies stated that they wanted to experience real patients beyond virtual reality. The present study recommended that the use of simulated models in dental anesthesia training should be considered complementary to student-to-student injections.

The student-to-student local anesthesia administration model has been an accepted part of formal dental education; however, ethical concerns and the value of informed consent are still important issues that need to be investigated. Students receiving injections from fellow students have had complications, such as syncope, hematoma, trismus, edema, paresthesia, and facial paralysis, associated with the procedure; however, informed consent was not obtained in a majority of dental schools in the United States during student-to-student local anesthesia.²³ Hossaini reported that a majority of students agreed on being consented before administration; moreover, 15.8% of respondents stated that it was not ethical to administer local anesthesia to a person for the sole purpose of practice and training.²⁴ Another study reported that only 10% of European dental schools required the permission of an ethics committee for the practical instruction of fellow students.³ Studies that aimed to evaluate differences related to local anesthesia education in Türkiye concluded that none of the schools needed the permission of an ethics committee or institutional review board approval before administering local anesthesia to fellow students.⁴

In the present study, informed consent from students was obtained before preclinical student-to-student local anesthesia education. The local complication rate among dental students was 72.7%. Pain/burning on injection (65.9%) and trismus (15.9%) were the most common complications. Hematoma, soft tissue injury, facial paralysis, subluxation, and syncope were also observed (2.3%). In conclusion, student-to-student local anesthesia administration in dental education could result in a wide range of complications.

This study had several limitations. The most important limitations were the low sample size and descriptive type study design without a control group. Additionally, the personality traits of participants, such as cultural differences, state/trait anxiety level, dental anxiety/dental fear level, intraoral anesthesia experience, and knowledge level of anatomical landmarks, were not examined. These factors could influence the success, perception, and satisfaction regarding local anesthesia administration. Finally, the sample population used in this study might not be represent entire dental student population because they were all from at the same school.

CONCLUSION

The results of this study confirmed that the student-to-student local anesthesia administration is not free of complications. However, most complications were local and mild. The present study also confirmed that this type of training showed positive influences on students' perception regarding satisfaction and empathy. On the other hand, the importance of obtaining informed consent should be emphasized regarding to the frequency of complications. More comprehensive studies are warranted to investigate the physical/behavioral factors that can influence students' perception and satisfaction related to preclinical local anesthesia education with various local anesthesia techniques among dental students.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: Sara Samur Ergüven; **Design:** Sara Samur Ergüven, Aydın Özkan; **Control/Supervision:** Sara Samur

Ergüven, Aydın Özkan, Metin Şençimen, Ümit Karaçaylı, Gürkan Raşit Bayar; **Data Collection and/or Processing:** Sara Samur Ergüven, Aydın Özkan, Metin Şençimen; **Analysis and/or Interpretation:** Sara Samur Ergüven, Aydın Özkan, Metin Şençimen; **Literature Review:** Sara Samur Ergüven, Aydın Özkan, Metin Şençimen, Ümit Karaçaylı, Gürkan Raşit Bayar; **Writing the Article:** Sara Samur Ergüven; **Critical Review:** Sara Samur Ergüven, Aydın Özkan, Metin Şençimen, Ümit Karaçaylı, Gürkan Raşit Bayar.

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