ORIGINAL ARTICLE

UDC: 37.018.43:616.31-057.875
https://doi.org/10.2298/VSP180622154M

The use of mobile-aided learning in education of local anesthesia for the inferior alveolar nerve block

Primena učenja putem mobilnih uređaja u edukaciji izvođenja mandibularne anestezije

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Abstract

Background/Aim. Dental education has developed over the years, and various technologies have been included. Considering the fact that mobile devices are an imperative of modern time, the aim of our research was to evaluate effectiveness of Mobile-Aided Learning on practical administering the inferior alveolar nerve block (IANB). **Methods.** This prospective study involved 34 students who were randomly divided into two groups: G1 (control) group with 16 students and G2 (study) group with 18 students. Students of both groups previously successfully completed theoretical and practical training provided by the curriculum. For the purpose of additional education, students of the G2 group used a mobile application for 3D simulation of local anesthesia (Mobile-Aided Learning) outside the dental office for a period of one semester. After that, all students completed a post-clinical questionnaire. **Results.** The average time for performing anesthesia by participants in the G1 group was 70.54 ± 20.16 seconds, while in the G2 group it was 57.13 ± 17.45 seconds, which was significantly shorter ($p < 0.05$). A successful anesthesia application was higher in the G2 group (83.3%) compared to the G1 group (75%). The results of the post-clinical test questionnaire also indicated difference in the mean values of the responses to all questions, which was in favor of the G2 group participants. **Conclusion.** Application of Mobile-Aided Learning showed a significantly higher efficiency in student education for practical implementation of the IANB.

Key words:
anesthesia, dental; mandible; nerve block; students; cell phone; learning; computer simulation.

Apstrakt

Uvod/Cilj. Stomatološka edukacija razvijala se tokom godina uz uključenje različitih novih tehnologija. Imajući u vidu činjenicu da su mobilni uređaji imperativ modernog doba, cilj našeg istraživanja bio je da se proceni efikasnost primene mobilnog učenja na praktično izvođenje anestezije kod studenata koji prvi put sprovode mandibularnu anesteziju. **Metode.** U ovoj propektivnoj studiji učestvovala su 34 studenta koji su nasumce bili podeljeni u dve grupe: G1 (kontrolnu) grupu sa ukupno 16 studenata i G2 (studijsku) grupu sa 18 studenta. Studenti obe grupe uspešno su završili teorijski i praktični deo nastave predviđene nastavnim programom. Studenti G2 grupe su, u cilju dodatne edukacije, koristili mobilnu aplikaciju za 3D simulaciju lokalne anestezije (*Mobile Aided Learning*) van stomatološke ordinacije u trajanju od jednog semestra. Nakon toga, svi student su popunili postklinički upitnik. **Rezultati.** Prosečno vreme izvođenja anestezije kod ispitanika G1 (kontrolne) grupe bilo je 70,54 ± 20,16 sekundi, dok je kod ispitanika G2 (studijske) grupe vreme izvođenja anestezije bilo 57,13 ± 17,45 sekundi ($p < 0.05$). Iako bez statističke značajnosti, uspešnost davanja anestezije bila je veća u studijskoj grupi (83,3%), u odnosu na kontrolnu grupu (75%). Rezultati postkliničkog upitnika (testa), takođe su ukazali na razliku u srednjim vrednostima odgovora na sva pitanja, koja je bila u korist studijske grupe. **Zaključak.** Primena mobilnog učenja pokazala je veću efikasnost u edukaciji studenata za izvođenje mandibularne anestezije.

Ključne reči:
anestezija, stomatološka; mandibula; blokada živca; studenti; mobilni telefon; učenje; simulacije, kompjuterske.

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Introduction

The basic principle of modern dentistry today is painless dentistry. Application of local anesthesia allows patients maximum comfort and completely painless treatment. Therefore, mastering anesthesia techniques is an important aspect of the dental curriculum [1]. However, learning anesthesia techniques is still a complex process, and moving to work with patients is often very difficult for students [2].

Dental education has developed over the years, and various technologies have been included in the curriculum. In this sense, simulation models of dental education have been used for more than 100 years [3]. They have a significant impact on education in many areas of dentistry such as endodontics, oral hygiene and operative dentistry [3–5]. This education system contributes to improving psychophysical skills of students before their first clinical experience, their manipulative abilities, increasing patient safety during clinical trials conducted by inexperienced clinicians [3, 6].

Today, we became owners of personal computers, the Internet happened, and information and communication technologies (IT) experienced flourishing and irreversibly changed the whole world. Undoubtedly, they unwittingly permeate the sphere of dental education in form of simulation models, complementing conventional teaching in that way. Computer teaching in the health profession, also known as Computer-Aided Learning (CAL), has become a popular means of providing information to students, patients and practitioners [7].

Today, in the context of the widespread use and appearance of mobile devices, such as smartphones and tablets, people can communicate, work, entertain, access the Internet, and even explore and learn. Bearing in mind the fact that mobile devices are an imperative of modern times, the aim of our research was to evaluate the effectiveness of Mobile-Aided Learning on practical application of anesthesia by students who are dealing with implementation of the inferior alveolar nerve block (IANB) procedure.

Methods

Participants

The presented research was approved by the Institutional Review Commission. This prospective study involved 34 students of the fourth year at the Department of Dentistry, Faculty of Medicine, Kosovska Mitrovica, University of Priština, Serbia, who did not have any practical skills regarding application of the IANB on patients. The participants were randomly divided into two groups: G1 group (control group) with 16 students and G2 group (study group) with 18 students (Figure 1). The students of both groups then successfully completed the theoretical and practical part of education envisaged by the curriculum, and we applied a direct anesthetic technique for the IANB [8].

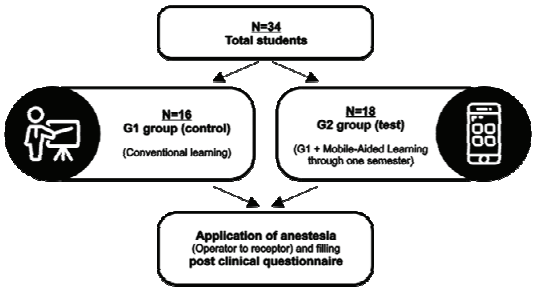


Fig. 1 – Learning protocol.

Mobile-aided learning

For the purpose of additional education, students of the G2 Group used the Dental Simulator mobile application (Campinas, SP 13083765, Brazil), which is available for iOS (App Store) and Android (Google Play Store), (Figure 2). After registering, students used an application outside the dental office *via* "University Mode" in Serbian through Study Mode (where dental students can read technical descriptions, watch clinical and simulation videos and practice) and Simulation Mode (students can simulate dental procedures and get feedbacks, so they can learn their mistakes in 3D) (Figure 3).

Fig. 2 – Home screen of Dental Simulator Application.

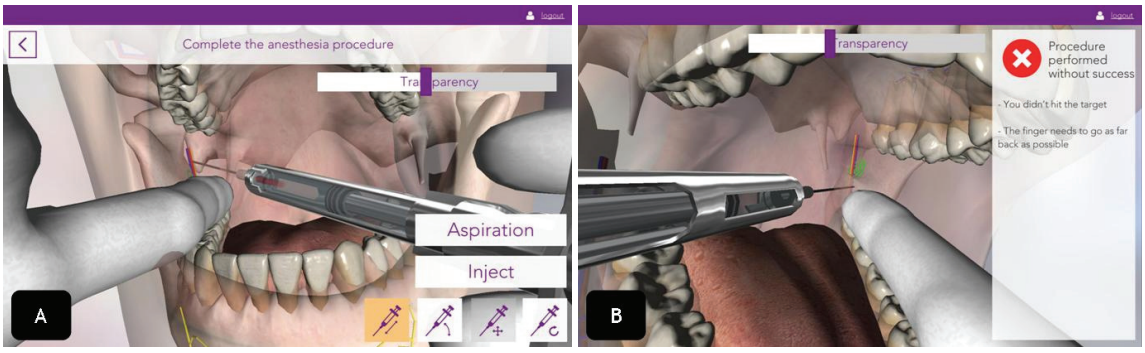
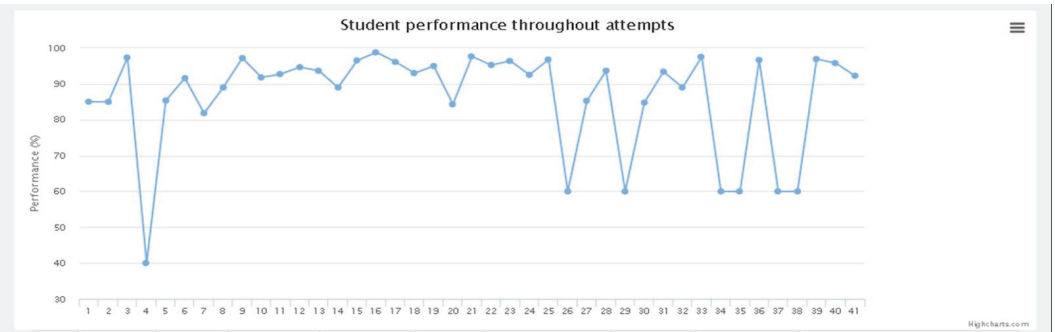


Fig. 3 – A) Simulation of dental procedure, and B) feedbacks.



n	Interval	Side	Finger	Aspiration	Sucess	Mode	Distance	Total Errors	Timestamp
1	55 s	Right	Thumb	No	No	Simulation	1.79	1	2016-12-14 12:42:14
2	41 s	Right	Thumb	No	No	Simulation	1.8	1	2016-12-14 15:21:05
3	50 s	Right	Thumb	No	Yes	Simulation	0.4	0	2016-12-14 15:22:18
4	65 s	Right	Index	No	No	Simulation	2.1	3	2016-12-14 15:23:36
5	86 s	Right	Index	No	No	Simulation	1.68	1	2016-12-14 15:25:55

Fig. 4 – Monitoring student education through the University Mode.

Through the University Mode, in order to monitor the success of the G2 student education, the educator had access to information about each student during exercise (Figure 4).

After completing their education and written consent, in the second phase of the research, students applied the IANB to each other (the operator to the receptor) by a direct method. We used 2% lidocaine with adrenaline (40 mg + 0.025 mg)/2mL (2% Lidokain®, Galenika AD, Serbia). The parameter for selecting the side for anesthesia was the presence of at least one tooth of a molar or premolar region with preserved pulp vitality. For this reason, as well as in order to monitor the success of an anesthesia, 15 minutes before and after anesthesia, the vitality of the teeth of these regions was checked by the standard procedure (Roeko Endo-Frost, Coltene Whaledent). The success of education was evaluated through the success of anesthesia, as well as the time of application that included the period from the moment of removal of needle protection until syringe aspirated for negative pressure and observed for the absence of blood. After that, the injection was administered at a rate of 0.4 mL over 30 seconds [9].

Post-clinical questionnaire

Additionally, the success of education was measured on the basis of post-clinical questionnaires. After application of anesthesia, participants completed a questionnaire that evaluated their knowledge and skills. Questions were quantified by a 5-point Likert scale, and possible answers and values were: I totally disagree = 1; I partially disagree = 2; abstained = 3; partially agree = 4; I totally agree = 5.

Statistical analysis

Statistical data analysis was performed using IBM SPSS Statistics 22 (IBM Corporation, Armonk, NY, USA). Results were presented as frequency (percentage), median (range) and mean ± standard deviation. The Fisher's exact test was used to test differences between nominal data (frequencies). For numeric data with normal distribution independent samples Student's *t*-test was used to test differences between groups. For numeric data with non-normal distribution and ordinal data Mann-Whitney U was used. All *p* values less than 0.05 were considered significant.

Results

The examined parameters showed a significant success of the participants in the G2 group compared to those in the G1 group. The average time for performing anesthesia by participants of the G1 group was significantly longer comparing to subjects who were using 3D simulation (Table 1). Also, after additional aided education, participants of the Group 2 performed the IANB more successfully, although it was not statistically significant (Table 1).

The results of the post-clinical test questionnaire also indicated differences in the mean values of responses to all questions in favor of the G2 group (Table 2), which was especialy notable (and statistically significant) for answers to the question "I easily identify the exact location of the sting".

Table 1

Average time for anesthetic procedure of the inferior alveolar nerve block (IANB)

Parameters	G1 (control) group (n = 16)	G2 (study) group (n = 18)	*p*
Time (seconds), mean ± SD	70.54 ± 20.16	57.13 ± 17.45	0.045*
Success of anesthesia, n (%)			
yes	12 (75)	15 (83.3)	0.609
no	4 (25)	3 (16.7)	

SD – standard deviation; *statistically significant difference.

Table 2

Post-clinical questionnaire and values classified according to a Likert scale

Question	G1 (control) group median (range)	G2 (study) group median (range)	*p*
I self-confident in the IANB anesthetic procedure	3 (1-5)	4.5 (3-5)	0.412
I easily identify the anterior border of the ramus	3 (1-5)	4 (2-5)	0.322
I easily identify the pterygomandibular raphe	3 (1-5)	3 (2-5)	0.197
I easily identify the exact location of the sting	3 (1-4)	4 (3-5)	0.033*
I can apply the IANB anesthesia next time without supervision	3.5 (1-5)	4 (1-5)	0.302

IANB – inferior alveolar nerve block; *statistically significant difference.

Discussion

Many dentistry students point to inadequate preparation for practical use of local anesthesia in clinical conditions [10], while studies show that even clinical dentists identify the administration of local anesthetics as one of the most stressful procedures in everyday clinical work [11]. It especially applies for the IANB, which is often complex for dentistry students to be understood and performed, primarily due to difficult and insufficiently clear identification of the sting location.

Researches show that an average person spend up to 5.5 hours with a mobile phone during the day, from that at least 2 hours with the so-called unnecessary content, such as social networking, games, etc. Also, several studies have found that mobile devices today play an important role in education and have the impact and benefits in relation to the point of pedagogical perspective [12, 13]. Therefore, our aim was to apply a 3D simulation of the IANB in education of students, beside conventional methods. Also, the learning process which includes simulation techniques allows students to critically evaluate how they felt during the exercise, to practice the same procedure repeatedly without the need for supervision and with synchronous computer feedback [14], and may have an impact on the level of reliability when applying the first anesthetic procedure [15]. Our study suggests that the model of student education which, in addition to conventional methods, includes mobile 3D simulation, gives better results than the conventional method alone considering skill of providing the IANB.

An important parameter that indicates knowledge of the IANB technique and the level of safety in its performance is time required for anesthesia. The procedure for giving anesthesia will be shorter in people with higher level of knowledge and education. In other research, higher education corresponds with shorter time of giving [16]. In our study, the time of anesthesia was statistically significantly shorter in the study group compared to the control which indicates that training with additional simulations can improve skill of students for the performance of the IANB. Similar results published López-Cabrera et al. [17], pointing the fact that students who were practicing on dental anaesthesia simulation model, besides the conventional methods, exhibited shorter time of the procedure for the anterior superior alveolar nerve.

Perception of students about the level of their knowledge and safety when performing the IANB was measured by a post-clinical questionnaire using the Likert scale. A similar instrument of research was used in other studies [15, 18]. Students of the study group had more positive answers to all questions of the post-clinical questionnaire, which was statistically significant for the question "I easily identify the exact location of the sting".

The effectiveness of anesthesia was also one of the tested parameters. In our study, the G1 group had a failure rate of 25%, while in the G2 group it was 16.7%. Although the difference was not statistically significant, it could indicate a better knowledge of the technique and self-confidence in performing the IANB.

Numerous studies have dealt with the effect of simulation models on education of students in the field of local anesthesia. Marei and Al-Jandan [15] compared theoretical and practical knowledge of students with conventional methods of learning in relation to knowledge when conventional methods were used together with a simulation model (electric phantom). Their results point to a better level of knowledge of students in which the simulation model was used, but the statistical significance existed only in terms of theoretical knowledge. López-Cabrera et al. [17], who used the phantom as a simulation model, also highlighted significantly higher level of self-confidence among students who used simulation models in addition to classical methods.

Our study confirms benefits of the use of simulation models as supplemental methods of education of students in providing the IANB. However, we would like to point out that, within the various types of simulation models, the aided learning model used in our study shows numerous benefits. First of all, the advantages of mobile learning are that mob ile phones are always at hand (having in mind the fact that daily use of a mobile phone is growing day by day) and, financially, they are more profitable because they do not need additional phantoms and tools for exercising. For the development of effective skills, awareness of reasons when and how the error occurred is more important than the final result [19], and the "University Mode" of the mobile application provides all the information and shows the most common student errors at any time during exercise.

Conclusion

The use of mobile-aided learning exhibited several benefits for student education concerning practical IANB application. Students who used a combination of conventional method and virtual simulation model exhibited shorter time of anesthesia, showed more self-confidence and had a higher percentage of successful anesthesia. This type of simulation model can be recommended for regular student education.

REFERENCES

1. *Plasschaert AJ, Holbrook WP, Delap E, Martinez C, Walmsley AD.* Association for Dental Education in Europe. Profile and competences for the European dentist. Eur J Dent Educ 2005; 9(3): 98–107.
2. *Jenkins DB, Spackman GK.* A method for teaching the classical inferior alveolar nerve block. Clin Anat 1995; 8(3): 231–4.
3. *Perry S, Bridges SM, Burrow MF.* A review of the use of simulation in dental education. Simul Healthc 2015; 10(1): 31–7.
4. *Wolgin M, Wiedemann P, Frank W, Wrbas KT, Kielbassa AM.* Development and Evaluation of an Endodontic Simulation Model for Dental Students. J Dent Educ 2015; 79(11): 1363–72.
5. *Tubelo RA, Branco VL, Dahmer A, Samuel SM, Collares FM.* The influence of a learning object with virtual simulation for dentistry: A randomized controlled trial. Int J Med Inform 2016; 85(1): 68–75.
6. *Fugill M.* Defining the purpose of phantom head. Eur J Dent Educ 2013; 17(1): e1–4.
7. *Rosenberg H, Grad HA, Matear DW.* The effectiveness of computer-aided, self-instructional programs in dental education: a systematic review of the literature. J Dent Educ 2003: 67(5): 524–32.
8. *Baart JA, Brand HS.* Local anaesthesia in dentistry. Oxford: Wiley-Blackwell; 2009.
9. *Kanaa MD, Meechan JG, Corbett IP, Whitworth JM.* Speed of injection influences efficacy of inferior alveolar nerve blocks: a double-blind randomized controlled trial in volunteers. J Endod 2006; 32(10): 919–23.
10. *Brand HS, Baart JA, Maas NE, Bachet I.* Effect of a training model in local anesthesia teaching. J Dent Educ 2010; 74(8): 876–9.
11. *Simon JF, Peltier B, Chambers D, Dower J.* Dentists troubled by the administration of anesthetic injections: long-term stresses and effects. Quintessence Int 1994; 25(9): 641–6.
12. *Hwang GJ, Yang TC, Tsai CC, Yang SJH.* A context-aware ubiquitous learning environment for conducting complex science experiments. Comp Educ 2009: 53(2): 402–13.
13. *Uzunboylu H, Cavus N, Ercag E.* Using mobile learning to increase environmental awareness. Comp Educ 2009: 52(2): 381–9.
14. *Wahlström O, Sandén I, Hammar M.* Multiprofessional education in the medical curriculum. Med Educ 199; 31(6): 425–9.
15. *Marei HF, Al-Jandan BA.* Simulation-based local anaesthesia teaching enhances learning outcomes. Eur J Dent Educ 2013; 17(1): e44–8.
16. *Newell KM, Liu YT, Mayer-Kress G.* Time scales, difficulty/skill duality, and the dynamics of motor learning. Adv Exp Med Biol 2009: 629: 457–76.
17. *López-Cabrera C, Hernández-Rivas EJ, Komabayashi T, Galindo-Reyes EL, Tallabs-López D, Cerda-Cristerna BI.* Positive influence of a dental anaesthesia simulation model on the perception of learning by Mexican dental students. Eur J Dent Educ 2017: 21(4): e142–7.
18. *Chandrasekaran B, Cugati N, Kumaresan R.* Dental Students' Perception and Anxiety Levels during their First Local Anesthetic Injection. Malays J Med Sci 2014; 21(6): 45–51.
19. *Weeks DL, Kordus RN.* Relative frequency of knowledge of performance and motor skill learning. Res Q Exerc Sport 1998; 69(3): 224–30.

Received on June 22, 2018.
Revised on September 13, 2018.
Accepted on October 2, 2018.
Online First October, 2018.