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High-fidelity simulation in training dental students for medical life-threatening emergency

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Abstract

Introduction: Any dental surgeon may be faced with a critical life-threatening emergency situation. In our university, all students in dentistry receive a standard course on emergency first aid. The aim of this prospective, comparative, single-centre study was to determine whether additional training on a high-fidelity patient simulator would improve student performance.

Methods: After approval by an Ethical Committee and written informed consent, the students of the Simulation group (n=42) had full-scale high-fidelity training on a patient simulator SimMan 3G™ (3 hours by six students). They participated in pairs in two scenarios (airway obstruction, seizures, allergies, vasovagal syncope, asthma, chest pain). The first scenario was simple, and the second was a progression to cardiac arrest. Three months later, the Simulation group and the Control group (n=42) participated in a test session with two scenarios. The primary end point was the score at the test session (with a standardised scoring grill, direct observation and audio-video recording). Data were median and 25%-75% percentiles.

Results: High-fidelity training strongly improved the score on the test obtained by the students of the Simulation group (146 [134-154]) which was much higher ($P<.0001$) than in the Control group (77 [67-85]). Technical as well as non-technical skills components of the scores were improved. In addition, performances of the Simulation group were increased between the training and the test. Simulation session was very positively assessed by the students.

Conclusions: The results support the systematic introduction of training to critical life-threatening emergency situations on high-fidelity patient simulators the dentistry curriculum. The impact on clinical practice in the dental office remains to be assessed.

KEYWORDS

dental surgeon, high-fidelity simulation, life-threatening emergency

1 | INTRODUCTION

Any dental surgeon may be faced with a critical life-threatening situation. The frequency of medical emergency occurring in the dental offices is difficult to specify because its estimation is essentially based on dental surgeon retrospective surveys. However, life-threatening events are rare but well real in dental practice.[1-5] Two events for 10 000 patients receiving local anaesthetic[3] and one cardiac arrest for 638 960 patients should occur in dental office.[2] It is also estimated that one of 20 practitioners performs cardiopulmonary resuscitation during her career.[1]

The drugs and materials used in the dental care can be the cause of serious adverse events. Patients, especially the elderly, often carry severe comorbidities.[6-8] In addition, the fear of going to the dentist

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triggers somatic reactions in patients.[9] The principal emergencies that occur in dental offices as reported in the literature are as follows: vagal syncope, minor allergic reactions, seizures and hypoglycaemic episodes. Respiratory distresses can be caused by accidental inhalation, asthma or psychogenic hyperventilation. Ischaemic cardiac events can lead to cardiac arrest.[1-10] As a health care professional, a dentist must be able to provide first aid until the arrival of the mobile medical assistance services. Already 1986, the analysis of 6505 questionnaires completed by dentists from 72 American schools emphasised the need to train practitioners in the management of medical emergencies in the dental office.[11] First aid care teaching is now integrated into the initial training of dental surgery students in most universities, but with a large disparity in the number of hours devoted to this learning.[12]

Since January 2010, training in emergency care has been required for all dental students in France. A total of 70 hour instruction is taught over 4 years. The course includes lectures and practical workshops on inert manikins. It focuses on the most common risk situations, but it is not specific to an emergency situation that could occur in the dental office (eg, bad reaction to local anaesthetic injection or pain, inhalation of a foreign body or anaphylactic reaction to latex glove) and does not take into account the emotional component that is always present in a context of vital distress.

Having proven itself in many industrial fields including aerospace, simulation has developed considerably in medicine and has become an essential educational tool both for initial training and continuing education. High-fidelity models can reproduce infrequent critical situations and enable professional training without risk to patient safety in multiple specialties such anaesthesiology, emergency medicine, obstetrics in order to improve clinical practice.[12-15]

Several studies have evaluated the ability of dental students to handle a medical emergency, but few of them use the high-fidelity simulation.[8,9,16] We hypothesised that integrating high-fidelity patient simulator training into the curriculum of dental surgery students could benefit them. Our aim was to determine whether training with high-fidelity patient simulator improves student performance in the management of a life-threatening emergency in a dental office.

2 | METHODS

This study was performed in the High-Fidelity Simulation Center of the University of Nantes, France, from March 2013 to June 2014 after approval by an Ethical Committee (Groupe Nantais d'Ethique dans le Domaine de la Santé, 8 July 2013). The participation to the study was proposed to all 5 year dental students of the 2013 and 2014 promotions of the University of Nantes. After written informed consent, the students were divided into Simulation and Control groups as following. The first half of students who contacted the investigators for registration were enrolled in the Simulation group. The following half of students constituted the Control group.

According the French law (2006, 10th March), the students of both groups had previously received a standard theoretical and practical course on first aid (70 hours) on an inert manikin during the first 4 years of their curriculum. The content of this basic training is detailed in Table 1.

In addition, the students of the Simulation group participated to a full-scale high-fidelity simulation training that was scheduled in March 2013 for the 2013 promotion and in March 2014 for the 2014 promotion.

The students of the Simulation and Control groups participated to a test on the high-fidelity patient simulator in June 2013 or 2014 according their promotion. Refusal to participate was the only non-inclusion criteria.

2.1 | Full-scale high-fidelity simulation training in the simulation group

The students of the Simulation group were trained on a full-scale high-fidelity patient simulator SimMan 3G™ (Laerdal Medical, Stavanger, Norway) in the High-Fidelity Simulation Center of the University of X (blinded version). Briefly, the patient simulator wearing a suit or a casual outfit according to the script was installed on a dentist's chair, in an environment replicating that of a dental's office. A standard first aid kit, an external automated defibrillator, an oximeter and a sphygmomanometer were available. Vocalisation of the patient simulator included coughing, snoring, stridor, breathing difficulty, vomiting and interactive dialogue. Airway anatomy, chest excursion, breathing pattern as well as hemodynamic variables could be modified to simulate respiratory or circulatory distresses.

Each training session lasted 3 hours with six students and was preceded by a brief lecture on the principles of simulation in health and a reminder about first aid procedures. The students were randomised in pairs and each of them directly participated in two scenarios among airway obstruction, seizure, allergies, vasovagal syncope, asthma or chest pain. The first scenario was simple, and the second was a progression to cardiorespiratory arrest. While a pair of students directly participated in the scenario, the two others simultaneously observed the case by audio-video transmission in another room. The order of direct or observational participation and the scenario were randomised. One of the investigators played the role of the dental assistant. The scenario began when students entered the dental office. The expected reaction of the participants was careful examination to identify the patient's history. Distress occurred early in the dental treatment. Students had to recognise the critical situation, to collect clinical signs of severity, to implement first aid procedures, to call the emergency medical assistance service with a comprehensive review and to ensure continuous and careful monitoring while awaiting rescue. If these decisions were delayed, they were suggested by the assistant. Each scenario took place in real time (20 minutes) and was followed by an equivalent period of debriefing.

2.2 | Test on the high-fidelity patient simulator

The test took place 3 months after the Simulation group had finished its training. It was also performed with the SimMan 3G™ in a dental office environment. Each test session included three pairs of students. In the Simulation group, the pairs were identical to those at the

TABLE 1 Standard first aid healthcare certification

Level 1	*Objectives*: to identify a medical emergency and to manage it alone or in teams until the arrival of the medical team
Module 1	Care for life-threatening emergencies according the French medical guidelines: • to identify immediate danger in the environment and to implement appropriate protection • to alert the emergency medical assistance service (15) or the internal number of the health institution devoted to the life-threatening emergencies, to transmit observations and follow the advices • to identify unconsciousness and ensure protection of the airway of an unconscious person in spontaneous ventilation • to identify cardiac arrest and to perform cardiopulmonary resuscitation (CPR) with basic equipment (automated external defibrillators (AED) • to identify acute airway obstruction and to carry out appropriate actions • to stop external bleeding
Module 2	To identify signs of gravity of a malaise, a bone or skin trauma and perform the appropriate actions: • to participate in the lift and stretcher • to identify signs of severity of a burn and act accordingly • to apply the basic rules of hygiene • to alert the emergency medical assistance service (15) or the internal number of the health institution devoted to the life-threatening emergencies, to transmit observations and follow the advices • in the absence of a doctor, to seek advice from the 15 or call the dedicated internal number, to transmit observations respecting the ethical and professional rules and to follow the advices
Module 3	Collective risks • to identify a hazard in the environment and apply the appropriate protection instructions (including in the case of populations alert or situations of emergency in the institution) • to identify its role in case of a health emergency plan • to be aware of the nuclear, radiological, biological and chemical risks
Level 2	*Objectives*: identify a medical emergency, to support it in teams using non-invasive techniques until the arrival of the medical team
Module 1 (3 h)	• to identify a cardiac arrest and perform cardiopulmonary resuscitation with emergency equipment according the French medical guidelines • to implement non-invasive devices for monitoring vital parameters
Module 1 (3 h)	• to use of the restraining equipment suited to trauma • to remove a full face helmet • Make a lift and a stretcher • to deal with an unexpected delivery • to apply the rules of protection face a risk of infection
Module 1 (3 h)	• to participate in the implementation of health plans • to integrate into the implementation of, according to the intended role of the profession exercised; • to identify its role in activation of the nuclear, radiological, biological and chemical risks health plan, to protect themselves by holding appropriated planned suite

training session. Each pair of students had to manage one simple and one severe case that were randomly drawn from a new bank of three simple and three severe scenarios. Only the students, who had already undergone the test, could observe the test of the others students.

2.3 | Evaluation

The evaluation of the simulation sessions and the scoring of the performances of the students were carried out in the same way during the simulation training sessions in the Simulation group and during the tests in the Simulation and Control Groups.

The students were given a questionnaire immediately before the simulation session to record their demographic data, previous experience in simulation and medical emergencies and stress level with a scale graded from 1 to 10. They completed a second questionnaire immediately after the simulation session to evaluate its quality, its educational contribution and to self-assess their performances with a 10-point scale.

The performances of each pair of students were evaluated with a standardised scoring grill developed for each scenario. Score A (graded from 0 to 180) was the sum of the score obtained by each pair, respectively, with the simple (A_{simple}, 0-60) and the severe (A_{severe}, 0-120) case. The reactions of students were weighted after classification according to three items: patient interview and analysis of medical records (B, 0-16), situational awareness and management of the situation (C, 0-132), call to the emergency medical service and transmission (D, 0-32). B, C and D was the sum of the score, respectively, obtained with the simple (B_{simple}—0-8, C_{simple}—0-36, D_{simple}—0-16) and the severe (B_{severe}—0-8, C_{severe}—0-96, D_{severe}—0-16) case. The score was rated during the simulation by the study main investigator. If needed, the scoring was completed using audio-video recording. For example,

TABLE 2 Standardised scoring grill for the simple airway obstruction scenario, A_{simple} (0-60)=B_{simple}+C_{simple}+D_{simple}

Patient interview and medical record analysis, B_{simple}(0-8)	
Reason for the visit to the dental office	0, 1 (partial) or 2 (complete)
Previous medical history	0, 1 (partial) or 2 (complete)
Allergy	0, 1 (partial) or 2 (complete)
Current treatment	0, 1 (partial) or 2 (complete)
Situational awareness and management of the situation, C_{simple} (0-36)	
Hazard identification and protection	
Stop dental care	0 (slow), 1 (immediate)
Spacing objects at risk	0 (delayed), 1 (immediate)
Clinical observation	
Sweats	0 (none), 1 (with help), 2 (without help)
Cyanosis	0 (none), 1 (with help), 2 (without help)
Patient evaluation	
Awareness	
Verbal stimulation	0 (none), 2 (done)
Simple command	0 (none), 2 (done)
Ventilation	
Placing a pulse oximeter	0 (none), 2 (done)
Value analysis	0 (none), 2 (done)
Circulation	
Pulse palpation	0 (none), 2 (done)
Cardiac rate	0 (none), 2 (done)
Blood pressure measurement	0 (none), 1 (done)
Blood pressure value analysis	0 (none), 1 (done)
Actions to be taken	
Body positioning	Lying (0), half-sitting or sitting(2)
Unpicking clothing	Slow (0), fast (4)
Oxygen administration	None (0), yes (4)
Mask positioning	None (0), not correct (1), correct (2)
Encouraged cough	None (0), not correct (1), correct (2)
Monitoring	None (0), discontinuous (1), continuous (2)
Call to the emergency medical service and transmission, D_{simple} (0-16)	
Identity and function of the caller	0 (none), 1 (partial), 2 (complete)
Call number	0 (none), 2 (complete)
Precise location	0 (none), 1 (partial), 2 (complete)
Presentation of the victim (identity, gender, age)	0 (none), 1 (partial), 2 (complete)
Context, patient status	0 (none), 1 (partial), 2 (complete)
Treatment and health care already carried	0 (none), 1 (partial), 2 (complete)
Hang up on invitation and leaves available on line	0 (none), 2 (complete)
Recommendations application	0 (none), 1 (partial), 2 (complete)

the scoring grills for the simple "obstruction airway" and the severe "anaphylaxis" scenarios are, respectively, given in Tables 2 and 3.

2.4 | Statistical analysis

The statistical analysis was performed using the Statview® 5 (Abacus Concept, Inc., Berkeley, CA, USA.) software. The primary end point was A score obtained by the pairs of students at the test session. During the development of the scenarios, the score obtained by students (12 pairs) not participating in the study and who did not receive training was 100±27. We therefore initially we hypothesised that 25 of pairs of student were needed in each group to reach a 25% difference in the A score with a α risk of 0.05 and a 0.9 power with bilateral test. An intermediate analysis was planned after the first year of study with a power analysis to adjust the number of students. Data were median and 25%-75% percentiles and compared by chi-square with correction de Yates, Mann and Whitney *U* test or Wilcoxon test as appropriate. $P<.05$ was considered as significant. In the Simulation group, data from student pairs, who participated to the training but who were not available for the test, were not analysed.

3 | RESULTS

The intermediate analysis, planned after the first year of study with, respectively, 14 (Control group) and 12 (Simulation group) pairs already showed a significant difference in the main criteria. The study was planned for a duration of 2 years; inclusions were pursued using identical procedures during the second year. Four pairs of students only participated to the training and were excluded from the analysis. Finally, the study included 84 students, that is 21 pairs in the Control group and 21 in the Simulation group (Figure 1).

Demographic data and previous clinical experience in critical situations are reported in the Table 4. Except for the age, which was slightly higher in the Control group, the characteristics of the students were not different between the groups. The self-assessment of their ability to handle emergencies in the dental office, the stress for an emergency in the dental office and the stress before the simulation were not different between groups. Most of the students (75.0%) had already had experience in at least one critical situation in the university dental clinic. Of the 84 events that the students

TABLE 3 Standardised scoring grill for the severe anaphylaxis scenario, A_{severe} (0-120)=B_{severe}+C_{severe}+D_{severe}

Patient interview and medical record analysis, B_{simple} (0-8)—see Table 1	
Situational awareness and management of the situation, C_{simple} (0-96)	
Hazard identification and protection	
Stop dental care	0 (slow), 1 (immediate)
Spacing objects at risk	0 (delayed), 1 (immediate)
Removing latex gloves	0 (delayed), 2 (immediate)
Clinical observation	
Sweats	0 (none), 1 (with help), 2 (without help)
Cyanosis	0 (none), 1 (with help), 2 (without help)
Edema	0 (none), 1 (with help), 2 (without help)
Awareness evaluation	0 (none), 2 (done)
Verbal stimulation	0 (none), 2 (done)
Simple command	0 (none), 2 (done)
Ventilation	
Pulse oximeter	0 (none), 2 (done)
Value analysis	0 (none), 2 (done)
Circulation	
Pulse palpation	0 (none), 2 (done)
Cardiac rate	0 (none), 1 (done)
Blood pressure	0 (none), 1 (done)
Value analysis	Slow (0), fast (2)
Actions to be taken	
Unpicking clothing	None (0), yes (2)
Oxygen administration	None (0), not correct (1), correct (2)
Mask positioning	None (0), not correct (2), correct (4)
Epinephrine administration	None (0), discontinuous (1), continuous (2)
Monitoring	Verbal (0), physical (1) stimulation, both (2)
Circulatory arrest diagnosis	
Awareness	No (0), yes (4)
Free airway	Listen (0), feel (1), look (2)
Ventilation	No (0), yes (4)
Pulse palpation	No (0), yes (2)
External cardiac massage	No (0), yes (2)
Implementation	No (0), yes (4)
Decubitus	No (0), yes (2)
Chest middle	No (0), yes (4)
Palms of the hands	No (0), yes (2)
Outstretched arms	<90 (0), 90-100 (1), 100-120 (2)
Raised fingers	No (0), yes (2)
Frequency	No (0), yes (4)
Chest depression 30/2 breaths	No (0), yes (2)
Automatic external defibrillator	No (0), yes (2)
Implementation	No (0), yes (1)
Continuing CPR when implemented	No (0), yes (1)
Turn on	No (0), yes (1)
One subclavicular electrode	No (0), yes (1)
One axillary electrode	No (0), yes (1)
Defibrillator connection	No (0), yes (2)
Discontinuing CPR during analysis	No (0), yes (1)
If indicated shock, CPR during loading	No (0), yes (1)
Deviating during shock	No (0), yes (2)
Delivered shock	
CPR resumption after the shock	No (0), yes (1)
Ventilation with self-refillable balloon	No (0), yes (2)
Assembly	No (0), yes (2)
Connection to oxygen	No (0), yes (2)
15 L/min oxygen flow	No (0), yes (2)
Tight mask and airway maintain	
Gentle balloon compression over 1s	
Call to the emergency medical service and transmission, D_{simple} (0-16)—see Table 1	

recalled, critical situations were in order of frequency vagal malaise (59.5%), hypoglycaemia (15.5%), orthostatic hypotension (14.3%), psychogenic hyperventilation (4.8%), inhalation of a foreign body (4.8%) and convulsion (3.5%). None of the students had previously participated in high-fidelity simulation; 79.2% of them had not received further training in emergency procedures outside of those in the usual curriculum.

Tests were conducted in June 2013 (5 days, 26 pairs) and 2014 (5 days, 16 pairs). For the Simulation group, the order and the nature of simple and serious scenarios were not different during training and testing. During the test, the order and the nature of simple and severe scenarios were not different between the Control and Simulation groups.

The overall score and all of its components obtained on the test were strongly higher in the Simulation group than in the Control group (Table 5). These scores were also higher during the test than during training in the Simulation group.

The evaluations of the simulation sessions (training and tests) by the students were very positive (Table 6). Self-assessment of their performances (identification of distress speed and adequacy of procedures performed) was better in the Simulation group during the test than during training. It was also better during the test in the Simulation group than in the Control group. After the test, the students in the Simulation group better estimated their ability to handle medical

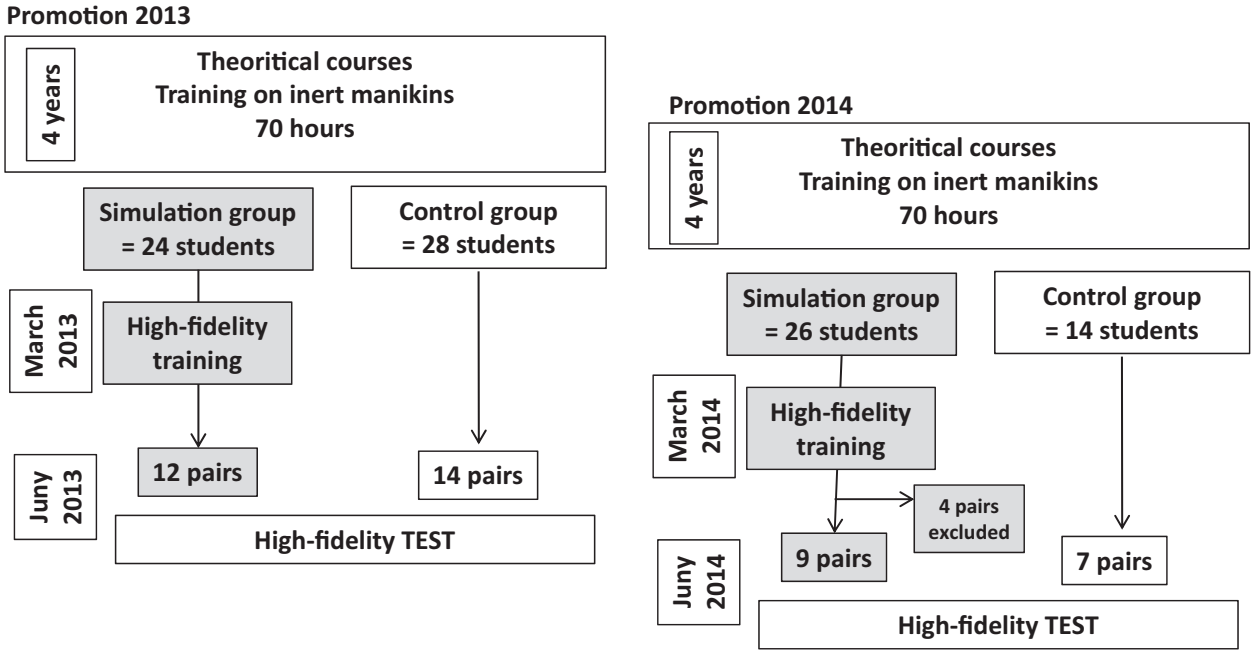

FIGURE 1 Flow chart of the study

emergency in a dental office. Most of the 84 students (95.2%) recommended training on patient high-fidelity simulator both for dental students and for dentists. The third year of the dental curriculum was ranked first by 45.2% of the students as the most suitable period for training on a high-fidelity patient simulator.

TABLE 4 Demographic data of the students

Group	Control (n=42)	Simulation (n=42)
Age, years	23 (23-24)	23 (23-23)*
Sex (female/male)	27 (64.3)/15 (35.7)	26 (61.9)/16 (38.1)
Other emergency care diploma	10 (23.8)	7 (16.7)
Previous experience in emergency in the dental office		
None	7 (16.7)	14 (33.3)
One	24 (57.1)	17 (40.5)
Two	8 (19.0)	9 (21.4)
Three	3 (7.1)	2 (4.8)
In another context	9 (21.4)	12 (28.6)
Self-assessment of ability to handle emergencies in the dental office	5 (4-5)	5 (4-6)
Stress towards an emergency in the dental office	7 (6-8)	7 (6-8)
Stress before the simulation	4 (2-5)	4 (2-5)

Data are n (%) or median (25%-75%).
Comparison Control vs simulation Mann and Whiney or Fisher's exact test as appropriate; *P=.0003.

4 | DISCUSSION

The main message of our study is that a full-scale high-fidelity training on a patient simulator increased both the technical and non-technical skills of dental surgery students when they are faced with a simulated life-threatening situation in a dental office.

The simulation is in the curriculum of dental students in some universities.[16,17] A very positive impact has been observed through a postal survey of residents and assistants in paediatric dentistry at the University of Colorado Denver.[9] But the originality of our work is that the influence of a full-scale high-fidelity simulation training on their technical and non-technical skills has never been studied. Our results confirm beyond any doubt our initial hypothesis, that is the beneficial effect of training on high-fidelity patient simulator. In addition, the scenarios were not solely limited to circulatory arrest but included a broad and increasing severity of medical distress.

However, a few biases should be discusses. Firstly, the enrolment in the Simulation group of the students who did rush out to participate to the study would be regarded as a bias insofar as these students may be the most interested.

A period of 3 months between training and the tests was chosen so that the study could be conducted during a school academic year. However, an analysis of the longer-term retention of educational messages would be of great interest, insofar as it diminishes with time.[14] Similarly, a more comprehensive assessment of behavioural performance would require a revised rating scale, based for example on score Anesthetists' Non-Technical Skills (ANTS) [18,19] in particular to assess the quality of communication during the management of the medical crisis. The reconstruction of a dental office environment was realistic but students were waiting for the occurrence of a medical

TABLE 5 Comparison of the scores obtained by the Simulation and the Control group during training and test simulation session

Scenario	Simulation group (n=21)		Control group (n=21) test
	Training	Test	
Simple			
B_{simple}	3 (1-4)	8 (7-8)**	5 (3-6)§
C_{simple}	16 (13-20)	27 (24-32)*	13 (8-17)§
D_{simple}	8 (6-11)	14 (13-15)*	8 (6-9)§
$A_S=B_S+C_S+D_S$	27 (22-32)	47 (45-53)*	25 (20-31)§
Severe			
B_{severe}	4 (3-4)	7 (6-8)**	3 (2-5)§
C_{severe}	54 (50-60)	77 (69-83)*	39 (36-52)§
D_{severe}	11 (10-13)	14 (14-16)***	9 (7-11)§
$A_{severe}=B_G+C_G+D_G$	70 (64-77)	98 (90-105)*	50 (47-58)§
$A=A_{simple+}A_{severe}$	105 (86-108)	146 (134-154)*	77 (67-85)§
$B=B_{simple+}B_{severe}$	8 (5-9)	14 (14-15)*	8 (7-10)§
$C=C_{simple+}C_{severe}$	73 (64-79)	103 (91-115)*	52 (46-58)§
$D=D_{simple+}D_{severe}$	19 (17-22)	29 (27-30)*	16 (13-18)§

Simulation group, training vs test, comparison by Wilcoxon test, *P<.0001, **P=.002, ***P=.0004.

Comparison Control vs Simulation group by Mann and Whitney U test, §P<.0001.

TABLE 6 Evaluation of the simulation by the students and self-assessment of their performances

Group	Simulation (n=42)		Control (n=42) test
	Training	Test	
Objective consistent with those provided	9 (8-10)	9 (8-9)	9 (8-10)
Quality of teaching methods	10 (9-10)	9 (9-10)	10 (9-10)
Level of interest in the subject	9 (8-10)	7 (7-8)	9 (8-10)
Realism of the simulation	8 (7-8)	8 (8-9)§§	8 (7-9)
Relevance of the technical environment	8 (7-8)	8 (7-9)	7 (7-9)
Relevance of the human environment	8 (7-8)	8 (7-8)	8 (7-9)
Degree of responsibility taken by the student	8 (7-8)	8 (7-8)	8 (7-8)
Stress level before the simple case	7 (5-8)	5 (4-7)§	7 (6-8)*
The severe case	6 (5-7)	6 (4-7)	7 (6-8)*
Identification distress speed	7 (6-7)	8 (7-8)§§	7 (6-8)*
Adequacy of procedure performed	7 (6-7)	8 (7-8)§§§	6 (6-8)***
Utility	9 (7-10)	9 (8-10)	9 (8-10)
Usefulness of the simulation of a call to the emergency medical service	9 (8-10)	8 (8-9)	7 (6-9)*
Education contribution of observation	8 (7-9)		
Ability to handle a medical emergency in the dental office after the simulation	7 (6-7)	7 (7-8)	6 (5-7)**
Acquisition of new data for practice	8 (7-9)	9 (8-9)	8 (7-8)*
Influence on the future practice	7 (7-8)	7 (7-8)	7 (6-8)

Data are median and 25%-75%.

Simulation group, training vs test, comparison by Wilcoxon test, §P<.05, §§P<.01, §§§P<.0001.

Comparison Control vs Simulation group by Mann and Whitney U test *P<.05, **P<.001, ***P<.0001.

emergency. Moreover, the emotional component of their response was impaired. To remedy this, the scenarios could be simulated in situ in the usual environment for students. The superiority of the score achieved by the Simulation group during the training sessions over the score achieved by the Control group on the test is not evidence of a disparity in basic knowledge of both groups. It rather reflects the positive educational effect of observation by video streaming in situation settings of other students and debriefing after each scenario during training. Another point is that one cannot affirm that skills acquired in a Simulation-based medical education can be generalised to clinical practice.[15] Nevertheless, full-scale simulation training of medical students is superior to problem-based learning in a growing number of disciplines.[20]

The goal of high-fidelity simulation is not only to become familiar with the algorithms of management of rare clinical situations but also to develop behavioural skills such as team work, a clinical sense, thinking and self-confidence.[15,21] One of the initial questionnaire items was designed to quantify previous experience in critical situation management of the students. The high proportion (75%) of students who had already faced medical emergencies can probably explained by a higher proportion of patients with numerous comorbidities in the dental school than in private practice. The most stressful hospital environment and the low student experience especially for local anaesthesia and dental extractions[10] could also favour the occurrence of adverse events. Despite or perhaps because of these previous experiences, the degree of stress before the situation was high. Carvalho et al.[21] emphasised the feeling of insecurity, dissatisfaction of the dental students for medical emergencies. The teaching of basic life support integrated in the curriculum of dental students probably remains too theoretical. Half of the students are able to properly administer oxygen in case of an angina attack[22] or to appropriately manage a cardiac arrest.[8,23,24] As suggested by Weller et al.[24] our results showed that full-scale high-fidelity simulation with the knowledge of action in a realistic environment improved basic life support teaching. At the end of the test session, the students who were benefited from a simulation training felt better prepared to handle an emergency. In addition, all of the students, who had never received training on a high-fidelity

manikin, appreciated the teaching method and want that this type of programme would be offered to dentists and dental students. However, as it has been shown with other health professionals, training on high-fidelity simulator is an excellent complement to theoretical training but does not replace it.[25,26]

In conclusion, high-fidelity training improves the technical and non-technical skills of dental students for the management of medical emergencies in a dental office. It should therefore be systematically introduced in their *curricula*. The next step is to verify whether the better results recorded on a simulator resulted in improved clinical practice. Finally, the time this positive effect persists should be determined and continuing education for dentists be organised in an identical fashion.

CONFLICT OF INTEREST

I confirmed that I have sourced from all co-authors a completed and signed interest conflict form.

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