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Prevalence and Prevention of Clinical Injuries Among Undergraduate Dental Students: A Post-COVID-19 Study

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Abstract: Background**:** Our study investigates the prevalence and causes of injuries among undergraduate dental students during clinical sessions. Methods: The study was conducted at the Department of Dentistry, National and Kapodistrian University of Athens, focusing on injuries reported from 2021 to 2024. Data were collected through self-reported questionnaires and clinical records. The primary variables assessed included the type of injury, the instrument involved, the clinical procedure being performed, and the immediate actions taken post-injury. Serological testing was conducted on both students and patients to assess the risk of bloodborne pathogen transmission. Results: The findings revealed a high prevalence of injuries, with needles being the most common cause, followed by burs and dental probes. The most frequent injury type was piercing, primarily affecting the fingers. Periodontal treatments, restorative procedures, and endodontic treatments were the main activities leading to injuries. Despite normal medical records for most patients treated by injured students, serological testing showed significant positivity rates for HCV and HBV. It is noteworthy that most injured students demonstrated their commitment to safety by adhering to recommended post-exposure protocols, including wound cleaning, disinfecting, and serological testing. Our study highlights the critical need for enhanced biosafety awareness and training among dental students to reduce injury risks. Conclusions: These findings underline the necessity for integrated safety protocols and continuous education to improve clinical practices and ensure student safety.

Keywords: percutaneous injuries; dentists; dental students; COVID-19 pandemic; dental students' stress; dental school environment

1. Introduction

Dentistry practice, among all other medical professions, exposes dentists and their personnel to patient**s'** oral fluids [1]. This, combined with using sharp instruments during dental procedures, increases the risk of injury to the dentist, potentially resulting in the transmission of infectious diseases carried by patients [2]. Specifically, there are certain infectious microorganisms known as bloodborne pathogens (BPS), including hepatitis B, hepatitis C, and HIV, which cause severe human diseases [3]. The primary sources of BPS in the workplace are percutaneous injuries from needles and other sharp tools [4]. Therefore, the daily activities in a dental office—where continuous handling, use, and transport of sharp tools occur between colleagues, along with replacing, cleaning, and sterilizing these tools—create a high-risk environment for percutaneous injuries [5]. According to the WHO, three million healthcare workers sustain injuries from needles and other sharp instruments annually [6].

During the COVID-19 pandemic, drastic measures were taken regarding the safety of dentists, their staff members, and the patients, as it was discovered that the way of contamination is through

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aerosols/droplets and small, tiny airborne particles containing the virus [7]. These measures included stricter surface decontamination, FFP2 masks, high-power suction, rubber dams, protective face shields, etc. [8]. Studies have shown that after the pandemic outbreak, the percentage of dentists using scrub caps has risen from 21% to 37%, and of those wearing protective face shields, from 36% to 59% [9]. However, even after the COVID-19 pandemic, it has been observed that the awareness of dentists and even more that of students about the appropriate utilization of personal protective equipment (PPE) is insufficient [10]. Therefore, practitioners without the proper cognition to shield themselves are more prone to life-threatening diseases [11].

The most common tools to cause injuries during dental practice are needles, followed by burs, scalpels, scalers, surgical elevators, explorers, and orthodontic wires, which are also found to be responsible for a significant portion of these injuries [12]. Nevertheless, it was reported that burs are the most frequent tools that can lead to percutaneous injuries among dentists [2]. This phenomenon can be explained by the fact that there is better awareness and education regarding the protective measures the practitioner should follow for the appropriate usage of needles during dental interventions in contrast with the lack of education referring to injuries caused by burs [2]. Other causes attributed to this situation are anxiety and excessive levels of confidence **[13,14]**. Additionally, research indicates that distraction and hurrying through clinical procedures are the primary factors contributing to accidental injuries, underscoring the importance of maintaining focus [15]. Moreover high chance of injuries occurs from occupational fatigue, long working hours, and lack of sleep [16]. Also, a higher risk factor has been associated with the lack of protective glasses, masks, and PPE [17]. Finally, lack of experience is another crucial factor correlated with a significant proportion of such injuries [18]. So, dental students are exposed to the highest rate of percutaneous injuries as they don't have the necessary skills to properly handle the various sharp tools used in dental practice [13].

Aiming at the limitation of dentist injuries, especially that of students due to sharp instruments, it is important to focus on their appropriate education [19]. This can be achieved through two types of educational conventions. One type is didactic. The other one is the interactive type of seminars, which can be implemented by organizing labs with role-playing activities and fruitful conversations focusing on the efficient protection of the students and ways of preventing percutaneous injuries [20]. The second type of educational seminar is especially effective in educating health practitioners [21]. Competent committees accountable for controlling and restricting infections, such as the Department of Occupational Safety and Health, can conduct these kinds of educational activities. Thus, it is possible to reduce injuries in the dental occupation by cultivating the knowledge and skills to safely manage needles and the rest of the sharp dental tools [22]. Lastly, a lack of reported incidents has been observed through numerous studies due to the ignorance of students addressing this critical issue [23]. Therefore, education should reinforce the importance of NSIS reporting too [24].

Several dental schools use recording systems for traumatic injuries during clinical procedures. The National Healthcare Group Polyclinics in Singapore includes an electronic system that gathers information on PCIs, such as the type and severity of injuries [25]. Similarly, the Griffith University Dental Clinic in Australia employs a risk incident reporting system (GSafe) and patient management software (Titanium) to track percutaneous exposure injuries (PEIs) among dental staff and students [26].

The purpose of this study is to present data collected at the Department of Dentistry School of Health Sciences of the National and Kapodistrian University of Athens, Greece, regarding dental undergraduate student**s'** injuries that occurred in everyday dental practice in the undergraduate clinics of the department. More specifically, information will be displayed in correlation with the following factors: the status of the person who suffered the injury, the location of the accident, the activity being performed at the time of the accident, the type of injury, the tool that caused it, the care of the trauma area, the patient's medical record, and the actions taken to address the injury.

Materials and Methods

For this study, we used records of undergraduate student accidents shared by the Committee of Hygiene and Sterilization of the Department of Dentistry of the National and Kapodistrian University

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of Athens. All necessary actions were taken to protect the students' personal data mentioned in the list. The study received a protocol citation from the department's Board of Ethics (611/17.10.2023) as part of a bigger research protocol addressing students' knowledge of safety and sterilization issues.

The hygiene and safety protocol of the Department of Dentistry needed no revision during the pandemic since it was already strict and was according to international guidelines. The committee keeps detailed records of each incident. Regarding relevant educational initiatives, specific seminars are conducted before the initiation of work in the clinics to inform students about proper reporting procedures. Before the clinics open, an informational meeting is held to explain the injury recording process. Specifically, if an injury occurs, students must complete a registration form detailing their personal information, the location and cause of the injury, the tool involved, and the steps taken afterward, as seen in Appendix A. Once recorded, these documents are sent to the committee, which collects them and provides the necessary instructions for the students to follow. In our study, the documented injury incidents occurred during the COVID-19 and post-COVID-19 period from 2021 to 2024, as shown in Table 1.

Table 1. Student injuries at the Department of Dentistry, National and Kapodistrian University of Athens, from 2021-2024.

Full Name	Date	Status (1.Faculty2.Associate3.Post-graduate student 4. Undergraduate student)	Place of the accident (1. Bs lab 2.Osc 3.Cmxs 4. Tpcc 5.2Fclaft 6.3Flclaft 7. Orthcl 8.Pedcl 9.Pstgrcl 10. Other)	Performed action (1. Extr 2. Fill 3. Perio 4. Exm 5.Ortho 6.Bιopsy 7.Endo 8. Pedo 9.Lab 10. Other)	Type of injury (1. Piercing 2.Abrasion 3. Material launch 4.Liquid launch)	Caused tool (1.Needle 2. Scalpel 3.Bur 4.Microtools 5. Band 6.Tool (Describe))	Trauma area (1.Fingers 2.Palms 3.Arm 4.Thigh 5.Edge of the foot 6.Face 7.Eyes 8. Mouth 9. Elsewhere (Describe))	Patient category (1. Clean medical history 2. Suspicious 3. Serological test a) HBV b) HCV c) HIV d) TBC)	Actions taken (1.Thorougly washing the wound, disinfection , dressing 2.Blood sample for serological test 3. Vaccine antibodies administration 4. Antiviral treatment (regimen) 5. Other (describe)
ID1	20.12.23	4	4	2	1	3	1	3A	1
ID2		4	4	3	1	1	1	1	1
ID3	23.10.23	4	4	9	1	1	1	1	1
ID4	8.12.22	4	4	3	1	1	1	1	1
ID5	28.02.23	4	4	3	1	1	1	1	2
ID6	22.11.22	4	6	3	1	6 Gracey	1	3	
ID7	14.11.22	4	4	10 (prosthodontics)	1	2	1	1,3ABC	1
ID8	17.10.22					1		1	
ID9	17.10.22	4	4	3	1	1	1	1,3BC	1,2
ID10	27.06.22	4			1		3	1,3BC	1,2

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ID11	23.06.22	4	4	7	1	1 (irrigation needle)	2	1	1
ID12	15.3.22	4	4	10 (prosthodontics)	1	1	1	3A	1
ID13	7.02.22	4	4	2	2	3	1	1	1
ID14	7.02.22	4	4	7	1	1	1	1	1,2
ID15	3.02.22	4	4	2	1	6 dental probe	1	1,3B	1,2
ID16	29.11.21	4	4	10 (prosthodontics)	1	6 dental probe	1	1	1
ID17	2.11.21	4	4	7	2	1	1		1,2 (to the patient)
ID18	1.11.21	2	9	2	1	1	1	1	1
ID19	26.10.21	4	4	3	2	4	1	1	1,2,3
ID20	12.12.23	4	4		1	1	1	1	
ID21	6.12.23	4	2	1	1	1	1	2	1
ID22	3.02.23	4	4	2	2	3	1		1,2
ID23	16.01.23	3	3		4		6,7	1	1,2
ID24	13.12.21		4	9 (partial denture trimming)		3	1	1 (serological test 3 months ago)	1
ID25	6.10.21	4	4		1	1	1	1	1,2
ID26	6.10.21	4	4		1	6 (dental excavator)	1		1
ID27	1.10.21	4	4	10 (fixed prosthodontics)	1	1	2	2 negative serological testing (A,B,C)	1,2,4 (Argiodin, PEP: Isentress)
ID28	24.05.21	4	4	10 (fixed prosthodontics)	1	6 dental probe	1	1	1
ID29	12.04.21	4	4	9	2	6 lab disc	1	1	1
ID30	20.04.21	4		1	1	1	1		1
ID31	10.04.24	4	4	10 (fixed prosthodontic)	1	1	1	1	1
ID32		4	4	7	1	1	1	1	1
ID33	18.4.24	4	4	2	1	3	1		
ID34	10.4.24	4	2	1	1	6 suture	1		1
ID35	21.3.24	4	4	9	1,2	Lab disc	1		1
ID36	6.3.24	4	4	2		1	1	3, B	1
ID37	22.2.24	4	4	7	1	6, Dental probe	1	1	1,2

*Note: BS LAB: Basement Laboratory, OSC: Oral Surgery Clinic, CMXS: Clinic of Maxillofacial Surgery, TPCC: Total Patient Care Clinic, 2FCAFT: 2nd floor Clinic Afternoon, 3FLCLAFT: 3rd floor Clinic Afternoon, ORTHCL: Orthodontic Clinic, PEDCL: Pediatric Dental Clinic, PSTGRCL: Post-Graduate Clinic, EXTR: Extraction, FILL: Filling, PERIO: Periodontic treatment, EXM: Examination, ORTHO: Orthodontic treatment, ENDO: Endodontic treatment, PEDO: Pediatric treatment.

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2. Results

In total, 37 students were injured by sharp tools during the period studied (2021 and 2024). It accounts for 2.64% (1400 students in total, 350 per year). It is essential to point out that, in the end, the students showed no problems after the injury, and the appropriate measures were taken. The most frequent actions after the injury involved thoroughly cleaning the wound, disinfecting it, and dressing it, followed by taking a blood sample for serological testing. Additionally, as shown in Table 1, one student received antiviral treatment, which included Argiodin and PEP: Isentress.

The summarized results of Table 1 are: 1) Most accidents occurred with undergraduate students (Category 4), particularly in the Oral Surgery Clinic (OSCL) and Prosthodontic Clinic (PRCL). 2) The most common action performed during the accident was periodontal treatment (PERIO). 3) Piercing injuries caused by needles were the most frequent type of injury. 4) The fingers were the most affected area. 5) Injured students most frequently treated patients with clean medical histories. 6) Thorough wound washing, disinfection, and dressing were the most common post-injury actions.

4. Discussion

Our study shows data on students' injuries during clinical work in the undergraduate clinics of the Department of Dentistry of the National and Kapodistrian University of Athens, in the post-COVID-19 period from 2021-2024. There is a considerable prevalence of injuries among undergraduate students during clinics, with the most common cause being the use of needles. In our study, needles, burs, and dental probes are the most common tools that cause injuries. These findings align with other studies conducted in universities such as in Australia and Trinidad, where needles were the most common instruments causing percutaneous injuries [27,28]. It is reported that the environment of dental schools is very challenging and stressful [29]. Many studies have shown that stress among undergraduate dental students increases according to their year of study [30,31]. On that account, the most stressful years are the clinical [32]. This can be explained by the fact that dental students are under a lot of pressure during dental procedures as they try to fulfill patients' needs and instructors' requirements in a short period and without sufficient experience [33]. At the same time, stress, conflict, and anxiety occur as students' skills are defined by the number of procedures they complete. This results in incomprehensive patient care and raises the possibility of injury [34].

The fingers are the trauma area with the highest prevalence, accounting for over half of all injuries. This anatomical region appears to be the most frequently affected area of injury, being implicated in roughly half or more of the occurrences in an Australian dental school (53%) and a Dental Department in Georgia (45%) [26,35].

The most common action performed in our research that caused the trauma is a periodontal treatment followed by a restorative procedure in placing a filling and endodontic treatment. Over 6 years of study conducted in a university dental clinic in Australia, it has been revealed that percutaneous injuries occurred most frequently during restorative procedures, with local anesthesia and oral surgery following closely behind in occurrence [27].

Furthermore, in our research, it was found that most patients who were treated by the injured students had average medical records. However, four cases out of thirty seven after undergoing serological testing, were found to be positive, primarily for HCV and HBV. It is essential to mention that through percutaneous injuries occurring in dentistry, serious bloodborne diseases like human immunodeficiency virus (HIV), hepatitis B virus (HBV), hepatitis C virus (HCV), and Treponema pallidum can be spread [36]. The chances of contracting infections following needlestick/sharp injuries (NSI) from sources carrying pathogens are roughly 0.3% for HIV, between 6.0% and 30.0% for HBV, and 3% for HCV [37]. In Greece, the vaccination against Hepatitis B is mandatory due to national regulations. At the School of Dentistry in Trinidad, the policy requires all students to be vaccinated against Hepatitis B and undergo cross-infection control training before starting patient care. Also, the school's sharps injury protocol necessitates that following a contaminated percutaneous injury, the affected individuals undergo immediate and three-month follow-up testing for HIV and Hepatitis B, receive anti-hepatitis B immunoglobulin and HIV PEP drugs, and are offered pre-and post-test counseling [38].

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At the University of the West Indies, School of Dentistry, when a PCI happens, students are advised to avoid bleeding, clean with soap and water, rinse mucous membranes with water, immediately report the incident to supervising faculty and clinic staff, and seek medical evaluation. Specifically, students are directed to the emergency department or occupational health clinic for risk assessment, potential prophylactic treatment, and follow-up [28]. In our study, most injured students cleaned the wound thoroughly, disinfected it, and dressed it. Many students also provided blood samples for serological testing. This testing was carried out regardless of whether patients had a clear medical history or whether they had tested positive for hepatitis or HIV. Some students received an antibody vaccine and antibiotic therapy, although to a lesser extent. According to WHO guidelines, after occupational exposure to bloodborne pathogens, it is crucial to clean wounds and skin using soap and water, avoid the use of alcohol or potent disinfectants, allow the wound to bleed freely, and refrain from applying a dressing. If eyes, nose, mouth, and mucous membranes are exposed, the traumatized person should rinse with water for a minimum of 10 minutes [39]. After a needlestick incident, patient risk factors should be evaluated, and blood samples collected for HBV, HCV, and HIV testing. Consent should be obtained before testing for HCV and HIV, followed by a decision on administering post-exposure prophylaxis (PEP) [40]. Exposed individuals should be referred to qualified providers for counseling, risk assessment, and consideration of antiretroviral drugs or hepatitis B vaccine [39,41,42].

While we reported an incidence rate of 2.64%, we believe that, as mentioned elsewhere, needlestick injuries are underreported in our case [43–45]. In contrast, a recent study by Zachar & Reher (2022) that collected data over a period of 6 years (2014-2019) reported almost 8.3 times more PEIs (308 PEIs from which 67 being needle stick injuries) with an incidence rate of 0.109%.

Consequently, there is a significant need for enhanced biosafety awareness among students, as derived from the high number of exposed students in our department. Educational institutions play a crucial role in shaping students' attitudes towards adopting correct habits to control cross-infection, as mentioned elsewhere, and this is the case in our study too [46]. This would help students develop a perception of risk, enhance their knowledge of proper protection, and understand the importance of care and caution during dental procedures. Ultimately, this will shape their clinical behavior, ensuring safe practices daily [47]. Consistent educational approaches on the subject would benefit students as it seems that the key to avoiding percutaneous injuries during dental practice is prevention. Wearing two pairs of gloves, as opposed to one, during surgery reduces the occurrence of perforations and blood stains on the skin. This can generally indicate decreased percutaneous exposure incidents [48]. Moreover, needle-stick and sharp instrument accidents can be prevented by carefully handling these instruments, safeguarding drills and needles, and ensuring their proper disposal. It is essential not to bend, break, or handle needles without proper protection [49]. In addition, after using disposable syringes, needles, scalpel blades, and other sharp objects should be placed in a puncture-resistant container. Personal protective equipment such as protective eyewear, use of masks, and unique gowns is also an essential measure during dental procedures as there is a risk of splashing with body fluids [50]. Other measures that can be implemented in routine dental practice include using safer instruments and devices, such as self-sheathing anesthetic needles and needless jet anesthesia [51,52].

Our study, while providing important information on dental students' injuries, is not without its limitations. Initially, the number of reported injuries during this period was relatively low to the total number of students in the clinical years, raising concerns regarding whether all students who experienced percutaneous injuries reported them. Underreporting is associated with a lack of awareness about post-exposure prophylaxis (PEP) and the tendency not to report injuries considered minor, involving clean instruments, or involving low-risk patients, preventing proper post-exposure management [53,54]. Overall, it is advised that dental schools offer additional education on PEI, highlighting the significance of addressing even minor incidents, as transmission of bloodborne pathogens can still occur [26].

5. Conclusions

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The study highlights the critical importance of preventive measures in reducing percutaneous injuries during dental practice. Needle injury was the most common incidence among undergraduate students, thus suggesting that proper handling and disposal of needles and sharp instruments, and personal protective equipment are essential practices for minimizing injury risks. There is also an urge to enhance educational initiatives on safety protocols and post-exposure prophylaxis. This comprehensive approach will help dental students develop a strong understanding of the risks, adopt safer practices, and ensure effective management of any injuries that occur, ultimately enhancing a safer clinical environment.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (or Ethics Committee) of the Department of Dentistry, National and Kapodistrian University of Athens (611/17.10.2023).

Informed Consent Statement: Patient consent was waived due to the use of only written data found in the relevant repository of the department.

Data Availability Statement: The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

The registration form prototype is completed by students in the event of an injury.

National and Kapodistrian University of Athens
INFECTION CONTROL COMMITTEE

REGISTRATION FORM OF INJURY AND RELEASE OF BIOLOGICAL FLUIDS

Full Name						
Date						
Status	FACULTY	ASSOCIATE	POST-GRADUATE STUDENT	UNDERGRADUATE STUDENT		
Place of the accident	BS LAB	OSC	CMXS	TPCC	2FCLAFT	3FLCLAFT
	ORTHCL	PEDCL	PSTGRCL	OTHER		
Action performed	EXTR	FILL	PERIO	EXM	ORTHO	ENDO
	PED	LAB	OTHER			
Type of injury	PIERCING	ABRASION	MATERIAL LAUNCH	LIQUID LAUNCH		
Caused tool	NEEDLE	SCALPEL	BUR	MICROTOOLS	BAND	TOOL(describe)
Trauma area	FINGERS	PALMS	ARM	THIGH	EDGE OF THE FOOT	FACE
	EYES	MOUTH	ELSEWHERE (describe)			
Patient Category	CLEAN HISTORY	MEDICAL	SUSPICIOUS	SEROLOGICAL TEST		HBV HCV HIV

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				TBC
Actions performed *	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
Level **1**	THOROUGLY WASHING THE WOUND, DISINFECTING IT, DRESSING IT			
Level **2**	BLOOD SAMPLE FOR SEROLOGICAL TEST			
Level **3**	VACCINE- ANTIBODIES ADMINISTRATION			
Level **4**	ANTIVIRAL TREATMENT (REGIMEN)			
Other (describe)				

* It can include 1 to 4 Levels. ** Delete the action that WASN'T performed. Note: BS LAB: Basement Laboratory, OSC: Oral Surgery Clinic, CMXS: Clinic of Maxillofacial Surgery, TPCC: Total Patient Care Clinic, 2FCAFT: 2nd floor Clinic Afternoon, 3FLCLAFT: 3rd floor Clinic Afternoon, ORTHCL: Orthodontic Clinic, PEDCL: Pediatric Dental Clinic, PSTGRCL: Post-Graduate Clinic, EXTR: Extraction, FILL: Filling, PERIO: Periodontic treatment, EXM: Examination, ORTHO: Orthodontic treatment, ENDO: Endodontic treatment, PED: Pediatric treatment.

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