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ORIGINAL ARTICLE

Evaluation of the Risk of Percutaneous Injuries in Students of a Brazilian University - A Preliminary Report

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ABSTRACT

Objective: To evaluate the risk of percutaneous injuries (PCIs) that novice predoctoral operators undergo due to non-compliance with biosafety standards in the Endodontics clinic. **Material and Methods:** This is a prospective longitudinal observational study, developed for two years, which included 120 dental students from the Endodontic Clinic of Dentistry course. The following circumstances were analyzed: burs left in the handpiece after use; bare needles lying on the instrument tray or being recapped with two hands; cannulas left in the suction; Gates-Glidden drills left in the micromotor; and biosafety violations involving endodontic files. Descriptive and inferential statistical analysis was performed using Chi-square test (α=5%). **Results:** The sample consisted of 75% women (90). Ninety-nine students (82.50%) were involved in situations that could cause percutaneous injuries. Despite the risk, no accidents occurred during the study period. In total, 364 situations involving risk of percutaneous injuries were observed. In this study, 209 (57.4%) cases of burs left in the handpiece after use were observed, 60 (16.5%) cases of aspiration cannulas left in the suction, 52 (14.3%) cases of bare needles on the instrument tray or being recapped with two hands, 26 (7.1%) cases of Gates-Glidden drills left in the micromotor socket and 17 (4.7%) cases of biosafety violations involving endodontic files. A significant difference ($p<0.05$) was observed between the 5 types of risk situations. **Conclusion:** There was a high percentage of the risk of percutaneous injuries in novice predoctoral operators. Burs left in the handpiece after use were the most encountered risk situation, and most novice predoctoral operators in the Endodontic Clinic disrespected biosafety standards.

Keywords: Accidental Injuries; Education, Dental; Endodontics; Containment of Biohazards.

Introduction

Dental care providers are at risk of percutaneous injuries (PCIs) due to the intimate nature of the patient-dentist environment and the routine use of sharp instruments and dental students are at a greater risk of sustaining PCIs when compared with professional staff [1]. Percutaneous injuries from needles or other sharp objects are the major sources of Bloodborn Pathogens (BBPs) in the workplace [2].

Percutaneous injury (PCI) is defined as a visible penetration of the dentist's skin caused by a needle or other sharp instrument [3,4]. It can also be described as any break in the integrity of the dentist's skin during the performance of dental procedures, regardless of the presence of resulting bleeding [5,6]. Percutaneous injuries are considered the most likely entry point for microorganisms during occupational accidents [4,7].

Inadequate postures before, during, and after clinical care and the occurrence of accidents are factors that can result in professional contamination, regardless of the use of personal protective equipment [5,6]. Simple and common maneuvers such as incorrect handling of dental tools during or after consultations and procedures can facilitate the occurrence of accidents with sharp instruments [7-9].

Due to the varied procedures performed in different dental specialties, risks must be assessed separately in each specialty [4,7]. Endodontists perform only a proportion of the procedures operated by general dental practitioners and utilize specialized endodontic equipment. These factors may account for the variance in the incidence of percutaneous injuries between endodontists and general dentists or other dental specialists [10]. Endodontists' constant use of sharp instruments such as endodontic files with limited operative vision in a small working field (i.e., root canal system) increases their risk of exposure to infection [11]. This fact may be responsible for the variation in the incidence of percutaneous injuries identified and recorded among general practitioners, endodontists, and dentists from other specialties [10].

Adequate biosafety practices significantly reduce the risks of occupational accidents, and it is also important to establish standards, conduct, and procedures that guarantee treatment for professionals and patients without risk of accidents [7-12]. The risk of PCI is aggravated in the case of dental students, who don't have enough professional skills, experience, and training [13].

Studies on sharps accidents in dental schools normally evaluate the percentage of occurrence after the accidents have occurred, with no focus on moments of risk before the accidents [7-9,14-18]. Clinicians, dental students, and inexperienced practitioners are the most vulnerable to percutaneous injuries [2].

There is a lack in literature verifying the risk of accidents of students in novice predoctoral operators in endodontics clinics prior to their occurrence, when students are familiarizing themselves with clinical procedures, standards, and biosafety behaviors. Therefore, the objective of this study was to evaluate the risk of percutaneous injuries to which students are subjected when using sharp instruments, due to non-compliance with biosafety standards at the Endodontics clinic of a Brazilian university.

Material and Methods

This study was conducted following the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines [19].

Study Design and Ethical Clearance

This is a longitudinal and observational study exploring novice predoctoral operators in a Brazilian University, providing an updated analysis of the presence or absence of specific parameters for the quantification

of inappropriate events according to the biosafety standards of the endodontic clinic. This closed cohort study with a prospective component was conducted between October 2013 and June 2016, including dental students.

The study was approved by the Research Ethics Committee of the Health Sciences Center (CCS) of the Federal University of Paraíba, CAAE n. 20141113.4.0000.5188. Students' participation was voluntary and anonymous, thereby guaranteeing the confidentiality of the data obtained. Informed consent was signed by participating students.

Setting and Study Participants

This investigation was conducted on dental students at Federal University of Paraiba (UFPB), which is a major university located in Paraiba State, Brazil. The institution is a public university based on a semester system and offers a 48-month Doctor's Dental Surgery (DDS) degree program. Each year consists of about 70 novice predoctoral operators, and each earns curricular credit for participating in the Clinic of Endodontics.

All participants engaged in full-time general dentistry training under the supervision of senior faculty members in their four years of education, which was the first year of their clinical training. In Endodontic clinic, each dental student acts as a novice predoctoral operator. They learn endodontic treatments and retreatments. All students in the classes of the 2013.1 and 2013.2 semesters, as well as those in the 2015.1 and 2015.2 semesters, were invited to participate in this study. Each student participated in this research for 5 months, once a week, during the semester they were attending endodontic clinic.

Inclusion Criteria and Sample Size

The universe included all students from the Dentistry course at the Federal University of Paraíba who were enrolled in the Endodontics Clinic totaling 122 students who were performing endodontic treatments on patients during the corresponding semester. Those who were under medical exemption or who did not want to participate in the research were excluded from this research. The final sample consisted of 120 students. Each participant was followed during the five months of the academic semester.

Safety standards for endodontic clinics are mandatory theoretical components of the discipline, guided by a protocol in the first week of class. Students were trained on biosafety standards in the endodontics clinic and instructed on the prevention of risk of percutaneous injuries, ways of transmission and the level of risk of hepatitis B and C and importance of personal protective equipment (PPE). Data was collected regarding the risk of PCI [20].

The variables were identified by observing situations of imminent risk of accidents with percutaneous injuries in a pilot study with 10% of the sample, that were not included in the main study, events included: bur left in the handpiece after use, bare needles lying on the instrument tray or being recapped with two hands, cannulas left in the suction, Gates-Glidden drills left in the micromotor after use, and biosafety violations involving endodontic files.

The infractions were noted by a trained researcher using a collection instrument, which reported the risk situations observed during the operation of the endodontic clinic, following the order of the variables described above in the methodology, two days a week, over a period of four semesters. During four hours at the Endodontics clinic, the researcher noted risk situations on a face-to-face validated collection instrument. The information collected was archived in a database and then subjected to statistical analysis.

Data Analysis

Data was computed and tabulated using SPSS Statistics 20.0 software (IBM Corp., Armonk, NY, USA). To carry out the analysis, the results were tabulated to obtain descriptive data. Chi-square association test and Chi-square test for difference in proportions were used for inferential statistics, with a 95% confidence interval, and a 5% significance level.

Results

Considering all observations, 99 students (82.5%) were involved in situations that could lead to percutaneous injuries, of which 75% were women. This study registered 364 events involving the risk of percutaneous injuries.

Table 1 describes the risk situations experienced from three aspects in the study: semester, gender, and type of situation. The prevalence of risk PCI is not associated ($p>0.05$) neither with the semester nor with the sex of the students, but there is a significant difference ($p<0.05$) among the 5 types of risk situations and the burs left in the handpiece after use represent more than 57.4% of the risk situations observed.

Table 1. Prevalence of exposure to risk of percutaneous injuries, according to the semester, gender, and type of situation.

Variables	Risk Situation				p-value
	Yes		No		
	N	%	N	%	
Semester					
2013.1	25	80.6.	6	19.4	0.8048(1)
2013.2	25	78.1	7	21.9	
2015.1	21	84.0	4	16.0	
2015.2	28	87.5	4	12.5	
Gender					
Female	230	64.00	0	0.00	0.5593(1)
Male	134	36.00	0	0.00	
Type of Situation					
Endodontic Files	17	4.7	0	0.00	0.0000(2)
Needles	52	14.3	0	0.00	
Access Burs	209	57.4	0	0.00	
Gates-Glidden Drills	26	7.1	0	0.00	
Aspirating Cannulas	60	16.5	0	0.00	

(1)Chi-square association test; (2)Chi-square test for difference in proportions.

Discussion

Dental students, trainees, and dental assistants are frequently exposed to sharps injuries or needle stick injuries (NSI) by needles contaminated with blood and saliva while managing their patients under restricted visibility [1,21]. In dentistry, these exposures occur uninterruptedly because of the close distance from treating patients, frequent movements, and the routine use of various sharp instruments under limited or indirect visual contact [8].

Several studies indicate that the rate of accidents occurring among dental students is quite high [1,7-9,22]. Some studies show that endodontic instruments and procedures are involved in the high prevalence of occupational accidents occurring among dental surgeons and dental students [4,10,16]. In the present study, there is a high prevalence of risk of accidents with percutaneous injuries.

The risk of PCIs in students is high because their technical abilities are under development, and their clinical experience is still limited when compared with professionals [13,23]. In the present study, instruments most frequently associated with risk of injuries were burs (48%) and needlesticks (18%). In a study in Australia,

dental students were at a greater risk of sustaining PEIs (65.6%) when compared with professional staff (34.4%). Most common instruments included needles (21.8%), probes (20.5%), and burs (18.2%) [1]. In other research about 31% of the injuries were caused by needlesticks, followed by burs (22.8%) [24].

Considering the four-semester period of this research, there was approximately one situation of risk of percutaneous injury every 39 minutes during the period in which the students were in clinical practice. In the present study, 82.50% of students reported experiencing risk of percutaneous injuries at some point, even though they had previously been instructed on biosafety rules. This data represents a worrying panorama, as students are not following recommendations regarding biosafety in the clinic, and demonstrates the possibility of accidents occurring. Simple procedures, such as not leaving burs and other rotating instruments mounted on the micromotor or high rotation, can possibly lead to a significant reduction in accidents during the operation of dental clinics [9,24], even because the cost of prophylaxis and post-exposure treatment is a significant institutional economic burden [25].

Gates-Glidden drill was left mounted on the handpiece after use in 26% of the total risk situations, within the student's field of activity, which could result in tears of clothing, scratches, and/or even more serious injuries, such as the penetration and breakage of the drill inside the student's arm. There are reports of serious accidents of this type with this drill in the literature [26,27].

There are few studies in literature observing percutaneous injuries in exclusive endodontics clinics or in endodontists. One study concluded that there was a low annual injury rate for endodontists and a high level of compliance with biosafety measures. This controversial data can be explained by the methodology used, which, as it is a questionnaire, can induce interviewees to make inaccurate statements. The study also reveals that 94% of percutaneous injuries occurring in Greek endodontists caused by used burs/Gates-Glidden drills could have been avoided by immediately removing them from the handpiece after use [10]. This data reinforces the need for greater attention on this point by dentists, reducing the potential risks of exposure.

Metallic aspiration cannula was the second most frequently observed type of risk in this study, in the general scenario of risk associated with PCIs. This instrument, in most cases, is placed on the equipment support, with its tip facing the student in risky situations. Furthermore, considering that this instrument is in direct contact with the infected root canal access cavity and its debris, it also becomes a potential vector for patient-professional transmission of infections. After the results of this research, the coordination of the endodontics clinic of UFPB changed the metal cannulas to disposable plastic cannulas.

In the present study there were 14.3% of situations of risk related to needlesticks. Another study showed that 25.0% of needlestick injuries (NSIs) were related to syringe needles, which accounted for most exposures among dental students [8]. In four Nigerian dental schools, 58.8% (n = 90) of the dental students had experienced at least one needlestick injury [14]. This type of accident can be easily avoided by adopting simple procedures, such as recapping needles, appropriately, immediately after use [7-9,14,28].

This research is based on the principle that accident risk situations may turn into a real accident among dental students and deserve maximum attention. Needlestick injuries are associated with several bloodborne infections and are common among dental health professionals, and the injuries are mainly related to cleaning instruments, recapping needles, and administering local anesthesia [6]. Some devices promise to prevent accidents; however, the efficiency of safety devices, such as retractable needles, is inconclusive [29]. Therefore, better training, care during cleaning instruments, avoiding hazardous practices such as recapping needles, and development of safer needles may prevent injury and disease [6].

Even for dental students who consider themselves to have good knowledge about biosafety, there is still a significant lack of adherence to biosafety protocols in the academic environment, making it essential that teachers evaluate teaching behaviors and analyze their ability to assimilate the principles biosafety taught [30]. There are infection control measures implementing infection-control precautions. These educational programs and training strategies should be implemented to maximize and enhance compliance among dental care providers with infection-control guidelines [2,7,21,28]. Additionally, the increase in accidents among students was the result of longer periods of clinical practice, and this highlights the need for continuous training of biosafety protocols to have a safer work environment for health professionals and for their patients [16].

As observed in the results, despite there being a high number of risk situations involving accidents with sharp instruments, during the study, there were no accidents that resulted in percutaneous injuries. The present results should be compared with other studies. Unfortunately, there is lack of evidence that compares risk situations with accidents with sharps before the accident occurs. Previous studies were carried out after the occurrence of injuries and their notification; therefore, in these cases, it was necessary for the Damage Principle so that the general biosafety framework is taken into consideration [4,5,8,9,15,16].

This study is preliminary and serves as a basis for future studies. The limitations of the present study are associated with the fact that potential risk situations could happen to a student at a time when the researcher was evaluating another student. Furthermore, the results of this research must be interpreted with caution, as they were carried out in a single institution, involving a specific population, making it difficult to generalize the conclusions about other endodontic clinics in other dentistry courses in Brazil and other countries. Moreover, social realities and influencing factors could be possible confounding variables affecting the level of the knowledge of students about biosafety [31].

A positive point of this study is that it is based on risk situations, which is a relevant difference to raise awareness among students before the occurrence of accidents. Furthermore, no accidents with percutaneous injuries occurred during the research data collection period. This is due to the fact that, at the moment the accident risk was identified, the situation was noted and the student was advised to reverse it, removing drills, cannulas, and recapping the needles appropriately. The presence of the researcher as a monitor actively identifying situations of risk of sharp injuries should be routine practice in teaching clinics.

This research was conducted prior to the COVID-19 pandemic. Regarding recommendations of Brazilian National Health Surveillance Agency (ANVISA) to prevent the risk of accidents with sharps, the recommendations have not changed much after the COVID-19 pandemic [32]. However, there are important gaps in dental students' knowledge and attitudes towards prevention and control measures against infection in dental environments in the context of COVID-19, indicating the need for improvements and that there is still a lack of specific studies on the level of knowledge and attitudes of professionals and dental students about biosafety after COVID-19 pandemic [31,33,34].

New studies should be carried out, based on this methodology evaluating the level of knowledge and preventive attitudes of dental students about the new recommendations in dental care environments after COVID 19 pandemic and also evaluating rotary and reciprocating Nickel Titanium (NiTi) instruments used in current Endodontic practice, with the aim of raising awareness among students and professionals about the risks that procedures in the practice of this dental specialty pose, Furthermore, due to the results found in this research, the need for greater rigor in complying with biosafety standards in the Endodontics clinic is clear.

Conclusion

There is a high percentage of risk of percutaneous injuries in novice predoctoral operators, access drills left in the handpiece after use were the most encountered risk situation and most novice predoctoral operators in Endodontic Clinic of the Federal University of Paraíba disrespected biosafety standards.

Authors' Contributions

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All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.

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Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

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