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Needlestick injuries and related occupational accidents with sharp objects in a dental school - a retrospective analysis over 5 years

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Keywords
Occupational accidents, needlestick injuries, sharp objects, blood-borne pathogens, dentistry

Abstract

The aim of this study was to retrospectively summarize all occupational incidents involving sharp objects, including needlestick injuries and scalpel blade cuts, reported among dental personnel and dental students at the University Center for Dental Medicine Basel (UZB) over a 5-year period, from 2019 to 2023. These incidents were documented by the UZB Human Resources Department. The information recorded included the two groups (dental personnel, i.e. dentists and dental assistants; dental students) as well as the gender and age of the person. The annual incidence ranged from five to 15 for dental personnel and from two to five for dental students. The mean incidence over the 5-year period was 4.4%. No statistically significant differences were observed between years (p = 0.48), sexes (p = 0.57), or groups (p = 0.99). The highest pooled annual incidence was observed in 2020 with a value of 5.8%. The highest incidence for dental personnel was 6.4% in 2020 and 6.4% in 2019 for dental students. Given the regular occurrence of sharp injuries, it is necessary to implement additional protective measures to further reduce the incidence of such accidents.

Introduction

Exposure to various infectious agents is an occupational risk for medical and dental healthcare workers. Potential transmission routes include percutaneous injury, contamination of mucous membranes or non-intact skin with blood or body fluids from infectious patients, or transmission of airborne pathogens via aerosols and droplets. Due to the SARS-CoV-2 pandemic, aerosols as a risk factor for dental personnel and the implementation of effective preventive measures have received much attention (1, 2). However, less information is available for percutaneous injuries, i.e. injuries from sharp objects that cut or penetrate the skin in a dental clinic setting (3).

These types of injuries put medical and dental health care workers at risk as the exposure to blood-borne pathogens can lead to severe diseases and incapacity for work. In the past, infection with the Hepatitis B virus (HBV) constituted a significant occupational risk for dental healthcare workers. The availability of an HBV vaccine and the implementation of infection prevention programs in dental settings have resulted in a decline of occupational HBV infections among healthcare personnel (4, 5). However, no vaccine is currently available for infections with either Human Immunodeficiency virus (HIV) or Hepatitis C virus (HCV).

Among healthcare professions, dentists face one of the highest risks of experiencing needlestick and sharp object injuries (NSI) as they come into direct contact with potentially contaminated blood on a regular basis during dental procedures. Nevertheless, there is a lack of literature on the prevalence of NSI among dental personnel. A recent systematic review on the prevalence of NSI among groups of healthcare workers, which included articles published between 2000 and 2018, identified only four study articles that met the inclusion criteria and analyzed NSI among dentists. In this review, NSI were reported in 889 of 1368 dentists and the prevalence of NSI was specified to range from 27.5% to 69.2% (6). Only one study, which analyzed NSIs among Polish dentists, was conducted in Europe out of the four included articles (7). Similarly, the majority of recent publications analyzing NSI, whether among healthcare workers or dental personnel, have reported results from developing countries. Dental students appear to be a particularly vulnerable group due to their limited training period and experience (8, 9). A similar pattern could be observed as most research was done in non-European countries. In a 2022 meta-analysis on the prevalence of NSI among dental students, consisting of 25 study articles from 15 countries, only two studies from Europe (United Kingdom) were included (9). So far, no data on the prevalence of NSI in dental personnel have been published for Switzerland.

Occupational NSI may not only result in serious health consequences. They can also have a profound impact on the mental well-being of the healthcare worker and may impose considerable economic burdens on both, the affected individual and the healthcare system (10). Consequently, the reduction of NSI should be regarded as a matter of importance. Therefore, the aim of this study was to analyze all needlestick and sharp object injuries that were reported for dental personnel and dental students at the University Center for Dental Medicine Basel UZB (UZB) between 2019 and 2023 retrospectively, and to establish a basis for the implementation of additional protective measures.

Materials and methods

Population under investigation

Any accident, either an occupational accident during working hours or a non-occupational accident for persons who work at least 8 hours a week at the University Center for Dental Medicine Basel (UZB), has to be reported to the Human Resources Department (HR) which will forward the necessary information to the appropriate Accident Insurance provider. Occupational accidents involving NSI, i.e. needlestick injuries or cuts from scalpel blades, are also recorded separately at HR. Here, only the person group, gender (male or female) and the age (in years) are documented.

The group of dental personnel includes dentists, dental hygienists, prophylaxis assistants, dental assistants and personnel working in the central sterilization unit of the UZB. As students at the UZB start clinical work in their 3rd year of training, only dental students in the 3rd, 4th and 5th years of their undergraduate studies are included in this investigation.

Injuries resulting from the use of disposable syringes, scalpels, scissors, suture needles or other sharp devices, which may lead to cuts, abrasions or percutaneous injuries were included in this study and referred to as NSI in this article.

Statistical analysis

Data was collected over a period of five years, i.e. from 2019 to 2023. Descriptive statistics comprised numbers and percentages per year for all dental healthcare personnel and categorized by person group (dental personnel or students) and by gender (male or female). For statistical analysis, data were entered into GraphPad Prism 8.3.0 for Windows (GraphPad Software, Boston, Massachusetts USA, http://www.graphpad.com). The Chi-Square test or, in the case of small sample sizes, the Fischer's exact test were used for detection of differences in incidence. The Kruskal-Wallis test was used to compare the averages of more than two groups. A p-value <0.05 was considered statistically significant.

Ethics approval

A study protocol was submitted to the ethical committee Northwest and Central Switzerland (EKNZ Req-2024–01108); however, the study was considered to be a quality control study and, therefore, did not require formal evaluation and approval.

Results

The mean annual number for dental personnel working at the UZB and dental students in clinical courses during the study period (2019-2023) was 239 (range: 231 – 248) and 83 (range: 76 – 93), respectively (Table). The number of yearly accidents involving needlesticks or sharps ranged from five to 15 for dental personnel and from two to five for dental students. The mean incidence over this 5-year period was 4.4%. No statistically significant differences were found between the years ($p = 0.48$).

Table. NSI per year, person group, and gender.

*DHCW: all dental healthcare workers

Year	Person Group*	NSI
2019	All DHCW (n=309)	10 (3.2%)
	Male (n=71)	2 (2.8%)
	Female (n=238)	8 (3.4%)
	Personnel (n=231)	5 (2.2%)
	Male (n=43)	0 (0.0%)
	Female (n=188)	5 (2.7%)
	Students (n=78)	5 (6.4%)
	Male (n=28)	2 (7.1%)
	Female (n=50)	3 (6.0%)
2020	All DHCW (n=310)	18 (5.8%)
	Male (n=69)	1 (1.5%)
	Female (n=241)	17 (7.1%)
	Personnel (n=234)	15 (6.4%)
	Male (n=41)	0 (0.0%)
	Female (n=193)	15 (7.8%)
	Students (n=76)	3 (3.9%)
	Male (n=28)	1 (3.6%)
	Female (n=48)	2 (4.2%)
2021	All DHCW (n=326)	16 (4.9%)
	Male (n=74)	2 (2.7%)
	Female (n=252)	14 (5.6%)
	Personnel (n=240)	12 (5.0%)
	Male (n=46)	2 (4.4%)
	Female (n=194)	10 (5.2%)
	Students (n=86)	4 (4.7%)
	Male (n=28)	0 (0.0%)
	Female (n=58)	4 (6.9%)
2022	All DHCW (n=336)	11 (3.3%)
	Male (n=83)	3 (3.6%)
	Female (n=253)	8 (3.2%)
	Personnel (n=243)	7 (2.9%)
	Male (n=51)	3 (5.9%)
	Female (n=192)	4 (2.1%)
	Students (n=93)	4 (4.3%)
	Male (n=32)	0 (0.0%)
	Female (n=61)	4 (6.6%)
2023	All DHCW (n=332)	16 (4.7%)
	Male (n=81)	6 (7.4%)
	Female (n=251)	10 (4.0%)
	Personnel (n=248)	14 (5.7%)
	Male (n=53)	5 (9.4%)
	Female (n=195)	9 (4.6%)
	Students (n=84)	2 (2.2%)
	Male (n=28)	1 (3.6%)
	Female (n=56)	1 (1.8%)

The highest annual pooled incidence was observed in 2020, with a value of 5.8%; the highest incidence for dental personnel was 6.4% in 2020 and 6.4% in 2019 for dental students (Table). When the data for personnel and students was pooled over the five-year period, no statistically significant difference was detected between the two groups (p = 0.99). While a higher percentage of female individuals (4.62%) than male individuals (3.70%) within the pooled sample experienced an NSI over the five years, this difference was not statistically significant (p = 0.57).

The mean age of persons reporting an NSI was 26.3 years (range: 22 – 33 years) in 2019, 29.1 years (range: 21 – 47 years) in 2020, 28.1 years (range: 18 – 58 years) in 2021, 28.2 years (range: 18 – 41 years) in 2022, and 28.3 years (range: 16 – 44 years) in 2023 respectively. There was no statistically significant differences in the mean age of persons experiencing an NSI over the five years study period (p = 0.78).

Discussion

In this retrospective study conducted at the University Center for Dental Medicine Basel (UZB), the yearly incidence of injuries involving sharp objects ranged from 3.2% to 5.8%, with a mean incidence of 4.4% over the 5-year study period. While there was no significant difference in yearly incidence numbers, higher numbers were observed in 2019 for students and in 2020 for dental personnel. In 2019, the Dental School moved to a new building, while in 2020, the more rigorous personal protection measures implemented in response to the ongoing SARS-CoV-2 pandemic may have influenced the annual numbers.

In order to reduce the incidence of NSI, the implementation of effective prevention measures is of particular significance. The Swiss Dental Association (SSO), which represents the interest of Swiss dentists, plays a significant role in educating and informing their members on various topics in dentistry, including aspects in dental practice hygiene and prevention measures (11). The recommended measures, which are also implemented at the UZB, include mandatory vaccination against HBV for all clinical personnel, the use of personal protective equipment and special containers for the disposal of sharp objects. It is essential that each employee is aware of the procedure to be followed after an accidental exposure to blood or saliva. This information must be documented in writing as it will facilitate the prompt implementation of appropriate measures in case of an accident (11).

Almost all Swiss dental healthcare workers are vaccinated against HBV (12). However, no vaccinations are currently available for infections with HIV, HCV, or other blood-borne diseases and seroconversion as a result of infection might occur. At the UZB, no seroconversion occurred during the period of this study (data not shown).

The two-handed recapping of needles, defined as the reinsertion of used needles back into their protective sheath, is considered a significant risk factor for injuries (13-15). In Switzerland, recapping is only permitted in cases where the device is intended for multiple use, such as anesthesia in dentistry (16). The recapping procedure must be performed with one hand only, e.g. using a protective cap holder (17). If a needle needs to be recapped and a protective cap holder is not available, the WHO recommends a one-hand-scoop technique (17). A recent investigation compared the one-hand-scoop technique with the use of dental tweezers among dental specialists. The results demonstrated that there was no significant preference among dentists for either technique when asked about the ease of use or on their evaluation of the prevention of needle stick injuries (18). To date, however, no research has been conducted to directly compare these two methods in terms of their potential for preventing needlestick injuries. The use of additional safety features such as shields or retractable needles might also help in the prevention of NSI. However, the evidence for these safety devices in preventing NSI is of low quality and/or inconsistent (19).

Various behavioral and organizational factors are known to influence the incidence of NSI in healthcare settings (15, 20, 21). A systematic review of needlestick injuries among healthcare workers in Iran identified individual and organizational factors such as young age, less work experience, work shift, and female gender as strong risk factors for NSI injury (21). In a prospective cohort study conducted over one year in university hospitals in Paris, France, accidental exposure to blood was analyzed among healthcare workers in their hospitals. Predictors of increased risk included, among others, younger age, irregular working hours and lack of support from supervisors (20). This is in contrast to the present study, where no statistically significant differences were observed for gender as well as person group, i.e. personnel or students. At the UZB, students will receive instructions on the proper methods for handling needles and sharps, either theoretically in lectures as well as hands-on training during their practical training and before having actual contact with their first patient. As they work under supervision, they are required to adhere to the appropriate measures in the event of an accidental exposure to blood (11).

In the present investigation, the yearly incidence of NSI was less than 6%. This incidence rate is in accordance with a retrospective study conducted at a governmental hospital in Saudi Arabia, which reported an incidence of NSI over a 26-month period of 4% among all healthcare workers at this hospital. The highest incidence were noticed for physicians and nurses at 8.6% and 7.7%, respectively (22). In contrast, markedly higher rates were observed in a German university hospital, where one third of the participating healthcare workers had sustained at least one needlestick injury over the past twelve months as assessed by a questionnaire. The highest yearly incidence rates were reported by surgeons (46.9%) (23). In Switzerland, a retrospective study, which was also based on a questionnaire distributed to healthcare workers in a Swiss university hospital, found that approximately 10% of the respondents had experienced one or more NSIs in the previous 12 months. Among these individuals, the rates of NSI were highest among nurses and doctors (24). Incidence numbers based on questionnaires might be higher as respondents who have experienced an NSI in the past year are probably more likely to participate which may explain the observed differences in incidence figures.

To date, only a limited number of studies have examined the prevalence or incidence of NSI in a dental setting. A recent systematic review, which included study articles published between 2000 and 2018, identified only four publications meeting the inclusion criteria. The meta-analysis indicated that prevalence, i.e. having experienced at least one NSI exposure during professional life, was the highest among dentists at 59.1%, compared with a global pooled prevalence of 44.5% NSI for all categories of healthcare workers (6). A more recent review from 2023 reached a similar conclusion, namely that there is a lack of literature on the global prevalence of NSI among dental practitioners (3).

Nevertheless, it remains uncertain whether all incidents involving sharps and needles were reported also for the present population assessed at the UZB as there is evidence that underreporting of NSI by healthcare workers is common (3, 24). A systematic review of the literature estimated the prevalence and reporting rates of NSI among dental healthcare workers in Pakistan. Of the nine publications included in this review, four also measured the reporting rate of NSI and underreporting in these four study articles ranged from 15% to 76%. The most common reasons for non-reporting of accidents were the lack of awareness regarding both, the reporting system and the necessity for reporting NSI (25). Underreporting has also been observed in a Swiss hospital, where only about three-quarters of the 260 individuals who experienced an NSI reported all events. Physicians not only had among the highest rates of NSI, they also had the highest rate of underreporting. The primary reason for not reporting was the perception that the risk of viral infection transmission via blood was minimal (24).

In order to improve protection of dental personnel and students from NSIs, it is necessary to combine various safety measures. Occupational health measures, including immunization against HBV virus and post-exposure measures following NSIs, have already been established at the UZB. Personal protective equipment, such as protective gloves or clothing, is also provided to dental personnel and students. A hygiene concept, to which employees have online access at any time, has been implemented as an organizational measure and students receive both theoretical and practical training. However, as there is no concept for regular follow-up education at the UZB, the implementation of periodic training sessions is currently under discussion. Technical measures refer to the use of technical aids such as safety engineered needles and syringes for the prevention of blood-borne infections. Various safety products and safety disposal containers are in place at the UZB; however, not all dental units at the UZB use safety syringes or protective cap holders, indicating a potential for improvement (26).

As this study is retrospective in nature, some important information might be lacking. In particular, more detailed information regarding the circumstances of the injury could not be obtained. Information on problematic handling and/or situations in which the accidents occurred and the clinics involved may prove useful in identifying potential improvements and solutions. Furthermore, a more profound analysis with a focus on total hours worked or day-time when the accidents occurred rather than on individuals alone may yield additional insight. Furthermore, it would have been interesting to assess the percentage of employment of the affected people, i.e. full-time versus part-time, as there are numerous part-time personnel as well as students who do not treat patients on a daily basis at the University Center for Dental Medicine in Basel.

Conclusions

Yearly incidences as high as 5.8% for NSIs at a dental university hospital emphasizes the importance of establishing a prevention program to minimize their occurrence. Further research is needed to collect more detailed information on the circumstances of the accident and the subsequent prophylactic measures taken by the healthcare workers in order to identify the most critical area(s).

Zusammenfassung

Einleitung

Die Exposition gegenüber verschiedenen Infektionserregern birgt ein berufliches Risiko für das medizinische und zahnmedizinische Personal. Perkutane Verletzungen, d.h. Verletzungen durch scharfe Gegenstände, welche die Haut schneiden oder durchdringen, können zu einer Exposition gegenüber durch Blut übertragbare Krankheitserreger führen. Eine solche Exposition kann zu schweren Erkrankungen und im schlimmsten Fall zu einer Arbeitsunfähigkeit führen. Unter den Berufen im Gesundheitswesen weist das zahnmedizinische Personal eines der höchsten Risiken für Verletzungen durch Nadelstiche und andere scharfe Gegenstände auf, da es bei zahnärztlichen Eingriffen regelmässig zu direktem Kontakt mit potenziell kontaminiertem Blut kommt. Gleichzeitig ist ein Mangel an Literatur zur Prävalenz und/oder Inzidenz von entsprechenden Verletzungen im zahnärztlichen Bereich festzustellen. Insbesondere fehlen bislang auch Daten zu Nadelstichverletzungen beim zahnärztlichen Personal in der Schweiz. Die vorliegende Studie hatte deshalb zum Ziel, retrospektiv alle Nadelstichverletzungen und weitere Verletzungen mit spitzen Gegenständen zusammenzutragen, die am Universitätszentrum für Zahnmedizin Basel (UZB) in den Jahren 2019 bis 2023 gemeldet wurden.

Material und Methoden

Die Erfassung sämtlicher Arbeitsunfälle mit scharfen Gegenständen erfolgte durch die Personalabteilung am UZB. Zu den erfassten Informationen gehörte die betroffene Personengruppe (d. h. zahnärztliches Personal oder Studierende), das Geschlecht der Person und das Alter. Die Gruppe des zahnärztlichen Personals umfasste dabei Zahnärztinnen und Zahnärzte, Dentalhygienikerinnen und Dentalhygieniker, Prophylaxe-Assistentinnen und Prophylaxe-Assistenten, Dentalassistentinnen und Dentalassistenten sowie Personal der Aufbereitungseinheit für Medizinprodukte. Da die Studierenden am UZB erst im dritten Ausbildungsjahr mit der klinischen Arbeit beginnen, wurden in dieser Untersuchung nur die Zahnmedizinstudierenden im dritten, vierten und fünften Studienjahr berücksichtigt.

Resultate

Die jährliche Inzidenz von Unfällen mit Nadelstichen oder scharfen Gegenständen lag zwischen fünf und 15 bei zahnärztlichem Personal und zwischen zwei und fünf bei Zahnmedizinstudenten. Die mittlere Inzidenz über diesen 5-Jahreszeitraum betrug 4,4%. Es wurden keine statistisch signifikanten Unterschiede zwischen den Jahren festgestellt ($p = 0{,}48$). Die höchste jährliche Inzidenz wurde im Jahr 2020 mit einem Wert von 5,8% beobachtet. Die höchste Inzidenz für das zahnärztliche Personal betrug 6,4% im Jahr 2020 und 6,4% im Jahr 2019 für Zahnmedizinstudierende. Bei der Analyse der gepoolten Daten für Personal und Studierende über den gesamten Fünfjahreszeitraum wurde kein statistisch signifikanter Unterschied zwischen den beiden Gruppen festgestellt ($p = 0{,}99$). Obwohl ein höherer Prozentsatz der weiblichen Personen (4,62%) als der männlichen Personen (3,70%) innerhalb der gepoolten Stichprobe in den fünf Jahren eine Nadelstichverletzung erlebte, war dieser Unterschied statistisch nicht signifikant ($p = 0{,}57$).

Diskussion

Angesichts des regelmässigen Auftretens von Verletzungen mit spitzen Gegenständen ist es notwendig, zusätzliche Schutzmassnahmen zu ergreifen, um die Häufigkeit solcher Unfälle zu verringern. Innerhalb der betrachteten fünfjährigen Zeitspanne wurden keine statistisch signifikanten Unterschiede festgestellt. Um die kritischen Bereiche zu ermitteln, sind weitere Untersuchungen erforderlich, wie z.B. detailliertere Informationen über die Umstände des Unfalls und die daraufhin vom Arzt ergriffenen prophylaktischen Massnahmen.

Résumé

Introduction

L'exposition à divers agents infectieux constitue un risque professionnel pour le personnel médical et dentaire. Les blessures percutanées, c'est-à-dire les blessures causées par des objets tranchants qui coupent ou pénètrent la peau, comportent un risque d'exposition à des agents pathogènes transmissibles par le sang. Une telle exposition peut entraîner des maladies graves et, dans le pire des cas, une incapacité de travail. Parmi les professions de santé, le personnel dentaire présente l'un des risques les plus élevés de blessures par piqûre d'aiguille et autres objets tranchants, car les interventions dentaires impliquent régulièrement un contact direct avec du sang potentiellement contaminé. Parallèlement, on constate un manque de littérature sur la prévalence et/ou l'incidence de telles blessures dans le domaine de la médecine dentaire. Il manque notamment des données sur la prévalence et/ou l'incidence des blessures par piqûre d'aiguille chez le personnel dentaire en Suisse. La présente étude avait donc pour objectif de rassembler rétrospectivement toutes les blessures par piqûre d'aiguille et autres blessures par objets pointus déclarées au Centre Universitaire de Médecine dentaire de Bâle (UZB) entre 2019 et 2023.

Matériel et méthodes

Tous les accidents du travail impliquant des objets tranchants ont été enregistrés par le service des ressources humaines (RH). Les informations recueillies comprenaient le groupe de personnes (c'est-à-dire le personnel qualifié ou les étudiants), le sexe de la personne et l'âge. Le groupe du personnel qualifié comprenait les médecin-dentistes, les hygiénistes dentaires, les assistants en prophylaxie, les assistants dentaires et le personnel de l'unité de traitement des dispositifs médicaux. Comme les étudiants du Centre Universitaire de Médecine Dentaire de Bâle (UZB) ne commencent à travailler cliniquement qu'en troisième année de formation, seuls les étudiants en médecine dentaire de troisième, quatrième et cinquième année a été pris en compte dans cette étude.

Résultats

L'incidence annuelle des accidents par piqûres d'aiguilles ou d'objets tranchants était comprise entre 5 et 15 cas pour le personnel dentaire et entre 2 et 5 cas pour les étudiants en médecine dentaire. L'incidence moyenne sur cette période de 5 ans était de 4,4%. Aucune différence statistiquement significative n'a été constatée sur cette période (p = 0,48). L'incidence annuelle groupée la plus élevée a été observée en 2020, avec une valeur de 5,8%. Le taux d'incidence le plus élevé pour le personnel dentaire était de 6,4% en 2020 et de 6,4% en 2019 pour les étudiants en médecine dentaire.

Discussion

Compte tenu de la survenue régulière de blessures avec des objets pointus et tranchants, il est nécessaire de prendre des mesures de protection supplémentaires afin de réduire la fréquence de ces accidents. D'autres travaux de recherche sont donc prévus dans le cadre

desquels des informations plus détaillées sur les circonstances de l'accident et les mesures prises par la suite par le médecin traitant doivent être recueillies. Sur la base de ces informations, il sera ensuite possible de définir les domaines d'intervention prioritaires pour mettre en œuvre des mesures de réduction des blessures par piqûre d'aiguille.

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