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ORIGINAL ARTICLE

Assessment of Needlestick and Sharps Injuries (NSSIs) Amongst Orthopaedic Surgeons in Clinical Practice: A Pan-India Cross-Sectional Study

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Abstract

Introduction Needlestick and sharps injuries (NSSIs) represent an existential occupational hazard risk to orthopaedic surgeons during their career due to the interaction with various devices, instruments and bone fragments. Consequently, NSSIs have the potential to transmit infections such as Hepatitis B (HBV), Hepatitis C (HCV) and Human Immunodeficiency Virus (HIV) leading to serious illness. The purpose of this cross-sectional study was to identify the clinical settings predisposing orthopaedic surgeons to NSSIs and assess their adherence to safety protocols in the Indian context.

Materials and Methods An online cross-sectional survey of 618 orthopaedic surgeons in India, stratified by experience into two groups: under five years and with 5 years or more was undertaken. The data were collected via an expert-validated online questionnaire to evaluate demographic distribution, injury characteristics, knowledge of safety protocols, and adherence to these protocols. Descriptive statistics summarized the data, Chi-square tests assessed variable associations, and odds ratios were computed for significant variables. Ethical integrity was maintained via electronic informed consent and for confidentiality assurances.

Results The study revealed that orthopaedic surgeons with less than 5 years of clinical experience had higher risks for NSSIs as compared to those with 5 or more years of clinical practice. Conversely, the latter group was more susceptible to bone spike injuries and viral positive needlestick incidents. The analysis shows that whilst the more experienced practitioners displayed greater proficiency in the application of universal precautions and NSSI prevention, they were also less likely to report injuries, often due to discomfiture. Risk profiles were consistent across different practice settings and affiliations, regardless of experience level.

Conclusion This cross-sectional study reveals less experienced orthopaedic surgeons face higher risks of NSSIs, possibly due to inadequate education or awareness. More experienced practitioners encounter distinct risks, likely owing to long-term exposure and traditional practices. There is an immediate need to raise awareness of the potential risks of NSSIs, enhanced education, appropriate training, collaboration with the hospital risk management team and developing a culture of transparent reporting to mitigate these risks. The emphasis should be on reducing the incidence and fostering open reporting of NSSIs to protect clinicians and promote health safety.

Keywords Cross-sectional studies · Needlestick injuries · Orthopaedic surgeons · Risk management · Universal precautions · Health promotion

Introduction

Healthcare workers are at risk of contracting blood-borne infections through percutaneous Needlestick and Sharps Injuries (NSSIs), which may include Human immunodeficiency virus (HIV), Hepatitis B (HBV), and Hepatitis C (HCV), as well as more than 20 other infections, such as Syphilis, Malaria, and Herpes [1–3]. It is a known fact that healthcare workers may experience mental health issues, such as post-traumatic stress disorder, distress, depression, and anxiety as a result of NSSIs, which can lead to more absences from work and lost days of work [4–8]. Out of 35 million HCWs worldwide, 3 million

Extended author information available on the last page of the article

experience such exposure annually, with 2 million of those exposures being to hepatitis B virus (HBV), 0.9 million to hepatitis C virus (HCV), and 0.17 million to human immunodeficiency virus (HIV) [9].

Healthcare professionals specializing in orthopaedics, such as orthopaedic surgeons, have a higher likelihood of experiencing needle stick injuries. This is because they are regularly exposed to bone fragments and utilize orthopaedic instruments that are sharp, such as Kirschner wires, metallic pins, drills, and saws during surgical procedures. The previous reports suggest orthopaedic surgeons have been found to face a sharp injury risk ranging from 80 to 90% over 10 years [10, 11]. It is worrying that a large majority of orthopaedic surgeons, specifically 67%, are choosing not to report incidents of exposure despite the average exposure rate being 1.4 per year. This may be due to reasons, such as a conceived notion about the low risk of the patient carrying blood-borne infections, or fear of stigmatization and unemployment [12, 13].

The primary objectives of this study are to determine the occurrence of NSSIs, amongst orthopaedic surgeons practising in the Indian subcontinent during orthopaedic procedures, identify the clinical circumstances that lead to such incidents, and evaluate their response after the event. In addition, the study aims to assess the level of familiarity with blood-borne pathogens and the extent of adherence to standard protective protocols among these healthcare workers.

Materials and Methods

Study Design and Participants

The present cross-sectional study was conducted on a sample size of 618 orthopaedic surgeons from various parts of India. Participants were classified based on their experience into two groups: those with less than 5 years of Postgraduate (PG) experience and those with 5 or more years of experience in the field of orthopaedics.

Sample Size Estimation

According to Tsuchiya et al. [14], by employing the Epi Info CDC sample size calculator, with an anticipated frequency of 39.7% and a confidence limit of 4% at a 95% confidence level, the calculated sample size is 606, factoring in a 2% nonresponse rate. Hence, the total sample size is determined to be 618.

Data Collection

The data were collected through an online questionnaire [https://forms.gle/SQBztpM2jJH2PKsQ9] administered using Google Forms. The questionnaire comprised multiple sections to gather information on demographic variables, incidence of NSSIs and exposures, knowledge, and training in safety measures, reporting injuries and safety practices, as well as injury characteristics and outcomes. The Google Form link was disseminated through electronic mail and various professional networking platforms [LinkedIn, Xing, Indeed, ResearchGate, Academia.edu, Facebook, and WhatsApp] frequented by orthopaedic surgeons. The responses submitted were checked for duplication, pooled, analysed, and summarised. To mitigate the potential recall bias, we designed the survey with careful consideration of question phrasing and employed various strategies, such as clear instructions and multiple-choice options where appropriate, to facilitate accurate responses. Furthermore, we recognize the importance of acknowledging and addressing potential limitations in our study, including the possibility of recall bias.

Instrument Validation

Before the data collection, the questionnaire underwent a rigorous validation process. To assess content validity rate (CVR), the questionnaire was distributed to six experts specialized in orthopaedics and occupational safety. Responses were collected using a three-point Likert scale: 'necessary', "helpful but not necessary", and "not necessary". Subsequently, the CVR of the questionnaire was evaluated; items scoring over 0.95, as per the Lawsche table, were deemed appropriate and necessary. Based on the obtained scores, expert feedback, and reconsideration of items with lower ratings or limited relevance, items deemed unable to measure the desired concept or lacking connection with the issue were excluded. Factors such as 'relevance', 'clarity', 'simplicity', and 'ambiguity' were scrutinized. Experts were asked to provide input on two aspects: (1) viewpoints they deemed essential to include and (2) suggestions for additional questionnaire items. A separate content validity index (CVI) was computed for each item and scale. Consequently, the scale-content validity index S-CVI/Average for all six constructs was calculated as $(1.00+1.00+0.83+1.00+1.00+0.83)/6=0.94$. Suggestions and feedback were incorporated, resulting in a finalized instrument deemed suitable for this study.

Statistical Analysis

Descriptive statistics were used to summarize the data. Continuous variables were reported as mean (SD), whereas categorical variables were presented as frequencies (percentage).

To evaluate the association between categorical variables, the Chi-square test was employed. Odds ratios along with 95% confidence intervals were calculated for variables found to be statistically significant in the Chi-square test. All statistical analyses were conducted using IBM SPSS Statistics for Windows, Version 26.0, IBM Corp., Chicago, IL.

Ethical Considerations

The study was conducted by ethical guidelines, ensuring the anonymity and confidentiality of the participants. Informed consent was obtained electronically before participants could access the questionnaire.

Results

A response rate of 100% with every individual in the sample participated in the survey. Mean years of experience were 9.89 years. Around 60 were with < 5 years of experience and 40% ≥ 5 years of experience. Male preponderance was seen with the study participants with 100% males ≥ 5 years of experienced orthopaedic surgeons. The distribution of places of practice was comparable between the groups. The risk of injury from sharps was comparable between the groups. The affiliation was periodically correspondent to the experience level (Table 1).

The incidence of needlestick injury (0–6) was 5.88 times more among < 5 years of experienced orthopaedic surgeons as compared to ≥ 5 years of experienced orthopaedic surgeons and this association was found to be statistically significant. The most common injury from sharps/blunt objects was 1.86 times more among < 5 years of experienced orthopaedic surgeons as compared to ≥ 5 years of experienced orthopaedic surgeons. Less than 5 years of experience as orthopaedic surgeons were 3.27 times more likely to experience sharp injuries than ≥ 5 years of experienced orthopaedic surgeons. Bone spike injury was 2.01 times more among ≥ 5 years of experienced orthopaedic surgeons. Injury from falls from heavy objects is less likely to happen among ≥ 5 years of experienced orthopaedic surgeons. Injuries from bleeding were 2.79 times more among ≥ 5 years of experienced orthopaedic surgeons. Exposure to viral-positive needle stick injury was 1.78 times more among ≥ 5 years of experienced orthopaedic surgeons. Post-exposure prophylaxis was 2.27 times more among ≥ 5 years of experienced orthopaedic surgeons. Unavailability of proper protection equipment is less likely to present among ≥ 5 years of experienced orthopaedic surgeons (Table 2).

The awareness of universal precautions was 1.32 times more among ≥ 5 years of experienced orthopaedic surgeons. The immunization against hepatitis B was 2.14 times present among ≥ 5 years of experienced orthopaedic surgeons. Training in handling sharps was less likely to be present among < 5 years of experienced orthopaedic surgeons (Table 3).

Injuries while driving drill in bone were 1.56 times more among ≥ 5 years of experienced orthopaedic surgeons. Splash of blood or bone pieces into the eyes of surgery is less likely to occur among ≥ 5 years of experienced orthopaedic

Table 1 Distribution of demographic variables among the study participants ($N = 618$)

Variable	≥ 5 years of experience ($n = 246$)	< 5 years of experience ($n = 372$)	X^2 (df) p	ORa (95% CI)
Gender				
Male	246 (100)	328 (88.2)	31.32 (1)	NA^
Female	0 (0)	44 (11.8)	< 0.001	
Place of practice				
Government	106 (43.1)	170 (45.7)	0.401 (1)	NA^
Private	140 (56.9)	202 (54.3)	0.52	
Orthopaedic surgeons have an increased risk of injury from sharp				
Yes	237 (96.3)	348 (93.5)	2.285 (1)	NA^
No	9 (3.7)	24 (6.5)	0.131	
Affiliation				
Consultants	72 (29.3)	9 (2.4)		1
Post-residency	43 (17.5)	27 (7.3)	166.29 (3)	5.02 (2.16 to 11.67)*
Senior residents	44 (17.8)	43 (11.6)	< 0.001	7.82 (3.47 to 17.59)*
Junior residents	69 (28)	293 (78.8)		33.97 (16.92 to 71.26)*
Healthcare division in the hospital which deals with sharp injuries				
Yes	122 (49.6)	191 (51.3)	0.182 (1)	NA^
No	124 (50.4)	181 (48.7)	0.67	

*Significant and ^ if Chi-square is not significant or value "0" is involved the odds ratio is not computed

Table 2 Distribution of incidence of sharp injuries and exposures among the study participants ($N=618$)

Variable	≥5 years of experience ($n=246$)	<5 years of experience ($n=372$)	X^2 (df) p	ORa (95% CI)
Estimate the total number of needlesticks or sharps injuries				
0–6	79 (32.1)	285 (76.6)	121.77 (2)	5.88 (3.42 to 10.08)*
6–12	123 (50)	60 (16.1)	<0.001	0.79 (0.45 to 1.41)
>12	44 (17.9)	27 (7.3)		1
Most common injury				
Sharps	210 (85.4)	263 (70.7)		1
Sharps/blunt objects	18 (7.3)	42 (11.3)	22.57 (3)	1.86 (1.04 to 3.33)*
Sharps/cautery burns	0 (0)	16 (4.3)	<0.001	NA^
All of the above	18 (7.3)	51 (13.7)		2.26 (1.28 to 3.98)
Type of surgery				
Trauma surgery	202 (82.1)	330 (88.7)		1.13 (0.60 to 2.11)
Arthroplasty	0 (0)	8 (2.2)	27.96 (4)	NA^
Oncology surgery	9 (3.7)	0 (0)	<0.001	NA^
Deformity correction	18 (7.3)	26 (7)		1
Experience sharp injuries				
0–3 times	97 (39.4)	226 (60.8)	36.94 (2)	3.27 (2.22 to 4.83)*
4–6 times	52 (21.2)	77 (20.7)	<0.001	2.08 (1.30 to 3.32)*
>6 times	97 (39.4)	69 (18.5)		1
Bone spike injury				
Yes	141 (57.3)	149 (40.1)	17.18 (1)	2.01 (1.45 to 2.78)*
No	105 (42.7)	223 (59.9)	<0.001	1
Injury from falls from heavy objects				
Yes	35 (14.2)	83 (22.3)	6.27 (1)	0.57 (0.37 to 0.89)*
No	211 (85.8)	289 (77.7)	0.01	1
Injury from bleeding				
Yes	195 (79.3)	215 (57.8)	30.57 (1)	2.79 (1.92 to 4.04)*
No	51 (20.7)	157 (42.2)	<0.001	1
Exposed to viral-positive needle stick injuries				
Yes	62 (25.2)	59 (15.9)	8.209 (1)	1.78 (1.19 to 2.66)*
No	184 (74.8)	313 (84.1)	0.004	1
Post-exposure prophylaxis				
Yes	54 (22)	41 (11)	13.59 (1)	2.27 (1.45 to 3.53)*
No	192 (78)	331 (89)	<0.001	1
Unavailability of proper protection equipment				
Yes	141 (57.3)	279 (75)	21.65 (1)	0.44 (0.13 to 0.63)
No	105 (42.7)	93 (25)	<0.001	1

*Significant

^If the Chi-square is not significant or value "0" is involved the odds ratio is not computed

surgeons. The usage of protection during surgery was 2.24 times more among ≥5 years of experienced orthopaedic surgeons. Around 100% double gloving during all procedures was seen 1.64 times more among <5 years of experienced orthopaedic surgeons. Around 50% double gloving during all procedures was seen 7.75 times more among ≥5 years of experienced orthopaedic surgeons. Embarrassment the reason for non-reporting was seen 8.62 times among ≥5 years of experienced orthopaedicians and orthopaedic surgeons (Table 4).

Patients getting tested for HCV, HBV, and HIV before surgery were seen as comparable between the groups. The left side of the body being injured was seen 1.48 times more among ≥5 years of experienced orthopaedic surgeons. Painless scars as the permanent effect of orthopaedic-related sharp injury were seen 1.23 times more among ≥5 years of experienced orthopaedic surgeons. Injuries during fracture fixation were 2.24 times more among ≥5 years of experienced orthopaedic surgeons. Injuries during fracture reduction were 2.76 times more among ≥5 years of experienced

Table 3 Distribution of knowledge and training in safety measures among the study participants ($N=618$)

Variable	≥5 years of experience ($n=246$)	<5 years of experience ($n=372$)	X^2 (df) p	ORa (95% CI)
Aware of universal precautions				
Yes	220 (89.4)	322 (86.6)	1.132 (1)	1.32 (0.79 to 0.17)*
No	26 (10.6)	50 (13.4)	0.28	1
Aware of disease transmitted through sharp objects				
Yes	237 (96.3)	347 (93.3)	2.67 (1)	NA^
No	9 (3.7)	25 (6.7)	0.102	
Immunization against hepatitis B				
Yes	238 (96.7)	347 (93.3)	12.14 (2)	2.14 (0.95 to 4.83)
No	8 (3.25)	25 (6.72)	0.002	1
Training in handling sharps				
Yes	69 (28)	168 (45.2)	18.34 (1)	0.47 (0.33 to 0.67)*
No	177 (72)	204 (54.8)	<0.001	1
Received occupational safety training				
Yes	246 (100)	355 (95.4)	11.56 (1)	NA^
No	0 (0)	17 (4.6)	<0.001	
Knowledge about cut-resistant or puncture-resistant glove availability				
Yes	53 (21.5)	66 (17.7)	1.37 (1)	NA^
No	193 (78.5)	306 (82.3)	0.24	

*Significant

^If the Chi-square is not significant or value "0" is involved the odds ratio is not computed

orthopaedic surgeons. Injuries during the hammering of an implant were 2.44 times more among ≥5 years of experienced orthopaedic surgeons (Table 5).

Discussion

Healthcare workers are at risk of occupational exposure to blood-borne infections through needle sticks and sharp injuries. This study was done to determine the occurrence of sharp injuries among orthopaedic surgeons during orthopaedic procedures, identify the clinical circumstances that lead to such incidents, and evaluate their response after the event.

The study revealed a predominance of males, as 100% of orthopaedic surgeons with more than 5 years of experience were male. More than half of the study participants had experienced less than 5 years. The place of distribution of practice and risk of NSSIs were comparable between the groups. The affiliations periodically correspond to the experience levels.

The incidence of needlestick injuries and the most common injuries from sharps and blunt objects were higher among orthopaedic surgeons with less than 5 years of experience. Conversely, bone spike injuries, injuries from bleeding, exposure to viral-positive needlestick injuries, injuries while using bone drills, and splashes of blood and bone into the eyes, as well as post-exposure prophylaxis, were more prevalent among orthopaedic surgeons with over 5 years of experience. Injuries resulting from falls caused by heavy objects and the unavailability of proper protective equipment were less likely to occur among orthopaedic surgeons with more than 5 years of experience. These findings suggest that NSSIs are more common among newly practising orthopaedic surgeons. Regarding the types of surgeries leading to NSSIs, trauma surgeries were the most frequent, followed by deformity correction, oncology surgery, and arthroplasty. In a study conducted by Bernard et al. it was observed that 83% of orthopaedic surgery trainees at a different institution had experienced sharps injuries [15].

Greater awareness of universal precautions and hepatitis immunization was evident among orthopaedic practitioners with over 5 years of experience. Conversely, orthopaedic surgeons with less than 5 years of experience were less likely to have received adequate training in sharp handling, which contributed to a higher incidence of NSSIs among this group. These findings are corroborated by a previous study in the field [16]. Previous studies have shown that ~385,000 healthcare-related NSSIs occur annually, with a reporting rate of 43.4% [17].

Although double-gloving has been shown to decrease the risk of blood contamination by a substantial factor of 7 to 8 (as reported in references 32 and 33), a study conducted among members of two surgical societies revealed that only approximately 12% of surgeons adopt this practice. The reasons for not double gloving, include reduced tactile feedback and decreased manual dexterity [18]. Most of the

Table 4 Distribution of reported injuries and safety practices among the study participants ($N=618$)

Variable	≥5 years of experience ($n=246$)	<5 years of experience ($n=372$)	X^2 (df) p	ORa (95% CI)
Reported injuries by sharps				
Yes	95 (38.6)	153 (41.1)	0.39 (1)	NA^
No	151 (61.4)	219 (58.9)	0.53	
Cautery burn				
<3	228 (92.7)	364 (97.8)	15.24 (2)	NA^
4–5	9 (3.7)	8 (2.2)	<0.001	
>5	9 (3.7)	0 (0)	15.24 (2)	
Injury while driving drill in bone				
Yes	115 (46.7)	134 (36)	7.08 (1)	1.56
No	131 (53.3)	238 (64)	0.008	(1.12 to 2.16)*
Splash of blood or bone piece into the eyes of surgery				
>10	33 (13.4)	76 (20.4)	5.02 (1)	0.60 (0.38 to 0.94)*
<10	213 (86.6)	296 (79.6)	0.03	1
Using protection during surgery				
Yes	130 (52.8)	124 (33.3)	23.28 (1)	2.24 (1.61 to 3.12)*
No	116 (47.2)	248 (66.7)	<0.001	1
Percentage of times you double glove during procedures				
100%	166 (67.5)	262 (70.4)		1.64 (1.06 to 2.52)*
90%	9 (3.7)	8 (2.2)	39.74 (4)	2.90 (1.04 to 8.11)*
50%	27 (11)	9 (2.4)	<0.001	7.75 (3.32 to 18.07)*
20%	8 (3.3)	0 (0)		NA^
1%	36 (14.6)	93 (25)		1
Reasons for non-reporting of orthopaedic-related injuries				
A feeling of no risk	26 (10.6)	60 (16.1)		2.02 (0.86 to 4.75)
Too much hassle	27 (11)	77 (20.7)		1.63 (0.70 to 3.80)
Embarrassment	61 (24.8)	33 (8.9)	63.66 (5)	8.62 (3.74 to 19.88)*
Other	43 (17.5)	93 (25)	<0.001	2.15 (0.96 to 4.82)
Forgot	9 (3.7)	42 (11.3)		1
Unclear what to do	80 (32.5)	67 (18)		5.57 (2.52 to 12.27)*

*Significant

^If the Chi-square is not significant or value "0" is involved the odds ratio is not computed

residents double-gloved for surgery because it is an effective way to reduce the risk for NSSIs and also when examining microsurgical skills in trainees who were single-gloved versus double-gloved, Hardison et al. found no difference in procedural speed [19]. The transmission risk increases with needle size and depth of penetration [20]. Using a double glove for surgery resulted in an inner glove perforation rate of only 3.7% [21]. Various factors contributed to the underreporting of orthopaedic-related injuries. These included a perceived lack of risk, the inconvenience of reporting, forgetfulness, uncertainty about the reporting process, and other factors. Notably, embarrassment was a leading cause of non-reporting, particularly among orthopaedic surgeons with over 5 years of experience. This could be attributed to concerns such as fear of potential job repercussions or other underlying psychological factors. A previous study examining surgery residents that found lack of time was the main reason for not reporting injuries [22]. Orthopaedic surgeons have been shown to have poor compliance with NSSI event reporting; Wallis et al. found that only 33% report all sharps injuries [13].

The frequency of patients undergoing HCV, HBV, and HIV testing before surgery was comparable across the groups, which may reflect increased awareness and advancements in technology. Injuries often occurred on body parts near equipment, with fingers being the most frequently affected, followed by the palm and eyes. Interestingly, injuries on the left side of the body were more common among orthopaedic surgeons with over 5 years of experience. Regarding the long-term effects of orthopaedic-related sharp injuries, issues such as fractures, numbness, and painful scars were more prevalent among orthopaedic surgeons with less than 5 years of experience, excluding painless scars. Injuries occurring during fracture fixation,

Table 5 Distribution of injury characteristics and outcomes among the study participants ($N=618$)

Variable	≥5 years of experience ($n=246$)	<5 years of experience ($n=372$)	X^2 (df) p	ORa (95% CI)
Patients get tested for HCV, HBV, and HIV before surgery				
Yes	228 (92.7)	354 (95.2)	1.67 (1)	NA^
No	18 (7.3)	18 (4.8)	0.198	
Part of the body being injured by orthopaedic injuries				
Eye	9 (3.7)	0 (0)	14.20 (2)	NA^
Finger	211 (85.8)	337 (90.6)	0.001	0.84 (0.49 to 1.44)
Palm	26 (10.6)	35 (9.4)		1
Side of the body being injured				
Left	157 (63.8)	202 (54.3)	5.513 (1)	1.48 (1.06 to 2.06)*
Right	89 (36.2)	170 (45.7)	0.02	1
Permanent effects of orthopaedic-related sharp injury				
Fracture	0 (0)	9 (2.4)		NA^
Numbness	0 (0)	50 (13.4)	44.65 (4)	NA^
Scar painful	9 (3.7)	16 (4.3)	<0.001	1
Scar painless	52 (21.1)	75 (20.2)		1.23 (0.51 to 3.00)
Most likely to get injured				
Fracture fixation	71 (28.9)	95 (25.5)		2.24 (1.40 to 3.57)*
Fracture reduction	71 (28.9)	77 (20.7)		2.76 (1.72 to 4.45)*
Hammering an implant	53 (21.5)	65 (17.5)	22.17 (4)	2.44 (1.47 to 4.04)*
While bone cuts	9 (3.7)	9 (2.4)	<0.001	3.00 (1.11 to 8.05)*
Wound closure	42 (17.1)	126 (33.9)		1
Double-glove while performing surgery				
Yes	220 (89.4)	372 (100)	41.04 (1)	NA^
No	26 (10.6)	0 (0)	<0.001	

*Significant

^If the Chi-square is not significant or value "0" is involved the odds ratio is not computed

reduction, implant hammering, and bone cuts were more frequent among orthopaedic surgeons with over 5 years of experience, except for wound closure incidents.

In the event of a needlestick and sharp injury (NSSI), immediate reporting to the appropriate infection control or occupational health department is crucial. The affected individual should undergo a rapid assessment for the risk of transmission of bloodborne pathogens, and the source patient should be tested for HIV, HBV, and HCV to guide post-exposure prophylaxis (PEP) [23]. The type of needle (hollow vs. solid) influences the risk of transmission, with hollow-bore needles posing a higher risk due to the potential for a larger volume of blood transfer [24]. The current guidelines for PEP suggest that antiretroviral therapy should be initiated as soon as possible, ideally within hours of exposure [25]. The regimen depends on the level of risk associated with the exposure and the source patient's infection status. Vaccination status for HBV should be verified, and if the exposed individual is not immune, hepatitis B immunoglobulin (HBIG) and vaccination may be recommended [26–28]. It is also recommended that healthcare institutions implement educational programs to raise awareness about the risks associated with NSSIs and the importance of following standard precautions, including the use of safety-engineered devices and proper disposal of sharps [23, 24]. Continuous education on how to properly report an incident and the steps to follow thereafter can significantly reduce the incidence and improve the management of NSSIs [23].

There are a few limitations to the study, which include recall bias, over-reporting, or under-reporting of the injuries by the respondents. In this study, the psychological effects of NSSIs and the type of infections caused were not investigated. This study has compared two groups of orthopaedic surgeons according to their experience.

Conclusion

Certain factors are more commonly observed among orthopaedic surgeons with limited experience, potentially attributed to their relative lack of exposure and inadequate education or awareness. In contrast, specific factors appear to be more prevalent among orthopaedic surgeons with extensive experience, possibly due to their prolonged exposure and the

constraints of conventional methods. Consequently, there is a critical need for comprehensive education and heightened awareness to mitigate the incidence of NSSIs. In addition, it is essential to promote a culture of reporting NSSIs without reservation. The primary emphasis should be on efforts aimed at minimizing the occurrence of NSSIs and fostering the reporting of such injuries.

Author Contributions (i) Conceptualization—VKJ and MJ; (ii) Manuscript writing—MJ, NJ, PS, and SR; (iii) Manuscript revision—NJ, KPI, and VKJ; (iv) Data analysis—MJ and PS; and (v) Administration—MJ and VKJ. All authors accepted to publish the manuscript.

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Data Availability All data is contained within the manuscript.

Declarations

Conflict of interest Nothing to disclose. "The authors declare no conflict of interest".

Ethical Approval The study was conducted by ethical guidelines, ensuring the anonymity and confidentiality of the participants.

Patient Consent Informed consent was obtained electronically before participants could access the questionnaire.

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