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RESEARCH ARTICLE

Work Characteristics and Needlestick-Injury Status of Dental Hygienists

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Background: Dental hygienists have a significant risk of infection due to occupational injuries caused by needles and sharp instruments. This study aimed to evaluate the current status of needle and "sharp-instrument injuries" among dental hygienists and to propose improved preventive guidelines.

Methods: A total of 251 dental hygienists completed an online survey between August 1, 2023 and September 2, 2023. Data from 245 respondents were analyzed using IBM SPSS version 20, using independent t-tests and one-way analysis of variance to assess the frequency of injuries and their correlation with job characteristics.

Results: Among the 251 dental hygienists, 77.6% had experienced needle or sharp-instrument injuries, with an average of 4.97 incidents per person. Infection prevention education significantly reduced the number of injuries, and participants with education exhibited better infection control practices than those without. Most injuries occurred during "instrument cleaning or maintenance" and "anesthesia preparation or disposal," with "scalers, probes, and curettes" being the main culprits. Hands were the most frequently injured body parts.

Conclusion: Preventive measures, continuous education, and improved guidelines are required to create a safer dental working environment.

Key Words: Dental hygienists, Needlestick injuries, Occupational exposure, Prevention and control, Sharps injury

Introduction

1. Background

Dental and other healthcare professionals frequently perform invasive procedures with significant occupational exposure to blood, resulting in a high risk of infection[1,2]. Needlestick and sharp-instrument injuries occur frequently among healthcare workers and may lead to infectious diseases[3-5]. Exposure of the damaged mucous membrane and skin to biological hazards such as blood and other bodily fluids can transmit pathogenic microorganisms, making needlestick and sharp-instrument injuries the major causes of infection[6,7]. Therefore, understanding biological hazards and taking preventive measures against them are necessary.

Needlestick and sharp-instrument injuries occur frequently in dental settings. Dental procedures involve complex treatments and the use of sharp tools, such as scalers, probes, and burs, that can easily cause injuries[5,6]. This increases the risk of pathogenic microorganisms entering the body, leading to an increased risk of infectious disease transmission. In a study on dentists and students with clinical experience at a university-affiliated dental hospital in Korea, 93.5% of participants experienced at least one needlestick injury in one year, with 89.6% of dentists and 92.1% of dental hygienists reporting similar incidents[8]. Another study reported that 76.6% of dental hygienists[8] had experienced needlestick or sharp-instrument injuries[9]. A 2010 study on infection control officers in Korean hospital-grade dental institutions re-

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ported an average of 1.83 needlestick injuries per person[10].

Previous studies have shown that needlestick and sharp-instrument injuries are serious issues in the dental field, and systematic prevention and management are required to reduce such incidents. Since 2014, the Ministry of Health and Welfare in Korea has implemented a certification system for dental hospitals that provides legal standards for medical institution evaluation and infection control[11,12]. This system applies only to dental hospitals and larger institutions, and infection-control evaluation regulations for dental clinics are insufficient. Moreover, systematic safety standards addressing occupational hazards, such as needlestick and sharp-instrument injuries, are lacking.

Efforts have been made to improve personal protective equipment and accidental exposure management in university and dental hospitals[13] following the release of standard policies for dental infection control in 2020. However, infection-control measures in dental institutions need to be strengthened to minimize the risks to healthcare workers from occupational exposure to potential infectious materials such as needles and sharp instruments[9,14]. Therefore, a safety management system that ensures the health and safety of both dental workers and healthcare consumers is essential.

Previous studies have reported a correlation between the existence of infection prevention guidelines and use of protective equipment and infection prevention practices[15]. Therefore, governmental institutional support and systematic regulatory policies are necessary. Healthcare workers and infection-control officers[7] within medical institutions play crucial roles, and their actions can contribute to infection prevention. The Korean Society for Healthcare-Associated Infection Control and Prevention states that the use of disinfectants or squeezing wounds to treat injuries does not reduce the transmission risk of bloodborne pathogens[16]. Instead, prevention of needlestick and sharp instrument injuries is emphasized as the best approach. Hence, treating all patients as potential carriers of infectious diseases and implementing thorough preventive measures to avoid needlestick injuries are important.

2. Objectives

Previous studies have focused on statistical analyses of the incidence of needlestick and sharp instrument injuries. Therefore, this study aimed to assess the current status of needlestick and sharp-instrument injuries among dental hygienists, examine the occupational risks based on job characteristics, and evaluate the impact of infection prevention education. Furthermore, the study aimed to improve the occupational safety of dental hygienists by analyzing the causes of such accidents and proposing preventive measures.

Materials and Methods

1. Participants

This study was conducted from August 1 to September 2, 2023, and included 251 dental hygienists working in tertiary dental hospitals, general hospitals, and dental clinics. The selection criteria were determined using G-Power 3.1 (HHU, Germany, Düsseldorf). The test family was set to "F tests," with a statistical test focused on "means." A compromise approach was applied to compute the required sample size with an effect size (d) of 0.25, an alpha error probability (α err prob) of 0.05, and a power (1-β err prob) of 0.8. The number of groups was set as three. The calculated minimum sample size was 159 participants. However, to account for potential non-responders, 250 participants were selected. After explaining the purpose of the study, dental hygienists who understood the study and voluntarily participated were included. An online self-administered questionnaire was used for data collection, and after excluding those who provided insincere answers, 245 participants were included in the final analysis.

This study was approved by the institutional review board of Hanseo University. Written consent has been obtained from all participants.

2. Variables

The variables in this study were selected based on previous studies by Noh[8] and Jeon[9]. The questionnaire consisted of 17 items, including eight items on general characteristics and working environment, three items on experiences and frequency of needlestick and sharp-instrument injuries, one item on job characteristics, one item on the habit of wearing protective gear, three items on actions taken after an injury, and one item on history of prevention education. Before the survey, a preliminary study was

conducted on 36 dental hygienists using an online Google form, and the questionnaire was revised accordingly. The Cronbach's α values for the practice of wearing protective gear and actions taken after an injury were 0.761 and 0.755, respectively, indicating a reliability coefficient ≥0.7.

3. Data analysis

Data were analyzed using SPSS version 20 (IBM Corp., Armonk, NY, USA). The frequency of needlestick injuries according to the general characteristics was assessed using independent-samples t-tests and one-way analysis of variance. Post-hoc analysis was performed using the Scheffé method. Multiple-response frequency analyses were performed for work-related factors, and independent-samples t-tests were used to assess the effect of infection prevention education on infection-control practices. Statistical significance was set at $p < 0.05$.

Results

1. General characteristics and number of stabbing accidents

The frequency of 'experience of needlestick injuries within the past year' and 'work experience' were significantly different according to the participants' general characteristics ($p < 0.001$) (Table 1). A total of 190 participants (77.6%) reported experiencing needlestick injuries in the previous year, with an average of 4.97 incidents per person ($p < 0.01$). The highest frequency of needlestick injuries was observed among those with work experience ≤ 5 years, averaging 5.13 incidents per person. The mean incidence per person among participants with 6～10 years and ≥10 years experience was 3.06 and 2.51, respectively. The ≤5 years experience group had the highest number of participants (112 [45.7%]) ($p < 0.01$).

2. Infection-prevention education and number of stabbing accidents

In the work experience ≤5 years and 0 night shifts groups, the number of needlestick injuries was signifi-

Table 1. General Characteristics and Number of Needlestick Injuries (n=245)

General characteristic	Category	n (%)	Number of needlestick injuries (mean±SD)	t or F	p
Experience of needlestick injuries	Yes	190 (77.6)	4.97±4.98	7.395	0.001
	No	55 (22.4)	0.00±0.00		
Years of experience	≤5 y	112 (45.7)	5.13±6.13	7.768	0.001
	6～10 y	66 (26.9)	3.06±3.20		
	≥10 y	67 (27.4)	2.51±2.89		
Workplace	Dental clinic	191 (78.0)	3.99±4.78	1.624	0.199
	Dental hospital	34 (13.8)	4.18±6.05		
	General/University hospital	20 (8.2)	2.00±2.40		
Working hours	<8 h	125 (51.0)	3.58±4.26	−0.925	0.356
	≥8 h	120 (49.0)	4.15±5.39		
Number of patients per day	<20	54 (22.0)	3.25±3.35	0.979	0.377
	20～50	99 (40.4)	3.66±4.25		
	>50	92 (37.6)	4.39±6.04		
Number of night shifts	0 time	105 (42.9)	3.16±4.22	1.904	0.151
	1 time	94 (38.4)	4.40±5.12		
	≥2 times	46 (18.7)	4.33±5.48		
Number of dental hygienists	≤5	122 (49.8)	3.56±4.43	−0.963	0.337
	≥6	123 (50.2)	4.15±5.23		

t-test, One-way analysis of variance and Post hoc test by Scheffe.
SD: standard deviation.

Table 2. Infection Prevention Education and Number of Needlestick Injuries

General characteristic	Category		n (%)	Number of needlestick injuries (mean±SD)	t or F	p
Years of experience	≤5 y	Yes	79 (32.2)	4.43±5.48	−2.149	0.034
		No	33 (13.5)	7.03±7.19		
	6∼10 y	Yes	46 (18.8)	3.24±3.39	0.682	0.497
		No	20 (8.2)	2.65±2.77		
	≥10 y	Yes	34 (13.9)	2.38±3.11	−0.357	0.722
		No	33 (13.4)	2.64±2.69		
Workplace	Dental clinic	Yes	113 (46.1)	3.72±4.19	−0.966	0.335
		No	78 (31.8)	4.40±5.53		
	Dental hospital	Yes	26 (10.6)	4.35±6.75	0.290	0.773
		No	8 (3.3)	3.63±3.11		
	General/University hospital	Yes	20 (8.2)	2.00±2.40	-	-
		No	0 (0)	0.00±0.00		
Working hours	<8 h	Yes	77 (31.4)	3.34±3.79	−0.790	0.431
		No	48 (19.6)	3.96±4.94		
	≥8 h	Yes	82 (33.5)	3.85±5.19	−0.882	0.379
		No	38 (15.5)	4.79±5.84		
Number of patients per day	<20	Yes	31 (12.7)	2.71±3.12	−1.558	0.125
		No	23 (9.4)	4.13±3.55		
	20∼50	Yes	65 (26.5)	3.83±4.40	0.562	0.576
		No	34 (13.9)	3.32±3.99		
	>50	Yes	63 (25.7)	3.81±5.27	−1.367	0.175
		No	29 (11.8)	5.66±7.40		
Number of night shifts	0 time	Yes	73 (29.8)	2.62±2.81	−2.029	0.045
		No	32 (13.1)	4.41±6.25		
	1 time	Yes	54 (22.0)	4.54±5.00	0.290	0.772
		No	40 (16.3)	4.23±5.34		
	≥2 times	Yes	32 (13.1)	4.28±6.36	−0.083	0.934
		No	14 (5.7)	4.43±2.73		
Number of dental hygienists	≤5	Yes	84 (34.3)	3.23±4.57	−1.228	0.222
		No	38 (15.5)	4.29±4.08		
	≥6	Yes	75 (30.6)	4.03±4.54	−0.337	0.736
		No	48 (19.6)	4.35±6.20		

t-test.
SD: standard deviation.

cantly different between the subgroups with and without infection prevention education in the previous year (both $p < 0.05$) (Table 2). Among participants with work experience ≤ 5 years, the mean number of needlestick injuries in participants with and without infection prevention education was 4.43±5.48 and 7.03±7.19, respectively ($p < 0.05$). Among participants with 0 night shifts, the mean number of needlestick injuries in participants with and without infection prevention education was 2.62±2.81 and 4.41±6.25, respectively ($p < 0.05$).

3. Degree of infection prevention education and infection control practice

In a survey conducted on a 1∼5 point Likert scale, evaluating infection control practices following needlestick and sharp instrument injuries in the past year, where 1 point represents “never practiced” and 5 points represents “always practiced,” The habitual use of protective equipment was not significantly different between participants. However, follow-up actions after needlestick and sharp-instrument injuries, including reporting to a super-

Table 3. Degree of Infection Prevention Education and Infection Control Practice

Category	Action method	Infection prevention education	n (%)	Degree of infection control practice[a] (mean±SD)	t	p
Habitual use of protective equipment	Gloves	Yes	159 (64.9)	4.47±0.72	0.013	0.989
		No	86 (35.1)	4.47±0.64		
	Mask	Yes	159 (64.9)	4.56±0.63	−0.781	0.436
		No	86 (35.1)	4.62±0.50		
	Safety glasses or face shield	Yes	159 (64.9)	3.47±1.20	1.925	0.055
		No	86 (35.1)	3.16±1.19		
Emergency measures post needlestick injury	Wash with water only	Yes	102 (63.7)	4.19±1.00	1.857	0.065
		No	58 (36.3)	3.86±1.23		
	Apply disinfectant only	Yes	104 (63.4)	3.68±1.26	1.707	0.090
		No	60 (36.6)	3.85±1.36		
	Wash with water and apply disinfectant	Yes	118 (65.9)	4.05±1.07	−0.793	0.429
		No	61 (34.1)	3.73±1.31		
Follow-up actions post needlestick injury	Confirm and investigate patient history	Yes	121 (64.4)	3.75±1.14	0.915	0.361
		No	67 (35.6)	3.58±1.33		
	Report to supervisor	Yes	117 (64.3)	1.50±0.92	2.641	0.009
		No	65 (35.7)	1.17±0.52		
	Visit infection control office/emergency room	Yes	113 (63.8)	1.50±0.92	2.641	0.009
		No	64 (36.2)	1.17±0.52		

t-test.
[a](5-point Likert scale).

visor and visiting the infection-control department or emergency room, were significantly different according to the infection prevention education status ($p < 0.01$; Table 3).

The mean scores for "reporting to a supervisor" under the "follow-up actions after needlestick and sharp-instrument injuries" category in the groups with and without infection prevention education within the past year were 1.50 and 1.17, respectively. Similarly, the mean scores for "visiting the infection control department or emergency room," in the groups with and without infection prevention education were 1.50 and 1.17, respectively ($p < 0.01$).

4. Experience and frequency of stabbing accidents based on work characteristics

The frequency analysis results of the multiple-response analysis for needlestick injuries experienced in the previous year by dental hygienists based on their work characteristics such as 'task,' 'causative instrument,' 'injury site,' and 'department' are presented in Table 4. In the 'task' category, 126 participants (27.9%) reported experiencing needlestick injuries during 'instrument cleaning or maintenance,' followed by 122 participants (27.1%) during 'anesthesia preparation or disposal.' However, the frequency of needlestick injuries was the highest during 'surgical procedures' with an average of 7.72±7.71 incidents, followed by 'waste management' with 7.26±7.33 incidents. In the 'causative instrument' category, 165 participants (32.5%) reported experiencing needlestick injuries while using 'scalers, probes, or curettes,' with the highest frequency of injuries occurring with 'surgical scalpels or suture needles' with an average of 6.43±7.06 incidents, followed by 'powered instruments (drills, burs, or files)' with 6.21±5.38 incidents. In the 'injury site' category, the most frequent site of needlestick injuries was the 'hand' in 187 participants (59.7%), whereas the highest frequency of injuries occurred at the 'buttocks or feet' with 7.67±6.84 incidents. In the 'department' category, the most frequent needlestick injuries occurred in the 'comprehensive dental care department' in 111 participants (35.8%), whereas the highest frequency of injuries occurred in the 'periodontology department' with 7.43±8.23 incidents, followed by the 'conservative dentistry department' with 7.03±8.40 incidents.

Table 4. Needlestick Injury Experience and Frequency by 'Task,' 'Causative Instrument,' 'Injury Site,' and 'Department'

Characteristic		Needlestick injury experience in task[a] n (%)	Needlestick injury frequency in task (mean±SD)
Primary tasks	Anesthesia preparation or disposal	122 (27.1)	5.43±5.61
	Surgical procedures	29 (6.4)	7.72±7.71
	Scaling	42 (9.3)	5.98±5.26
	Handpiece preparation and use	98 (21.7)	6.06±5.68
	Instrument cleaning or maintenance	126 (27.9)	5.56±5.66
	Waste management	34 (7.5)	7.26±7.33
Causative instrument	Anesthesia, general syringe	132 (26.0)	5.55±5.54
	Surgical scalpel, suture needle	60 (11.8)	6.43±7.06
	Scaler, probe, curette	165 (32.5)	5.16±4.84
	Powered instruments (drill, bur, file)	114 (22.4)	6.21±5.38
	Orthodontic wire or metal	37 (7.3)	5.46±5.58
Injury site	Hand	187 (59.7)	5.01±5.00
	Arm	48 (15.3)	6.29±3.94
	Thigh or leg	63 (20.1)	6.90±5.70
	Buttocks or foot	15 (4.8)	7.67±6.84
Department	Comprehensive dental care department	111 (35.8)	5.49±4.81
	Oral surgery	47 (15.2)	6.09±7.55
	Periodontology	37 (11.9)	7.43±8.23
	Prosthodontics	51 (16.5)	6.08±6.53
	Conservative dentistry	33 (10.6)	7.03±8.40
	Pediatric dentistry, orthodontics	31 (10.0)	5.06±5.87

SD: standard deviation.
[a]Multiple response frequency analysis.

Discussion

1. Key results

This study assessed the incidence of needlestick and sharp-instrument injuries during the past year among dental hygienists working in dental clinics and hospitals and aimed to propose improved prevention guidelines. A total of 251 dental hygienists voluntarily participated in the survey after understanding the study objective. Previous studies have primarily targeted dental hygienists working in higher-level institutions that often provide infection control related to hospital accreditation evaluations[17]. However, programs to prevent needlestick and sharp-instrument injuries are lacking in smaller dental clinics. In this study, 78.0% of the participants worked in dental clinics, which helped identify the risk factors for needlestick injuries in these settings. A total of 190 participants (77.6%) experienced needlestick injuries, which is consistent with the previously reported rates of 93.5%[8] and 59.3%[9] in domestic studies on dental workers. Furthermore, these results are similar to those in international studies. Studies on dentists in Australia[4] and dental nurses and students in university hospitals in Iran[18] reported incidences of 79.9% and 71.1%, respectively. These findings confirm the frequent occurrence of needlestick injuries and the risk of exposure to infection among dental healthcare workers. In this study, participants with lesser work experience had a higher frequency of injuries in the previous year. Participants with <5, $6\sim10$, and >10 years of experience reported an average of 5.13, 3.06, 2.51 injuries, respectively. Kim et al.[16] reported that the incidence of infectious diseases was higher among healthcare workers in their twenties, particularly new nurses. This aligns with the findings in this study that dental hygienists with less work experience have a higher frequency of accidents, indicating the need for additional training and support. Regarding "infection prevention education," the group with education and <5 years of experience reported a

lower average number of needlestick injuries per person (4.43) compared to the group without education (7.03). Similarly, among those working in dental clinics, the groups with and without education reported an average of 3.72 and 4.40 injuries per person, respectively, and a small difference in incidence was observed.

All participants working in general and university hospitals reported receiving infection prevention education, indicating a significant difference between dental clinics and hospitals in terms of education. This is consistent with the findings of Jeong and Lee[17], who reported that a lack of infection prevention education was more common among dental clinic workers. Kim et al.[19] reported that 80.6% of dental clinics and 92.8% of university and dental hospitals provided infection prevention education, and hospitals had higher rates of education.

In this study, participants with infection prevention education had a lower frequency of needlestick injuries, particularly in scenarios like "night shifts," where the group with education reported an average of 2.62 injuries per person, compared to 4.41 in the group without education. Yoon and Choi[3] emphasized the need for infection prevention education for dental hygienists, and several of dental rovided infection prevention education to students. Park and Choi[20] reported a strong correlation between infection-control education and awareness and practice among clinical dental hygienists, highlighting the importance of mandatory infection prevention education and the need for continuous education to maintain skills and knowledge. In this study, overall infection-control scores was higher among those with education, particularly in areas such as "reporting to a superior" and "visiting the infection control office or emergency room" after an accident. However, the scores were lower than those for infection-control practices related to wearing protective equipment and emergency treatments. Previous studies have shown that students hesitate to report incidents because of fear of blame[21], fear of specific tests or disciplinary actions, concerns about confidentiality, and not knowing where to report[22]. In emergency situations, quick and accurate management is crucial, and reporting procedures[23,24] should be made more convenient to improve knowledge and awareness of post-exposure guidelines[25]. Therefore, in addition to prevention, guidelines or practical instructions on needlestick injury prevention that reduce reporting barriers should be provided. Furthermore, encouraging reporting during injection practices and creating a non-blaming environment are necessary. Considering the high frequency of needlestick injuries and low participation in education, dental clinics should mandate regular infection prevention education and training to strengthen safety protocols and accident response procedures. To reduce accidents during cleaning and disposal of instruments, detailed procedures and safety guidelines should be established, and practical simulations should be emphasized during education. Hospitals that provide good education should continue to strengthen their programs and regularly assess practitioners' knowledge to ensure that they follow the updated infection-control guidelines. Additionally, awareness of reporting procedures and follow-up actions after accidents should be enhanced through educational programs. In this study, accidents frequently occurred during processes such as "cleaning or washing instruments" and "preparing or disposing of anesthesia." The frequency of injuries was the highest during "surgical procedures" (7.72 injuries per person) and "waste management" (7.26 injuries per person). The most common instruments causing injuries were "scalers, probes, or curettes" and "anesthesia syringes." Other tools like "scalpels and suture needles" (6.43 injuries) and "powered instruments" (6.21 injuries) also showed high injury rates. Kim et al.[26] reported that 59.8% of injuries occurred during post-procedure instrument cleaning, which is similar to the findings in this study. In a study involving Australian dental students and staff, local anesthesia procedures were the most common causes of injuries[25], with needles being the most frequently involved instrument. Another study by Choi and Bae[27] reported that probes were the most common cause of injuries, followed by needles, which aligns with the findings in this study that injuries often occur during instrument cleaning and organization. Noh[8] reported that dental syringes were the most common cause of needlestick injuries, particularly during infiltration anesthesia, and the results differed between dentists and dental hygienists. Nam et al.[28] reported that 87.5% of dental hygienists experienced injuries, with probes being the most commonly used instrument (75%). Injuries

were most frequently reported on the "hands," followed by the "buttocks or feet" (7.67 injuries per person) and "thighs or legs" (6.90 injuries per person). Kim et al.[26] reported that injuries occurred in the hands, legs, feet, and arms, with needles and sharp instruments being the most common causes. Another study on healthcare workers showed that injuries often occur because of sharp instruments in inappropriate locations during or after disposal. Considering the frequent occurrence of needlestick injuries from instruments such as scalers, probes, curettes, and anesthesia syringes, clarifying the precautions to be taken during the use and disposal of these instruments is essential. Additionally, considering that injuries often occur on the hands and legs, particularly during instrument cleaning and disposal, reinforcing safety protocols for these processes and providing detailed education on preventive measures are necessary.

2. Limitations and scope for further studies

Further research is recommended to create safer dental clinical environments. Because infection prevention education influences the frequency of needlestick and sharp-instrument injuries, educational content should reflect the latest infection-control guidelines and include practical training based on real-life scenarios. Preventive guidelines tailored to specific departments and instruments should be established, and specific response measures should be actively implemented. This will help reduce the fear of reporting incidents, and reporting procedures should be emphasized during training to ensure appropriate responses after accidents.

Future studies should analyze the characteristics of needlestick injuries that occur in various dental environments and with different instruments to develop customized preventive measures. It is important to note that the use of convenience sampling in this study limits its generalizability to all dental hygienists. Additionally, recalling needlestick injuries over the past year may introduce bias, and caution is needed when interpreting survey items with multiple responses.

We hope that the findings in this study will contribute to creating a safer working environment in dental clinics, and we performed an evaluation of all methods used previously. Strategies to prevent needlestick injuries. Our findings will serve as a reference for future research and practice.

Notes

Conflict of interest

No potential conflict of interest relevant to this article was reported.

Ethical approval

This study was approved by the institutional review board of Hanseo University (IRB No. HS23-08-01).

Author contributions

Conceptualization: Yeon-Soon Park and Sung-Suk Bae. Data acquisition: Yeon-Soon Park. Formal analysis: Jin-Soo Kim. Supervision: Kyoung-Ok Yun. Writing-original draft: Yeon-Soon Park and Sung-Suk Bae. Writing-review & editing: Yeon-Soon Park and Jeong-Hyun Lee.

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Data availability

Raw data is provided at the request of the corresponding author for reasonable reason.

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