

Dental Infection and Prevention Measures in South Korea in the Absence of Restrictions on Dental Practices During COVID-19 Pandemic

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ABSTRACT: Dental practices are associated with many risk factors for transmitting viral diseases such as COVID-19. Given such strong transmissibility, not only practitioners and dental staff, but also patients are exposed to the possibility of COVID-19 infection during dental procedures. The World Health Organization (WHO) provided interim guidance to postpone dental treatment with the exception of emergency treatments. The governments of the United States and Australia also recommended postponing dental procedures and closed dental clinics. However, for at least one year from January 21, 2020, when the first COVID-19 patient was reported, to the present, dentistry in Korea has been fully open without any particular restrictive measures. A review of the data for the last year showed that the infection rate in dentistry was lower compared to that in other daily activities such as restaurants, karaoke rooms, religious meetings, etc. Of the 26,500 practicing dentists, only three were infected, and two were not infected in their clinic and one was infected through an unclear infection route. To find the reason for the low infection rate among dentists in South Korea and the most commonly used protective measures, we conducted a survey with 252 practicing dentists in South Korea. The survey results show that in addition to the regular infection control protocols prior to COVID-19, additional personal protective equipment (PPE) such as KF94-grade face masks and face shields reduced the infection risk among dentists. Therefore, based on the experience of South Korea, this study explores whether the long-term recommendation of publicly trusted organizations such as the WHO and the US government to shut down dental practices except for emergency treatment should be reconsidered. This study concludes that dentistry in other countries can also be appropriately open with regular and additional PPE, which can benefit patients in need of dental works and also reduce economic impacts on dental industry.

KEYWORDS: COVID-19; Dentistry; Infection Control; Personal Protective Equipment.

■ Introduction

There have been reports indicating that the severe acute respiratory syndrome-associated coronavirus (SARS-CoV) SARS can be transmitted airborne more than 6 feet in aerosol particles,¹ and studies indicating that large amounts of SARS CoV RNA are found in saliva in the oral cavity.² In addition, cellular receptors for 2019-novel corona virus (nCoV) are found in the oral mucosa and the surface of the tongue,³ suggesting that the oral cavity can be a route of COVID-19 infection. Based on these studies, many countries imposed restrictions on dental practices at the beginning of the COVID-19 pandemic. Since the pandemic began in early 2020, dental clinics were shut down from the end of March to June in the United States. During the same period in Australia, there were guidelines for dental clinics to refrain from general treatment except for emergency patients, where the number of infected patients was much smaller compared to the U.S. and South Korea.⁴

According to two papers published in April 2020, the SARS-CoV-2 virus can survive up to three hours in an aerosol state, one day on cloth and wood, two days on glass, four days on stainless steel and plastic, and seven days on the surface of medical masks.^{5,6} Therefore, the Korea Disease Control and Prevention Agency recommended that the spaces used by any COVID-19 patient must be well ventilated, and surfaces and

objects must be thoroughly disinfected to reduce potential infection risk factors.

In addition, on August 3, 2020, the WHO announced interim guidance indicating that dental treatment should be postponed as much as possible, except for emergencies, because of the nature of dental procedures such as aerosol generation due to highspeed dental handpieces, proximity between practitioners and patients, frequent exposure to saliva, blood, and bodily fluids, and handling of sharp instruments during treatment.⁷ As a result, the revenues of U.S. dental clinics dropped sharply, and the US federal government provided financial support to dentists. Patients had to endure pain, the progression of disease, and economic losses due to delayed care resulting from missing appointments. In addition, the reduction of jobs in the dental industry and the national economy were affected. On the other hand, the South Korean government has permitted regular dental treatment from throughout the pandemic.⁸ The South Korean quarantine guidelines have had no restriction on dental treatment at any stage of quarantine. Although it was thought that the theoretical prediction of the characteristics of the virus and the resulting risk of infection in dentistry could be applied equally anywhere, the forms of dentistry allowed differed by country. Due to COVID-19, a huge experiment was inadvertently conducted to see what kind of infection-related results were brought about by bioaerosols, including viral

infectious agents in dentistry during the pandemic.

This work studied the outcomes of the South Korean government policy to allow all dental practices regardless of positive cases reported in the dental clinics, and what type of personal protective equipment and procedures were employed by the dentists in Korea. The study aimed to translate the results into the government policy regarding dental practices in future viral disease outbreaks.

■ Materials and Methods

Official data from the Korea Disease Control and Prevention Agency regarding the number of infected dentists over the year and restrictions on treatment were obtained. Analyzing the data from the National Statistical Services of Korea, the cumulative number of patients treated over the year and the number of currently active dentists were confirmed. To find out the actual situation in the field of treatment regarding the number of infected dentists over the year, an online survey was conducted with 252 South Korean dentists.

Survey Questions:

The survey questions are as follows:

1. Sex: Male / Female
2. Specialty:
 - 1) general practitioner (GP)
 - 2) endodontist
 - 3) periodontist
 - 4) prosthodontist
 - 5) orthodontist
 - 6) oral surgeon
 - 7) oral medicine and orofacial pain specialist
 - 8) pedodontist
 - 9) oral and maxillofacial radiologist
 - 10) advanced general dentist
3. Type of institution:
 - 1) private office /local clinic
 - 2) university hospital
 - 3) general hospital
4. Number of dentists working in the facility:
 - 1) one person
 - 2) two to three people
 - 3) four or more people
5. Changes in the average number of patients per day since the COVID-19 pandemic:
 - 1) increase by more than 10%
 - 2) decrease by up to 10%
 - 3) decrease by 10%-20%
 - 4) decrease by more than 20%
6. Masks worn during treatment:
 - 1) KF94 masks
 - 2) dental masks
- 6-1. If 1) since what month was KF94 worn
7. Whether face shields are in use:
 - 1) yes, since pre-pandemic
 - 2) yes, sometimes pre-pandemic and always post-pandemic
 - 3) not worn pre-pandemic, but always after post-pandemic
 - 4) not worn, only mask

8. What additional preventive measures against COVID-19 are available in addition to question No. 7 and No. 8?

1) no changes from pre-pandemic infection prevention measures

2) checking temperature and offering hand sanitization for patients

9. Have you ever experienced the symptoms of COVID-19?

1) yes

2) no

10. Have you ever been tested for COVID-19?

1) yes

2) no

11. Has a patient confirmed with COVID-19 ever visited your hospital?

1) yes

2) no

11-1. If so, did you have to go through quarantine?

1) yes

2) no

11-2. Were you also infected?

1) yes

2) no

12. Were you infected in another place?

13. Are you willing to voluntarily shut down your dental service if the number of patients in the entire community increases rapidly and the government declares the third stage of quarantine? (Dentists are not subject to shut down even in the third stage of quarantine.)

■ Results and Discussion

Official data announced by the government:

According to the official statistics released by the Korea Disease Control and Prevention Agency in response to a member of the National Assembly, only one dentist was infected by October 2020.⁹ Thereafter, one additional dentist was infected in December 2020 and another in January 2021. Two of the three cases were identified as cases of infection through routes other than infection in a clinic due to direct contact with patients. The one case in January 2020 was shown to be a case of infection through an unknown route of infection (Table 1).¹⁰

Table 1: Confirmed Cases of COVID-19 Among Health Care Workers.

Nurses	101
Nurse Assistants	33
Medical Doctors	10
Dentists	1
Other allied health care professionals	14
Total	159

A press release from the Korean Dental Association (KDA) on August 13, 2020 indicated that there had been no cases of infection by droplet transmission among dentists and patients for seven months after the outbreak of the first positive patient on January 20.¹¹

Table 2: Total Numbers of Practitioners.

Classification	Total Number of Practitioners
Dentists	26,486
Medical Doctors	105,628

Table 3. Total Numbers of Outpatients

Classification	Total Number of Practitioners
Dental Hospital	4,344,553
Private Clinic	71,830,444

In the 2018 dental clinic data from the National Statistical Office, the number (times) of outpatient visits to dental hospitals was 4,344,553 and that of dental clinics was 71,830,444. The number of practicing dentists was 26,486 as of 2019 based on an announcement by the National Health Insurance Service (Table 2).¹² The number of confirmed COVID-19 cases in South Korea was 69,114, and the number of deaths was 1,140 (as of 00:00 on January 11, 2021).¹³ The Korea Disease Control and Prevention Agency implemented a quarantine system with five stages, and there were no restrictions on dental treatment at any stage.¹⁴

Survey Results:

Table 3: Survey Questions and Results.

1. Sex	Male	190	75%
	Female	62	25%
2. Specialty	General Practitioner	58	23%
	Endodontist	18	7%
	Periodontist	30	12%
	Prosthodontist	40	16%
	Orthodontist	31	12%
	Oral surgeon	29	12%
	Oral medicine and orofacial pain specialist	4	2%
	Pedodontist	11	4%
	Oral and maxillofacial radiologist	1	0%
	General dentist	30	12%
	3.Type of Institution	private office /Local clinic	218
university hospital		21	8%
general hospital		13	5%
4.Number of dentists working at the facility	1 person	96	38%
	2-3 people	86	34%
	4 or more people	70	28%
5.Changes in the average number of patients per day since the COVID-19 pandemic	increase by more than 10%	9	4%
	decrease by up to 10%	90	36%
	decrease by 10%~20%	85	34%
	decrease by more than 20%	68	27%
6. Masks worn during treatment since the COVID-19 pandemic	dental masks	37	15%
	KF94 masks	215	85%
6-1.Whether KF94 mask are in use	since 2020 01(mo)	13	6%
	since 2020 02(mo)	17	8%
	since 2020 03(mo)	32	15%
	since 2020 04(mo)	8	4%
	since 2020 05(mo)	7	3%
	since 2020 06(mo)	6	3%
	since 2020 07(mo)	4	2%
	since 2020 08(mo)	17	8%
	since 2020 09(mo)	15	7%
	since 2020 10(mo)	24	11%
	since 2020 11(mo)	31	14%
	since 2020 12(mo)	41	19%
7. Whether face shields are in use	yes, since pre-pandemic	41	16%
	yes, sometimes pre-pandemic and always post pandemic	83	33%
	not worn pre-pandemic but always after post-pandemic	73	29%
	no, only mask	55	22%
8. What other preventive measures against COVID-19 are available in addition to No. 7 and No. 8	wearing protective clothing	1	
	using disposable equipment	1	
	treating in an isolated room	1	
	Protective Glasses and Shield	1	
	Sterilization through the use of Glue gun	1	
	Non-contact Alcohol Disinfecting setting	1	

Assign time to disinfect areas with frequent contact on a daily basis	Ventilation	1		
	a disposable gown	2		
	Indoor Air Disinfection	3		
	Disinfection of instruments	3		
	Gargle	8		
	Same as before Covid-19	8		
	Chairs disinfection	10		
	checking temperature and offering hand sanitization for patients	222		
	9.Have you ever experienced symptoms of COVID-19?	yes	6	2%
		no	246	98%
10. Have you ever been tested for COVID-19?	yes	22	9%	
	no	230	91%	
11. Has a confirmed patient ever visited your hospital?	yes	30	12%	
	no	222	88%	
11-1.If so, did you have to go through quarantine?	yes	7	23%	
	no	23	77%	
11-2.Were you also infected?	yes	0	0%	
	no	30	100%	
12.Were you infected at other place?	yes	0	0%	
	no	252	100%	
13.Are you willing to voluntarily shutdown dental service if the number of patients in the entire community increases rapidly and the government declares the third stage of quarantine? (Even in the third stage of quarantine, dentists are not subject to shutdown)	yes	46	18%	
	no	206	82%	

A total of 252 South Korean dentists (190 males and 62 females) participated in the questionnaire survey. The participants were in their 30s and 40s and worked in the metropolitan areas and large cities. Among them, 218 were working at private clinics, 21 at university hospitals, and 13 at general hospitals. As for the classification of the dentists who responded to the questionnaire by type, general practitioners were the most common, and the distribution of dentists by type is shown in Table 3, No. 2. From the item changes in the daily average number of patients treated, it could be seen that the number of treatment cases mostly decreased, and the rates of decrease were in a range of -20% to 0% for 70% of the respondents.

Since the South Korean government or the Korean Dental Association (KDA) did not impose any particular restrictions on the types of patient treatment or the number of patients, it is believed that the number of visiting patients decreased rather than the dentists reducing appointments. This indirectly indicates the degree of South Korean people's fear of COVID-19 due to dental treatment over the last one year.

Table 4: Usage of Personal Protection Equipment.

Classification	Respondents	Percentage
KF94-masks + Face Shields	177	70%
KF94-masks	38	15%
Dental masks + Face Shields	20	8%
Dental masks only	17	7%
	252	

As for the mask worn during treatment, 215 or 85% of the dentists wore KF94-grade masks and 37 or 13% of the dentists wore dental masks as before the coronavirus outbreak. As for the timeframe when the dentists began to wear KF94 masks, 66 dentists began to wear the KF94-grade masks from January, February, or March 2020, 96 from October, November, or December 2019, and 41, or the largest number of dentists, began wearing them from December 2019. Whether the den-

tists wore a shield during treatment and whether they took other measures to prevent infection are shown in Table 3, No. 8 and 9. Of the 37 dentists who wore only dental masks, 15 treated patients without wearing a shield, and according to the result of sorting conditions, they responded that no infected patients had ever occurred, and no patient had been subjected to self-quarantine (Table 3, No. 4).

Table 5: Usage of Personal Protection Equipment.

Among 30 Respondents	
Private Clinic	18
University Hospitals	9
General Hospitals	3
Among 30 Respondents	
4 or more dentists at the facility	20
2-3 dentists at the facility	6
Solo practice at local clinics	3
Solo practice at general hospital	1

Also, 30 dentists answered that a COVID-19 patient had been treated at the hospital where they were currently working, and none of the dentists were infected with COVID-19. Workplaces included nine university hospitals, three general hospitals, and 18 private hospitals. Among the hospitals, 20 were facilities where four or more dentists were working in the same clinic, three were single-dentist private hospitals, and one was a general hospital (Table 5). Seven dentists had been subjected to self-quarantine by epidemiological investigators. Lastly, 46 of the 252 dentists expressed an intention to shut down their practice when the number of COVID-19 patients surged.

■ Discussion

In the case of South Korea, dentistry has been performed normally without any particular restrictions for more than one year starting from January 21, 2020, when the first positive patient was reported, until now. A total of three COVID-19 cases have occurred among dentists in South Korea so far, one in the result of official counts until October 2020, one in December 2020, and one in January 2021.^{9,10} There were a total of 69,114 COVID-19 cases (as of 00:00AM on January 11, 2021) out of a population of about 52 million in South Korea, so the number of COVID-19 cases among dentists, which is three out of 26,500 dentists, can be regarded as an extremely small percentage. Moreover, two of these dentists were not infected at their clinic. Regarding the remaining case, the route of infection has not been identified. However, as shown in the survey, this result is not due to a sharp decline in the number of patients. Even when the decrease in patients in the questionnaire survey is considered based on the data on the number of dental treatments in 2018, before the outbreak of COVID-19, dentists in South Korea had been routinely exposed to bio-aerosols, including various oral bacteria and viruses.

It cannot be concluded that the number of infections of dentists in clinics was zero because the degree of South Korean dentists' response to infection, as shown in No. 6-9 of Table 3 of the questionnaire survey, was sufficient. Whether the result was because of good luck or because the existing countermeasures such as thorough wearing of gloves, KF-94 masks, shields, etc., were adequate should be studied further. The South Korean government is still taking strong measures

against crowding such as in karaoke rooms, cafes, health clubs, religious facilities, and restaurant businesses and places where a mask cannot be worn. At the beginning of the COVID-19 pandemic, there were debates over the suitability of KF-94 masks and dental masks due to the size of the virus, but from May, when the weather became warmer, such theoretical and academic debates disappeared and everyone began to wear dental masks. In South Korea, the first wave surge was from the end of February to March. A small second wave occurred in August, caused by a large-scale rally, and the third large wave came in December. Further studies to find out how dental masks and KF-94 masks showed differences are necessary.

Although the American Dental Association (ADA) classified dental masks as part of levels 1 to 3,¹⁵ the standards for masks in dentistry in South Korea have not been exactly determined. The questionnaire survey showed that Korean dentists started to more actively use face masks starting December 2019 in accordance with the standards mandated by the South Korean government.

The standards for self-quarantine when the treatment of an infected patient in a hospital has been identified to have changed to add the wearing of protective equipment such as disposable surgical gowns to gloves, KF-94 masks, and face shields.¹⁶ Currently, dentists at university hospitals are wearing disposable surgical gowns when performing general procedures, and the number of dentists at private hospitals who are also wearing such gowns is gradually increasing. In this regard, the relationship between disposable surgical gowns and dentist infections in clinics should be sufficiently examined to see whether wearing the gowns is a necessary standard for self-quarantine.

Using the results of a study on COVID-19 in 10 major U.S. cities using the location tracking of 98 million mobile phones published in the November 20 issue of the journal *Nature*, it was found that a small number of virus spreaders contributed to the most infections, and that reducing the number of people occupying a space is more effective than controlling people's movement. In addition, COVID-19 cases increased overwhelmingly due to full-service restaurants and religious facilities, and only a few occurred among primary care physicians. It was also shown that the lower the social economic status, the higher the probability of infection.¹⁷

Given the information above, the COVID-19 infection rates among dentists are even lower than among general public, and we assume that the low infection rate is due to social distancing such as the reduced number of patients in the office, scattered scheduling, and physical distancing in the waiting area. Based on the results, dentists in South Korea are excluded from the medical workers who would be inoculated with COVID-19 vaccines first, and the Korean Dental Association has requested the authorities recognize dentists as a priority vaccination group. In contrast, dentists were excluded from the medical workers for priority vaccination with the swine flu vaccine in 2009.¹⁸

Overall, COVID-19 led to a huge unintended experiment in the field of infection during dentistry, although this is also the case with other fields. Therefore, based on the case of South

Korea, it is necessary to consider whether it is more correct for publicly trusted organizations such as the WHO to prohibit dental procedures except in case of emergency treatments based on only academic grounds. Rather than shutting down dental clinics, it is necessary to allow the opening dental practices as long as appropriate protective equipment and infection control procedures are implemented. The prevention of the situation of missing treatment for dental diseases, which include chronic diseases due to unneeded fear, and the economic and industrial issues such as job loss are also important. In addition, the mechanism of virus spreading in the dental settings also needs to be studied further.

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