

ORIGINAL ARTICLE

Cases of dental clinic visits by COVID-19-confirmed patients

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Abstract

Objectives: This study aims to review cases of dental visits by patients who had confirmed COVID-19 infection in Seoul and Gyeonggi-do. It analyses the patterns of infection transmission among dental healthcare professionals and dental clinic visitors.

Methods: This study obtained data from reports on disease trends and press releases published by the Korea Centers for Disease Control and Prevention (KCDC) on its COVID-19 website.

Results: After examining cases of patients with a confirmed COVID-19 infection, 24 people (10 in Seoul and 14 in Gyeonggi-do) visited the dental office 1–13 days prior to their case confirmation; however, the spread of the virus in the dental office was not confirmed.

Conclusion: The WHO and KCDC guidelines must be followed to curb transmission of the SARS-CoV-2 virus among dental patients and professionals.

KEYWORDS

aerosols, COVID-19, dental clinic, droplet exposure

1 | INTRODUCTION

Coronavirus disease 2019 (COVID-19) was first detected in Wuhan, Hubei Province, China, in December 2019, and consequently spread rapidly worldwide.^{1,2} The World Health Organization (WHO) declared COVID-19 a pandemic on 11 March 2020, making it the third global pandemic, after the Hong Kong flu of 1968 and the H1N1 pandemic of 2009.³ By 31 July 2020, there were 17,162,848 confirmed cases of COVID-19 and 670,020 associated deaths across 219 countries and territories.³

COVID-19 is a respiratory disease characterized by high fever, muscle pain, dry cough and dyspnoea. These symptoms can arise after 1–14 days of incubation (average: 4–7 days). In cases where the disease is exacerbated by factors such as old age, reduced immunity and/or pre-existing conditions, critical alveolar damage, progressive dyspnoea and even death may occur.^{2,4}

COVID-19 spreads through droplet transmission into the respiratory organs via the eyes, nose or mouth. This usually occurs through direct contact with an infected person.⁵ To prevent the spread of

infection, the WHO recommends that people avoid close contact and that efforts be made to prevent infection transmission among healthcare workers. It also recommends that mass events, which facilitate the superspreading of the infection, be cancelled, and that measures to prevent the international spread of COVID-19 be implemented.⁵

Studies have suggested that healthcare workers have a higher risk of infection, as they are consistently in close contact with patients.⁶ By 5 April 2020, healthcare workers accounted for 2.4% of all confirmed cases worldwide. This percentage was 9.1% in Italy and 15.5% in Spain.⁷ To address this risk, the WHO published guidelines concerning occupational safety and health for medical staff. The guidelines emphasize the need for droplet and airborne transmission precautions when performing aerosol-producing procedures.⁸

In the United States, Lu⁹ evaluated the risk of exposure to COVID-19 for 100 occupations (the occupations analysed were selected using the criterion that they are held by over 20,000 people in the country). The occupations were evaluated in terms of their general level of contact and physical proximity to others, as well as risk of exposure to disease and infection. This analysis showed that the

following occupations were high risk: dental hygienists (COVID-19 risk score: 99.7), respiratory therapy technicians (COVID-19 risk score: 95.0), dental assistants (COVID-19 risk score: 92.5), general dentists (COVID-19 risk score: 92.1) and orderlies (COVID-19 risk score: 90.2). Thus, dental hygienists are the most at-risk occupational group. This finding highlights the need to identify the actual risk of COVID-19 exposure to dental healthcare professionals.

Dental care settings have a high risk of exposure to droplets from patients' mouth cavities. Additionally, many dental procedures are aerosol-producing, which increases the risk of the spread of pathogenic viral infections.^{10,11} Based on these occupational factors, studies have suggested that when patients with COVID-19 visit dental clinics, there is a high probability that they will transmit the infection to other patients and/or dental healthcare professionals. There is also an increased risk of various cross-infections.¹²⁻¹⁴

Considering the abovementioned findings regarding the COVID-19-related risks associated with dental clinics, this study aims to analyse the patterns of COVID-19 transmission to dental healthcare professionals and patients through dental visits. This was done by reviewing the cases of patients with COVID-19 who visited dental clinics in Seoul and Gyeonggi-do, South Korea. The analysis was performed from 3 January to 31 July 2020.

2 | METHODS

2.1 | Data collection

The data for this study were obtained from reports on disease trends and press releases published by the Korea Centers for Disease Control and Prevention (KCDC) on its COVID-19 website.^{7,15}

The status of COVID-19-confirmed cases and the route of infection were identified, focusing on Seoul and Gyeonggi-do. The purpose and date of dental visits, symptom expression date, confirmed date of visit, period between dental visit and the confirmed date, and the contactor during dental visits were collected to track the spread of COVID-19.

2.2 | COVID-19-Confirmed patients

The KCDC Central Disinfection Headquarters defines a confirmed patient as an individual who has been diagnosed, based on test criteria and regardless of the presence of symptoms, as being infected by an infectious disease pathogen.¹⁶

2.3 | Contact person

On 3 January 2020, the KCDC Central Disinfection Headquarters began classifying individuals who had been in contact with a confirmed patient as either close contacts or casual contacts. This classification was based on the confirmed patient's symptoms, use of face mask and the nature of exposure (e.g. location of contact and duration

of contact).¹⁷ However, from 4 February 2020, the KCDC ceased classifying contacts as close or casual, and simply labelled all types of contacts as 'contacts'.¹⁸ In this new approach, contacts were defined as persons who interacted with an individual suspected of or confirmed as having COVID-19 at any time from 2 days before the onset of the individual's symptoms to 14 days after the onset of their symptoms.¹⁶ Contact was defined as at least 15 min of face-to-face contact at a distance of <1 m, direct physical contact and/or direct caregiving without the use of appropriate personal protection equipment.¹⁶

2.4 | Regions for data collection

Data were collected from Seoul and Gyeonggi-do, which account for approximately 50.3% of the dental health facilities (as of 2017), 49.1% of dentists (as of 2017) and 45.5% of dental hygienists (as of 2016) in South Korea.¹⁹

2.5 | Data collection period

Since 3 January 2020, the KCDC Central Disinfection Headquarters has been disclosing information, obtained through detailed epidemiologic investigation, regarding the movement patterns of patients with COVID-19. The date range for collected cases spans from the date of a suspect contact event to 14 days after. All information is deleted once this period ends.²⁰ The disclosed information includes contact events that were temporally and spatially sufficient to cause infection and transmission.²⁰ However, owing to multiple epidemiologic, legal and privacy-related issues, since 1 July 2020, only the minimum amount of information required to prevent infection was disclosed. Moreover, the scope of the information disclosed also varies depending on the local government's policy.²¹ In this study, data of approximately 7 months, from 3 January to 31 July 2020, were used.¹⁵

2.6 | Research ethics

This study received approval from the Institutional Review Board (IRB) of Yonsei University Wonju Severance Christian Hospital on 11 July 2017 (IRB approval number: CR320316).

3 | RESULTS

3.1 | Status of COVID-19-confirmed patients in Seoul and Gyeonggi-do

As of 31 July 2020, there were 1600 confirmed COVID-19 patients in Seoul and 1546 cases in Gyeonggi-do. The most common sources of infection were mass group infections ($n = 1783$; 56.7%), entry from a foreign country or contact with someone who had recently arrived from a foreign country ($n = 884$, 28.1%) (Table 1).

3.2 | Cases of patients with COVID-19 who visited dental clinics in Seoul and Gyeonggi-do

3.2.1 | Mass group infections

Patients #1531, #1532, #11013 and #11382 of Seoul and patients #10989 and #11384 of Gyeonggi-do were confirmed as having contracted COVID-19 through mass group infections and had visited a dental clinic prior to diagnosis. Patient #11384 had contact with four people during their dental visit, but the infection was not transmitted.

3.2.2 | Contact with a confirmed patient

Patients #7027 and #7539 of Seoul and patients #3068, #11628, #11685, #11761, #12151, #12188, #13090, #13233 and #13437 of Gyeonggi-do were confirmed as having contracted COVID-19 due to contact with a confirmed patient and had visited a dental clinic prior to diagnosis. Patients #11685, #12151, #12188 and #13090 had contact with one to four people during their dental visits, but the infection was not transmitted.

3.2.3 | Entry from a foreign country or contact with someone who had recently arrived from a foreign country

Patient #8057 of Seoul and patients #10410, #10438 and #10375 of Gyeonggi-do were confirmed as having contracted COVID-19 after entering South Korea from a foreign country or having contact with someone who had recently arrived from a foreign country. They had

visited a dental clinic prior to diagnosis. Patient #8057 was the only patient of this cohort to transmit the infection to another person (patient #9277). However, #9277 had no record of a dental visit during the same period. Patients #10410 and #10438 visited the same dental clinic and had contact with four people during their visits, but the infection was not transmitted.

Patient #10375 had previously recovered from COVID-19, but visited a dental clinic on May 7 and was re-infected with the virus on May 9. The patient had contact with five people during the visit, but the infection was not transmitted.

3.2.4 | Unknown source of infection

Patients #11988 and #12047 of Seoul were healthcare workers working in the same dental health facility. The source of infection for both patients is unknown. They were confirmed on June 11 (#11988) and June 12 (#12047), respectively. However, no additional cases of COVID-19 were confirmed in the healthcare facility in question.

4 | DISCUSSION

This study analysed the KCDC survey results in relation to the movement of confirmed patients. The study did this in a relatively detailed and accurate manner within a fixed period and region. It also investigated the transmission status of confirmed patients who visited the dental clinic.

COVID-19 is a global pandemic.⁵ As of 31 July 2020, 14,305 people were confirmed as having contracted COVID-19 (representing 0.028% of the Korean population), and 301 had died from COVID-19.¹⁵ In Seoul, in which 18.8% of the total Korean population

TABLE 1 Status of COVID-19-confirmed patients in Seoul and Gyeonggi-do

	Classification	COVID-19-confirmed patients (%)	Deaths (%)	Fatality rate (%)
Region	Seoul	1600 (50.9)	11	0.69
	Gyeonggi-do	1546 (49.1)	31	2.01
Route of infection	Mass group infection ^a	1783 (56.7)	–	–
	Entry from a foreign country and relevant case ^b	884 (28.1)	–	–
	Contact of COVID-19-confirmed patient ^c	164 (5.2)	–	–
	Specific religious group-related ^d	37 (1.2)	–	–
	Other ^e	278 (8.8)	–	–
Total		3146	42	

^aMass group infection: individuals who contracted the infection as part of a mass spread in companies, sports facilities, hospitals, and long-term care facilities.

^bEntry from a foreign country and relevant case: Entrants from a foreign country who have been confirmed with the infection or individuals who contracted the infection after coming into contact with an entrant from a foreign country.

^cContact of COVID-19-confirmed patient: individuals confirmed with the infection after coming into contact with a COVID-19-confirmed patient.

^dSpecific religious group-related: individuals confirmed with the infection as part of the mass spread centred around a specific religious group in Daegu and Gyeongbuk.

^eOther: individuals with the unclear route of infection.

resides, 1600 cases (11.2% of the total number of cases) were confirmed, and in Gyeonggi-do, in which 25.5% of the total Korean population is located, 1546 cases (10.8%) were confirmed.²¹ The KCDC classifies sources of COVID-19 infection as mass group infections, contact with a confirmed patient, association with a specific religious group, exposure in a foreign country, contact with an individual recently arrived from a foreign country and other.¹⁵ In both Seoul and Gyeonggi-do, the most common source of infection was mass group infections in companies, sports facilities, hospitals and long-term care facilities ($n = 1783$; 56.7%; [Table 1](#)).²²

There were 10 and 14 patients from Seoul and Gyeonggi-do, respectively, who had visited a dental clinic 1–13 days prior to their diagnosis ([Table 2](#)). Of these 24 patients, 23 did not transmit the infection to another person. The one patient who transmitted the infection did so via direct contact with a person who had not visited a dental clinic.^{15,23}

Globally, there have been cases in which patients with COVID-19 have transmitted the virus to others, including healthcare workers, by visiting hospitals and long-term care facilities.^{24–26} In China, over 3000 healthcare workers were infected by February 2020.²⁷ By August 2020, approximately 300,000 healthcare workers in 37 countries were reported to have contracted COVID-19.²⁸ In South Korea, 241 healthcare workers had tested positive for COVID-19 by 5 April 2020, with the infections occurring through community infection ($n = 101$, 42%), routine patient care ($n = 62$, 28%), mass group infection in hospitals ($n = 62$, 28%) and at screening centres ($n = 3$, 1%).⁷ The majority of these healthcare workers were nursing staff ($n = 190$, 78.3%). Physicians and other staff accounted for approximately 10% of the cases ($n = 25$ and 26 , respectively).⁷

A survey conducted in April 2020 of 4308 dentists in Italy found that 31 (0.86%) had previously contracted COVID-19, and 474 (13.47%) had experienced COVID-19-related symptoms.²⁹ In June 2020, a survey of 2195 dentists in the United States reported that 20 (0.91%) had contracted COVID-19,³⁰ whereas a May 2020 survey conducted in Italy reported that seven out of 2869 dental hygienists (0.24) had contracted COVID-19.³¹ However, it is difficult to conclude whether these dental healthcare professionals contracted the virus during patient care.^{29–31}

According to the data obtained for our study, there were three cases in which multiple patients from the same dental health facility were confirmed as having COVID-19 ([Table 2](#)). Two patients (#1531, #1532) visited Dental Clinic A on February 18 and February, respectively, and were diagnosed with COVID-19 on the same day (February; [Table 2](#)). These two patients were family members and had contracted the virus through a mass group infection at a healthcare facility.²³ However, they did not transmit COVID-19 to other visitors of the dental clinic.

Two staff members of Dental Clinic H (patients #11988 and #12047) were diagnosed with COVID-19 on June 11 and June 12, respectively ([Table 2](#)). The contact history of these two patients could not be confirmed based on the disclosed data, and no cases of transmission to other colleagues or patients were reported. According to the reported data, patient #11988 worked at a dental clinic from

June 3 to 10, and it was confirmed that #11988 patient was wearing a mask during working hours.¹⁵ However, it was not clearly reported whether patient #12047 has worn a mask. Since March 2020, the KCDC has recommended wearing a mask, hand washing, ventilation and periodic disinfection as quarantine guidelines, and these guidelines have been followed in most facilities.³² The lack of reported cases of COVID-19 transmission in dental settings may be due to the acceptance of these guidelines.³³

Two people (patients #10410 and #10438) were diagnosed with COVID-19 after visiting Dental Clinic J. They had visited the clinic on the same day (April 4) for a dental check-up and were diagnosed on April 8 and April 9, respectively ([Table 2](#)). One of these patients (#10438) had entered South Korea from a foreign country (France), and the two patients lived in the same studio building. They were found to have crossed paths at a coffee shop, hospital, pharmacy and bookstore approximately 10 days before visiting the dental clinic. Although from 1 April 2020, the Korean government enforced a mandatory 14-day self-quarantine for people arriving from foreign countries,³⁴ patient #10438 seemed to have entered South Korea before the mandatory quarantine was implemented.

Two other special cases were found. A patient (#8057), who was diagnosed with COVID-19 after visiting Dental Clinic D, was the only patient analysed who transmitted the infection to another person (patient #9277). However, patient #9277 had not visited the dental clinic. Meanwhile, a patient (#10375) who was diagnosed as COVID-19 positive after visiting Dental Clinic K was confirmed as having previously recovered from a prior COVID-19 infection. According to the KCDC, there is no evidence that reinfections are transmissible, and there has been no case in which a patient has contracted the virus through contact with a re-infected person.²²

Dental clinics have a high risk of droplet infections because most dental procedures involve exposure to saliva, blood, aerosols and droplets. There is also a high risk of direct and indirect contact with mucous membranes and oral fluids. Contaminated dental devices are also associated with a risk of infection.^{4,35} While droplet infection can occur through exhaled breath, sneezing or coughing releases approximately 3000–40,000 droplets. This escalates the risk of viral transmission of SARS-CoV-2.³⁶ As most dental care procedures involve treating the oral cavity, dental healthcare professionals are at high risk of droplet exposure. The use of high-speed dental devices, which can increase the number of aerosols produced, may increase the risk of infection.³⁶ These risks can be prevented or reduced through implementation of proper infection-control measures.³⁷

Face masks protect dental healthcare professionals' noses and mouths from patients' blood, saliva and aerosols during dental care. According to Ma et al,³³ N95 masks and dental masks block 99.98% and 97.14% of viruses, respectively, compared with not wearing a mask. Furthermore, safety goggles and face shields protect the eyes and skin and reduce cross-infections by approximately 78%.³⁷ Protective clothing prevents the contamination of dental healthcare professionals' clothes and protects their skin from exposure to blood and saliva. In addition, wearing gloves after practicing proper hand hygiene has been found to block over 96% of viruses.³⁷

TABLE 2 Cases of patients with COVID-19 who visited dental clinics in Seoul and Gyeonggi-do

Region	Patient number	Gender/ Year of birth	Route of infection	Visited dental clinic	The purpose of dental visit	Date of dental visit	Symptom expressed date of COVID-19	Confirmed date of COVID-19	Period between dental visit and confirmed date of COVID-19 (days)	Contacts during dental visit (people)	Transmissions of COVID-19 through dental visit (people)	Special note
Seoul	#1531	Female/73	Mass group infection	A	Treatment	2/21	2/25	2/26	5	-	0	-
	#1532	Female/37	Mass group infection	A	Treatment	2/18	-	2/26	8	-	0	-
	#7027	Male/55	Contact of COVID-19-confirmed patient	B	Treatment	3/2	2/27	3/6	4	-	0	-
	#7539	Female/68	Contact of COVID-19-confirmed patient	C	Treatment	3/5	3/6	3/10	5	-	0	-
	#8057	Male/84	Contact of COVID-19-confirmed patient	D	Treatment	3/11	-	3/12	1	-	0	#9277 (male/78)
	#9757	Male/36	Contact of COVID-19-confirmed patient	E	Treatment	3/27	-	3/29	2	-	0	transmission, confirmed date: 3/26
	#11013	Male/95	Entry from a foreign country	F	Treatment	5/12	-	5/13	1	-	0	-
	#11382	-	Mass group infection	G	Treatment	5/24	-	5/28	4	-	0	-
	#11988	-	-	H	Work	6/3-6/10	6/5	6/11	1	-	0	-
	#12047	-	-	H	Work	6/10-6/11	-	6/12	1	-	0	-
Gyeonggi-do	#3068	Female/78	Contact of COVID-19-confirmed patient	I	Treatment	2/24	2/26	2/29	5	-	0	-
	#10410	Female/98	Entry from a foreign country	J	Treatment	4/4	3/28	4/8	4	4	0	-
	#10438	Male/98	Entry from a foreign country	J	Treatment	4/4	3/24	4/9	5	4	0	-
			relevant case									
		Entry from a foreign country										

(Continues)

TABLE 2 (Continued)

Region	Patient number	Gender/ Year of birth	Route of infection	Visited dental clinic	The purpose of dental visit	Date of dental visit	Symptom expressed date of COVID-19	Confirmed date of COVID-19	Period between dental visit and confirmed date of COVID-19 (days)	Contacts during dental visit (people)	Transmissions of COVID-19 through dental visit (people)	Special note
	#10375	Female/00	Entry from a foreign country	K	Treatment	5/7	-	5/9	2	5	0	Reconfirmation
	#10989	Male/87	Mass group infection	L	Treatment	5/11	5/9	5/13	2	-	0	-
	#11384	-	Mass group infection	M	Treatment	5/15	5/16	5/28	13	4	0	-
	#11628	Male/37	Contact of COVID-19-confirmed patient	N	Treatment	5/28	5/30	6/3	6	-	0	-
	#11685	-	Contact of COVID-19-confirmed patient	O	Treatment	6/2	-	6/5	3	4	0	-
	#11761	-	Contact of COVID-19-confirmed patient	P	Accompany	6/3	6/3	6/6	3	-	0	-
	#12151	Female/-	Contact of COVID-19-confirmed patient	Q	Treatment	6/13	6/12	6/15	2	2	0	-
	#12188	Male/-	Contact of COVID-19-confirmed patient	R	Treatment	6/11	-	6/16	5	1	0	-
	#13090	Female/-	Contact of COVID-19-confirmed patient	S	Treatment	7/1	-	7/4	3	3	0	-
	#13233	-	Contact of COVID-19-confirmed patient	T	Treatment	7/6	7/6	7/7	1	-	0	-
	#13437	-	Contact of COVID-19-confirmed patient	U	Treatment	7/7	-	7/11	4	-	0	-

-, Not reported.

To curb COVID-19 transmission, the Korea Central Quarantine Countermeasures Headquarters prepared and applied guidelines. These guidelines were applied for different types of medical institutions, including dental hospitals and clinics, nursing care institutions, psychiatric institutions and artificial kidney rooms.¹⁷ At dental clinics, dental personnel as well as visitors were advised to wear masks and not to take them off. Guidelines were provided mandating that dental personnel should not gather in medical institutions to drink tea or socialize.³⁶ In Korea, most citizens wore masks in multi-use facilities. This may have played an important role in reducing the spread of COVID-19 in dental clinics.

One limitation of this study is that we could not obtain important details regarding the types of dental care that may increase the risk of droplet-based viral transmission because we primarily analysed data disclosed by the KCDC. Furthermore, this was a short-term (7 months) study limited to two regions in South Korea, during which there were few cases of patients with COVID-19 visiting dental clinics. Thus, the cases described in this study may not be generalizable. In the future, the status of COVID-19 transmissions in dental clinics should be reported on a continuous basis and various relevant cases should be shared, as this may help to develop safer dental care environments for both providers and patients.

5 | CONCLUSION

This study examined the cases of patients with confirmed COVID-19 infection in Seoul and Gyeonggi-do in Korea. A total of 24 people (10 in Seoul and 14 in Gyeonggi-do) visited dental clinics 1–13 days before their cases were confirmed, but the spread of the virus in the dental clinic was not confirmed. To prevent COVID-19 transmissions in dental clinics, relevant cases should be monitored continuously, and infection-prevention guidelines should be updated as necessary.

6 | CLINICAL RELEVANCE

6.1 | Scientific rationale for the study

While COVID-19 can be transmitted to people of all ages, studies have suggested that healthcare workers have a higher risk of infection, as they are consistently in close contact with patients. By 5 April 2020, healthcare workers accounted for 2.4% of all confirmed cases worldwide.

6.2 | Principal findings

The status of COVID-19 transmissions in dental clinics should be continuously reported, and various relevant cases should be shared, as this may help to develop safer dental care environments for both providers and patients.

6.3 | Practical implications

The spread of COVID-19 is occurring in various countries. In such a situation, a medical institution is a very risky environment. In order to ensure the safety of the health and dental personnel and patients at dental medical institutions, it is very important to check whether or not COVID-19-confirmed patients visit dental medical institutions.

AUTHOR CONTRIBUTIONS

EBS and HN were responsible for designing the study, data collection, statistical analysis in SPSS and the interpretation of data and revised the manuscript for important intellectual content. EBS, HN and HWK contributed to the writing of the draft of the manuscript. HN supervised the design of the study, contributed to the interpretation of data and critically revised the manuscript. All authors read and approved the final manuscript.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are openly available in <http://ncov.mohw.go.kr/>.

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