Original Article

Aerosols Generated During Endodontic Treatment: A Special Concern During the Coronavirus Disease 2019 Pandemic in Delhi NCR Region

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Abstract

Background: The endodontists of Delhi NCR region were quite in dilemma regarding the transmission of coronavirus through aerosols in endodontic procedures. There was a need for analysis of the aerosols produced during the endodontic procedures regarding their potential in the transmission of microorganisms and what safety protocol should be maintained to reduce the danger it possess in the transmission of coronavirus. This study was carried out to analyze the special concern of aerosols produced in endodontic procedures in the COVID-19 pandemic in Delhi NCR region. **Materials and Methods:** In this study sixty study subjects were included in the study. Twenty subjects underwent pulpotomy, twenty subjects were subjected to pulpectomy while twenty subjects were subjected to non-surgical root canal treatment. The samples from patients were collected before the treatment as well as at the end of the treatment. The samples were collected from patients while they were kept in rest position in the rooms. The approach for sampling was passive air sampling approach. There was the placement of agar plates all across the dental clinal setting. Then, there was evaluation of extent of contamination of aerosols by measurement of colony-forming units at four different locations. Extent of contamination was analyzed in different treatment modalities along with the duration of treatment. **Results:** When there was evaluation of level of contamination at location in front of the patient mouth then it was observed that contamination was more in pulpotomy when the location was 500 cm in comparison with the location of 2000 cm from the patient mouth. The difference was statistically significant with $P < 0.005$. In case of pulpectomy also it was found that contamination was more when the location was 500 cm in comparison with the location of 2000 cm from the patient mouth. The difference was statistically significant with $P < 0.005$. However, in the treatment modality of non-surgical root canal treatment, there was no statistical difference in contamination when the location was 500 cm in front of the mouth in comparison to location of 2000 cm from the mouth with $P = 0.05$. **Conclusion:** From this research, it was concluded that the production of aerosols is greater in the pulpectomy as compared to pulpotomy and the extent of contamination is directly proportional to the duration of treatment and the distance from the oral cavity of patient. More studies should be carried out to address this special concern.

Keywords: Aerosols, Corona virus disease 2019, Endodontic procedures, Extent of contamination.

Introduction

Corona Virus disease 2019 is being considered as one of the deadliest pandemic of this century. It is still affecting the life of millions of people all across the globe. Millions of people have lost their lives due to this deadly virus. Lots of people have been affected both physically as well as financially. Its early symptoms included cough, sneezing with mild fever. Later on, there is condition of breathlessness owing to the attack of the coronavirus over the respiratory system of the body. Within short duration, this breathlessness aggravates and there may be death of the person.[1,2]

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In this era of COVID-19, a worldwide pandemic air borne droplets have been considered as one of the most common route of transmission of virus. In dentistry production of aerosols is very common phenomena especially in the endodontic procedures. The chances of transmission of corona virus through these aerosols is a matter of debate. Nowadays dental associations are making recommendations regarding protection from the coronavirus disease the chances of which have increased due to the production of aerosols. These recommendations included reduced dental procedures having the involvement of production of aerosols.[3,4]

Due to these recommendations involving reduction in the use of aerosol-based endodontic procedures, there was a great problem in the management of the diseases of the pulp and periradicular tissues. In the early phase of the pandemic, only palliative treatment was provided to the patients due to these recommendations. Moreover, the endodontists were also apprehensive in carrying the endodontic procedures because they feared that there may be increased possibility of transmission of the viruses through the aerosols.[5,6] In previous studies there have been evidence regarding the transmission of bacteria in restorative dentistry as well as periodontal problems. However, no studies have been conducted to study the transmission of corona virus and bacteria through aerosols produced during the endodontic procedures.[7,8]

As a result, the endodontists of Delhi NCR region were quite in dilemma regarding the transmission of coronavirus through aerosols in endodontic procedures. There was a need for analysis of the aerosols produced during the endodontic procedures regarding their potential in the transmission of microorganisms and what safety protocol should be maintained to reduce the danger it possess in the transmission of coronavirus. Hence, this study was carried out to analyze the special concern of aerosols produced in endodontic procedures in the COVID-19 pandemic in Delhi NCR region.

Materials and Methods

Microbial fallout during pulpotomy, pulpectomy, and NSRCT was investigated utilizing a passive air sampling technique employing "settle plates." This sampling method is frequently utilized in a variety of fields.[9-11] A total of 45 endodontic treatments were studied, comprising full pulpotomy (n = 20), pulpectomy (n = 20), and NSRCT (n = 20). The sampling was done on maxillary and mandibular teeth that were being treated for primary root canal infection and symptomatic apical periodontitis. This study did not include nonsurgical retreatment or periapical surgery. About 2.5% sodium hypochlorite was used to irrigate the root canals.

Sampling Procedures

All samples were taken in a 4 × 4 m^2 room with closed doors in the endodontic resident's operatory. After an overnight rest in the room, samples were taken first thing in the morning. Throughout the procedure, a high-efficiency particulate air filter (OSO Pure ADP-70 Air Disinfecting Purifier; Skaare Enterprises Inc, Glendale, AZ) was left on. A batch of agar plates was exposed to air for 30 min in the operatory before treatment for the first sample (s1), room resting sampling. After that, the plates were sealed and incubated as directed. The colony-forming unit (CFU) count was calculated using this s1 sample. A set of new agar plates was opened concurrently with the start of the access cavity for the second sample (s2), treatment sampling. The dentist, helper, and patient were already seated to prevent traffic air turbulence. The dentist and dental assistant were seated at 11 o'clock and 1 o'clock, respectively. Personal protection equipment was worn by both the dentist and the dental assistant, including a 6000 Series Half Facepiece Respirator and iMask + Face Shield. At four different locations, the plates were spatially scattered at 1-m high from the floor.

1. Positioning at 500 cm in front of the mouth of patient
2. Positioning at 2000 cm in front of the mouth of patient
3. Positioning at 500 cm at a diagonal to the mouth of patient
4. Positioning 2000 cm at a diagonal of the mouth of patient.

Patients were instructed to apply a 0.12% chlorhexidine digluconate antiseptic rinse for 60 s prior to rubber dam isolation and access cavity. With a high-speed handpiece spinning at 40,000 rpm and water spray, the access cavity was created under rubber dam isolation. For the dental unit, the water flow rate was adjusted at 6 on a scale of 0 (no flow) to 100 (highest). In front of the patient's mouth (=20 cm), the ADS EOS Extraoral Suction System (ADS Dental System Inc, Ontario, CA) was used. The plates were left open until the therapy was finished. The microbial contamination levels (CFU/plate) and the makeup of target bacterial species were determined using this s2 sample.

Measure of Microbial Fallout (Microbial Load/CFU Count)

Standard Petri dish plates 9 cm in diameter containing brain-heart infusion agar 1 5% sheep blood were used to measure the fallout bacteria. The number of CFUs in the plate was counted using a stereomicroscope with a magnification of 1000× after the incubation time. (VWR, Radnor, PA). The average number of CFUs was determined.

Investigation of Microbial Composition

Plates containing selective chromogenic culture media (CHROMagar, DRG International, Inc., Springfield, NJ, USA) were employed for the isolation and presumptive identification of target Staphylococcus spp, Streptococcus spp, and Pseudomonas spp for the investigation of microbial composition. Fungi were also investigated using Sabouraud dextrose agar with 1 0.05 g chloramphenicol. The manufacturer's instructions were followed for preparing all culture medium. Throughout the treatment, a set of standard Petri dish plates 9 cm in diameter with the aforementioned culture media were left open and spatially distributed as previously indicated. The plates were then sealed and incubated as directed. The colony's presence in the agar plate was confirmed after the incubation period, and the presumptive identification was done based on the manufacturer's description of normal colony look. Before presumptive identification of the materials, strains from the American Type Culture Collection (Manassas, VA) were

evaluated as a positive control. CHROMagar is a type of agar media. By using a stopwatch, the time it took to finish endodontic therapy was measured in minutes. The timer started when the access cavity was prepared with a high-speed handpiece and terminated when the temporary repair was placed.

Statistical Analysis

The data was reported as a mean with a standard deviation of six. Following the Shapiro-Wilk test, the data were analyzed using a 1-way analysis of variance (ANOVA) to determine group differences, followed by a Tukey test for multiple comparisons. To determine the differences between groups, a two-way ANOVA was used (position and distance factors). The length of the treatment was assessed using a Kruskal-Wallis 1-way ANOVA on ranks (time in minutes). Pearson correlation analysis was used to look into the possibility of a link between time and bacteria levels. The entire study sample was subjected to correlation analysis.

A significance level of 5% was utilized for all tests.

Results

When there was evaluation of level of contamination at the location in front of the patient mouth then it was observed that contamination was more in pulpotomy when the location was 500 cm in comparison with the location of 2000 cm from the patient mouth. The difference was statistically significant with $P < 0.005$. In case of pulpectomy also it was found that contamination was more when the location was 500 cm in comparison with the location of 2000 cm from the patient mouth. The difference was statistically significant with $P < 0.005$. However, in the treatment modality of non-surgical root canal treatment, there was no statistical difference in contamination when the location was 500 cm in front of the mouth in comparison to location of 2000 cm from the mouth with $P < 0.05$ (Table 1).

When there was evaluation of level of contamination at location diagonal to patient mouth then it was observed that contamination was more in pulpotomy when the location was 500 cm in comparison with the location of 2000 cm from the patient mouth. The difference was statistically significant with $P < 0.005$. In the case of pulpectomy also it was found that contamination was more when the location was 500 cm in comparison with the location of 2000 cm from the patient mouth. The difference was statistically significant with $P < 0.005$. In treatment modality of non-surgical root canal treatment also there was statistical difference in contamination when the location was 500 cm in front of the mouth in comparison to the location of 2000 cm from the mouth with $P < 0.05$. (Table 2).

When there was evaluation of the level of contamination of extent of contamination and the duration of treatment at different locations then it was found that the extent of contamination was more as the duration of the treatment increases (Tables 3 and 4).

Table 1: Evaluation of the no of colonies forming units of microorganisms formed when the location of plate was in front of the patient mouth

Type of endodontic treatment	Distance between the patient mouth and plate when plate placed in front of patient mouth		*P*-value
	500 cm	2000 cm	
Pulpotomy	0.51±0.6	0.37±0.5	0.01
Pulpectomy	3.6±2.1	2.6 ±1.9	0.03
NRSCT	3.1±2.2	1.9±0.7	0.08

Table 2: Evaluation of the no of colonies forming units of microorganisms formed when the location of plate was at diagonal to patient mouth

Type of endodontic treatment	Distance between the patient mouth and plate when plate placed at a location diagonal to the mouth of patient		*P*-value
	500 cm		
Pulpotomy	0.6±0.6	0.3±0.5	0.03
Pulpectomy	3.57±3.6	1.5±1.4	0.02
NRSCT	2.9±1.4	1.9±0.9	0.04

Table 3: Data showing correlation between the duration of treatment and extent of contamination (R values)

Conditions evaluated	R-values
Positioning at 500 cm in front of the mouth of patient	0.35
Positioning at 2000 cm in front of the mouth of patient	0.62
Positioning at 500 cm at a diagonal to the mouth of patient	0.71
Positioning 2000 cm at a diagonal of the mouth of patient	0.58

Table 4: Data showing correlation between the duration of treatment and extent of contamination (P-values)

Conditions evaluated	*P*-values
Positioning at 500 cm in front of the mouth of patient	0.01
Positioning at 2000 cm in front of the mouth of patient	0.02
Positioning at 500 cm at a diagonal to the mouth of patient	0.01
Positioning 2000 cm at a diagonal of the mouth of patient	0.001

Discussion

There was a significant problem in managing pulp and periradicular tissue illnesses as a result of suggestions for endodontic treatment by dental associations in coronavirus disease, which included a reduction in the use of aerosol-based endodontic operations. Due to these instructions, only palliative therapy was given to patients during the early stages of the pandemic. Furthermore, endodontists were reluctant about performing endodontic operations because they were concerned about the increased risk of viral transmission via aerosols. There has been evidence of bacterial transmission in restorative dentistry as well as periodontal issues in prior research.[6-8,12]

However, no research has been done on the transmission of the coronavirus and bacteria via aerosols created during endodontic operations. As a result, endodontists in the Delhi NCR region were at a loss as to how to prevent coronavirus transmission via aerosols during endodontic procedures. There was a need for an examination of the aerosols formed during endodontic treatments to see if they had the capacity to transmit microorganisms and what safety protocols should be followed to decrease the risk of coronavirus transmission.[13,14,9] As a result, this study was carried out to investigate the unique concern of endodontic aerosols in the COVID 19 pandemic in Delhi NCR.

When the level of contamination in front of the patient's mouth was measured, it was discovered that contamination was higher in pulpotomy when the distance was 500 cm versus 2000 cm. With a $P = 0.005$, the difference was statistically significant. In the case of pulpectomy, contamination was shown to be higher when the position was 500 cm from the patient's mouth compared to a location of 2000 cm. With a $P = 0.005$, the difference was statistically significant. However, with a $P = 0.05$, there was no statistical difference in contamination whether the location was 500 cm in front of the mouth versus 2000 cm from the mouth in the nonsurgical root canal treatment modality. When the degree of contamination, the extent of contamination, and the time of treatment were evaluated at various sites, it was discovered that the extent of contamination increased as the duration of treatment increased. The findings of this study were comparable to those of other studies conducted in other parts of the world, but they were also distinct from those of other studies.[10,11,15-17]

Corona Virus Infection is one of the deadliest pandemics of this century which striked in 2019. It continues to have an impact on the lives of millions of people all around the world. This devastating illness has claimed the lives of millions of people. A large number of people have been impacted, both physically and financially. Coughing, sneezing, and a moderate temperature were among the first signs. Later on, due to the corona virus's attack on the body's respiratory system, there is a situation of dyspnea. Within a short period of time, the breathlessness worsens, and the person may die.[18-21]

In the period of COVID-19, a global pandemic, airborne droplets have been identified as one of the most common routes of virus transmission. Aerosol production is a regular occurrence in dentistry, particularly during endodontic operations. The possibility of coronavirus transmission via these aerosols is debatable. Nowadays, dental associations are issuing advice for protection against the coronavirus disease, which has become more common as a result of the generation of aerosols. Reduced dental operations involving the creation of aerosols were among the recommendations.[22-25]

When the degree of contamination at a position diagonal to the patient's mouth was measured, it was discovered that contamination was higher in pulpotomy when the location was 500 cm from the patient's mouth than when the location was 2000 cm. With a $P = 0.005$, the difference was statistically significant. In the case of pulpectomy, contamination was shown to be higher when the position was 500 cm from the patient's mouth compared to a location of 2000 cm. With a $P = 0.005$, the difference was statistically significant. In the treatment modality of non surgical root canal treatment also there was statistical difference in contamination when the location was 500 cm in front of the mouth in comparison to location of 2000 cm from the mouth with $P > 0.05$. More studies should be conducted in the future with a larger sample size to further enhance the research on aerosols in endodontic procedures.[26-28]

Conclusion

From this research, it was concluded that the production of aerosols is greater in the pulpectomy as compared to pulpotomy and the extent of contamination is directly proportional to the duration of treatment and the distance from the oral cavity of patient. More studies should be carried out to address this special concern.

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