Research Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2020;10:4:379-382.

Minimizing the Aerosol-Generating Procedures in Orthodontics in the Era of a Pandemic: Current Evidence on the Reduction of Hazardous Effects for the Treatment Team and Patients

Saurav Kumar[1*] Taufique Anwer[2] Nadira Hassan[3] Rehan Ahmad Khan[4] Gaurav Verma[5] Sana Shaikh[6]

[1]Senior Lecturer, Department of Orthodontics and Dentofacial Orthopedics, Mithila Minority Dental College and Hospital, Darbhanga, Bihar, India.
[2]Private Dental Practioner, Araria, Bihar, India.
[3]Private Dental Practioner, Ara, Bhojpur, Bihar, India.
[4]Private Dental Practioner, Muzaffarpur, Bihar, India.
[5]Reader, Department of Oral and Maxillofacial Surgery, Awadh Dental College and Hospital, Jamshedpur, Jharkhand, India.
[6]Private Dental Practioner, Hadapsar, Pune, Maharashtra, India.

ABSTRACT

Background: The pandemic outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has had a large impact on the frontline of health care workers, and among those, on dentists and orthodontists. Orthodontic practices are not to be left aside. An aerosol is defined as a suspension system of solid or liquid particles in a gas. Aim of the study: To study minimizing the aerosol-generating procedures in orthodontics in the era of a pandemic.

Materials and methods: The present study was conducted in the Department of Orthodontics of the Dental institution. The ethical clearance for the study was approved from the ethical committee of the hospital. For the study, a total of 20 patients who were ready for the debonding volunteered for the experimental group (debonding; DB). All subjects had been treated with full-banded edgewise nonextraction treatment with bands on their molars and brackets on the rest of the teeth. The patients were randomly grouped into two groups, Group A and Group B. The patients in Group A received treatment with usual aerosol generating instruments and in group B, patients received treatment with hand instruments which do not require aerosol generating instruments. The orthodontist and his assistant wore sterilized surgical gloves, masks, and face shields during all of the study procedures.

Results: There were 10 patients in each group. The mean age of patients in Group A was 13.69 years and in Group B was 14.58 years. It was observed that mean CFU number in Group A was 63.98 and in Group B was 22.68. The results on comparison were found to be statistically significant.

Conclusion: Within the limitations of the present study, it can be concluded that procedures which involve usage of handpieces and other instruments producing aerosols poses much higher risk of infection from patient as compared to procedures in which handpieces are not required. Thus, in the era of pandemic, the usage of aerosol generating handpieces should be minimized.

Keywords: Aerosols, bonding, orthodontic treatment, pandemic.

INTRODUCTION

The pandemic outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has had a large impact on the frontline of health care workers, and among those, on dentists and orthodontists. [1] Besides the public health and economic burdens of the coronavirus disease 2019, it is now evident that

Received: June. 28, 2020**: Accepted**: Aug. 5, 2020
***Correspondence Dr. Saurav Kumar.**
Department of Orthodontics and Dentofacial Orthopedics, Mithila Minority Dental College and Hospital, Darbhanga, Bihar, India.
Email: dr.sauravmishra29@gmail.com

pISSN 2278-0076
eISSN 2321-9270

its massive spread around the world has imposed great occupational challenges, with the implementation of routine dental services being at stake.[2] The nature of the virus' infectious route, with direct implication of airborne droplets in the form of aerosol, has revealed certain potential hazards underlying conventional and standard oral health care procedures.[3] Orthodontic practices are not to be left aside. An aerosol is defined as a suspension system of solid or liquid particles in a gas. [4] Evidently, common categories and burdens of orthodontics-related applications producing aerosol and/or airborne particulates are focusing on bonding and debonding strategies. The former involve application of water-spray practices in connection to enamel etching, before conditioning with bonding agents and bracket bonding; the latter pertain to enamel clean-up practices after removal of fixed appliances on completion of orthodontic treatment. Of late, in the line of debonding strategies, an additional procedure liable to aerosol generation has emerged in the clinical field; composite attachment removal after aligner therapy or possible attachment replacement and/or removal cycles during treatment with aligners should not be neglected. [5, 6]Hence, the present study was conductedto study minimizing the aerosol-generating procedures in orthodontics in the era of a pandemic.

MATERIALS AND METHODS

The present study was conducted in the Department of Orthodontics of the Dental institution. The ethical clearance for the study was approved from the ethical committee of the hospital. For the study, a total of 20 patients who were ready for the debonding volunteered for the experimental group (debonding; DB). All subjects had been treated with full-banded edgewise nonextraction treatment with bands on their molars and brackets on the rest of the teeth. To participate in the study, the subjects had to meet the following inclusion criteria: no signs of respiratory infection, rheumatic heart disease, or any other systemic disease requiring antibiotic medication; no current anticoagulant or steroid therapy; no periodontal therapy including scaling, root planning, or prophylaxis during the past 6 months, and the presence of a mean plaque index and gingival index #1.5. The patients were randomly grouped into two groups, Group A and Group B. The patients in Group A received treatment with usual aerosol generating instruments and in group B, patients received treatment with hand instruments which do not require aerosol generating instruments. The orthodontist and his assistant wore sterilized surgical gloves, masks, and face shields during all of the study procedures. To collect baseline bacterial samples in the unoccupied and closed room, blood agar plates were placed on various surfaces around the dental chair (dental chair, chair table, light, suction area etc) before the orthodontist, dental assistant and the patient entered into the room. All blood agar plates were less than 30 cm from the dental chair. Blood agar plates were chosen for their nonselective characteristics and ability to promote the growth of many aerobic organisms. The plates were exposed for 30 minutes during which nobody entered the room. The color-coded agar plates were incubated for 3 days at 37° C. One microbiologist, blinded to the treatment groups, counted the number of colony forming units (CFUs) on each plate using a Quebe Colony Counter.

The statistical analysis of the data was done using SPSS version 11.0 for windows. Chi-square and Student's t-test were used for checking the significance of the data. A p-value of 0.05 and lesser was defined to be statistically significant.

RESULTS

Table 1 shows the demographic data of Group A and B. There were 10 patients in each group. The mean age of patients in Group A was 13.69 years and in Group B was 14.58 years. The number of boys in group A and B was 4 and 5, respectively. Table 2 shows the mean number of Colony forming units (CFUs) after the procedure. It was observed that mean CFU number in Group A was 63.98 and in Group B was 22.68. The results on comparison were found to be statistically significant. ($p<0.05$)

DISCUSSION

In the present study, we studied reduction of hazardous effects in aerosol-generating procedures in orthodontics. From the results, this can be reported that treatment procedures which include use of aerosol producing handpieces poses much higher risk of contamination as compared to procedures which do not require the handpieces.

The results on comparison were found to be statistically significant.

Table 1: Demographic data of Group A and B.

Variables	Group A	Group B
Total no. of patients	10	10
Mean age (years)	13.69	14.58
Number of boys	4	5
Number of girls	6	5

Table 2: Mean number of Colony forming units (CFUs) after the procedure.

	Group A	Group B	p-value
Mean CFU	63.98	22.68	0.005

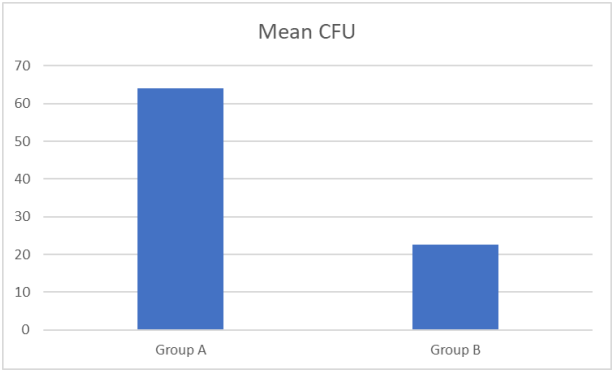

Fig 1: Mean CFU.

D. Koletsi et al [7] identified the effectiveness of different interventions used in dental practice to reduce microbial load in aerosolized compounds. They report that tempered chlorhexidine (CHX) 0.2% as compared with nonactive control mouth rinse, prior to routine ultrasonic scaling, was most effective toward reduced postprocedural bacterial load with an MD of −0.92 in log10 bacterial CFUs (colony-forming units). For CHX 0.2%, an MD of −0.74 was observed as compared with control. Tempered CHX 0.2% presented the highest probabilities of being ranked the most effective treatment (31.2%). Level of confidence varied from very low to moderate across all formulated comparisons. These findings summarize the current state of research evidence in the field of aerosolized bacteria in dentistry. Instigated by the era of SARS-CoV-2 pandemic, the stipulation of a broader evaluation of the aerosolized microbes, including viruses, potentially coupled with disinfectant-based prevention schemes should be prioritized. Toroğlu M et al [8] evaluated the aerosol generated by the use of an air turbine handpiece during debonding procedures increases the potential risk factor for the distribution of infectious agents. Blood agar plates were attached to the face shields and the dental chair table and were used for collecting the aerosol samples. In the first part of the study, 260 samples were collected for the baseline group in an empty room, 36 samples were collected for the control group (C), in which the orthodontist, dental assistant, and the patient were in the operatory room, and 42 samples were collected for the debonding group (DB). The microbiologic analysis showed significant differences between the baseline group and the control group ($P < .05$). Furthermore, aerosol contamination increased significantly during the debonding procedure when compared with the control group ($P < .01$). Results of this study indicated that orthodontists are exposed to high levels of aerosol generation and contamination during the debonding procedure, and preprocedural chlorhexidine gluconate mouth rinse appears to be ineffective in decreasing the exposure to infectious agents. Therefore, barrier equipment should be used to prevent aerosol contamination.

Dawson M et al [9] described bacterial load and diversity of the aerosol created during enamel cleanup after the removal of fixed orthodontic appliances and to assess the effect of a preprocedural mouth rinse. They studied the sampling of ambient air adjacent to the patient's mouth during adhesive removal using a slow-speed handpiece and a spiral fluted tungsten carbide bur without water irrigation. Sampling was carried out during enamel cleanup with or without a preprocedural mouth rinse of either sterile water or chlorhexidine. Airborne particles were collected using a viable inertial impactor simulating the human respiratory tree. The bacteria collected were analyzed using both culture and molecular techniques. Bacteria produced during debond and enamel cleanup can reach all levels of the respiratory tree. The use of a preprocedural mouth rinse, either sterile water or chlorhexidine, increased the numbers and diversity of the bacteria in the air. They concluded that when using a slow-speed handpiece and a spiral fluted tungsten carbide bur for enamel cleanup after orthodontic treatment, the bacterial load and diversity of the aerosol produced are lower when a preprocedural

mouth rinse is not used. Day CJ et al [10] studied inhalation of aerosols produced during the removal of fixed orthodontic appliances. Orthodontic brackets and bands were attached to extracted teeth to simulate complete dental arches. Four variations of enamel cleanup were used: the variables were hand-piece speed and presence or absence of water. Air sampling was conducted by using a cascade impactor, and the filter media collected from each experiment were viewed under a scanning electron microscope to locate the particulate matter. X-ray microanalysis was used to identify particle composition. The amount of debris deposited on the filter media was highly variable. The combination of fast hand piece with water irrigation demonstrated the highest concentration of debris deposited at the greatest depth in the (artificial) lung. Although the particles are most likely to be deposited in the conducting airways and terminal bronchi, some might be deposited in the terminal alveoli of the lungs and cleared only after weeks or months. The most common elements identified were calcium, phosphorus, silica, and aluminum. Other elements included iron and lanthanum.

CONCLUSION

Within the limitations of the present study, it can be concluded that procedures which involve usage of handpieces and other instruments producing aerosols poses much higher risk of infection from patient as compared to procedures in which handpieces are not required. Thus, in the era of pandemic, the usage of aerosol generating handpieces should be minimized.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

REFERENCES

1. World Health Organization Coronavirus situation report.

2. Meng L, Hua F, Bian Z. Coronavirus Disease 2019 (COVID-19): emerging and future challenges for dental and oral medicine. J Dent Res. 2020; 99: 481-487

3. Tang D, Comish P, Kang R. The hallmarks of COVID-19 disease. PLoSPathog. 2020; 16: e1008536

4. Hinds W.C. Aerosol technology: properties, behavior, and measurement of airborne particles. 2nd ed. Wiley-Interscience, Hoboken1999

5. Eliades T., Papageorgiou S.N., Ireland A.J. The use of attachments in aligner treatment: analyzing the “innovation” of expanding the use of acid etching-mediated bonding of composites to enamel and its consequences. Am J Orthod Dentofacial Orthop. 2020;158:166–174.

6. Iliadi A., Koletsi D., Papageorgiou S.N., Eliades T. Safety considerations for thermoplastic-type appliances used as orthodontic aligners or retainers. A systematic review and meta-analysis of clinical and in-vitro research. Materials (Basel) 2020;13:1843.

7. D. Koletsi, G.N. Belibasakis, T. Eliades. Interventions to Reduce Aerosolized Microbes in Dental Practice: A Systematic Review with Network Meta-analysis of Randomized Controlled Trials. Volume: 99 issue: 11, page(s): 1228-1238

8. Toroğlu, M &Haytaç, M &Koksal, Fatih. (2001). Evaluation of Aerosol Contamination during Debonding Procedures. The Angle orthodontist. 71. 299-306. 10.1043/0003-3219(2001)071<0299:EOACDD>2.0.CO;2.

9. Dawson M, Soro V, Dymock D, Price R, Griffiths H, Dudding T, Sandy JR, Ireland AJ. Microbiological assessment of aerosol generated during debond of fixed orthodontic appliances. Am J Orthod Dentofacial Orthop. 2016 Nov;150(5):831-838. doi: 10.1016/j.ajodo.2016.04.022. PMID: 27871710.

10. Day CJ, Price R, Sandy JR, Ireland AJ. Inhalation of aerosols produced during the removal of fixed orthodontic appliances: a comparison of 4 enamel cleanup methods. Am J Orthod Dentofacial Orthop. 2008 Jan;133(1):11-7. doi: 10.1016/j.ajodo.2006.01.049. PMID: 18174065.