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COMPARISON OF PHYSICAL AND ACCEPTABILITY TESTS OF EXTRA ORAL SUCTION IN RSGM UGM PROF. SOEDOMO

PERBANDINGAN UJI FISIK DAN AKSEPTIBILITAS PADA PENGGUNAAN EXTRA ORAL SUCTION DI RSGM UGM PROF. SOEDOMO

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ABSTRAK

Penyebaran Covid-19 melalui aerosol dan droplet terjadi selama perawatan gigi. Dokter gigi menggunakan high-volume suction (HVS) dan saliva ejector untuk menyedot saliva, darah, dan air dari rongga mulut. Sejak pandemi, pembuatan prototipe, produksi, dan penggunaan extra oral suction (EOS) meningkat. EOS terdiri dari filter HEPA (High Efficiency Particulate Air), plasma ions, dan ultraviolet (UV). Penelitian ini digunakan untuk melihat efektivitas penggunaan EOS, melalui perbandingan uji fisik dan akseptibilitas pada penggunaan EOS di RSGM UGM Prof. Sodeomo dengan menggunakan tiga merk EOS, Coxo™, Eighteeth™ Vacstation, dan Eostra™. Uji Fisik digunakan untuk menilai kemampuan sebuah alat saat digunakan. Tes Akseptabilitas untuk menilai penerimaan pengguna terhadap EOS berdasarkan pengalaman penggunaan. Penelitian dilakukan di RSGM UGM Prof. Soedomo (Klinik Pendidikan Profesi, Klinik Pendidikan Residen, Unit Pelayanan Umum dan Unit Pelayanan Spesialistik) pada tahun 2021 dengan 90 responden yang merupakan pengguna EOS. EOS yang memiliki daya hisap, angka kebisingan, dan daya listrik terbesar adalah Eostra™, sedangkan berdasarkan pengalaman pengguna, EOS yang lebih diterima dan lebih nyaman untuk digunakan oleh pengguna adalah Coxo™. EOS mengurangi paparan aerosol saat perawatan gigi dan berdasarkan pada penelitian ini, EOS yang memiliki kapasitas yang baik belum tentu nyaman digunakan oleh pengguna, hal ini karena masing-masing merk memiliki kelebihan dan kekurangan, sehingga dalam pemilihan EOS disesuaikan dengan kapasitas operator dan tempat praktik.

Keywords: *Extraoral; Suction; Covid-19; Dental; Coronavirus.*

ABSTRACT

The spread of COVID-19 through aerosols and droplets occurs during dental treatment. Dentists use high-volume suction (HVS) and saliva ejectors to suction saliva, blood, and water from the oral cavity. Since the pandemic, prototyping, production, and use of extraoral suction (EOS) have increased. EOS comprises HEPA (High-Efficiency Particulate Air), plasma ions, and ultraviolet (UV) filters. This study was used to see the effectiveness of the use of EOS through a comparison of physical and acceptability tests on the use of EOS at UGM Prof. Sodeomo Dental Hospital using three EOS brands, Coxo™, Eighteeth™ Vacstation, and Eostra™. Physical Test is used to assess the ability of a tool when used – Acceptability Test to assess user acceptance of EOS

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based on usage experience. The study was conducted at the UGM Prof. Soedomo Hospital (Professional Education Clinic, Resident Education Clinic, General Service Unit, and Specialistic Service Unit) in 2021 with 90 respondents who were EOS users. The EOS with the most incredible suction power, noise figure, and electrical power was Eostra™, while based on user experience, the EOS that was more accepted and more comfortable for users to use was Coxo™. EOS reduces aerosol exposure during dental treatment, and based on this study, EOS that had good capacity was not necessarily comfortable to use by users; this was because each brand had advantages and disadvantages, so the selection of EOS was adjusted to the capacity of the operator and the practice site.

Keywords: *Extraoral; Suction; Covid-19; Dental; Coronavirus.*

INTRODUCTION

Coronavirus has wide variations, especially when attacking the respiratory tract, and its manifestations range from mild to severe. The COVID-19 virus is a single-stranded RNA (ribonucleic acid) virus with a crown-like shape because its glycoprotein spikes on its outer layer [1]. In 2019, the coronavirus that caused an infection outbreak was SARS-CoV-2 (Severe Acute Respiratory Syndrome Corona Virus 2), better known as COVID-19. This virus was first discovered in Wuhan, and it spreads very quickly and is deadly. WHO declared a pandemic on March 11, 2020 [2].

COVID-19 was first reported in Indonesia on March 2, 2020, with two cases. Data for March 31, 2020, shows that there were 1,528 confirmed cases and 136 deaths. The COVID-19 mortality rate in Indonesia is 8.9% in Southeast Asia. The spread of SARS-CoV-2 from human to human is the primary transmission source, making the spread more aggressive. Transmission of SARS-CoV-2 from symptomatic patients occurs through droplets released when coughing or sneezing and also aerosols (produced via nebulizers). Transmission of SARS-CoV-2 can occur through direct contact, indirect contact, or close contact with an infected person through secretions such as saliva and respiratory tract secretions or respiratory droplets that come out when an infected person coughs, sneezes, talks, or sings [1].

The spread of COVID-19 is through mucous membranes directly in the eyes, nose, and oral cavity, which come into contact with aerosols that carry infection [4]. Respiratory droplets have a diameter of > 5-10 µm, while droplets with a diameter of ≤ 5 µm are called droplet nuclei or aerosols [5]. The spread of coronavirus (COVID-19) presents challenges for dental healthcare providers. The COVID-19 pandemic has forced dental practices to limit the type of treatment they provide to emergency cases only. This is due to the high risk of transmission to health workers, especially dental health service providers (dentists and dental nurses) [6]. In dental practice, transmission of SARS-CoV-2 is via droplets and aerosols formed during clinical procedures, especially when using dental burs, ultrasonic equipment, and handpieces [7].

The use of high-speed handpieces accompanied by water, ultrasonic scalers, and three-way syringes during dental treatment causes the formation of aerosols and droplets that mix with saliva and blood from the patient's oral cavity. During patient treatment, the dentist uses high-volume suction (HVS) and saliva ejector, or what is usually called intraoral suction, which functions to suck saliva, blood, and water from the oral cavity. Since the start of the pandemic, there has been an increase in prototyping, production, and use of extraoral suction (EOS). Extraoral suction is used to suck up aerosols and droplets that come out of the patient's oral cavity.

Extraoral suction is used in dental care to reduce the risk of infection, particularly during procedures that produce droplets and aerosols. Several researchers discovered that extraoral suction protects against the spread of droplets and aerosols, limiting their areas to the left and posterior sides of the dental chair head when performed by right-handed dentists and dental hygienists [8].

Using external suction is an effective method of reducing droplet spatter. It can help reduce the risk of COVID-19 spread during dental procedures, especially near the patient's

head, where most aerosols are generated [9]. Apart from that, extra oral suction is used simultaneously with HVS, and a saliva ejector operated by an assistant [10]. The specific composition of extra oral suction units may vary depending on the manufacturer and model. The extraoral suction device typically consists of a suction hose with a trumpet-shaped suction port and a HEPA filter designed to capture particles as small as 0.3 microns.

The HEPA filter is an essential component of the unit, as it helps to remove aerosol particles from the air effectively. In addition to the HEPA filter, extra oral suction units may include a suction pump, tubing, and a collection container for the captured aerosol particles. The suction pump creates a negative pressure that draws in the aerosols while the tubing transports the aerosols to the collection container. The collection container is designed to safely contain the captured aerosol particles, preventing their release into the environment [11].

In addition to extraoral suction, dentists and dental assistants can use appropriate PPE to reduce splatter during dental procedures, which can help minimize the risk of exposure to infectious agents like COVID-19. Using PPE, such as face shields, goggles, or protective eyewear, can provide a barrier against splatter and protect the eyes from contamination. Wearing a mask, such as an N95 respirator or a surgical mask, can help prevent the inhalation of splatter particles.

Disposable gowns or protective clothing can be worn to protect the body from splatter and minimize the risk of contamination. Gloves should be worn to protect the hands and prevent the spread of infectious agents. Regular hand hygiene, including handwashing and the use of hand sanitizers, is also essential [12].

RSGM UGM Prof. Soedomo is a hospital that provides dental and oral health services. RSGM UGM Prof. Soedomo also provides clinical education for dental students. Since the COVID-19 pandemic, RSGM UGM Prof. Soedomo has made changes to minimize the spread of COVID-19 and be able to provide safe dental and oral health services for patients and operators, one of which is using extraoral suction and negative chamber, both in general services, specialists and in educational clinics.

The various types of extraoral suction devices in circulation have different specifications. The main aim of this research was to see the effectiveness of the use of EOS through a comparison of physical and acceptability tests of EOS at UGM Prof. Sodeomo Dental Hospital using three EOS brands, Coxo™, Eighteeth™ Vacstation, and Eostra™™ for dental and oral health service providers.

METHOD

This experiment used two tests: the physical test and the acceptability test. Physical examinations were conducted by measuring suction power, noise, and electrical power on three brands of extra oral suction on the Indonesian market and used at the RSGM UGM Prof. Soedomo. The acceptability test was given to extra-oral suction users based on their experience using extra-oral suction brands. The extraoral suction brands used in this study were Eostra™, Coxo™, and Eighteeth™ Vacation.

The physical test was implemented using a phantom to simulate the patient's position. It was attached to a dental unit in the RSGM UGM Prof. Soedomo dental office with an area of 18.20 m2 (4.92 m x 3.70 m) and negative pressure with an ACH (air change per hour) of 24.7.

Measurement of suction power using an anemometer. This research used Krisbow™ 10176832 5 in 1 Pro Environment Meter with specification air velocity range 0.40 to 30.00 meters per second (m/s), resolution 0.01, and accuracy ± 3.5% to ± 20%. Aerosol simulation using ultrasonic scaler Bonart Piezo™ ART-1 with specification operating frequency 25 khz ± 5%, output power in regular scaling mode approximately 10W to 30W±10% and output power in turbo mode 20W to35W±10%. Extraoral suction (EOS) capacity was measured on the extra oral suction hose, marked at 9 measuring position points (Figure 1).

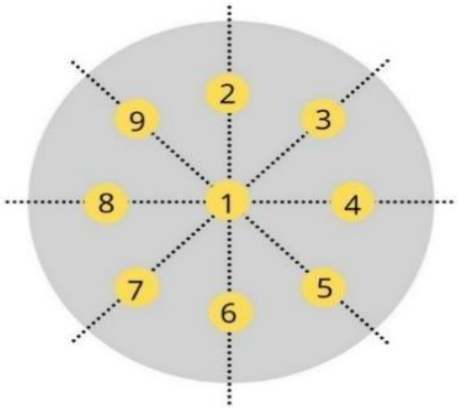

Figure 1
Measurement Point of Suction Power on the Hose
Source: Personal Analysis, 2022

The measurement of noise using a sound level meter/DB meter Krisbow™ 10176832 5 in 1 Pro Environment Meter with specification two modes provides 2,5 dB or 3,5 dB accuracy, low measuring ranges (35 to 100dB), high measuring ranges (65 to 130dB), with resolution 0,1dB. Measurements were performed at specific points in the chamber of a closed environment and taken from the distance between the unit and the user or operator, the distance between the unit and the patient, the distance between the unit and the assistant operator, and the distance at each corner of the room or chamber (Figure 2).

Area selection was based on the activity patterns of operators, assistants, and patients. Point 1 measurement was used to determine the noise level of the extra-oral suction device with the airflow rate of the room air conditioner. Point 2 measurement was used to determine the noise level of the extra-oral suction device with the center distance between the extra-oral suction device and the room air conditioner. Measurement point 3 was used to determine the noise level of the extra-oral suction device against the operator's assistant. Point 4 measurement was used to determine the noise level of the extra-oral suction device toward the patient.

Measurement point 5 was used to determine the noise level of the extra-oral suction device to the operator. Measurement point 6 was used to determine the noise level of the extra-oral suction device with the center distance between the extra-oral suction device and the room's exhaust fan. Measurement point 7 was used to determine the noise level of the extra-oral suction device at the farthest point from the device. Measurement point 8 was used to determine the noise level of the extra-oral suction device with the room's exhaust fan air flow rate.

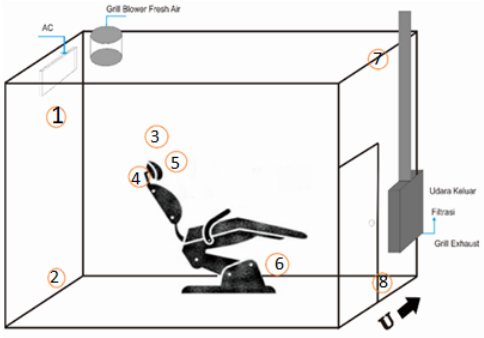

Figure 2
Noise Measurement Point in Dentist Office
Source: Data Analysis (2022)

Electrical power measured by Clamp Meter Sanwa™ types DCM60R with specification true RMS, measurable AC 0.1A to 600A, ACV & Resistance measurement, Sampling rate approximately two times / second, and AC frequency bandwidth: 50 to 400 Hz. The procedure for measuring electrical power was extra oral suction, measured when the tool was turned on until it stabilized and the maximum current value was taken. Then, after the maximum current value had been obtained, the electrical power calculation was applied.

Acceptability testing was carried out on extra-oral suction users to assess whether users received this extra-oral suction well. The test was evaluated using a Likert Scale questionnaire based on respondents' experience using a scale based on tool specifications consisting of tool size, suction power, noise level, tool design, tool operation, arm movement, and ease of disinfection. The Likert scale allows respondents to express their agreement or disagreement on a set of issues by placing

their attitudes on a scale that ranges from 1 as strongly disagree to 5 as strongly agree.

All questions in the questionnaire were the result of the author's analysis, which was tested for validity and reliability first. The questionnaire consisted of 11 questions that had never been used in research (Table 1).

Table 1
Questionnaire Question List

No	Question	Score				
		1	2	3	4	5
1.	This extra oral suction can be used easily					
2.	This extra oral suction has a stable arm					
3.	Extra oral suction has a physical form that is suitable for use in a dentist's office					
4.	This extra oral suction has an ergonomic design					
5.	When used to perform actions, the sound produced by extra oral suction does not make noise					
6.	Extra oral suction has the ability to compete with other extra oral suction brands on the market.					
7.	Extra oral suction can be easily learned to use					
8.	Extra oral suction can be easily used or operated.					
9.	This extra oral suction can be cleaned easily					
10.	I am satisfied with the performance of this extra oral suction					
11.	I would recommend this extra oral suction to others to be used in the office/hospital/clinic.					

Source: Personal Analysis, 2022

The questionnaire filling began with an explanation by the researcher, and then after the respondent was willing to fill in, the respondent filled out the informed consent. The questionnaire was aimed at respondents who worked at the Klinik Pendidikan Profesi, Klinik Pendidikan Residen, Unit Pelayanan Umum dan Unit Pelayanan Spesialistik. The total questionnaire respondents were 90, divided into 30 Coxo™ users, 30 Eostra™ users, and 30 Eighteeth™ Vacstation users. Respondents were operators and assistants. Extraoral suction users were not limited by age and gender. In addition, work experience and learners' supervision level were the exclusion criteria.

RESULTS AND DISCUSSION

Suction Power

Suction power was one of the physical tests used to see the suction power of an extra-oral suction. The results were obtained by measuring the 9 points, taking the average, and then comparing the results with those of extra oral suction (see Figure 3 and Table 2).

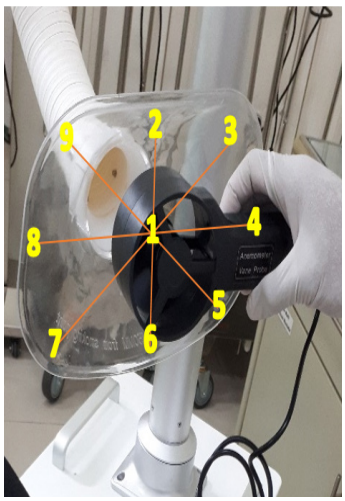

Figure 3
Suction Power Measurement Points Using Anemometer
Source: Personal Documentation (2022)

Table 2
Suction Power Measurement Result

Brands	Suction Power (average) (m/s)
Coxo™	1,61
Eighteeth™ Vacstation	1,16
Eostra™	2,22

Source: Data analysis (2022)

Based on the measurement results in the table, the Eostra™ brand extra oral suction had the most considerable suction power, and Eighteeth™ Vacstation had the most minor suction power. The suction power of an extra-oral suction was related to the capacity of the extra-oral suction machine. In addition, the three extra oral suction machines had different hose and arm shapes, which could also affect the suction power. Long, curved arms will create poor airflow, reducing suction power. On the other hand, a wider hose would also make suction power less localized.

Noise

The noise level measurement was one of the physical tests used to see the amount of sound produced by a device. The louder noise would make the environment less comfortable. Eostra™ had the highest noise value, followed by Coxo™ and Eighteeth™ Vacation. It is related to the suction power measurement result. A large extra oral suction machine capacity would produce a loud sound and create more noise.

Table 3
Noise Measurement Result

Brands	Noise
Coxo™	90 db
Eighteeth™ Vacstation	77 db
Eostra™	99 db

Source: Data analysis (2022)

Electrical Power

Electrical power was one of the physical tests to see the maximum electrical power required by a device to work. Eostra™ spent the highest electrical power compared to Eighteeth™ Vacstation and Coxo™. This electrical power calculation aimed to see how much power is needed to use extra-oral suction tools so that users could choose extra oral suction according to their needs and according to the electrical power in clinics, private practices, and hospitals.

Table 4
Electricity Power Measurement

Brands	Ampere	Voltage	Power
Coxo™	1,9 A	220 V	418 W
Eighteeth™ Vacstation	1,5 A	220 V	330 W
Eostra™	4,4 A	220 V	968 W

Source: Data analysis (2022)

Acceptabillity Test

Validity and reliability tests were performed to evaluate the questions list. Based on the measurement, the list of questions was valid and reliable. Based on the questionnaire result, the extra-oral suction that resulted in the highest point was Coxo™, followed by Eighteeth™ Vacstation and Eostra™. It could show that in this study, users prefer to use Coxo™ rather than other brands.

Table 5
Statistics Test

No	R (value)	R (table)	Level of Significance	Cronbach's Alpha
1	0.8042	0.2072	0.05	0.922
2	0.7296			
3	0.7079			
4	0.6511			
5	0.6966			
6	0.8119			
7	0.6779			
8	0.8153			
9	0.7816			
10	0.8271			
11	0.7769			

Source: Data analysis (2022)

Table 6
Questionnaires Result

Brands	Questionnaire Value
Coxo™	1205
Eighteeth™ Vacstation	1181
Eostra™	1171

Source: Data analysis (2022)

Since the beginning of the COVID-19 pandemic, the spread of Coronavirus has been associated with aerosols and droplets from the oral cavity. In oral health care, dentists, dental assistants, and the dental practice environment were at high risk of being exposed to aerosols contaminated with Coronavirus or other viruses and bacteria that spread through splashes or air. The COVID-19 pandemic made many restrictions related to oral health services, especially for emergency cases only [13].

Various efforts were made to minimize aerosol production and exposure to the aerosols entering the respiratory tract. Dentists, dental assistants, and health services teams must use proper personal protective equipment (PPE) to protect their bodies from aerosol exposure. On the other hand, to minimize exposure in the dentist's office, the dental practitioner should rearrange the airflow and pay more attention to office sterilization [14].

Treatment procedures in dental practices could be a transmission route for COVID-19. Transmission could occur through direct dentist-patient contact, aerosols formed during treatment procedures, and contamination from instruments or surfaces in the dental office. Postponing dental treatment during the pandemic might temporarily reduce the risk of transmission, but for long periods, dental care must still be carried out.

Dental treatment often involves instruments that create aerosols during the procedure, for example, handpieces and ultrasonic scalers. It could increase the risk of disease transmission through aerosols and droplets. Before the era of extra oral suction, saliva ejectors were commonly used to reduce aerosol, and high-volume suction was installed in the dental units. Several manufacturers produced extra oral suction devices. During dental treatment, extraoral suction was added to minimize aerosols and protect the dental team from exposure to viruses, bacteria, and airborne disease [15]

The extraoral suction became popular after COVID-19. Extraoral suction is an essential tool in the dental office. Extraoral suction collects aerosols, droplets, dust, and pathogens produced during routine dental procedures through a suction hose. Extraoral and intraoral suction are two methods used in dental care to reduce the risk of infection. Extraoral suction refers to using a suction device outside the oral cavity to remove droplets and aerosols produced during dental treatments [16]. It is recognized as a valuable tool for reducing the spread of airborne pathogens, such as SARS-CoV-2, in dental care [17].

However, the effective area of extraoral suction is limited and depends on the physical characteristics of the dental professional. In contrast, intraoral suction involves using a suction catheter inside the oral cavity to remove fluids and debris. It is designed to assist dental staff during procedures by providing chair-side, hands-free suction, and isolation. The main body of the intraoral suction device may be made of a flexible, high heat-resistant, and autoclavable material, such as silicone, making it reusable [18].

The main difference between extra-oral and intra-oral suction lies in their respective functions and areas of operation. Intra-oral dental suction achieves visibility and removes fluids from the oral cavity during dental procedures. On the other hand, extra oral suction is designed to absorb droplets and aerosols produced during these procedures, thereby preventing viral and microbial transmission via aerosols. While intra-oral suction focuses on the operating site within the oral cavity, extra-oral suction targets the surrounding environment, reducing the spread of aerosols and enhancing overall safety in the dental clinic. The combination of intraoral and extra-oral suction can provide maximum results.

The effectiveness of extra oral suction can be seen from physical tests such as measuring suction power, noise, and electrical power. The suction power of extra oral suction units varies depending on the model and manufacturer. Suction power was related to the machine's capacity used by an extra oral suction. But generally, extra oral suction with solid suction power would produce louder noise and require higher electricity power. On the other hand, extra oral suction that had low suction power would produce more quiet noise and needed lower electricity power. Strong suction power would reduce aerosol exposure. It could minimize the spread of aerosol created during oral treatment.

Strong suction power has been shown to reduce aerosol exposure effectively in dental procedures. Studies have found that high-volume dynamic suction devices consistently reduce particle counts to background levels, eliminating aerosol particle escape from the oral cavity. On the other hand, low-volume and static suction devices have shown spikes in particle counts, indicating moments where particles could escape [18]. Additionally, using an air extractor during the coughing of simulated patients has been found to significantly reduce the number of aerosols spreading toward the operator's face [19].

Furthermore, using a chairside extra-oral suction (EOS) device has been shown to reduce aerosol contamination in the dental setting, particularly near the patient's head, where most aerosols are generated [20]. Therefore, strong suction power, whether intra-oral or extraoral, can effectively mitigate aerosol exposure and reduce the risk of infection.

The suction power, electricity power, and noise levels of extra oral suction units are related. The suction power of extra oral suction units is determined by the power of the motor, which is also associated with the electricity power consumption. The higher the suction power, the higher the electricity power consumption. The noise levels of extraoral suction units are also associated with the motor's power. The higher the suction power, the higher the noise levels. As the suction power increases, the noise level typically also increases. This relationship is due to the higher airflow and vacuum pressure generated by the system's motor to achieve greater suction power, resulting in increased noise levels.

The high suction strength would reduce aerosols dispersed in the air, thus reducing the risk of airborne disease transmission. However, what needs to be considered is that the sound produced by a device with a high suction strength would generally be noisier, which could disturb dentists, operators, and patients. However, some extra oral suction units were designed with noise suppression technology to reduce noise levels significantly. The mechanism of extra oral suction is similar to that of a vacuum cleaner. Getting a tool with strong suction power commonly requires a large-capacity machine requiring much electrical power. The higher the electrical power required; the more electricity consumed for each use. This study showed that extraoral suction, which had greater suction power, also required greater electrical power.

Therefore, the suction power, electricity power, and noise levels of extra oral suction units are interrelated, and the specific specifications could vary between different models and manufacturers. Acceptance tests were designed to replicate the real-life use of the product to verify that it's functioning as expected. Acceptance testing aimed to ensure that the final product had the specifications and quality before use. The acceptability test was performed to investigate the acceptance from the users (dentist and assistant) based on their experience.

Based on the scores collected by the 11 questions from the questionnaire, Coxo™ got the highest score. It showed that users prefer to choose Coxo™ rather than the other brands. From the results of the measurements, Coxo™ did not have the highest score of suction power and did not produce a loud noise. This means the user (dentist and assistant) felt comfortable performing dental treatment with Coxo™ extra oral suction.

User acceptance, in this case, of extra oral suction by dentists and assistants was only sometimes based on the better performance of a device. Still, this acceptance was a preference of each user. Some users preferred strong suction to the noise produced by an extra oral suction. Still, some users prioritized extra oral suction as being comfortable to use for patients (not making too much noise), even with the spread of aerosols that were riskier. When considering the use of extraoral suction, it is essential to evaluate the benefits and costs of the technology. Extraoral suction effectively reduces the spread of aerosols and droplets during oral treatment.

Still, users needed to consider the noise produced by the device, suction power, the position of the extra-oral suction in the patient's oral cavity, and the device's design. However, the investment in extra-oral suction technology can be significant, and the specific specifications, such as suction power, electricity power, and noise levels, can vary between different models and manufacturers. Additionally, using extra-oral suction may require additional training for dental staff and changes to the dental office's layout to accommodate the equipment. Overall, using extraoral suction can significantly improve a clinician's safety protocol, but it is essential to evaluate the benefits and costs of the technology before making a decision.

CONCLUSION

Rotary and ultrasonic instruments produced many droplets and aerosols and were used in dental treatment procedures. These particles could spread around the environment, especially in the air. Extraoral suction was used to reduce aerosols created during dental treatment. Extraoral suction, which had higher suction power, would make a higher noise level and needed significant electrical power. EOS, which had good capacity, was uncomfortable for users because the brand had advantages and disadvantages. The selection of extra oral suction was adjusted to the capacity of the operator and the practice site.

Additional oral suction was not limited to the Covid-19 pandemic; it was also used to handle patients with a history of airborne diseases. For further research, it is necessary to conduct a study to see the efficacy of aerosol spreading during dental treatment and to see the efficiency of the device design, including the hose and the arms of extra oral suction, and also investigate the amount of particle that absorbs in the extraoral suction.

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BIBLIOGRAPHY

[1] Stevanie, C. 2020. Efektivitas Extraoral Suction dalam Praktik Kedokteran Gigi di Masa Pandemi COVID-19. *Jurnal Kedokteran Meditek*. Page 91-98. DOI: https://doi.org/10.36452/jkdoktmeditek.v26i3.1919

[2] Muktawat, K. 2020. Dental Clinic Management in Between/After COVID-19. *Internatinal Journal of Applied Dental Science*. Vol 6 no 3 pp. 31-38. https://doi.org/10.22271/oral

[3] WHO. 2014. *Infection Prevention and Control of Epidemic-and Pandemic-Prone Acute Respiratoty Infections in Health Care*. Geneva, Switzerland. 2014. https://www.who.int/publications/i/item/infection-prevention-and-control-of-epidemic-and-pandemic-prone-acute-respiratory-infections-in-health-care

[4] Matys, J., Grzech-Lesniak, K. 2020. Dental Aerosol as a Hazard Risk for Dental Workers. *Journal Material*. https://doi.org/10.3390/ma13225109

[5] WHO. 2020. Transmission of SARS-CoV-2: implications for infection prevention precautions. https://www.who.int/news-room/

commentaries/detail/transmission-of-sars-cov-2-implications-for-infection-prevention-precautions

[6] Susilo, Adityo; Rumende, C. Martin; Pitoyo, Ceva W.; Santoso, Widayat Djoko; Yulianti, Mira; Herikurniawan, Herikurniawan; Sinto, Robert; Singh, Gurmeet; Nainggolan, Leonard; Nelwan, Erni J.; Chen, Lie Khie; Widhani, Alvina; Wijaya, Edwin; Wicaksana, Bramantya; Maksum, Maradewi; Annisa, Firda; Jasirwan, Chyntia OM; and Yunihastuti, Evy. 2020. Coronavirus Disease 2019: Tinjauan Literatur Terkini. *Jurnal Penyakit Dalam Indonesia*. Volume 7. https://doi.org/10.7454/jpdi.v7i1.415

[7] Chmielewski, M. 2021. COVID-19 in dental care: What do we know?. *Journal Of Oral Microbiology*. Volume 13. https://doi.org/10.1080/20002297.2021.1957351.

[8] Hidenobu, Senpuku., Masahiko, Fukumoto., Toshikazu, Uchiyama., Chieko, Taguchi., Itaru, Suzuki., Kazumune, Arikawa. 2021. Effects of Extraoral Suction on Droplets and Aerosols for Infection Control Practices. *Dentistry Journal*. https://doi.org/10.3390/DJ9070080

[9] Sydnee, E., Chavis., Stella, E., Hines., Donita, Dyalram., Nicholas, Cole, Wilken., Richard, N., Dalby. 2021. Can extraoral suction units minimize droplet spatter during a simulated dental procedure. *Journal of the American Dental Association*, https://doi.org/10.1016/J.ADAJ.2020.10.010

[10] Gheorghita, Dorottya & Szabó, Fruzsina & Ajtai, Tibor & Hodovány, Szabolcs & Bozóki, Zoltán & Braunitzer, Gabor & Antal, Márk. 2022. Aerosol Reduction of 2 Dental Extraoral Scavenger Devices In Vitro. *International Dental Journal*. 72. https://doi.org/10.1016/j.identj.2022.05.007

[11] Nermin, Demirkol., Irem, Karagozoglu., İpek, Koçer. 2023. Efficiency of HEPA-filtered extra-oral suction unit on aerosols during prosthetic dental preparation: A pilot study. *Clinical Oral Investigations*. https://doi.org/10.1007/s00784-022-04850-x

[12] Vedushi, M., Jain., Soumya, Raj, Singh, Parihar., Shruthi, Acharya., Shashidhar, Acharya. 2023. Effects of wearing personal protective equipment (PPE) and its role in affecting the work efficiency of dentists during the COVID-19 pandemic. *Journal of Prevention Assessment & Rehabilitation*. https://doi.org/10.3233/wor-220083

[13] Muhamad, Tio, Dwi, Hertanto., Ajeng, Kartika, Sari., A., Furqoni. 2022. Implementation of community dental and oral health care before COVID-19 pandemic to new normal period at Public Health Care. *Padjajaran Journal of Dentistry*. 34(3)210-210. https://doi.org/10.24198/pjd.vol34no3.40410

[14] Alchusnah, RH. Sarastuti, D. Hidayati, LF. Septiantari, F. Lasara, BY. 2023. The effectiveness of using local exhaust ventilation, hepa filter, and dental aerosol suction on indoor air quality. *Padjajaran Journal of Dentistry*, March. 35(1):23-28.

[15] Nermin, Demirkol., Irem, Karagozoglu., İpek, Koçer. 2023. Efficiency of HEPA-filtered extra-oral suction unit on aerosols during prosthetic dental preparation: A pilot study. *Clinical Oral Investigations.* https://doi.org/10.1007/s00784-022-04850-x

[16] Hidenobu, Senpuku., Masahiko, Fukumoto., Toshikazu, Uchiyama., Chieko, Taguchi., Itaru, Suzuki., Kazumune, Arikawa. 2021. Effects of Extraoral Suction on Droplets and Aerosols for Infection Control

Practices. *Dentistry Journal*, https://doi.org/10.3390/DJ9070080

[17] Choi, Bum, Kyoo., Park, Mi, Ra. 2016. Intra-oral or extra-oral device for dentistry and dental device including the same.

[18] Krystyna, M., Piela., P.A., McGee, Watson., Reuben, Donnelly., MJ, Goulding., Fiona, L., Henriquez., William, G, Mackay., Shauna, Culshaw. 2022. Aerosol reduction efficacy of different intra-oral suction devices during ultrasonic scaling and high-speed handpiece use. *BMC Oral Health*, https://doi.org/10.1186/s12903-022-02386-w

[19] Asuka, Fujishiro., Takashi, Asai., Tomoyuki, Saito., Yasuhisa, Okuda. 2022. Efficacy of an aerosol suction device Free-100 M in removing aerosols produced by coughing to minimize COVID-19 infection. *Journal of Anesthesia*. https://doi.org/10.1007/s00540-022-03144-6

[20] Benjamin, Y., Wang, Lori E Henrichs, Kelli Arricale, Wen Lien, Daniel A Savett, Kraig S Vandewalle. 2023. Efficacy of a chairside extraoral suction system in the reduction of aerosol contamination. 71(3), 16-21.