

EVAC-AERO: Modified Extraoral High Volume Evacuator

Dr. Shreyasi Jogi¹, Dr. Anushree Bhoge², Dr. Rohit Patil³, Dr. Vaishnavi Banode⁴.

Abstract

Background: Dentists and dental hygienists are exposed to ubiquitous aerosolized cloud which mainly consists of particulate matter and fluid which is contaminated with pathogens due to use of high-speed hand-pieces and ultrasonic scalers.

Aim: To provide inexpensive and highly effective extra oral suction device which will minimize the microbial load during routine dental procedures and also will be highly effective in controlling transmission of air borne infections.

Materials and method: Evac aero works on the principle of negative suction pressure which being modified from a household vacuum cleaner evacuates coarse, fine and ultra fine particles of aerosol effectively which in turn will create a comparative safer zone for dental health care workers. Mobility of working arm will offer easy adaptability in all areas of function.

Conclusion: The EVAC AERO is highly effective in preventing air contamination by dental procedures. Main advantages are that it can be easily modified for its use with any dental unit and is relatively inexpensive.

Keywords: aerosol, dentistry, covid 19, extra oral suction, household vacuum cleaner

Presented at: 48th IPS National Virtual Conference 2020, Nagpur.

VSPMDCRC, Nagpur.

Introduction: Dentistry is classified under high-risk profession in terms of air borne infections. The novel corona virus now renamed as SARS CoV-2 has brought a significant setback in dentistry which gave room for research and inventions for exposure control from aerosols. Dentists and dental hygienists are exposed to ubiquitous aerosolized cloud which mainly consists of particulate matter and fluid which is contaminated with pathogens due to use of high-speed hand-pieces and ultrasonic scalers.

This current SARS COVID-19 pandemic gave us an eye-opening situation.

It gave us an introspect to look things minutely, as minute as an aerosol particle. Dentistry cannot work without production of aerosols which puts us into a high-risk zone for numerous airborne infections.

Also talking about dental clinical setup where we use intra oral suction tips for isolation and fluid



control in the oral cavity why there is a need of extra oral suction device? The answer lies in the definition of aerosol itself. Definition by Micicle and colleagues which says aerosols are particles of less

TECHNICAL INNOVATIONS

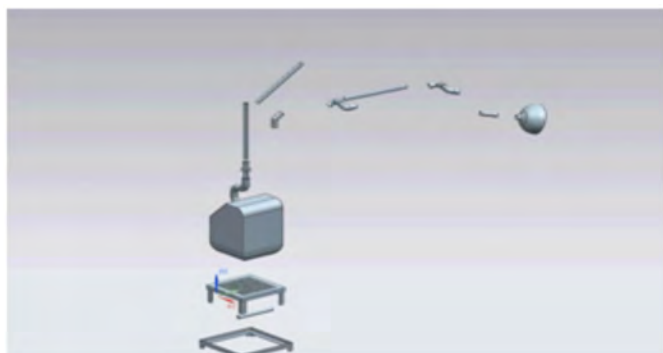
than 50 micrometers in diameter which are small enough to stay airborne for extended period. Yes, for extended period! Various diseases known to spread by droplets or aerosols are Pneumonic Plague, Tuberculosis, Influenza, Legionnaires' Disease, Severe Acute Respiratory Syndrome.

This gave us the scope of extra oral suction device which when used as a separate unit with all other universal precautions can help in substantial reduction of health hazards of aerosols.

Materials and methods: The central idea behind this innovative technique was to develop an inexpensive device using **household vacuum cleaner** for extra oral suction in clinical practice. It is portable and concise in a way that it can fit in any clinical space without interfering with four handed dentistry.

Evac aero works on principle of negative suction pressure. Suction pressure of 260 Kpa was used in the prototype device made and can be manufactured up to 320- 600 Kpa in the actual model.

It has a freely movable an arm length connector long enough with a funnel shaped suction which works to an effective height of 5.5 meters for better capture of bio-aerosols which makes it **hands-free high-volume evacuator**. The funnel shaped suction opening works best when kept around 15 cms from the aerosol generating source.



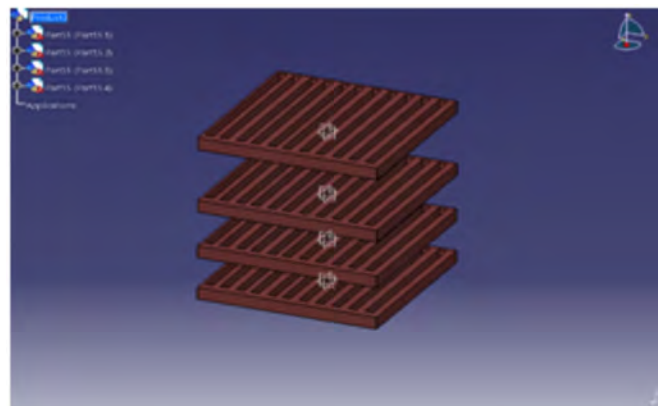
By placing the extra-oral suction device in the effective range, the evacuated particulate matter is captured with the help of vacuum pump inside the chamber, which then passes through four filter layers:

1. Prefilter for blood and contaminants

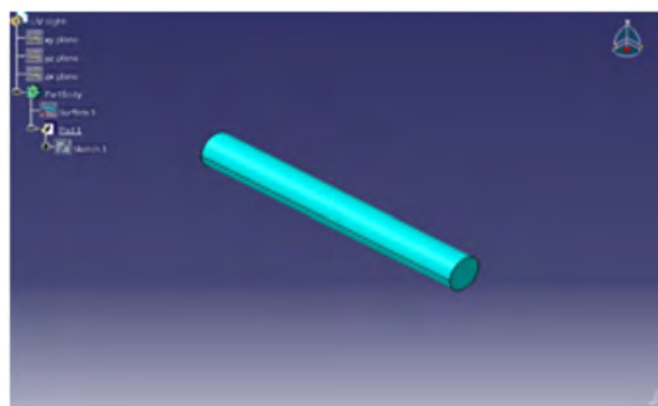
2. Moisture filter

3. HEPA filter

4. An additional Carbon filter



All of these layers are enclosed in the closed chamber where UV light of 220 Nm. is present which ensures the complete disinfection of the enclosed space of the device.



Power source used in this device is around 1400 Mpa and material used in the assembly of this prototype device is (stainless steel) SS304/ SS316/ SS3254 but fiber can also be used for final product.

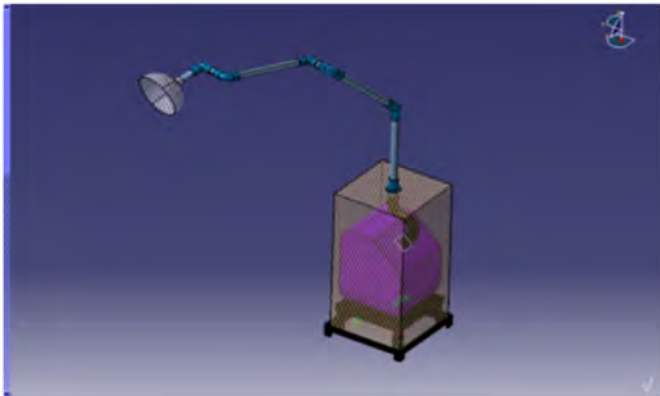
Advantages:

- 1 One of the major advantages of it is being Cost effective.
- 2 Reduces microbial load in clinical environment, therefore reduces chances of airborne infections.
- 3 Filters the collected particulate matter and air through stages.
- 4 Mobile and easy to store.

TECHNICAL INNOVATIONS

Disadvantages: Drawback of using an extra oral suction device is the noise generated during the procedure.

But to overcome this in this prototype, the entire chamber assembly is covered with foam sheet from inside, also rubber push button is used to ensure sound control. Furthermore, in the final manufactured product use of sound absorbing material can be considered.



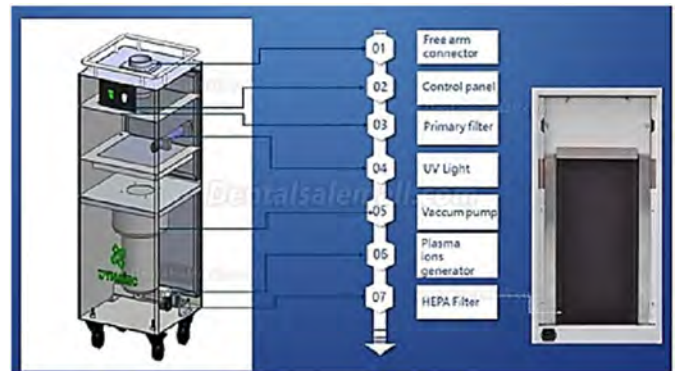
Discussion: Extra oral suction devices are proved to control and deplete the microbial load in a clinical environment but can sometimes impede the work flow as it occupies space and creates noise. To make it portable and freely movable was to overcome these drawbacks also a regulator knob was incorporated to ensure the control of suction pressure by the operator during procedures generating less aerosol and while operating in pediatric patients.

Another important feature to be highlighted is to filter the particulate matter before emitting it out as it will to control further contamination of the surrounding. The outlets will receive waste that has passed through filter layers making it safer.

Conclusion: As a strict measure for infection control in dentistry use of extra oral suction devices are increased and also with the SARS-Cov-2 pandemic, practical additional means of protection become more critical. The use of ESUs for clinical procedures helps in reduction of procedural splatter, surface contamination, and potential transmission of the SARS-Covid-virus in the dental setting.

The EVAC-AERO developed is maneuverable, did

not impede work flow, and provided an additional level of protection for clinical providers. Patient screening, PPE, proper infection control, and procedural isolation with intra oral techniques like rubber dam, as well as intra oral high-volume evacuation are still necessary to mitigate the risk of experiencing procedural contamination and transmission.



References:

1. Teanpaisan R, Taeporamaysamai M, Rattanachone P, Poldoung N, Srisintorn S. The usefulness of the modified extra-oral vacuum aspirator (EOVA) from household vacuum cleaner in reducing bacteria in dental aerosols. *International dental journal*. 2001 Dec;51(6):413-6.
2. Maharjan A, Joshi S, Maharjan SK. Effectiveness of Extra Oral Vacuum Aspirator During Dental Treatment in COVID-19 Pandemic. *Nepal Medical Journal*. 2020 Dec 31;3(2):47-50.
3. Harrel SK, Molinari J. Aerosols and splatter in dentistry: a brief review of the literature and infection control implications. *The Journal of the American Dental Association*. 2004 Apr 1;135(4):429-37.
4. Han P, Li H, Walsh LJ, Ivanovski S. Splatters and Aerosols Contamination in Dental Aerosol Generating Procedures. *Applied Sciences*. 2021 Jan;11(4):1914.
5. Polednik B. Aerosol and bioaerosol particles in a dental office. *Environmental research*. 2014 Oct 1;134:405-9.

Instructions for Authors

Please read the following instructions carefully and follow them stringently. Submissions not complying with these instructions will not be considered.

The Editorial Process: Manuscripts that are found suitable for publication in journal of prosthetic dentistry are sent to two or more expert reviewers. The journal follows a double-blind review process, wherein the reviewers and authors are unaware of each other's identity. Every manuscript is also assigned to a member of the editorial team, who based on the comments from the reviewers takes a final decision on the manuscript. The comments and suggestions (acceptance/ rejection/amendments in manuscript) received from reviewers are conveyed to the corresponding author. If required, the author is requested to provide a point by point response to reviewers' comments and submit a revised version of the manuscript. This process is repeated till reviewers and editors are satisfied with the manuscript. Manuscripts accepted for publication are copy edited for grammar, punctuation, print style, and format. Page proofs are sent to the corresponding author. The corresponding author is expected to return the corrected proofs within maximum two days. It may not be possible to incorporate corrections received after that period. The whole process of submission of the manuscript to final decision and sending and receiving proofs is completed by email.

Authorship Criteria: Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content. One or more authors should take responsibility for the integrity of the work as a whole, from inception to published article. Authorship credit should be based on the i. sizeable contributions to conception or design of the work, or the acquisition, analysis, or interpretation of data for the work; ii. Drafting of the work or revising it critically for important intellectual content; iii. Final approval of the version to be published; iv. Agreement to be accountable for all aspects of the work in ensuring that questions

related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. Each author should be accountable for the parts of the work he or she has done. In addition, each author should be able to identify which coauthors are responsible for specific other parts of the work and should have confidence in the integrity of the contributions of any coauthors.

All those designated as authors should meet all 4 criteria for authorship, and all who meet the 4 criteria should be identified as authors. Those who do not meet all 4 criteria should be acknowledged.

Scope of the journal: Journal Of Prosthetic Dentistry publishes original research, review papers, case reports in all areas of dental fields including dental educational research and bioethics in dentistry.

Submission of Contributions: All submissions and correspondence should be addressed to the Editor, Journal Of Prosthetic Dentistry, VSPM Dental College & Research Centre, Digdoh Hills, Hingna Road, Nagpur, 440019. All articles submitted for publication are meant exclusively for publication in this journal and must be accompanied by duty filled copyright form and contributors form and if editors require ethical committee approval form to be sent to ipsnagpureditor@gmail.com.

Conflict of interests: All vested interests must be declared by all the authors eg. Money received directly or indirectly for the study or for its presentation from all sources including commercial/ pharmaceutical companies, and including gifts, travel perks, hospitality etc.

Manuscripts:

- 1) Manuscripts must be submitted in precise, unambiguous, concise and easy to read English.
- 2) The number of authors should not exceed six for original research, 4 for review and case report.

INSTRUCTIONS FOR AUTHORS

Manuscripts should be submitted by email to ipsnagpureditor@gmail.com along with duty filled signed and scanned copyright form. They should be typed in font: times new roman and in font size: 12, only on one side of the A4 size paper with double spacing (space between two lines not less than 6 mm) and at least 2.5 cm margin on all sides.

Word Limit: Original article : Up to 3000 words (excluding abstract of 250 words and a maximum of 30 references).

Case report: Up to 1000 words (excluding abstract of 150 words and a maximum of 10 references).

Review article: Up to 4000 words (excluding abstract of 250 words and a maximum of 70 references).

Title page on a separate sheet of paper and should included.

- a. Title of the article.
- b. Names and designations and emails of all authors.
- c. Affiliations (name of department, institution, city, pin code, state and country where the work was done), indicating which authors are associated with which affiliation.
- d. The name, address, telephone and fax numbers and e-mail address of the corresponding author.

Text (original article): The text should include the following:

Word limit: Up to 3000 words (excluding abstract and a maximum of 30 references). Abstract should be structured containing titles like Introduction, materials & methods, results, and conclusion. It should not exceed maximum of 250 words and be on first page without abbreviations and references. Up to 6 keywords should also be given at the end of the abstract.

Introduction should define the reason for the study, the nature of the problem, and its relation to previous work, quoting the references by numbers within brackets in the order in which they are cited. Materials and Methods should contain sources of special chemicals, kits, animals, case material

and all the actual methods employed briefly with references. Use generic names with the trade name in parenthesis. All measurements must be in metric units and temperature in degrees Celsius. Use only standard abbreviations, symbols and acronyms that are universally accepted.

Ethics: All research study should confirm to ethical principles as laid down in the Helsinki declaration and it should be explicitly stated if permission of an IRB / human or animal ethics committee was taken.

Study Design: Reports of randomized clinical trials should present information on all major study elements, including the protocol, assignment of interventions (methods of randomization, concealment of allocation to treatment groups), and the method of masking (blinding), based on the CONSORT Statement (<http://www.consortstatement.org>).

Results: Present the results in logical sequence using appropriate, tables and figures without duplication. Results must include statistical analysis when ever applicable.

Discussion: Distinguish clearly new information from previous findings, and speculation from fact. Problems arising out of the study may be identified, and relevant hypotheses may be generated. Indicate the conclusions that may be drawn and place them in the context of a critical appraisal of previous work.

Acknowledgement: Acknowledgement of those who have actually contributed substantially to the study mentioning their contribution.

References: This should be numbered in order of citation in the text at appropriate place in brackets in line with the text for e.g. (1). References in the end must be on separate sheets in serial order. They must be complete in Vancouver format.

List all authors: If the number is seven or more, cite first six names followed by et all. References must be given in the following format.

Articles: Penner A, Timmons V. Seniors, attitudes: oral healthand quality of life. *Int J Dent Hygiene* 2004; 2:2-7.

INSTRUCTIONS FOR AUTHORS

Books: Whittaker DK, MacDonald DG. Bite marks in flesh. In: Whittaker DK, MacDonald DG, editors. A Colour Atlas of Forensic Dentistry. London: Wolfe Medical Publications Ltd.; 1989.p. 26-43.

Abstracts: Nath N. Effect of certain compounds on the lysosomal stability in vitro. Proceedings of All India Seminar on Contemporary development in bioenergetics and membrane function. Waltair,1982:82.

Others: Unpublished work, work in preparation, and personal communications should only be mentioned in the text and not used as references. Personal communication must carry the date of the communication. However, work accepted for publication should be included in the reference list as 'In Press' giving the name of the Journal. 'Quoted by' references are not accepted.

Responsibility: Authors are solely responsible for the accuracy of references

Tables: No table should exceed the limit of one page. Each table should be typed double spaced, on a separate sheet of paper, should carry a title and be serially numbered in Arabic numerals in the order of its first citation in the text. Each column should have a short heading with units of measure, if applicable, in parenthesis. Do not use vertical rules. Use horizontal rules only above and below column headings and at the bottom of the Table. Explanatory matter should only be given in footnotes using a, b, c, ... as symbols sequentially. Matter given in a sentence or two in the text should not be repeated in the Table. Use graphs as alternative to Tables with many entries. Statistical significance to be given as foot-note to the tables.

Figures (with Legend) and Photographs: To appear on separate pages and should be unmounted in black ink drawings of professional quality with clear lettering and numbered consecutively (I, II etc). Only standard symbols should be used for figures. They should have a brief legend. Statistical significance to be given as foot-note to the figures. Photographs should be in colored glossy prints and if black and white there should be a sharp contrast

between black and white areas. They should be 8x13 cm size. If applicable a linear scale should be incorporated in the photograph or magnification stated.

The word "Top" should be written in the appropriate place at the back of the photograph. A legend should be supplied for each photograph typed double spaced in consecutive order on a separate sheet of paper. Matter given in a table must not be repeated as a figure.

Case Report: Word limit: Up to 1000 words (excluding abstract of 150 words and a maximum of 10 references). Because of their rarity and innovative management, case reports of practical interest to clinicians will be accepted for publication. The case report should be arranged in the following order:-

Abstract, Key-words, Introduction, Case History, Discussion and References.

Review Article: It is expected that these articles would be written by individuals who have done substantial work on the subject or are considered experts in the field. A short summary of the work done by the contributor(s) in the field of review should accompany the manuscript. Word limit: Up to 4000 words (excluding abstract of 250 words and a maximum of 90 references). Articles of current innovative interest extensively studied. Proof correction will be done by the Editors.

Copyright Clearance: Copyright clearance for material / illustration that is not original must be obtained by the authors in writing from both the original authors and the publishers. That is exclusive liability of author/authors.

Letter to the Editor: These should be short and decisive observations. They should preferably be related to articles previously published in the Journal or views expressed in the journal. They should not be preliminary observations that need a later paper for validation. The letter could have up to 500 words and 5 references. It could be generally authored by not more than four authors.

Other: Editorial, Guest Editorial, Commentary and Opinion are solicited by the editorial board.

Copyright Form

THE JOURNAL OF PROSTHETIC REHABILITATION CONTRIBUTOR'S FORM

(Sign and scan copy of form to be submitted along with manuscript)

Journal Title : _____

Manuscript Title : _____

I/we certify that I/we have participated sufficiently in the intellectual content, conception and design of this work or the analysis and interpretation of the data (when applicable), as well as the writing of the manuscript, to take public responsibility for it and have agreed to have my/our name listed as a contributor. I/we believe the manuscript represents valid work. Each author confirms they meet the criteria for authorship as established by the ICMJE. Neither this manuscript nor one with substantially similar content under my/our authorship has been published or is being considered for publication elsewhere, except as described in the covering letter. I/we certify that all the data collected during the study is presented in this manuscript and no data from the study has been or will be published separately. I/we attest that, if requested by the editors, I/we will provide the data/information or will cooperate fully in obtaining and providing the data/information on which the manuscript is based, for examination by the editors or their assignees. Financial interests, direct or indirect, that exist or may be perceived to exist for individual contributors in connection with the content of this paper have been disclosed in the cover letter. Sources of outside support of the project are named in

the cover letter. I/We hereby transfer(s), assign(s), or otherwise convey(s) all copyright ownership, including any and all rights incidental thereto, exclusively to the Journal, in the event that such work is published by the Journal. The Journal shall own the work, including 1) copyright; 2) the right to grant permission to republish the article in whole or in part, with or without fee; 3) the right to produce preprints or reprints and translate into languages other than English for sale or free distribution; and 4) the right to republish the work in a collection of articles in any other mechanical or electronic format.

We give the rights to the corresponding author to make necessary changes as per the request of the journal, do the rest of the correspondence on our behalf and he/she will act as the guarantor for the manuscript on our behalf. All persons who have made substantial contributions to the work reported in the manuscript, but who are not contributors, are named in the Acknowledgment and have given me/us their written permission to be named. If I/we do not include an Acknowledgment that means I/we have not received substantial contributions from noncontributory and no contributor has been omitted.

	Name	Signature	Date signed
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____

(Additional signatures may be added provided the authors meet the ICMJE criteria stated above)

Manuscript Number: _____