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Dental Journal of Indira Gandhi Institute of Medical Sciences



Review Article

Laser Plume: The Severity of Surgical Smoke and Safety Management

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Received: 25 March 2025
Accepted: 23 September 2025
EPub Ahead of Print: 08 November 2025
Published: 31 January 2026

DOI
10.25259/DJIGIMS_13_2025

Quick Response Code:

ABSTRACT

Laser technology has revolutionized various fields, including dentistry. Dentistry uses lasers for enamel and dentin removal, cavity preparation, tooth whitening, gingival depigmentation, gingivectomy, frenectomy, and other periodontal treatments. Despite its growing popularity and effectiveness in dentistry, laser treatment has a notable drawback: the emission of hazardous laser plumes. To mitigate health risks, it is crucial to prevent the emission of hazardous laser plumes. Effective controls must be implemented to mitigate and manage laser plumes.

Keywords: Disadvantages of laser, Electrosurgery plumes, Laser plumes, Laser smoke, Laser surgical smoke

INTRODUCTION

The term LASER stands for Light Amplification by Stimulated Emission of Radiation.[1] LASER plays an important role in the management of both hard and soft tissue procedures.[2] Lasers with diverse wavelengths harness thermal energy to perform procedures such as tissue cutting, coagulation, ablation, and vaporisation.[3,4] It is also used for initial periodontal therapy, scaling and root planning, Laser Assisted New Attachment Procedures (LANAP), and wound healing.[5] Despite the emerging success rate of laser use in dentistry, it poses certain drawbacks. Laser produces by-products called Laser plumes, which contain vapour smoke and particulate debris.[1] These plumes contain biological and non-biological materials.[1] Plume exposure results in headache, nausea, muscle weakness, and irritation to the eyes, nose, and throat.[4] It also causes carcinogenic and mutagenic effects.[4] Studies have detected the presence of Human papillomavirus DNA in laser plumes.[2] To overcome these health hazards, certain measures are to be taken, such as protective clothing and gloves for the eyes and respiratory systems, and smoke evacuators called Plume Scavenging Systems (PSS).[4] Applicable Occupational Safety and Health Administration (OSHA) standards exist that can be followed.[1] This article summarisesthe contents of plumes, the effects of plumes on human health, and the various preventive measures that can be followed.

Contents of plume

The contents of the plume vary depending on the treatment, health of the patient, chemicals involved, and machine used.[1] Plumes produced by LASERs contain biological and nonbiological

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materials.[1]

Biologically originated materials such as aerosolisedblood, blood by-products, and bloodborne pathogens such as bacteria and viruses may be present.[1]

Non-biological materials in plumes contain chemicals such as benzene, formaldehyde, cyanide, ammonia, toluene, and particulate materials such as fatty acids, polyaromatic hydrocarbons, phenols, and acrylonitrile.[4]

Health hazards of plumes

Symptoms from plume exposure include headache, nausea, muscle weakness, and irritation to the eye, nose, and throat.[4] It also resulted in long-term mutagenic and carcinogenic effects.[4] Systematic reviews have highlighted the presence of Human papillomavirus DNA in laser plumes.[2] HPV-containing laser plumes caused human viral papillomas in the larynx and HPV-16-associated oropharyngeal carcinomas.[3] Animal studies stated the development of tumourswhen an area was exposed to a laser plume containing bovine HPV.[1]

Management of laser plumes

Workspace should assess risks and identify the hazards in order to implement the control measures needed.[1] There is no standard OSHA protocol, especially for LASER plumes, but applicable OSHA standards exist.[1] It emphasisesplume scavenging systems, protective clothing, and gloves for the eye and respiratory system.[4] Plumes can be controlled by using smoke evacuations or local exhaust ventilators, also called PSS, which contain high-volume evacuation systems and mobile portable smoke evaluators. These systems are designed to capture surgical smoke effectively.[4]

CONCLUSION

The plume generated by LASER procedures contains a blend of biological and non-biological materials that can be hazardous to health. The health risks associated with LASER plumes are cumulative, and since no safe exposure levels have been identified, continued caution is warranted, even as research on precautions evolves. Established standards and guidelines provide requirements, best practices, and recommendations for ensuring safety when working with laser plumes. Effective laser plume mitigation requires a combination of engineering and work controls, as well as a designated Laser Safety Officer (LSO) who can educate healthcare teams, develop protocols, and maintain records in dentistry and medicine.

Ethical approval: Institutional Review Board approval is not required.
Declaration of patient consent: Patient's consent is not required as there are no patients in this study.
Financial support and sponsorship: Nil.
Conflict of interest: There are no conflicts of interest.
Use of artificial intelligence (AI)-assisted technology for manuscript preparation: The authors confirm that there was no use of artificial intelligence (AI)-Assisted Technology for assisting in the writing or editing of the manuscript, and no images were manipulated using AI.

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How to cite this article: Elangovan G, S H, T G, M G, N H. Laser Plume: The Severity of Surgical Smoke and Safety Management. Dent J Indira Gandhi Int Med Sci. 2026;5:37-8. doi: 10.25259/DJIGIMS_13_2025