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Journal homepage: <https://www.joas.co.in/>**Case Report****Photobiomodulation therapy for the management of acute radiation dermatitis in head and neck cancer: A case report****Rajkumari Khatri<sup>1\*</sup>, Dhigpal Dharkar<sup>2</sup>**<sup>1</sup>Dept. of ENT & Laser, Indian Institute of Head and Neck Oncology, Indore, Madhya Pradesh, India<sup>2</sup>Dept. of Surgical Oncology, Indian Institute of Head and Neck Oncology, Indore, Madhya Pradesh, India**ARTICLE INFO***Article history:*

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**ABSTRACT**

To assess the effectiveness of photobiomodulation therapy (PBMT) for the management of acute radiation dermatitis (ARD) in a head and neck cancer (HNC) patient. This case study examines a patient who developed a severe radiation reaction during radiotherapy for squamous cell carcinoma of the alveolus, which was successfully managed with supportive care, including PBMT. PBMT significantly reduced grade IV ARD and grade III oral mucositis to grade zero within one week after the completion of radiotherapy. The patient completed treatment without interruption or hospitalization. PBMT appears to be a safe and effective method for managing severe ARD. The incidence of radiation dermatitis may be influenced by factors such as the type of radiation equipment used and whether concomitant chemotherapy was administered as an adjunct. More studies are needed to establish standardized PBMT protocols. This case study supports the implementation of PBMT in clinical oncology practice.

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For reprints contact: [reprint@ipinnovative.com](mailto:reprint@ipinnovative.com)**1. Introduction**

Radiotherapy is a key treatment modality for head and neck cancers. It is often used either alone or in combination with surgery and chemotherapy, depending on the stage and type of cancer. Approximately 60-70% of patients with head and neck cancer receive radiotherapy at some point during their treatment, but it can cause significant side effects that impact patients' quality of life.

Common side effects during radiotherapy for head and neck cancer include oral mucositis, xerostomia, fatigue, and acute radiation dermatitis (ARD), which can impair vital functions such as chewing, swallowing, and speech.<sup>1</sup> ARD affects 95% of patients, typically manifesting from the second week of treatment, although skin damage begins after the first radiation exposure.<sup>2,3</sup> It is characterized by erythema, desquamation, and pain.<sup>1,4,5</sup> Despite

technological advancements like intensity-modulated radiotherapy (IMRT) and skin-sparing techniques, ARD remains an unfortunate adverse reaction that can negatively impact patient quality of life, cause infections, and lead to treatment interruptions.<sup>6-9</sup>

The severity of skin reactions depends on both treatment-related and patient-related factors. Treatment factors include total dose, fractionation scheme, equipment type, irradiated tissue area, concurrent chemotherapy, treatment positioning, and tissue radiosensitivity. Patient factors that can interfere with tissue regeneration include age, obesity, malnutrition, smoking, skin pigmentation, sun exposure, diabetes mellitus, inflammatory skin diseases, and autoimmune conditions.<sup>3-5</sup>

**2. Case Presentation**

This case report is from the Indian Institute of Head and Neck Oncology, a flagship charitable cancer institute under

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the Indore Cancer Foundation. A 55-year-old male with a 30-year history of tobacco addiction was diagnosed with carcinoma of the left alveolus. A biopsy revealed well to moderately invasive keratinizing differentiated squamous cell carcinoma. The patient had no comorbidities. He underwent a left commando's operation with reconstruction by a pectoralis major myocutaneous (PMMC) flap. Post-operative histopathology was uneventful and confirmed stage III squamous cell carcinoma of the left alveolus with neck metastasis (T1N1Mx).

He was prescribed radiotherapy at a dose of 60 Gy in 30 fractions, with 200 cGy per fraction. On the 18th day of radiotherapy, the patient developed grade III oral mucositis (according to WHO mucositis grading) with a pain score of 9 on the Visual Analog Scale (VAS). He was aphasic due to pain and experienced bleeding from ulcers throughout the oral cavity, necessitating full Ryle's tube feeding. The institute follows a multidisciplinary action plan under the early integration of supportive care and given the severity of his condition, the patient began supportive care with Photobiomodulation Therapy (PBMT).

The PBMT protocol was as follows: - For oral mucositis: 660 nm, 100 mW, 30 seconds/cm<sup>2</sup> intraorally - For neck pain: 810 nm, 200 mW, 5 minutes on the neck PBMT was administered three times a day for one week during radiotherapy. On the 24th day of radiotherapy, the patient developed grade IV radiation dermatitis, characterized by complete loss of epithelium on the neck skin, with slough and bleeding (Figure 1).



**Figure 1:** Reveals Grade IV RD during RT

Systemic and topical antibiotics were administered, along with local wound care and continued PBMT. The PBMT protocol for the neck wound was 660 nm, 75-100 mW, 30 seconds/cm<sup>2</sup>. Treatment continued throughout radiotherapy (3 times/week) and for one week post-radiotherapy. Initially, 100 mW (3 J/cm<sup>2</sup>) was used for pain

reduction, then reduced to 75 mW (2.2 J/cm<sup>2</sup>) to promote skin healing.

## 2.1. Outcomes

1. Oral mucositis: Improved from grade III to grade 0 within 15 days.
2. Radiation dermatitis: Improved from grade IV to near-normal skin within 15 days (Figure 2). The patient successfully completed radiation therapy without interruption or hospitalization, highlighting the efficacy of this technique as a long-term tool for improved treatment outcomes. Additionally, it underscores the potential cost-effectiveness of incorporating PBMT as a supportive care modality during cancer treatment.



**Figure 2:** reveals healthy skin after completio of PBMT

## 3. Discussion

Radiodermatitis is a frequent adverse effect of radiotherapy, impacting 90-95% of patients undergoing treatment.<sup>3,10</sup> It is particularly prevalent in cancers of the breast, perineum, and head and neck regions, where the skin is directly involved in the treatment field.<sup>11</sup> Initially, erythema usually becomes manifest from the second week of treatment, although skin damage starts after the first exposure to radiation.<sup>5,10</sup> From the first day of irradiation, the skin loses its natural protective layer and cutaneous immune system is compromised, and the skin becomes more sensitive to allergens, ultraviolet radiation, and infection to bacteria, fungi, and viruses.<sup>11</sup>

The severity of radiodermatitis can vary, presenting as erythema and hyperpigmentation in milder cases, and progressing to dry desquamation, moist desquamation, and even ulceration in more severe cases.<sup>5,10</sup>

Despite the wide range of therapies explored for managing acute radiation dermatitis (ARD), no single approach has emerged as universally effective.<sup>5,11</sup>

Photobiomodulation Therapy (PBMT) has gained attention for its biostimulatory effects, promoting tissue repair, reducing inflammation, preventing fibrosis, and offering antimicrobial properties.<sup>2,8,11</sup>

Based on laboratory and animal studies, light therapy is used to enhance angiogenesis, increase proliferation of keratinocytes and fibroblasts, increase collagen synthesis, increase granulation and epithelialisation and to reduce inflammation<sup>12</sup>

PBMT functions by emitting low-power light in the visible and infrared spectrum, which is absorbed by cytochrome c oxidase in the mitochondria. This absorption increases ATP production, activates signaling pathways, and initiates various cellular responses that can induce cellular proliferation, migration, apoptosis inhibition, and intense protein and nucleic acid synthesis,<sup>3,13</sup> promoting an anti-inflammatory and analgesic action that accelerates tissue repair.<sup>2</sup> The increased ATP production leads to the dissociation of nitric oxide and a consequent increase in blood flow due to its vasodilator action,<sup>11</sup> thereby mitigating the consequences of the treatment and preventing its interruption,<sup>5</sup> that promote healing and reduce inflammation.<sup>2,3,13</sup> Several studies have highlighted PBMT's potential in ARD management. Robijns et al. observed a significant reduction in the incidence of grade 2-3 ARD in patients treated with PBMT compared to a control group.<sup>14</sup> Other research has demonstrated that PBMT can decrease the frequency of radiotherapy interruptions caused by severe ARD.<sup>15,16</sup>

In our case study, the patient showed rapid improvement in both oral mucositis and radiation dermatitis following PBMT. The patient's grade III oral mucositis and grade IV radiation dermatitis were reduced to grade 0 within 15 days, enabling the completion of radiotherapy without interruption.

#### 4. Conclusion

This case report highlights the potential role of Photobiomodulation Therapy (PBMT) in the supportive care of cancer patients undergoing radiotherapy.

PBMT has demonstrated promise as a safe and effective option for managing the side effects of radiotherapy, particularly acute radiodermatitis and oral mucositis. By enhancing patients' quality of life during treatment and minimizing the risk of therapy interruptions, PBMT may contribute to improved overall outcomes. However, further research is necessary to establish standardized PBMT

protocols for the prevention and treatment of ARD in cancer patients. Future studies should focus on identifying optimal energy doses, treatment schedules, and potential combinations with other supportive care measures to maximize PBMT's benefits in oncology practice.

#### 5. Conflict of Interest

None.

#### 6. Source of funding

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