Laser photobiomodulation for the management of oral cancer complications


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Cancer can be treated in many ways but the therapies may come with side effects. The most common complication of radiotherapy (RT) of head and neck (H&N) cancer is oral mucositis (OM)[1]. These are the inflammatory and/or ulcerative lesions of the mouth and throat resulting in pain, dysphagia and impairment of speech[2]. It is also a lesser complication of haemopoietic stem cell transplantation (HSCT) and chemotherapy[3].

Mucositis occurs in 20–40% of the patients receiving anti-cancer treatments for solid tumours, 60–80% of patients undergoing HSCT, and is experienced by almost all patients receiving radiotherapy for head and neck (H&N) cancers[4].

In Australia, standard care currently for OM is symptomatic, directed towards pain management and the prevention of infection[5,6]. Pain control usually requires the use of topical anaesthetic and in severe cases may require opioid analgesics[7–10]. Additionally, the pain and discomfort may require enteral or parenteral nutrition and reduces the patient's quality of life in terms of their ability to socialise, speak and perform normal daily functions[8,9,11,12]. Mucositis also has a considerable economic impact due to costs associated with symptoms management, nutritional support, management of secondary infection, and abrupt and/or extended hospitalisation[13,14]. It is therefore a highly significant and sometimes dose-limiting factor of the toxicity of cancer therapy.

Following successful cancer therapy, the most common long-term complication is xerostomia due to salivary gland hypofunction with a prevalence of 93% during RT and 74%-85% following RT[15]. Not only does xerostomia significantly impair patients' quality-of-life (QoL) but it also has important medical sequelae, incurring high medical and dental costs[15].

While there are saliva substitutes and sialagogic agents to stimulate saliva, they are unable to replace the antibacterial and immunological components of the saliva so high caries risk and oral infections become more prevalent[16].

The biological effects of photobiomodulation (PBM) therapy were discovered by Endre Mester in 1967[17]. PBM therapy aims to treat or prevent oral mucositis complications by reducing inflammation, reducing cellular damage, increasing cell metabolism and promoting healing[18]. It was first used for the prevention and treatment of radiation-induced mucositis in 1999 by Bensadoun and co-workers[19].

According to systematic reviews and meta-analyses, photobiomodulation therapy has been shown to enhance survival rates, decrease the occurrence and intensity of mucositis, shorten its duration, alleviate pain, mitigate xerostomia, minimize interruptions in cancer treatment, and enhance nutritional outcomes[20–23]. These results were shown in both adult and paediatric populations[24,25].

A prospective RCT of PBM for OM showed statistically significant differences between the groups from week 5 of oncological treatment; 73% of the laser group showed normal mucosa (Table 1), while in the control group, 20% showed grade 0 mucositis and 40% showed grade 2 mucositis ($P < 0.01$)[26].

Table 1 World Health Organization Oral Mucositis Grading Scale

Grade	Description
Mild	
0 (none)	None, normal mucosa
I (mild)	Oral soreness, erythema, no ulceration
II (moderate)	Oral erythema, ulcers, solid diet tolerated
Severe	
III (severe)	Oral ulcers, extensive erythema, liquid diet only
IV (life-threatening)	Oral feeding not possible, requires parenteral nutrition

Photobiomodulation therapy is currently the recommended treatment for preventing oral mucositis when using certain treatment modalites, as recently outlined in the clinical practice guidelines of the Multinational Association for Supportive Care in Cancer/International Society of Oral Oncology (MASCC/ISOO)[27]. Expanding on these recommendations, the World Association of photobiomoduLation Therapy (WALT) group outlines evidence and prescribes PBM treatment parameters for prophylactic and therapeutic use in supportive care of radiodermatitis, dysphagia, xerostomia, dysgeusia, trismus, mucosal and bone necrosis, lymphedema, hand-foot syndrome, alopecia, oral and dermatologic chronic graft-versus-host disease, voice/speech alterations, peripheral neuropathy, and late fibrosis amongst cancer survivors[28].

The challenge faced by the patient is that the treatment should ideally be administered every 48 hours, or practically, three times per week. However, maintaining a regular attendance schedule can pose challenges in addition to their hospital visits.

Both lasers and LEDs can be used to perform photobiomodulation but the use of laser often results in shorter treatment times and immediate pain relief. The advantage of LEDs are that they can be self-administered by the patient at home, unlike laser PBM which needs to be performed by a certified laser practitioner.

Case Report 1

A 79-year old male attended our clinic to have PBM therapy in conjunction with radiochemotherapy. A prophylactic protocol for OM commenced on the day of cancer treatment and continued three times a week for the duration of his cancer treatment. 650 nm laser PBM therapy was done around the mouth in accordance with dosimetry parameters recommended[29,30]. The patient was able to remain mucositis-free for the duration of his cancer treatment (Fig. 1)

Case Report 2

A 64-year old male presented to our clinic with large ulcerated lesions on his cheek, tongue and lip due to chemotherapy for pancreatic cancer. This marked his second round of chemotherapy and the ulcers had worsened compared to the previous round. As his chemotherapy was scheduled every 3rd week, some ulcers were not able to heal

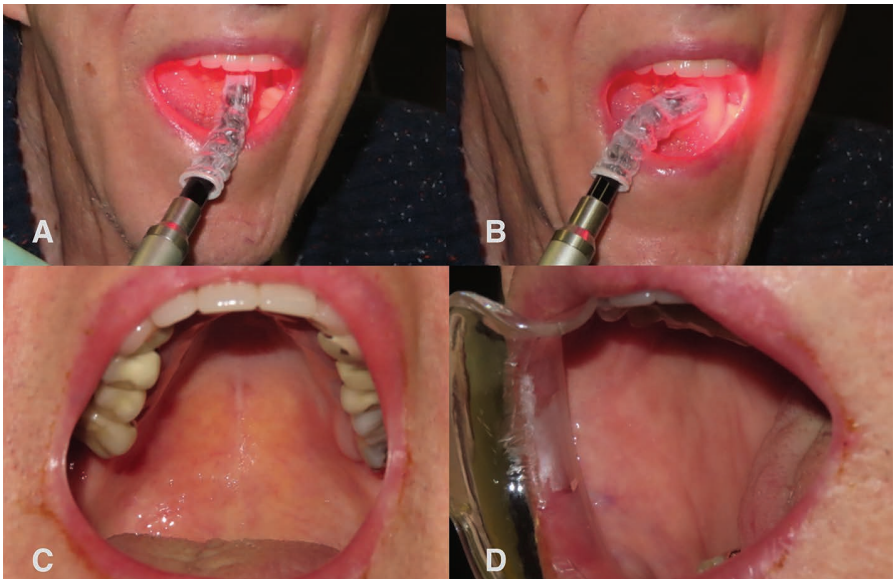

Fig. 1 650 nm laser PBM therapy applied to the palate and cheek (A & B); Normal, undamaged mucosa throughout treatment (C & D)

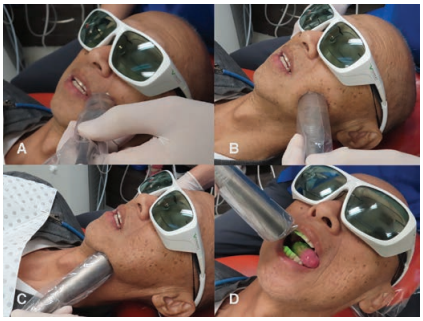

Fig. 2 1064 nm Nd:YAG laser PBM therapy of the cheek (A & B); Treatment of the submandibular lymph nodes (C); Treatment of the lateral border of the tongue (D)

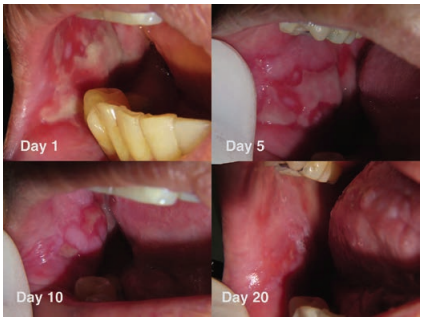

Fig. 3 Large cheek ulcer showing healing over 20 days

Fig. 4 Lower lip ulcer showing healing over 10 days

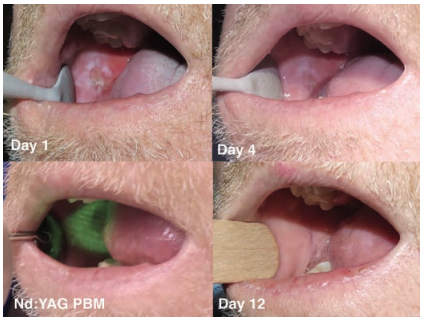

Fig. 5 Cheek ulcer showing healing over 12 days after 1064 nm Nd:YAG laser PBM

Fig. 6 Radiation dermatitis of the neck showing healing over 12 days

Fig. 7 Intraoral LED device switched off (A); Switched on (B); Intraoral device in use (C); 1064 nm Nd:YAG laser PBM of the cheek (D)

completely resulting in fibrotic lesions. 1064 nm Nd:YAG laser PBM therapy was performed 3x weekly to assist with pain and accelerate healing. A combination of intra- and extraoral treatment was performed as mouth opening was restrictive due to trismus (Fig. 2). Symptomatic relief was noticed during the session and faster healing was observed by the patient (Fig. 3). Many ulcers showed complete healing prior to the next round of chemotherapy (Fig. 4). PBM therapy continued until the cessation of chemotherapy.

Case Report 3

A 61-year old male presented to our clinic with a large cheek ulcer despite self-administering home LED photobiomodulation. The patient was undergoing radiotherapy for tonsillar cancer and required daily opioids for pain management. 1064 nm Nd:YAG laser PBM therapy was administered 3x weekly as an adjunct to his home therapy. The patient found immediate relief from the therapy and healed rapidly (Fig. 5). Furthermore, the patient was concurrently dealing with radiation dermatitis on his neck, which had nearly fully healed within 12 days following a 70 Gy radiation treatment administered over a span of 7 weeks. Typically, radiation dermatitis reaches its peak around two weeks after the completion of radiotherapy (Fig. 6).

Case Report 4

A 71-year old male presented to our clinic with painful ulceration of his tongue and cheek. These lesions appeared toward the end of his radiotherapy despite home photobiomodulation with LEDs. Both intraoral and extraoral 1064 nm Nd:YAG laser PBM therapy was performed 3x weekly (Fig. 7) and provided immediate relief. Therapy continued until the lesions resolved.

In conclusion, LED and laser photobiomodulation can provide prophylactic and therapeutic relief for the complications of cancer therapy. They can be used as a monotherapy or in combination to modulate pain, accelerate healing and reduce inflammation using complementary wavelengths.

As international guidelines endorse the use of photobiomodulation therapy and lasers become more readily accessible in dental clinics and hospitals, an increasing number of people with cancer can hope to avoid the debilitating complications associated with cancer treatments. ◆

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