



## Case report

## Fostering a faster post-operative wound healing process with hyperbaric oxygen therapy in a rare case of squamous odontogenic tumor

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## ABSTRACT

**Introduction:** The surgical removal of an intraoral tumor and preventing intraoral wound dehiscence are constant challenges faced by surgeons today. Hyperbaric oxygen therapy (HBOT), the inhalation of 100% oxygen at a greater atmospheric pressure, is often used in cases of wounds to induce a faster wound healing process, alongside other treatment modalities. We report a rare case of squamous odontogenic tumor (SOT) treated with HBOT after being surgically removed to foster an accelerated wound recovery.

**Case presentation:** A 39-year-old Asian male presented with an intraoral 3 × 4 cm tumor, accompanied by acute pain on the maxillary region. Biopsy results showed a solid, brown parenchyma with islands of mature squamous epithelial cells, confirming the diagnosis of an SOT. An intraoral surgical approach was performed to remove the tumor. The patient was then treated with prophylactic antibiotics and 5 consecutive, daily sessions of HBOT at 2.0 ATA as an adjuvant therapy. No further complaints and no abnormalities were found at the 2-week follow-up evaluation.

**Discussion:** In our case of SOT, HBOT plays a role to inhibiting the bacterial growth which could lead to post-operative wound infections. A number of studies have incorporated HBOT as an adjuvant therapy for post-operative intra oral wounds which has resulted in minimal wound complications.

**Conclusion:** The use of HBOT as an adjunctive therapy in managing possible wound complications after the resection of an intraoral tumor enables a faster angiogenesis process, reduces tissue hypoxia and minimizes the risk of post-operative wound infections; hence fostering the wound healing process.

### 1. Introduction

The prevention of intra oral infections, particularly after oral surgeries, adds a burden in the post-operative management of intra oral tumors [1]. Intra oral surgeries can be unpredictable and result in post-operative haemorrhage, wound dehiscence and oral infections. Treatment modalities such as surgery, antibiotics, antifibrinolytic agents and

proper wound management are exercised to lower the risk of intra oral complications following oral surgeries [2]. Hyperbaric oxygen therapy (HBOT), the inhalation of highly pressurized oxygen, serves as a supplementary treatment in the field of wound healing. The aim of this modality is to facilitate angiogenesis, fibroblast proliferation and prevent the risk of infections by enhancing bactericidal abilities of the cell [3,4].

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**Fig. 1.** A 39 year-old male patient with tumor on the maxillar region. (A) Frontal view (B) Lateral view.

In this case report, HBOT was used in managing intra oral wound after the resection of a squamous odontogenic tumor (SOT). SOT itself is considered exceptionally rare with less than 100 reported cases [5]. SOT is a local lesion that infiltrates and is interpreted as an aggressive odontogenic epithelial lesion. It was first found in 1975 by Pullon et.al, where they reported 6 similar cases of an undescribed lesion [6]. Many theories believe that the epithelial component of the odontogenic apparatus is the initial source of these tumors. SOT is frequently found at the maxilla within the bicuspid and incisor areas, as well as at the posterior mandible. Lesions appear cystic in the alveolus adjacent to the root of the tooth, resulting in a mobile and displaced tooth [7]. The incidence of SOT is higher in males and at the age of 30 [6,7].

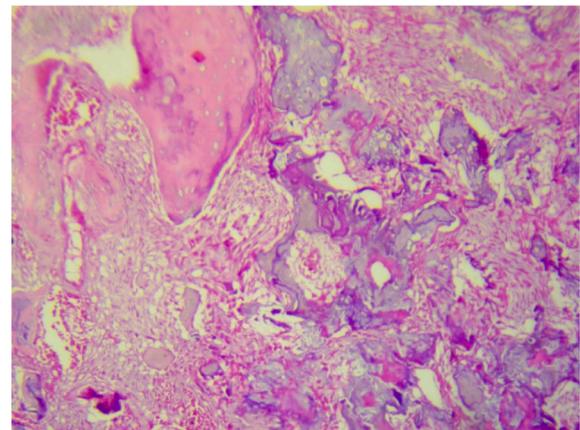
We report a rare case of squamous odontogenic tumor (SOT) treated with HBOT after being surgically removed to foster an accelerated wound recovery to be published according to the updated consensus-based surgical case report (SCARE) guidelines [8].

## 2. Case presentation

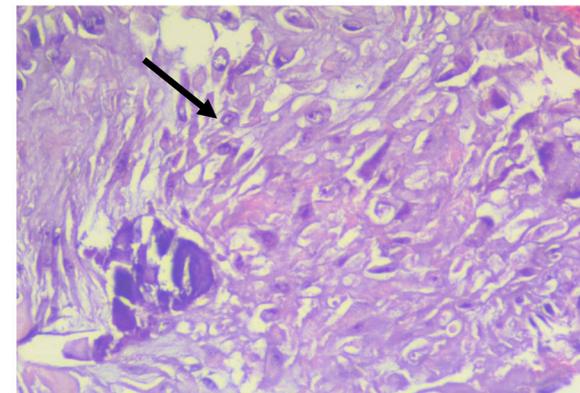
A 39-year-old Asian male was referred from a district hospital to our centre with an intra oral tumor on the upper jaw (Fig. 1). The tumor was first noticed 2 years ago and has grown ever since. The tumor was accompanied by radiating pain from the upper jaw to the left nostril, which only began 5 months prior to his visit. No significant medical and social histories were reported like diabetes mellitus or hypertension, but the patient's grandfather had a history of lymphoma.

On physical examination, we found a 3 × 4 cm mass, solid on palpation, immobile, with a bumpy surface was observed in the upper gingiva. The mass extended just above the incisors to the bicuspids. No bleeding was observed, and no mandibular or cervical lymph nodes swelling were palpated. The patient did not complain of eating or swallowing difficulties. A biopsy was obtained which revealed a solid, brown parenchyma with a group of encrusted squamous epithelial cells, calcifications, and fibrous connective tissue, confirming the diagnosis of an SOT (Fig. 2). A 3-dimensional CT of the skull was obtained and revealed a mass on the maxilla (Fig. 3).

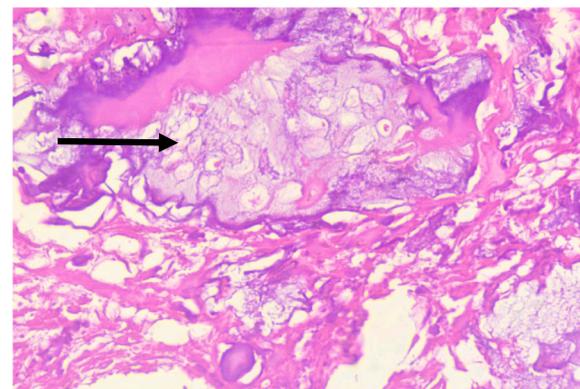
Our team of plastic and reconstructive surgeons performed an intraoral surgery to remove the tumor under general anesthesia (Fig. 4). The mucosa was set aside and a solid, yet fragile mass was found fixated between 1st and 2nd upper left incisivus. The mass was removed slowly with a raspatorium and once bleeding was controlled, the wound was closed using a braided 5/0 polyglacton thread. A tumor sized 4 × 6 cm



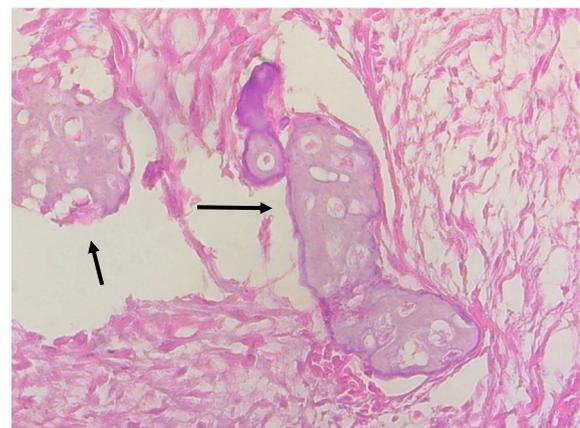
**A**



**B**



**C**



**D**

(caption on next page)

**Fig. 2.** A. Islands of benign squamous epithelium of various sizes and shapes uniformly scattered amid a dense fibromyxoid connective tissue stroma with hematoxylin–eosin staining, magnification  $\times 100$ .

B. Squamous cell and calcification with  $400\times$  magnification (hematoxylin–eosin staining)

C. Islet cartilago with  $400\times$  magnification (arrow) (hematoxylin–eosin staining).

D. Islet cartilago with  $400\times$  magnification (arrow) (hematoxylin–eosin staining).

was obtained after the surgery (Fig. 5).

Three days after the surgery, the patient began receiving daily, 90-min sessions of HBOT at 2.0 ATA until the day he was discharged, which was on day-7. Follow-ups were made 2 weeks after the discharge and showed a healed intraoral wound with no complaints of bleeding, wound dehiscence, or infection (Fig. 6). The patient shared their perspective on the treatment in mastication, stating that they felt no symptoms and could return to their normal activity.

### 3. Discussion

Post-operative management of intraoral tumors remains a challenging issue as surgeons are ought to ensure successful yet prompt wound healing process in order to prevent haemorrhage and wound dehiscence after tumor resection. Several treatment methods have been used to minimize the risk after intraoral tumor resections, including prophylactic antibiotics and proper intraoral wound care [2]. A study even reported a novel, hydrophilic, self-dissolving dressing material which has proven to be more effective in handling post-operative intra oral pain and wound in the subject group than the control group [9].

As the main entry point of the digestive tract, the oral cavity is subjected to the presence of saliva, plaque and food debris [9]. This creates an environment that is susceptible to microbial growth which explains why intraoral operative wounds are relatively common [10]. In open wounds the wound healing process becomes slower due to delayed epithelial closure and a higher rate of granulation tissue formation, resulting in a prolonged inflammatory response [11].

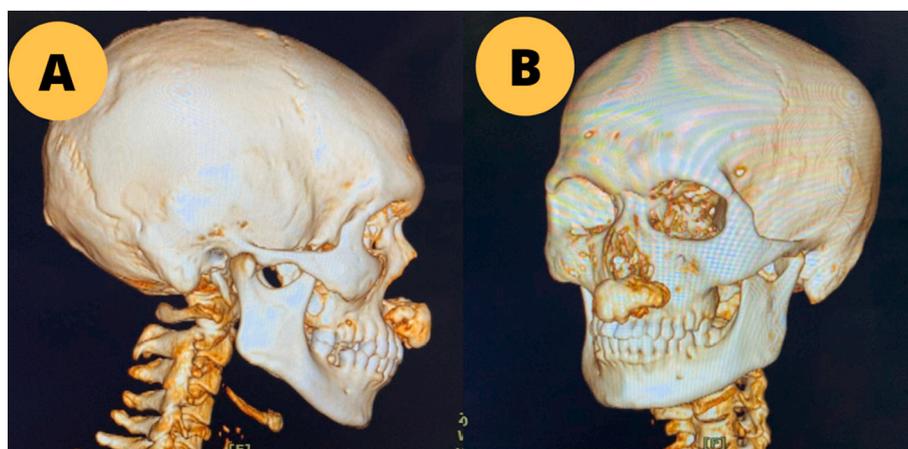
In our case of SOT, HBOT plays a role to inhibiting the bacterial growth which could lead to post-operative wound infections. A number

of studies have incorporated HBOT as an adjuvant therapy for post-operative intra oral wounds which has resulted in minimal wound complications [12,13]. A retrospective study on osteoradionecrosis of the mandible found that HBOT was able to foster a better wound healing process [14]. HBOT is known to have the ability to maximize tissues oxygenation by stimulating the production of growth factors. The highly-pressurized oxygen creates a hyperoxic environment which stimulates the release of growth factors for angiogenesis and enhances the immune system response [3]. A case study incorporated HBOT after undergoing intra oral grafting and found it effective in managing wound dehiscence after the surgery [12].

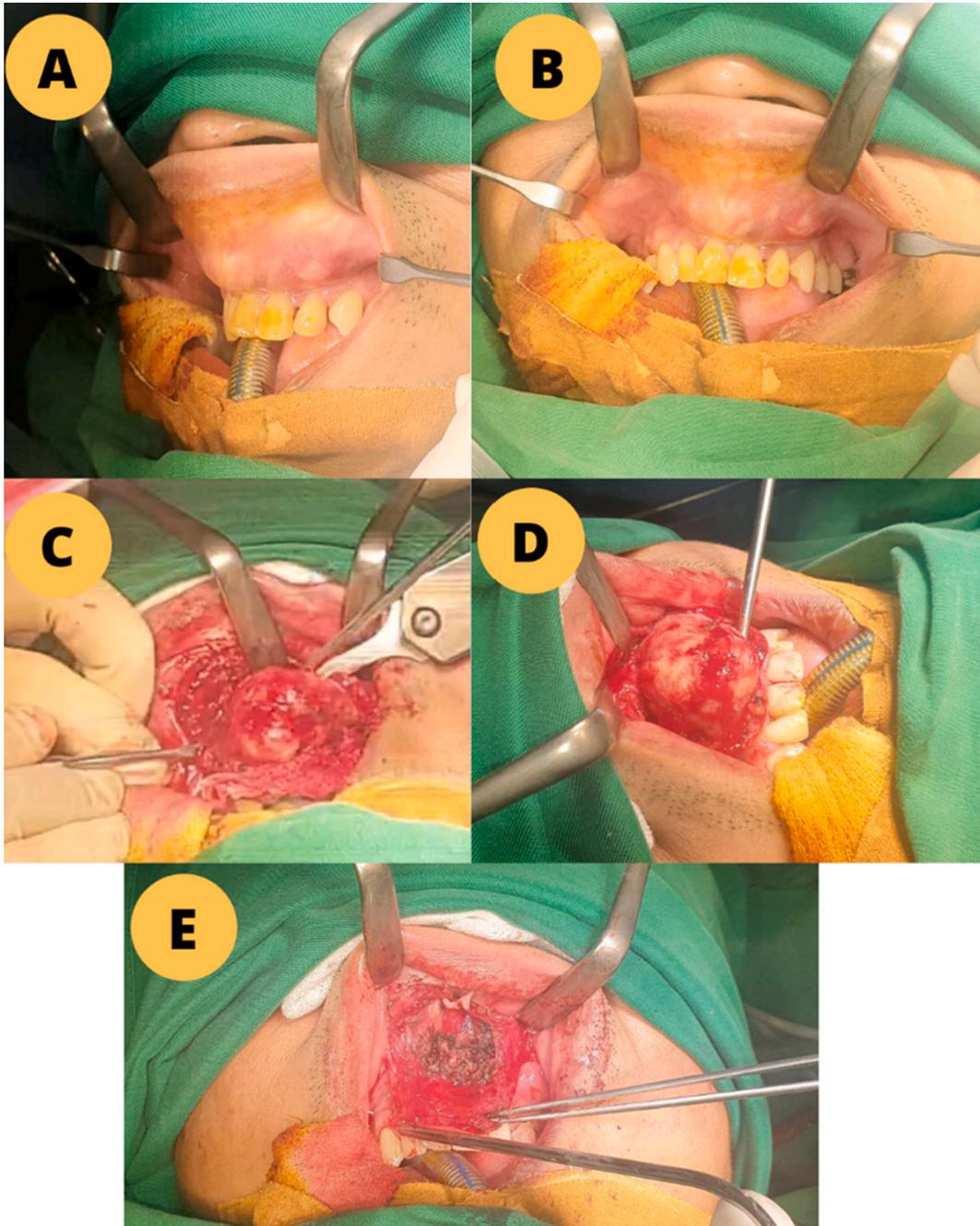
The incidence of SOT itself is rare amongst other intraoral tumors. Many theories argue that the epithelial component of the odontogenic apparatus is the initial source of SOTs [5]. Malassez cell rest, reducing the amount of enamelepithelium, serres rest in gingiva, and odontogenic cysts linings. Squamous cell carcinomas are divided into 3 sub-categories which are primary intraosseous carcinomas, carcinomas arising from the epithelial lining of odontogenic cysts, and carcinomas arising from benign epithelial odontogenesis tumors. A study shows an immunohistochemical reaction where the tumor cells showed positive staining for a wide spectrum cytokeratin, CK-19 and some epithelial membrane antigen, which has been shown to react with all kinds of odontogenic epithelial cells. [15] There is also a positive reactivity of varying intensity in the neoplastic epithelial cells for Notch1, Notch 3, Notch4, also Jagged1 and Delta1 [16]. SOT lesions tend to be aggressive locally and surgery is still considered as the main therapy [15]. Radiographic examination shows radiolucent, well-circumscribed, semi-circular mass with sclerotic borders between the roots of the tooth [17]. In this case, the tumor was resected to eradicate the lesion and maintain healthy surrounding tissues. Finally, in the effort to maintain a favourable environment for wound healing, HBOT was added as an adjunctive therapy to maximize intraoral recovery, reduce the edema and prevent possible wound infections [12].

### 4. Conclusion

HBOT can be used as a supportive therapy in the post-operative management of intraoral surgeries to minimize the possibility of post-operative infection, hence fostering the wound healing process.



**Fig. 3.** (A) and (B) 3D bone reconstruction showing a tumor on the maxilla region.



**Fig. 4.** (A–D) An intraoral surgery was performed. We found a solid, brittle, easily bleeding mass when the mucosa was set aside. The tumor was slowly removed using a raspatorium. (E) After tumor removal.



Fig. 5. Macroscopic features reveal a solid brown tumor. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)



Fig. 6. At two weeks post-surgery and after 5 sessions of HBOT (A and B) showed there was no tumor on the maxillar region (C and D) showed a healed intraoral wound, (E and F) 3D bone reconstruction showing there was no tumor on the maxilla region.

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**Ethical approval**

The study is exempt from ethical approval in our institution.

**Consent**

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

**Registration of research studies**

Not applicable – single case report.

**Guarantor**

Mendy Hatibie Oley and Maximillian Christian Oley.

**Provenance and peer review**

Not commissioned, externally peer-reviewed.

**CRedit authorship contribution statement**

Mendy Hatibie Oley: study concept and surgical therapy for this patient. Meilany Feronika Durry, Rizky Natanael Adam, and Deborah Florencia Gunawan: Data collection and Writing-Original draft preparation. Maximillian Christian Oley: senior author and the manuscript reviewer. Muhammad Faruk: Editing and Writing. All authors read and approved the final manuscript.

**Declaration of competing interest**

Nothing to declare.

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None.

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