Photodiagnosis and Photodynamic Therapy 34 (2021) 102167

Contents lists available at ScienceDirect

Photodiagnosis and Photodynamic Therapy

journal homepage: www.elsevier.com/locate/pdpdt

Medical infrared thermography in peri-operative management of peripheral ameloblastoma: A case report

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ARTICLE INFO

Keywords
Peripheral ameloblastoma
Gingival lesion
Infrared thermography-assisted-surgery
Surgical margins

ABSTRACT

Peripheral ameloblastoma (PA) is a rare benign peripheral odontogenic tumor arising in the gingiva and in the overlying mucosa of tooth-bearing areas of the jaws. Recent data suggestthat the recurrence rate is directly related to inadequate surgical excision. This case of a 71-year-old man reports a poorly delineated mass effecting the gum of the left mandibular canine-premolars area histologically corresponded to PA. In complement to clinical visual examination of such a poorly delineated, non-exophytic and non-dyschromic inflammatory lesion, medical infrared thermography (MIT) — a non-invasive, non-ionizing and real-time imaging technique — was used to optimize the soft tissue margins, and a marginal bone resection was performed. MIT has also been found to be a useful tool in monitoring the absence of diseased tissue crossing the excisional margins at the end of the operation to minimize the risk of recurrence. After two years of follow-up, no local recurrence was found.

1. Introduction

Peripheral odontogenic tumors (POTs) are rare, benign, focal and extraosseous neoplasms of the oral cavity. These tumors share a common oral mucosal origin, but the progressive tumors can lead bone erosion. Most POTs are found in gingiva or edentulous alveolar. Peripheral ameloblastoma (PA) represents less than 5% of all odontogenic tumors and 2–10 % of all ameloblastomas (central and peripheral). The size of tumor may range from 0,5 cm to 4 cm in diameter [1].

As clinical and imaging features of POTs are not specific, an incisional or excisional biopsy is mandatory for the diagnosis. Surgical excision with adequate disease-free margin is usually curative. POTs show a high recurrence rate of approximately 50 % after surgical excision [2]. An incomplete initial resection, with inadequate disease-free margins, is considered as the major risk factor for recurrence.

The current imaging modalities for the detection and delineation of POTs include computed tomography (CT), magnetic resonance imaging (MRI) and ultrasound. For small lesions and those that show no radiological evidence of bone involvement, conventional imaging techniques may not be conclusive. This makes it difficult to accurately determine the appropriate surgical margins in bone and soft tissue.

Infrared thermography is non-invasive and non-ionizing medical imaging technique that has been used for many years in various fields of medicine. Medical infrared thermography (MIT) produces a heat map from thermal radiation emitted by skin, mucous membrane as well as by surface tissues in the vicinity of deeper inflammatory lesions located at muscular or bone levels [3]. In oral and maxillofacial areas, previous studies have shown that tumors and acute inflammation appear to cause an increase in skin temperature [4]. MIT could be a helpful tool to assist the surgeon in the surgical treatment of POTs.

Herein, we describe a case of peripheral ameloblastoma (PA), removed by conservative surgery assisted by a MIR camera in order to optimize the excision margins and limit the recurrence risk.

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https://doi.org/10.1016/j.pdpdt.2020.102167
Received 27 November 2020; Received in revised form 23 December 2020; Accepted 28 December 2020
Available online 2 January 2021

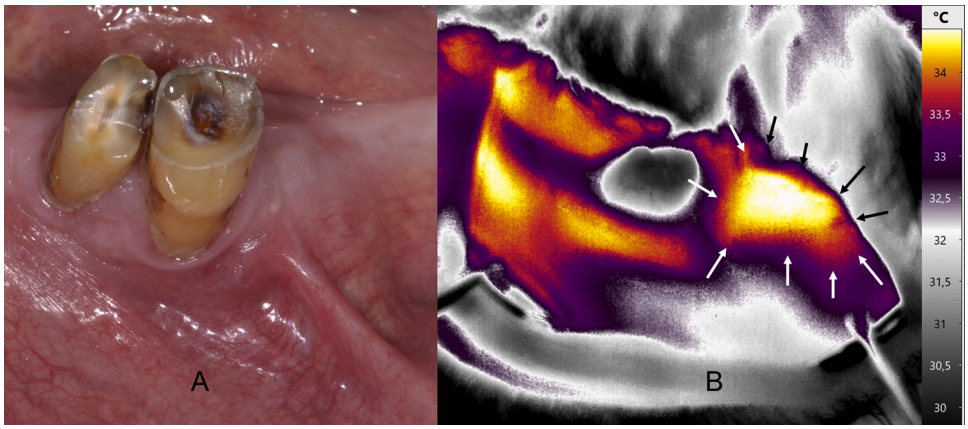

Fig. 1. (A) Initial clinical view. Ill-defined and sessile nodule located in edentulous alveolar ridge of the left mandibular canine-premolars area, as evidenced by white and black arrows. (B) View of PA with thermography infrared camera examination before surgical procedure. Infrared thermography allowed us to more specifically delineate the extension of the lesion in the soft tissues. The lesion area was identified by yellow and red colors (high temperature), as evidenced by white and black arrows.

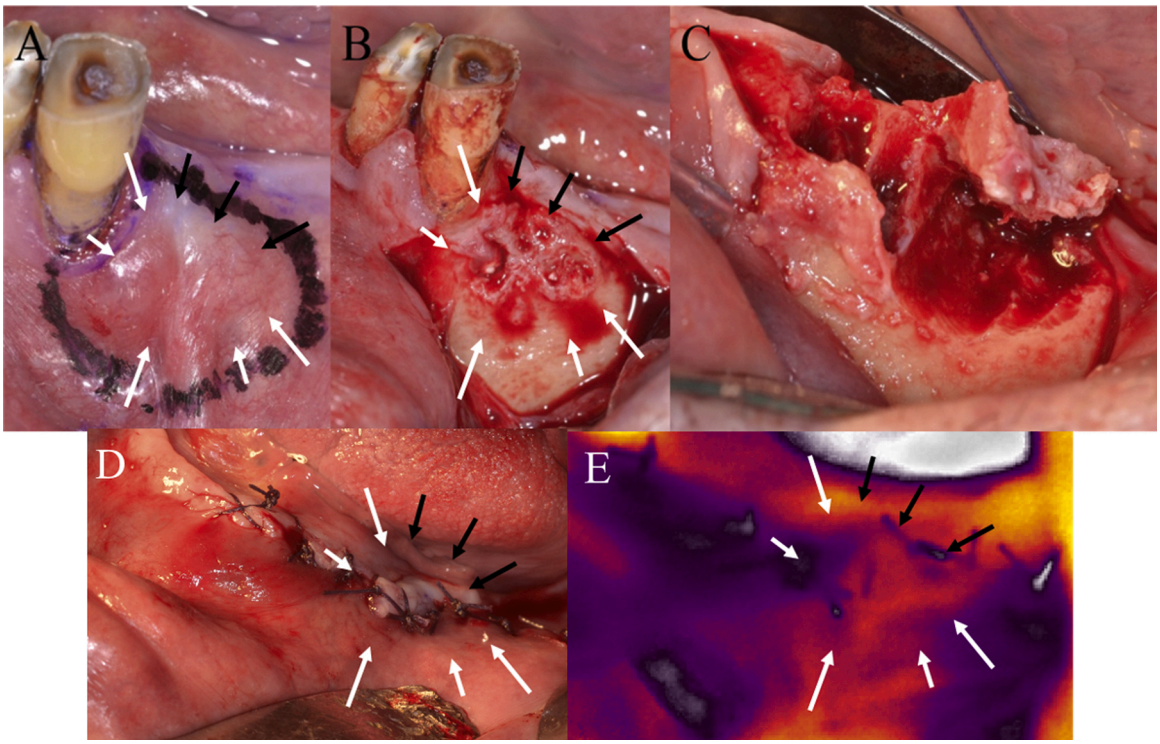

Fig. 2. Surgical procedure. (A) Limits of conservative excision. (B) The underlying bone of the lesion showed multiple superficial erosions. (C) After adjacent teeth extraction, a circumferential osteotomy was performed. (D,E) Post-operative wound stitches and corresponding thermal control.

2. Case report

A 71-year-old man was referred by his dentist for a mass **(**Fig. 1A**)** that was "similar to a periodontal abscess" at 3 months after teeth extractions (teeth 34 and 35).

The clinical examination revealed a firm 1.5 cm in diameter with a poorly delimited mass affecting the gum in the left mandibular canine-premolars area. The overlying mucosa was normal in color, and the mass was not tender to palpation. The adjacent teeth were vital by electric pulp testing and cold provocation. No cervical lymph nodes were palpable. Routine panoramic and periapical radiographs showed no bone involvement. A punch biopsy was performed and submitted for histopathological evaluation. The microscopic analysis revealed two islands of odontogenic epithelium within the loose inflammatory connective tissue. No capsule surrounding the tumor was observed. The basal cells were columnar with hyperchromatic nuclei arranged in a palisading pattern with reverse polarity. In the center of the islands, disjointed stellate cells mimicking the starry reticulum of the enamel organ were identified. Squamous metaplasia with keratin production and microcalcifications were also found. The final diagnosis was follicular PA.

In order to optimize the surgical procedure and definite adequate free margins, imaging examinations and medical infrared thermography were performed preoperatively to assess the extension of the tumor in the soft tissue with an in-depth examination to identify potential bone involvement. Cone beam computed tomography (CBCT) highlighted calcifications and bone erosion that were not observed on periapical radiographs. The MIT camera (InfraTech VarioCAM HD 1024 × 768 pixels) identified the residual tumor (in the range of red, yellow and white colors) around healthy adjacent tissues (in the range of purple and gray colors). **(**Fig. 1B**)** A wide subperiosteal surgical excision of the tumor followed by marginal bone resection was performed under local anesthesia and sent for histopathologic evaluation. Teeth 32 and 33 were extracted for prosthesis reasons. **(**Fig. 2A, B and C) At the end of

surgery, MIT was used to verify that all tumor tissue had been removed from the soft tissue, a control surgical procedure already used in the literature in inflammatory diseases [5,6] (Fig. 2D and E).

Pathological examination confirmed the initial diagnosis of PA and the surgical excision was complete. Bone and soft-tissue margins were free (Supplementary data A and B). The size of residual tumors was 5 × 5 × 3 mm. Soft tissue healing was complete in 3 weeks. After 2 years of follow-up, no local recurrence was noted.

3. Discussion

The clinical appearance and palpation often yield limited information to accurately define tumor margins. Currently, MRI and ultrasound are the usual methods for evaluating lesions located in soft tissues. These imaging modalities fail to pinpoint small neoplastic tissues near the alveolar bone. MIT is non-invasive, non-ionizing, and real-time imaging technique.

The use of a thermal camera with high optical resolution (thermal resolution of 0.03 °C) has been efficient for identifying PA as a "hot spot". PA was warmer than the surrounding healthy tissue with an increase thermal gradient of 1.5–2.5 °C. The borders indicated by the MIT (the temperature differences) are diffuse and gradative but this technique could be a sufficient complementary aid to improve the localization of the excision margins. Significant increase of temperature was previously observed over benign tumors in oral cavity in the range from +0.4 °C to +1.4 °C [4]. Higher temperature differences have been observed with malignant tumors [4,7].

For detection of tumor margins, absolute temperature values are not important, only temperature differences between the tumor and the surrounding healthy tissues need to be determined. However, the temperature difference also depends peripheral vascular circulation and on environmental conditions such as inflammation unrelated to the investigated disease. The opposite area of the affected one was used as the comparison reference area in order to limit the nonspecific findings. The main limitation of MIT is the low depth of penetration, usually confined to 2−3 mm [5].

In conclusion, MIT could be helpful to evaluate the tumor margins of small masses and/or tumors undetected with conventional imaging, but not for diagnosis purposes. In such a way, the present study where no local recurrence was noted after 2 years of follow-up paves the way for future investigations to further support the benefits MIT could give in the surgical treatment of similar inflammatory injuries.

Informed consent

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. Informed consent was obtained from all patients for being included in the study.

Declaration of Competing Interest

The authors declare that they have no conflict interest.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.pdpdt.2020.102167.

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