Treatment of Maxillary Inflammatory Odontogenic Cyst with Laser Therapy – Case Report

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ABSTRACT

Purpose
Odontogenic cysts occur in the oral and maxillofacial region; most jaw cysts are lined by epithelium derived from odontogenic epithelium associated with tooth development. Odontogenic cysts can be classified as "developmental type" or "inflammatory type". A correct diagnosis is essential for planning the treatment of conditions that compromise the maxilla-mandibular complex. Given that, a significative number of cystic lesions of the jaws share similar clinical and radiographic features, the diagnosis of odontogenic cysts, usually requires detailed analysis of the clinical, radiological and histopathological findings. All odontogenic cysts, with the exception of inflammatory periapical cyst and lateral radicular cyst, should be treated with surgical intervention. The periapical cystic lesions are usually treated by conservative endodontic treatment (periapical curettage) or surgical treatment (enucleation, marsupialization and decompression). In lateral radicular and inflammatory periapical cysts, surgery is indicated only if the lesions do not regress after removal of odontogenic infection intra-canal the affected tooth. In case of residual cyst, surgery is the only option.

Case Report
A 55-year-old female patient, caucasian, attended the Oral-Maxillofacial Surgery consultation at Clitrofa - Centro Médico, Dentário e Cirúrgico, in Trofa - Portugal, to evaluate a dental cyst in the second quadrant diagnosed during the evaluation to place dental implants in the upper jaw. It was decided to carry out surgical treatment of the lesion using LightWalker® from Fotona with application of Er:YAG and Nd:YAG lasers.

Conclusion
After a 12-month follow-up period, the patient is pain free and the lesion has no signs of recurrence. Laser therapy may be considered a successful treatment modality for inflammatory odontogenic cyst.

KEYWORDS
Inflammatory odontogenic cyst; Er:YAG laser; Nd:YAG laser; bone reconstruction

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INTRODUCTION

Odontogenic cysts can be anatomically located in the oral and maxillofacial region. Most jaw cysts are lined by epithelium derived from odontogenic epithelium associated with tooth development. Odontogenic cysts can be classified as "developmental type" or "inflammatory type".[1]

Developmental odontogenic cysts include keratocyst, dentigerous cyst, lateral periodontal cyst, sialo odontogenic cyst, gingival and eruption cysts. The inflammatory type includes radicular, residual, and paradental cysts. Although some odontogenic cysts are relatively common and do not pose a diagnostic challenge, they are often misdiagnosed because of the many clinical and radiological similarities. Given that some of these cysts are aggressive and have a high recurrence rate, all surgically excised tissue must be examined histopathologically. An early and accurate diagnosis usually ensures proper treatment and follow-up.[2,3]

Cysts are epithelial odontogenic inflammatory lesions characterized by a slow, expansive, non-infiltrated growth pattern. This type of pathologies are of a benign biological nature, however, they can reach considerable dimensions with relevant anatomical implications, if not diagnosed and treated in a timely manner. Considering that the number of cystic lesions of the jaws have similar clinical and radiographic characteristics, the diagnosis of odontogenic cysts usually requires a detailed evaluation of clinical, radiological and histopathological findings.[2,4,5]

Epithelium at the apex of a nonvital tooth can be presumably stimulated by inflammation to form a true epithelium lined cyst, or periapical cyst. The inflammatory response appears to increase the production of keratinocyte growth factor by periodontal stroma cells, leading to increased proliferation of normally quiescent epithelium in the area. The source of the epithelium is usually a rest of Malassez, but also may be traced to crevicular epithelium, sinus lining, or epithelial lining of fistulous tracts. Cyst development is common; the reported frequency varies from 7% to 54% of periapical radiolucencies.[1]

There is a large disparity in prevalence in the literature, probably related to the rigour of the diagnostic criteria used in each specific study. When strict criteria are used, the prevalence of periapical cysts appears to be approximately 15%.[1]

Since the distinction between an epithelialized periapical granuloma and a periapical cyst has few post-surgical implications, this laborious histopathological examination is impractical.[1]

Periapical cysts represent a fibrous connective tissue wall lined by epithelium with a lumen containing fluid and cellular debris. Theoretically, as the epithelium desquamates into the lumen, the protein content is increased.

Fluid enters the lumen in an attempt to equalize the osmotic pressure, and slow enlargement occurs. On occasion, a similar cyst, best termed a lateral radicular cyst, may appear along the lateral aspect of the root.[2,3]

Like the periapical cyst, this lesion also usually arises from Malassez remnants, and the source of inflammation may be periodontal disease or pulp necrosis with dissemination through a lateral foramen. Radiographically, these cysts mimic the developmental lateral periodontal cysts. Histopathologically, however, they are compatible with cysts of inflammatory origin.[2]

Periapical inflammatory tissue that is not curetted at the time of tooth removal can give rise to an inflammatory cyst called a residual periapical cyst; over time, many of these cysts exhibit a general reduction in size, and spontaneous resolution can occur from a lack of continued inflammatory stimulus.[1,2,3]

HISTOPATHOLOGY

The histopathological features of the types of inflammatory cysts are similar. The cyst is lined by stratified squamous epithelium, which may demonstrate exocytosis, spongiosis, or hyperplasia. Sometimes, the lining epithelium may demonstrate linear or arch-shaped calcifications known as Rushton bodies. Dystrophic calcification, cholesterol clefts with multinucleated giant cells, red blood cells, and areas of hemosiderin pigmentation may be present in the lumen, wall, or both. The wall of the cyst consists of dense fibrous connective tissue, often with an inflammatory infiltrate containing lymphocytes variably intermixed with neutrophils, plasma cells, histiocytes, and (rarely) mast cells and eosinophils.[1,3]

Occasionally, the walls of inflammatory cysts will contain scattered hyaline bodies (pulse granuloma, giant-cell hyaline angiopathy). These bodies appear as small, circumscribed pools of eosinophilic material that exhibits a corrugated periphery of condensed collagen, often surrounded by lymphocytes and multinucleated giant cells. The eosinophilic material may be uniform or contain a variable mixture of lymphocytes, plasma cell, multinucleated giant cells, neutrophils, necrotic debris, and dystrophic calcification. Initially, these foci were thought to be a vascular degenerative process or a foreign-body reaction to machinery oil or vegetable matter. Subsequently, these bodies have been shown to represent pools of inflammatory exudate that ultimately undergoes fibrosis and occasionally dystrophic calcification. The multinucleated giant cells are drawn to the site for removal of insoluble hemosiderin granules. Hyaline bodies may be found in any area of chronic intraosseous inflammation, especially periapical inflammatory disease.[1,3]

CLINICAL AND RADIOGRAPHIC FEATURES

Typically, periapical cysts have no symptoms unless it is an acute inflammatory exacerbation. In addition, if the cyst reaches a considerable size, swelling and mild tenderness are identifiable. Movement and mobility of adjacent teeth are possible as the cyst increases in size by intraluminal pressure. The tooth from which the cyst originated does not respond to thermal and electrical pulp testing.[1,2,3]

This type of cyst can develop even in small periapical radiolucencies, and radiographic size should not be used as a decisive factor in the definitive diagnosis. There is a loss of lamina dura along the adjacent root and a rounded radiolucency surrounds the apex of the affected tooth; root resorption is common. With enlargement, the radiolucency usually flattens out as it approaches adjacent teeth. Significant growth is possible and lesions occupying an entire quadrant have been observed.[2,3]

Periapical cysts are also known to involve primary teeth. These are most often associated with molar teeth and appear as a radiolucent zone that surrounds the roots and fills the interradicular space at the bifurcation.[2,3]

Lateral radicular cysts appear as discrete radiolucencies along the lateral aspect of the root. Lamina dura loss and an obvious source of inflammation may go undetected without a high index of suspicion. Prior to surgical exploration of laterally positioned radiolucencies, a thorough assessment of the periodontal status and vitality of adjacent teeth should be performed.[2,3]

Residual periapical cysts. The residual periapical cyst appears as a rounded to oval radiolucency of variable size within the alveolar ridge at the site of a previous tooth extraction. As the cyst ages, degeneration of cellular contents within the lumen occasionally leads to dystrophic calcification and central luminal radiopacity.[2,3]

TREATMENT OPTIONS

Larger and anatomically compromised lesions that may be associated with restorable teeth have been successfully treated with conservative endodontic therapy, when combined with biopsy and marsupialization, decompression or fenestration. In this type of periapical inflammatory lesion, the minimum recommended follow-up should always be 1 to 2 years.[1,2,3,4]

Periapical surgery is indicated for lesions larger than 2 cm and those associated with teeth that are not suitable for conventional endodontics. Biopsy is indicated to rule out other possible differential diagnoses.[5,6]

As any number of odontogenic and non-odontogenic cysts can mimic the appearance of a residual periapical cyst, all of these cysts must be surgically excised. All inflammatory foci in the area of a lateral radicular cyst must be eliminated. In some cases, lateral radicular cysts are removed prior to tooth vitality testing or periodontal evaluation for an adjacent focus in case of infection. If this diagnosis is made, a thorough evaluation for an inflammatory source is mandatory.[1,2,3]

Cysts of inflammatory origin do not recur if properly addressed. Fibrous scarring is possible, especially when both cortical plates have been lost; once diagnosed, no further therapy for fibrous scars is indicated. In rare cases, the development of squamous cell carcinoma has been reported in periapical cysts; therefore, even in the absence of symptoms, treatment is necessary for all persistent intraosseous pathologies that have not been definitively diagnosed by histopathological examination.[2,3,5,]

A surgical approach to this type of pathologies with a more comprehensive laser protocol could also be considered. The use of Er:YAG and Nd:YAG laser wavelengths to achieve degranulation, disinfection, deepithelialization, clot stabilization and photobiomodulation seems to allow an effective therapy of the cystic cavity.

CLINICAL CASE

A 55-year-old female patient, caucasian, attended the Oral-Maxillofacial Surgery consultation at Clitrofa - Centro Médico, Dentário e Cirúrgico, in Trofa - Portugal, to evaluate a dental cyst in the second quadrant diagnosed during the evaluation to place dental implants in the upper jaw.

After anamnesis, there were no allergies or use of medications. On extraoral clinical examination, an aspect of normality was observed. On intraoral physical examination, a slight bulging of the cortical bone was noted in the anatomic region of 2.1, 2.2 and 2.3, with no chromatic alteration in the oral mucosa.

The computed tomography showed an unilocular, well-defined, homogeneous radiotransparent image that surrounded the 2.1 tooth, extending to the area of 2.2 and 2.3 teeth region (Figure 1a). In the coronal, sagittal and axial sections, it can be seen that the lesion was in close contact with the nasal floor and there was cortical bulging (Figure 1b and Figure 1c).

Local anesthetic was infiltrated into the soft tissue surrounding the lesion (Lidocaine/ Epinephrine 20 mg/ml + 0.0125 mg/ml solution for injection EFG). It was decided to carry out surgical treatment of the lesion using LightWalker® from Fotona with application of Er:YAG and Nd:YAG lasers. The following laser settings were executed:

For the soft tissue approach (incision), the Er:YAG handpiece H14 was used, 150 mJ Energy, 20 Hz Frequency, 3.0 W Power, 4 water, 2 air, LP Mode (Figure 2 a).

For the hard tissue approach (osteotomy), the Er:YAG handpiece H14 was used, 170 mJ Energy, 15 Hz Frequency, 2.55 W Power, 6 water, 4 air, SP Mode (Figure 2b). The cystic capsule was completely excised (Figure 2 c).

In terms of laser cystic cavity preparation, the following settings were executed (Figure 3A and Figure 3B):

Step 1: Degranulation - Er:YAG handpiece H14 was used, 160 mJ/cm^2 Energy, 15 Hz Frequency, 2.40 W Power, 4 water, 2 air, SP Mode.

Step 2: Disinfection - Nd:YAG handpiece 300 was used, 20 Hz Frequency, 2.0 W Power, 60 seconds, SP Mode

Step 3: De-Epithelialization - Er:YAG handpiece H14 was used, 120 mJ/cm^2 Energy, 20 Hz Frequency, 2.40 W Power, 4 water, 2 air, SP Mode.

Step 4: Clot Stabilization - Nd:YAG handpiece 300 was used, 15 Hz Frequency, 4.0 W Power, 60 seconds, VLP Mode.

Bone regeneration was performed in the same surgical time, using Cerasorb M® (Curasan®) in granules combined with fibrin and Osgide® a resorbable membrane (Curasan®). Cerasorb M® is a resorbable and pure phase tricalcium beta-phosphate ceramics for implantation filling, binding and reconstruction of bone defects. The granules have a polygonal shape and, due to the open intercommunicating multiporosity composed of micro, meso and macropores (about 65%), the radiopacity is lower and absorption is effected faster. Cerasorb M® has no local or systemic toxicity and no risk of allergic reaction.7

The use of autologous leukoplakelet fibrin (PRF) in the graft process allows to maximizing its characteristics, namely in the modeling of the inflammatory response, immune response and tissue repair, tissue reorganization and angiogenesis.[8]

The association of PRF with biomaterials (I-PRF) facilitates handling, application and allows immediate adhesion to the receiving bed. The fibrin can be combined with biomaterials described in the literature as sticky bone, may be used as glue or used as membranes.8 Sticky bone provides stabilization of bone graft in the defect, is easy to manipulate, and therefore, accelerates tissue healing and minimizes bone loss during the healing period (Figure 3c). Suture was performed with simple stitches using non-resorbable thread (Silk 4.0).

The procedure was finalized with the Photobiomodulation (LLLT). The Nd:YAG, Genova™ handpiece was used, MSP mode, 10 Hz Frequency, 0.5 W Power, one spot from buccal side, one from palatine side, 60 seconds per spot for pain reduction and to achieve faster healing. Photobiomodulation was repeated twice,

Figure 1. (a) Initial computed tomography coronal section, (b) Initial computed tomography sagittal section, (c) Initial computed tomography cross section

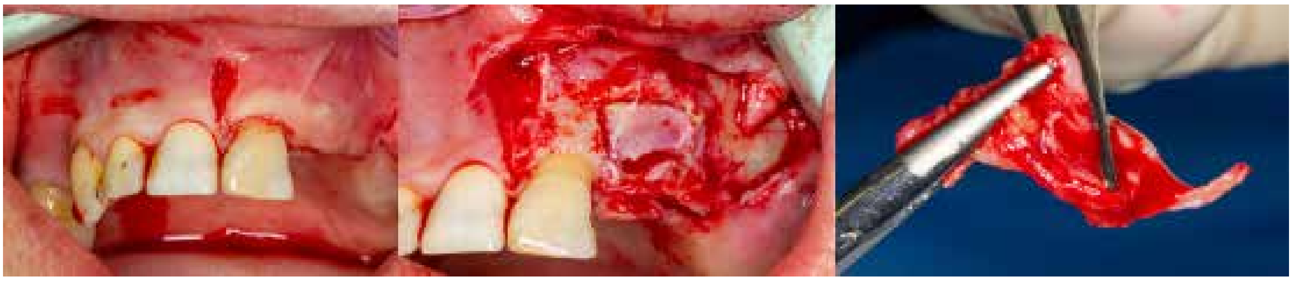

Figure 2. (a) Incision with Er:YAG, figure 2 (b) Osteotomy with Er:YAG, figure 2 (c) Cystic capsule

every second day.

The patient had a postoperative period with no pain and local edema. Antibiotic (amoxicillin 875 mg + clavulanic acid 125 mg for 8 days) and Anti-inflammatory analgesic (100 mg nimesulide for 8 days) was prescribed.

In postoperative care, the patient was instructed to maintain strict oral hygiene. The material obtained from the cystic cavity was sent to pathological examination, and the result reports: a wall of a cystic lesion with a thick fibrous capsule, covered by stratified squamous epithelium with reactive acanthosis, permeated by leukocytes and with focal eosinophytic inclusions compatible with Rushton bodies. There is an abundant inflammatory infiltrate with a predominance of lymphoplasmacytic cells. These findings confirmed the diagnosis of inflammatory odontogenic cyst.

The patient is in the postoperative period of twelve months, without any sign of recurrence of the lesion. In the coronal, sagittal and axial sections, there is evidence of bone neoformation in the area previously occupied by the lesion (Figure 5a, Figure 5b and Figure 5c).

DISCUSSION

The results of a recent study demonstrate that a broader laser intervention in post-extraction clinical cases consisting of degranulation, disinfection, deepithelialization, clot stabilization and photobiomodulation (PBM) using Er:YAG and Nd:YAG lasers, significantly improves bone healing at 4 months after extraction.[9] Irradiation with Nd:YAG laser after tooth extraction promotes osteoblastic differentiation, as demonstrated by the higher expression of osteocalcin in experiments with rats.[10] It is interesting to note that, in studies that compared the result of guided tissue regeneration alone or in combination with Nd:YAG PBM for the treatment of furcation or periodontal defects, have shown a significant improvement in pocket depth, clinical attachment level, horizontal probing depth, and alkaline phosphatase levels with laser use.[11, 12]

The protocol applied in the cystic cavity, namely: Er:YAG debridement, Nd:YAG disinfection, Er:YAG deepithelialization and Nd:YAG clot stabilization, is still not very widespread. However, these steps have proven to be beneficial in peri-implant and periodontal therapy, improving healing of periodontal pockets and bone defects, but are rarely used in post-extraction studies.[13] Obviously, more studies will be needed to determine the contribution of each step to the final result.

Sticky bone is biologically solidified bone graft which is entrapped in a fibrin network. Sticky bone graft granules are strongly interconnected to each other by fibrin network. Sticky bone has numerous advantages: 1) it is moldable, so well adapted over various shape of bony defect; 2) Micro and macro movement of grafted bone is prevented. So, the volume of augmentation is maintained during healing period, therefore the need of block bone and titanium mesh is minimized; 3) Fibrin network entraps platelets and leukocytes to release growth factors, so bone regeneration and soft tissue is accelerated; 4) No biochemical additives are needed to make sticky bone; 5) Fibrin interconnection minimizes soft tissue ingrowth into the sticky bone graft.[7, 8]

The use of membranes with their barrier effect has significant positive effects on alveolar ridge preservation outcomes. It should be noted that the stabilization of the clot and the prevention of epithelial growth are important factors for obtaining the final result.[14]

CONCLUSION

A comprehensive laser post-extraction protocol using Er:YAG and Nd:YAG laser wavelengths for degranulation, disinfection, de-epithelialization, clot stabilization, and photobiomodulation of the extraction socket and cystic cavity proved to be effective in increasing bone density, resulting also in fewer side effects. The reduced rate of complications and bone healing enhanced by the laser protocol used allow for earlier oral rehabilitation and facilitate the optimal placement of implants.

CONFLICT OF INTEREST

The authors declares that there is no conflict of interest regarding the publication of this article.

Figure 3 (a) Intraoperative image of the cystic cavity, (b) Laser cystic cavity preparation, (c) Sticky bone for cyst cavity reconstruction

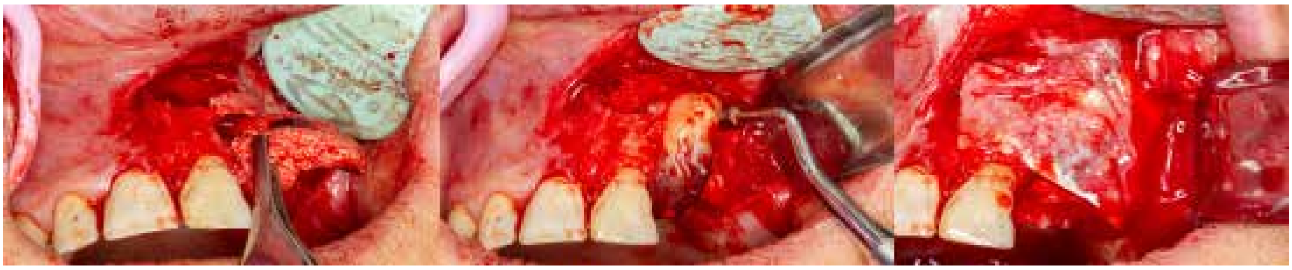

Fig.ure 4 (a) Sticky bone for cyst cavity reconstruction, (b) Fibrin membrane and glue placement (c) Osgide® resorbable membrane covering all bone reconstruction

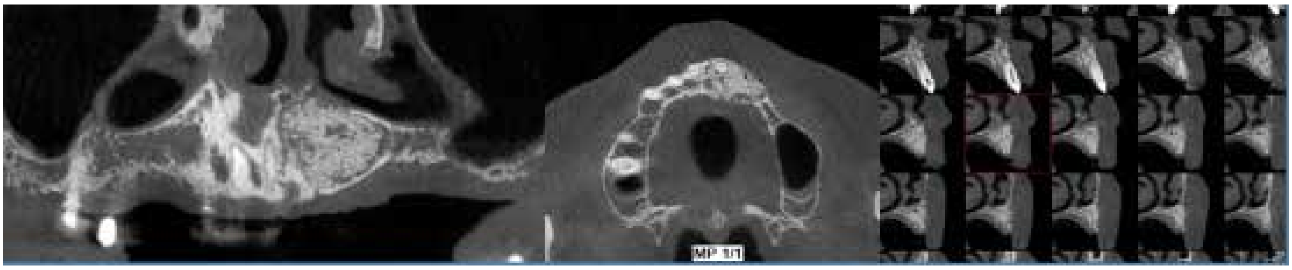

Figure 5 (a) Final computed tomography coronal section, (b) Final computed tomography sagittal section, (c) Final computed tomography cross section

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