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The use of Cone-Beam-Computed Tomography in the diagnosis of maxillary sinus inflammatory changes of endodontic origin

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ABSTRACT

Periapical or periradicular pathology of posterior maxillary teeth can cause an inflammatory response in the maxillary sinus. The presented clinical cases show this complex and difficult situation, both for the establishment of a precise diagnosis, but also of the causal relationship, which leads to a treatment addressed to the endodontic infectious cause, without which, only a symptomatic treatment would not ensure the necessary conditions for the healing of this pathology.

Keywords: maxillary sinusitis, root canal, endodontic treatment

INTRODUCTION

Maxillary sinusitis represents the inflammation of the Schneiderian membrane lining the maxillary sinuses (MS). It can be sinogenic or odontogenic. The two entities differ both pathogenically and therapeutically. Odontogenic causes can be multiple, but if we strictly refer to endodontic ones, especially chronic apical periodontitis, the treatment of sinusitis of endodontic origin involves the removal of the cause through endodontic treatment [1].

Through endodontic treatment, the microbial cause represented by the infection in the root canal is removed and, in this way, the premises are created for the healing of maxillary sinusitis, without the need for the invasive and financially more expensive intervention of Ear Nose Throat (ENT) surgery [1].

The prevalence of maxillary sinusitis of endodontic origin (MSEO) in recent studies varies quite a lot, reaching 72% of all sinusitis of dental cause, and this is due to the use of CBCT, able to highlight the relationship between apical pathology and maxillary sinusitis [2,3].

The endodontic cause is therefore the majority and the terminology itself also suggests the most obvious therapeutic method, namely endodontic treatment [4].

The most affected age group is cited as 41-50 years (30.5%). The most affected dental group associated with these sinus changes were the maxillary 1st molars. (35.6%). More than 44% of the lesions were mucosal thickening, and its prevalence increases with the size of the apical lesion, but also with the decreasing distance between the lesion and the sinus. [5] The risk factors associated with this condition were: the presence of previously performed and incorrect endodontic treatment, the presence of apical periodontitis, the relationship with the sinus of the dental apices (in contact and inside) [5].

The diagnosis of this condition is difficult. If the patient has specific symptoms of acute sinusitis, then he will present himself to the ENT specialist. In case of suspicion of a dental cause, he should send the patient to the endodontist or dentist, because if the causal treatment (for the endodontic infection) is not instituted, strictly symptomatic therapy will not be effective. Patients with persistent unilateral maxillary sinusitis should be evaluated by a dentist [6].

Establishing the endodontic cause requires a precise imaging examination. Unfortunately, periapical radiography is unable to highlight this aspect,

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by superimposing anatomical structures over the apical area, where these areas of inflammation, chronic apical periodontitis, are located. Both the zygomatic-alveolar process, the floor of the maxillary sinus, but also the overlap of the roots, located in different planes, specific to the anatomy of the maxillary molars and the cortical bone, can mask the presence of apical resorptive lesions and their relationship with the maxillary sinus. This is also the reason why the prevalence varies so much in the primary studies compared to the most recent ones, when CBCT (cone beam computed tomography) was used for this purpose.

Although computed tomography (CT) scanning is considered the "gold standard" in imaging for visualization of the maxillary sinus, Cone Beam Computed Tomography (CBCT) imaging offers a lower radiation dose, shorter scanning time, and higher image resolution compared with CT scanning and allows for the determination of a "cause-effect relationship" between periapical disease and sinus changes [7].

According to the American Association of Endodontists (AAE) statement [7] the following sinus changes of endodontic cause may occur:

1. Periapical osteoperiostitis: the apical periodontitis lesion pushes the sinus cortical floor to cause expansion of the periosteum, which is displaced and stimulated to deposit a layer of bone with a dome shape
2. Periapical mucositis (›2-3 mm): The image shows mucosal thickening or dome-shaped expansion of soft tissue on the floor of the sinus directly adjacent to the apex of the infected root
3. Partial obstruction of the MS associated with MSEO (maxillary sinusitis of endodontic origin)
4. Total obstruction of the MS associated with MSEO.

It is rightly stated that maxillary sinusitis of endodontic cause is underdiagnosed and often overlooked, which leads to persistent symptoms and failure of medical and surgical treatment.

Through the proposed clinical cases, the authors want to show the correlation between endodontic pathology and sinus inflammation, as well as its evolution after endodontic treatment. The 4 clinical cases are characterized by the presence of a periapical lesion, MSEO, previous endodontic treatment and their completion in a single visit.

CLINICAL CASE 1

A 36- year-old male patient was referred to endodontic practice for retreatment of tooth 16. This molar underwent root canal retreatment 7 months ago. After this time patient returned to the dentist who performed the retreatment due to a palatal sinus tract. On clinical examination, the tooth gave a

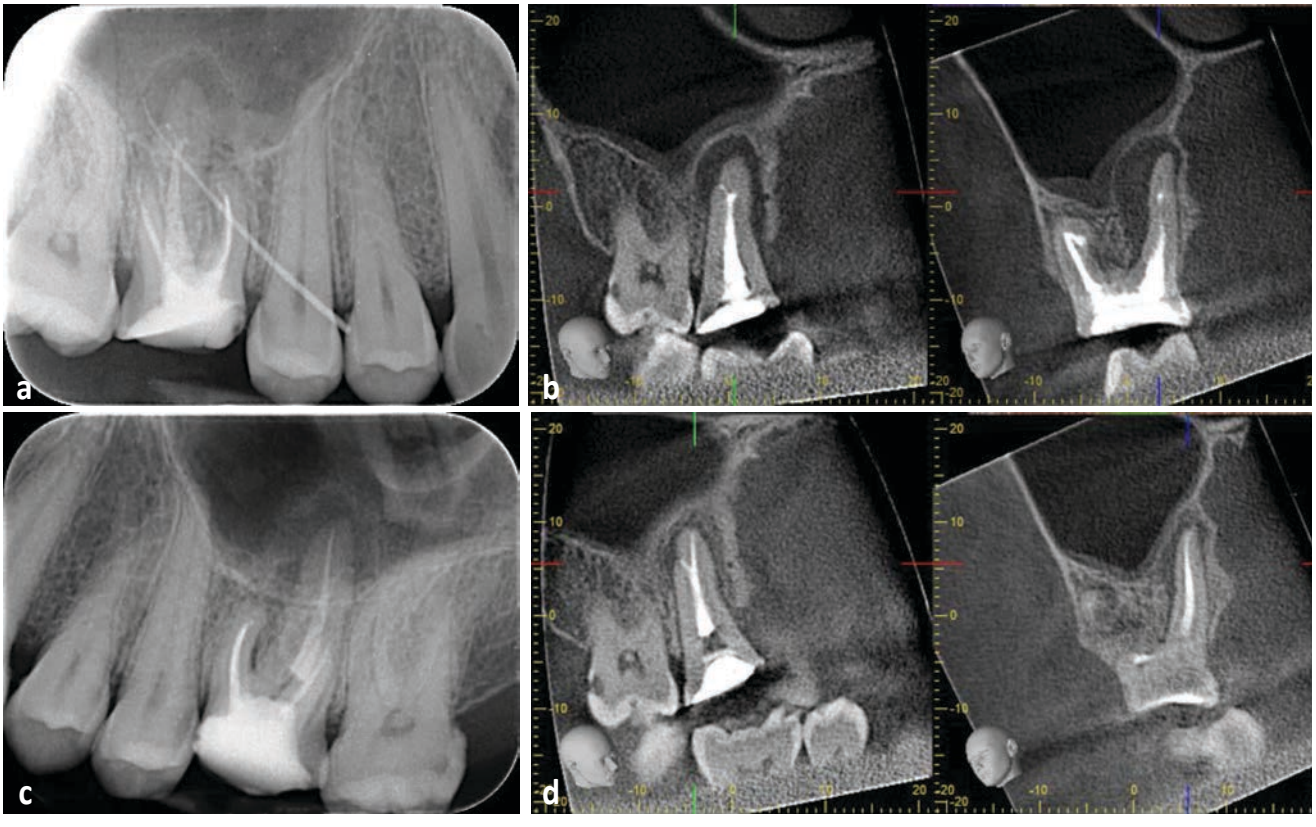


FIGURE 1. a - preoperative radiograph; b - preoperative CBCT; c - postoperative radiograph; d - follow-up CBCT

slightly positive reaction to percussion test. There was fistula present in the projection of root apex. The periodontal probing was within normal findings. Intraoral periapical preoperative radiograph with a gutta-percha cone inserted through the fistula revealed periapical lesion in relation with the palatal root. The palatal canal was underfilled and the filling ended in a lateral canal (Figure 1a).

The CBCT scan was performed with Veraviewepocs 3D P (R100) equipment (J. Morita MFG Corp., Kyoto, Japan). The scan parameters were 90 kV, 5 mA, 9.4 s exposure time, 125 μm spatial resolution and 40×40 mm field of view (FoV).

The CBCT scan showed a satisfactory root canal fillings for disto-buccal and mesio-buccal 1 and 2 root canals, with no periapical lesion in connection with these roots. The palatal canal presented a chronic apical periodontitis and MSEO, an osteoperiostitis affecting the sinus was diagnosed in relation with this root. The apical part of the palatal canal appeared calcified (Figure 1b).

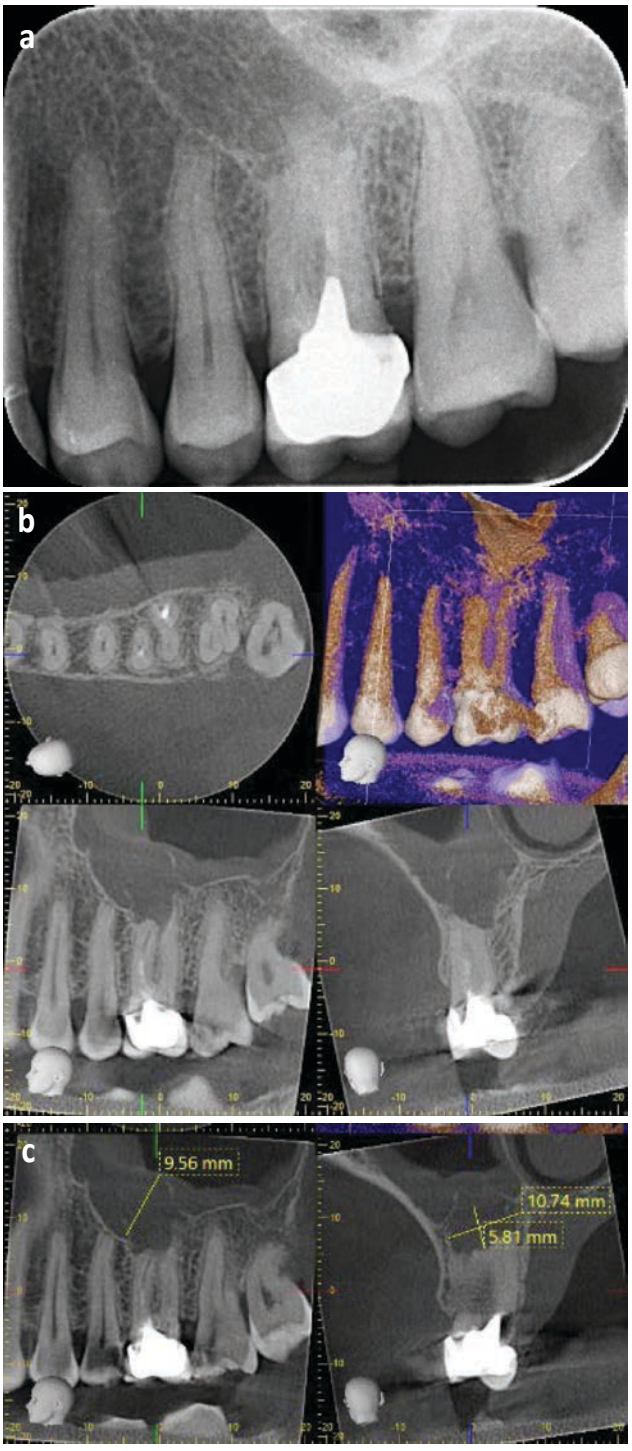
We decided for a selective retreatment, for the palatal canal only. The patient signed informed consent.

Postoperative intraoral radiograph showed the filling of both the main and lateral canals (Figure 1c).

The patient came back for a follow-up after 4 months. The tooth was completely asymptomatic, the fistula was healed and the CBCT scan showed complete resolution of sinus inflammation and healing of the periapical bone (Figure 1d).

CLINICAL CASE 2

A 52-year-old male patient was referred to our endodontic office for the retreatment of tooth 26. The patient reported pain when biting on the left side. Tooth 26 was highly responsive for percussion and restored with prosthetic crown and cast post. Intraoral periapical preoperative radiograph was not conclusive as to the extent of the periapical pathology (Figure 2a). Tooth 16 underwent RCT in the past. Periodontal probing was normal.



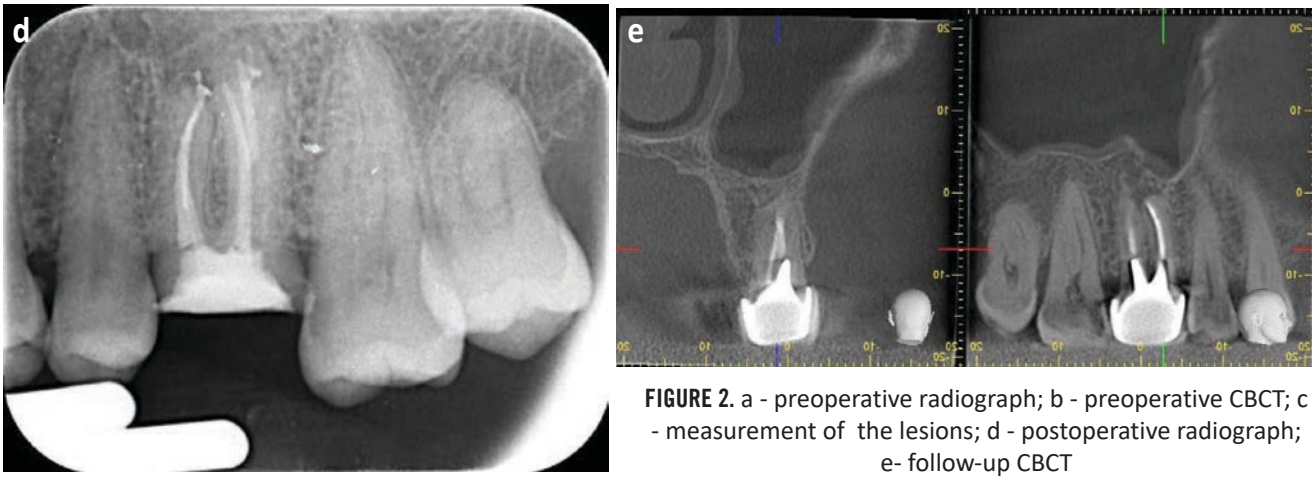


FIGURE 2. a - preoperative radiograph; b - preoperative CBCT; c - measurement of the lesions; d - postoperative radiograph; e- follow-up CBCT

CBCT scan highlighted the large periapical lesion, of 10.74 mm/5.81 mm. It resorbed the sinus floor and consequently appeared a mucosal thickening of almost 10 mm. The mesio-buccal and disto-buccal root canals were not treated (Figure 2b,c).

Diagnosis: symptomatic apical periodontitis and MSEO.

We decided for a retreatment. Postoperative intraoral radiograph showed the complete filling of the root canals (Figure 2d). The tooth was restored by the referral dentist.

Due to the pandemic conditions, the patient was able to come back for the control after 2 years. He reported the tooth was asymptomatic and functional. The CBCT showed the complete resolution of the maxillary sinusitis, the restored sinus floor, and the healed periapical lesion (Figure2e).

CLINICAL CASE 3

A 32-year-old male patient was referred for the endodontic evaluation of tooth 16. Patient complained of pain when biting on this tooth. On clinical examination, the tooth was tender to vertical percussion. Periodontal probing was within normal limits.

The periapical radiograph revealed a large coronal restoration, a previous endodontic treatment, incomplete in the mesio-buccal canal and a post cemented in the palatal canal. No periapical lesion could be identified on this radiograph (Figure 3a).

CBCT showed the periapical lesion on the mesio-buccal root, due to a second missed mesio-buccal root canal. Also, CBCT revealed a mucosal thickening of dome shape of the maxillary sinus mucosa, in relation with the mesio-buccal root (Figure 3b).

We retreated the tooth and were able to clean and shape the four root canals to length (Figure 3c). 1 year follow-up CBCT showed the complete healing of the periapical lesion and the mucosal thickening was resolved (Figure 3d). The tooth was asymptomatic and functional.

CLINICAL CASE 4

A 48-year-old female patient was referred to our endodontic office for the evaluation of tooth 26. On clinical examination, the tooth was tender to vertical percussion and the patient related the pain when biting on the left side.

The periapical radiograph showed a previous root canal treatment for the tooth 26, incomplete in the mesio-buccal canal and a large and overextended cast post in the palatal canal. The disto-buccal was omitted. Also a large periapical lesion was observed in relation with this tooth. Patient presented a periodontal condition (Figure 4a).

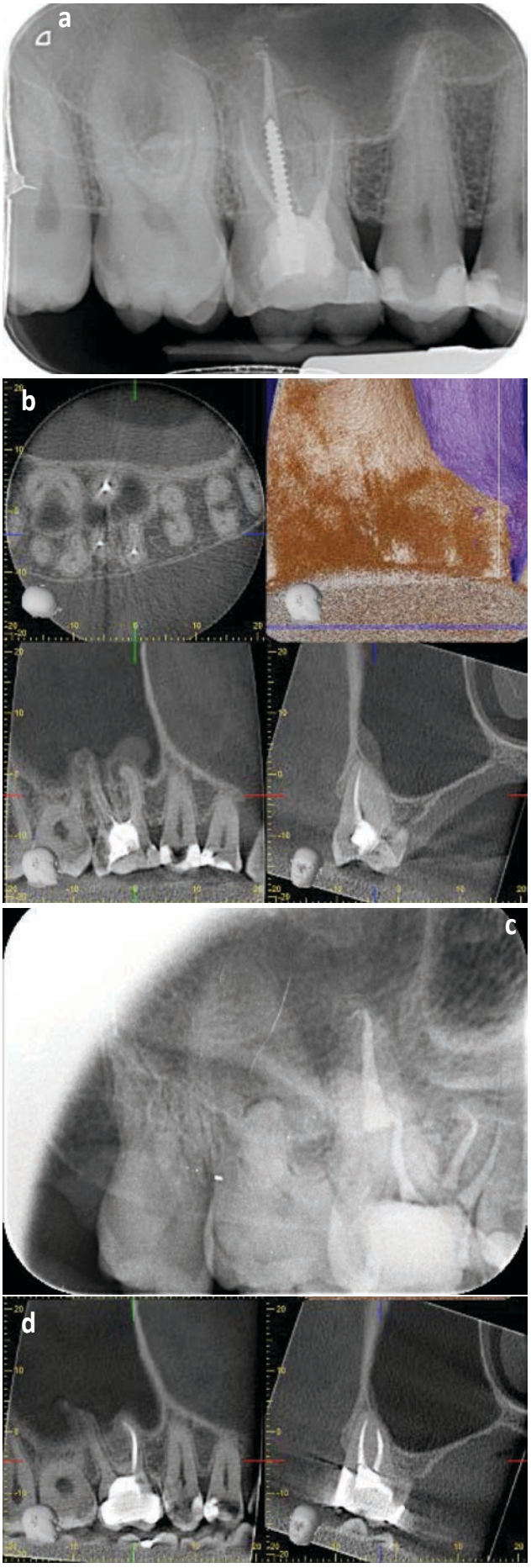


FIGURE 3. a - preoperative radiograph; b - preoperative CBCT; c - postoperative radiograph; d- follow-up CBCT

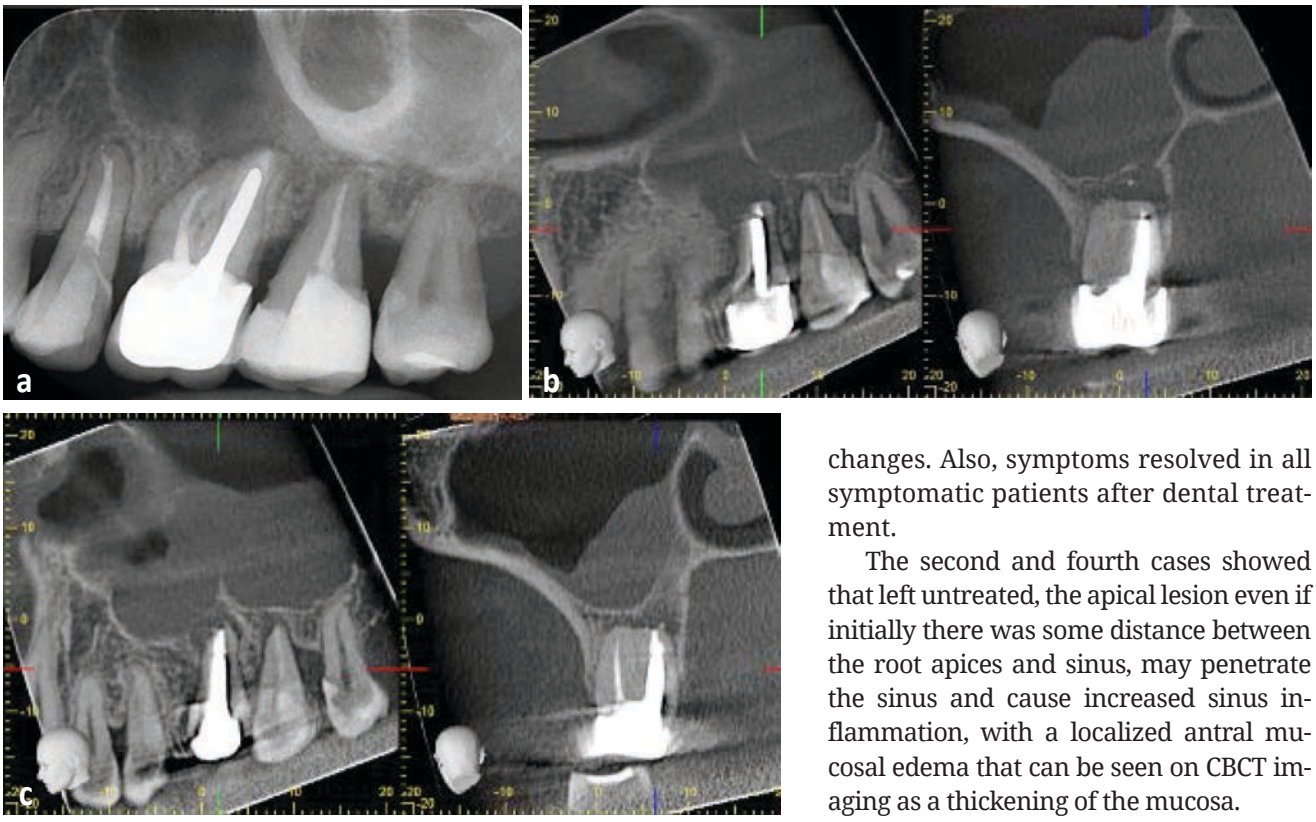


FIGURE 4. a - preoperative radiograph; b - preoperative CBCT; c - follow-up CBCT

CBCT showed a partial obstruction of the maxillary sinus and the perforated sinus floor, due to the periapical lesion. Also it confirmed the presence of the missed disto-buccal canal (Figure 4b).

We retreated all the 3 root canals. Patient returned 10 months later. The tooth was asymptomatic and functional. CBCT showed a significantly reduced periapical radiolucency, the restored sinus floor and the reduced maxillary sinus inflammation (Figure 4c).

DISCUSSION

These clinical cases showed sinus pathological conditions suspected of endodontic cause, as the CBCT highlighted. All cases were of teeth with symptomatic apical periodontitis, previously treated. We performed a single visit endodontic retreatment, without the additional use of antibiotics. The treatment was proved to be successful at the follow-up, even for the short 4 month-period of time for the first case. CBCT imaging revealed that the apical periodontal lesions suspected to be associated with the sinus involvement were healed, as well as the sinus inflammatory changes; a reduced lesion and inflammatory sinus changes for one of them. It is possible that the sinus inflammation for this fourth case had both sinogenic and endodontic origin. We told the patient to return for another follow-up to evaluate the complete healing of the periapical lesion and the evolution of the sinus inflammatory changes. Also, symptoms resolved in all symptomatic patients after dental treatment.

The second and fourth cases showed that left untreated, the apical lesion even if initially there was some distance between the root apices and sinus, may penetrate the sinus and cause increased sinus inflammation, with a localized antral mucosal edema that can be seen on CBCT imaging as a thickening of the mucosa.

The cause-effect relationship between the periapical lesion and sinus inflammation cannot be determined on a periapical radiograph. Only CBCT, with its advantages of lower radiation dose compared to CT, the high resolution of a small field of view scan and rendering of axial, coronal and sagittal sections of the involved area can elucidate the diagnosis, but also help in the later endodontic treatment plan, as it provides optimal information about the case.

An apical periodontitis of maxillary posterior teeth may disseminate to the maxillary sinus either due to anatomical proximity or by direct diffusion, through the maxillary bone, or indirectly, through lymphatics and blood vessels and determines sinus mucosal changes [8]. Thus it is important to diagnose and treat these pathological conditions as soon as possible, otherwise, the lesion extends and may penetrate the sinus floor.

Most studies considered a thickness greater than 2 mm as pathogenic, which is a consensus in most of the scientific literature [5].

In one study the authors showed that maxillary posterior teeth with periapical radiolucent lesions had the highest frequency of sinus abnormalities and that it is not the size of a periapical lesion, but a close spatial relationship between this lesion and the sinus that resulted most frequently in sinus abnormalities [9].

Following AAE recommendations, control was performed with CBCT, given that we had a preoperative CBCT and anyway sinus and periapical details in maxillary molars cannot be accurately assessed on a periapical radiograph [10].

As the maxillary sinusitis has an impact on patient quality of life and health care costs, it is important to avoid the delay in starting the treatment because of the misdiagnosis [5].

CONCLUSIONS

In the era of personalized medicine, it is essential to know all the possible data for the respective tooth, in order to create an individualized treatment plan.

MSEO is reported to be underdiagnosed and often overlooked, leading to persistent symptoms and the failure of medical and surgical sinusitis therapy. In order to avoid such negative outcome, the clinician should suspect an odontogenic sinusitis and the patient should be evaluated by a dentist.

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Odontogenic sinusitis usually requires professional intervention to remove the cause, while the sinogenic sinusitis is usually treated with an exclusive focus on the symptoms.

Root canal treatment can prevent future sinus complications by removing the cause of sinus inflammation, even in the early stages of sinus involvement.

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