EDORIUM Journals

Int J Case Rep Images 2022;13(2):189–195.
www.ijcasereportsandimages.com

CASE REPORT PEER REVIEWED | OPEN ACCESS

Resolution of chronic secondary rhinosinusitis of odontogenic origin after endodontic treatment: A case report

Amanda Assumpção Marques, Marília Fagury Videira Marceliano-Alves, Fábio Vidal Marques, Vivian Ronquete, Carlos Sardenberg Pereira, Thais Machado de Carvalho Coutinho

ABSTRACT

Introduction: A case of successful resolution of odontogenic rhinosinusitis after endodontic treatment is presented.

Case Report: The patient previously diagnosed with rhinosinusitis presented with an active parulid between the 25 and 26 teeth. The sinus tract-tracing indicated 26 tooth as the source and periapical radiography showed a chronic apical periodontitis lesion. A cone beam computed tomography (CBCT) demonstrated hyperdense imaging on the floor of the left maxillary sinus of posterior teeth region, and rupture of the cortical bone of sinus floor and thickening of its membrane. The odontogenic localized secondary rhinosinusitis was diagnosed. Conventional endodontic treatment was performed with intracanal medication. Nine months later, the patient returned without symptoms and the new CBCT showed no periradicular lesion, corticalization of the maxillary sinus floor, and no sinus disease.

Conclusion: The dental resolution of presented case showed that patients with unsuccessful previous treatment for rhinosinusitis may suffer from endodontic diseases, which may fail without the dentist's approach. The presented case showed that the implemented treatment protocol was effective to improve the patient's health, as well shows the necessity of proper approach to achieve success.

Keywords: Endodontic treatment, Maxillary sinus, Odontogenic localized secondary rhinosinusitis, Rhinosinusitis

How to cite this article

Marques AA, Marceliano-Alves MFV, Marques FV, Ronquete V, Pereira CS, Coutinho TMC. Resolution of chronic secondary rhinosinusitis of odontogenic origin after endodontic treatment: A case report. Int J Case Rep Images 2022;13(2):189–195.

Article ID: 101358Z01AM2022

****

doi: 10.5348/101358Z01AM2022CR

Amanda Assumpção Marques[1], DDS, Marília Fagury Videira Marceliano-Alves[1], DDS, MSc, PhD, Fábio Vidal Marques[2], DDS, MSc, PhD, Vivian Ronquete[3], DDS, MSc, Carlos Sardenberg Pereira[1], DDS, MSc, PhD, Thais Machado de Carvalho Coutinho[1], DDS, MSc, PhD

Affiliations: [1]Department of Dentistry Research, Iguaçu University, Nova Iguaçu, RJ, Brazil; [2]Post-Graduation Program in Dentistry, Estacio de Sá University, Rio de Janeiro, Brazil; [3]Department of Endodontics, Iguaçu University, Nova Iguaçu, RJ, Brazil.

Corresponding Author: Marília Fagury Videira Marceliano-Alves, DDS, MSc, PhD, Department of Endodontics and Dental Research, Av. Abílio Augusto Távora, 2134 Nova Iguaçu – RJ 26260-045, Brazil; Email: mmarceliano@hotmail.com

Received: 31 August 2022
Accepted: 18 October 2022
Published: 21 November 2022

INTRODUCTION

Rhinosinusitis is a common condition worldwide and significantly interferes with both the health of the population and the loss of professional productivity [1, 2]. According to The European Position Paper on Rhinosinusitis and Nasal Polyps 20201 (EPOS20201) [1], this pathology received a new classification, being first divided into primary and secondary and later divided into localized and diffuse disease, the latter based on the anatomical distribution. Localized secondary chronic

rhinosinusitis (LSCR) includes odontogenic changes, fungal ball, and neoplasms. Odontogenic localized secondary rhinosinusitis (OLSR) refers to bacterial maxillary sinusitis, with or without extension to other sinuses, with odontogenic infections as the main etiology [2–6]. It can be triggered by periapical lesions (cysts, abscesses, and granulomas), periodontitis, oroantral fistula (OAF), and paranasal sinuses foreign bodies related to dental treatment [3].

Odontogenic localized secondary rhinosinusitis was first described in the scientific literature in 1943, but with low prevalence, which can be explained by underreporting, concomitant with inconclusive diagnosis [7]. Previous studies have reported that OLSR represented 10–12% of rhinosinusitis cases. However, recent studies have reported that OLSR is responsible for about 25–45% of cases of rhinosinusitis and, that within this percentage, 45–75% of these cases have unilateral maxillary sinus opacity on multidetector or cone-beam computed tomography [8].

Odontogenic localized secondary rhinosinusitis signs and symptoms are purulent nasal discharge, nasal congestion, facial, periorbital, or head pain, halitosis, tiredness, toothache, cough, and pressure in the ear [1, 4, 9, 10]. According to Fokkens et al. (2020) computed tomography is the gold standard exam in the radiological evaluation of chronic nose and sinus diseases, with unilateral opacity as its main characteristic [4].

Although OLSR is usually a self-limiting disease, it is one of the main reasons for prescribing antibiotics. Thus, proper management is essential, frequently requiring a multidisciplinary approach, involving Dentists and Otolaryngologists, to control the infectious process and treat the disease [4, 11].

CASE REPORT

A male patient, 69 years old, Caucasian, with no systemic diseases, came to the dental office for evaluation of tooth #26 (FDI). During anamnesis, he reported daily nasal congestion and having undergone previous treatment for rhinosinusitis with systemic antibiotics and the use of both local and oral corticosteroids, which failed to resolve the case. Multidetector computed tomography showed a hyperdense image on the floor of the left maxillary sinus in the region of the posterior teeth, compatible with localized odontogenic secondary rhinosinusitis (OLSR). The patient gave full consent to report the present case.

During the physical examination, an active parulis was observed in the buccal gingiva between teeth 25 and 26. Fistula tracking showed that the source of infection was the mesial root of tooth #26, which also presented a radiolucent image at the periapical area, compatible with chronic apical periodontitis (Figure 1). Clinical pulp percussion and cold temperature tests showed negative results, the latter being compatible with pulp necrosis.

Cone-beam computed tomography (CBCT) (PreXion 3D device (Yoshida Dental Mfg Co, Ltd, Tokyo, Japan)) with a 0.14-mm voxel size; exposure parameters of 90 kV, 4 mA, and 19 seconds; and a field of view of 80 × 80 mm, was obtained to evaluate the entire volume of the region, anatomically relating the root apices of the maxillary posterior teeth with the cortical floor of the left maxillary sinus, and to exclude the possibility of root fracture of tooth #26. The CBCT images confirmed the presence of a periapical lesion, rupture of the cortical bone of the sinus floor maxillary and thickening of the sinus membrane (Figure 2). Therefore, the diagnostic hypothesis was OLSR, because of pulp necrosis of tooth #26.

During the first appointment, the fistula was drained, and the mechanical chemical preparation of the canal system was completed with mechanized instrumentation and irrigation with sodium hypochlorite solution (NaOCl 5.25%), finished with the removal of the smear layer with 17% ethylenediaminetetraacetic acid (EDTA) and mechanical agitation of this solution with easy clean. The root canal system was dried with a sterile paper cone and filled with intracanal medication with HPG paste (calcium hydroxide, camphorated paramonochlorophenol, and glycerin). The patient used oral Nimesulide 100 mg in the first 5 days and Dipyrone 500 mg in the first 24 hours.

At the second session, 20 days after the first one, the patient returned with complete remission of the fistula and no complaints associated with his general condition. The root canal system was filled with gutta-percha and N-Richet endodontic cement with Tagger's hybrid technique and provisional restoration with glass ionomer cement. After 30 days of follow-up, the patient returned with the total absence of fistula and no symptoms. Digital periapical radiographic examination showed improvement in the periradicular region with a discrete radiolucent image associated with the apex of the mesiobuccal root of tooth 26. The patient was referred for prosthetic rehabilitation.

After approximately nine months, the patient returned for follow-up and no clinical symptoms and with radiographic evidence of repair in the periapical region. Cone-beam computed tomography of the region of tooth #26 was performed to assess the status of both periradicular and sinus disease, in which could be seen repair of the periradicular lesion, newly formed cortical bone at the sinus floor of the left maxillary sinus, and regression of the membrane thickening (Figures 1 and 2).

- A 0.14-mm voxel size; exposure parameters of 90 kV, 4 mA, and 19 seconds; and a field of view of 80 × 80 mm.

This case report has been written according to Preferred Reporting Items for Case reports in Endodontics (PRICE) 2020 guidelines [12].

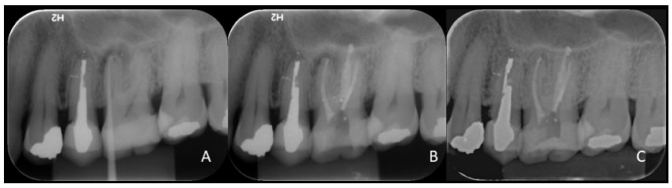


Figure 1: Radiographic features of the presented case (A). Fistulous path tracking showing relation with teeth 16 (B). Immediate post-operative radiography after endodontic treatment (C).

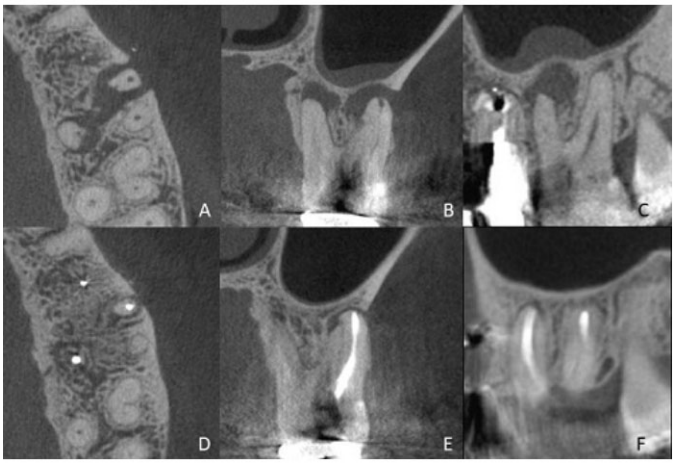


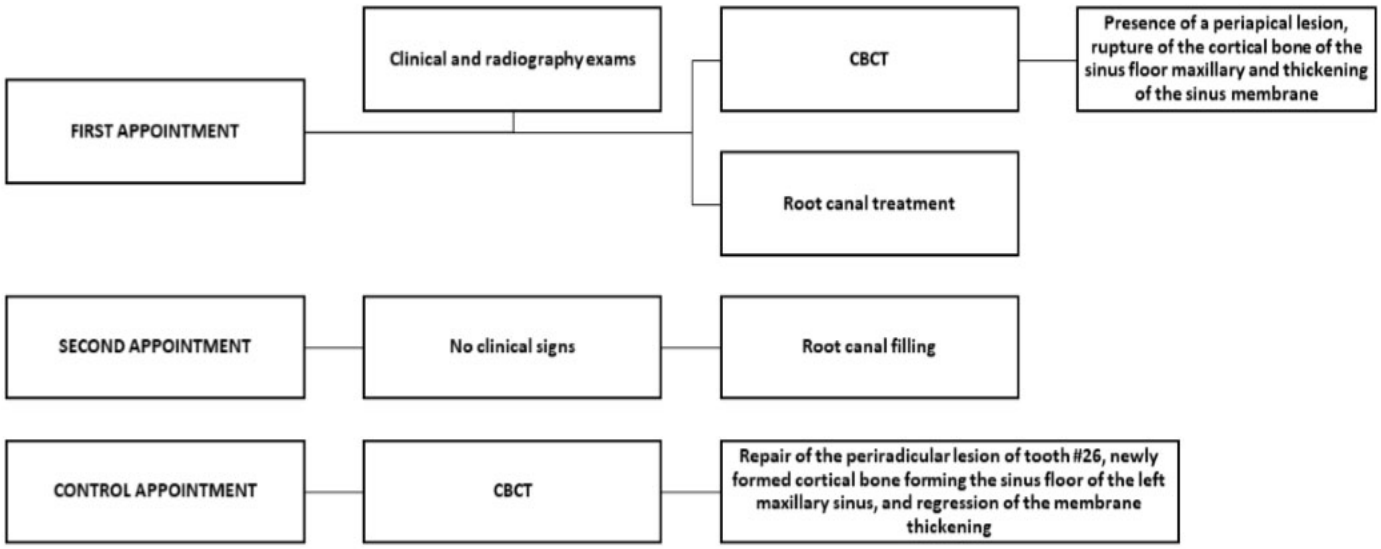
Figure 2: Computed tomography scan. (A) Axial view showing the periapical lesion associated to the mesial and palatal roots. (B) Coronal view showing the periapical lesions and the mucosal thickening. (C) Sagittal view showing the periapical lesions and the mucosal thickening. (D) Axial view showing regression of periapical lesion after root canal treatment. (E) Coronal view showing no signs of sinus membrane thickening. (F) Sagittal view showing no signs of sinus membrane thickening.

DISCUSSION

This article reports on 01 patient case, a male in the sixth decade of life, who showed sinus pathologic conditions suspected to have an odontogenic cause. Current literature describes a higher frequency of odontogenic sinus disease in female patients [4, 13–15] and the mean age previously described [4, 15] is compatible with the age of the aforementioned patient. Available data supports the hypothesis that teeth affected by chronic apical periodontitis may be retained in the oral cavity for many years [16].

This patient showed pain of dental or sinus origin and was referred to the endodontist for further examination and treatment. One limitation of this study could be considered that the patient did not provide previous image exams that could help the clinicians to assess the disease evolution time, the diagnosis was set considering the present exams. The treatment indicated for maxillary sinusitis of odontogenic origin normally includes nonsurgical root canal treatment, periradicular surgery, intentional replantation, or extraction of the responsible tooth 4. Especially in the case described, the treatment performed was only endodontic with the total repair of the sinus condition.

In view of the proximity of the apex of the maxillary posterior teeth to the maxillary sinuses, changes arising from dental structures can cause destruction of the floor of the maxillary sinus, causing sinus pathology, known as localized secondary chronic rhinosinusitis (LSCR) [10]. This condition, which was also observed in this case, highlights the close anatomical relationship of the root of



tooth #26, culminating with the left sinus alteration due to anatomical relationship of contiguity [4, 11, 14, 17–19].

The rupture of the cortical floor of the maxillary sinus, accompanied by the thickening of the Scheiderian membrane due to the progress of any odontogenic inflammation originating from dental elements, was first described in 1943 by Bauer et al., and observed in this case report, characterizing the pathological entity called LSCR. According previous study, the simple presence of the periradicular lesion did not present statistical significance in relation to sinus alterations [4], and these results are in addition to other findings [6, 20]. It is noteworthy that sinus changes are related not only to the proximity of the dental apices to the maxillary sinus but also to the presence of changes in the periapical region [4].

Localized secondary chronic rhinosinusitis is caused by iatrogenic factors in more than 60% of cases [10]. The maxillary first and second molars are the teeth that most commonly cause sinus disease, consistent with the case presented, which had the alteration of the left maxillary sinus from the buccal root of tooth #26 [21] (Wuokko-Landén, 2020). However, it must be noted that LSCR has a diverse etiology, such as untreated dental infection, root cysts, caries disease, odontogenic foreign bodies, inadequate endodontic treatments, as well as inadequate implantation [10].

The exact prevalence of LSCR is still uncertain, with data ranging from 10% to 41% of all cases of rhinosinusitis. This variation may be due to the difficulty of an accurate diagnosis without an interdisciplinary evaluation of patients. In addition, since chronic apical periodontitis is highly prevalent, it is considered the most common cause of LSCR, with up to 83% of the cases having an endodontic origin. Thus, it is reasonable to consider that endodontic pathologies, with periapical repercussions, are of great importance in the etiology of sinus disease, such as shown in this case [10].

The main difficulty in the diagnosis of LSCR is the presence of nonspecific signs and symptoms that can be related to several other allergic and viral conditions, such as purulent nasal discharge, nasal congestion, facial, periorbital or head pain, halitosis, tiredness, toothache, cough and pressure in the ear [1, 4, 9, 10], all of which were reported by the patient of the present case during the anamnesis. Thus, a detailed dental evaluation is of utmost importance to exclude sinus pathology of dental origin.

It is also noteworthy that according to the medical history, the patient had been previously treated as a non-odontogenic rhinosinusitis case, but with no remission of symptoms.

Regarding the treatment of RSCSL, there is still no consensus in the literature. The prevalence of medical management, the use of systemic antibiotics, and nasal irrigation with saline solution can be cited [22]. When evaluating the treatment of RSCSL with the use of short-term and long-term oral, topical, and intravenous antibiotics, EPOS 2020 [1] did not find a significant difference in the improvement of these groups compared to placebo. The use of nasal corticosteroids, on the other hand, demonstrates high-quality evidence of their prolonged use. In cases of RSCSL with the presence of nasal polyps, corticosteroids reduce the size of the nasal polyp, as well as may reduce its incidence when administered after endoscopic sinus surgery. These findings were not observed in the case described in which the patient made regular use of nasal corticosteroids without success.

It is common for patients who have symptoms compatible with RSCSL to look for otolaryngologists who have endoscopic sinus surgery in the early stages as a treatment option if they do not improve after systemic antibiotic therapy [22]. Recent studies also show that endoscopic surgery of the primary facial sinuses can present results as effective as a dental intervention. However, they point out that physiologically, it is more appropriate to perform dental treatment primarily to remove the causative agent and with the main advantage of not performing a surgical procedure [4, 12, 22]. In the case described, systemic treatments had been performed, however, there was no involution of signs and symptoms. As recommended in the literature, only endodontic treatment was performed, obtaining control of the patient's signs and symptoms. Although there is no consensus in the medical and dental literature regarding the cause of CRSSL, there is a consensus regarding the fact that whenever there is a dental cause associated with sinusitis that does not respond to conventional therapy, dental treatment is essential and must precede the surgical treatment of the maxillary sinus [4].

The current literature is conclusive regarding the superiority of CBCT images compared to periapical radiographs, both for the diagnosis of periradicular lesions and for visualization of the sinus membrane [1, 6, 16, 20, 23–27]. According to 20201, when comparing imaging methods (conventional radiography, computed tomography, and magnetic resonance) for the diagnosis of CRSSL, computed tomography remains the gold standard.

According to the European Society of Endodontists [28], although the CBCT exam has a greater specificity in relation to the evaluation of the periradicular region, periapical radiography remains the first choice of imaging exam, and the CBCT exam will be recommended in the face of a diagnostic complexity where cases must be evaluated separately and performed in high resolution, small volume cone-beam tomographs, ensuring a quality image with a reduced dose of radiation [4, 24, 25]. Thus, it is important to understand that CBCT images can serve as auxiliary tools in the diagnosis of sinus alterations, as well as the possible association between periapical diseases, periradicular lesions, and sinus diseases.

The RSCSL presents a radiopaque radiographic image in the unilateral maxillary sinus and when evaluated through CT shows a hyperdense image [4]. The relationship of these larger unilateral thickenings associated with some

images suggestive of a periradicular lesion was observed, suggesting the diagnosis of RSCSL, this correlation was observed in the present case [4, 13, 16, 20, 27, 29–31]. It is noteworthy that all previous studies do not present information regarding clinical characteristics because they are cross-sectional retrospective studies. Different from what can be seen in the description of this clinical case, which both anamnesis and a complete physical examination of the patient are available, allowing a close correlation of dental alterations with sinus alterations.

The cone-beam computed tomography (CBCT), as it is a multiplanar exam, clearly shows the anatomical relationships of the posterior regions of the maxilla, being possible to observe the suggestive images of sinus alterations (mucositis, mucous retention cysts, sinusitis, and sinusitis odontogenic) [25]. These images, associated with clinical data and anamnesis, can contribute to the diagnosis of sinus disorders, as described in this case report.

The American Association of Endodontists published an article for managing MSEO and recommended position that this condition be firstly addressed, by controlling the infection (AAE, 2018). After endodontic management, the patient should be followed up for clinical and radiologic evaluation, with most sinus changes resolving in a few months. In recalcitrant cases, the patient should be returned or referred to the otolaryngologist for evaluation. If untreated or not properly treated, the sinus infection may aggravate and evolve to complications such as orbital cellulitis, meningitis, subdural empyema, brain abscess, thrombosis, and cavernous sinus. Both endodontists and otolaryngologists should participate in the decision-making process for the best treatment, and each one should take over the treatment procedures of their respective competence and expertise [32, 33].

CONCLUSION

In view of the evidence of the close relationship between the maxillary sinus and the oral cavity, more specifically with the periradicular region, it is of great importance to elucidate the issues related to the diagnosis and management of infections of dental origin that can trigger odontogenic sinusopathy, in which the treatment presents its particularity and needs a multidisciplinary team to achieve success.

REFERENCES

1. Fokkens WJ, Lund VJ, Hopkins C, et al. European position paper on rhinosinusitis and nasal polyps 2020. Rhinology 2020;58(Suppl S29):1–464.
2. Psillas G Papaioannou D, Petsali S, Dimas GG, Constantinidis J. Odontogenic maxillary sinusitis: A comprehensive review. J Dent Sci 2021;16(1):474–81.
3. Craig JR, McHugh CI, Griggs ZH, Peterson EI. Optimal timing of endoscopic sinus surgery for odontogenic sinusitis. Laryngoscope 2019;129(9):1976–83.
4. Coutinho TMC. Associação entre periodontite apical crônica e alterações da membrana sinusal: estudo transversal retrospectivo por meio de tomografia computadorizada por feixe cônico (dissertação). Rio de Janeiro (RJ): Universidade Estácio de Sá; 2020.
5. Drago L, Vassena C, Saibene AM, Del Fabbro M, Felisati G. A case of coinfection in a chronic maxillary sinusitis of odontogenic origin: Identification of Dialister pneumosintes. J Endod 2013;39(8):1084–7.
6. Nascimento EHL, Pontual MLA, Pontual AA, Freitas DQ, Perez DEC, Ramos-Perez FMM. Association between odontogenic conditions and maxillary sinus disease: A study using cone-beam computed tomography. J Endod 2016;42(10):1509–15.
7. Allevi F, Fadda GL, Rosso C, et al. Diagnostic criteria for odontogenic sinusitis: A systematic review. Am J Rhinol Allergy 2021;35(5):713–21.
8. Goyal VK, Ahmad A, Turfe Z, Peterson EI, Craig JR. Predicting odontogenic sinusitis in unilateral sinus disease: A prospective, multivariate analysis. Am J Rhinol Allergy 2021;35(2):164–71.
9. Bajoria AA, Sarkar S, Sinha P. Evaluation of odontogenic maxillary sinusitis with cone beam computed tomography: A retrospective study with review of literature. J Int Soc Prev Community Dent 2019;9(2):194–204.
10. Tsuzuki K, Kuroda K, Hashimoto K, et al. Odontogenic chronic rhinosinusitis patients undergoing tooth extraction: Oral surgeon and otolaryngologist viewpoints and appropriate management. J Laryngol Otol 2020;134(3):241–6.
11. Ferguson M. Rhinosinusitis in oral medicine and dentistry. Aust Dent J 2014;59(3):289–95.
12. Nagendrababu V, Chong BS, McCabe P, et al. PRICE 2020 guidelines for reporting case reports in endodontics: Explanation and elaboration. Int Endod J 2020;53(7):922–47.
13. Little RE, Long CM, Loehrl TA, Poetker DM. Odontogenic sinusitis: A review of the current literature. Laryngoscope Investig Otolaryngol 2018;3(2):110–4.
14. Nunes CABCM, Guedes OA, Alencar AHG, Peters OA, Estrela CR, Estrela C. Evaluation of periapical lesions and their association with maxillary sinus abnormalities on cone-beam computed tomographic images. J Endod 2016;42(1):42–6.
15. Troeltzsch M, Pache C, Troeltzsch M, et al. Etiology and clinical characteristics of symptomatic unilateral maxillary sinusitis: A review of 174 cases. J Craniomaxillofac Surg 2015;43(8):1522–9.
16. Vestin Fredriksson M, Öhman A, Flygare L, Tano K. When maxillary sinusitis does not heal: Findings on CBCT scans of the sinuses with a particular focus on the occurrence of odontogenic causes of maxillary sinusitis. Laryngoscope Investig Otolaryngol 2017;2(6):442–6.
17. Brook I. Sinusitis of odontogenic origin. Otolaryngol Head Neck Surg 2006;135(3):349–55.
18. Nurbakhsh B, Friedman S, Kulkarni GV, Basrani B, Lam E. Resolution of maxillary sinus mucositis after

endodontic treatment of maxillary teeth with apical periodontitis: A cone-beam computed tomography pilot study. J Endod 2011;37(11):1504–11.
19. Bornstein MM, Seiffert C, Maestre-Ferrín L, et al. An analysis of frequency, morphology, and locations of maxillary sinus septa using cone beam computed tomography. Int J Oral Maxillofac Implants 2016;31(2):280–7.
20. de Lima CO, Devito KL, Baraky Vasconcelos LR, Prado MD, Campos CN. Correlation between endodontic infection and periodontal disease and their association with chronic sinusitis: A clinical-tomographic study. J Endod 2017;43(12):1978–83.
21. Wuokko-Landén A, Blomgren K, Suomalainen A, Välimaa H. Odontogenic causes complicating the chronic rhinosinusitis diagnosis. Clin Oral Investig 2021;25(3):947–55.
22. Yoo BJ, Jung SM, Lee HN, Kim HG, Chung JH, Jeong JH. Treatment strategy for odontogenic sinusitis. Am J Rhinol Allergy 2021;35(2):206–12.
23. Siqueira JF Jr, Lenzi R, Hernández S, et al. Effects of endodontic infections on the maxillary sinus: A case series of treatment outcome. J Endod 2021;47(7):1166–76.
24. Steier L, Steier G, Doğramaci EJ, Rossi-Fedele G. Maxillary sinus unilateral aplasia as an incidental finding following cone-beam computed (volumetric) tomography. Aust Endod J 2014;40(1):26–31.
25. Dutra KL, Haas L, Porporatti AL, et al. Diagnostic accuracy of cone-beam computed tomography and conventional radiography on apical periodontitis: A systematic review and meta-analysis. J Endod 2016;42(3):356–64.
26. Kamburoğlu K, Yılmaz F, Gulsahi K, Gulen O, Gulsahi A. Change in periapical lesion and adjacent mucosal thickening dimensions one year after endodontic treatment: Volumetric cone-beam computed tomography assessment. J Endod 2017;43(2):218–24.
27. Expert Panel on Neurologic Imaging, Kirsch CFE, Bykowski J, et al. ACR appropriateness Criteria® Sinonasal disease. J Am Coll Radiol 2017;14(11S):S550–9.
28. Ly D, Hellgren J. Is dental evaluation considered in unilateral maxillary sinusitis? A retrospective case series. Acta Odontol Scand 2018;76(8):600–4.
29. Patel VA, Pool CD, Dunklebarger M, Schaefer E, Goyal N. Sinonasal disease in total laryngectomy patients. Ann Otol Rhinol Laryngol 2019;128(9):811–8.
30. Maillet M, Bowles WR, McClanahan SL, John MT, Ahmad M. Cone-beam computed tomography evaluation of maxillary sinusitis. J Endod 2011;37(6):753–7.
31. Hoskison E, Daniel M, Rowson JE, Jones NS. Evidence of an increase in the incidence of odontogenic sinusitis over the last decade in the UK. J Laryngol Otol 2012;126(1):43–6.
32. Lechien JR, Filleul O, Costa de Araujo P, Hsieh JW, Chantrain G, Saussez S. Chronic maxillary rhinosinusitis of dental origin: A systematic review of 674 patient cases. Int J Otolaryngol 2014;2014:465173.
33. Tataryn RW, Lewis MJ, Horalek AL, et al. Maxillary sinusitis of endodontic origin: AAE position statement. [Available at: https://www.aae.org/specialty/wp-content/uploads/sites/2/2018/04/AAE_PositionStatement_MaxillarySinusitis.pdf]

****

Acknowledgments
This study was supported by grants from Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ) and Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Brazilian Governmental Institutions.

Author Contributions
Amanda Assumpção Marques – Conception of the work, Design of the work, Acquisition of data, Interpretation of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Marília Fagury Videira Marceliano-Alves – Conception of the work, Design of the work, Acquisition of data, Analysis of data, Interpretation of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Fábio Vidal Marques – Analysis of data, Interpretation of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Vivian Ronquete – Acquisition of data, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Carlos Sardenberg Pereira – Analysis of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Thais Machado de Carvalho Coutinho – Conception of the work, Design of the work, Acquisition of data, Analysis of data, Interpretation of data, Drafting the work, Revising the work critically for important intellectual content, Final approval of the version to be published, Agree to be accountable for all aspects of the work in ensuring that

questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved

Guarantor of Submission
The corresponding author is the guarantor of submission.

Source of Support
This study was supported by grants from Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ) and Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq), Brazilian Governmental Institutions.

Consent Statement
Written informed consent was obtained from the patient for publication of this article.

Conflict of Interest
Authors declare no conflict of interest.

Data Availability
All relevant data are within the paper and its Supporting Information files.