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CASE REPORT/CLINICAL TECHNIQUES

Differential Healing Patterns of Odontogenic Maxillary Sinusitis Following Nonsurgical Endodontic Therapy: A Cone-Beam Computed Tomography-Based Case Series

SIGNIFICANCE

Sinus mucosa appears to heal faster than periapical bone, typically within about 3 months. Periapical radiographs effectively assess extensive bone destruction or sinus floor perforation. Early mucosal healing on cone-beam computed tomography (3 months) may predict subsequent alveolar bone regeneration.

ABSTRACT

This case series evaluated the differential healing patterns of maxillary sinus mucosa and periapical bone following nonsurgical root canal treatment for odontogenic maxillary sinusitis to propose a prognostic perspective based on distinct radiographic features. Ten cases of odontogenic maxillary sinusitis managed by primary nonsurgical root canal treatment or retreatment were categorized into 4 radiographic patterns based on periapical and sinus lesions. Clinical symptoms were recorded, and radiographic healing was assessed using cone-beam computed tomography (CBCT) at baseline and during follow-up periods ranging from approximately 3–17 months. All cases showed clinical symptoms recovery and sinus opacities radiographic resolution. Maxillary sinus mucosal lesions, including extensive opacification and sinus floor perforations, resolved to a normal physiological thickness (<2 mm) within approximately 3 months. Conversely, periapical alveolar bone regeneration required a longer progress (approximately 3–17 months) to demonstrate radiographic healing. Cases with extensive bone destruction or periosteal displacement (periapical osteoperiostitis/halo sign) showed delayed bone healing. Within the limits of this case series, maxillary sinus mucosa appears to heal faster than periapical tissues, typically resolving within 3 months. Although periapical radiographs remain useful for evaluating sinus floor perforation and extensive bone destruction, CBCT offers superior three-dimensional assessment in anatomically complex cases or when radiographs are inconclusive. We suggest that, in selected cases, early postoperative CBCT evidence of mucosal resolution (approximately 3 months) may be considered as an adjunctive early indicator of treatment response, while acknowledging that periapical bone regeneration often lags and requires longer follow up. *(J Endod 2026;52:1206–1213.)*

KEY WORDS

Apical periodontitis; case series; cone-beam computed tomography; odontogenic maxillary sinusitis; root canal therapy

Odontogenic maxillary sinusitis (OMS) is inflammation of the maxillary sinus secondary to dental disease or iatrogenic injury. With advances in diagnostic imaging, reported prevalence of OMS has increased; evidence indicates odontogenic causes account for approximately 30%–40% of chronic maxillary sinusitis and up to 75% of unilateral cases[1,2]. Common causes include periapical lesions, advanced periodontal disease, and complications such as displaced root fragments or sinus floor perforations[3]. Despite its prevalence, OMS remains a diagnostic challenge because spread of periapical infection into the sinus may obscure typical dental symptoms, potentially leading to delayed intervention and indiscriminate antibiotic use[4,5].

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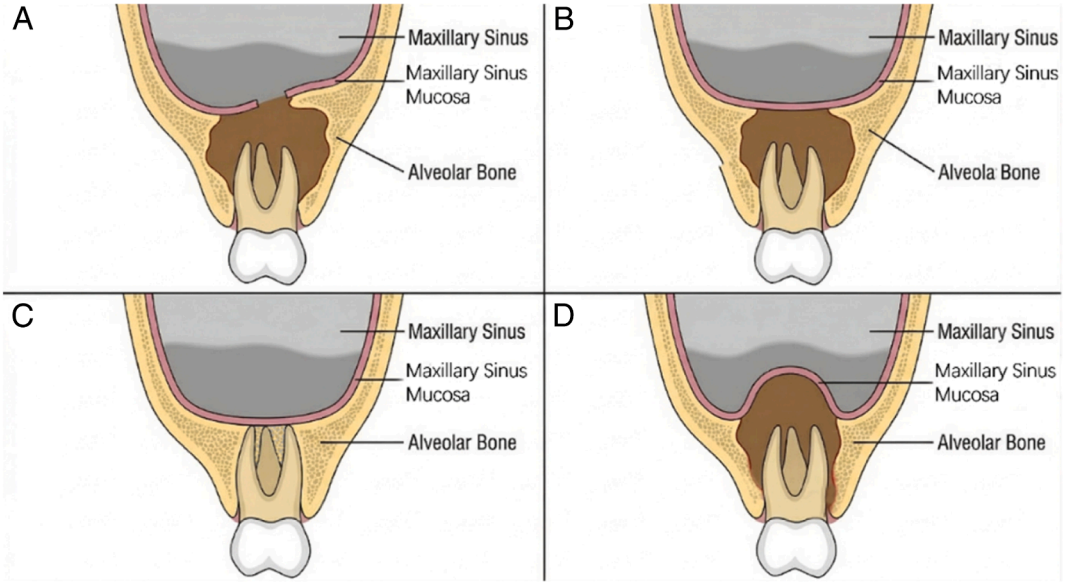

FIGURE 1 – Schematic diagrams of odontogenic maxillary sinusitis (OMS). (*A*) OMS with periapical bone destruction and maxillary sinus mucosal perforation (Case 1–2). (*B*) OMS with periapical bone destruction but intact maxillary sinus mucosa (Case 3–4). (*C*) OMS with minimal or no evident periapical bone destruction (Case 5–9). The root apex is close to or protrudes into the maxillary sinus. (*D*) Periapical osteoperiostitis ("halo lesion") (Case 10).

The pathophysiology of OMS relates to the close anatomical relationship between maxillary posterior root apex and the sinus floor. This proximity facilitates microbial and inflammatory spread into the sinus, manifesting radiographically as localized mucosal thickening or periapical osteoperiostitis ("halo lesion")[6,7]. Conventional two-dimensional radiography is limited due to anatomical superimposition; consequently, cone-beam computed tomography (CBCT) has become increasingly important for three dimensional and volumetric assessment of both periapical bone and sinus changes[8,9].

Elimination of the odontogenic causes is the primary goal in OMS management. Nonsurgical root canal treatment (NSRCT) is the preferred, least invasive approach and has been shown to resolve associated sinus opacities in many cases while preserving the natural dentition[10,11]. However, critical clinical dilemmas remain regarding the necessity of CBCT when periapical radiographs fail to clearly identify bone destruction or sinus pathosis preoperatively, as well as the optimal timing and indications for postoperative CBCT follow-up. Although several studies have investigated maxillary sinus healing following endodontic therapy[12-14], including specific research on maxillary sinus osteoperiostitis[15], existing literature has not fully clarified the temporal discrepancy in healing between the sinus mucosa and the periapical alveolar bone. Furthermore, there remains a lack of consensus for OMS regarding optimal imaging and postoperative follow-up strategies.

This case series of 10 OMS cases (categorized into 4 radiographic patterns) uses CBCT follow up (3–17 months) to describe differential healing of the maxillary sinus mucosa versus periapical bone after NSRCT and to propose a pragmatic imaging perspective for preoperative and postoperative assessment.

MATERIALS AND METHODS

Patient Selection and Ethical Considerations

All patients in this case series were treated at Shanghai Stomatological Hospital, Fudan University from 2022 to 2025. The protocol was conducted in accordance with the Declaration of Helsinki, and informed consent was obtained from all participants. Inclusion criteria comprised nonvital teeth or previously treated teeth with apical periodontitis, confirmed by pulp sensibility testing and radiographic examination (periapical radiographs and CBCT).

Endodontic Procedures

All treatments were performed under a dental operating microscope with rubber dam isolation after local anesthesia. Root canals were instrumented using a rotary NiTi system. In retreatment cases, previous filling materials were removed using retreatment files and solvents. Irrigation was performed using 1% NaOCl and 17% EDTA, supplemented by Er:YAG laser-activated irrigation (photon-induced photoacoustic streaming) to enhance disinfection. Calcium hydroxide was applied as an intracanal medicament for at least 2 weeks between appointments. Systemic antibiotics were prescribed for one patient (case 2) who presented with severe symptoms, a 3-day course was given. Upon resolution of symptoms, root canals were obturated using either warm vertical compaction or a single-cone technique with a bioceramic sealer. Teeth were restored with resin composite or full-coverage crowns to ensure a coronal seal.

Radiographic Analysis and Outcome

Follow-up CBCT imaging was conducted at 3 months to assess early healing, with subsequent scans at 6–17 months as needed, following ALARA principles. Images were acquired using a standardized protocol (Planmeca Viso G5; FOV 80 × 80 mm, voxel size 0.2 mm). Two calibrated endodontists independently analyzed the images using Planmeca Romexis software, and any measurement discrepancies were resolved by joint review to reach consensus.

Success criteria included the absence of clinical symptoms and radiographic evidence of healing[16]. Given the absence of clinical symptoms in all patients at follow-up, outcome evaluation prioritized radiographic healing. Quantitative radiographic analysis concurrently evaluated osseous and mucosal healing. Periapical bone destruction was scored (0–5) based on the largest dimension

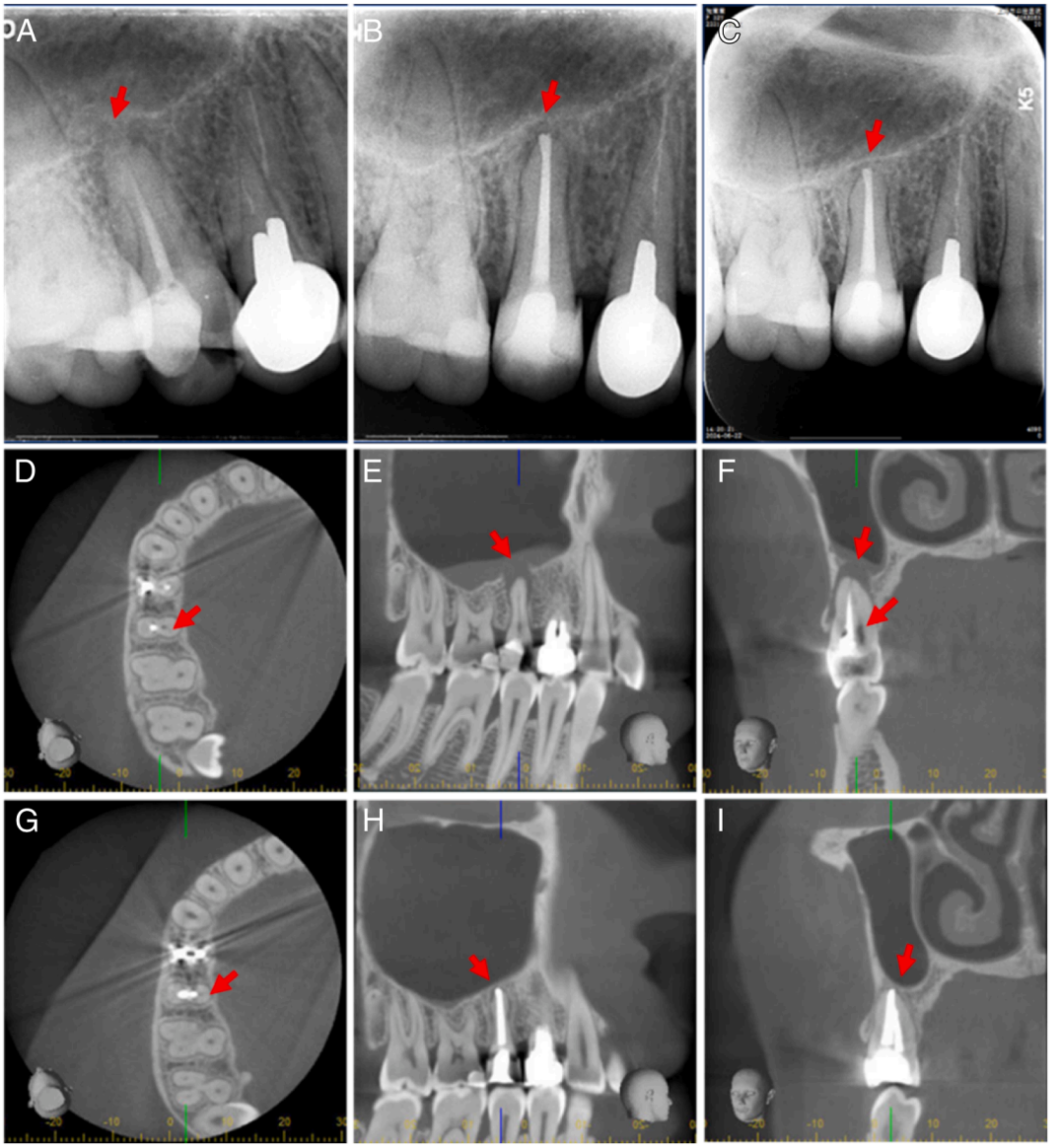

FIGURE 2 – Chronic apical periodontitis of tooth #4 with maxillary sinus perforation. (*A–C*) Serial periapical radiographs showing preoperative sinus floor disruption (*arrow*), partial re-establishment at 3 months (*arrow*), and continuous sinus floor at 6 months (*arrow*). (*D–F*) Preoperative CBCT views (axial, sagittal, coronal) identifying a missed palatal canal (*D* and *F*, *arrows*), sinus floor perforation, and associated mucosal opacification (*E*, *arrow*). (*H–J*) 6-month postoperative CBCT views (axial, sagittal, coronal) demonstrating dense canal obturation, repair of the sinus floor, and resolution of sinus opacification (*I*, *arrow*). CBCT, cone-beam computed tomography.

of the lesion in 3 planes using the CBCT-PAI index[17]. Maxillary sinus mucosal thickness was measured on coronal slices perpendicular to the sinus floor, with mucosal thickness <2 mm defined as normal[13].

CASE PRESENTATIONS

This report evaluated 10 patients (ages 25–41) diagnosed with OMS secondary to diverse endodontic causes, including dental caries, missed root canals, and cracked tooth syndrome. Clinical presentations varied, ranging from asymptomatic incidental findings to spontaneous pain or rhinological symptoms. Preoperative CBCT demonstrated varying degrees of maxillary sinus opacification and periapical alveolar bone destruction. Management focused on eliminating the endodontic infection through NSRCT or retreatment. Based on differential periapical and sinus lesions, the cases were categorized into 4 radiographic patterns (Fig. 1), which inform our proposed clinical perspective.

Pattern A: OMS with Maxillary Sinus Floor Perforation

Cases 1 (Fig. 2) and 2 (Supplemental Fig. S1) presented with chronic apical periodontitis complicated by direct perforation of the maxillary sinus floor. Preoperative CBCT clearly revealed cortical discontinuity accompanied by extensive sinus opacification, while periapical radiographs also showed disruption of the sinus floor "white line". Although both cases ultimately achieved clinical and radiographic improvement, healing after retreatment was relatively slower in case 1. Both cases demonstrated re-establishment of sinus floor continuity (the "white line") and mucosal normalization within 3–6 months on periapical radiographs and CBCT. In settings without CBCT, dynamic changes in the sinus floor "white line" on periapical radiographs may serve as a practical indicator of healing.

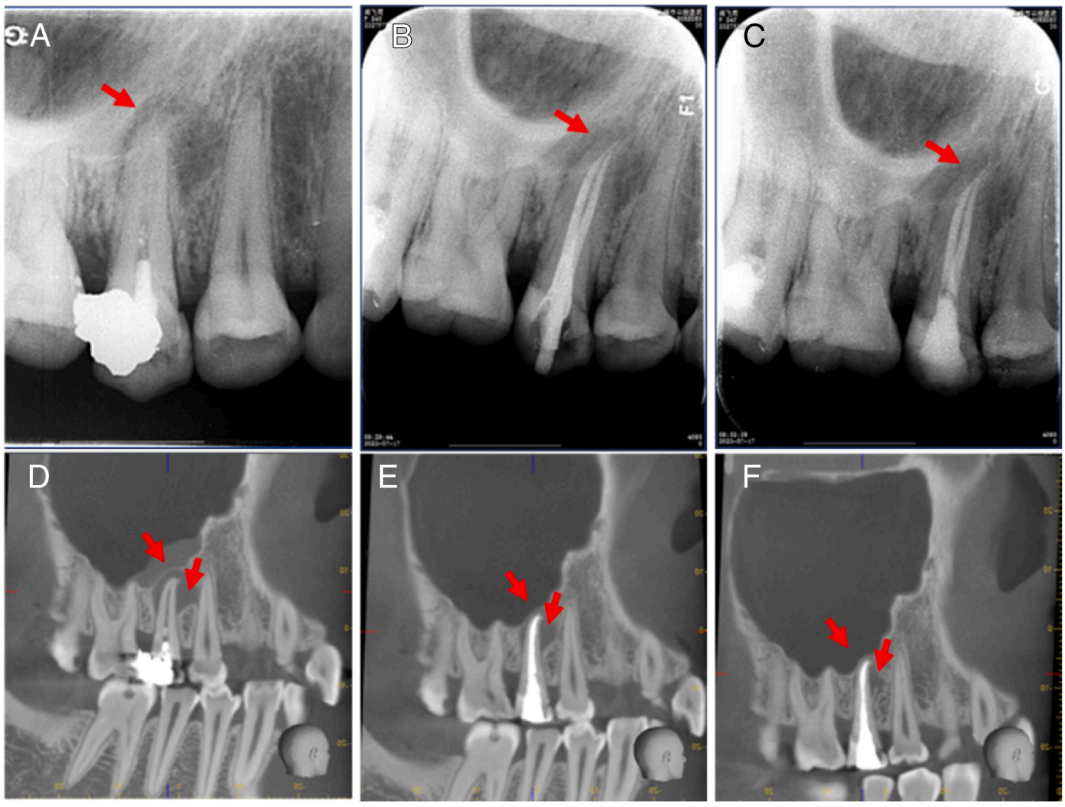

FIGURE 3 – Chronic apical periodontitis of tooth #4 without maxillary sinus perforation. (*A–C*) Periapical radiographs showing preoperative radiolucency (*arrow*), postobturation status, and persistent radiolucency at 3 months (*arrow*). (*D–F*) Sagittal CBCT views showing: (*D*) preoperative extensive osteolysis and sinus opacification (*arrow*); (*E*) 3-month follow-up showing partial osseous healing but complete resolution of sinus opacification (*arrow*); and (*F*) 17-month follow-up showing advanced osseous healing with a clear sinus (*arrow*). CBCT, cone-beam computed tomography.

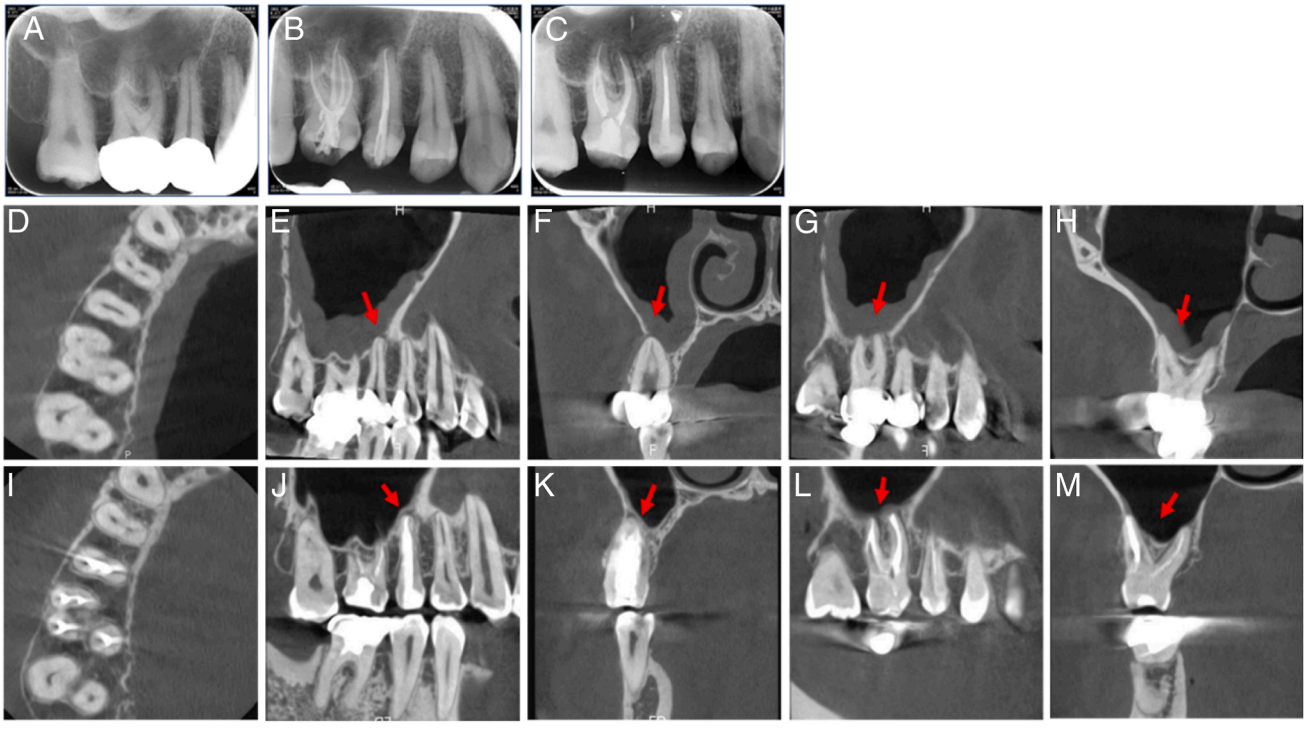

FIGURE 4 – Sinus opacification without evident periapical bone destruction involving teeth #3 and #4. (*A–C*) Serial periapical radiographs: preoperative view with unclear apical status, postobturation, and postrestorative status. (*D–H*) Preoperative CBCT views (axial, sagittal, coronal): (*E* and *F*) *arrows* indicate roots of tooth #4 within the maxillary sinus with associated mucosal opacification; (*G* and *H*) *arrows* indicate similar findings for tooth #3. (*I–M*) 3-month follow-up CBCT (axial, sagittal, coronal): (*J* and *K*) *arrows* show complete resolution of opacification associated with tooth #4; (*L* and *M*) *arrows* show corresponding resolution for tooth #3. CBCT, cone-beam computed tomography.

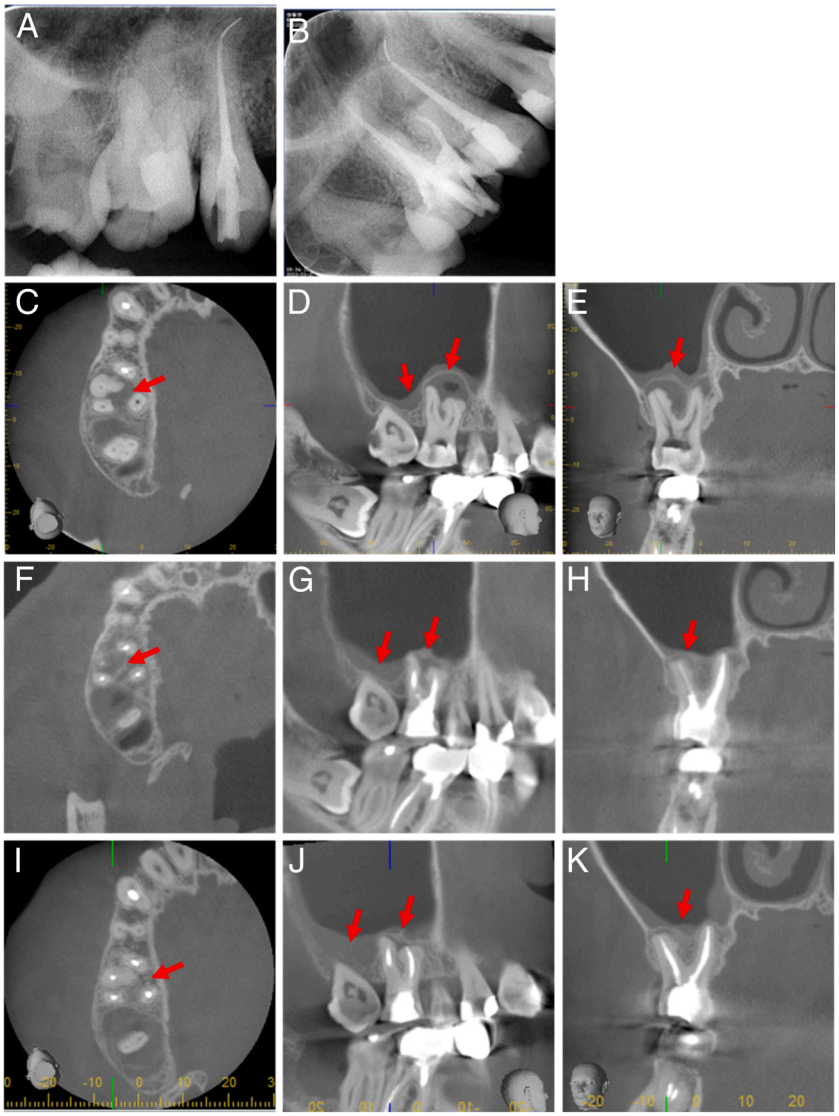

FIGURE 5 – Periapical osteoperiostitis ('Halo lesion') associated with tooth #3. (*A* and *B*) Preoperative and post-obturation radiographs. (*C–E*) Preoperative CBCT views (axial, sagittal, coronal): *arrows* identify periapical radiolucency (*C*) and superiorly displaced periosteum with associated sinus opacification (*D*). (*F–H*) 6-month follow-up CBCT (axial, sagittal, coronal) showing partial osseous healing and resolution of sinus opacification (*F*, *arrow*). (*I–K*) 17-month follow-up CBCT (axial, sagittal, coronal) showing complete osseous regeneration, total resolution of sinus opacification, and restoration of the original sinus floor contour (*I* and *J*, *arrows*). CBCT, cone-beam computed tomography.

Pattern B: OMS with Bone Destruction but Intact Sinus Floor

Cases 3 (Fig. 3) and 4 (Supplemental Fig. S2) involved symptomatic apical periodontitis after inadequate prior endodontic treatment. On periapical radiographs, extensive periapical bone destruction is only faintly visible. CBCT showed a temporal discrepancy between sinus mucosal and alveolar bone healing: sinus opacification resolved to normal within about 3 months, whereas periapical bone regeneration lagged (Case 3 required 17 months for complete osseous healing). Case 4 similarly showed resolved sinusitis at 3 months despite incomplete bone healing. These findings suggest early mucosal resolution may precede and predict slower alveolar bone regeneration.

Pattern C: Sinus Opacification without Evident Periapical Bone Destruction

Cases 5–9 presented with varied etiologies, including multitooth involvement after crown placement (Case 5, Fig. 4), deep caries (Case 6, Supplemental Fig. S3), resin-filled deep caries (Case 7, Supplemental Fig. S4), hidden caries with a calcified MB2 canal (Case 8, Supplemental Fig. S5), and cracked tooth syndrome (Case 9, Supplemental Fig. S6). In these patients, the root apices were adjacent to or protruded into the sinus, allowing inflammatory mediators to diffuse through porous bone. Sinus opacification was present despite minimal periapical bone destruction (PAI score 0–1). In such cases, periapical radiographs have limited diagnostic/prognostic value, making CBCT a valuable adjunctive imaging modality. Resolution of sinus opacification within 3 months may serve as the primary radiographic indicator of infection control.

Pattern D: Periapical Osteoperiostitis/"Halo Lesion"

Case 10 (Fig. 5) demonstrated periapical osteoperiostitis, with inflammatory exudate elevating the intact maxillary sinus periosteum and producing a characteristic radiopaque "halo." Periapical radiographs were limited by superimposition. Although complete radiographic healing was not confirmed until 17 months, a reduction in the elevated sinus contour was already apparent on CBCT at 3 months.

Detailed demographic and clinical data are summarized in Table 1. Supplementary radiographic figures are provided in Supplementary Material.

DISCUSSION

The findings of this case series support the effectiveness of NSRCT in managing OMS. In all reported cases, clinical and radiographic resolution of sinus pathology was achieved following endodontic treatment, reinforcing the concept that the Schneiderian membrane can recover once the endodontic infection is controlled[18,19]. Our observations are consistent with evidence that sinus mucosal thickening is primarily a reactive inflammatory response rather than an autonomous infectious process[20]. Consequently, a conservative endodontic approach is generally preferable to more invasive procedures such as functional endoscopic sinus surgery when the etiology is strictly odontogenic, provided that appropriate clinical and radiographic follow up is performed[4].

A key observation of this case series is the differential healing pattern between periapical lesions and maxillary sinus pathology in OMS. Specifically, in cases with periapical bone destruction (Cases 1–4), regardless of sinus floor perforation, and even in instances of near-total sinus opacification (Case 2), the resolution of sinus inflammation and the closure of perforations were typically achieved within about 3 months. Conversely,

TABLE 1 - Clinical Characteristics, Radiographic Findings, and Treatment Outcomes

Case	Fig.	Sex/ Age	Tooth no.	Diagnosis (pulpal/ periapical)	Maxillary sinus diagnosis	Treatment plan (anatomical relationship)	Follow-up (month)	Outcome: sinus mucosa	Outcome: periapical bone
1	2	F/32	#4	Previously treated/ asymptomatic AP	Mucositis	Retreatment (perforation)	3, 6	Healed (3 mo)	Healed (6 mo)
2	S1	M/26	#5	Pulpless (necrosis)/ symptomatic AP	Mucositis and obstruction	RCT (perforation)	3	Healed (3 mo)	Healed (3 mo)
3	3	F/25	#4	Previously treated/ symptomatic AP	Mucositis	Retreatment (close)	3, 6, 12, 17	Healed (3 mo)	Healing (17 mo) (PAI = 1)
4	S2	F/35	#15	Previously treated/ symptomatic AP	Mucositis	Retreatment (close)	3	Healed (3 mo)	Healing (3 mo) (PAI = 1)
5	4	M/28	#3, #4	Pulpless (necrosis)/ symptomatic AP	Mucositis	RCT (roots in sinus)	3	Healed (3 mo)	No bone defect
6	S3	F/33	#14	Pulpless (necrosis)/ asymptomatic AP	Mucositis	RCT (close)	3	Healed (3 mo)	No bone defect
7	S4	M/31	#15	Symptomatic IP/ symptomatic AP	Mucositis	RCT (roots in sinus)	3	Healed (3 mo)	Healed (3 mo)
8	S5	F/41	#14	Symptomatic IP/ symptomatic AP	Mucositis	RCT (roots in sinus)	3	Healed (3 mo)	No bone defect
9	S6	M/37	#14	Symptomatic IP/ symptomatic AP	Mucositis	RCT (close)	3	Healed (3 mo)	Healed (3 mo)
10	5	M/25	#3	Pulpless (necrosis)/ asymptomatic AP	Osteoperiostitis	RCT (Halo lesion)	3, 6, 17	Healed (6 mo)	Healing (17 mo) (PAI = 1)

AP, apical periodontitis; F, female; IP, irreversible pulpitis; M, male; mo, month; PAI, periapical index (score: 0–5); RCT, root canal treatment.

extensive periapical alveolar bone defects required a longer period (approximately 3–17 months) to demonstrate radiographic healing. This temporal separation likely reflects their distinct histological responses: the highly vascularized Schneiderian membrane can more rapidly clear inflammatory exudate and re epithelialize once the root canal microbial load is reduced[21-23]; in contrast, alveolar bone regeneration depends on a slower sequence of angiogenesis, matrix deposition, and osteoblastic mineralization[24].

Similarly, when the root apex abuts or protrudes toward the sinus without evident bone destruction (Cases 5–9), early resolution of sinus opacification (within about 3 months) was the predominant radiographic sign of infection control. Furthermore, maxillary sinus osteoperiostitis ("halo lesion", Case 10) exhibits a delayed healing progress: inflammatory exudate in osteoperiostitis elevates the intact sinus periosteum, and because the periosteum contributes cortical blood supply and osteoprogenitor cells, its detachment impedes resorption of exudate and delays bone remodeling[15,25,26].

As stated in the Introduction, the dilemma in managing OMS lies in the inherent limitations of periapical radiographs and the need for evidence-based application of CBCT. Anatomical superimposition often obscures bone destruction or early signs of healing, making it difficult for clinicians to distinguish between physiological delayed healing and true treatment failure. Based on the ALARA principle and the 4 patterns proposed in this report (Fig. 1), we propose a practical perspective for radiographic evaluation: when periapical radiographs clearly depict dynamic changes, such as sinus floor perforation (Fig. 1*A*) or evident bone defects (Fig. 1*B*), they remain an appropriate modality for follow-up. However, when encountering complex pathoses where periapical radiographs present substantial diagnostic blind spots (for example, an intact sinus floor obscured by roots, osteoperiostitis [Fig. 1*B* and *D*], and root apex protruding into the sinus [Fig. 1*C*]), CBCT can be a valuable adjunct[27]. It also allows for volumetric assessment to differentiate between generalized maxillary sinusitis and localized periapical mucositis[23]. More importantly, in cases with large bone defects and slow regeneration, we suggest shifting the early prognostic focus from periapical bone regeneration to early resolution of sinus mucosa. If mucosal improvement is observed on CBCT within about 3 months postoperatively, it may serve as a potential early indicator of endodontic treatment response.

We acknowledge the inherent limitations of our study, primarily its retrospective design, the absence of a control group, and a limited sample size of 10 cases. Furthermore, the varying and relatively short follow-up periods for certain cases preclude definitive conclusions regarding long-term osseous regeneration. Consequently, our findings are presented as preliminary observations. The propose that early mucosal resolution may serve as an early indicator of treatment response requires further validation in larger, prospective studies using standardized CBCT measurement protocols before being adopted as a routine prognostic criterion.

From a technical perspective, management of OMS prioritized minimizing apical extrusion of chemical and mechanical irritants to protect the sinus mucosa. Working length was carefully controlled using electronic apex locators and verified by periapical radiograph. Adjunctive techniques such as Er:YAG laser activated irrigation (photon-induced photoacoustic streaming) were used to enhance disinfection, and bioceramic sealers were selected for their biocompatibility during obturation.

CONCLUSION

Within the limitations of this case series, maxillary sinus mucosal abnormalities tended to resolve faster than periapical alveolar bone changes, typically within 3 months, whereas alveolar bone regeneration was slower and more variable. Periapical radiographs remain useful for monitoring clear sinus floor perforations or extensive bone defects, but CBCT is a valuable adjunct in anatomically complex cases or when periapical radiographs are inconclusive, balancing ALARA considerations. Early mucosal resolution on CBCT at about 3 months may serve as a practical early prognostic indicator of endodontic success, but this hypothesis requires confirmation in larger prospective cohorts.

DATA AVAILABILITY

Data is contained within the article.

AUTHOR CONTRIBUTIONS

Guofeng Yang: conceptualization; data curation; formal analysis; investigation; methodology; project administration; resources; visualization; writing—original draft preparation; writing—review & editing.

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The authors deny any conflicts of interest related to this study.

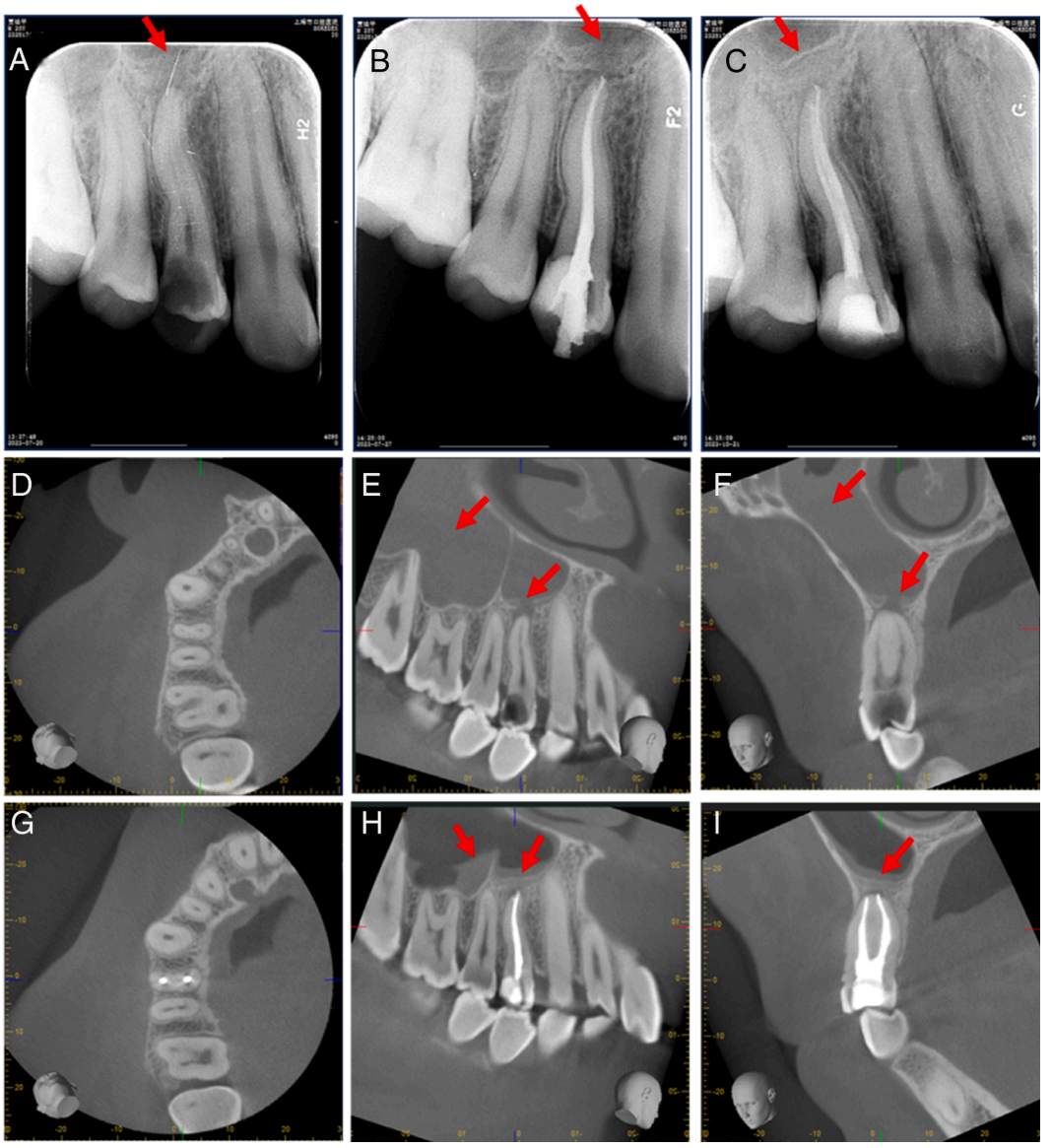
SUPPLEMENTARY MATERIAL

Supplementary material associated with this article can be found in the online version at www.jendodon.com (https://doi.org/10.1016/j.joen.2026.03.013).

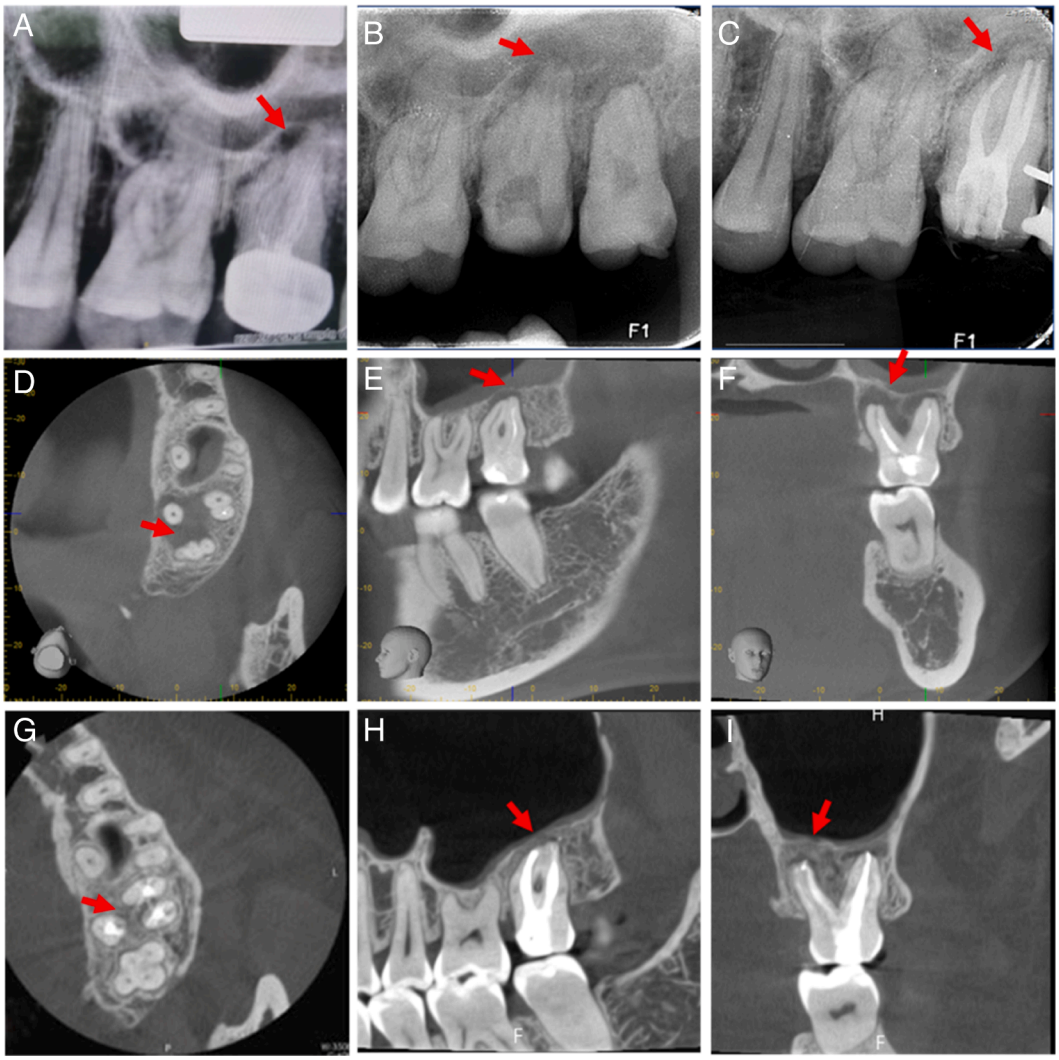
REFERENCES

1. Psillas G, Papaioannou D, Petsali S, et al. Odontogenic maxillary sinusitis: a comprehensive review. J Dent Sci 2021;16:474–81.
2. Vitali FC, Santos PS, Massignan C, et al. Global prevalence of maxillary sinusitis of odontogenic origin and associated factors: a systematic review and meta-analysis. J Endod 2023;49:369–81.
3. Tröltzsch M. Epidemiology of odontogenic sinusitis. Otolaryngol Clin North Am 2024;57:919–26.
4. Craig JR, Tataryn RW, Aghassi KR, et al. Management of odontogenic sinusitis: a multidisciplinary consensus statement. Int Forum Allergy Rhinol 2020;10:901–12.

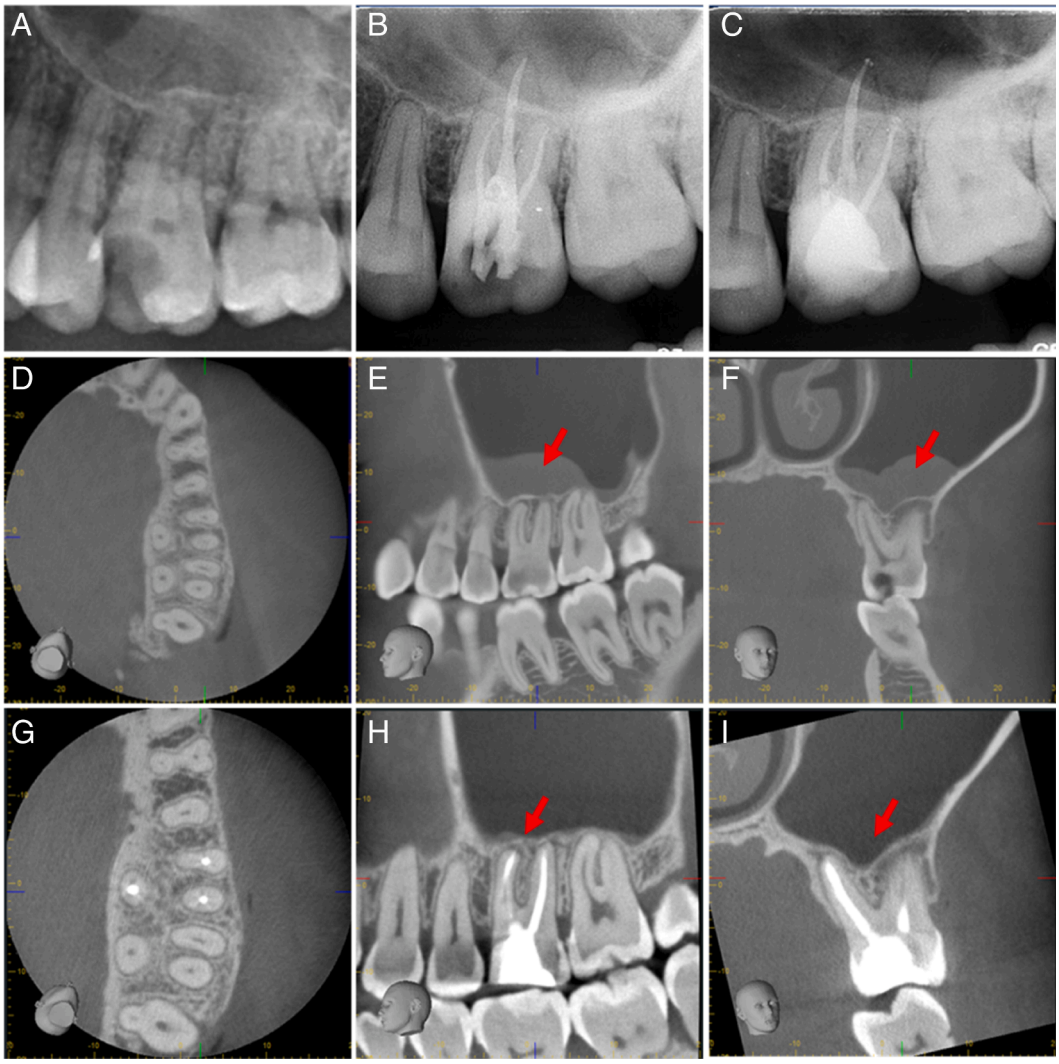
5. Lechien JR, Filleul O, Costa de Araujo P, et al. Chronic maxillary rhinosinusitis of dental origin: a systematic review of 674 patient cases. Int J Otolaryngol 2014;2014:4651730.
6. Zhao Y, Huang S, Xu M, et al. Characteristics and risk factors in odontogenic maxillary sinusitis from different dental infections: a retrospective study based on sinus CT imaging. BMC Oral Health 2025;25:308.
7. Estrela C, Nunes CA, Guedes OA, et al. Study of anatomical relationship between posterior teeth and maxillary sinus floor in a subpopulation of the Brazilian central region using cone-beam computed tomography - part 2. Braz Dent J 2016;27:9–15.
8. Patel S, Brown J, Semper M, et al. European Society of Endodontology position statement: use of cone beam computed tomography in endodontics. Int Endod J 2019;52:1675–8.
9. Kruse C, Spin-Neto R, Evaristo B, et al. Diagnostic accuracy of cone beam computed tomography used for assessment of apical periodontitis: an *ex vivo* histopathological study on human cadavers. Int Endod J 2019;52:439–50.
10. Silva EJNL, Pinto KP, Versiani MA, et al. Dental pathophysiology of odontogenic sinusitis: endodontic infections. Otolaryngol Clin North Am 2024;57:941–55.
11. Pannkuk TF, Craig JR, Tušas P, et al. Management of endodontic disease for odontogenic sinusitis. Otolaryngol Clin North Am 2024;57:1119–38.
12. Buizastrow J, Roque-Torres GD, Handysides R, et al. Impact of maxillary sinus mucosal thickening on endodontic outcomes: a retrospective cone-beam computed tomographic cohort study. J Endod 2025.
13. Gürhan C, Şener E, Miçooğulları S, et al. The evaluation of resolution of maxillary sinus mucosal thickening of endodontic origin using periapical and endodontic status scale: a clinical CBCT study. J Endod 2025;51:1557–65.
14. Szczurowski P, Gronkiewicz K, Czopik B. Factors influencing the healing of maxillary sinusitis of endodontic origin after nonsurgical endodontic treatment. J Clin Med 2025;14:6778.
15. Mora M, Nguyen J, Mehta S, et al. Prevalence and predisposing factors of periapical osteoperiostitis: a retrospective cross-sectional study. Int Endod J 2026;59:38–46.
16. Zanjir M, Cardoso E, Harman NL, et al. Development of a Core Outcome Set in Endodontics (COS-ENDO): part 2 - COS-ENDO for studies of nonsurgical root canal treatment and retreatment in permanent teeth. J Endod 2025;51:412–26.
17. Estrela C, Bueno MR, Azevedo BC, et al. A new periapical index based on cone beam computed tomography (CBCT-PAI). J Endod 2008;34:1325–31.
18. Lin J, Wang C, Wang X, et al. Expert consensus on odontogenic maxillary sinusitis multi-disciplinary treatment. Int J Oral Sci 2024;16:11.
19. Craig JR, Poetker DM, Aksoy U, et al. Diagnosing odontogenic sinusitis: an international multidisciplinary consensus statement. Int Forum Allergy Rhinol 2021;11:1235–48.
20. Akhlaghi F, Esmaeelinejad M, Safai P. Etiologies and treatments of odontogenic maxillary sinusitis: a systematic review. Iran Red Crescent Med J 2015;17:e25536.
21. Nunes CA, Guedes OA, Alencar AH, et al. Evaluation of periapical lesions and their association with maxillary sinus abnormalities on cone-beam computed tomographic images. J Endod 2016;42:42–6.
22. Nurbakhsh B, Friedman S, Kulkarni GV, et al. Resolution of maxillary sinus mucositis after endodontic treatment of maxillary teeth with apical periodontitis: a cone-beam computed tomography pilot study. J Endod 2011;37:1504–11.
23. Sakir M, Ercalik Yalcinkaya S. Associations between periapical health of maxillary molars and mucosal thickening of maxillary sinuses in cone-beam computed tomographic images: a retrospective study. J Endod 2020;46:397–403.
24. Nair PNR. On the causes of persistent apical periodontitis: a review. Int Endod J 2006;39:249–81.
25. Estrela CRA, Bueno MR, Estrela MRA, et al. Frequency and risk factors of maxillary sinusitis of endodontic origin evaluated by a dynamic navigation and a new filter of cone-beam computed tomography. J Endod 2022;48:1263–72.
26. White SC, Pharoah MJ. Oral Radiology: Principles and Interpretation. 7th ed. St. Louis, MO: Mosby Elsevier; 2014.
27. Zhang J, Liu L, Yang L, et al. Diagnosis of odontogenic maxillary sinusitis by cone-beam computed tomography: a critical review. J Endod 2023;49:1445–56.



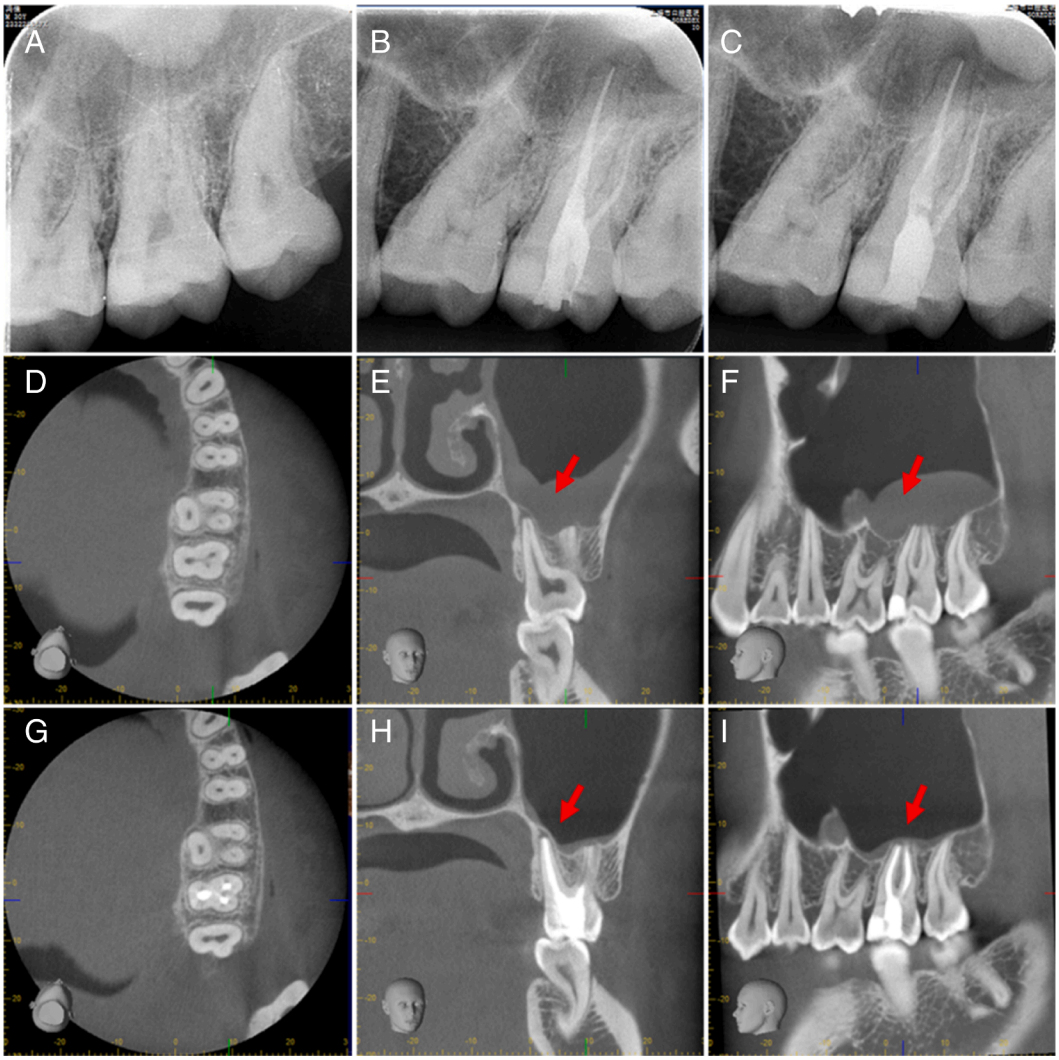
SUPPLEMENTAL FIGURE S1 – Chronic apical periodontitis of tooth #5 with maxillary sinus floor perforation. (*A–C*) Serial periapical radiographs: (*A*) preoperative sinus floor disruption (red *arrow*); (*B*) postobturation status with persistent discontinuity (red *arrow*); and (*C*) 3-month follow-up showing re-established continuity (red *arrow*). (*D–F*) Preoperative CBCT views (axial, sagittal, coronal): red *arrows* show the perforation and extensive opacification filling the sinus (*E* and *F*). (*G–I*) Three-month follow-up CBCT (axial, sagittal, coronal): red *arrows* show osseous healing, repair of the perforation, and substantial resolution of sinus opacification (*H* and *I*). CBCT, cone-beam computed tomography.



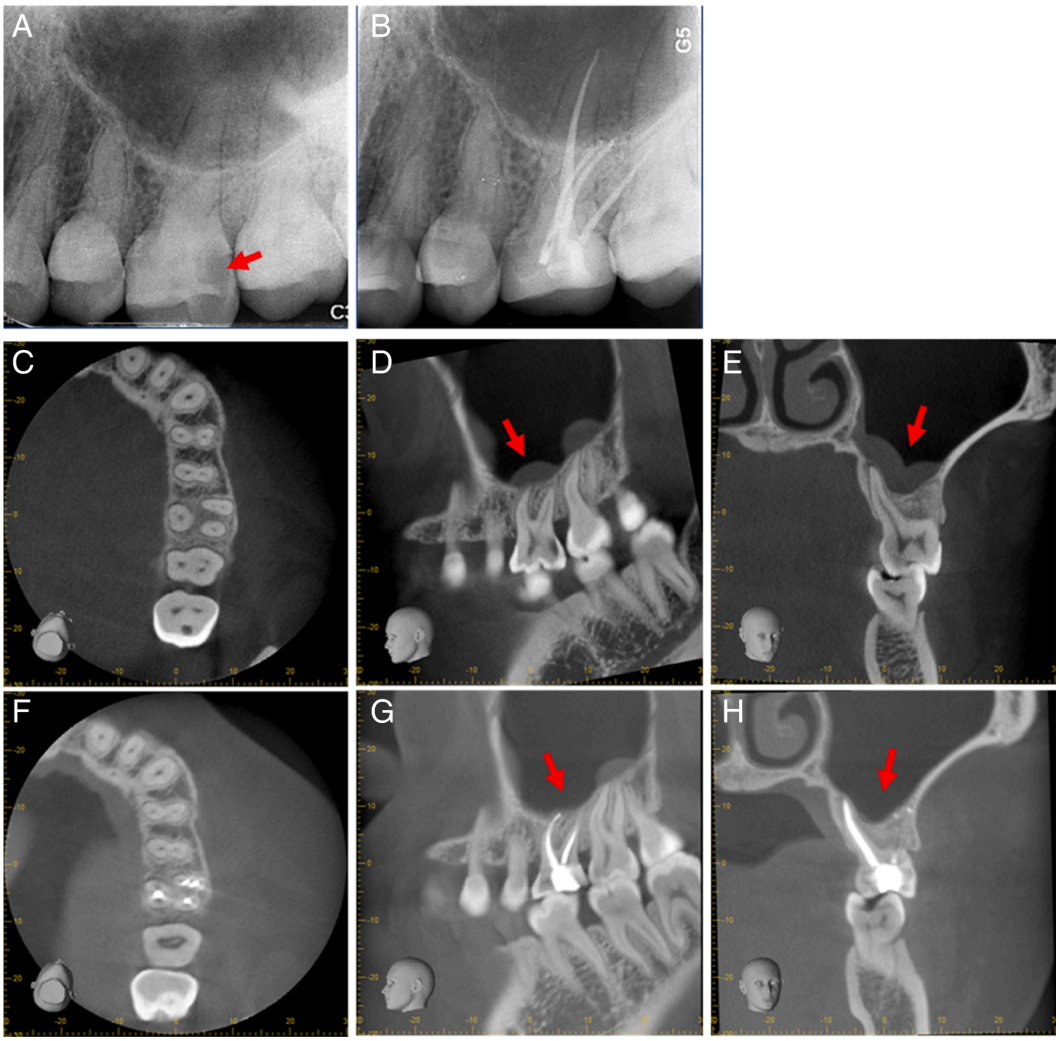
SUPPLEMENTAL FIGURE S2 – Chronic apical periodontitis of tooth #15 without maxillary sinus perforation. (*A–C*) Serial periapical radiographs showing preoperative faint radiolucency (*A*, red *arrow*), status post–gutta-percha removal, and postobturation. (*D–F*) Preoperative CBCT (axial, sagittal, coronal): red *arrows* identify periapical osteolysis (*D*) and extensive sinus opacification (*E* and *F*). (*G–I*) Three-month follow-up CBCT (axial, sagittal, coronal): red *arrows* show substantial bone healing and complete resolution of sinus opacification (*H* and *I*). CBCT, cone-beam computed tomography.



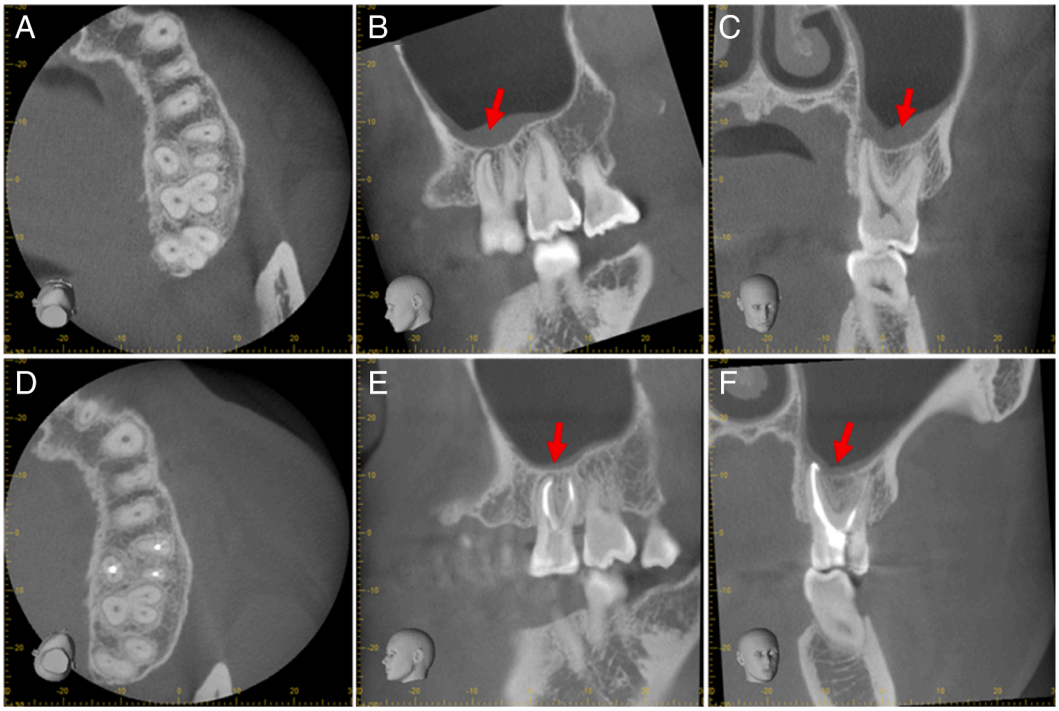
SUPPLEMENTAL FIGURE S3 – Maxillary sinus opacification associated with tooth #14 without evident periapical bone destruction. (*A–C*) Serial periapical radiographs showing preoperative mesial caries, postobturation status, and postrestorative composite core placement. (*D–F*) Preoperative CBCT views (axial, sagittal, coronal): red *arrow* indicates sinus opacification associated with tooth #14 (*E* and *F*). (*G–I*) Three-month follow-up CBCT (axial, sagittal, coronal): red *arrow* shows complete resolution of sinus opacification (*H* and *I*). CBCT, cone-beam computed tomography.



SUPPLEMENTAL FIGURE S4 – Maxillary sinus opacification associated with tooth #15 without evident periapical bone destruction. (*A–C*) Serial periapical radiographs: preoperative, postobturation, and 3-month follow-up. (*D–F*) Preoperative CBCT (axial, sagittal, coronal): roots protrude into the sinus, with red *arrows* identifying extensive opacification (*E* and *F*). (*G–I*) Three-month follow-up CBCT (axial, sagittal, coronal): red *arrows* show complete resolution of sinus opacification (*H* and *I*). CBCT, cone-beam computed tomography.



SUPPLEMENTAL FIGURE S5 – Maxillary sinus opacification associated with tooth #14 in the absence of evident periapical bone destruction. (*A*) Preoperative radiograph showing deep distal caries and pulp exposure (red *arrow*). (*B*) Postobturation radiograph. (*C–E*) Preoperative CBCT views (axial, sagittal, coronal) revealing four canals (*C*) and sinus opacification corresponding to tooth #14 (*D* and *E*, red *arrows*). (*F–H*) Three-month follow-up CBCT views (axial, sagittal, coronal) demonstrating complete resolution of opacification associated with tooth #14 (*G* and *H*, red *arrow*). CBCT, cone-beam computed tomography.



SUPPLEMENTAL FIGURE S6 – Maxillary sinus opacification secondary to a cracked tooth #14 without evident periapical bone destruction. (*A*–*C*) Preoperative CBCT views (axial, sagittal, coronal) revealing sinus opacification (*B* and *C*, red *arrow*). (*D*–*F*) Three-month follow-up CBCT views (axial, sagittal, coronal) demonstrating complete resolution of sinus opacification (*E* and *F*, red *arrow*). CBCT, cone-beam computed tomography.