



# The Bony Window Technique as a mini-invasive surgery to retrieve foreign bodies in the maxillary sinus: A technical note



Ettore Lupi, MD, PhD<sup>a</sup>, Giulia Ciciarelli, DDS, PhD<sup>b</sup>, Sara Bernardi, DDS, PhD<sup>b</sup>, Davide Gerardi, DDS, PhD<sup>b</sup>, Maurizio D'Amario, DDS<sup>b</sup>, Serena Bianchi, MD, PhD<sup>b</sup>, Filippo Giovannetti, MD, PhD<sup>b</sup>

From the <sup>a</sup>Department of Biotechnological and Applied Clinical Sciences, University of L'Aquila, L'Aquila, Italy

<sup>b</sup>Department of Life, Health and Environmental Sciences, University of L'Aquila, L'Aquila, Italy

## KEYWORDS

Sinusitis;  
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 intervention

The dislocation of foreign bodies in the maxillary sinus is not an unusual complication of dental treatments like tooth extraction, root canal treatment, maxillary sinus surgery, or dental implant installation, whose related significant risk is the onset of pathologies involving the maxillary sinus or all the paranasal sinuses. Many previous techniques have been proposed, including intraoral and endoscopic approaches to sinus surgery. However, their recommendation varies depending on the local and systemic factors that affect patients.

This article describes the “Bony Window Technique,” which has been demonstrated as a mini-invasive approach to retrieve foreign bodies in the maxillary sinus to treat mild odontogenic sinusitis and systemic complications, even in different pathologic conditions of the maxillary sinus.

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## Introduction

According to the literature, odontogenic sinusitis is a well-known pathology, with a percentage ranging between 12% and 40% of maxillary sinusitis cases.<sup>1</sup>

Accurately diagnosing odontogenic sinusitis is crucial because its pathophysiology, etiology, and treatment differ.<sup>2</sup>

Common causes of odontogenic sinusitis procedural-related include extractions, endodontic therapies, implant placements, extensive sinus lifts, and orthognathic surgery, which can trigger an inflammatory response and disrupt mucosal clearance.<sup>3</sup> An accurate diagnosis of sinusitis following dental treatment is essential to distinguish sinusitis caused by drainage obstruction or iatrogenic factors. A late diagnosis can lead to chronic sinusitis.<sup>4</sup>

Therefore, removing foreign bodies is highly recommended before the clinical situation worsens. Through the years, the continued innovation in oral and maxilla-facial surgery and related technology allowed the development of several protocols with a certain degree of invasive and post-operative morbidity,<sup>5-7</sup> such as “ad modum Caldwell-Luc”

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Address reprint requests and correspondence: Sara Bernardi, Department of Life, Health and Environmental Sciences, University of L'Aquila, Via Vetoio, edificio Angelo Camillo de Meis, 67100, L'Aquila, 67100, L'Aquila, Italy

E-mail address: [sara.bernardi@univaq.it](mailto:sara.bernardi@univaq.it)

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**Figure 1** OPG showing the presence of a dental implant as a foreign body in the right maxillary sinus.

and the Functional Endoscopic Sinus Surgery (FESS). Both of them, used and developed to assure the correct mucosal drainage and to restore the physiological mucosal clearance, present a certain degree of invasiveness.

The present technical note aims to describe a less invasive technique to retrieve a foreign body in the maxillary sinus in determined clinical conditions to lower the degree of post-operative morbidity.

## Technique

The patients who can benefit from this technical surgery should present a foreign body, thus a dental implant located within the maxillary sinus following a dental procedure, without oro-antral communication and with the standard functionality of the osteo-meatal complex.

The protocol includes the following steps:

1. Pre-surgical radiological investigation: An orthopantomogram (OPG) (Figure 1) and a Cone Beam Computed Tomography (CBCT) are performed to assess the foreign body's position, as muco-ciliary activity can cause significant changes in its location within the maxillary sinus within days or even hours. The OPG is usually prescribed by the general physician or when the medical history is difficult to obtain, to understand the true nature of the sinusitis symptomatology.
2. Local anesthesia: Patients are treated with local anesthesia, using local anesthetics like mepivacaine or articaine, with vasoconstrictors, like epinephrine 1: 1000000 concentrations, through infiltrations into the vestibular and palatal mucosa.
3. Flap surgery: A horizontal incision is made from the canine to the molar area, with mesial and distal release cuts. The horizontal incision can be made in the vestibular area or along the alveolar ridge, depending on the clinical situation and surgical needs, such as sinus floor level, foreign body position, and recent incisions along the alveolar ridge.
4. Access to the lateral wall of the maxillary sinus: Access to the anterolateral wall of the maxillary sinus is provided (Figure 2), extending upward to identify the



**Figure 2** Bony window with a rectangular shape.



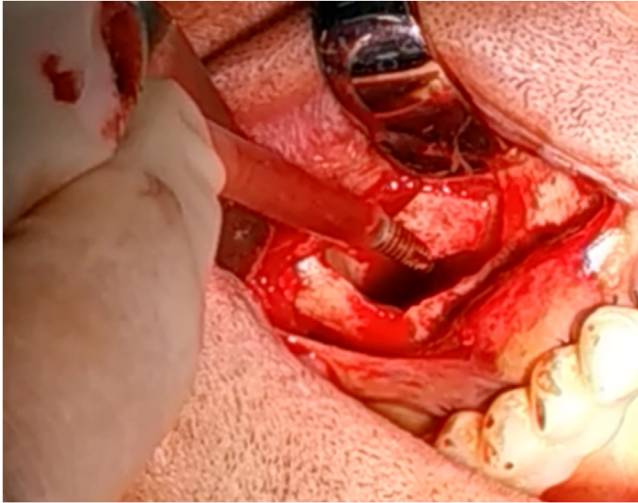
**Figure 3** Bony window rotated in order to have an access to the maxillary sinus.

infraorbital nerve. The flap is retracted, maintaining two retractors in the mesial and distal positions, respectively, compared to the nerve position, this could prevent any nervous traction or compression.

The second phase is developed by creating the flap through an osteotomy, similar to that prepared for a lateral sinus lift—the mesial, distal, and lower margins are created using thin-diameter burs or piezoelectric instruments, encompassing the bone wall and the underlying Schneiderian membrane, ensuring it is cut and not torn.

The upper horizontal osteotomy is made with a diamond burr, leaving the membrane intact in order to maintain mucosal continuity for flap mobilization and vascularization, which helps to avoid post-operative adhesions or resorption.

Once the bony window is rotated inward or outward (Figure 3), the interior of the sinus cavity becomes visible,



**Figure 4** Phase of retrieving the foreign body through a surgical aspirator.

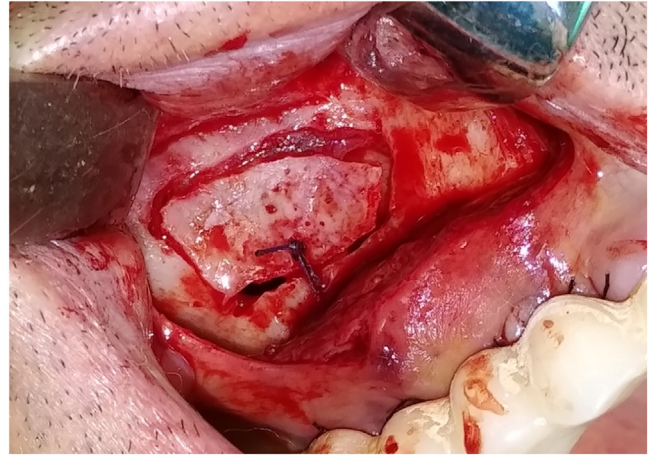


**Figure 5** Foreign body retrieved.

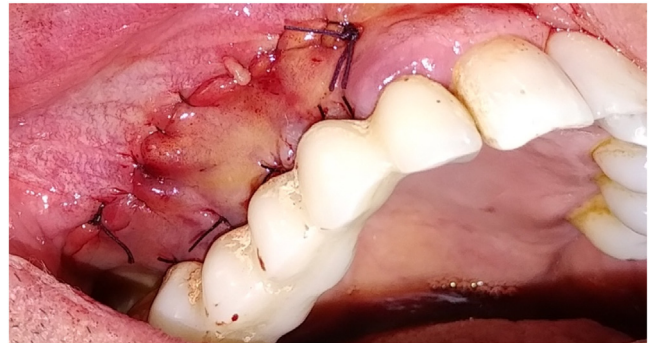
allowing for foreign body retrieval with surgical forceps or a surgical aspirator.

Foreign body removal: The retrieval of the foreign body could be provided through forceps or the auxiliary of the surgical aspirator (Figures 4 and 5). Moreover, if the foreign body is surrounded by hypertrophic or hyperplastic reactive sinus mucosa, this can be removed with gentle curettage.

1. Maxillary sinus irrigation: The sinus cavity is irrigated with ample sterile saline solution, in order to reduce the risk of bacterial contamination in the maxillary sinus.
2. Suturing: The flap is sutured in its original position, using absorbable sutures (Figure 6). The bone is drilled to produce small holes to ensure the suture. Flap stabilization is ensured by the mucosa superiorly and sutures



**Figure 6** Bony window sutured to the adjacent bone.



**Figure 7** Mucoperiosteal flap sutured.

inferiorly. The procedure is completed by suturing the mucoperiosteal flap (Figure 7).

### Pharmacologic management

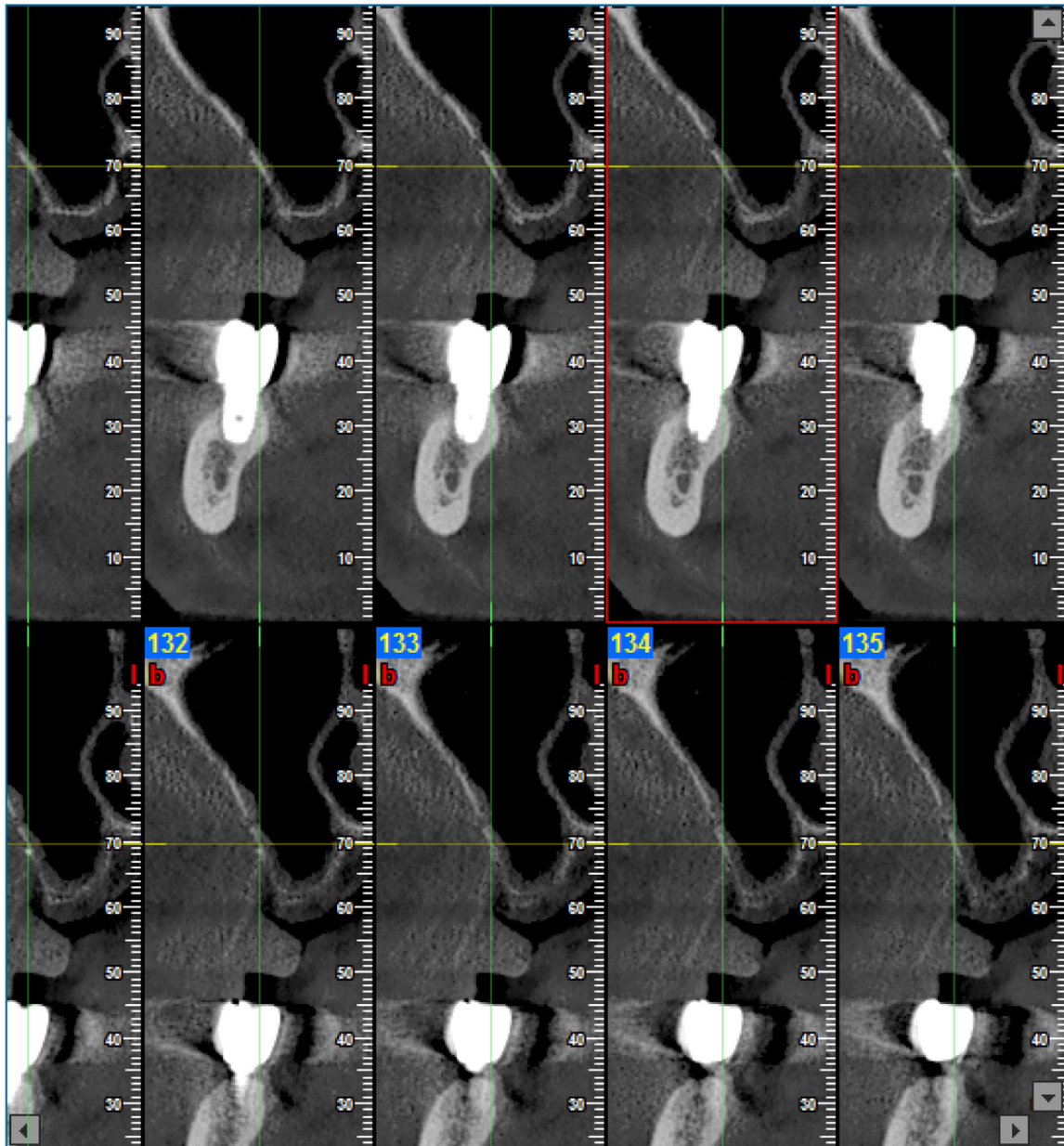
The systemic management of the surgery consists of antibiotic therapy, which starts the day before the surgery, prescribing amoxicillin and clavulanic acid, and continues for seven days. Besides, the post-operative management of the patient consists of anti-inflammatory therapy with non-steroidal anti-inflammatory drugs and steroids systemically administered, associated with aerosol nasal therapy using beclometasone for two weeks, to reduce the discomfort derived from the oedema of nasal mucosa.

The local management of the surgical wound involves 0.2% chlorhexidine rinses, associated with routine oral hygiene maneuvers during the following two weeks.

### Post-operative instructions

Patients are instructed not to blow their noses for three weeks and to avoid sneezing while holding their noses. A liquid diet is recommended for the first 2-3 days, followed by a semi-liquid diet until suture removal.

Typically, the bony window healing is almost completed in 3 months, the mucosal thickening regresses spontaneously after foreign body removal, and the sinus shows no signs of sinusitis, as observed in follow-up CT scans (Figure 7).



**Figure 8** CBCT showing the process of healing tissue after 3 months.

After 3 months from the surgery, a follow-up CBCT demonstrated the healthy condition of the right sinus after a period of healing the surgical treatment of retrieving the foreign body (Figure 8, Figure 9A-B, Figure 10>A-B, Figure 11A-B).

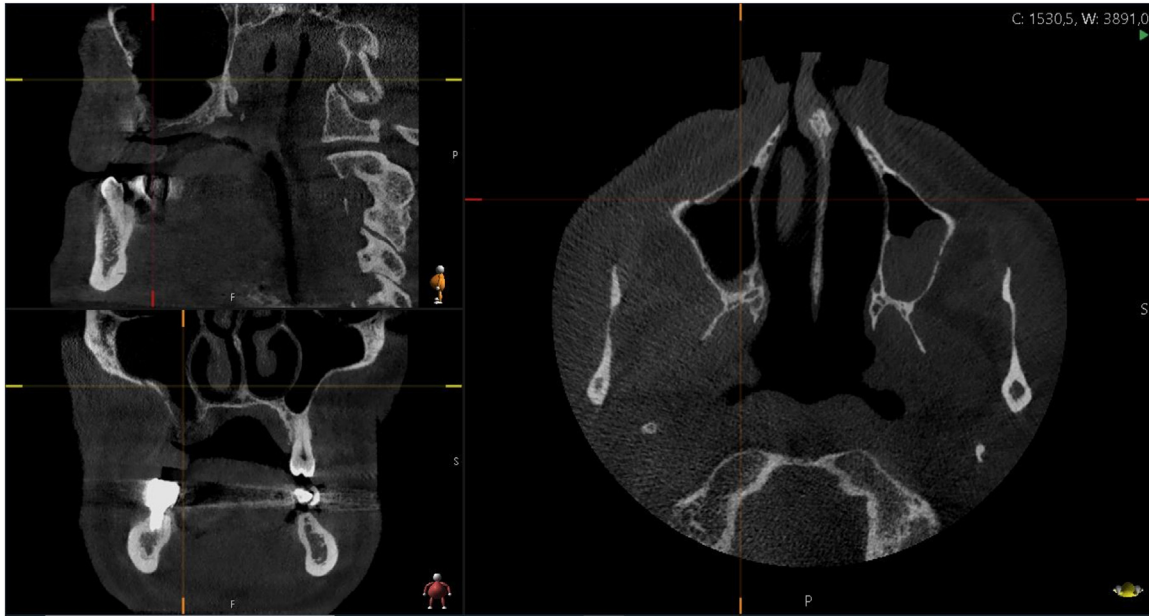
## Discussion

The sinus mucosa is an active component that responds to pathological and external stimuli with various specific and different reactions. Reducing the efficiency of mucosal clearance increases the susceptibility to maxillary sinus diseases, facilitating the development of odontogenic infections within the sinus.<sup>8</sup>

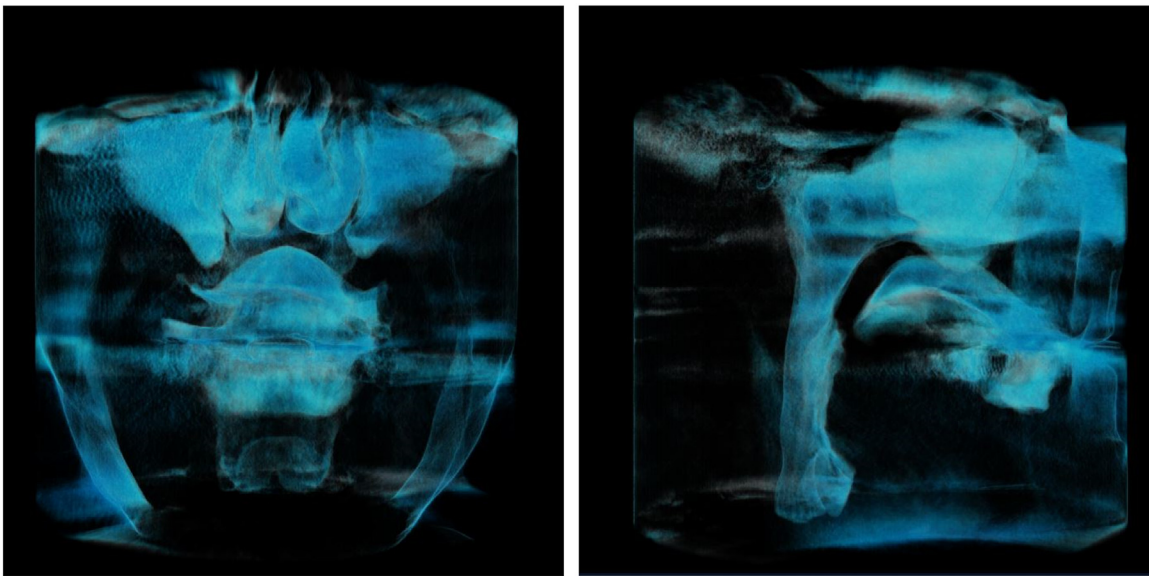
Odontogenic infections occur when there is a pathological condition of the Schneiderian membrane, such as irritation or perforation due to periapical abscesses, periodontitis, trauma, or iatrogenic causes due to tooth extraction, endodontic treatment, implant placement, or sinus lift procedures.<sup>8</sup>

The anatomy of the maxillary sinus is characterized by great variability, playing an important role as a local factor in sinus diseases, influencing both the pathogenesis and the treatments.<sup>9</sup>

The maxillary sinus is entirely covered by a mucosal membrane known as the Schneiderian membrane, which consists of a pseudostratified columnar ciliated epithelium containing three types of cells: ciliated cells, muciparous cells, and basal cells.<sup>10</sup> Essential regulators of cil-



**Figure 9** Multi-panel showing the current state of healing of the right sinus and the bony window after 3 months from the surgery, using Sectra®.



**Figure 10** (A-B) 3D volume rendering of the sinuses obtained using Sectra®.

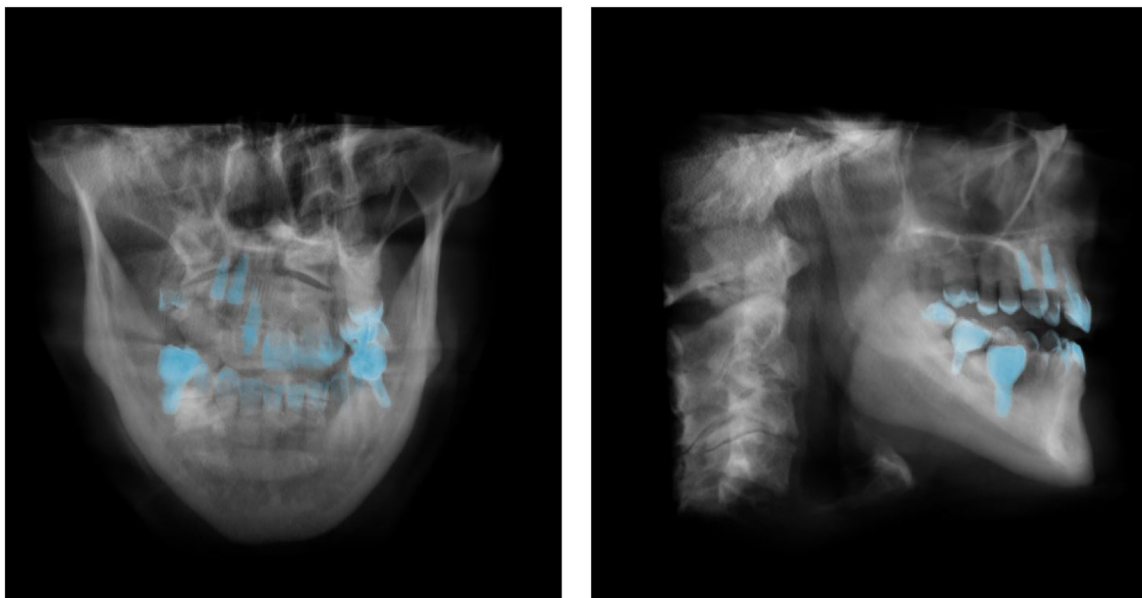
ary movement are nitric oxide (NO), whose production increases during inflammation or infections.<sup>11</sup>

The leading cause of the dislocation of the foreign body in the maxillary sinus is iatrogenic, thus related to different dental treatments, like surgical procedures or root canal treatments.<sup>12,13</sup>

Tooth extraction is a standard surgical procedure that can cause important complications involving the maxillary sinus, thus the dislocation of dental root debris. This depends on different factors like the anatomical relationship between the maxillary sinus and the teeth, which is highly variable, and the pneumatization of the alveolar processes.<sup>14</sup> Third molars are the teeth most commonly asso-

ciated with the maxillary sinus, while canines and first and second molars are occasionally related.<sup>14</sup> Normally, molars are separated from the sinus by a layer of compact bone, but sometimes this layer can be very thin or even absent, providing a direct path for odontogenic infections to spread into the sinus.<sup>14</sup>

Other complications in oral surgery are the accidental displacement of endodontic materials during root canal treatment that can lead to sinusitis by triggering an inflammatory response and disrupting mucosal clearance<sup>3</sup> or the displacement of dental implants during their installations on atrophic alveolar ridge.<sup>15</sup>



**Figure 11** A-B 3D volume rendering obtained using Sectra<sup>®</sup>, highlighting the sinuses, the maxilla, and the mandible.

The displacement of foreign bodies into the maxillary sinus may not lead to significant consequences or can result in sinus infection due to the contaminated foreign bodies or in oro-antral communications,<sup>16</sup> which increase the risk of sinus infection by pathogens, sometimes extending to other paranasal sinuses, even involving the orbital or intracranial cavity with more severe complications.<sup>5-7</sup>

In order to avoid the complications described earlier, it is essential to remove foreign bodies from the maxillary sinus as soon as possible, make a correct diagnosis, and plan an adequate surgical protocol. The gold standard radiological examination for the diagnosis and surgical treatment of odontogenic sinusitis is cone beam computed tomography (CBCT), which offers a three-dimensional visualization of the anatomy of the maxillary bones, the sinuses, and the osteo-meatal complex.<sup>17</sup>

Over the years, various surgical techniques for retrieving foreign bodies from the maxillary sinus have been proposed.

One of the first techniques proposed was the intraoral approach “ad modum Caldwell-Luc,” this technique consists of the removal of a part of the lateral-anterior wall of the sinus and its mucosa.<sup>18</sup> This feature provides excellent access and visibility but leaves a significant bony defect that can lead to scar tissue formation, soft tissue retraction of the cheek, paresthesia, and pain if the infraorbital nerve branches are affected. Additionally, it may complicate subsequent sinus lift procedures.<sup>18</sup>

Another less invasive technique than the previous one described is the Functional Endoscopic Sinus Surgery (FESS) through the nasal cavity, whose technical protocol aims to retrieve foreign bodies from the sinus, preserving the integrity of the sinus walls and mucosa.<sup>7</sup> It represents the primary technique when significant sinusitis is diagnosed and associated with an ostial obstruction and involvement of other paranasal sinuses.<sup>7</sup> FESS can improve

drainage, ventilation, and mucociliary function and reduce hospitalization time. According to a study by Giovannetti et al.,<sup>7</sup> the procedure’s success rate is 95%. However, it has limitations when the foreign body is located in the anterior and inferior areas of the sinus, which are difficult to reach with existing instruments. Additionally, FESS requires general anesthesia and enlargement of the natural ostium.<sup>5</sup> The post-operative complications following FESS could be immediate, such as bleeding; short-term, such as infection and turbinate lateralization; or long-term complications, such as ostial stenosis, refractory disease, and disease recurrence.<sup>5-7</sup>

Moreover, the illustrated technique in the present technical note, called “Bony Window Technique,” was first proposed by Biglioli and Goisis in 2002:<sup>19</sup> it is an intraoral surgery that consists in the creation of a pedunculated bony window in the Schneiderian membrane and aims to the retrieval of foreign objects in maxillary sinus from the lateral wall of the bone, without the nasal antrostomy approach. The pedunculated flap is similar to the flap used in traditional lateral sinus lift procedures, but, in this case, it is cut on three sides and preserved only at the upper margin. This technique allows the flap to remain vascularized and rotatable to provide better visibility to the operator.<sup>19</sup> Unlike the Caldwell-Luc approach, in the technique described, the bony window is preserved by rotating it inward or outward, then sutured to the bone to stabilize it and let a complete regeneration of the bony access to the maxillary sinus.

This technique in particular is recommended when there is no significant infection in the sinus, the ostium is clear, and other sinuses are not involved: these are the clinical conditions to consider an intraoral surgical approach as an excellent choice, reducing systemic morbidity and post-operative complications, thanks to the possibility of performing the surgery under local anesthesia and performing the surgical treatment in the outpatient setting, unlike

the FESS approach. Besides, even in the case of a moderate mucosal reaction within the sinus, sinus anatomy, and function often return to a healthy state after the foreign body is removed, letting the surgeon reduce the indications to the FESS approach.<sup>20</sup>

Other advantages of the “Bony Window Technique” are: the subperiosteal dissection minimizes bleeding and optimizes access to the sinus wall; the infraorbital nerve is easily visualized to prevent damage; the mucosal vascularization ensures flap survival with minimal resorption and ossification of its margins; rapid mucosal healing and complete ossification of bony margins enable subsequent lateral sinus lift procedures.<sup>21</sup>

## Conclusions

The Bony Window Technique is a mini-invasive procedure helpful in retrieving foreign bodies displaced in the maxillary sinus. However, this procedure is indicated when the presence of the foreign body is not followed by significant sinus infection, ostial obstruction, or involvement of other paranasal sinuses. In selected cases, it can also be extended to the treatment of sinus pathology, provided it is monosinusal and of clear odontogenic nature. In other cases, the treatment of choice remains Functional Endoscopic Sinus Surgery (FESS).

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## CRediT authorship contribution statement

**Ettore Lupi:** Methodology, Investigation, Conceptualization. **Giulia Ciciarelli:** Writing – original draft, Methodology, Investigation. **Sara Bernardi:** Writing – original draft, Formal analysis. **Davide Gerardi:** Writing – original draft. **Serena Bianchi:** Writing – review & editing. **Filippo Giovannetti:** Writing – review & editing, Visualization, Validation.

## Disclosure

The authors reported no proprietary or commercial interest in any product mentioned or concept discussed in this article.

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