

# Foreign Bodies of Dental Iatrogenic Origin Displaced in the Maxillary Sinus - A Safety and Efficacy Analysis of a Retrospective Study

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## Abstract

**Introduction:** Foreign bodies (FB) of the paranasal sinuses are an uncommon clinical entities with the maxillary sinuses being those most frequently affected. According to the literature, 60% of paranasal sinus FB are of iatrogenic origin, while 25% are of traumatic origin. This article aims to present an iatrogenic origin series of cases of FB displaced or projecting into the maxillary sinus. **Materials and Methods:** In this retrospective study, the presence of the foreign body was revealed with radiologic methods and confirmed during the operation with macroscopic or later with histopathologic examination. All cases were treated with osteoplasty with vascularised pedicled bone flap or through minimally invasive intraoral procedure. **Results:** A total of 27 patients were included in our study, 14 men and 13 women. The age range was 18–65 years with mean age of 46.14 (standard deviation = 10.35) years. Foreign body was displaced fragments of teeth in 11 patients (40.27%), complete teeth in four patients (14.81%), dental implants in five patients (18.51%), dental impression material in 2 cases (7.40%), gutta percha cone in two patients (7.40%), endodontic sealer associated with aspergillosis in two patients (7.40%), and dental burr in one patient (3.7%). The time between dental foreign body displacement and the surgical intervention for its removal was critical for the occurrence of sinusitis. All operated patients remained asymptomatic during a follow-up of at least 1 year. **Discussion:** Prompt intervention for removal of FB eliminates the risk for chronic inflammation of the affected maxillary sinus and reduces the odds for sequelae.

**Keywords:** Dental implants, foreign bodies, maxillary sinus, sinusitis, tooth roots

## INTRODUCTION

Foreign bodies (FB) of the paranasal sinuses are an uncommon clinical entity mostly affecting the maxillary sinuses. 60% of paranasal sinus FBs are of iatrogenic, while 25% are of traumatic origin.<sup>[1-4]</sup> Those of iatrogenic origin usually result from dental practice and are rarely related to ENT surgical interventions.<sup>[5-7]</sup> FBs frequently found into the maxillary sinus include fractured roots, whole intact teeth, gutta percha points, dental impression materials, filling materials, or even dental implants.<sup>[6,8-10]</sup> A great proportion of FB into the maxillary sinus comprise roots/fragments from the upper posterior teeth. In the last decades, an increasing number of publications have reported on dental implants displaced into the maxillary sinus.<sup>[8,11,12]</sup>

The clinical manifestation can be diverse and is dependent on the FB, the time it remains in the sinus, the causative intervention and remaining oroantral communication.<sup>[13-15]</sup>

Diagnosis of maxillary sinus FB in asymptomatic patients may be performed owing to clinical suspicion or during the diagnostic examination for sinusitis.<sup>[15,16]</sup>

Functional endoscopic sinus surgery (FESS) has recently been widely approved as a less traumatic method for surgical treatment of maxillary sinus diseases. This method is also popular for removing FB from maxillary sinus. However, some of these FBs are located in areas of the maxillary sinus that are not accessible with the endoscope or are associated

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with oroantral communication and need closure in the same procedure with FB removal. In those cases, osteoplasty of the maxillary sinus is preferred alone or in combination with FESS.<sup>[17-19]</sup>

This article aims to report an iatrogenic origin case series of FB displaced/projecting into the maxillary sinus, the type of FB, investigate the status of the maxillary sinuses, the time elapsed between FB entrance and the diagnosis/intervention, the preferred method of treatment and finally the postsurgical results.

## MATERIALS AND METHODS

The Ethics Committee of Aristotle University of Thessaloniki, School of Dentistry waived the need for ethics approval and the need to obtain consent for the collection, analysis, and publication of the retrospectively obtained and anonymised data for this study due to the observational retrospective nature of the study. All procedures performed in the study were conducted in accordance with the ethics standards given in 1964 Declaration of Helsinki, as revised in 2013.

This retrospective study included a database search from June 2010 to June 2019 that enrolled all eligible patients. Inclusion criteria were the presence of FB of odontogenic origin into the maxillary sinus and a previous dentofacial procedure on the ipsilateral area. Exclusion criteria were a history of previous trauma or bilateral acute/chronic infection or tumour affecting the maxillary sinus or previous ENT intervention on the affected site. The presence of the FB was revealed with radiologic methods and confirmed during the operation with macroscopic or later with histopathologic examination. Some patients were referred by dentists while others presented directly to maxillofacial surgeons with symptoms of unilateral sinusitis or oroantral communication following dental procedures. Preoperative diagnosis was based on the history of previous dental procedure, the suspicion of the presence of a foreign body, the detailed clinical evaluation to detect oroantral communications and radiologic confirmation.

Variables recorded included age, sex, etiology, kind of FB, radiographic imaging, and method of removal. All patients were submitted to panoramic X-ray and cone beam computed tomography (CBCT) or conventional computed tomography (CT) to reveal the status of the maxillary sinus [Table 1]. Independent variables were type of foreign body, presence of clinical signs or pathology of maxillary sinus, type of operation performed. Primary independent outcome was time elapsed until diagnosis-operation and unfavourable operative result.

In this study, all cases were treated with osteoplasty with vascularised pedicled bone flap<sup>[17]</sup> or minimally invasive intraoral procedure. In all cases, high loupe magnification ( $\times 5$ ) with illumination mounted on the loupe was used, to facilitate identification of the foreign body. The osteoplasty with vascularised pedicled bone flap procedure

**Table 1: Foreign bodies of dental iatrogenic origin displaced in the maxillary sinus**

Variable	N (%)	P <sup>SS</sup>
Sex		
Male	14 (52)	0.847
Female	13 (48)	
Etiology <sup>S</sup>		
Dental extraction	17 (63)	0.001
Dental implant	5 (18)	
endodontic treatment	3 (23)	
Type of foreign body		
Teeth/teeth fragments	15	0.044
Implants	5 (18)	
Gutta percha tips, impression materials, burr	7 (26)	
Clinical signs/pathology of maxillary sinus*		
Without signs/slight thickening of the sinus membrane at the base of the sinus	7 (26)	0.388
Mild symptoms/moderate thickening of sinus membrane	6 (23)	
Sinusitis/polypoid lesions/small oroantral communication	11 (41)	
Type of operation**		
Minimally invasive intraoral	3 (12)	<0.001
Osteoplasty	23 (88)	
Time elapsed until diagnosis-operation (days), mean (range)	96 (2-730)	

A safety and efficacy analysis of a 27 patient case series. <sup>S</sup>Two cases were undetected and presented with radiographic findings, <sup>SS</sup>Pearson's Chi-Square test, \*Three cases were referred immediately, also no symptoms, \*\* One patient refused operation

was applied in the majority of the cases because the location of the foreign body was not accessible with FESS and due to the presence of oroantral communication. In osteoplasty with vascularised pedicled bone flap, a bony window is made at the anterior maxillary wall, which is not fully detached from the investing Schneiderian membrane but after cutting its inferior and lateral borders, the membrane is left intact at its upper border assuring the vascularisation of the bony window and allowing inward rotation of the bony vascular flap to access the whole extent of the maxillary sinus cavity. At the end of operation, the flap is repositioned and stabilised with three absorbable sutures.

Minimally invasive intraoral procedures were performed after location of the exact position of foreign body in three dimensions with CBCT and creation of a small opening on the anterior maxillary wall over the foreign body and simple removal without extensive or traumatic manipulation of the maxillary sinus. The selection of general or local anaesthesia depended on the presence of symptoms of acute or chronic sinusitis and the status of the maxillary sinus with the aid of CT or CBCT. One patient declined the surgical operation as he was asymptomatic and remains under clinical surveillance [Table 1].

Central tendency is described with mean ( $\pm$  standard deviation [SD]). Pearson's Chi-square test was used for tabular

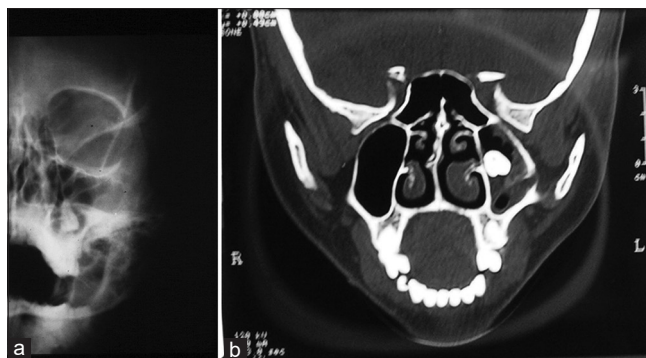
comparisons. An alpha value of  $P < 0.05$  was considered significant.

## RESULTS

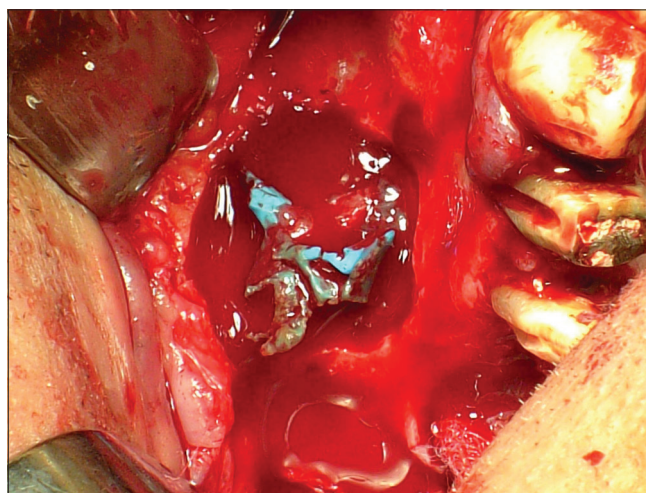
A total of 27 patients presented with different kinds of FB in the maxillary sinus of iatrogenic origin and were included in our study, 14 men and 13 women ( $P = 0.847$ ). The age range was 18–65 years with mean age of 46.14 (SD = 10.35) years. Eleven of these cases (40.27%) had displaced fragments of teeth during extraction with the majority of cases (nine patients) involving the first and second maxillary molars. The roots of first molars were more frequently implicated (25.92%), followed by the second molar (7.40%). Displacement of entire maxillary third molar was recorded in four patients (14.81%) during the effort of extraction [Figures 1a and b]. In five patients (18.51%), implant displacement into the maxillary sinus was recorded and in two cases dental impression material was removed from maxillary sinus [Figure 2]. In both those cases, oroantral communication was undetected until the impression material was iatrogenically pushed in the maxillary sinus. Dental impression material was also noted in one case postextraction, as the dentist tried to obtain an impression immediately following dental extraction.

Projection of gutta percha cone was observed in two patients (7.40%) into maxillary sinus [Figure 3a and b] and another two cases of displaced endodontic sealer were associated with aspergillosis (7.40%). In one case, a straight burr of a high speed dental handpiece during dental extraction impinged into the maxillary sinus [Figure 4 and Table 1]. Displaced teeth fragments were the most common occurrence among types of foreign bodies ( $P = 0.044$ ).

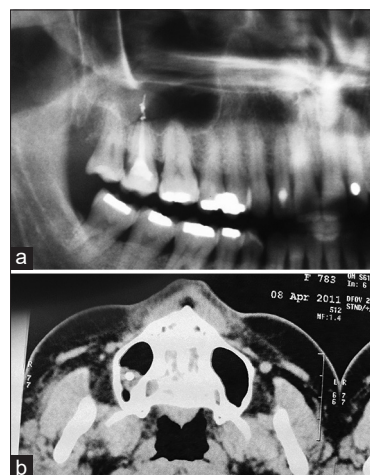
Eleven of the 27 cases (40.74%) presented with acute ipsilateral sinusitis and typical symptoms of pain, nasal discharge, and foul smell. From those cases with typical symptoms of sinusitis, impression material was removed from the maxillary sinus in three cases, a displaced tooth root was found in another three cases, endodontic sealer was removed and an implant displaced into the maxillary sinus was also removed in two cases. Symptoms were more pronounced in four patients with root displacement into the maxillary sinus and in three patients with impression material escaping into the sinus through an undiagnosed maxillary oroantral communication. The remaining cases concerned two cases with dental implant displaced into the sinus and two with endodontic filling material into the sinus. Three out of five cases with dental implant displacement were asymptomatic. In six cases (22.22%), thickening of the Schneiderian membrane at the base of the maxillary sinus ranging between 3 mm and 12 mm was recorded on either CT or CBCT, which was associated with mild symptoms or even asymptomatic in one case. The time elapsed between dental foreign body displacement into the maxillary sinus and the surgical intervention for its removal was critical for the status of maxillary sinus. In the cases treated early in the first 48 h



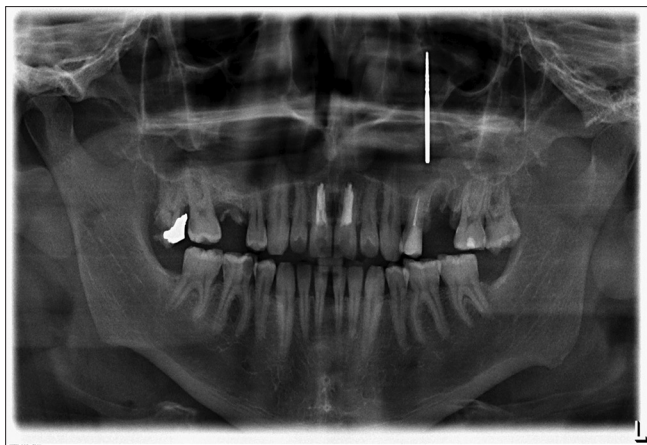
**Figure 1:** (a) Plain radiographic view sinus X-ray showing displacement of the left maxillary third molar into the sinus. (b) Transverse section of computed tomography confirms the displacement of the third molar into the left maxillary sinus



**Figure 2:** Intraoperative view of case with impression material displaced into the right maxillary sinus



**Figure 3:** (a) A part of orthopantomogram showing the presence of gutta percha cone of endodontically treated maxillary second molar projecting far away from the apex of the tooth root into the maxillary sinus (b) Transverse section of computed tomography from the same patient showing the exact position of the foreign material into the right maxillary sinus



**Figure 4:** A straight burr impinged into the left maxillary sinus

after foreign body displacement, the maxillary sinus was clear during surgical exploration. In cases where time had elapsed for over one month, thickening of the maxillary sinus or acute sinusitis were documented. Endodontic root canal sealer was observed in two cases and both these cases were associated with development of aspergilliosis.

Oroantral communication at the time of surgical exploration for the foreign body was observed in 16 cases (59.25%). Small oroantral communications, undetected upon clinical evaluation were related with more severe sinus pathology. From these cases, those that healed shortly after their establishment were asymptomatic. Five patients (18.51%) with dental implant displacement were included in our study. In one of them, the implant was placed in severely atrophied alveolar bone (height of alveolar bone of 1 mm) with open sinus lift procedure and bone allograft. The patient was asymptomatic for the next 5 months and the displacement of implant was discovered postoperatively in a routine control panoramic X-ray. In this case, during surgical exploration to remove the dental implant, the maxillary sinus was clear without signs of acute or chronic sinusitis. In two cases with displaced implants into the maxillary sinus, infection of the maxillary sinus was observed early (3-week postoperatively) and these were removed 1 month after placement. All operated patients remained asymptomatic during a follow-up of at least 1 year [Table 1].

## DISCUSSION

FBs of the maxillary sinus may arise either from penetrating trauma or medical procedures.<sup>[2,5,9,10,20-24]</sup> In most of the cases (91%),<sup>[25]</sup> the FBs are of dental iatrogenic origin.<sup>[5]</sup> Type of FB in the maxillary sinuses included dental implants, root fragments, impression materials, restorative material as amalgam, gutta percha material or endodontic sealer and *Aspergillus*. A study reported,<sup>[25]</sup> 7 cases of amalgam, 2 dental implants, and 1 dental root, while in another study,<sup>[5]</sup> dental implants were the most frequent FB (38.77%), followed by dental filling materials (28.57%) In our study, the displaced dental root fragments were the most frequently observed FB,

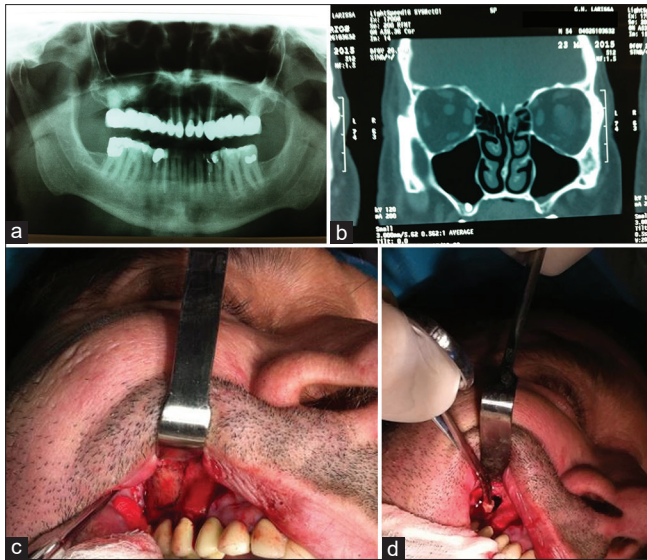
followed by dental implants, displacement of entire third molar and impression material.

The maxillary sinus may be contaminated through the ostium or through the oral cavity after an oroantral communication,<sup>[23,26]</sup> resulting in thickening of the Schneiderian membrane and possible acute or chronic infection.<sup>[13,27]</sup> This causes disturbance of the ciliary function, obstructing clearance, while filling materials containing zinc may stimulate *Aspergillus* development due to inhibition of other respiratory flora.<sup>[22,25]</sup> That was the case in both patients with endodontic sealer leak from the present series. FBs in the maxillary sinus may be associated with acute infection or might remain asymptomatic for some years. Symptomatic cases present with nasal discharge, foul smell, swelling of the cheek, pain of the head, symptoms also attributed to presence of oroantral communication.<sup>[28,29]</sup> In our study, acute sinusitis symptomatology was observed in 11 patients with small or undetected oroantral communication. Dental implants have not always been associated with infection of the maxillary sinus even though they might remain displaced for months or years possibly due to the sterile procedure during their placement.<sup>[11,24]</sup> In one patient from our series, the displaced implant remained asymptomatic for months in the maxillary and without any inflammation at the time of surgery.

It has been reported that FB might rarely cause pansinusitis and due to the close proximity with the orbit, orbital abscess.<sup>[5,7,30]</sup> Intracranial extension of the inflammation is another rare but more severe sequelae.<sup>[31]</sup> Other more rare complications include unilateral severe orofacial pain in supraorbital area, photophobia, and nasal congestion without sinusitis due to amalgam lodged in the maxillary sinus.<sup>[32]</sup> In our series, no complications affecting the orbit or the cranial cavity were recorded.

Diagnosis of FB in patients with symptoms of unilateral chronic sinusitis can be made in the context of investigation taking into account previous history, cautious clinical examination-for previously undetected oroantral communication-and radiographs.<sup>[29,33]</sup> Panoramic X-ray, Water's view, or lateral skull simple radiographs are useful in detection of a foreign body.<sup>[33]</sup> CT is considered the gold standard for imaging of the maxillary sinus and the other paranasal sinuses.<sup>[16]</sup> CBCT can also be a valuable diagnostic tool in investigation of the etiology of an acute or chronic maxillary sinusitis or may reveal FB in the sinus in asymptomatic patients.<sup>[10,15,34]</sup>

The removal of FB of the maxillary sinus can be performed with surgical interventions either with FESS or with intraoral approach or through a combined approach. FESS is advocated and ENTs are familiar with the use of endoscopic procedures due to lower morbidity as a less invasive procedure.<sup>[35-37]</sup> However, the location of the foreign body at areas less accessible to endoscopic procedures such as the anterior wall or the base of the maxillary sinus<sup>[38]</sup> makes it impossible to remove it exclusively with the use of endoscope as well as in cases with FB of large dimension.<sup>[11,29,38]</sup> In addition, in

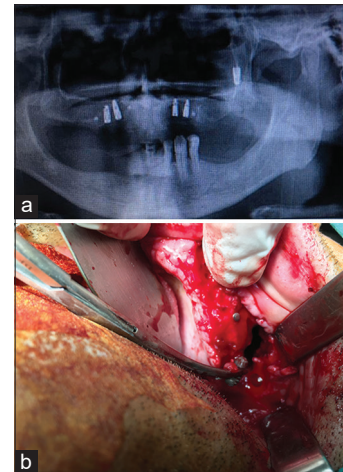


**Figure 5:** (a). A tooth root displaced into the right maxillary sinus is obvious in orthopantomogram. (b). A coronal section of computed tomography confirms the exact position of the tooth root. (c). Intraoral osteoplasty for access the right maxillary sinus. (d). Removal of the foreign body

some cases, the removal of a foreign body can be done with concurrent closure of an oroantral communication. For these reasons, we selected to apply the intraoral approach either as osteoplasty with vascularised bony flap or the intraoral minimally invasive removal.<sup>[17,36]</sup> Osteoplasty of the maxillary sinus gives the surgeon the opportunity to remove any type of foreign body irrespectively of its dimensions, permits the clearance of the maxillary sinus from polyps and concurrently gives the opportunity for successful closure of an existing oroantral communication [Figure 5a-d and 6a and b]. This operation was applied successfully in most of our cases. In selected cases where teeth fragments were displaced into the maxillary sinus without symptoms or signs, a minimally invasive procedure can be contemplated based on the findings of the CBCT. This modality gives the surgeon the opportunity to three dimensionally precisely locate the position of the foreign body and remove it with an intraoral incision through a small opening in the anterior maxillary wall.

Limitations of the present study include a convenience case series sample. Strengths include the operation in a tertiary university center, the inclusion of all eligible cases through certain criteria, the minimum year-long postoperative follow-up, and the confirmation of all cases through radiology and surgery.

With regard to treatment modalities, some authors advocate that FBs such as amalgam may remain encapsulated under the Schneiderian membrane and not require surgical exploration.<sup>[39]</sup> Others suggest that removal of FB from the maxillary sinus is recommended even if patients are asymptomatic.<sup>[40]</sup> Based on present results, we support believe that FB irrespectively of their nature should be removed as soon as possible to avoid



**Figure 6:** (a) Dental implant displaced into the left maxillary sinus. (b) Intraoral removal of the displaced implant

the development of sinusitis through compromising ciliary function.

## CONCLUSIONS

Iatrogenic FBs are not uncommon with dental extractions being the most common etiology. Dental implants may become more common as implant dentistry increases in popularity. A reassuring finding is that dental implants displaced in the maxillary sinus appear to have an uneventful clinical course, possibly owing to the aseptic implantation procedure. Impression taking following extractions of maxillary teeth warrants caution to avoid pushing material into the sinus which may only be diagnosed after a long time by its associated sinusitis symptoms.

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## Conflicts of interest

There are no conflicts of interest.

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