Modified Endoscopic-Assisted Approach for Removal of Ectopic Third Molar in the Maxillary Sinus

Mi-Hyun Seo 1,2,†, Ju-Young Lee 3,†, Paul Frimpong 4, Mi-Young Eo 1 and Soung-Min Kim 1,4,*

1 Department of Oral and Maxillofacial Surgery, Dental Research Institute, School of Dentistry, Seoul National University, Seoul 03080, Korea; tjalgs@snu.ac.kr (M.-H.S.); miyoungeo@snu.ac.kr (M.-Y.E.)
2 Department of One-Stop Specialty Center, Seoul National University Dental Hospital, Seoul 03080, Korea
3 Department of Oral and Maxillofacial Surgery, Seoul St Mary’s Hospital, Catholic University of Korea, Seoul 06591, Korea; jdl258@gmail.com
4 Oral and Maxillofacial Microvascular Reconstruction LAB, Brong Ahafo Regional Hospital, Sunyani N12, Ghana; frimpongpaull@gmail.com
† Correspondence: smin5@snu.ac.kr; Tel.: +82-2-2672-0213; Fax: +82-2-766-4948
†† Co-first author.

Abstract: This case series describes an alternative approach for removing ectopically erupted tooth in the maxillary sinus using an improved endoscopic approach known as modified endoscopic-assisted sinus surgery (MESS). We reviewed medical charts and radiographs of patients who underwent surgical removal of an ectopic tooth in the maxillary sinus using MESS. The surgical technique consisted of creating a bony window in the maxillary sinus wall with a pre-adapted microplate, which was repositioned after the tooth was removed. For all the patients included in this study, there were no postoperative complications clinically and radiographically. At the time of microplate removal, satisfactory bone regeneration was observed around the bony window margins of the maxillary sinus wall. MESS is an effective technique that modifies and integrates the techniques of the conventional Caldwell-Luc procedure (CLP) and functional endoscopic sinus surgery (FESS) and can be used to remove ectopic tooth in the maxillary sinus by avoiding the risk of postoperative sinus-related complications.

Keywords: modified endoscopic-assisted sinus surgery (MESS); ectopic tooth; maxillary sinus

1. Introduction

Ectopic eruption of a tooth in a non-dentate area is a rare phenomenon. The event has been reported to occur in many different locations, and the most frequently affected teeth are maxillary canine and mandibular third molar [1]. Although the pathogenesis remains unclear, assumptions have been made about the process, such as tissue interactions during tooth development, which can be due to developmental disturbances, trauma, iatrogenic, pathology, and genetic factors [1]. In rare cases, a tooth may exist in the maxillary sinus with or without symptoms. According to a literature review of 51 ectopic teeth in the maxillary sinus by Lombroni et al. [2], the majority of cases presented with symptoms including headache, facial pain, epistaxis, purulent rhinorrhea, swelling, and epiphora-related nasolacrimal duct obstruction with 15 cases associated with pathology, mostly being a dentigerous cyst. The treatment for an ectopic tooth with symptoms and/or pathology was surgical removal. For asymptomatic cases, the treatment of choice was observation with regular follow-up, and only one patient [3] underwent surgical removal upon the patient’s request. Even though an asymptomatic ectopic tooth usually does not require surgical removal, it may develop into a cyst or tumor if left untreated [2]. Therefore, patients should be informed of the possible consequences of retaining ectopic teeth.
In the past, the Caldwell-Luc procedure (CLP) has been used to remove teeth or foreign bodies from the maxillary sinus since this surgical approach provides good access through the canine fossa [4]. Recently, however, a less invasive technique using an endoscope, such as functional endoscopic sinus surgery (FESS), has been favored by many surgeons to treat such cases [5]. The benefits of the endoscopic removal of teeth from the maxillary sinus over the CLP include less perioperative morbidity and complications and shorter operation times [5]. Despite the advantages of the endoscopic approach, postoperative complications still have been reported. This study presents various cases of an ectopic maxillary third molar, which was successfully removed using an innovative technique, modified endoscopic-assisted sinus surgery (MESS), and aims to emphasize the role of the endoscopic approach for removing ectopic teeth in the maxillary sinus.

2. Case Series

2.1. Case 1

A 21-year-old male presented at the Department of Oral and Maxillofacial Surgery, Seoul National University Dental Hospital seeking treatment for impacted maxillary third molars. A panoramic radiograph taken during the initial visit showed impacted maxillary third molars on both sides (Figure 1A), and Waters’ view and computed tomography (CT) was performed to assess any pathologic changes and confirm the exact locations of the teeth. CT showed that both maxillary third molars were in the posterior wall of the maxillary sinuses with no pathological changes (Figure 1B). After informing the patient about the consequences of not removing the impacted ectopic third molar in the sinus, the patient requested prophylactic surgical removal of the ectopic tooth. The maxillary third molars were planned to be extracted via MESS, as previously described in the literature [5]. A titanium microplate (KLS Martin Co., Tuttlingen, Germany) was adapted to the round bony window and secured with micro screws (Figure 2A). An intact Schneiderian membrane (SM) was observed underneath the bony window. A small incision was made in the SM with a scalpel to make an opening for inserting an endoscope to inspect the maxillary sinus (Figure 2B). The ectopic maxillary third molar was found on the posterior wall of the maxillary sinus, and suction was inserted through the sinus bony window while the nasal meatal endoscope was utilized for visualization and illumination of the maxillary sinus. The tooth was removed with the force of the suction tip (Figure 2C). Then the bony window with a 4-hole microplate was repositioned and fixed with micro screws using predrilled holes. After discharge, the patient was followed-up periodically and underwent panoramic and Waters’ view assessments; during the one year and 6 months of follow-up, no complications were observed (Figure 1C,D). When the microplate was removed after 1 year, adequate bone regeneration was observed where the bony window was repositioned in the antero-lateral buccal aspect of the maxillary sinus wall (Figure 2D).
**Figure 1.** Preoperative panoramic view and CT showing different ectopic eruption patterns of maxillary third molars (arrow), and postoperative panoramic and Waters’ views after successful removal of the tooth via modified endoscopic-assisted sinus surgery. *Case 1:* Panoramic radiograph taken during the initial visit showing impacted maxillary third molars on both sides (A). Both maxillary third molars located in the posterior wall of the maxillary sinuses with no pathological changes, as shown in the preoperative CT (B). Postoperative panoramic radiograph (C) and Waters’ view (D) taken at 1 year and 6 months after successful removal of the third molars with normal transparency of the maxillary sinuses. *Case 2:* Preoperative panoramic radiograph showing inverted maxillary third molar in the left maxillary sinus (E). Preoperative CT scan showing cystic change associated with the left maxillary third molar and left maxillary sinus mucosal thickening (F). Postoperative panoramic radiograph (G) and Waters’ view (H) taken at 2 years and 9 months after successful removal of the left maxillary third molar with normal transparency of the maxillary sinuses. *Case 3:* Panoramic radiograph taken during the initial visit showing impacted right maxillary third molar (I). Right maxillary third molar located in the posterior-superior aspect of the right maxillary second molar, as shown in the preoperative CT (J). Postoperative panoramic radiograph (K) and Waters’ view (L) taken after removal of the right maxillary third molar and adaptation of the microplate. *Case 4:* Preoperative panoramic radiograph showing impacted left maxillary third molar (M). Preoperative Waters’ view showing left maxillary sinus thickening (N). Four months after removal of the left maxillary third molar, bone grafting was done in the left maxillary posterior alveolar ridge for future implant placement, as shown in the panoramic radiograph (O). Postoperative Waters’ view taken at 4 months after successful removal of the third molar with normal transparency of the left maxillary sinus (P).
2.2. **Case 2**

A 26-year-old female presented with impacted maxillary and mandibular third molars on both sides (Figure 1E,F). A CT scan showed inverted impaction of the left maxillary third molar with cystic change, and left maxillary sinus mucosal thickening was observed, which was most likely due to a periapical lesion of the left maxillary second molar (Figure 1F). The ectopic left maxillary third molar was removed via MESS. The SM was horizontally incised with a scalpel to identify the cystic lesion, and the sinus bony window was enlarged superiorly to create enough space to remove the cystic lesion and the impacted tooth (Figure 2E,F). Finally, the bony window with a pre-adapted microplate was repositioned and fixed with micro screws. After two years and nine months of follow-up, no complications were observed clinically and radiographically (Figure 1G,H) and complete bone regeneration was observed in the gap between the bony window and the antero-lateral aspect of the maxillary sinus wall after a 1-year follow-up (Figure 2G,H). After 1 year, adequate bone regeneration was observed where the bony window was repositioned in the antero-lateral buccal aspect of the maxillary sinus wall (Figure 2D).

2.3. **Case 3**

A 65-year-old female presented with a chief complaint of a mobile left maxillary second molar. Upon clinical and radiographic examination, chronic apical periodontitis of the left maxillary second molar was suspected due to vertical root fracture and impacted maxillary third molars were observed in both maxillary sinuses with no signs or symptoms of sinusitis (Figure 1I). The right maxillary third molar was located in the posterior-superior aspect of the right maxillary second molar (Figure 1J), and the left maxillary third molar was located in the antero-medial wall of the maxillary sinus. The left maxillary second molar was extracted first, followed by extraction of the right maxillary third molar via MESS.

Extraction of the maxillary third molar was performed in the same manner as described in the previous cases. A round bony window with a 1 cm diameter was made...
in the antero-lateral wall of both maxillary sinuses using a small round bur (Figure 2l). Use of the smallest round bur makes the osteotomy margins as narrow as possible to allow optimal stability of the bony window upon repositioning. A pre-bent titanium microplate was adapted to the bony window and secured with micro screws (Figure 2j) to enhance the stability of the bony window. Then the microplate was carefully removed (Figure 2k) to extract the impacted maxillary third molar (Figure 2l). Postoperative radiographs were taken to show satisfactory removal of the tooth and adaptation of the microplate (Figure 1k,l).

2.4. Case 4

A 54-year-old male presented with a mobile left maxillary second molar due to chronic periodontitis and an impacted left maxillary third molar with sinus mucosal thickening (Figure 1m,n). The patient underwent extraction of the left maxillary second molar with treatment of the maxillary sinusitis and surgical extraction of the left maxillary third molar via MESS. An endoscope was inserted through the nasal cavity to observe the ectopic tooth in the maxillary sinus (Figure 3a). The overlying mucosa was curetted to confirm the presence of the tooth (Figure 3b), and after the tooth was identified, it was carefully luxated and removed (Figure 3c,d). After confirming the absence of pathology in the left maxillary sinus approximately four months later, bone grafting was performed in the left maxillary posterior alveolar ridge for future implant placement, and the microplate was removed simultaneously (Figure 1o,p).

Figure 3. Intraoperative endoscopic images. A maxillary third molar embedded in the sinus mucosa was identified (A). After using a curette to expose the tooth (B), the tooth was luxated (C) and successfully removed with an elevator (D).

3. Discussion

Tooth development occurs during the 6th-week of intrauterine development and results from the interaction between the oral epithelium and the underlying mesenchymal tissue [6]. Therefore, ectopic eruption of teeth rarely occurs in regions outside the oral cavity, such as the nasal septum, coronoid process, condyle, and maxillary sinus because abnormal interaction of tissues during tooth development is challenging. There is a higher prevalence of ectopic tooth eruption among third molars and canines since these teeth take longer to erupt [6]. The ectopic teeth in the maxillary sinus may induce headache, nasal obstruction, fever, and secondary infection [7]. Although the cause is not clear, misplaced teeth may induce ROS production, which can lead to abnormal neutrophil recruitment [8]. Ectopic erupted maxillary third molars often have pathological findings and require surgical removal. However, they are technically difficult to remove, and intramaxillary sinus removal can often be accompanied by complications.

In the past, CLP was the preferred surgical technique to remove ectopic teeth in the maxillary sinus due to the ease of access for visualization, which can reduce the sensitivity of the technique. However, there are several drawbacks to this procedure. Many postoperative complications after CLP have been reported, such as postoperative maxillary cysts (POMC) and a high incidence of recurrence of sinus symptoms. POMC is known to be a late complication that occurs decades after radical maxillary sinus surgery. This is most likely caused by a decrease in the sinus volume after an inferior nasoantrostomy. During CLP, the sinus mucosal lining is completely removed and
replaced by nonfunctional mucosa which adversely affects sinus physiology. In addition, a high incidence rate of CLP-related complications has been reported such as postoperative facial edema which is impacted by intraoperative bleeding, oroantral fistula, recurrent sinusitis, numbness or paresthesia of infraorbital nerve distribution, and sclerotic changes in the remaining maxillary sinus wall [9,10]. Therefore, there has been a shift towards endoscopic management of ectopic teeth in the maxillary sinus, such as FESS, because this approach is less invasive, and carries a reduced risk of injury to the tooth root and the infraorbital nerve and has been associated with rapid sinus function recovery [5]. Enlargement of the middle nasal meatus with complete removal of diseased tissues could open the drainage pathway of the sinus to restore function and health while preserving the inner respiratory mucosa and remaining SM. However, when this conventional endoscopic technique was used, overly aggressive removal of physiologic structures of the nasal cavity and incomplete odontogenic sinus pathology removal have been inevitable, leading to an elevated risk of sinus complications [5].

Versatile applications for the MESS technique have been reported in recent literature, such as the intraoral reduction of blow-out orbital fractures [11] and the treatment of mucous retention cysts or maxillary sinusitis [12]. The main advantage of this renovated procedure is that the physiological functions of the paranasal sinus (PNS) are maintained while avoiding formation of POMC or sinus scar tissues. The rationale behind this technique is that osteomeatal unit enlargement is performed to improve drainage and ventilation of PNS into the nasal cavity without performing inferior antrostomy, as in CLP, and preserving the middle nasal meatus. Therefore, MESS accomplishes maximal preservation of the sinus anatomy by integrating advantages of traditional CLP and endoscopic sinus surgery. After removal of the tooth misplaced in the maxillary sinus using MESS technique, postoperative swelling or pain may accompany the operation. Natural proteolytic enzymes, such as bromelin, can help reduce postoperative complications with other drugs used for pain control [13].

Another means of avoiding postoperative scarring and POMC is repositioning the bony window to its original position. In traditional CLP, SM may adhere to the oral mucosa. Therefore, additional membrane is required to isolate the maxillary sinus from the oral cavity, and many techniques have been proposed to close the antrostomy site, such as using a collagen plug, membrane, and/or autogenous platelet-rich fibrin membrane [14]. However, repositioning the bony window may be a better option due to the following advantages: the osteoinductive and non-immunogenic properties of the autogenous bone, no additional membranes are needed, and it better prevents soft tissue migration into the sinus cavity [14,15]. Also, securing the bony window with a microplate facilitates optimal stability and bone healing.

Repositioning the bony window promotes adequate bone healing by creating and maintaining an isolated space where a blood clot could form. This follows the principle of guided bone regeneration where a mechanical barrier membrane is used to form a confined space that is favorable for exclusive recruitment and proliferation of osteoprogenitor cells, while preventing the passage of non-osteogenic cells, which eventually leads to complete osteogenesis [16]. Forming and repositioning the window so that the bony gap is as small as possible is thought to be the best for bony regeneration and restoration of the original shape of the maxillary sinus, but sometimes it may be difficult. As an alternative, plasticity of muscle acellular scaffold suggests that it may be possible to use various tissue regeneration [17].

The disadvantages of using the conventional CLP method to remove teeth in the maxillary sinus include damage to the adjacent maxillary second molar, loss of bone due to fracture of the maxillary tuberosity, which leads to failure of bony healing of the posterior or posterolateral sinus wall, and buccal fat filling the sinus which can lead to a decrease in the maxillary sinus function. Additionally, oroantral fistula or other dental pathologies may occur after tooth extraction, which compromises the integrity of SM, leading to odontogenic maxillary sinusitis. The interruption of the inner respiratory
mucosa lining of the maxillary sinus means there is a high risk of bacterial infection, predominantly anaerobic, in the oral cavity. However, MESS preserves the integrity of the SM. Therefore, to avoid these complications, removal of a tooth via MESS using simultaneous inspection of the maxillary sinus through a bony window and endonasal approach will preserve the sinus anatomy and lead to clinically satisfactory results.

4. Conclusions

This case series provides additional insight into the benefits of MESS as a safe, effective, and minimally invasive procedure for ectopic teeth in the maxillary sinus. MESS takes into consideration the drawbacks of conventional CLP and FESS and improves the surgical technique to reduce the risk of postoperative sinus-related complications after removing an ectopic tooth in the maxillary sinus, although more cases are needed to prove the efficacy of this technique. MESS is a method that can reduce postoperative complications by preserving the integrity of the SM while providing a sufficient field of view.

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