The Use of Inferior Meatal Antrostomy to Decrease Sinusitis with the Placement of Zygomatic Implants


Purpose: To present a case series treated by inferior meatal antrostomy as a prophylactic maneuver after the placement of zygomatic implants to decrease the risk of sinusitis. Materials and Methods: All patients undergoing zygomatic implant placement using the lower meatal antrostomy protocol between June 2011 and March 2019 at the Department of Oral and Maxillofacial Surgery, Universidad El Bosque, were included. Patients were evaluated after 12 months of the procedure using clinical and radiologic criteria described by Kuriyama and Reiskin. Results: Forty-eight patients were included, in whom 184 implants were placed. Complications were as follows: paresthesia (6.2%), orosinus fistula (4.1%), skin infection (2.1%), and loss of the implant (1.6%). There were no cases of sinusitis. Conclusion: This study provides evidence that the technique is effective and should be considered because of its simplicity. The inferior meatal antrostomy has proven to be a simple, effective, and reliable technique to decrease the risk of sinusitis associated with the placement of zygomatic implants. Int J Oral Maxillofac Implants 2021;36:126–130. doi: 10.11607/jomi.8507

Keywords: case-control study, implant, oral and maxillofacial, surgery, zygomatic

Different techniques have been described for the rehabilitation of severely atrophic arches, such as the use of pterygoid implants, angled implants, short and wide implants, or techniques such as maxillary sinus elevation.1 Zygomatic implants (ZIs) are another option that have been applied increasingly for the functional rehabilitation of edentulous patients with severe maxillary atrophy. In fact, over time, this has become its main indication.

Some of the most frequent complications associated with the placement of ZIs are the lack of osseointegration, local infections, and the alteration of local sensitivity; however, sinusitis has been documented to be the most frequent complication.2 In order to minimize the invasion of the maxillary sinus, Migliorança et al introduced the exteriorized approach in 2006, in which the antrostomy is unnecessary.3 In an article published in 2015, the same research group presented a randomized clinical trial reporting the benefits of using an intraoperative inferior meatal antrostomy (IMA) as a prophylactic maneuver to decrease the risk of developing sinusitis in patients undergoing ZI placement.4 Recently, D’Agostino et al described a similar maneuver, performing an endoscopically guided middle meatal antrostomy, and concluded that this complementary maneuver appears to significantly improve sinusosal health after ZI placement.5

The objective of this study was to present a recent case series of edentulous patients receiving ZIs who have undergone a prophylactic IMA.

MATERIALS AND METHODS

A retrospective case series study design was implemented that included all the patients who received ZIs identified in the database of the Department of Oral and Maxillofacial Surgery, Universidad El Bosque, Bogotá, Colombia, from June 2011 to March 2019. Patients with clinical and radiologic indications for ZI placement due to severe maxillary atrophy were included. Patients who did not have a minimum follow-up of 1 year were excluded. The ZIs were inserted following the same protocol described in the present authors’ original publication in 2015.6 It is important to add two factors: (1) the
antrostomy was performed bilaterally with 14-cm Kelly forceps with a 2-mm-diameter tip and with an opening control device of 5 mm (which generates a maximum opening diameter of 7 mm); (2) in the last 5 patients, the minimally invasive approach was implemented for the placement of the ZIs, incorporating the use of personalized drilling guides. A comprehensive clinical and radiographic postoperative examination was performed after 1 and 2 weeks, and after 3, 6, and 12 months, after which the patients were classified as “sinusitis” or “sinusitis-free” using the clinical criteria indicated by Kuriyama et al,6 and the radiographic principles of Röntgen as described by Reiskin.7

**Surgical Technique**

Under general anesthesia, using nasotracheal intubation, a vestibular incision was made in the area of the anterior wall of the maxillary sinus, separately, both on the right and on the left side. Subperiosteal dissection of the maxilla was performed, and a full-thickness mucoperiosteal flap was reflected up to the malar bone; the palatal mucosa was not dissected. A window was made in the uppermost lateral aspect of the sinus wall using a round bur (Fig 1). The drilling protocol was carried out starting with a 2.9-mm twist drill, followed by 3.5-mm pilot and twist drills. After the implant size was calculated using the depth indicator, the ZI was inserted (Fig 2). Subsequently, the IMA was performed, using 14-cm curved Kelly forceps to perforate the lateral nasal wall at the level of the inferior meatus, by positioning it on the nasal floor and exerting constant lateral pressure until reaching the lumen of the sinus (Fig 3). Subsequently, the 7-mm-guided opening of the forceps was performed with a simultaneous semicircular movement, followed by the closing and removal of the instrument. It should be noted that, from the time of osteotomies until drilling, placement of the ZIs, and antrostomy, profuse irrigation with saline was maintained to avoid bone heating and eliminate undesirable residues. The preoperative medication consisted of cefazolin 1.0 g intravenously and dexamethasone 8.0 mg intravenously. Postoperative prescription included cephalexin 500 mg for 7 days, dexamethasone 8 mg for 1 day, and diclofenac sodium 75 mg for 5 days.

**RESULTS**

As presented in Table 1, the final sample consisted of 48 patients, in which 184 implants were inserted. Forty-four patients received four implants, and only four patients received two ZIs. The mean age of the sample was 57.3 years. One hundred two zygomatic implants were placed in women (55.4%) and 82 in men (88.4%). The complications included three cases of infraorbital paresthesia (6.2%), two cases of orosinus fistula (4.1%), and one case of skin infection in the malar region (2.1%). There were three cases of implant loss due to failure in osseointegration (1.6%), all occurring in different patients. All the cases were diagnosed as sinusitis free using the aforementioned clinical criteria and radiographic principles.
The relationship between sinusitis and the placement of ZIs is up for debate. Several factors could be associated with its postoperative appearance, among which the following stand out: a foreign body reaction that manifests itself as inflammation of the mucosa, the communication generated by the sinus membrane, the lack of osseointegration, and the lack of hygiene in the area that facilitates the migration of microorganisms. The present hypothesis considers that perforation of the maxillary sinus membrane causes inflammation, which in turn causes obstruction of drainage, mucus accumulation, decreased mucociliary clearance, and bacterial growth. The superior location of the ostium in relation to the sinus floor can decrease the mucosal flow due to the gravitational principle, and its obstruction can also cause a decrease in oxygenation within the maxillary sinus. Furthermore, the inoculation of bacteria from the oral cavity during access, drilling, or implant placement is another aspect to consider.

D’Agostino et al reported that there is no direct relationship between the placement of ZIs and the appearance of complications in the maxillary sinus, but also that subclinical changes could predispose some patients to sinus complications in the future. Molinero-Mourelle et al performed a systematic review in which they reported an average prevalence of 3.9% of postoperative sinusitis, with varied percentages among the studies consulted, which could even reach up to 19.4%. In the present authors’ first article published referring to ZIs in 2014, the placement of 244 implants was documented, with sinusitis being the most frequent complication with 7.5% of cases. In 2015, Bothur et al studied the survival of the implants, and the bone and mucosal changes of the maxillary sinus, in 58 patients with ZIs; they found osteitis in all the patients and fundibular obstruction in 9 cases, of which 7 presented accessory ostium. Thickening of the mucosa was observed in all cases, but due to the asymptomatic nature of this finding, it was not possible to establish whether they had this condition before implant placement. As part of the conclusions, the authors suggested that the accessory ostium could serve as a ventilatory support for the maxillary sinus. Later, Zhao et al studied the thickening of the sinus membrane and the long-term obstruction of the ostium, related to the placement of ZIs, using preoperative and postoperative CBCTs. A total of 49 maxillary sinuses were studied in which the increase in the obstruction of the ostium went from 2.0% to 12.2%, which was not considered statistically significant. However, it was determined that patients who initially presented a thickening of the membrane of more than 2 mm (24.5%) increased significantly to 28.6%. The mean follow-up time was 23 months, suggesting that implant placement may be related to chronic thickening of the membrane. It should be noted that the authors state that at the time of preparing their study, there was no study that compared these variables preoperatively and postoperatively.

Miglieranza et al reported in 2006 for the first time a technique in which ZIs were inserted outside the maxillary sinus, which minimized the alteration of the sinus mucosa. Aleksandrowicz et al carried out a study that included 22 patients, in whom they placed 35 implants, using the intrasinus and extrasinus approach, reporting that four cases developed sinusitis for the first group (11.42%), but none for the second. The aforementioned suggests the relevance of maintaining the integrity of the sinus membrane to prevent postoperative sinusitis. However, it is important to mention that the use of this technique is limited by anatomical factors, due to which it is not superfluous to consider another option, capable of minimizing the risk in the event that the placement must be performed by perforating the sinus membrane. This is why the second surgical option is to use an IMA prophylactically when using the intrasinusal maneuver, which was first described in 2015 by the present research group, through a randomized clinical trial that included 44 patients, 22 of whom underwent the antrostomy without developing sinusitis, unlike the

### DISCUSSION

#### Table 1 Summary of Patients Treated with Zygomatic Implants in Conjunction with Inferior Antrostomy

<table>
<thead>
<tr>
<th>Variables</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients (n = 48)</td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>27</td>
</tr>
<tr>
<td>Men</td>
<td>21</td>
</tr>
<tr>
<td>Mean age (y)</td>
<td>57.3</td>
</tr>
<tr>
<td>Zygomatic implants</td>
<td></td>
</tr>
<tr>
<td>Total inserted</td>
<td>184</td>
</tr>
<tr>
<td>In women</td>
<td>102</td>
</tr>
<tr>
<td>In men</td>
<td>82</td>
</tr>
<tr>
<td>Surgical technique</td>
<td></td>
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<tr>
<td>Modified intrasinusal classic approach</td>
<td>43 (89.5%)</td>
</tr>
<tr>
<td>Intrasinusal minimally invasive approach</td>
<td>5 (10.5%)</td>
</tr>
<tr>
<td>Complications</td>
<td></td>
</tr>
<tr>
<td>Infraorbital nerve paresthesia</td>
<td>3 (6.2%)</td>
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<tr>
<td>Orosinusal fistula</td>
<td>2 (4.2%)</td>
</tr>
<tr>
<td>Skin infection</td>
<td>1 (2.1%)</td>
</tr>
<tr>
<td>Implant loss</td>
<td>3 (1.6%)</td>
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group that did not undergo an antrostomy, in which three cases were documented (13.6%).

Since Hempstead and Moore separately described their results using the IMA in 1939, this technique has been used for the treatment of chronic sinusitis, mucocoeles, and more recently, combined with the middle meatal antrostomy, to identify and remove fungal debris. Despite the fact that authors like Coleman and Duncavage consider the middle meatal antrostomy to be more effective than the IMA because it allows the mucociliary system to provide physiologic drainage of the maxillary sinus, preventing circular flow, other authors such as Ochi et al concluded that IMA provides both intraoperative and postoperative benefits. They documented a series of 27 patients suffering from moderate-to-severe chronic sinusitis, treated with IMA, in whom they found that 86.7% presented a normal sinus mucosa, complete removal of recurrent mucosal lesions, and no case of circular flow on the India ink test.

Although there is discussion regarding which meatus is most suitable for performing the antrostomy, the middle or the inferior one, in the present study, the decision was made to use the IMA due to two reasons: (1) the procedure is safe and relatively simple to perform because the nasal floor is a fixed and easily identifiable reference point, and because it is the point at which the medial sinus wall is thinnest; (2) the physiologic principle that supports its effectiveness. The inferior antrostomy provides an alternative drainage path that allows the cilia to become functional, even if this capacity is reduced by an inflammatory process. This becomes relevant because secondary ciliary dysfunction has been observed in patients with open middle antrostomies who have persistent infections.

The use of the prophylactic antrostomy was also evaluated through a prospective longitudinal study conducted by D’Agostino et al in 2019, in which endoscopic antrostomies were executed in the middle meatus in 13 patients. None of the patients showed radiologic findings of sinonasal pathology, but mucosal hypertrophy appeared in three maxillary sinuses (11.5%). Three interesting differences were observed in this study with respect to the original application of the maneuver. The first was the use of the middle meatal antrostomy instead of the IMA. In the present case, the perforation was performed in the inferior meatus due to the reasons explained earlier; in addition, Hood et al found that the presence of accessory ostia can increase the sinus ventilation due to an increase in the air net flow through the sinus. However, the same study also found that the presence of a single ostium can limit ventilation unless it is very large, which validates the fact that the widening achieved by the middle meatus antrostomy is also effective in restoring physiologic aeration of the sinus. The second observation was that a 3-month follow-up is too short to assess the appearance of chronic sinusitis. Although the objective of the maneuver is not therapeutic, but prophylactic, the authors of the present study considered extending the time for observation after their first publication, because of the inherent risks of the procedure and also because of the appearance of a less frequent but also important complication, oro-sinusal fistulation. Therefore, postoperative controls were added at 6 and 12 months, at which time clinical and radiologic evaluation was carried out. The third observation was that the endoscopic antrostomy is a less invasive method than the surgical one. The authors consider that, undoubtedly, this is a better option when the equipment and resources are available. Advantages of the present technique include its probable cost-effectiveness factor since it can be executed in a maximum time of 1 minute per side, that it does not imply the expense of additional resources, and was proven effective. This factor is relevant in the present case because the objective of implant placement in the entire population included in this study is restorative and not reconstructive. Social security system does not cover these procedures, and thus, the costs of the surgery are covered by the patient. The IMA was implemented experimentally as part of the original study, but to date, it was included as part of the protocol due to its effectiveness, with the advantage that it does not require an increase in costs.

The authors would like to consider an additional variable: the size of the antrostomy. Brumund et al carried out a sheep model study in which they compared the effectiveness of achieving ventilation of the maxillary sinus by performing a uncinectomy, a small antrostomy (2 to 4 mm), or a large antrostomy (6 to 9 mm), and they found that there is less ventilation using the first technique than the second and third ones, but also found that there is no significant difference between the second and third. Considering that this case series does not use the endoscopic technique, which could have allowed better control of the size of the perforation, “big” antrostomies of approximately 7 mm in size were performed, which so far have proven to be effective in the control of postoperative sinusitis.

It should be noted that the objective of the present study was not to use the IMA as a treatment for sinusitis, or to prevent its appearance years after the placement of ZIs (which can appear due to different causes beyond the operator’s control, such as loosening of any of the implants, trauma, respiratory infections, etc), but as an immediate prophylactic intraoperative maneuver that prevents the appearance of sinusitis due directly to postoperative inflammation, which is quick to apply and low cost.
CONCLUSIONS

The authors consider the IMA to be an effective method for achieving adequate prophylactic ventilation in the maxillary sinuses, whereas the inflammatory conditions induced by the placement of ZIs have passed. Over the course of 7 years, the authors have been able to document the effectiveness of this maneuver, and this pathology did not appear in any of the cases. Despite the foregoing, this research group believes that additional research should be conducted on the subject, and at the same time, they hope that this study will prove valuable in continuing to encourage scientific questions in other researchers and a gradual improvement in the state of the art of the procedures.

ACKNOWLEDGMENTS

The authors reported no conflicts of interest related to this study.

REFERENCES