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Reasons for the Development of Maxillary Sinusitis after Corticobasal® Implant Placement. Analysis of a Case and Suggestions for Prevention of this Complication and for a Corrective Intervention

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Abstract

Introduction: For cases of severely resorbed ridges, placement of implants and the application of the method of oral osseofixation presents solutions that require a number of considerations.
This case report describes the development of a maxillary sinusitis following **irregular** placement of a Corticobasal® implant and points out possibilities on how intra-operatively, a standard treatment would have probably avoided the complications that occurred here.

Clinical case presentation: A 57-year-old male patient, partially edentulous, with a history of unstable dentures, requested oral implant treatment, using immediate loading protocol. The non-smoking patient reported no medical or family history of maxillary sinusitis nor any allergies. The clinical examination revealed a severely resorbed maxillary jaw and a moderately resorbed mandible. A treatment plan was set up; it included the use of Corticobasal® implants and fixed prostheses thereon. Most implants were inserted following the standard surgical and prosthetic technique [19]. In order to insert implant 25, a trans-sinusal approach directly into the body of the zygomatic bone was chosen. The prosthetic treatment followed directly on the surgical treatment and was finished within 72 hours with the insertion of a cemented, circular MFC bridge. At the six-month follow-up, the patient presented with pain in the right infra orbital area and repeated nasal congestion. The patient's cone beam CT showed complete opacity in the right maxillary sinus. Antibiotics, non-steroidal anti-inflammatory agents, expectorants, and antihistamines were prescribed without improvement for four weeks. A problem with the "open bone wound" was diagnosed to be the cause of the chronic inflammation in the maxillary sinus. To cure the infection, the treatment provider decided to section the zygomatic implant off from the fixed bridge. In the next follow-up visit after two months, the patient reported complete recovery with no signs or symptoms of sinusitis. The cone beam CT showed a fully clear maxillary sinus with normal sinus membrane thickness, although the body of this implant had remained inside the maxillary sinus.

Conclusion: Within the limitations of a single-case study, we can conclude that even if most of the smooth implant's body is located within the maxillary sinus, this will not lead to the development of a maxillary sinusitis nor a chronic infection. The true reason for the sinus infection is the missing seal between the maxillary sinus and the oral cavity and the persistent possibility of bacterial inoculation into the maxillary sinus. Hence, the use of antibiotics is not an effective treatment approach for this infection unless the bony seal is given in the area of the cortical between the maxillary sinus and the oral cavity. Such a "seal" can be created by careful implant placement with the help of PRF membranes.

Keywords: Oral osseofixation, immediate functional loading, maxillary sinus seal, zygomatic implant, open bone wound, PRF seal for the maxillary sinus.

1. Introduction

Tooth loss can adversely affect the patient's quality of life, compromising aesthetics, phonetics, mastication, and self-esteem [1]. Many methods have been proposed for replacing missing teeth, with implant treatment being the method of first choice today [2, 3]. Cases with severely resorbed upper jaw ridges sometimes require a modified surgical approach [4-6]. The amount of limited residual bone has a significant negative influence on the stability of a denture [4, 5, 7]. It may also limit the possibility of creating a sufficiently large endosseous area for the ankylotic bone-to-implant connection that is required for osseointegrated implants [4, 5]. Bone augmentation procedures are associated with many clinical risks and increase the overall costs by at least 30% [4, 5, 7, 8]. The treatment time may increase by more than 50%.

With the advancement of implant dentistry, the use of cortically anchored Corticobasal® implants has become increasingly popular. This method shows very high success rates without necessitating the use of bone grafting [4, 5, 9-11]. The

implant can be anchored bi-cortically or even tri- or multi-cortically into highly mineralized cortical bone, which results in excellent primary stability [4, 5, 9-11]. As a consequence, implant tips may protrude into the lower airway and into the maxillary sinuses. The protrusion of endosseous implants, including zygomatic implants, has historically sparked controversy [4, 5, 12]. However, recent literature has documented that implant protrusion into the maxillary sinus and into the lower airway per se will not affect the health of the maxillary sinus nor of the implant [4-6, 10, 13-17].

Ahmad et al. [4] and Awadalkreem et al. [5] investigated prospectively and retrospectively the effect of Corticobasal® implant protrusion both clinically and radiographically. They concluded that if the Corticobasal® implant protrudes (following the standard protocol) into the maxillary sinus, the treatment is safe and effective and will not be associated with sinusitis. Ahmed et al. [5] reported an increase in the sinus membrane thickness in two patients after treatment with Corticobasal® implants. The same observation was associated with rough 2-stage implants [12].

On the other hand, Lazarov [10] documented the occurrence of a maxillary sinusitis in one out of 131 maxillary sinuses equipped with Corticobasal® implants, while other investigators reported the radiographic evidence of maxillary opacification in 20% of the patients after placement of 2-stage implants, with clinical evidence of sinusitis in 2% of the cases [1]. A recent review by Nocini et al. in 2022 [18] documented that 12.3% of the patients presented with maxillary sinusitis as a complication of zygomatic implant placements. However, limited data exists to support the management of this sinusitis associated with implants.

This is the first case report to describe the incidence of maxillary sinusitis following an irregular Corticobasal® implant placement and a successful management of the maxillary sinusitis.

2. Case Presentation

A 57-year-old partially edentulous male patient with a history of instable dentures was presented in the author's clinic seeking immediate implant-supported treatment, Fig. 1.

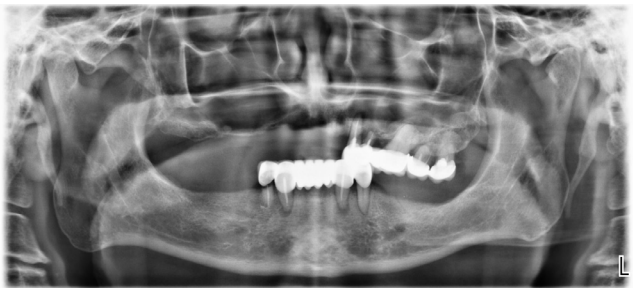

***Fig. 1**: The preoperative panoramic radiograph of the patient.*

The patient was a non-smoker and reported no medical, family, or allergic history. The patient's clinical examination revealed a severely resorbed maxillary jaw and a moderately resorbed mandible. A treatment plan was set up, including the use of prostheses supported by Corticobasal® implants. A team composed of three specialists with more than ten years of vast experience in Corticobasal® implants was devised. Implant insertion was performed however using a non-standard technique, i.e. an approach that is not mentioned in detail in the 6th IF® consensus document for proven methods [19]. The applied approach is nevertheless used frequently in cases of severe atrophy of the maxillary bone. Implant osteotomy was planned to be flapless. The direction for trans-sinusal zygomatic implant placement may lead to a very palatal start-point for the drilling, Fig. 2.

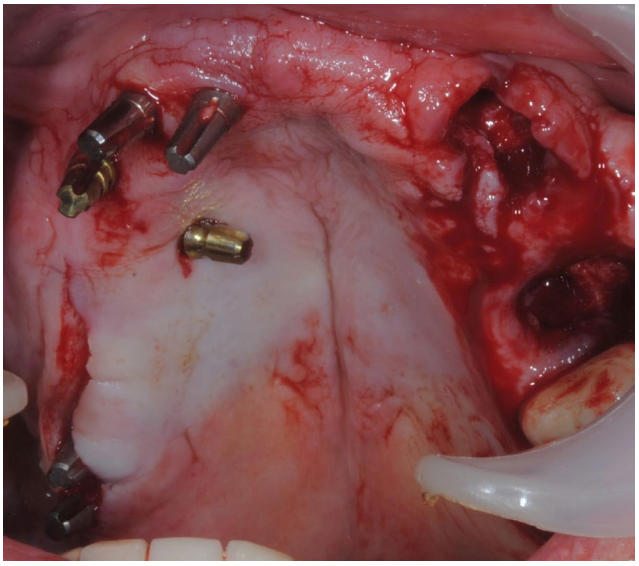

***Fig. 2**: The direct zygomatic implant is well fixated, but the position of the abutment head requires a change of its direction to achieve the required parallelism needed for the prosthesis insertion.*

Drilling and insertion of the implants were done under aseptic conditions created by the use of betadine 10% (watery solution) before and during the implant osteotomy. The osteotomies were rinsed with Betadine 10%. Thirteen implants with appropriate length and width were inserted in the maxilla and distributed, including three implants at the tuberopterygoid area ("double tuberopterygoid technique"), one zygomatic implant at the right zygoma, and seven implants in the areas of 25, 23, 21, 11, 31, 35, and 37. Eight implants were inserted in the mandible

and distributed in the following areas: 47, 46, 43, 42, 33, 34, 37, and 37.

Implant osteotomy was planned to be flapless, but the direction for trans-sinusal zygomatic implant placement had led to a very palatal start-point for the drilling, Fig. 2. The surgeon corrected this situation by forming a vertical slot into the palatal mucosa and the bone as well as by bending parts of the implant's shaft to achieve the prosthetically required parallelity with other abutments heads. Thereby, a situation was created where the abutment head "came under the mucosa.". Hence, the transition zone of the implant towards the prosthetic workpiece was submerged under the mucosa. Furthermore, the vertical bone slot was left uncovered, and hence, a large open bone wound had been created (Fig. 2 and 3).

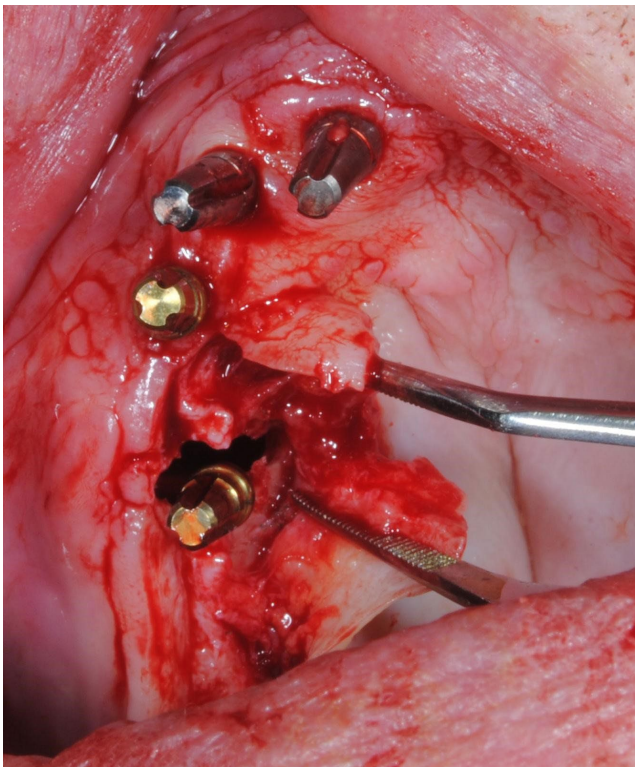

***Fig. 3**: The surgeon corrected this by forming a vertical slot into the palatal bone and by bending parts of the implant's shaft to achieve the required parallelism and to align it with all other abutment heads. The transition zone of the implant towards the prosthetic work piece was submerged under the mucosa. Furthermore, the vertical bone slot was left uncovered. This had created a large "open bone wound".*

A digital panoramic view was taken postoperatively (Fig. 4). Amoxicillin 1 g and Metronidazole 500 mg, as well as 50 mg diclofenac potassium (Rapidus), were prescribed. The next day, a metal framework was constructed to splint the

implants, while on the third day, the final zirconium prostheses were inserted and cemented using Fuji cement (GC Corporation, Tokyo, Japan), Fig. 4. Occlusal adjustment had been done, and the patient was scheduled for follow-up after one week, one month, 3 months, six months, one year, and every year afterward. In each follow-up, the patient should be examined clinically and radiographically.

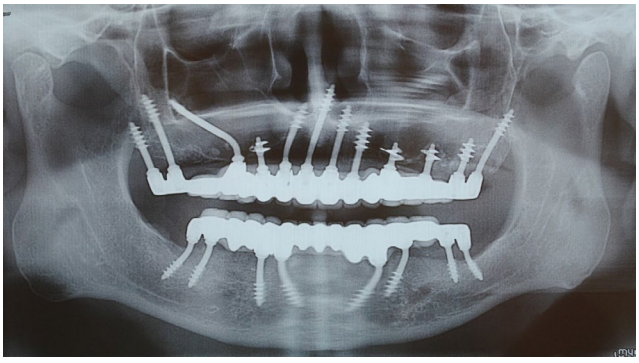

***Fig. 4**: The postoperative panoramic radiograph showing Corticobasal® implant-supported prostheses with one long implant being anchored in the zygomatic bone. Next to this implant, we observe two opaque structures that may be located in the maxillary sinus.*

At six months of postoperative follow-up, the patient presented with pain in the right infra-orbit area, a headache in the right temporal region, and repeated nasal congestion. Both clinical and radiographical examinations were performed. The clinical investigation revealed a stable bridge with healthy peri-implant issues. However, the cone beam CT of the patient showed complete opacity of the right maxillary sinus (Fig. 5a, 5b).

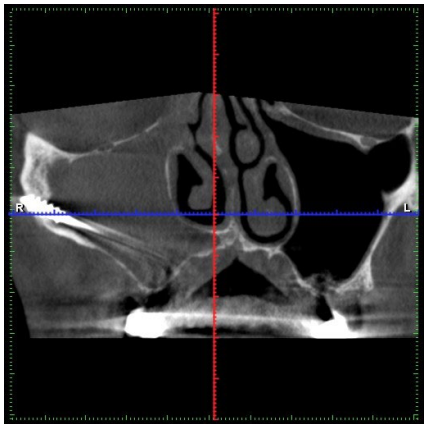

Fig. 5a

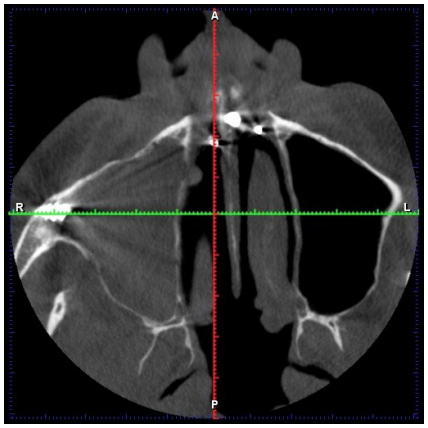

Fig. 5b

***Fig. 5a and 5b**: Computed Tomography CT revealed complete opacification of the right maxillary sinus and slight sinus membrane thickness during six months' postoperative follow- up.*

The patient was referred for ENT specialization for the confirmation of sinusitis and for advising a treatment. Antibiotics, non-steroidal anti-inflammatory drugs, expectorants, and antihistamines were prescribed.

No improvement was reported after four weeks of follow-up; hence, the decision was made to cut the long intra-sinusal body of the zygomatic implant off from its head and to leave the implant body inside the maxillary sinus. To achieve this, a flap was elevated on the palatal side. The implant was thereby cut off from the bridge; experience shows that the retention of a Corticobasal® zygomatic implant (ZDI type) is extremely good and removal out of the zygomatic bone is difficult. As this case shows, the removal of the body of the implant is not necessary to allow the maxillary sinus to heal. Stable osseofixated Corticobasal® implants are never the cause of a maxillary sinusitis [4, 5, 10, 20] as long as a (typically bony) seal between the maxillary sinus and the oral cavity is given. In the case shown here, the body of the implant and the abutment head were cut off from each other. The abutment head was left in the crown, whereas the body of the implant was left in the zygomatic bone and in the lumen of the maxillary sinus. Two months later, the patient reported the complete recovery of the health of the maxillary sinus with no signs or symptoms of sinusitis left. A cone beam CT showed a clear maxillary sinus with normal sinus membrane thickness (Figs. 6a, 6b, 6c).

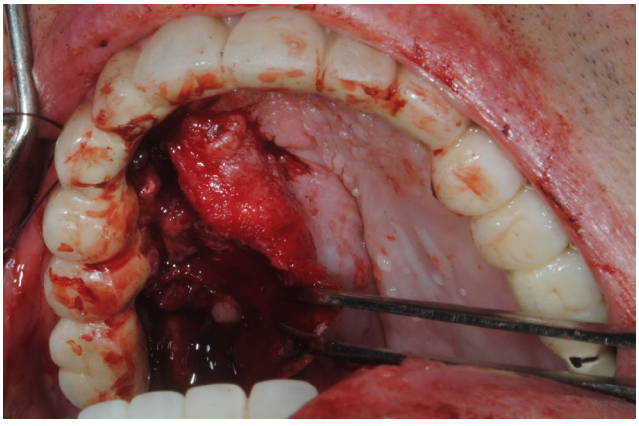

***Fig. 6a**: The surgical situation after the cutting the abutment of the implant off from the large intra-sinusal body.*

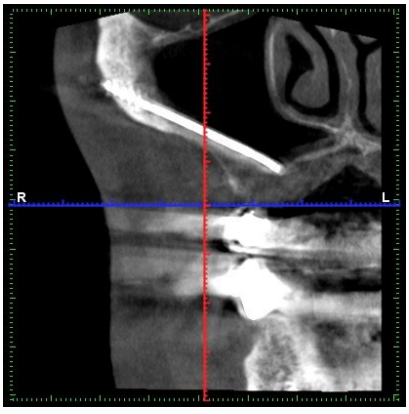

Fig. 6b

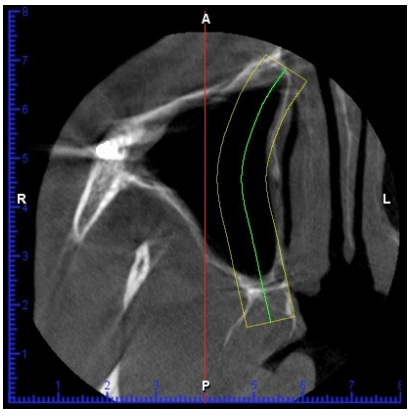

Fig. 6c

***Fig. 6b and 6c**: Computed Tomography CT (taken three months later than Figs. 5) revealed the complete clearance of the right maxillary sinus with normal sinus membrane thickness and the reduced implant shaft. The implant is not connected to the bridge anymore.*

3. Discussion

Cases of severely resorbed ridges used to impose difficulties for implant practitioners working with conventional ankylosed implants. Several treatment modalities have been proposed to overcome the need for bone grafting with associated risk factors, including the use of short implants, "All-on-4" or "All-on-6" implants, remote implant anchorage (i.e., tuberopterygoid and zygomatic implants), and the use of Corticobasal® implants [4-6].

Corticobasal® implants have gained popularity in recent years due to a variety of well-documented advantages, including the elimination of the need for bone augmentation and its associated risks. The metallic framework, which splints the single implants, provides an excellent biomechanical distribution for the masticatory load. Moreover, it provides the patient with immediate fixed prostheses within 72 hours. All of these factors make the selected implant treatment the first choice for severely resorbed ridges, such as in the prescribed case [4, 5, 9-11].

Despite the fact that many investigators emphasized that the protrusion of the apex or a longer portion of an implant into the maxillary sinus does not compromise health and / or is associated with the incidence of sinusitis [4-6, 12-17], the onset of sinusitis reported in this case is matched by Kämmerer et al. [21], who documented a 9.53% probability of sinusitis onset with zygomatic implants after reviewing twenty-four studies, including 2194 implants in 918 patients. Lazarov [10] studied prospectively the maxillary sinus complications in relation to treatments with Strategic Implant® (which feature the same design as Corticobasal® implants). As a result, he showed that only one out of the 98 patients developed a maxillary

sinusitis. This single case of an implant-derived maxillary sinusitis showed similarities to the case described here: the transition zone between the cemented crown and the implant was submerged deep into the mucosa and very close to the (atrophic) bone that formed the caudal border of the maxillary sinus.

Candel-Martí et al. [22], Brennand et al. [23], and others [1, 18, 23-26] highlighted that sinusitis is the most common complication associated with zygomatic implants, with an incidence rate ranged between 1.5–18.42%, while Al-Nawas et al. [26] reported 14.2% prevalence of maxillary sinusitis over 65.4 months of follow-up. On the other hand, some investigators reported the incidence of epistaxis as a clinical complication [4, 6, 17, 27] and increased sinus membrane as a radiographical complication [4, 6, 10, 12]. This case report demonstrates for the first time one possible pathway and reason for the development of the maxillary sinusitis. The use of Corticobasal® implants under such extreme (non-standard) conditions as well as the approach to solve the problem was never described so far.

In the described case, the persistence of an "open bone wound" leading to an oroantral communication was the main reason for developing a maxillary sinusitis, an observation that is in line with Nedir et al. [27], who reported a complete radio-opacity of the left side maxillary sinus in a female patient discovered in a routine follow-up visit with the absence of clinical sinusitis symptoms. His patient reported a history of a slight and painless discomfort in the left infra-orbital region that had lasted for a few months. The intraoral examination of the patient revealed a peri-implant pocket depth of 4 and 7 mm for the implants 23, 24, and 26, with crestal bone loss around implant 25, and periimplantitis. Hence, the main reason for sinusitis can be the peri-implant infection. The treatment protocol for that case involved the removal of the failed rough surface implant; however, in our case, the main cause of sinusitis is the lack of the bony seal. In our case, the intra-sinusal body of the implant was not removed due to the strong cortical anchorage and the smooth surface of this implant, which will prevent retention of the infection on the implant body in contrast to the rough surface implant [4, 5].

Several approaches have been reported in the literature to re-create a healthy maxillary sinus after infections, such as antibiotic administration, incision and drainage, defect degranulation, Caldwell-Luc surgery, and functional endoscopic sinus surgery (FESS) [28-34]. In the described case, the antibiotic therapy alone cannot be considered an effective treatment unless it is accompanied by complete closure of the oroantral communication associated with an "open bone wound".

Some might argue that the placement of the zygomatic implant was useless in the end and that this should not have been inserted from the beginning. Such a conclusion is not correct since the implant was in place for six months. The main role of the zygomatic implant is to widen the supporting polygon and to provide lateral stability to the BIPS® (Bone-Implant -Prosthetic-System) while the bone of the maxilla is under strong postoperative remodeling and this role was fulfilled completely. The implant provided additional security to the overall treatment as such, although an almost horizontally placed elastic zygomatic implant hardly provides any vertical stability to the BIPS®.

If the method of Corticobasal® implants is used, in general more than minimally necessary implants are placed in each jaw. This is possible because these implants will never lead to periimplantitis. The demand for using as few implants as possible (known from the field of osseointegrated implants) does not exist in this modern field of implantology.

After six months, the implant in question here could have been removed (or disconnected from the bridge) without any danger to the stability and survival of the BIPS® in the upper jaw. This clinical scenario of sinus recovery cannot be predicted in the case of rough osseointegrated implants, where the rough surface of the implants will be rapidly canalized by bacteria as it is anchored on the first cortical of a jawbone.

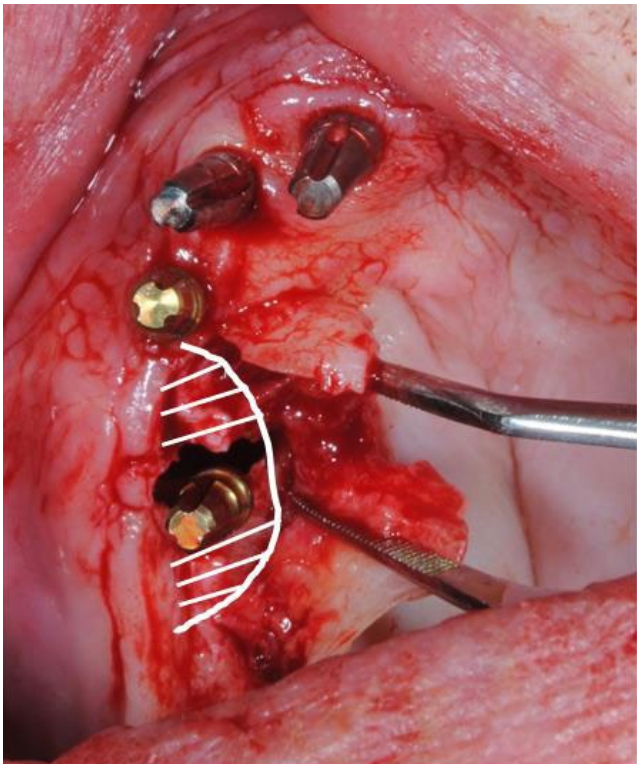

***Fig. 7**: Instead of "burying" the abutment head deep in the palatal mucosa as shown here, the surgeon could have reduced the vertical height of the bony alveolar (i.e. the white marked area) around the implant significantly. This would have (on one hand) increased the bony defect (i.e. the "open bone wound") at the base of the maxillary sinus (which is in general rarely ever the point of origin of a maxillary sinusitis). By increasing the soft tissue flap slightly more towards the palate and the vestibular side, the seal around could have been created by installing several layers of PRF membranes before closing the flap. This step results in woven bone formation around the shaft of the implant, and we know from placement of these implants into fresh extraction sockets that fresh callus seals the open bone wound very well. Both measures together (reducing bony crest and placement of PRF membrane on layers) would have contributed to an uneventful healing of the site.*
As an alternative, a longer zygomatic implant could have been chosen by the surgeon, as this will lead automatically to a full protrusion of the abutment head out of the mucosa.

Experience shows that the thickness of the second cortical has no influence on the success of Corticobasal® implants if enough woven bone formation is possible along some of the vertical axis of the implant (especially in compromised situations as shown here), and if enough implants per jaw are placed. Corticobasal® implants may also be placed in extraction sockets of the palatal root of the upper molar, even if the thickness of the cortical there is less than one millimeter. This amount of cortical bone is enough for the initial and permanent anchorage and the safe load transmission. The length of the extraction socket, however, decides about the question of how much callus can develop within the socket postoperatively. The blood clot that leads to the callus seals the "open bone wound" almost instantly. Later, the mature callus is remodeled into osteonal bone, which will even contribute (with increasing mineralization) to the stability of

the implant and the prosthetic construction.

All the above-mentioned aspects have to be considered when performing both the surgical treatment steps and the corrective intervention. Removal of Corticobasal® implants in contact with the maxillary sinus may be the easier way of resolving the problem. The indications for such a removal is described in the first Consensus document regarding Corticobasal® implants, as issued by the International Implant Foundation IF®, Germany [35].

Enough distance between the lower border of the abutment head and the oral mucosa is one of the indispensable prerequisites for avoiding such a problem.

This case shows that the statements that were assessed in the Delphi study as published by Testori et al. [12] can be applied to cases where during the placement of Corticobasal® implants, the seal between the oral cavity and the maxillary sinus is missing or has been destroyed. The implant's body may be left inside the maxillary sinus as long as the problem of the missing seal is solved.

4. Conclusions

Within the limitations of this case observation, we can conclude:

1. If the bony seal between the oral cavity and the maxillary sinus is missing resulting in an oroantral communication, a maxillary sinusitis can occur along even with polished shafts implants.

2. If a tight (soft tissue) seal between the oral cavity and the maxillary sinus is reestablished, a maxillary sinusitis is expected to self-heal.

3. If several implants are penetrating into the maxillary sinus, the treatment provider should investigate radiographically to identify which implant is causing the bony seal in the direction of the maxillary sinus. If complication are encountered, the responsible implants should be removed or disconnected from the prosthetic construction. If the prosthesis lacks stability and support owing to the reduced implant support, an extra implant must be added to improve the BIPS®.

4. Probing should be prohibited and considered a bad practice to identify the implant who lacks the bony seal; this diagnostic step might by itself lead to a new

"open bone wound" and a subsequent infection [36].

5. The usage of the "Deep Cementing Technique" (as it has been described for Corticobasal® implants [37]) is not recommended in connection with zygomatic implants and trans-sinus tuberopterygoid implants. In IF® Method 6 and IF® Method 8 (when the sinus membrane is intact), there should not be a problem with deep cementing.

References

1 Mehta NK, Arunkumar A, Murr AH, Pletcher SD. Surgical treatment for zygomatic implant related maxillary sinusitis: A method for implant salvage. Otolaryngology Case Reports. 2020 Sep 1;16:100196. DOI: https://www.sciencedirect.com/science/article/pii/S2468548820300412?via%3Dihu.

2 Nam KY, Kim JB. Treatment of dental implant-related maxillary sinusitis with functional endoscopic sinus surgery in combination with an intra-oral approach. J Korean Assoc Oral Maxillofac Surg. 2014 Apr;40(2):87-90. DOI: 10.5125/jkaoms.2014.40.2.87.

3 Jiam NT, Goldberg AN, Murr AH, Pletcher SD. Surgical treatment of chronic rhinosinusitis after sinus lift. Am J Rhinol Allergy. 2017 Jul 1;31(4):271-275. DOI: 10.2500/ajra.2017.31.4451

4 Ahmad AG, Awadalkreem F, Osman M, Palka L. Does the Protrusion of Corticobasal Implants in the Maxillary Sinuses Affect Sinus Health? A Retrospective Study. J Contemp Dent Pract. 2023 Jun 1;24(6):357-363. doi: 10.5005/jp-journals-10024-3521.

5 Awadalkreem F, Ahmad AG, Ihde S, Osman M. Effects of Corticobasal Implant Protrusion inside the Nasal and Maxillary Sinus. Ann Maxillofac Surg. 2020 Jan-Jun;10(1):114-121. DOI: 10.4103/ams.ams_42_20.

6 Ragucci GM, Elnayef B, Suárez-López Del Amo F, et al. Influence of exposing dental implants into the sinus cavity on survival and complications rate: A systematic review. Int J Implant Dent 2019;5(1):6. DOI: 10.1186/s40729-019-0157-7.

7 Sanz-Sánchez I, Sanz-Martín I, Ortiz-Vigón A, Molina A, Sanz M. Complications in bone-grafting procedures: Classification and management. Periodontol 2000. 2022 Feb;88(1):86-102. DOI: 10.1111/prd.12413.

8 Chiapasco M, Casentini P, Zaniboni M. Bone augmentation procedures in implant dentistry. Int J Oral Maxillofac Implants 2009;24 Suppl:237–259. PMID: 19885448.

9 Pałka ŁR, Lazarov A. Immediately loaded bicortical implants inserted in fresh extraction and healed sites in patients with and without a history of periodontal disease. Ann Maxillofac Surg 2019;9(2):371–378. DOI: 10.4103/ams.ams_147_19.

10 Lazarov A. A prospective cohort study of maxillary sinus complications in relation to treatments

with strategic implants® penetrating into the sinus. Ann Maxillofac Surg 2020;10(2):365–369. DOI: 10.4103/ams. ams_85_20.

11 Patel K, Madan S, Mehta D, et al. Basal implants: An asset for rehabilitation of atrophied resorbed maxillary and mandibular jaw - A prospective study. Ann Maxillofac Surg 2021;11(1):64–69. DOI: 10.4103/ams.ams_446_20.

12 Testori T, Clauser T, Saibene AM, Artzi Z,et al. Radiographic protrusion of dental implants in the maxillary sinus and nasal fossae: A multidisciplinary consensus utilising the modified Delphi method. Int J Oral Implantol (Berl). 2022 Sep 9;15(3):265-275. Erratum in: Int J Oral Implantol (Berl). 2022 Nov 15;15(4):371-373. PMID: 36082660.

13 Jung JH, Choi BH, Jeong SM, et al. A retrospective study of the effects on sinus complications of exposing dental implants to the maxillary sinus cavity. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007;103(5):623–625. DOI: 10.1016/j.tripleo.2006.09.024.

14 Abi Najm S, Malis D, El Hage M, et al. Potential adverse events of endosseous dental implants penetrating the maxillary sinus: Long- term clinical evaluation. Laryngoscope 2013;123(12):2958–2961. DOI: 10.1002/lary.24189.

15 Jung JH, Choi BH, Zhu SJ, et al. The effects of exposing dental implants to the maxillary sinus cavity on sinus complications. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2006;102(5):602–605. DOI: 10.1016/j.tripleo.2005.10.061.

16 Tabrizi R, Amid R, Taha Özkan B, et al. Effects of exposing dental implant to the maxillary sinus cavity. J Cranio 2012;23(3):767–769. DOI: 10.1097/SCS.0b013e31824dbd19.

17 Kim HY, Yang JY, Chung BY, et al. Peri-implant bone length changes and survival rates of implants penetrating the sinus membrane at the posterior maxilla in patients with limited vertical bone height. J Periodontal Implant Sci 2013;43(2):58–63. DOI: 10.5051/jpis.2013. 43.2.58.

18 Nocini R, Panozzo G, Trotolo A, Sacchetto L. Maxillary Sinusitis as a Complication of Zygomatic Implants Placement: A Narrative Review. Applied Sciences. 2022; 12(2):789. https://doi.org/10.3390/app12020789

19 Antonina I, Lazarov A, Gaur V, Lysenko V, Konstantinovic V, Grombkötö G, Palka L, Ihde S. Consensus Regarding 16 Recognized and Clinically Proven Methods and Sub-Methods for Placing Corticobasal® Oral Implants. Ann Maxillofac Surg. 2020 Jul-Dec;10(2):457-462. DOI: 10.4103/ams.ams_62_20.

20 7th Indications and treatment modalities with Corticobasal® implants. https://www.implant-foundation.org/en/consensus-papers/7th-indications-and-treatment-modalities-for-corticobasal-jaw-implants/version-2

21 Kämmerer PW, Fan S, Aparicio C, Bedrossian E, Davó R, Morton D, Raghoebar GM, Zarrine S, Al-Nawas B. Evaluation of surgical techniques in survival rate and complications of zygomatic implants for the rehabilitation of the atrophic eden-

tulous maxilla: a systematic review. Int J Implant Dent. 2023 May 17;9(1):11. DOI: 10.1186/s40729-023-00478-y.

22 Candel-Martí E, Carrillo-García C, Peñarrocha-Oltra D, Peñarrocha-Diago M. Rehabilitation of atrophic posterior maxilla with zygomatic implants: review. J Oral Implantol. 2012 Oct;38(5):653-7. DOI: 10.1563/AAID-JOI-D-10-00126.

23 Jin S, Ma H, Ling X, Tao B, Wang F, Wu Y. Longitudinal reactions of maxillary sinus in patients treated with multiple zygomatic implants: A modified radiographic evaluation with clinical follow-up. Clin Implant Dent Relat Res. 2023;25(6):1091-1102. DOI:10.1111/cid.13256

24 D'Agostino A, Lombardo G, Favero V, et al. Complications related to zygomatic implants placement: a retrospective evaluation with 5 years follow-up. J Craniomaxillofac Surg. 2021;49(7):620-627. DOI: 10.1016/j.jcms.2021.01.020

25 Davó R, Malevez C, López-Orellana C, Pastor-Beviá F, Rojas J. Sinus reactions to immediately loaded zygoma implants: a clinical and radiological study. Eur J Oral Implantol. 2008 Spring;1(1):53-60. PMID: 20467644.

26 Al-Nawas B, Aghaloo T, Aparicio C, Bedrossian E, et al. ITI consensus report on zygomatic implants: indications, evaluation of surgical techniques and long-term treatment outcomes. Int J Implant Dent. 2023 Sep 12;9(1):28. DOI: 10.1186/s40729-023-00489-9.

27 Nedir R, Nurdin N, Paris M, El Hage M, Abi Najm S, Bischof M. Unusual Etiology and Diagnosis of Oroantral Communication due to Late Implant Failure. Case Rep Dent. 2017;2017:2595036. DOI: 10.1155/2017/2595036.

28 Park WB, Kang KL, Han JY. Intraoral Approach for Sinus Graft Infection Following Lateral Sinus Floor Augmentation With Simultaneous Implant Placement: A Clinical Case Series. J Oral Implantol. 2020 Jun 1;46(3):253-262. DOI: 10.1563/aaid-joi-D-18-00296.

29 Chirilă L, Rotaru C, Filipov I, Săndulescu M. Management of acute maxillary sinusitis after sinus bone grafting procedures with simultaneous dental implants placement - a retrospective study. BMC Infect Dis. 2016 Mar 8;16 Suppl 1(Suppl 1):94. DOI: 10.1186/s12879-016-1398-1.

30 Schwartz-Arad D, Herzberg R, Dolev E. The prevalence of surgical complications of the sinus graft procedure and their impact on implant survival. J Periodontol. 2004 Apr;75(4):511-6. DOI: 10.1902/jop.2004.75.4.511.

31 Costa F, Emanuelli E, Robiony M, Zerman N, Polini F, Politi M. Endoscopic surgical treatment of chronic maxillary sinusitis of dental origin. J Oral Maxillofac Surg. 2007 Feb;65(2):223-8. DOI: 10.1016/j.joms.2005.11.109.

32 Hong SB, Kim JS, Shin SI, Han JY, Herr Y, Chung JH. Clinical treatment of postoperative infection following sinus augmentation. J Periodontal Implant Sci. 2010 Jun;40(3):144-9. doi: 10.5051/jpis.2010.40.3.144. Epub 2010 Jun 25. Erratum in: J

Periodontal Implant Sci. 2010 Aug;40(4):207. DOI: 10.5051/jpis.2010.40.4.207.

33 Chiapasco M, Felisati G, Zaniboni M, Pipolo C, Borloni R, Lozza P. The treatment of sinusitis following maxillary sinus grafting with the association of functional endoscopic sinus surgery (FESS) and an intra-oral approach. Clin Oral Implants Res. 2013 Jun;24(6):623-9. DOI: 10.1111/j.1600-0501.2012.02440.x.

34 Falco A, Amoroso C, Berardini M, D'Archivio L. A retrospective study of clinical and radiologic outcomes of 69 consecutive maxillary sinus augmentations associated with functional endoscopic sinus surgery. Int J Oral Maxillofac Implants. 2015 May-Jun;30(3):633-8. DOI: 10.11607/jomi.3757.

35 1st Consensus on Corticobasal® Implants, https://www.implantfoundation.org/en/consensus-papers/1st-consensus-on-corticobasal-implants/version-6.

36 Statement of the International Implant Foundation IF® Concerning Probing Around Basal Implants. https://www.implantfoundation.org/en/consensus-papers/2nd-consensus-on-probing-around-basal-implants/version-3.

37 Lazarov A. Soft-Tissue Augmentation in Periodontally Compromised Patients during Immediate Placement and Immediate Loading Dental Implant Surgery - A Retrospective Study. Ann Maxillofac Surg. 2023 Jan-Jun;13(1):37-43. DOI: 10.4103/ams.ams_207_22.