Extra-Sinus Zygomatic Implants to Avoid Chronic Sinusitis and Prosthetic Arch Malposition: 12 Years of Experience

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This report retrospectively at the 12-year follow-up results of the treatment and rehabilitation of edentulous maxillae, applying extra-sinus zygomatic implants alone or in combination with intra-sinus zygomatic implants. We recruited 22 patients with 35 zygomatic Brånemark system implants; 24 implants in the standard Brånemark protocol through the sinus and 11 extra-sinus implants outside the sinus. Additionally, 147 regular implants were placed. The minimum follow-up period was 50 months to a maximum of 152 months. The zygoma survival rate after 12 years was 97.15%. Chronic sinusitis occurred in 11.42% of patients. We lost 1 (2.85%) zygomatic implant placed through the sinus and none of those in the extra-sinus position. The survival rate of the regular implants was 93.87%. Chronic sinusitis occurred in 4 patients (11.42%) who received zygomatic implants using standard protocol through the sinus. None of the extra-sinus zygoma patients developed sinusitis. Peri-implantitis was detected with only 3 zygomatic implants. In the original P-I Brånemark zygoma protocol the implants were passing through the sinus, which resulted in chronic sinusitis in some patients and malposition of the prosthetic platform toward the palate. These complications can be avoided by the extra-sinus placement of zygoma implants as demonstrated in this study.

Key Words: zygomatic implants, maxillary sinus, chronic sinusitis, extra-sinus zygomatic implant, prosthetic rehabilitation

INTRODUCTION

The maxillary sinuses are even pneumatic spaces in the shape of a three-sided pyramid located on both sides of the jawbone. The maxillary sinuses drain into the nasal cavity through the "ostium"; its opening is located on the medial wall. The inner surface of the sinus is lined with mucoperiosteum with pseudostratified ciliated columnar epithelial cells.

In regard to the maxillary sinus, additional anatomical structures are noted, that is, a septa shape as an inverted gothic arch that may divide the sinus into two or more cavities, which cause impaired turbulent airflow and thickening of the sinus membrane.[1–3]

The sinus lift is a surgery that consists of preparing the bone to place endosseous implants in the oral cavity of patients with a low maxillary sinus. Sometimes, extensive bone atrophy and pathological changes in the mucous membrane of the maxillary sinus make the sinus lift surgery impossible. To rehabilitate this group of patients, zygoma implants were introduced. They are placed in the body of the zygomatic bone.

Oral rehabilitation of patients with extensive bone loss in the maxilla by the means of zygomatic implants bypassing the sinus (extra-sinus position) has not been well documented, although extra-sinus zygoma positioning has shown to reduce the rate of complications of chronic sinusitis and malposition of the upper prosthetic arch.[26–28]

In the original zygoma protocol by P-I Brånemark (Nobel Biocare AB, Gothenburg, Sweden), the implants were passing through the maxillary sinus to be anchored in the zygomatic bone. The prosthetic platform of the zygoma implant was located on the palatal side of the alveolar process,[5,6] compromising the position and mechanics of the upper prosthetic framework (Figure 1).

In our 12-year followup of zygomatic implants, we have encountered clinical challenges that we had to overcome. The most important were chronic sinusitis and malposition of the upper prosthetic arch. We started to use extra-sinus zygomatic implants and found them efficient in avoiding chronic sinusitis and malposition of the upper prosthetic arch.

The use of zygomatic implants shortened implant treatment time, and guided bone regeneration (GBR)[7,8] techniques were not necessary. Further modification of this technique was through the use 4 zygomatic implants in edentulous upper jaw, 2 on each side.[9] The disadvantage of this protocol was the offset of the prosthetic framework. To avoid this offset, we modified the protocol and placed implants toward the front to allow anchorage at the front of the maxilla.[10] In this protocol, we used 30-mm implants. The implant passed through the

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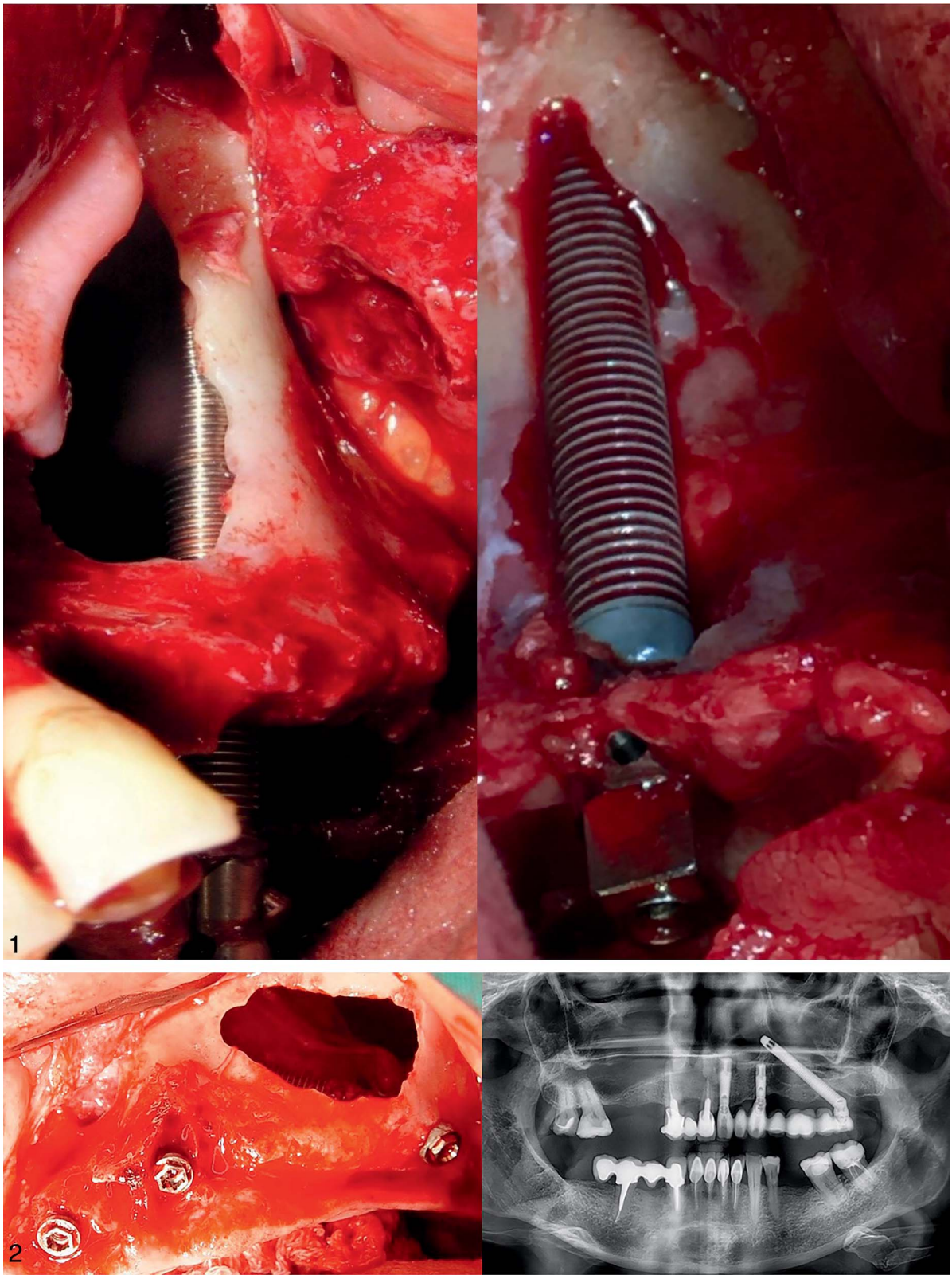
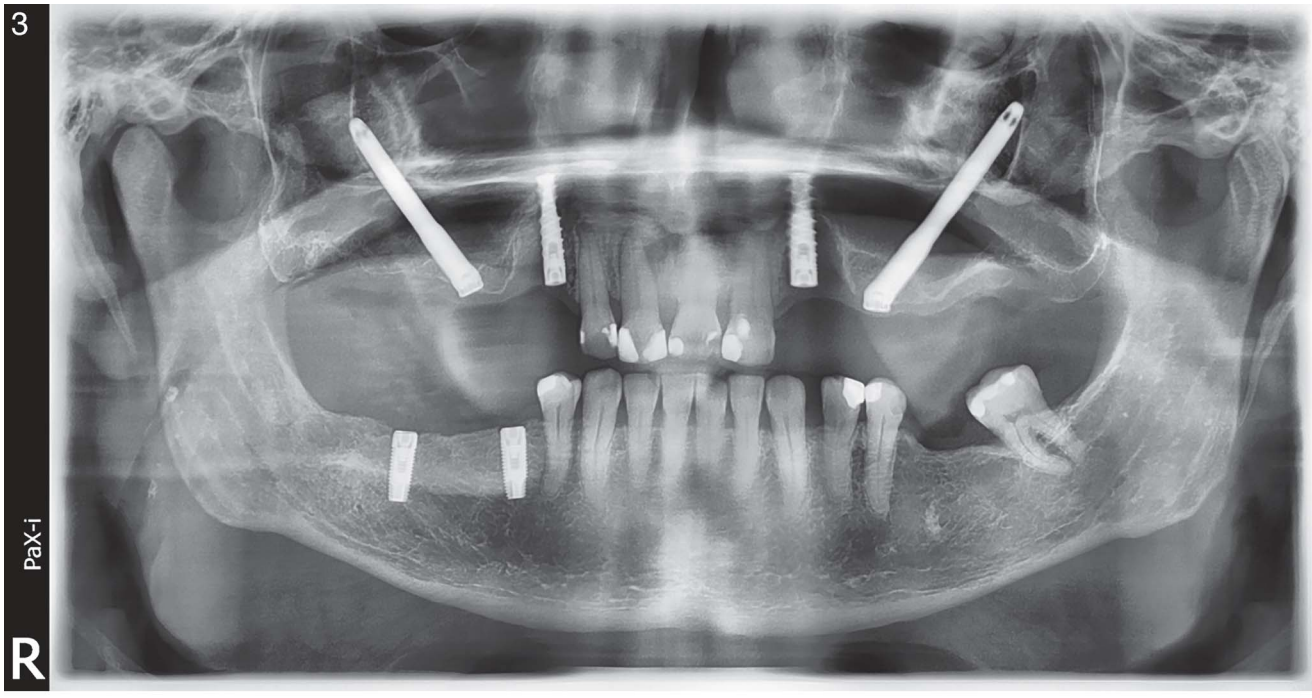
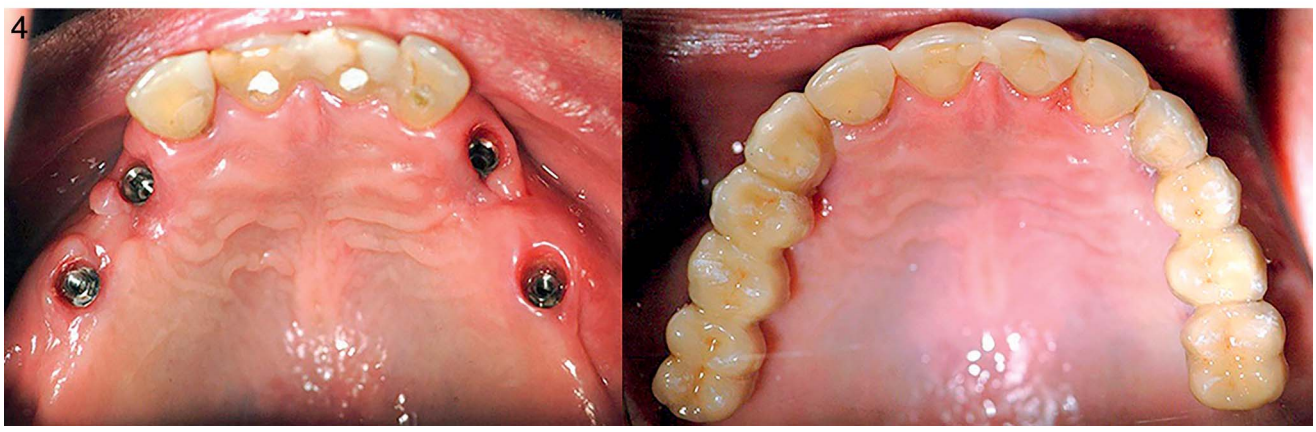


Figures 1 and 2. Figure 1. Intra-sinus and extra-sinus zygomatic implant. **Figure 2.** Implant in the frontal process, 11 years after.





Figures 3 and 4. Figure 3. Orthopantomogram patient with extra-sinus zygomatic implants. **Figure 4.** Extra-sinus zygoma implants and prosthetic bridges.

maxillary sinus with the implant shoulder (prosthetic platform) on the top of the alveolar process at the position of the second molar. Prosthetic framework on this type of implant configuration was normal and free of palatal deviation (Figure 2).

Additionally, to avoid penetrating the maxillary sinus, we used the third type of implant configuration: the zygomatic implant placed in the diaphysis of the zygomatic bone, shifted buccally to pass through the sinus wall or beyond. The implant shoulder is located at the top of the alveolar process at the height of the second premolar or first molar. In such cases, we used 40- or 45-mm long implants[11] (Figures 3 and 4).

Materials and Methods

The study involved 22 patients (11 women and 11 men) ages 33 to 69 years (average 50.4 years), treated at the Department of Periodontology of the Medical University of Lublin in 2004–2017. The mean age of the study group was 50.41 $\pm$ 9.29 years.

The patients in this study were generally healthy; 5 patients were smokers, 8 (36.36%) patients were totally edentulous, 14 (63.64%) patients had absent jaw, and 7 (31.82%) patients had a hip graft (Table 1).

Each patient had an orthopantomogram (OPG) and a cone beam computerized tomography (CBCT) scan and were examined by an otolaryngologist (Figure 5). All patients who underwent zygomatic implants procedures were a selected group previously disqualified for sinus lift procedures for laryngological reasons.[30] Patients were treated otolaryngologically before implantation or they had functional endoscopic sinus surgery (FESS). Additional regular implants were placed according to the treatment plan. All treatments were performed under general anesthesia.

Implants were uncovered and multi-unit abutments placed

Table 1

Patient characteristics

No.	Initials	Age on the Day of Implantation	Sex	Observation Time, Follow-Up Period From Implant Placement (mo)	1: Totally Edentulous 2: Lack in Jaw-Winger	Date of Surgery
1	JG	47	F	114	1	9/25/2007
2	WZ	54	M	53	2	10/6/2012
3	JO	45	F	68	1	7/9/2011
4	HK	55	F	68	1	11/21/2007
5	EFZ	51	F	152	2	7/21/2004
6	TJ	55	M	81	1	6/19/2010
7	AP	55	F	117	1	5/12/2007
8	AC	36	M	73	2	2/3/2011
9	RJ	55	M	142	2	5/31/2005
10	WH	45	F	109	2	2/27/2008
11	TK	49	F	116	1	7/27/2007
12	BO	36	F	114	2	9/29/2007
13	KK	41	M	50	1	1/26/2013
14	LM	56	M	92	2	7/17/2009
15	HS	64	M	55	2	8/11/2012
16	MB	41	M	62	1	1/7/2012
17	EBB	61	F	61	2	2/4/2012
18	MK	58	F	63	2	12/17/2011
19	BP	33	M	110	2	1/16/2008
20	WN	49	M	118	2	9/30/2008
21	MG	69	M	135	2	12/7/2005
22	EG	54	F	123	2	12/16/2006

after 6 to 8 months. All patients were provided with fixed titanium milled bridges with porcelain crowns.

In all cases, mandatory follow-up visits were carried out after 7, 15, 30, and 60 days, and after 3, 6, and 12 months. After this period, patients were asked to come for control visits at least once every 12 months.

In total, 35 zygomatic Brånemark system implants were placed: 24 (68.57%) in the standard Brånemark protocol through the sinus and 11 (31.43%) extra-sinus implants outside the sinus. Additionally, 147 regular implants were placed (Brånemark System, Straumann, Nobel Replace, SternGold, Basel, Switzerland). The minimum follow-up period was 50 months and the maximum period was 152 months.

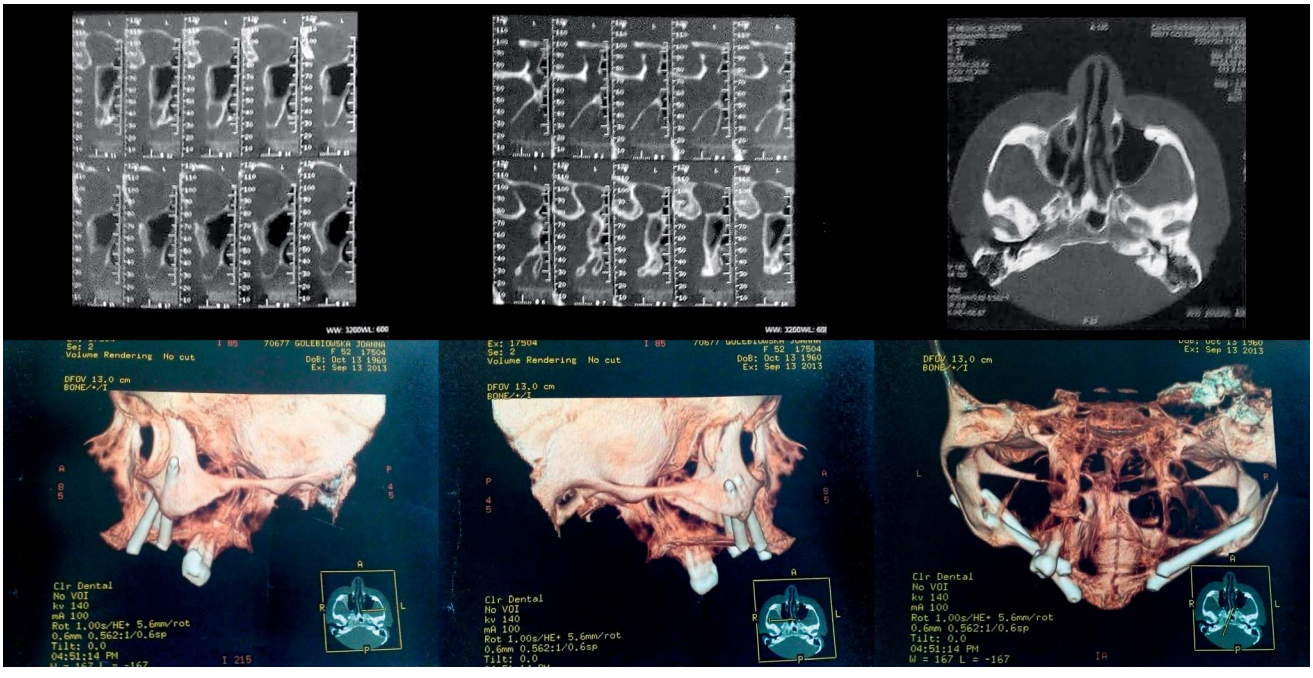


Figure 5. Pre- and post-zygoma procedure cone beam computerized tomography scans.

Table 2

Findings from studies of zygomatic implants

Study	Number of Patients	Number of Inserted Zygomatic Implants	Smokers	Survival Rate	Incidence of Sinus Infection
Brånemark et al[5]	28	56	Non-smokers	94.3%	4 (14.3%)
Aparicio et al[16]	20	36	12 smokers	100%	0
Becktor et al[18]	16	31	Not known	92.3%	6 (37.5%)
Zwahlen et al[17]	18	34	Not known	94.1%	1 (5.6%)
Bedrossian et al[13]	14	28	Not known	100%	0
Davo et al[12]	18	36	Not known	100%	1 (5.6%)
Penarrocha et al[14]	21	40	3 smokers	100%	2 (9.5%)

Results

The zygoma survival rate after 12 years was 97.15% (34 of 35 implants); 2.85% of the zygomatic implant placed through the sinus were lost. None of the zygomatic implants placed through the extra-sinus position were lost. The survival rate of the regular implants was 93.87%.

Chronic sinusitis occurred in 4 patients (11.42%) who received zygomatic implants in the standard protocol through the sinus. None of the extra-sinus zygoma patients developed either acute or chronic sinusitis.

Five of the patients (22.72%) who underwent surgery were smokers; however, the only rejection of the zygomatic implant occurred in a non-smoker. Peri-implantitis was detected with only 3 zygomatic implants. Twelve patients were supplied with 1 zygomatic implant, 8 patients received 2, 1 patient was treated with 3 implants, and 1 patient with 4 zygomatic implants. Of the 35 zygomatic implants, 40% were 45-mm long, 34% had a length of 30 mm, 17% were 35-mm long, and 9% were 40-mm implants.

Twenty implants (57.14%) were implanted at the top of the alveolar process, and 15 implants (42.86%) were implanted palatally. Twenty-four implants (68.57%) were implanted through the maxillary sinus, 11 implants (31.43%) were implanted in an extra-sinus position or in the front wall of the maxillary sinus. Nineteen (54.29%) implants were inserted into the zygomatic bone, and 16 (45.71%) implants were placed in the frontal process of the jaw. Chronic sinusitis occurred after implantation through the sinus of 4 zygomatic implants (11.42%).

None of the zygomatic implants positioned in the extra-sinus position were lost.

Discussion

Each type of sinus procedure presents a risk of complication, such as a damage to the alveolar antral artery resulting in hemorrhage, a perforation of the Schneider membrane, or an obstruction of the antral meatal ostium complex. Complications associated with a maxillary sinus lift can range from a possible obliteration of the maxillary sinus, hemoptysis, graft mobility, sinusitis induced by the biomaterials, formation of a cyst to overfilling necrosis, swelling, hematoma, wound dehiscence, or adjacent teeth sensitivity.[3,29]

The sinus lift procedure is a predictable procedure; however, the previously mentioned complications force surgeons to look for alternative methods, among which the procedure involving the use of zygomatic implants positioned outside of the sinuses remains an encouraging one.

Zygomatic implants are used to rehabilitate patients after oncological treatment, after injuries, congenital malformations,[19–21] and for oral rehabilitation of patients with severe loss of the alveolar bone in the maxilla.[22,23] Older studies used implants placed palatally through the maxillary sinus, while recent ones used anchorage in the anterior wall of the maxillary sinus, that is, the extra-sinus positioning.

The success rate of zygomatic implants in the literature is in the range of 92.3% to 100%.[12–14] In our study, the success rate was 97.4%. Our followup ranged from 18 months to 15 years.[15]

Current literature reports that the primary complication after zygomatic implants is chronic sinusitis, resulting in atrophy of the maxillary sinus. This may occur even a few years after implantation in up to 37.5% of patients.[5,12–14,16–18] These data have been confirmed in our study: Chronic nasal sinusitis occurred in 4 zygomatic implants (11.42%) in 4 (18.18%) patients (Table 2).

This study did not observe nasal sinusitis in extra-sinus implantation of zygomatic implants. Hirsch et al[25] argue that the rejection of the implant is not necessarily associated with a nasal sinusitis, which also corresponds to the results of this study. In addition, data from the literature and our own observations indicate that patients do not require augmentation procedures in the form of bone blocks and GBR,[18] which is consistent with the results of our study.

Literature and our own experience confirm that simultaneous implantation of zygomatic and conventional implants is beneficial for patients.[15,24]

Conclusion

The extra-sinus positioning of the zygomatic implants provides known benefits of the standard intra-sinus placement, minimizing the risk of sinusitis and avoiding prosthetic palatal offset. The extra-sinus placement provides the implants with greater bone-to-implant contact (BIC) and, therefore, increases implant stability and durability BIC ratio.

Abbreviations

BIC: bone-to-implant contact

CBCT: cone beam computerized tomography

FESS: functional endoscopic sinus surgery
GBR: guided bone regeneration
OPG: orthopantomogram

Note

The authors have no conflicts of interest, as this report has been self-funding.

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