

# ZYGOMATIC IMPLANT COMPLICATED WITH RECURRENT ORO-ANTRAL COMMUNICATION

**Cite this article:**  
Politis C, Vrielinck L, Dormaar T, Daems L, Legrand P, Nanhekhani L, Schoenaers J. Zygomatic implant complicated with recurrent oro-antral communication. *Stoma Edu J.* 2015;2(2):145-152.

[https://doi.org/10.25241/stomaeduj.2015.2\(2\).art.7](https://doi.org/10.25241/stomaeduj.2015.2(2).art.7)

Constantinus Politis <sup>1a\*</sup>  
Luc Vrielinck <sup>2b</sup>  
Titiaan Dormaar <sup>1c</sup>  
Luc Daems <sup>3d</sup>  
Paul Legrand <sup>4e</sup>  
Lloyd Nanhekhani <sup>5f</sup>  
Joseph Schoenaers <sup>1g</sup>

<sup>1</sup> Department of Oral and Maxillofacial Surgery, Leuven University Hospitals, Department of Imaging and Pathology, KU Leuven, Belgium

<sup>2</sup> Department of Oral and Maxillofacial Surgery, Ziekenhuis Oost Limburg, Genk, Belgium

<sup>3</sup> Department of Oral and Maxillofacial Surgery, ZNA Middelheim Antwerp, Belgium

<sup>4</sup> Department of Oral and Maxillofacial Surgery, Maria Ziekenhuis Overpelt, Belgium

<sup>5</sup> Department of Plastic and Reconstructive Surgery, Leuven University Hospitals, Belgium

<sup>a</sup> MD, DDS, PhD, Head

<sup>b</sup> MD, DDS, Head

<sup>c</sup> MD, DDS, Staff Member

<sup>d</sup> MD, DDS, Head

<sup>e</sup> MD, DDS, Head

<sup>f</sup> MD, Staff Member

<sup>g</sup> MD, DDS, Staff Member

## Abstract

**Aim:** Zygomatic implants are not without complications, but they can be contained with surgical techniques available in contemporary oral and maxillofacial surgery.

**Summary:** A 52 year old Caucasian male received 2 zygomatic implants and 2 screw form implants in the upper jaw with a bridge construction. Both the implants and the prosthetic solution were stable and fully functional. However the patient developed a large oro-antral communication along the left zygomatic implant. Several reconstructions with local flaps failed, only enlarging the defect with deterioration of speech and loss of fluids through the nose. An anterolateral thigh free flap transfer was used to cover the implant and to close the hemimaxillary defect. Healing was uneventful and no secondary measures or additional procedures were needed to retain the integrated implants and the well-functioning bridge at the one year follow-up.

**Key learning points:** Removal of a zygomatic implant can exceptionally be avoided with a free flap transfer to obliterate a soft and hard tissue defect around a well-integrated implant that is surrounded by an oro-antral communication and maxillary sinusitis. Infection of the transferred tissue is rare due to the perfect vascularization of a free flap. The anterolateral thigh flap is well suited for obliteration of large unilateral maxillary Brown-Shaw class II defects.

**Keywords:** zygomatic implant, complication, oro-antral communication, free flap, anterolateral thigh flap.

## CASE-REPORT

### Introduction

Zygomatic implants have been used as an alternative to bone grafts in the treatment of very atrophic maxillae or as a salvage solution after failed bone grafts in atrophic maxillae.<sup>1</sup> The surgical procedure to insert zygomatic implants is very demanding and is prone to a number of complications: perforation of the skin, perforation to the orbit, oro-antral communication, refractory maxillary sinusitis, persistent edema, lacerations of the lips, neuropathic pain, paresthesia, peri-implantitis, implant loss and implant fracture.<sup>2,3</sup> In the atrophic maxilla, zygomatic implants can cause maxillary sinusitis with or without oro-antral communication.<sup>4</sup> When repetitive surgical closure of such an oro-antral communication fails, the residual defect can resemble that of a partial maxillary resection.

In oncology, the choice of prosthetic reconstruction on dental implants after a maxillary resection is done either by zygomatic implants through a soft tissue free flap reconstruction<sup>5</sup> or by conventional implants in case of a free vascularized fibular graft.<sup>6</sup>

The clinical case we present is a case where a free soft tissue flap is used to cover a large oro-antral communication caused by zygomatic implants, without removing them.

### Clinical Case

In 2011 this patient was diagnosed with the impossibility to construct a new fixed prosthetic solution on the remaining 3 natural teeth in the upper jaw due to the deep periodontal pocket and pathological tooth mobility (Fig. 1). Subsequently all teeth were removed in the upper jaw and a temporary full prosthesis was manufactured. After a healing period of 3 months, the

Received: August 4, 2015  
Accepted: November 4, 2015

### \* Corresponding author:

Constantinus Politis  
MD, DDS, MM, MHA, PhD  
Professor & Chairperson Oral & Maxillofacial Surgery  
University Hospitals Leuven  
UZ Leuven, Campus Sint-Rafaël  
Kapucijnenvoer 33  
3000 Leuven, Belgium  
Tel: +32 16 3 32462  
Fax: +32 16 3 32437  
e-mail: constantinus.politis@uzleuven.be



**Figure 1.** Panoramic radiograph at the initial presentation of the patient



**Figure 2.** Panoramic radiograph immediately after implant placement; an all-on-four construction existing of two zygomatic implants and two parasasal implants is supporting a temporary bridge in the upper jaw

patient received 2 standard Nobel Biocare Nobel Groovy RP implants of 13 mm and 2 zygomatic Nobel Biocare implants of 47,5 mm each.

The 2 standard implants were placed in the left and right parasasal area and the two zygomatic implants were placed in the left and right zygomatic buttress (Fig. 2).

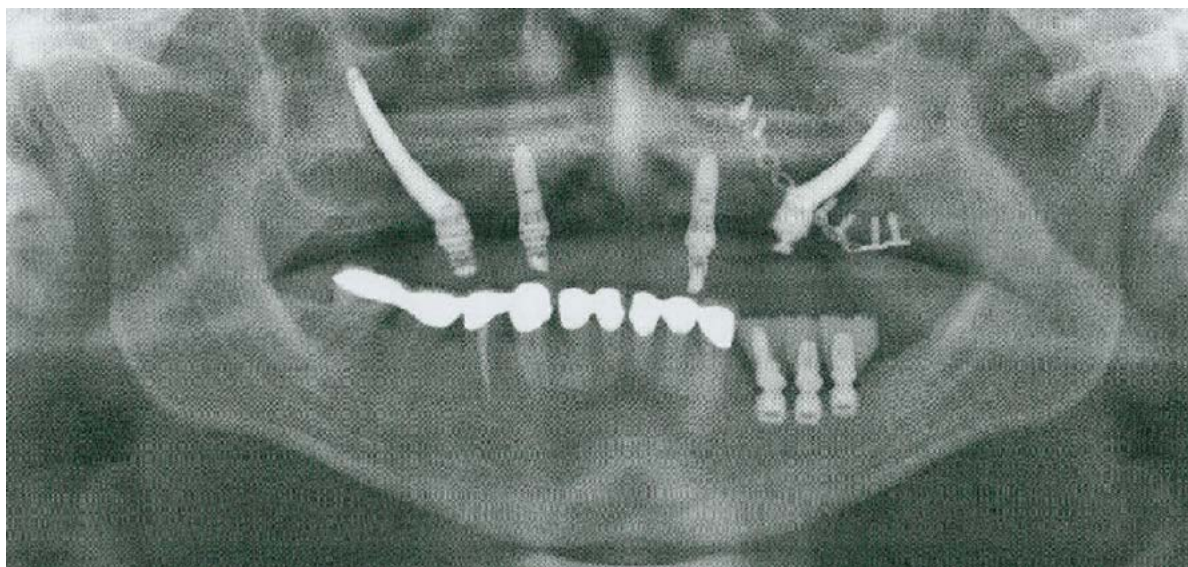
In the lower jaw three BICON short 5 x 5 mm implants were placed with a 3 mm internal well.

The zygomatic implants were placed according to Stella's technique<sup>7</sup> using a channel through which the implant installation was guided into the maxillary sinus and further vertically into

the zygomatic buttress. The zygomatic implants emerged closely to the crest of the alveolar ridge. A temporary bridge was used to splint the implants. After 12 months a final bridge restoration was accomplished.

All implants integrated well, but the patient continued to complain about the left zygomatic implant. The complaints consisted of mucosal inflammation adjacent to the abutments, chronic discharge around the implant with bad taste.

In 2014, 15 months after placement of the implants the zygomatic implant at the left zygomatic buttress was removed and the oro-antral communication



**Figure 3.** Panoramic radiograph; after earlier loss of the left zygomatic implant and recurrence of the oroantral communication the surgical procedure consisted of a reconstruction of the posterior maxilla with a bone graft of the right iliac crest, a new zygomatic implant and soft tissue closure; the bone graft is stabilized with one osteosynthesis plate



**Figure 4.** Preoperative panoramic radiograph; around the left zygomatic implant the entire alveolar crest together with the bonegraft and whatever has been left of the bony sinus wall has vanished; the only bone supporting the implant is the zygomatic buttress

was closed with a local flap. This resolved the complaints of the patient.

Three months later a new surgical procedure was performed consisting of the placement of a bone graft from the right anterior iliac crest to reconstruct the distal maxilla at the left side, the placement of a new zygomatic implant and tight soft tissue closure. The bone graft was stabilized with an osteosynthesis plate (Fig. 3).

Due to recurring infections, eight weeks later the bone graft was removed including the osteosynthesis material and the new oro-antral

communication was closed with a mobilized buccal fat pad.

Due to unfavorable healing with recurrence of the oro-antral communication four weeks later a new attempt to close the fistula in presence of the zygomatic implant was performed, this time utilizing a palatal rotation flap.

This did not resolve the problem. A large soft tissue and bony defect remained around the well-integrated zygomatic implant at the left side.

Meanwhile a new bridge incorporating the new zygomatic implant was constructed to replace the



**Figure 5.** Preoperative intraoral view illustrating the important loss of hard and soft tissues around the left zygomatic implant



**Figure 6.** Intraoperative view; threads of the left zygomatic implant are covered with calculus; the implant is integrated in spite of loss of bony coverage well over 75% of its surface



**Figure 7.** Postoperative view, healing abutments in situ, bulky anterolateral thigh flap



**Figure 8.** 6 months postoperative, palatal view

previous one. This bridge was well functioning allowing the restoration of the chewing ability of the patient. Due to the large soft tissue and bony defect around the left zygomatic implant the patient complained about malodor, bad taste, fluid discharge from the nose when drinking and a severe distortion of speech causing work incapacity.

The patient was then referred to a tertiary center. The panoramic radiograph (Fig. 4) shows an absence of bone all around the zygomatic implant up to the entrance into the zygomatic buttress. The clinical exam confirmed a large soft tissue and bony defect around the zygomatic implant, which clinically was well integrated clinically upon testing for mobility (Fig. 5).

An initial proposition to remove the left zygomatic implant and to close the gap by a free vascularized flap was rejected by the patient due to his satisfaction with the existing prosthetic result. A mere prosthetic solution with an obturator was deemed impossible to solve the complaints. With the patient's informed consent the decision was taken to restore the defect with a free vascularized

flap without removing the implant. Four months after the palatal rotation flap, a procedure under general anesthesia was undertaken.

The procedure consisted of removal of the bridge and placing healing abutments, local debridement and cleaning of the maxillary sinus, cleaning of the zygomatic implant with acid gel (the one to etch teeth before placing brackets) which was covered with tartar and plaque (Fig. 6) and reconstruction with a free vascularized anterolateral thigh flap of 6 x 5 cm. Intraoperatively, the implant was found to be integrated in spite of loss of bony coverage well over 75% of its surface. The anterolateral thigh flap composed of skin, fat and fascia was anastomosed to the superior thyroid artery and vein. Healing was uneventful and one week postoperatively the bridge was reinstalled on the existing implants of the upper jaw, allowing the patient to chew. The surface of the implant was cleaned with an ultrasonic device and etched for 180 seconds with a 38% phosphoric acid gel and cleaned with saline. The main postoperative complaint was the feeling of a lump and swelling in the upper jaw (Fig. 7). At the one year follow-up all complaints had



**Figure 9.** 6 months postoperative, frontal view



**Figure 10.** 6 months postoperative, facial frontal view

disappeared. Initially a further surgical thinning of the flap was planned, but due to the favorable development, this was abandoned. The flap got thinner with tight fitting skin around the implant. The patient is satisfied with the result (Fig.8, Fig. 9, Fig. 10) and is able to keep the region clean. He was discharged from surgical follow-up and referred to his dentist for the prosthetic and implant follow-up.

### Discussion

In recent systematic reviews of survival and complications of zygomatic implants, both Chrcanovic and Goiato e.a. find a cumulative survival rate of 96,7% after 36 months.<sup>3,8</sup> Postoperative complications include maxillary sinusitis, soft tissue infections, paresthesia and oro-nasal fistulas.<sup>3</sup> Maxillary sinusitis is the most common complication, ranging from 1.5% to 18.42%.<sup>9</sup> Maxillary sinusitis, both acute and chronic, are the main reasons of failure of zygomatic implants.<sup>10</sup> Removal of the zygomatic implants from the infected area is often performed, if antibiotics cannot resolve the infection, arguing that the implants act as a foreign body and maintain the infection. Other reasons why zygomatic implants can cause maxillary sinusitis are given by Davó<sup>11</sup>: the invasiveness of the surgery to the sinus, the persistence of an oro-nasal communication, mainly in absence or loss of the thin palatal bony wall. Resorption of the thin palatal boneplate that covers the zygomatic implant leads to oro-antral fistula followed by implant loss.<sup>12</sup>

Bedrossian reported on three patients with zygomatic implants and persistent sinus infections refractory to oral antibiotic treatments, in which a Functional Endoscopic Sinus Surgery (FESS) procedure completely resolved the sinus infections without removal of the zygomatic implants.<sup>13</sup> De Moraes reported on the successful use of the buccal fat pad technique to resolve an oro-antral communication;<sup>14</sup> this procedure however was reported concomitant with the placement of zygomatic implants and did not resolve an oro-antral communication secondary to an infectious process. Peñarocha-Oltra (2015) reported on the successful use of the buccal fat pad to close an oro-antral communication with an accompanying maxillary sinusitis in one patient. Their procedure involved the removal of the zygomatic implant.<sup>15</sup>

The reported follow-up period was 6 months. Stella and Warner advocated the sinus slot technique in 2000<sup>7</sup> as an alternative to the original technique introduced by Bränemark in 1998.<sup>16</sup> In both techniques the sinus is penetrated. Bränemark explicitly states : "The sinus mucosa was then reflected and no special effort was made to keep it intact" (Bränemark e.a., 2004).<sup>16</sup> The third alternative is the exteriorized technique avoiding passage through the maxillary sinus.<sup>17,18</sup> Chrcanovic e.a.(2013) compared the three surgical techniques and concluded that neither claimed to cause sinusitis.<sup>19</sup>

Adverse complications as for example an oro-antral communication secondary to surgical treatments with zygomatic implants however do occur. Visscher e.a., in a review of the literature concluded that surgical closure of oro-antral communications by a buccal or palatal flap therefore remain the treatment of choice.<sup>20</sup> Even in the absence of dental implants, the recurrence rate after surgical closure of oro-antral communications is high at about 10%.<sup>21</sup> The risk of recurrence is 15 times higher with maxillary sinusitis at follow-up. After two failed surgical attempts to close the oro-antral communication, once with removal of the zygomatic implant and once without removal of the newly placed zygomatic implant, the resulting defect involved the substantial loss of both hard and soft tissues, corresponding to defect of class II b according to Brown and Shaw.<sup>22</sup> Due to the presence of the zygomatic implant, neither a pedicled flap nor a hard-tissue or composite free flap were favored. The most commonly used soft-tissue free flaps in Brown-Shaw Class II maxillary defects are the radial forearm flap, the anterolateral thigh flap, the rectus abdominis free flap and the latissimus dorsi flap.<sup>22</sup> The preference of the reconstructive surgeon (L.N.) to use the anterolateral thigh flap in this indication was due to the versatility of this flap, pliable enough to be folded, tubed, or packed into the maxillary cavity around the implant. An additional advantage of the anterolateral thigh flap over the radial forearm flap is the reduced donor site morbidity. The anterolateral thigh flap can be harvested as thin as the radial forearm flap.<sup>23</sup> The advantage of a free flap as compared to a local flap is that it brings along its own vascularity, not depending on the nutrition of inflamed, scarred or malnourished surrounding

tissues, nor being negatively influenced by it. The main disadvantage of the anterolateral thigh flap in males is the hair growth on the flap.<sup>24</sup>

When zygomatic implants and free flaps are considered to close a maxillary defect, three timing options exist for placement of the zygomatic implants: after, simultaneous or before the free flap reconstruction.<sup>5</sup>

Placement of implants before soft tissue closure is the least favorable scenario since the zygoma implant could trouble the soft tissue reconstruction with a persistent oroantral communication around the implant.<sup>5</sup>

In routine dental implants the biological seal around the implant is identified as a determining factor of the long-term success of the peri-implant health.<sup>25</sup> This case-report seems to indicate that in zygomatic implants, even when the implant surface has been soiled with calculus, the application of a free vascularized flap allows for a clinically sufficient seal provided the adequate cleaning of the skin around the implant.

A question to be raised is whether the initial planning could have favored the placement of short implants.

The old assumption that it is contraindicated to place short implants into atrophic posterior maxillae has been recently challenged by excellent results.<sup>26, 27</sup> The necessity to apply a free vascularized flap to close a defect after

recurrent failures to surgically resolve an oro-antral communication around zygomatic implants has been well perceived by this patient. The advantage to be able to preserve a well-functioning prosthetic solution and to preserve well integrated implants certainly outweigh the surgical morbidity and work incapacity of a free flap surgery.

This choice could be a solution in rare instances where the gold standard of removing zygomatic implants in an infected area, even if well integrated, is not achievable for some reason.

## Conclusion

Adverse complications do occur in zygomatic implant surgery.

One of these is a recurrent oro-antral communication leading to a large soft tissue and bony defect around a well-integrated zygomatic implant with a most satisfactory prosthetic solution but with severe complaints of malodor, bad taste, loss of fluids through the nose.

Local debridement, surface treatment of the zygomatic implant and an anterolateral thigh free flap were able to resolve these issues completely, retaining the full advantage of the existing and well-functioning prosthetic solution.

## Permission

Written permission of the patient is obtained to disclose all data and images in this manuscript.

## Bibliography

1. Ali SA, Karthigeyan S, Deivanai M, Kumar A. Implant rehabilitation for atrophic maxilla: a review. *J Indian Prosthodont Soc.* 2014;14(3):196-207. Review.
2. Block MS, Haggerty CJ, Fisher GR. Nongrafting implant options for restoration of the edentulous maxilla. *J Oral Maxillofac Surg.* 2009;67(4):872-881.
3. Chrcanovic BR, Abreu MH. Survival and complications of zygomatic implants: a systematic review. *Oral Maxillofac Surg.* 2013;17(2):81-93.
4. Maló P, Nobre Md, Lopes A, Francischone C, Rigolizzo M. Three-year outcome of a retrospective cohort study on the rehabilitation of completely edentulous atrophic maxillae with immediately loaded extra-maxillary zygomatic implants. *Eur J Oral Implantol.* 2012;5(1):37-46.
5. Vega LG, Gielincki W, Fernandes RP. Zygoma implant reconstruction of acquired maxillary bony defects. *Oral Maxillofac Surg Clin North Am.* 2013;25(2):223-239.
6. Chang YM, Coskunfirat OK, Wei FC, Tsai CY, Lin HN. Maxillary reconstruction with a fibula osteoseptocutaneous free flap and simultaneous insertion of osseointegrated dental implants. *Plast Reconstr Surg.* 2004;113(4):1140-1145.
7. Stella JP, Warner MR. Sinus slot technique for simplification and improved orientation of zygomatic dental implants: a technical note. *Int J Oral Maxillofac Implants.* 2000;15(6):889-893.
8. Goiato MC, Pellizzer EP, Moreno A, Gennari-Filho H, dos Santos DM, Santiago JF Jr, dos Santos EG. Implants in the zygomatic bone for maxillary prosthetic rehabilitation: a systematic review. *Int J Oral Maxillofac Surg.* 2014;43(6):748-757.
9. 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;38(5):653-657.
10. Yates JM, Brook IM, Patel RR, Wragg PF, Atkins SA, El-Awa A, Bakri I, Bolt R. Treatment of the edentulous atrophic maxilla using zygomatic implants: evaluation of survival rates over 5-10 years. *Int J Oral Maxillofac Surg.* 2014;43(2):237-42.
11. Davó R, Malevez C, López-Orellana C, Pastor-Bevía F, Rojas J. Sinus reactions to immediately loaded zygoma implants: a clinical and radiological study. *Eur J Oral Implantol* 2008;1(1):53-60.
12. Al-Nawas B, Wegener J, Bender C, Wagner W. Critical soft tissue parameters of the zygomatic implant. *J Clin Periodontol.* 2004;31(7):497-500.

13. Bedrossian E. Rehabilitation of the edentulous maxilla with the zygoma concept: a 7-year prospective study. *Int J Oral Maxillofac Implants.* 2010;25(6):1213-1221.
14. de Moraes EJ. The buccal fat pad flap: an option to prevent and treat complications regarding complex zygomatic implant surgery. Preliminary report. *Int J Oral Maxillofac Implants.* 2012;27(4):905-910.
15. Peñarrocha-Oltra D, Alonso-González R, Pellicer-Chover H, Aloy-Prósper A, Peñarrocha-Diago M. Closure of oroantral communication with buccal fat pad after removing bilateral failed zygomatic implants: A case report and 6-month follow-up. *J Clin Exp Dent.* 2015;7(1):e159-62.
16. Brånemark PI, Gröndahl K, Öhrnell LO, Nilsson P, Petruson B, Svensson B, Engstrand P, Nannmark U. Zygoma fixture in the management of advanced atrophy of the maxilla: technique and long-term results. *Scand J Plast Reconstr Surg Hand Surg.* 2004;38(2):70-85.
17. Maló P, Nobre Mde A, Lopes I. A new approach to rehabilitate the severely atrophic maxilla using extramaxillary anchored implants in immediate function: a pilot study. *J Prosthet Dent.* 2008;100(5):354-366.
18. Cordero EB, Benfatti CA, Bianchini MA, Bez LV, Stanley K, de Souza Magini R. The use of zygomatic implants for the rehabilitation of atrophic maxillas with 2 different techniques: Stella and Extrasinus. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2011;112(6):e49-53.
19. Chrcanovic BR, Pedrosa AR, Neto Custódio AL. Zygomatic implants: a critical review of the surgical techniques. *Oral Maxillofac Surg.* 2013;17(1):1-9.
20. Visscher SH, van Minnen B, Bos RR. Closure of oroantral communications: a review of the literature. *J Oral Maxillofac Surg.* 2010;68(6):1384-1391.
21. Visscher SH, van Roon MR, Sluiter WJ, van Minnen B, Bos RR. Retrospective study on the treatment outcome of surgical closure of oroantral communications. *J Oral Maxillofac Surg.* 2011;69(12):2956-2961.
22. Brown JS, Shaw RJ. Reconstruction of the maxilla and midface: introducing a new classification. *Lancet Oncol.* 2010;11(10):1001-1008.
23. Chana JS, Wei FC. A review of the advantages of the anterolateral thigh flap in head and neck reconstruction. *Br J Plast Surg.* 2004;57(7):603-609.
24. Ali RS, Bluebond-Langner R, Rodriguez ED, Cheng MH. The versatility of the anterolateral thigh flap. *Plast Reconstr Surg.* 2009;124(6 Suppl):e395-407.
25. Chai WL, Brook IM, Palmquist A, van Noort R, Moharamzadeh K. The biological seal of the implant-soft tissue interface evaluated in a tissue-engineered oral mucosal model. *J R Soc Interface.* 2012;9(77):3528-3538.
26. Esposito M, Pistilli R, Barausse C, Felice P. Three-year results from a randomised controlled trial comparing prostheses supported by 5-mm long implants or by longer implants in augmented bone in posterior atrophic edentulous jaws. *Eur J Oral Implantol.* 2014;7(4):383-395.
27. Lombardo G, Corrocher G, Pighi J, Faccioni F, Rovera A, Marincola M, Nocini PF. The impact of subcrestal placement on short locking-taper implants placed in posterior maxilla and mandible: a retrospective evaluation on hard and soft tissues stability after 2 years of loading. *Minerva Stomatol.* 2014;63(11-12):391-402.

**Constantinus Politis**

MD, DDS, PhD, Head  
Department of Oral and Maxillofacial Surgery, Leuven University Hospitals,  
Department of Imaging and Pathology, KULeuven, Belgium



**CV**

Dr. Constantinus Politis is Oral and Maxillo-Facial Surgeon. He is currently Professor and Chairperson of the Department of Oral and Maxillofacial Surgery at Leuven University, KULeuven, Belgium. He is invited Lecturer at the EHSAL in Brussels. He graduated at the Catholic University of Leuven in medicine (MD, summa cum laude), in dentistry (DDS, magna cum laude).

He specialized in oral and maxillofacial surgery at the Catholic University of Leuven. Postgraduate training was additionally followed in Arnhem (Stoelinga), Aachen (Koberg), Copenhagen (Pindborg), Göteborg (Bränemark) and San Francisco (Marx). He also holds a master degree in management (MM) from the Applied Economic Sciences at the University of Hasselt and a master degree in Hospital Management (MHM) from the Catholic University of Leuven. He became a recognition as medical specialist in management of health care data and is now member of the National Council of Hospital Facilities. He is Secretary General of the Professional Union of Belgian Oral and Maxillofacial Surgeons. He is acknowledged trainer of OMFS trainees. He defended his doctor's thesis on the subject of complications of orthognathic surgery (PhD).

His professional field of interest is in orthognathic and orthodontic surgery and trigeminal nerve dysfunction. Clinical research projects include prevention and repair of iatrogenic trigeminal nerve injury; transplantation of teeth and orthognathic surgery.

**Questions**

**Which of following is not a complication of zygomatic implants?**

- a. Implant fracture;
- b. Blindness;
- c. Oro-antral communication;
- d. Perforation of the skin.

**Stella's technique of zygomatic implant insertion requires:**

- a. A sinus slot approach;
- b. A sinus lift preceding implant placement;
- c. A drilling guide;
- d. An extrasinus approach.

**The most frequent zygomatic implant lengths are between:**

- a. 20 - 30 mm;
- b. 30 - 40 mm;
- c. 40 - 50 mm;
- d. 50 - 60 mm.

**The zygomatic implant techniques advocated by Branemark, Stella, Maló result in surrounding bone contact to following part of the total zygomatic implant length:**

- a. More than 50%;
- b. More than 75%;
- c. Approximately one third;
- d. Less than 25%.