# 12 The Delphi Consensus for Prostheses Anchored on Zygomatic Implants

## Appendix

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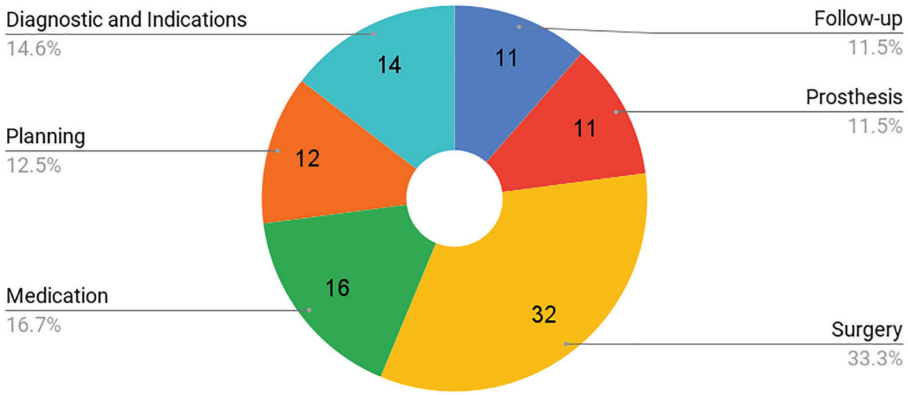
Zygomatic implants are a reliable and predictable solution for treating severe maxillary atrophy.[1] Different surgical approaches with excellent cumulative success rates regarding long-term implant survival have been described in the literature.[2,3] It is noteworthy, however, that these same publications report varying results regarding complications associated with the technique. Multiple techniques and systems for planning, complication prevention, and performing follow-ups with patients have also been extensively researched.[4,5] Zygomatic implant rehabilitation is performed in steps according to different protocols identified in the literature. Currently, there is a trend toward determining and agreeing upon standard decision-making protocols for different aspects of treatment, such as determining the optimized path of the zygomatic implant to prevent complications.[6,7] However, a consensus protocol that includes complete guidance on rehabilitation with zygomatic implants, from indications to long-term follow-up, has not yet been published. A harmonized protocol is the first step to proceeding with incremental changes and progress in this discipline.




**APP FIG 12-1** Distribution of questions during Round 1 and 2.

The Delphi method is a consensus process and structured communication framework based on the results of multiple questionnaires sent to a panel of experts. The process is completely anonymous to prevent bias. This process is used to identify existing areas of agreement between experts and to foster discussion surrounding topics where consensus is not reached. It helps identify and explore new areas of knowledge. Delphi processes have been used in dentistry before to cover topics such as treating dental patients with disabilities,[8] evaluating adult oral health,[9] assessing risk in implant treatment planning,[10] the impact of COVID on the dental sector,[11] clinical imaging guidelines,[12] checklists for dental implant placement,[13] and evaluating trends in the field of implant dentistry.[14]

The network of ZAGA Centers, composed of more than 60 professionals who regularly rehabilitate patients with zygomatic implants, was selected to perform a modified Delphi process focusing on the complete zygomatic implant protocol for patients with severe maxillary atrophy.

The objectives of this process included the following:

1. Reach as much of a consensus as possible for each step of treatment, from indications to follow-up.
2. Use discrepancies found between techniques as the bases for future discussions on those issues to lead to rational consensus.
3. Share the outcome of the process as the first comprehensive protocol for zygomatic implant therapy to serve as a basis for practitioners beginning to use this treatment option.
4. Use the results of the Delphi process in a controlled way to serve as the basis for further research.

## Modified Delphi survey process

The outcome of the modified Delphi process is a consensus on a protocol for performing zygomatic implant rehabilitation, from indications to long-term follow-up. Six separate sections of the report were defined: *(1)* Diagnostics and Indications, *(2)* Planning, *(3)* Medication, *(4)* Surgery, *(5)* Prosthesis, and *(6)* Follow-up (App Fig 12-1). The first round of 17 open-ended questions distributed among the 6 sections was shared with 48 participants, all experts in zygomatic implant rehabilitations and part of the ZAGA Centers network (App Tables 12-1 and 12-2). The answers were gathered in text, voice, or video format over a period of 4 weeks. Responses from the first round were analyzed, and follow-up questions were generated. A second round of 79 close-ended questions was generated to dive deeper into the answers provided during the first round and identify existing consensus (App Table 12-3).

VideoAsk (Typeform) was used to capture responses to the first round, and Google Forms was used to gather answers to the second round. The modified Delphi survey was completely anonymous. The overall level of agreement was assessed based on a predetermined set of criteria:

- *Consensus* means that more than 70% of the participants agree on a joint answer.
- *Option Consensus* means that two answers were identified, with more than 30% of participants supporting each. This situation may occur when regional or legal limitations exist.
- *No Consensus* means that less than 70% of the participants agree on a joint answer.

**APP TABLE 12-1 >> List of experts**

| Name | Country | Name *(cont.)* | Country *(cont.)* |
|---|---|---|---|
| Dr Ken Anderson | United States of America | Dr Manuel Martín Luque | Spain |
| Dr Masami Ando | Japan | Dr Miljan Micunovic | Montenegro |
| Dr Leonard Anglis | United States of America | Dr Amit Mistry | United Kingdom |
| Dr Carlos Aparicio | Spain | Dr Miguel Moura Goncalves | Portugal |
| Dr Arturo Bilbao | Spain | Dr Jay Neugarten | United States of America |
| Dr Corradu Cazacu | Romania | Dr Eduardo Nicolaeivsky | United States of America |
| Dr Antoine Chehade | Canada | Dr Costa Nicolopoulos | EAU / Greece |
| Dr James Chow | Hong Kong | Dr Antonio Olivo | Italy |
| Dr Eduardo Crooke | Spain | Prof Miguel Peñarrocha | Spain |
| Dr Lesley David | Canada | Dr Michael Pikos | United States of America |
| Dr Rubén Davó | Spain | Dr Waldemar Polido | United States of America |
| Dr Eduardo Jose de Moraes | Brazil | Dr Johnson Raja James | India |
| Dr Victor de Paz | Spain | Dr André Sakima | Brazil |
| Dr Ludovic Denglos | France | Dr Marc Shenouda | Canada |
| Dr Sergio Duarte | Portugal | Dr Aleksandr Shevela | Russia |
| Dr Juan Alberto Fernandez | Spain | Dr Hessam Siavash | Egypt |
| Dr José Ferreira | Portugal | Dr Madalina Simon | Germany |
| Dr Wieslaw Frankowski | Poland | Dr Peter Simon | Germany |
| Dr Reed Gibbins | United States of America | Dr Johann Styger | United Kingdom |
| Dr Pedro Guitián | Spain | Dr Leslie Sultan | United States of America |
| Dr Daniel Kraus | Germany | Dr Cemal Ucer | United Kingdom |
| Dr Samintharaj Kumar | Singapore | Dr Petros Yuvanoglu | EAU / Greece |
| Dr Roberto López Piríz | Spain | Dr Hooman Zarrinkelk | United States of America |
| Dr Adi Lorean | Israel | Dr Sergey Zhzhonov | Estonia |
| Prof Chantal Malevez | Belgium | | |

**APP TABLE 12-2 >> List of open-ended questions from the first round**

| Section | Round 1 questions |
|---|---|
| Diagnostics and Indications | In which anatomical situations do you select zygomatic implants as the best option? |
| Diagnostics and Indications | How does ENT evaluation affect your planning? |
| Diagnostics and Indications | How does terminal dentition affect your planning? |
| Planning | What is your planning protocol to determine the position of the zygomatic implant critical zone? |
| Planning | What is your planning protocol to determine the entrance point in the zygoma? |
| Medication | What do you prescribe pre-surgery? |
| Medication | What do you prescribe post-surgery? |
| Surgery | Anesthesia: What is your protocol? |
| Surgery | What are your soft tissue considerations when opening the flap? |
| Surgery | How do you perform the osteotomy(ies)? |
| Surgery | How do you choose the implant design? |
| Surgery | How do you choose the implant length? |
| Surgery | How do you prevent intraoperative complications? |
| Surgery | How do you prevent late complications? |
| Prosthesis | What are the key parameters a provisional immediate prosthesis should meet? |
| Prosthesis | What are the key parameters a final prosthesis should meet? |
| Follow-up | How do you follow up with your patients? |

**APP TABLE 12-3 >> List of close-ended questions from the second round**

| Diagnostics and Indications |
|---|
| What is the limit dimension of the anterior crest (zone 1 between canines) to switch to zygomatic implants? (in mm) |
| What is the limit dimension of the posterior crest (zone 2 premolars & 3 molars) to switch to zygomatic implants? (in mm) |
| What is the limit width of the ridge to switch to zygomatic implants? (in mm) |

*(continues) >>*

**APP TABLE 12-3 *cont.*** >> **List of close-ended questions from the second round**

| Diagnostics and Indications |
|---|
| In cases of bone height lower than 4 mm in zones 2 & 3 and enough anterior bone for placement of 2–4 implants in zone 1 (between canines), what would be your preferred treatment option?<br>• Sinus grafting in all cases<br>• Sinus grafting in patients below 40 ys old<br>• Sinus grafting in patients below 50 ys old<br>• Anterior implants plus zygomatic implants on the posterior in all cases<br>• I let the patient choose<br>• Other |
| In a patient without lower teeth and zygomatic implant indication, you identify some bone at the pterygoid region. Would you place a pterygoid implant?<br>• Always, in addition to the zygomatic implant<br>• Depending on posterior zygomatic implant stability<br>• Yes, instead of a zygomatic implant<br>• Never<br>• Other |
| In a patient with a maintained lowered dentition and zygomatic implant indication, you identify some bone at the pterygoid region. Would you place a pterygoid implant?<br>• Always, in addition to the zygomatic implant<br>• Depending on posterior zygomatic implant stability<br>• Yes, instead of a zygomatic implant<br>• Never<br>• Other |
| For which reasons do you refer the patient to an ENT Specialist before the zygomatic surgery?<br>• Always<br>• Pathology observed in the CT scan<br>• Anatomical abnormality observed<br>• History of sinusitis<br>• Clinical symptoms of acute rhinosinusitis<br>• No ostium patency<br>• Other |
| Do you record the sinus statuses before and after the surgery?<br>• Always<br>• Most of the time<br>• Sometimes<br>• Rarely<br>• Never |
| In case you record sinus status after surgery, when do you do it?<br>• Right after surgery<br>• At the final prosthesis delivery<br>• One year later<br>• Other |
| Which of these symptoms do you check for before the surgery?<br>• Snoring<br>• Running nose<br>• Sleep apnea<br>• None<br>• Other |
| How much time before surgery do you recommend extracting the terminal dentition when zygomatic implants are the selected treatment option? |

*(continues)* >>

**APP TABLE 12-3 *cont.* >> List of close-ended questions from the second round**

| Planning |
|---|
| Please mark the options you regularly use to prepare and plan your surgery:<br>• CBCT analysis<br>• Planning software<br>• 3D Models<br>• Intraoral scanners<br>• Pictures<br>• Surgical direction indicator |
| Mark the parameters you are using to determine the implant head position:<br>• Geometry of the crest<br>• Quality of the bone<br>• Quantity of bone at specific site<br>• Location of the bone<br>• Prostheses screw on ideal position<br>• Type & amount of soft tissue to remain buccal to the implant head<br>• AP distribution<br>• Geometry of the zygomatic buttress<br>• Maxillary wall curvature<br>• Other |
| Mark the parameters you are using to determine the antrostomy position in the case of an intramaxillary implant positioning (ZAGA Types 0 & 1):<br>• Geometry of the crest<br>• Quality of the bone<br>• Quantity of bone at specific site<br>• Location of the bone<br>• Prostheses screw on ideal position<br>• Type & amount of soft tissue to remain buccal to the implant head<br>• AP distribution<br>• Geometry of the zygomatic buttress<br>• Maxillary wall curvature<br>• Other |
| Mark the parameters you are using to determine the antrostomy position in the case of an extra maxillary implant positioning (ZAGA Types 2, 3 & 4):<br>• Geometry of the crest<br>• Quality of the bone<br>• Quantity of bone at specific site<br>• Location of the bone<br>• Prostheses screw on ideal position<br>• Type & amount of soft tissue to remain buccal to the implant head<br>• AP distribution<br>• Geometry of the zygomatic buttress<br>• Maxillary wall curvature<br>• Other |
| How much do you agree that staying away from the sinus at the zygomatic implant critical zone (ZICZ) highly reduces the risk of oro/antral communication? |
| Do you use a diagnostic prosthesis for planning?<br>• Yes<br>• No<br>• Other |
| What is the minimum thickness of bone facially to the apical part of the implant you aim at having? (in mm) |
| Do you check for drilling capability due to mouth opening when planning?<br>• Yes<br>• No |

*(continues)* >>

**APP TABLE 12-3 *cont.*** >> **List of close-ended questions from the second round**

| Planning |
|---|
| Do you use guides to perforate the zygomatic bone?<br>• Yes<br>• No |
| Which aspects of the soft tissue do you evaluate before the treatment?<br>• Quantity<br>• Quality<br>• Location |
| **Medication** |
| In which cases do you prescribe antibiotherapy before the surgery?<br>• Always<br>• Just in case of infection or sinus disorder<br>• Just in case of periodontal disease<br>• Never<br>• Other |
| If applicable, for how many days do you prescribe antibiotherapy before the surgery? |
| If applicable, for how many days do you prescribe corticosteroids before the surgery? |
| If applicable, for how many days do you prescribe nonsteroidal anti-inflammatory drugs (NSAIDs) before the surgery? |
| Do you prescribe tranquilizers or sedatives before the surgery?<br>• Yes<br>• No |
| Do you prescribe decongestants BEFORE the surgery?<br>• Yes<br>• No |
| Do you advise using a Chlorhexidine product BEFORE the surgery?<br>• Yes<br>• No<br>• Only in the presence of remanent teeth |
| If yes, for how many days BEFORE the surgery? |
| Do you prescribe a gastric protector BEFORE the surgery?<br>• Yes<br>• No |
| For how many days do you prescribe antibiotics after the surgery, if applicable? |
| For how many days do you prescribe corticosteroids after the surgery, if applicable? |
| For how many days do you prescribe nonsteroidal anti-inflammatory drugs (NSAIDs) after the surgery, if applicable? |
| Do you prescribe a gastric protector after the surgery?<br>• Yes<br>• No |
| Do you prescribe tranquilizers or sedatives after the surgery?<br>• Yes<br>• No |

*(continues)* >>

**APP TABLE 12-3 *cont.* >> List of close-ended questions from the second round**

| Surgery |
|---|
| Do you actively try to avoid perforating the sinus membrane at the crest level?<br>• Yes<br>• Sometimes<br>• No |
| Do you actively try to avoid perforating the sinus membrane at the maxillary wall level?<br>• Yes<br>• Sometimes<br>• No |
| Do you actively try to avoid perforating the sinus membrane at the zygomatic buttress level?<br>• Yes<br>• Sometimes<br>• No |
| Which options do you regularly use to prevent soft tissue dehiscence?<br>• Use of the Bichat fat pad<br>• Keratinized soft tissue grafting<br>• Embed the implant head in the remaining alveolar bone<br>• Use of site-specific implant design<br>• Perform the surgery on a totally healed mucosa<br>• Adequate incision<br>• Other |
| In a case of extra maxillary implant placement, do you believe the implant section is important to avoid soft tissue compression?<br>• Yes<br>• No<br>• Other |
| What implant surface do you prefer? [Neck level, Extrasinus]<br>• Machined with no threads<br>• Machined threaded<br>• Rough with no threads<br>• Rough threaded<br>• I don't care |
| What implant surface do you prefer? [Body level, Extrasinus]<br>• Machined with no threads<br>• Machined threaded<br>• Rough with no threads<br>• Rough threaded<br>• I don't care |
| What implant surface do you prefer? [Neck level, Intrasinus]<br>• Machined with no threads<br>• Machined threaded<br>• Rough with no threads<br>• Rough threaded<br>• I don't care |
| What implant surface do you prefer? [Body level, Intrasinus]<br>• Machined with no threads<br>• Machined threaded<br>• Rough with no threads<br>• Rough threaded<br>• I don't care |
| What implant surface do you prefer? [Apical level]<br>• Machined with no threads<br>• Machined threaded<br>• Rough with no threads<br>• Rough threaded<br>• I don't care |



*(continues)* >>

**APP TABLE 12-3** *cont.* >> **List of close-ended questions from the second round**

| Surgery |
|---|
| Do you use a connective graft to cover an exposed implant?<br>• Always<br>• Sometimes<br>• Rarely<br>• Never<br>• Depending how much it protrudes buccally<br>• Depending how much available tissue there is<br>• Other |
| Do you use the buccal fat pad to cover an exposed implant?<br>• Always<br>• Sometimes<br>• Rarely<br>• Never<br>• Depending how much it protrudes buccally<br>• Depending how much available tissue there is<br>• Other |
| Which incision type do you prefer as a routine?<br>• Vestibular<br>• Mid crestal<br>• Palatal<br>• Palatal rolled<br>• It depends on implant head positioning<br>• Other |
| Do you use release incisions?<br>• Yes<br>• No |
| Do you prefer to raise the flap on one side or on both sides at a time?<br>• One side at a time<br>• Both sides at the same time |
| Most participants report placing the implants exclusively using a manual implant transporter. How much do you agree with this approach? |
| The second most frequent answer is using the handpiece up to a certain torque, then finishing by hand. How much do you agree with this statement? |
| What would be the limit torque to switch to a manual implant transporter in this case? |
| In a quad zygoma situation, what would be the minimum torque in one of the implants to abort immediate loading, supposing the others reached more than 45 Ncm? |
| Do you perform a window osteotomy before the implant osteotomy?<br>• Yes, always<br>• Yes, if I have doubts regarding the drilling direction<br>• I use it sometimes (please specify)<br>• No<br>• Other |
| In the case you perform a “window osteotomy,” where do you do it?<br>• At the high part of the maxillary trajectory<br>• At the middle part of the maxillary trajectory<br>• At the lower part of the maxillary trajectory<br>• Other |

*(continues)* >>

**APP TABLE 12-3 *cont.* >> List of close-ended questions from the second round**

| Surgery |
|---|
| In the case you perform a "window osteotomy," how do you design it?<br>• As small as possible<br>• Slot type<br>• Extended window |
| The implant size is most frequently defined using digital planning, a 3D model and then the depth gauge. How much do you agree with this process? |
| Which of the following do you use to measure the implant length during the surgery?<br>• With normal bone conditions, I place the hook on the inferior part of the facial perforation and note the crestal mark.<br>• I place the wider part of the gauge in the osteotomy and my finger on the skin. Then I introduce the gauge until I feel it through the skin.<br>• If bone is soft or thin, I place the hook on the inferior part of the facial perforation and note the crestal mark plus 2.5 mm. |
| Do you regularly use final abutments?<br>• Yes<br>• No, I prefer to change after soft tissue healing<br>• Sometimes (specify)<br>• Other |
| **Prosthesis** |
| Please mark the parameters you consider important for an immediate prosthesis:<br>• Framework rigidity<br>• Simultaneous bilateral occlusal contacts in maximal intercuspation<br>• Absence of distal cantilevers<br>• Smooth lateral excursions<br>• Some freedom from maximal intercuspation to centric relation<br>• Respected vertical dimension<br>• Convex gingival profile allowing for hygiene maintenance<br>• Nice appearance<br>• Other |
| How soon do you deliver the immediate prostheses? |
| Please mark the parameters you consider important to evaluate in the immediate prosthesis follow-up:<br>• Hygiene maintenance<br>• Occlusion<br>• Esthetics<br>• Soft tissue stability<br>• Sinus status<br>• Chewing ability<br>• Patient satisfaction<br>• Screw tightening<br>• Other |
| After how many days do you follow/up on the provisional prosthesis? |
| When do you take impressions for the final prosthesis? |
| Please mark the parameters you consider important for a final prosthesis:<br>• Framework rigidity<br>• Simultaneous bilateral occlusal contacts in maximal intercuspation<br>• Absence of distal cantilevers<br>• Smooth lateral excursions<br>• Some freedom from maximal intercuspation to centric relation<br>• Respected vertical dimension<br>• Convex gingival profile allowing for hygiene maintenance<br>• Nice appearance |

*(continues)* >>

**APP TABLE 12-3** *cont.* >> **List of close-ended questions from the second round**

| Prosthesis |
|---|
| When do you recommend installing the final prostheses? |
| How frequently do you follow up after the final prosthesis delivery? |
| Do you regularly use immediate loading?<br>• Yes<br>• No<br>• Sometimes (specify)<br>• Other |
| **Follow-up** |
| What is your follow-up frequency for CBCT?<br>• Never<br>• Once a year<br>• Twice a year<br>• Three times a year<br>• Four times a year |
| What is your follow-up frequency for panoramic x-ray?<br>• Never<br>• Once a year<br>• Twice a year<br>• Three times a year<br>• Four times a year |
| What is your follow-up frequency for periapical x-ray of the zygomatic implants?<br>• Never<br>• Once a year<br>• Twice a year<br>• Three times a year<br>• Four times a year |
| What is your follow-up frequency for intraoral pictures?<br>• Never<br>• Once a year<br>• Twice a year<br>• Three times a year<br>• Four times a year |
| What is your follow-up frequency for hygiene/unscrewing the prosthesis?<br>• Never<br>• Once a year<br>• Twice a year<br>• Three times a year<br>• Four times a year |
| What is your follow-up frequency for screw tightening?<br>• Never<br>• Once a year<br>• Twice a year<br>• Three times a year<br>• Four times a year |
| What is your follow-up frequency for individual implant stability?<br>• Never<br>• Once a year<br>• Twice a year<br>• Three times a year<br>• Four times a year |

*(continues)* >>

**APP TABLE 12-3 *cont.* >> List of close-ended questions from the second round**

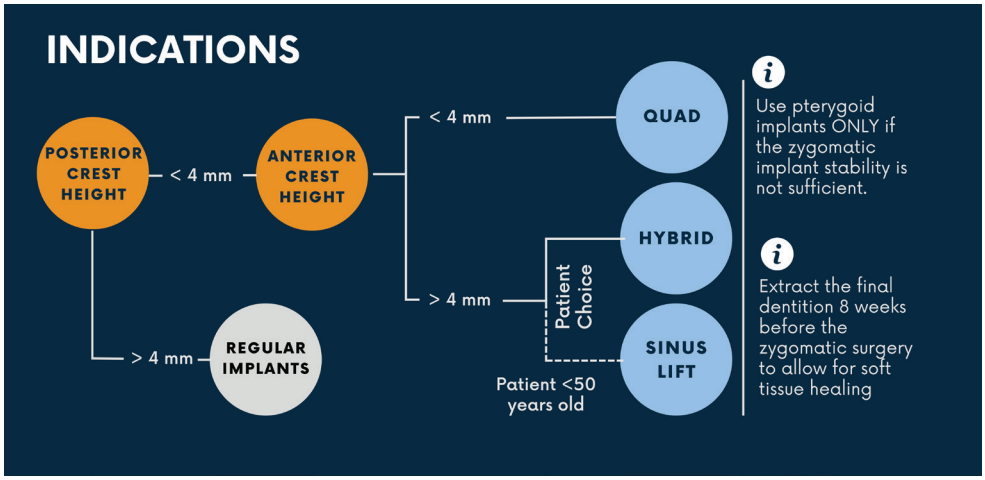
| Follow-up |
| --- |
| What is your follow-up frequency for oral status?<br>• Never<br>• Once a year<br>• Twice a year<br>• Three times a year<br>• Four times a year |
| What is your follow-up frequency for occlusion?<br>• Never<br>• Once a year<br>• Twice a year<br>• Three times a year<br>• Four times a year |
| What is your follow-up frequency for patient satisfaction?<br>• Never<br>• Once a year<br>• Twice a year<br>• Three times a year<br>• Four times a year |

## Data analysis

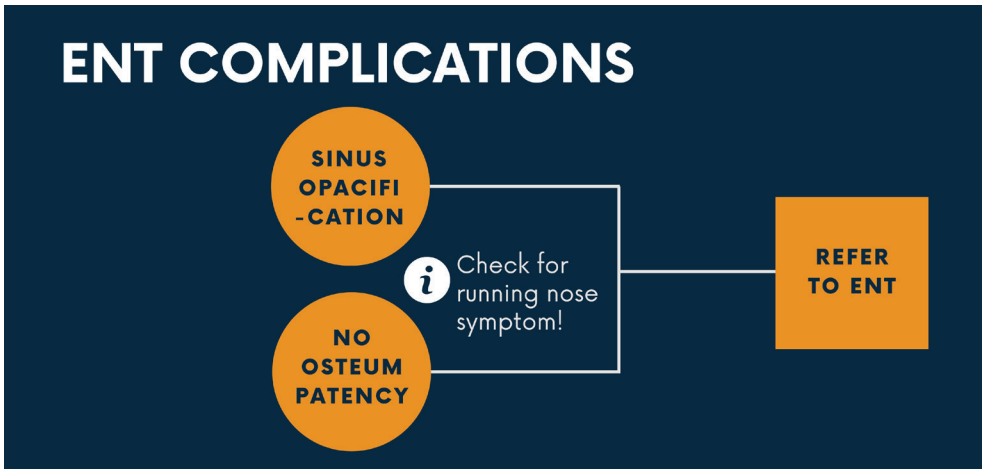
One author (D.P.) collected the anonymized data and comments for each question in the survey. After each round, a report of consensus level was created using Google Sheets.

## Outcome of the Modified Delphi Process

The analysis of the two rounds of questions led to the following results. Each section contains the aggregated answers and the percentage of participants agreeing on each question. Also, the overall consensus status is detailed per question and per section.




**APP FIG 12-2** Outcome of the modified Delphi process regarding indications for zygomatic implant rehabilitation.



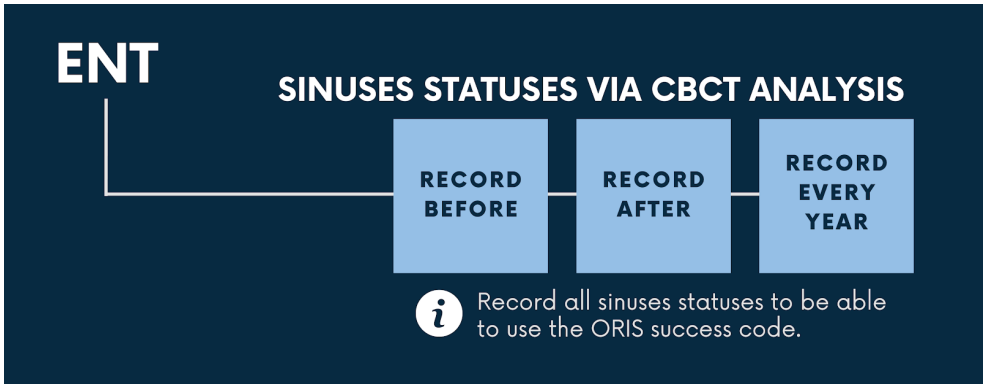

**APP FIG 12-3** Outcome of the modified Delphi process regarding ENT follow-up for zygomatic implant restorations.

## Section 1: Diagnostics and Indications

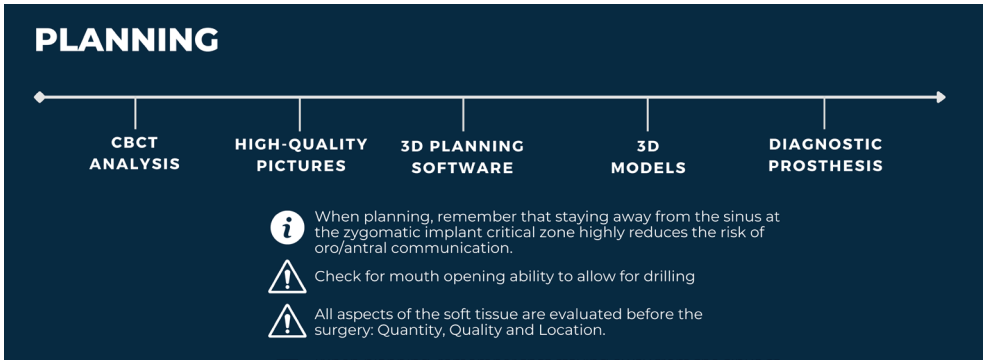
The limit dimension of the anterior crest to select zygomatic implants as the preferred treatment option is 4.1 ±1.1 mm. The anterior crest corresponds to zone 1 (the anterior zone from canine to canine). The level of consensus reached was 72%. The limit dimension of the posterior crest to select zygomatic implants as the preferred treatment option is 3.9 ±1.2 mm. The posterior crest corresponds to zones 2 (premolars) and 3 (molars). The level of consensus reached was 85%. The limit width of the ridge to select zygomatic implants as the preferred treatment option is 6.6 ±1.1 mm. The level of consensus reached was 92%.

In cases where severe maxillary atrophy is diagnosed in zones 2 and 3 but not in zone 1, regular anterior and posterior zygomatic implants are preferred, according to 55% of the participants (App Fig 12-2). Of the participants, 20% rely on sinus grafting if the patient is 50 years old or younger, while 20% let the patient choose. In a patient indicated for zygomatic implant treatment in the maxilla with sufficient bone volume in the pterygoid region, pterygoid implants are not used unless posterior zygomatic implant stability is not ideal. This applies whether the patient has an edentulous mandible or remaining mandibular dentition, with a consensus score of 88% and 73%, respectively. The terminal dentition should be extracted at least 8 weeks before the zygomatic implant surgery to allow for soft tissue healing. The consensus score was 73%.

Referring the patient to an ENT specialist is indicated when pathology is observed on the CT scan and when there is no ostium patency (App Fig 12-3). The consensus score is 70%.




**APP FIG 12-4** Outcome of the modified Delphi process regarding ENT follow-up for zygomatic implant restorations.




**APP FIG 12-5** Outcome of the modified Delphi process regarding the planning tools and processes for zygomatic implant rehabilitation.

The sinus statuses are always recorded before and after the surgery, with a consensus of 88% (App Fig 12-4). Sinus status after surgery is measured during the first year following the surgery with a consensus score of 81%. Precisely, 12% of participants measure it right after surgery, 40% measure it at the final prosthesis delivery, and 30% measure it 1 year after surgery. Sinus status is recorded routinely after the surgery. In addition to the anatomical and ENT aspects of diagnosis, it is recommended to check for a running nose symptom (70%).

## Section 2: Planning

Use of the following options for enhancing the quality and outcome of surgical planning reached the minimum consensus level (App Fig 12-5):

- CBCT analysis (97%)
- 3D planning software (76%)
- Diagnostic prosthesis (71%)
- High-quality pictures (71%)
- 3D stereolithographic models (70%)

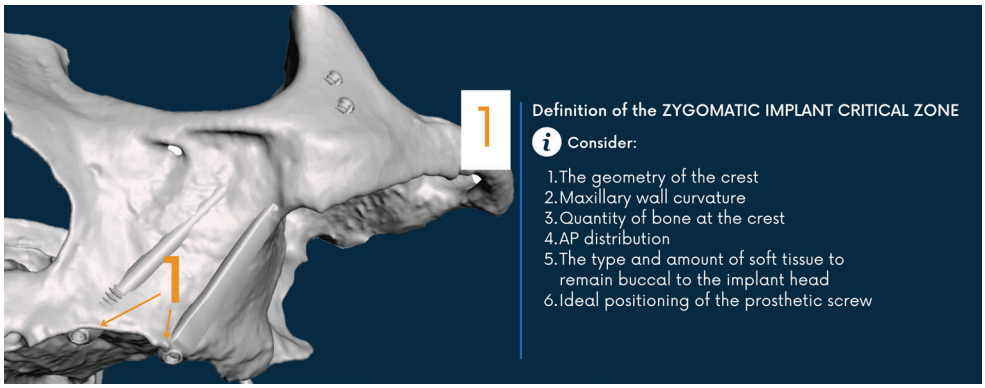
When planning, it is critical to check the patient's mouth-opening ability to allow for drilling (85%). All aspects of the soft tissue are evaluated before the surgery: quantity (80%), quality (85%), and location (75%).

Planning of the implant angulations and locations are performed using the ZAGA concept, adapting each implant path to the patient's anatomy. The results can vary from an intrasinus to an extramaxillary path. The planning protocol is widely described in the literature. The planning of each implant position involves locating the following three areas:

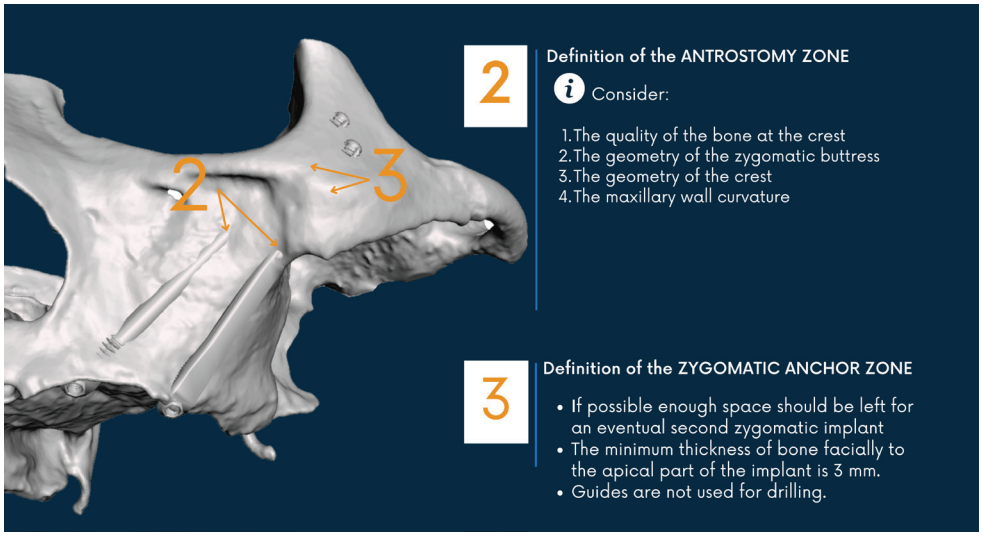
- Implant head position/zygomatic implant critical zone (ZICZ)
- Antrostomy zone (AZ)
- Zygomatic anchoring zone (ZAZ)

### THE ZIZC

The ZICZ is identified using the following factors in order of reported importance depending on whether the implant path is intra- or extramaxillary (App Fig 12-6):




**APP FIG 12-6** Outcome of the modified Delphi process regarding the identification of the ZICZ.




**APP FIG 12-7** Outcome of the modified Delphi process regarding the position of the AZ and ZAZ for zygomatic implant rehabilitation.

- Geometry of the crest (89%)
- Maxillary wall curvature (77%)
- Quantity of bone at the crest (77%)
- Anterior-posterior (AP) distribution (66%)
- Type and amount of soft tissue to remain buccal to the implant head (56%)
- Ideal positioning of the prosthetic screw (54%)

Also, staying away from the sinus at the ZICZ highly reduces the risk of oroantral communication (89%).

### THE AZ

The AZ is identified using the following factors in order of reported importance (App Fig 12-7):

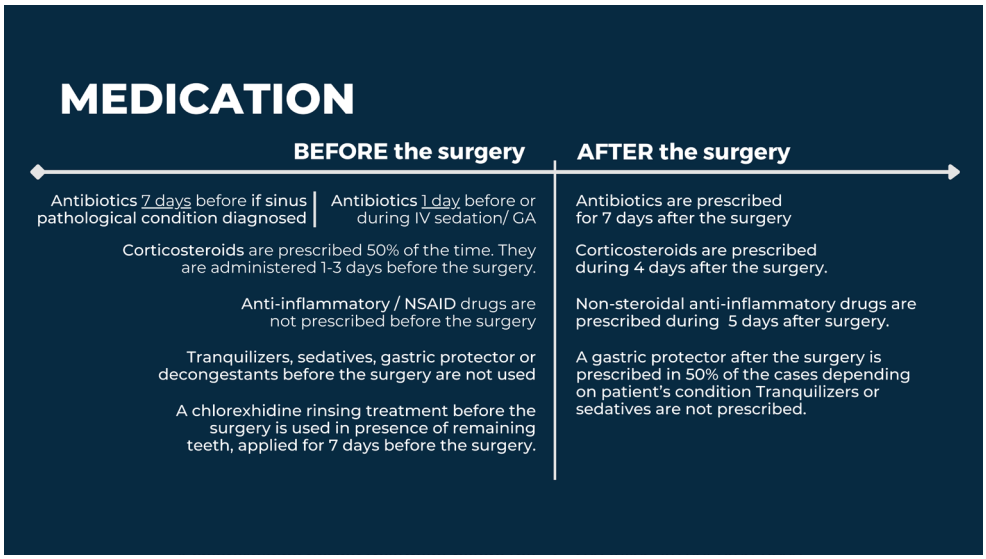
- Quality of bone at the crest (73%)
- Geometry of the zygomatic buttress (70%)
- Geometry of the crest (68%)
- Curvature of the maxillary wall (44%)

### THE ZAZ

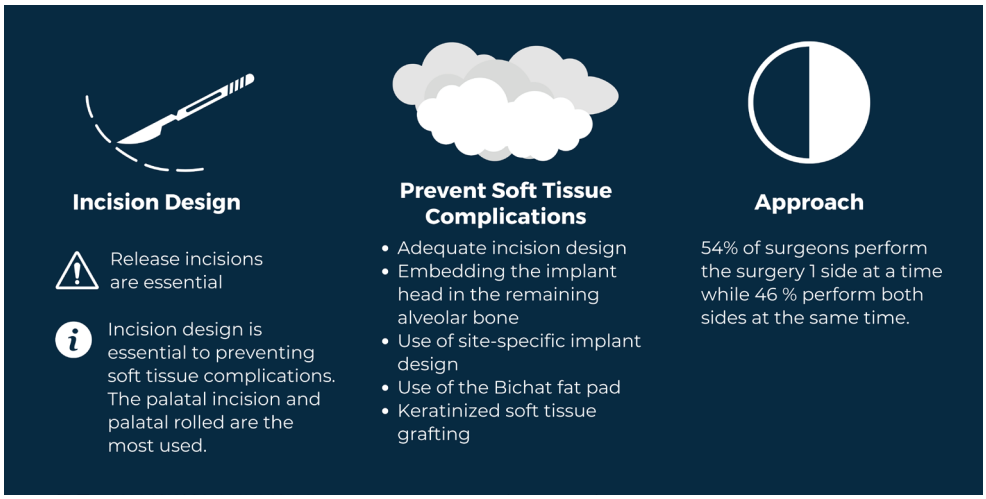
When defining the ZAZ, enough space should be left for an eventual second zygomatic implant, if possible. The minimum thickness of bone facial to the apical part of the implant is 3.1 ± 0.7 mm (see App Fig 12-7), with a consensus score of 85%. Zygomatic implant guides are not used for drilling (74%). If possible, enough space should be left for an eventual second zygomatic implant.

## Section 3: Medication

Antibiotics are prescribed before the surgery (92%) (App Fig 12-8). If the patient doesn't present any sinus condition, antibiotics are delivered 1 day before the surgery or, alternatively, during general or IV sedation directly. In case of a pathologic sinus condition, antibiotics are started 7 days before the surgery. Corticosteroids are prescribed 50% of the time and are administered 1 to 3 days before the surgery.




**APP FIG 12-8** Outcome of the modified Delphi process regarding medication before and after zygomatic implant surgery




**APP FIG 12-9** Outcome of the modified Delphi process regarding the surgical aspects of zygomatic implant rehabilitation.

Rinsing twice a day with chlorhexidine before the surgery can be prescribed, especially in the presence of remaining teeth (total consensus score of 55%). When performed, it is initiated 7 days before the surgery.

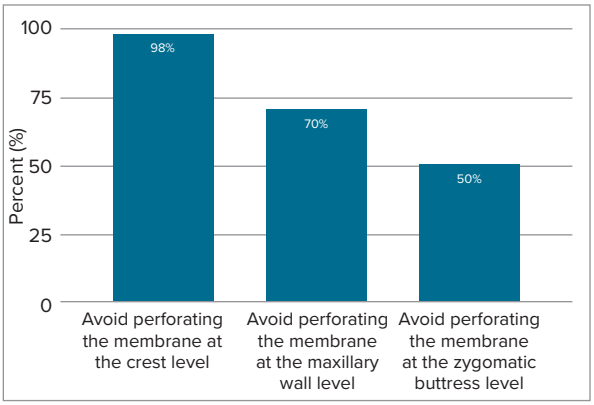
Nonsteroidal anti-inflammatory drugs (NSAIDs) are not prescribed before the surgery (consensus score of 53%), while 37% of participants administer NSAIDs at the beginning of surgery. Tranquilizers or sedatives before the surgery are not used, with a consensus score of 70%. Decongestants before the surgery are not used, with a consensus score of 77%. A gastric protector before surgery is generally not prescribed (85%).

After surgery, antibiotics are prescribed for 7 days. Corticosteroids are prescribed by 76% of the participants for an average of 4 days after the surgery. NSAIDs are prescribed by 86% of the participants for an average of 5 days after surgery. A gastric protector after the surgery is prescribed in 50% of cases. This mostly depends on the patient's condition. Tranquilizers or sedatives are not prescribed after the surgery (95%).

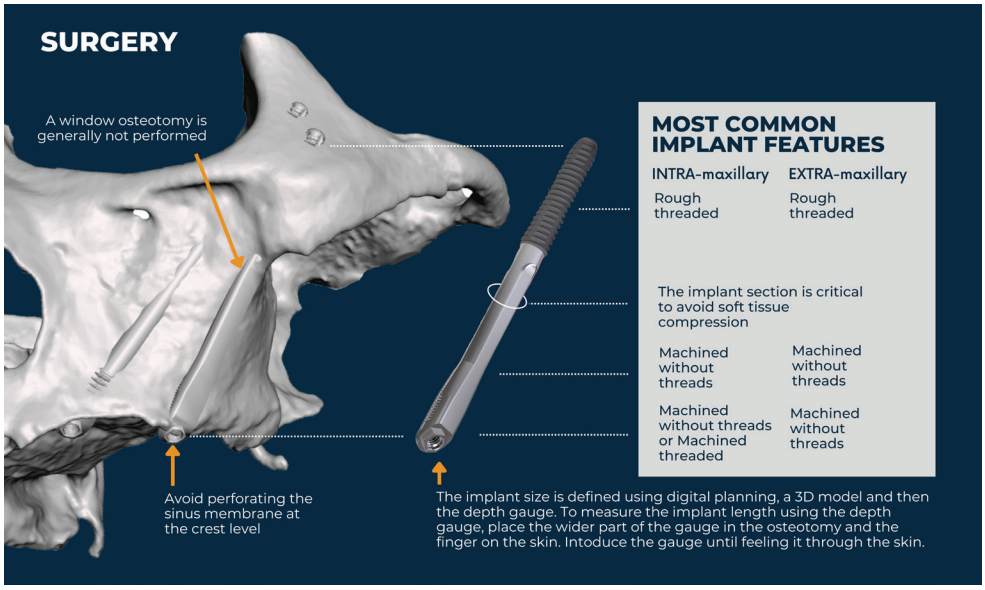
## Section 4: Surgery

Release incisions are essential (95%). Good incision design is also essential for preventing soft tissue complications. The palatal incision is the most common (68%). Of the participants, 54% perform the surgery one side at a time, while 46% perform both sides simultaneously (App Fig 12-9).

When it comes to preparing the osteotomy, participants report actively avoiding perforating the sinus membrane at the crest level (98%), the maxillary wall




**APP FIG 12-10** Outcome of the modified Delphi process regarding the surgical aspects of zygomatic implant rehabilitation.




**APP FIG 12-11** Outcome of the modified Delphi process regarding the surgical aspects of zygomatic implant rehabilitation.

level (70%), and the zygomatic buttress level (50%; App Fig 12-10).

A window osteotomy is generally not performed (65%; App Fig 12-11). In ZAGA Type 0 and 1 cases, a slot window can be used to preserve membrane integrity if doubt exists regarding the direction of drilling (21%). If performed, the window is located at the highest part of the maxillary trajectory, close to the zygomatic bone (73%). It is a slot-type window (83%).

The implant size is defined using digital planning, a 3D model, and a depth gauge (72%). The following two methods were identified for measuring the implant length using the depth gauge:

1. I place the wider part of the gauge in the osteotomy and my finger on the skin. Then I introduce the gauge until I feel it through the skin (40%).
2. With normal bone conditions, I place the hook on the inferior part of the facial perforation and note the crestal mark (35%).

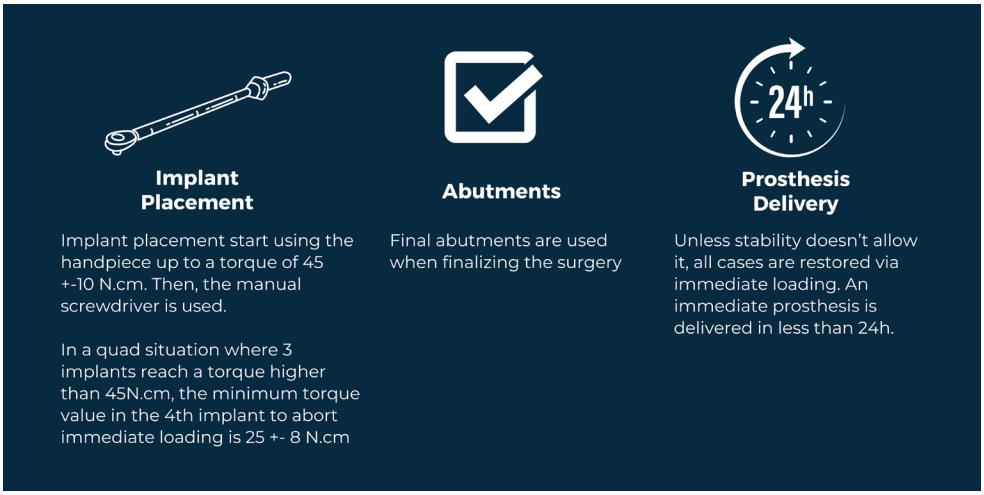
Regarding implant design and features, 90% of the participants agree that the type of implant section is critical to avoid soft tissue compression. App Table 12-4 shows the implant surfaces that are reported as preferred depending on the anatomical position of the implants.

Implant placement starts by using the handpiece up to a torque of 45 ± 10 Ncm. Then, the manual screwdriver is used (82%). In a quad situation where three implants reach a torque higher than 45 Ncm, the minimum torque value in the fourth implant to abort immediate loading is 25 ± 8 Ncm (73%; App Fig 12-12).

Final abutments are used when finalizing the surgery (92%).

**APP TABLE 12-4 >> Commonly used implant surfaces depending on the implant path and implant region**

| PREFERRED IMPLANT SURFACE | EXTRASINUS | INTRASINUS |
|---|---|---|
| Neck level | Machined without threads (63%) | Machined without threads (46%) and Machined threaded (41%) |
| Body level | Machined without threads (89%) | Machined without threads (76%) |
| Apical Level | Rough threaded (80%) | |




**APP FIG 12-12** Outcome of the modified Delphi process regarding the surgical aspects of zygomatic implant rehabilitation.

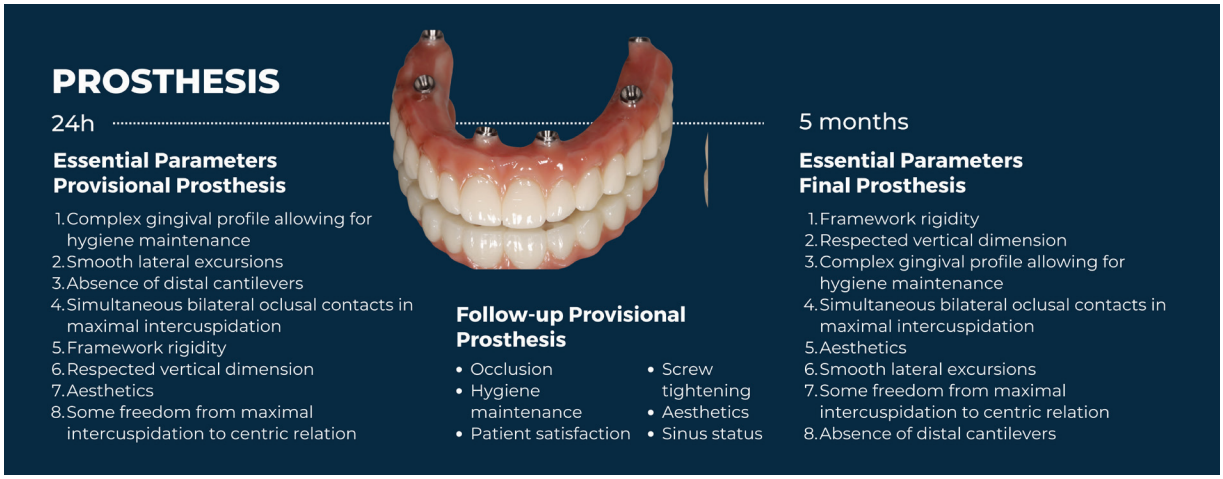
**APP TABLE 12-5 >> Frequency of use of methods to prevent implant exposure**

| FREQUENCY | CONNECTIVE GRAFT | Bichat's fat pad |
|---|---|---|
| Always | 15% | 25% |
| Sometimes | 30% | 22% |
| Rarely/Never | 23% | 29% |
| Other | 32% | 24% |

To prevent soft tissue complications, the following approaches are used:

- Adequate incision design (88%)
- Embedding the implant head in the remaining alveolar bone (73%)
- Use of site-specific implant design (54%)
- Use of Bichat's fat pad (51%)
- Keratinized soft tissue grafting (42%)

When an implant is exposed, the use of a connective graft, as well as Bichat's fat pad, is reported (App Table 12-5).




**APP FIG 12-13** Outcome of the modified Delphi process regarding prosthetic aspects of zygomatic implant rehabilitations.

## Section 5: Prosthesis

Unless a lack of stability prevents it, all cases are restored via immediate loading (100%), and an immediate prosthesis is delivered in less than 24 hours (98%). The essential parameters for an immediate prosthesis include the following (App Fig 12-13):

- Complex gingival profile allowing for hygiene maintenance (90%)
- Smooth lateral excursions (89%)
- Absence of distal cantilevers (83%)
- Simultaneous bilateral occlusal contacts in maximal intercuspation (81%)
- Framework rigidity (78%)
- Respected vertical dimension (76%)
- Esthetics (59%)
- Some freedom from maximal intercuspation to centric relation (56%)

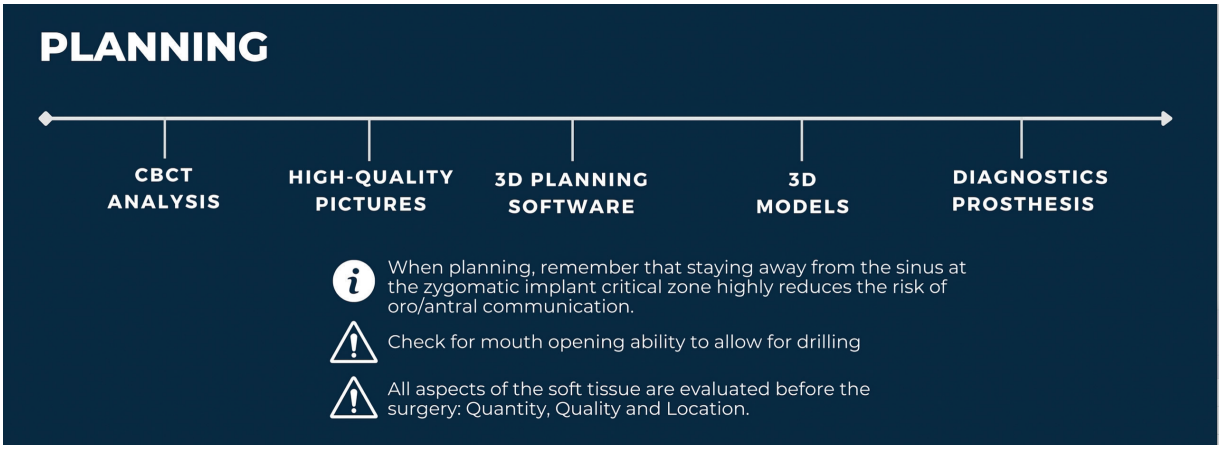
After the delivery of the immediate prosthesis, minor adjustments are performed after 7 days (55%) and, if necessary, every week for 3 to 6 weeks. The following aspects of the immediate prosthesis are also to be evaluated:

- Occlusion (100%)
- Hygiene maintenance (88%)
- Patient satisfaction (88%)
- Screw tightening (68%)
- Esthetics (59%)
- Sinus status (54%)

Impressions for the final prosthesis are taken after an average of 5 ± 1 months. The essential parameters for a final prosthesis include the following:

- Framework rigidity (98%)
- Respected vertical dimension (95%)
- Complex gingival profile allowing for hygiene maintenance (95%)
- Simultaneous bilateral occlusal contacts in maximal intercuspation (93%)
- Esthetics (83%)
- Smooth lateral excursions (81%)
- Some freedom from maximal intercuspation to centric relation (54%)
- Absence of distal cantilevers (27%)

The delivery of the final prosthesis takes place an average of 6 months after the surgery (70%). After the final prosthesis is delivered, a follow-up appointment is performed 2 months later.




**APP FIG 12-14** Outcome of the modified Delphi process regarding patient follow-up of zygomatic implant rehabilitations.

## Section 6: Follow-up

Follow-up is essential to ensure long-term treatment success and prevent/treat eventual complications early. Several factors are evaluated at different frequencies, including (App Fig 12-14):

- CBCT scans: once a year (83%)
- Panoramic radiographs: once a year (77%)
- Periapical radiograph of the zygomatic implants: never (74%)
- Intraoral pictures: once a year (70%)
- Hygiene (unscrewing the prosthesis): once a year (59%) or twice a year (26%)
- Screw tightening (unscrewing the prosthesis): once a year (59%) or twice a year (24%)
- Individual implant stability (unscrewing the prostheses): once a year (62%) or never (24%)
- Oral status: once a year (45%) or twice a year (45%)
- Occlusion: once a year (51%) or twice a year (41%)
- Patient satisfaction: once a year (59%) or twice a year (36%)

## Conclusion

Through a consensus process, the modified Delphi process allowed the creation of a harmonized protocol for zygomatic implant restoration. Because this work represents the first protocol, from indications to published long-term follow-up, it will serve as a basis for future improvements and advancements in care. Moreover, if this protocol is adopted, it will allow progress in knowledge by making it possible to compare results after varying a single factor, such as implant trajectory, implant design, the type of incision, etc, while keeping all other factors constant. Areas in which consensus has not been reached should also be the next issues to be discussed to make further progress.

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