Zygomatic Implants—Protocol for Immediate Occlusal Loading: A Preliminary Report

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Purpose: To investigate the modified protocol for immediate occlusal loading of the zygomatic implants and to report the preliminary results of this modified protocol.

Materials and Methods: Four male patients and 1 female patient with edentulous maxillae were consecutively treated with the zygomatic implants under general anesthesia. All 5 patients were examined by computed tomography and investigated by the SimPlant software (Materialise NV, Leuven, Belgium). Based on the virtual surgical plans, mucosa-supported surgical guides were manufactured by rapid prototyping technique before implant operation. Instead of making a Le Fort I Osteotomy incision or a crestal incision, buccal vestibular incision was used to expose the surgical site for the zygomatic implant osteotomy and placement. Three patients had their remaining upper teeth removed on the same day as implant placement. One patient had undergone simultaneous placement of upper and lower implants followed by immediate loading. The immediate loading protocol was a 2-stage method using a customized provisional fixed prosthesis.

Results: Ten zygomatic implants and 20 normal implants were installed in these 5 patients. These 5 patients were reviewed regularly for 6 to 10 months after immediate loading. The zygomatic implants were considered to be successful when they were asymptomatic with no clinical mobility and no sign of infection. All the zygomatic implants and normal implants were investigated individually after removing the provisional prosthesis and were found to be clinically stable and asymptomatic.

Conclusion: According to our observation, immediate occlusal loading of the zygomatic implants has a very good potential for success, as much as immediate occlusal loading of normal dental implants. The surgical placement of the zygomatic implant is simplified and facilitated by making use of the computer-assisted planning and the rapid-prototyping surgical guides.

This year is the 40th anniversary of Osseointegration ad modum Brånemark. After 40 years of work and development, general and specialist dentists can routinely use osseointegrated dental implants to provide oral function and restore dental esthetics for dental amputees. The current standard of dental implant treatment is defined by the following factors: atraumatic experience, minimally invasive surgery, and immediate function.

To make dental implant treatment a pleasant experience for every patient is not easy, but it should be our objective to make it more acceptable and more comfortable for our patients. The introduction of 1-stage surgery, flapless surgery, and immediate implantation allows the clinicians to offer minimally invasive surgery to many patients with a predictable outcome. The concept of immediate function includes immediate esthetics and immediate occlusal loading. It is well recognized that immediate restoration after implant placement can enhance the esthetic
result when restoring anterior maxillary implants. In fact, providing the patients with a definitive prosthesis at the time of dental implant placement is the ultimate goal of advanced dental implant treatment.\textsuperscript{1,2}

The state-of-the-art dental implant treatment is to apply the same standard to more complex cases. Brånemark et al developed the zygomatic implant techniques in the early 1990s to overcome the problem of rehabilitating patients with severely atrophic posterior maxillae. As compared with major ridge augmentation procedures, zygomatic implants are less traumatic with shorter treatment time. Brånemark and his team in Sweden published the long-term results on 28 patients treated by zygomatic implants in 2004 and reported high success rates with minimal morbidity.\textsuperscript{3} Other authors also confirmed the effectiveness and safety of the Brånemark zygomatic implant method.\textsuperscript{4-7} This article reports the preliminary result of using a modified protocol to place zygomatic implants for immediate occlusal loading.

\section*{Materials and Methods}

Five consecutive patients were treated by zygomatic implants using a modified protocol. All of them were examined with computed tomography. The axial computed tomography images were converted us-
ing the SimPlant software (Materialise NV, Leuven, Belgium) for 3-dimensional simulation and virtual implant placement (Fig 1). When conducting the virtual implant surgery, the length of each implant could be determined by using the measurement tools in the software (Fig 2). Rapid-prototyping mucosa-supported surgical guides were manufactured subsequently based on the virtual surgical plan (Fig 3). The purpose of the mucosa-supported guides was to minimize the extent of the mucoperiosteal flap raising.

While waiting for the mucosa-supported surgical templates, a customized provisional prosthesis was fabricated on the mounted study casts of each patient in the dental laboratory. This provisional prosthesis was basically an acrylic denture with a Co/Cr skeleton.8 Occlusal openings were prepared on this provisional prosthesis according to the planned/predicted implant positions.

During implant placement, the longest possible zygomatic implants were used for each patient. In addition, the maximum insertion torque value of an individual anterior implant was recorded as a reference.

INCLUSION/EXCLUSION CRITERIA

Only nonsmokers and patients with good general health were included in this study.

SURGERY

Zygomatic implant placement was scheduled as a day operation under general anesthesia for these 5 patients.


FIGURE 4. Buccal vestibular incision was used to access the maxillary sinus and zygomatic bone.


FIGURE 5. Exposing the lateral surface of the maxillary sinus.


FIGURE 6. The maxillary sinus was opened.

Instead of the Le Fort I Osteotomy incision or a crestal incision with anterior and posterior releasing incisions, a short incision was made on the buccal vestibule on each side of the maxilla to expose the lateral maxillary sinus wall (Figs 4, 5). The crest of the zygoma bone was exposed, as suggested by the original protocol\(^3\) and the buccal tissues were retracted by using a sigmoid notch retractor engaging the zygomatic crest. The maxillary sinus was entered by drill and the sinus membrane integrity was not as critical as the normal sinus lift procedure (Fig 6). The size of the sinus window created was large enough to allow direct vision to the base of the zygoma bone.

During zygomatic implant osteotomy, the palatal entry point was made transmucosally and guided by the mucosa-supported template (Figs 7, 8). The exit point at the zygoma bone was again guided by the template and also controlled by direct vision. After the implant osteotomy was completed, the zygomatic implant

![FIGURE 7. Implant placement: 2.85-mm diameter twist drill was guided by the mucosa-supported surgical guide when preparing the palatal entry point for the zygomatic implant.](image)


![FIGURE 8. Palatal entry point (blue arrow) for the zygomatic implants.](image)


![FIGURE 9. Implant placement: the zygomatic implant was installed transmucosally through the palatal entry point.](image)


![FIGURE 10. Immediate loading: titanium cylinders were connected to the abutments and/or the zygomatic implants. After that, small pieces of rubber dam were used to prevent the soft tissue from contacting the cold-cure acrylic resin.](image)

was installed through the palatal entry point transmucosally (Fig 9).

**IMMEDIATE OCCLUSAL LOADING**

After implant placement, the definitive abutments (MUA; Nobel Biocare, Göteborg, Sweden) were connected to the implants and tightened accordingly. Titanium cylinders were connected and shortened by bur before suturing the mucosal wounds. After that, the provisional prosthesis was inserted for adjustment. The occlusal openings were modified according to the position of the titanium cylinders so that the prostheses could be fitted with ease. When the prosthesis was in place, attention had to be given to make sure that the upper dental midline, the incisor show, and the occlusion were correct. Once the vertical dimension and occlusion were established, small pieces of rubber dam were used to separate the soft tissue from the provisional prosthesis (Figs 10, 11). Finally, the provisional prosthesis was attached to the titanium cylinders with cold-cure acrylic resin (Unifast Trad, GC America Inc, Alsip, IL) (Figs 12, 13). The cold-cure acrylic resin was mixed and loaded into a syringe and then injected into the occlusal openings. The resin was condensed and molded by fingers and later on polished with rubbers (Fig 14). Postoperative orthopantomograph and postero-anterior skull radiograph were taken for every patient as a baseline reference (Fig 15).

**Results**

The normal implants in the anterior maxillary region were evaluated for marginal bone changes and clinical stability at 3 months after surgery and then they will be followed up annually. The zygomatic implants were evaluated for clinical stability only. These implants were considered to be successful if they were asymptomatic without any sign of infection and stable without mobility.

Five patients with 10 zygomatic implants and 20 normal implants installed for immediate occlusal loading were reported (Table 1). The length of the zygomatic implants and the maximum insertion torque value of the conventional implants were listed for every patient (Table 2). These 5 patients were reviewed regularly for 10 months. There was no implant failure during this short observation period (Fig 16).

**Discussion**

**ZYGOMATIC IMPLANTS PROTOCOL**

The original protocol recommends Le Fort I Osteotomy incision. However, it leaves a bulk of palatal tissue, which is difficult to retract during zygomatic implant placement.
Therefore, crestal incision is suggested as an alternative.\(^7\) In order to minimize the surgical trauma, we make use of a short buccal vestibular incision instead. Our experience showed that this short incision can provide sufficient exposure for the zygomatic implant osteotomy and placement.

**TEMPLATE NAVIGATION**

The development of template-guide implantology allows precision surgery.\(^9,10\) With precision surgery, the extent of the surgical procedure is reduced and the immediate loading protocol is facilitated. The use of the mucosa-supported template makes flapless surgery possible at the crestal/peri-crestal entry point level. However, it is advisable to have the exit point prepared under direct vision to prevent the long zygomatic implant from coming too close or even perforating to the orbit.

**IMMEDIATE LOADING**

There are 2 different ways of performing immediate occlusal loading: 1-stage and 2-stage methods. Examples of the 1-stage method are the Brånemark Novum\(^11\) and the Teeth-in-an-Hour\(^2\) techniques. Examples of the 2-stage method are All-on-4\(^12\) and “Hong Kong Bridge” techniques.\(^8\) No matter which method is used, the critical factor for immediate occlusal loading is initial implant stability.\(^13\) In this study, we used the longest possible zygomatic implants for maximum anchorage in the zygoma bone and applied immediate rigid splinting to the dental implants by using the provisional prosthesis. According to our experience, initial implant stability of the individual implant is important but not as critical as in a single implant situation. Once the implants are linked together with a rigid connector, the individual implant will become part of an integrated system to distribute and share the occlusal loading. Because most of our patients require extraction of their remaining teeth prior to implant placement, it is very difficult to deliver a definitive prosthesis at the time of surgery. It is advantageous to perform the 2-stage method to accommodate any soft tissue shrinkage before making the final impression for the definitive prosthesis.

This preliminary report shows the good potential to load the zygomatic implants immediately with a provisional prosthesis. This immediate loading protocol is beneficial to the patients by being minimally invasive. However, further study should be conducted to investigate the long-term results of immediate occlusal loading of the zygomatic implants.

**Table 1. PATIENT INFORMATION**

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<tr>
<th>Name</th>
<th>Sex</th>
<th>Age</th>
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<th>Extraction</th>
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<td>-</td>
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</table>

Abbreviation: U/L, simultaneous placement of upper and lower implants for immediate occlusal loading.


**Table 2. IMPLANT INFORMATION**

<table>
<thead>
<tr>
<th>Name</th>
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<th>Maximum Insertion</th>
<th>Conventional Implants (N-cm)</th>
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<tr>
<td>Patient 5</td>
<td>50 mm</td>
<td>20 40 40 40</td>
<td>52.5 mm</td>
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</table>

Abbreviation: ZI, zygomatic implant.

FIGURE 15. Immediate loading: the postoperative radiograph shows the position of the implants and the metal skeleton of the provisional prosthesis.


FIGURE 16. Immediate loading: the peri-implant soft tissue condition one week after the implant placement surgery. The buccal wounds are indicated by the black arrows.

References