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Case Report

Eye-Lid approach for four zigomatic implant placement in the severely reabsorbed maxillae: technical note

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Abstract: Up to date, zygomatic implants (ZIs) have been considered a predictable treatment modality for cases of atrophic maxilla. In some severe cases with severe vertical and/or horizontal bone resorption in the anterior maxilla, the placement of standard implants in the anterior area represents a challenge. In these arduous scenarios, performance of a zygomatic "quad-approach" might be advocated. Nevertheless, in limited zygomatic bone width, orbital cavity perforation constituted a potential risk that must be controlled during surgery. This paper focused at presenting a novel technique modification of conjunctival incision to expose the inferolateral orbital rim by an ophthalmologist, to assist the oral surgeon to have direct visualization of the orbital margin and to easily control the drilling direction. With this modification, the potential risk of orbital cavity penetration and its content damage could be diminished and ZIs might be well placed on accordance to prosthetically planned position.

Keywords: Complication, implant success, modified technique, zygomatic implant

Introduction

Osseointegration of dental implants is nowadays considered to be highly predictable. However, rehabilitation of extremely atrophic totally edentulous maxillae by insertion of standard implants is still very challenging even with bone grafting procedure. For those cases, zygomatic implants (ZIs) arose as an alternative method to overcome the situations [1].

The concept of this treatment modality was firstly developed to obtain anchorage and consequent stability in the zygomatic bone (ZB) by the use of longer implant (30 mm to 52.5 mm) and the placement of 2-4 standard implants in the anterior area to increase prosthesis support. Despite the good results by means of survival rate of ZIs, which indicate a strong anchorage for the implants in the ZB, the standard implants in atrophic anterior maxilla with or without additional bone grafting have shown a higher failure rate (8%-27%) [2].

Therefore, in order to provide a graft-free procedure and at the same time to eliminate the risk for standard implants failure, a modified technique with multiple ZIs was described. Quadruple ZIs were placed into ZB with no anterior implant-support for the rehabilitation of the severely atrophic maxilla [3]. One study presented that the average width of the ZB was 20.5 mm and hence, it offers the possibility of inserting 2 implants into the ZB [4]. In the following year, maxillary rehabilitation by immediate loading of four ZIs with no anterior support has been revealed as a reliable treatment in short-/medium-term with a mean survival rate of 96.7%, minimal technical and biological complications, and high patient´s satisfaction [5, 6].

However, as shown by Wang et al. the most commonly found surgical complication during four ZI insertion was orbital cavity penetration by drilling because of limited ZB width for implant anchorage, which may jeopardize patients' vision function [7]. Even with the use of computer tomography guide-based for ZI bed preparation, due to the vertical and inclination deviation, especially for the long implant placement,it is tricky to achieve a precise/ideal position for ZIs [8]. All in all, these clinical reports aimed at documenting a new approach to protect the orbital cavity.

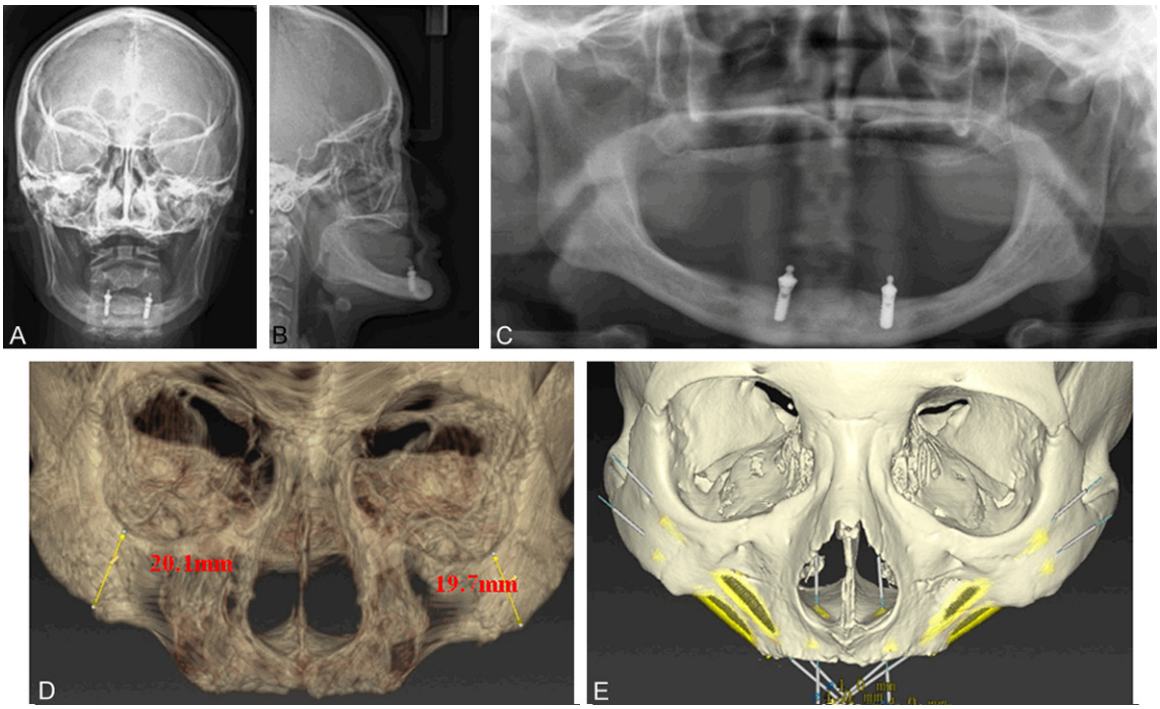

Figure 1. Patient I A-C: Cephalogram and orthopantomograms were taken to evaluate the resorption of maxilla, maxilla-mandible relationship and to exclude sinus disease pre-surgery; D: The minimum ZB width for ZIs anchorage were 19.7 mm and 20.1 mm respectively in 3D reconstruction with software; E: Two ZIs were planned to place bilaterally in 3D reconstruction.

Cases report

Two fully edentulous patients presented to the Department of Oral Implantology, Shanghai Ninth People's Hospital affiliated with Shanghai Jiao Tong University, School of Medicine requesting implant-supported prosthesis for oral rehabilitation.

Clinical case I

A 46-year-old female, presented with severe atrophic edentulous maxilla because of history of aggressive periodontitis. Her chief complaints were persistent problems with conventional maxillary and mandibular complete dentures. The patient was absence of severe systemic or bone metabolic disease and no drug or alcohol abuse history were reported.

Clinical case II

A 22-year-old male, presented hypohydrotic ectodermal dysplasia (HED). The medical history was otherwise unremarkable. Clinical examination revealed no permanent teeth and severe atrophic maxilla and mandible. The patient had not received comprehensive dental care because of financial constraints and he was absence of severe systemic or bone metabolic disease and no drug or alcohol abuse history.

Methods

Pretreatment planning

The presurgical radiographic examinations included cephalogram, orthopantomogram and computed tomography scans (CT) (Philips Brilliance 64 Spiral CT, Netherland) were taken in both patients to provide an anatomic evaluation to exclude sinus disease and evaluate the condition of maxillary and ZB. CT data for each patient were imported to the planning software (Nobel Biocare AB, Goteborg, Sweden), allowing the surgical team to simulate implant placement on a 3D model.

For both patients, the inter-canine alveolar crest had a maximum bone height of 7 mm and width of 4-5 mm. The width of ZB was 20.1 mm and 19.7 mm for Patient I and 21.3 mm and 21.0 mm for Patient II, respectively (**Figure 1**).

While the most anterior implant entrance was designed to be placed in the canine/lateral incisor region, the second implant was designed to

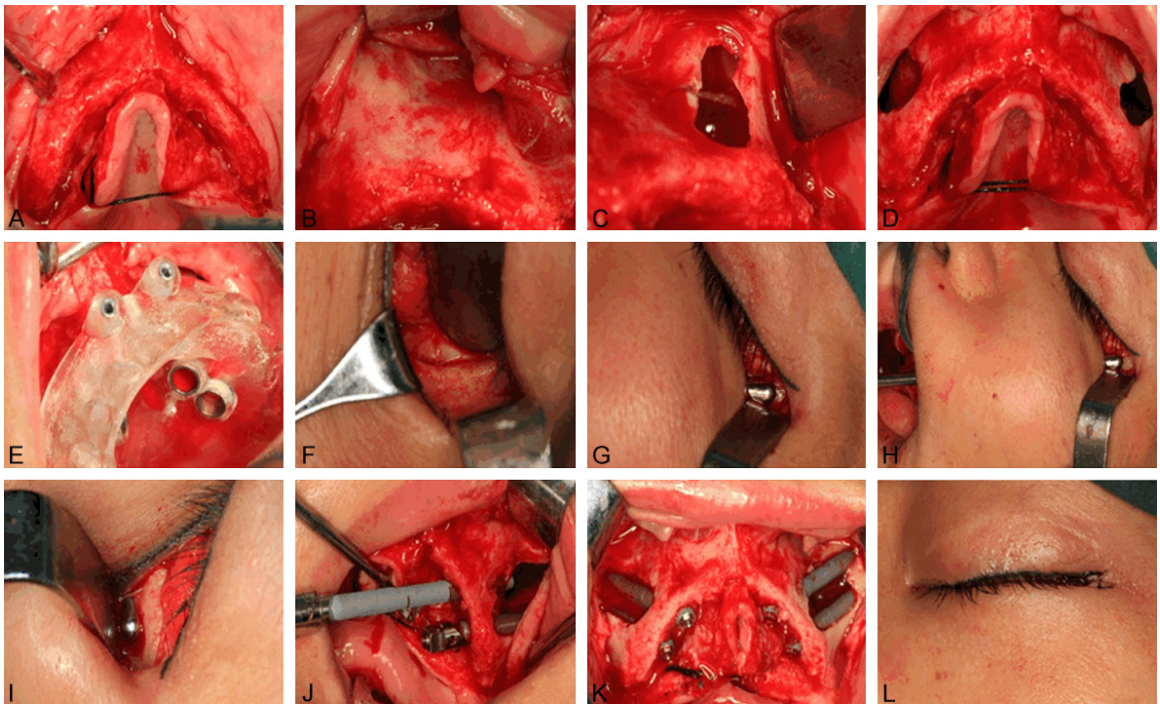

Figure 2. Patient I A-D: After total exposure of the maxilla following incision, bilateral windows were opened in the extension of infrazygomatic crest according to classical approach; E: With the surgical template, a guided twist drill was placed at the entry area for four zygomatic implants (ZIs); F: The inferolateral orbital margin was exposed by by an ophthalmologist; G: The depth gauge was used to penetrate along with the entry area of first ZI at the level of crestal bone to the inferolateral orbital margin; H: The drilling for anterior ZI parallel along the guide of depth gauge to protect the orbit and its contents; I: The depth gauge was used to check the relationship between drilling hole and the orbital rim after first drilling; J: ZIs placement; K: Four ZIs placed at ZB: the anterior one entrance in the canine/lateral incisor region and the second one at the level of the second premolar/first molar region; L: Eye-lid wound closure.

be placed at the level of the second premolar/first molar running along the infra-zygomatic crest. A NobelGuide (Nobel Biocare AB, Göteborg, Sweden) surgical template was then fabricated for guiding ZI placement during surgery.

Surgery procedure

Both patients were treated under general anesthesia and with local injections of lidocain/epinephrine. The approach introduced by Brånemark in 1998 was applied to both patients [9]. The operative technique begins with a crestal incision extending from one maxillary tuberosity to the contralateral tuberosity. A palatal flap was raised to expose the alveolar crest and the hard palate. The dissection was continued along the infra-zygomatic crest towards the ZB. The infraorbital nerve was localized and the zygomatic region exposed. A window of 3×2 cm was opened in the uppermost lateral aspect of the sinus wall in the extension of the infra-zygomatic crest, using a round bur. The sinus mucosa was then reflected. The window provided direct visibility of the roof of the sinus and enables localization of the optimal point for entrance of the drill into the ZB. With the surgical template placed, a guided twist drill was used through the drill sleeve and used to penetrate the crestal bone at the entry area for the ZIs. With local anesthesia (2% concentration, Fuxinzhaohui Medicine Co., Shanghai, China) around lower eyelid skin, a conjunctival incision combined with 2 mm external canthus was made by an experienced ophthalmologist. After blunt dissection the orbital fat, the lateral and inferior orbital wall was exposed.

The depth gauge (Brånemark system zygoma surgical kit, Nobel Biocare AB, Göteborg, Sweden) was used to penetrate along with the entry area of first ZI at the level of crestal bone to the lateral orbital margin. The anterior implant was placed first, drilling parallel along the guide of depth gauge to protect the orbit and its contents (**Figure 2**). After the first drill, the depth gauge was used to check the depth, direction of the drilling hole and the relation-

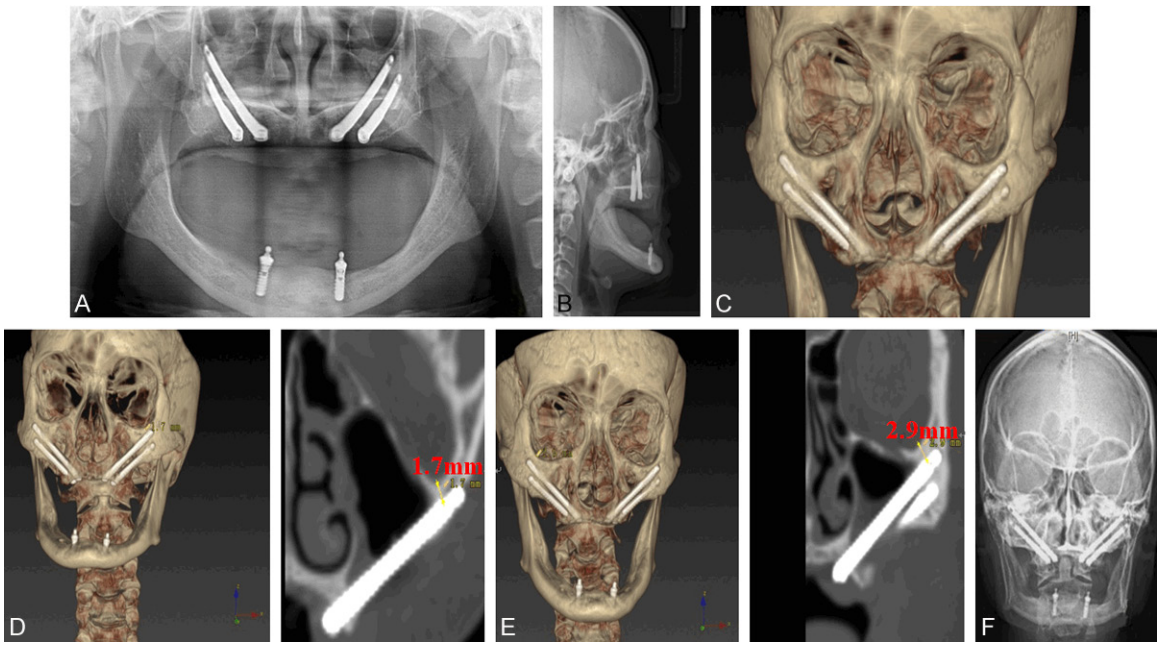

Figure 3. Patient I A-C, F: Post-surgerical cephalogram, orthopantomograms and CT showing ideal distribution of four ZIs; D: The minimum distance between left orbital margin and anterior ZI was 1.7 mm from 3D model; E: The minimum distance between left orbital margin and anterior ZI was 2.9 mm from 3D model.

ship to the orbital margin. Then the standard drilling steps for the first ZI were followed as described. The second implant then was placed at the level of the second premolar/first molar running along the infra-zygomatic crest. The depth gauge inserted in the drilling hole of first ZI was used as a reference to guide the direction to the drilling for the second ZI as parallel as possible. After the standard drilling steps for the second ZI, two ZIs with planned length were inserted for each patient. After implant insertion, a cover screws were placed on top of the implant and the soft tissue was closed. Both patients were given 5-day prescriptions for antibiotics, analgesics, and mouthwash (chlorhexidine 0.12%). Periosteum in the orbital area was sutured with Monocryl 8-0 (Johnson & Johnson Co., Belgium), eyelid incision and skin suture were with Nylon 5-0. Chloramphenicol eye drops was prescribed for a frequency of 5-6 times a day for 3 days. Stitches in eye area were removed after one week healing. Post-surgery CT and orthopantomogram radiographs were employed for both patients to evaluate the position of inserted implants.

Results

During the surgery, four implants in each patient were anchored at the level of the maxillary alveolar process and ZB. No sinus infection was detected based on radiographic or clinical examination. Post-surgery CT showed ideal distribution of two ZIs in ZB for each side in both patients. The nearest distance between first ZIs (near orbital wall) and the orbital margin was 2.3 mm ± 0.5 mm in average (range from 1.7 mm to 2.9 mm) (**Figure 3**). Mild edema around orbital area was found for both patients on the second day post-surgery. Mild bruise was observed in Patient I on the day of eye stitches removal (7 days post-surgery); however, uneventful wound healing with no suppuration or discomfort presented (**Figure 4**). The 2-week follow-up examination, uneventful wound healing without other symptoms were found in both patients. After 3-month healing, all ZIs showed clinical stability without mobility when examined individually.

Discussion

When the maxillary sinus extends anteriorly to the nasal cavity and there is insufficient bone beneath the palate-nasal recess, implant placement in the anterior area might be complicated.

In a cadaver study, van Steenberghe et al. determined that the average width of the ZB is 20.5 mm [4]. It offers the possibility of inserting multiple ZIs anchored by the ZB. In these two

Figure 4. A: Patient I: mild bruise around eye area was observed 7 days post-surgery; B: Patient I: uneventful wound healing without bruise 14 days post-surgery; C, D: Patient II: uneventful wound healing without symptoms 7 days post-surgery (on the day of stitch removal).

cases, the average width of ZB was limited of 20.5 mm, so it is crucial to adequately locate two ZIs in each side to make sufficient distance between two implants and safety distance between the anterior implant and the lateral orbital margin.

According to previous data, the lateral orbit wall, the infraorbital nerve and the anatomy of the bone determined the drilling direction [6]. However, even if the angle between the zygomatic arch and the frontal process of the ZB can be identified by moving the elevator in a cranial direction, the orbital rim can't be direct visualization by surgeon. For this reason, penetration of the orbital cavity is a potential risk that must be controlled. Although some researchers have reported the application of template based on CT scanned data for ZI bed preparation, the large angular deviation was noted [2]. So in the present clinical cases, CT data based guide was only used to identify the entrance of four ZIs.

With the modified technique, the lateral orbital rim was easily accessed, which helped the surgeon direct visualization the operation area and control drilling direction to protect the

orbital and its content and diminish surgical risk. Post-surgical trauma of this modified technique was limited and only mild edema and bruise around eye incision area were observed in both patients, which faded very quickly. No discomfort was presented by both patients.

When the lateral orbital rim was exposed, one anatomical structure had to be concerned. The ZB contains several small openings including the zygomatico-facial (ZF), zygomatico-orbital (ZO) and zygomatico-temporal (ZT) foramina, which serve as exit sites for respective branches of the maxillary nerve (V2). The ZF was located in close proximity to the infero-lateral orbital margin with a range of 0.5-2.2 cm and a mean distance of 1.1 cm and the incidence of one ZF foramen was highest and declined with increasing number of foramina [10]. When the infero-lateral orbital margin was exposed and the anterior ZI was placed, care should be taken to avoid close implant placement or to potentially perforating into the ZF foramen, damaging this nerve, which may lead to paresthesia in their area of nerve distribution.

Conclusions

The technique modification of eyelid incision to expose the infero-lateral orbital rim by an ophthalmologist could help oral surgeon to direct visualization the orbital margin and to more easily control the drilling direction when placed two ZIs bilaterally for reconstruction of atrophic maxilla. With this modification, the potential risk of orbital cavity penetration and its content damage could be diminished and ZIs could be well placed on accordance to planned position.

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Disclosure of conflict of interest

None.

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