The fabrication of a maxillary denture with adequate retention and stability for patients with an atrophic edentulous maxilla presents a significant challenge for the prosthodontist. There exists a direct relationship between prosthesis retention and patient satisfaction. Different techniques have been used successfully to restore the atrophic maxilla by creating more bone volume and better bone topography. The techniques used are: (1) iliac block grafting procedures; (2) maxillary sinus augmentation; (3) Le Fort I osteotomies; and (4) placement of implants in the pterygoid maxillary region. Despite all of these techniques, many patients are unable or unwilling to undergo the rigors of these procedures. The zygomatic implant is an alternative method of treatment for the atrophic maxilla.

CASE REPORT

Patient History

The patient was a 63-year-old woman in good general health, with no known allergies or sensitivities to medications, who presented to Prosthodontics Intermedica, Fort Washington, PA, for a second opinion seeking an improved reconstruction of her dentition. At the initial visit (Fig. 1, a-c), she presented with three mandibular implants that were supporting an overdenture and two maxillary implants that were supporting an overdenture. She was not satisfied with the lack of stability, retention, and esthetics of her existing overdentures.

The patient's past dental history revealed that 11 years prior she had undergone an iliac crest bone graft procedure with the subsequent insertion of four IMZ implants (Interpore International, Irvine, CA) in each arch. Particulate hydroxyapatite had been placed in the mandible for vertical ridge augmentation. After the implant surgery the patient experienced pain, and some of the implants had become infected. During the first few months she had lost one maxillary implant, then one additional implant a few years later. In addition, the patient reported suffering a fractured mandible subsequent to these procedures. She was treated with internal fixation of the fracture.

Purpose: The purpose of this report is to present a reliable surgical and prosthodontic protocol for the treatment of the atrophic maxilla by placing four zygomatic implants.

Materials and Methods: The surgical and prosthodontic procedures are described for the retreatment of a 63-year-old woman who had previously undergone an iliac crest bone graft transplant, which had resorbed. Results: It is possible to place double zygomatic implants bilaterally, in addition to conventional implants in the anterior maxilla. Bone grafting procedures can be avoided, resulting in a fixed implant-supported maxillary prosthesis.

Conclusion: A logical treatment solution is four zygomatic implants for the atrophic maxilla, especially because the previous iliac crest bone graft had resorbed. A treatment plan was formulated to include Bränemark System dental implants (Nobel Biocare, Yorba Linda, CA). For the maxillary arch: four Zygomatic implants, two implants of the standard type, and two Prototype Mark IV (EBON) implants. This was intended to provide for cross-arch support and maximum biomechanical stability. Three implants would be placed for the mandibular arch. The existing implants were anticipated to be kept.

Treatment

To avoid the need for regenerating the atrophic maxilla, four zygomatic implants were proposed in the initial treatment plan. These new and specially designed implants penetrate the zygoma and provide posterior support.
for a fixed prosthesis. Although implants placed in maxillary-grafted bone have been shown to have a success rate of 90% or higher, limited alternative treatment options were also discussed to the patient. These included iliac crest bone grafting in the maxillary arch with conventional implant placement or a complete removable prosthesis. The patient expressed the desire to be restored with a fixed prosthesis and also articulated the fact that she had a negative experience with her previous iliac crest graft. Additional bone grafting would have been difficult to accomplish because of scarring and the inherent avascularity in the anterior maxilla. The patient approved of the initial treatment plan. Diagnostic casts were articulated to replicate the oral and craniofacial structures three-dimensionally. Provisional dentures were fabricated to serve as the blueprint for the final prostheses as well as to clarify the amount of lip support and cheek support needed at the established vertical dimension. These would be worn during the osseointegration period.

General anesthesia was administered by a board-certified anesthesiologist in the surgical suite of Prosthodontics Intermedia (Fort Washington, PA). Three carpules of 1:50,000 lignospan (Cooke-Waitz, North Chicago, IL) were administered as well. A board-certified prosthodontist performed the surgical procedure by initiating a crestal incision with dissection and flap elevation in the areas of teeth nos. 2 to 15. The tissue was reflected to reveal the bone in the maxillary arch. A window was made in the sinus floor for entrance into the zygoma. The sinus cavities were packed with packing strip gauze saturated with Lidocaine HCL 2% (Cooke-Waitz) and Epinephrine 1:100,000. The existing implants were evaluated at this time—area no. 7 and 8. They were both mobile because of fibrous encapsulation and were removed. The following Bränemark implants (Nobel Biocare) were placed in the maxilla: area no. 1 (3.75 mm × 15 mm); area no. 3 (40-mm zygomatic); area no. 4 (35-mm zygomatic); area no. 7 (4.0 mm × 8.5 mm); area no. 8 (4.0 mm × 8.5 mm; Mark IV Prototype); area no. 9 (4.0 mm × 8.5 mm; Mark IV Prototype); area no. 10 (4.0 mm × 8.5 mm; Mark IV Prototype); area no. 13 (35-mm zygomatic); area no. 14 (30-mm zygomatic); area no. 16 (5.0 mm × 12 mm). The implant in area no. 16 was a “spinner,” which is...
To minimize swelling and postsurgical discomfort, the patient followed a standard regimen of Pen VK antibiotic (Par Pharmaceutical, Spring Valley, NY), Decadron corticosteroid (Merck, West Point, PA) and Ibuprofen (Interpharm Inc., Hauppauge, NY), and Vicoprofen (Abbott Laboratories, Abbott Park, IL) pain medication. Cold compress therapy was recommended for the first 48 hours after implant placement surgery. Peridex (Zila Pharmaceuticals, Phoenix, AZ) was also prescribed to be used as an antimicrobial mouthwash during initial osseointegration.

Two weeks after the implant placement, the sutures were removed and a postsurgical radiographic examination was performed to provide a base-line. The provisional dentures were relined again using a soft lining material. Three months after the implant placement, the mandibular implants were uncovered following conventional mandibular second-stage surgery, and a traditional implant-supported fixed prosthesis was fabricated with a previously determined arch form and vertical dimension of occlusion.

Five months after the implant placement, the maxillary implants were uncovered. Angulated abutments were used with each zygoma implant to position the prosthetic retaining screw toward the occlusal table. At this time the all-acrylic conversion prosthesis was constructed. The occlusion was adjusted and an interocclusal registration was made using Regisil (Dentsply, York, PA). An alginate impression was made of the existing mandibular prosthesis. A final impression was made by using the maxillary conversion prosthesis as an impression template. Heavy body Reprosil (Dentsply) impression material was syringed beneath the all-acrylic mandibular implant prosthesis and a pick-up impression was made. A master cast was created by placing abutment analogs to the modified impression copings within the acrylic prosthesis. A final one-piece gold casting was designed and created on the master cast, tried-in, and the final implant-supported prosthesis was finalized by the dental laboratory (Fig. 3).

The final implant-supported prosthesis was delivered to the patient (Fig. 4, a and b). The patient was extremely satisfied with the esthetics, comfort, and function of the new prostheses (Fig. 4c). The occlusion was adjusted and radiographic evaluation was made of the final prosthesis (Fig. 5, a and b). The patient has been followed-up clinically and radiographically for the past 3 years without any complications from treatment.

**DISCUSSION**

This patient initially presented with several complicating factors, which were taken into consideration for the final treatment to have predictable results. These factors were: the resorption of the previously placed iliac crest bone grafting; the presence of hydroxyapatite particulate material in the mandible; a fractured mandible; and failed implants.

A logical solution to treat the atrophic maxilla was the use of four zygomatic implants. By placing zygomatic implants, the patient had the advantage of wearing a maxillary removable complete denture during the healing period of the implants. Had another iliac crest onlay procedure been performed, wearing a removable complete denture would have been contraindicated because of the possibility of resorption of the graft. In addition to using the standard implants in...
the anterior region, using four zygomatic implants posteriorly provided for cross-arch stabilization of the final implant-supported prosthesis.

In the mandibular arch, the presence of the particulate hydroxyapatite prevented the patient from having another removable prosthesis because of the soft tissue compression, the pain associated with the impingement of the nerve, and the continual resorption of the ridge. By using a fixed implant-supported prosthesis in the mandible, the posterior support was obtained by the implants, and, at the same time, the ridge was preserved and the patient was comfortable.

**CONCLUSION**

A clinically successful treatment using four zygomatic implants, in a patient who had previously undergone iliac crest bone grafting procedures that had resorbed, has been described. The entire process was enhanced by the brevity of the treatment process that was performed by a team of prosthodontists in a prostodontic surgical suite with predictable results and without any complications.

**Disclosure**

The authors claim to have no financial interest in any company or any of the products mentioned in this article.

**REFERENCES**


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**Abstract Translations [German, Spanish, Portuguese, Japanese]**


**ZUSSAMENFASSUNG:** Zielsetzung: Der vorliegende Bericht möchte die Grundlagen für ein zuverlässig nachverfolgbares Protokoll für sowohl den chirurgischen Eingriff als auch die nachfolgende Prothesebehandlung bei Behandlung eines atrophischen Oberkiefers durch Setzung von vier Jochbogenimplantaten schaffen. **Materialien und Methoden:** Der Fall einer 63 Jahre alten Patientin wird geschildert, die sich nach Resorption des ursprünglich eingesetzten Beckenkammknochentransplantats einer erneuten Behandlung unterzog. Die beim Eingriff selbst und zur letztendlichen Erstellung der Prothese notwendigen Behandlungsschritte werden einzeln aufgeführt. **Ergebnisse:** Doppelte Jochbogenimplantate können seitensymmetrisch eingepflanzt werden. Als Ergebnis der Behandlung erhält der Patient eine feste implantatgestützte Oberkieferprothese. **Schlussfolgerung:** Als logischer Behandlungsansatz empfiehlt sich der Einsatz von vier Jochbogenimplantaten im atrophischen Oberkiefer. Dies gilt besonders für die Fälle, in denen eine vorherige Beckenkammknochentransplantation durch Resorption fehlschlagen ist.

**SCHLÜSSELWÖRTER:** atrophischer Oberkieferknochen, implantatgestützte Prothese, in das Knochengewebe integrierende Zahnimplantate, Verfahren zur Sinusanhebung

ABSTRACTO: Propósito: El propósito de este informe es presentar un protocolo prostodontico y quirúrgico confiable para el tratamiento de la maxila atrófica al colocar cuatro implantes zygomáticos. Materiales y métodos: Los procedimientos quirúrgicos y prostodonticos se describen para el retratamiento de un paciente femenino de 63 años que había recibido previamente un trasplante de injerto de hueso en la cresta iliaca que se había reabsorbido. Resultados: Es posible colocar doble implantes zygomáticos bilateralmente, además de implantes convencionales en la maxila anterior. Los procedimientos de injerto de hueso pueden evitarse, resultando en una prótesis maxilar fija apoyada por implantes. Conclusión: Una solución lógica del tratamiento es 4 implantes zygomáticos para la maxila atrófica, especialmente debido a que el injerto de hueso en la cresta iliaca se había reabsorbido.

PALABRAS CLAVES: maxila atrófica, prótesis apoyada por implantes, implantes dentales endósseos, procedimientos de levantamiento del seno


SINOPSE: Finalidade: o propósito deste relatório é apresentar um protocolo prostodontico e cirúrgico confiável para o tratamento de maxila atrófica por meio da colocação de quatro implantes zygomáticos. Materiais e métodos: os procedimentos cirúrgicos e prostodonticos são descritos para um segundo tratamento de uma paciente mulher de 63 anos que havia anteriormente recebido um transplante de enxerto de crista de osso iliaco que foi reabsorvido. Resultados: é possível a colocação de implantes duplos zygomáticos de maneira bilateral, em acréscimo aos implantes convencionais na maxila anterior. Os procedimentos de implante ósseo podem ser evitados, resultando em uma prótesis maxilar fixa suportada por implante. Conclusão: uma solução lógica de tratamento consiste em 4 implantes zigomáticos para a maxila atrófica, especialmente ao considerarmos que o enxerto iliaco ósseo anterior foi reabsorvido.

PALAVRAS-CHAVES: maxila atrófica, prótese suportada por implante, implantes odontológicos endósseos, procedimentos de levantamento de ânigos.
吸収された顎骨窩の付着移植を再治療するための4片式骨科インプラント・サポート

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概要：
目的：本報告の目的は、妊娠した上顎に4片の顎骨インプラントを設置することによって起こる外科的・歯周科的的なプロトコルを簡略することにある。
素材と方法：過去に顎骨窩の骨片移植を受けその移植が吸収されてしまった53歳の女性患者のための、外科的・歯周科的的な再処置が説明される。
結果：上顎後部に、従来のインプラントに変えて4片の顎骨インプラントを2つ横に並べて設置することができた。術後1年間経過し、機能再建が成されていることが確認される。そのため現在インプラント支持による上顎後部を可能にした。
結論：以前の顎骨窩への骨片移植が吸収されてしまったことから、視覚的に良好な結果は、妊娠した上顎に4片式骨科インプラントを用いることを示す。

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