SUBPERIOSTEAL IMPLANT TECHNOLOGY: REPORT FROM RUMANIA

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KEY WORDS

Oral implantology
Oral subperiosteal implant

As a result of the progress made in the area of endosseous implants in the last 15 years, the value of the subperiosteal implant has been minimized. Yet endosseous implants are not appropriate for all patients in need of implants. Well-designed subperiosteal implants have been reported to function successfully for many years. Among the relevant factors contributing to the success of this method are implant design, atraumatic surgery, understanding of the involved anatomic structures, accurate impression techniques, and appropriate occlusal adaptations of the final prosthesis. This report reviews the design characteristics of successful subperiosteal implants and the anatomy of the areas upon which subperiosteal implants rest in both mandibles and maxillae based on recent research performed in Rumania.

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INTRODUCTION

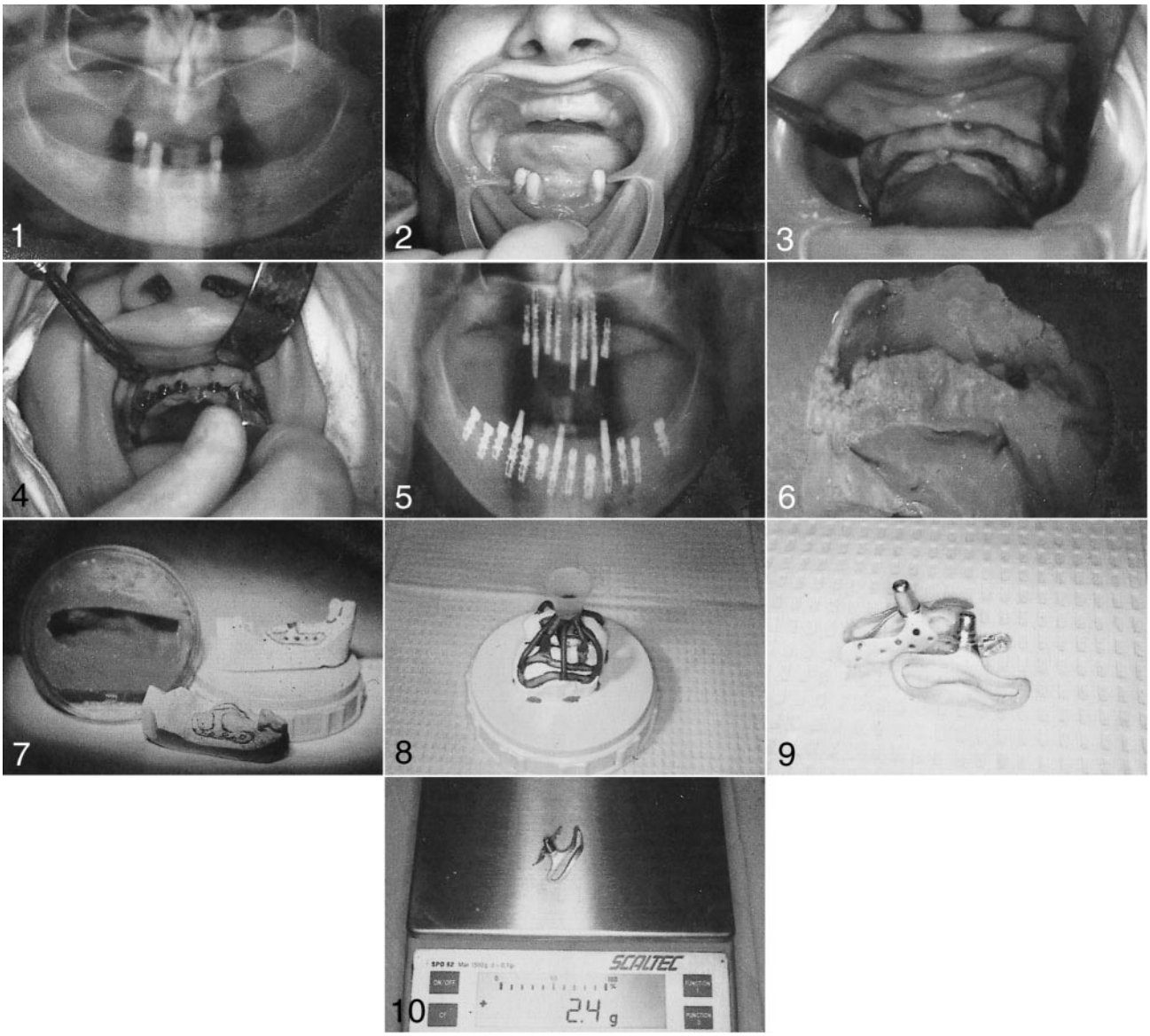
Bone morphology and texture play major roles in determining the success of subperiosteal implants. Placing the supporting points of castings (the peripheral struts) on a specified series of traditionally acceptable, dense anatomic sites plays a vital role in the longevity and success of the implant. Finding such dense areas in maxillae is more challenging than in areas of the normally denser mandibles. Linkow[1] has made valuable contributions to this method.

To ensure the success of the procedure, subperiosteal implants should be seated on the densest bone available. The density of the bone is often not appreciated during the period immediately following tooth extraction. In the posterior maxilla, for example, the bone quality is found to be coarse and cancellous in nature. Although surrounded by cortical bone, the enlarged antra of older patients are often thin, and thus less resistant to compressive forces. The best areas to place subperiosteal implants are between the two canine pillars, the zygomatic buttresses, and the anterior maxilla, particularly in the dense infranasal rims and up to the anterior nasal spine.

Although the first-stage operation requires an accurate impression, several transfer procedures are required in order to produce a model upon which the implant ''wax-up'' is directly made. This is the ''refractory'' model, which is created by a series of duplication processes. The accuracy of the casting is entirely dependent on the skill of the laboratory technician.

PATIENT SELECTION

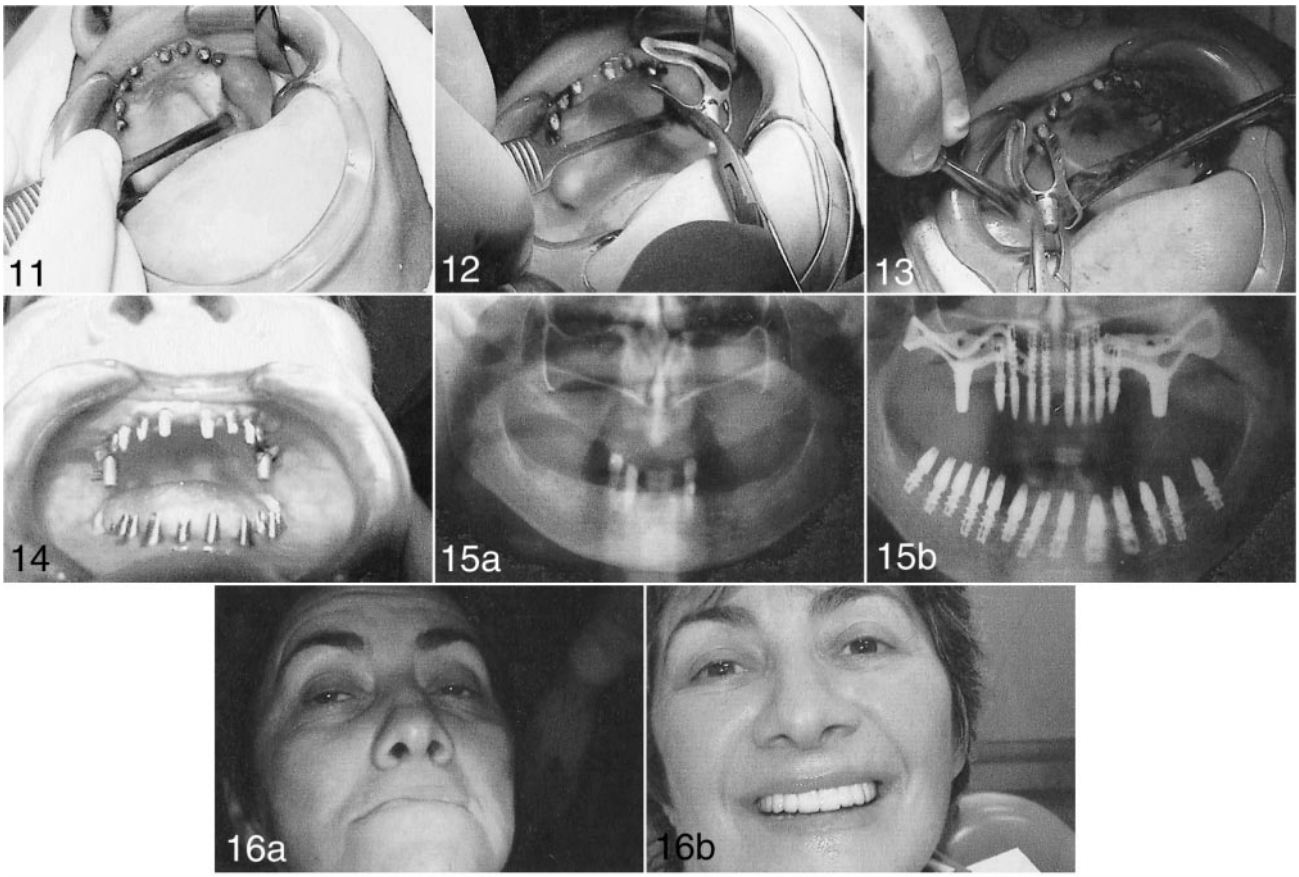
Radiographic studies should include periapicals, panoramics, cephalonetric,



FIGURES 1–10. FIGURE 1. Presurgical radiograph. FIGURE 2. Presurgical intraoral aspect. FIGURE 3. Intraoral view of the alveolar ridge after incision from 1 tuberosity to the other and reflection of the flaps. FIGURE 4. Eight endosseous implants in the anterior maxillary region. FIGURE 5. Postsurgical radiograph. FIGURE 6. An impression of the host maxilla. FIGURE 7. The working model and investment (refractory) model. FIGURE 8. The ''wax-up'' of the left subperiosteal implant. FIGURE 9. Both subperiosteal implants after finishing. FIGURE 10. The weight of these unilateral subperiosteal implants is 2.4 g.

occlusal, and CT scan, and the clinical examination must include orofacial and head and neck evaluations. A thorough physical examination is required to rule out any potential contraindications to the surgical procedure. Blood chemistries should be within normal limits and should include glucose, potassium, calcium, sodium, creatinine, urea, alkaline phosphatase, chloride, and albumen/total protein. There should be no active infections present. Patients with the following conditions should be excluded: alcoholism, history of stroke or myocardial infarction within the past year, valvular prostheses of less than 18-months' duration, end-stage renal disease, treatment-resistant osteomalacia, generalized osteoporosis, unstable diabetes mellitus, postradiotherapy to the face or neck, significant endocrinopathies, and drug addiction. Clinician discretion will determine whether patients with less severe conditions may be candidates for the target procedure.

In this study, 2 clinical cases are presented. The first patient is a 55-year-old woman with total maxillary edentulism and a Kennedy class I mandible (Figures 1–16). The second case is a 74-year-old woman with Kennedy class edentulism of both jaws. The remaining teeth are not salvageable due to severe periodontal disease (Figures 17–29).



FIGURES 11–16. FIGURE 11. The second-stage surgery: insertion of the abutments on the anterior implants at the same time as the incision and reflection of the mucoperiosteum of the subperiosteal implant. FIGURE 12. The placement of the left subperiosteal implant. FIGURE 13. The placement of the right subperiosteal implant. FIGURE 14. Insertion of the abutments and the unilateral subperiosteal implants. FIGURE 15. (a) Pre- and (b) postsurgical radiographs after the insertion of the abutments and the unilateral subperiosteal implants. FIGURE 16. (a) Before and (b) after treatment. The prostheses are fixed because the patient presents with excellent oral hygiene.

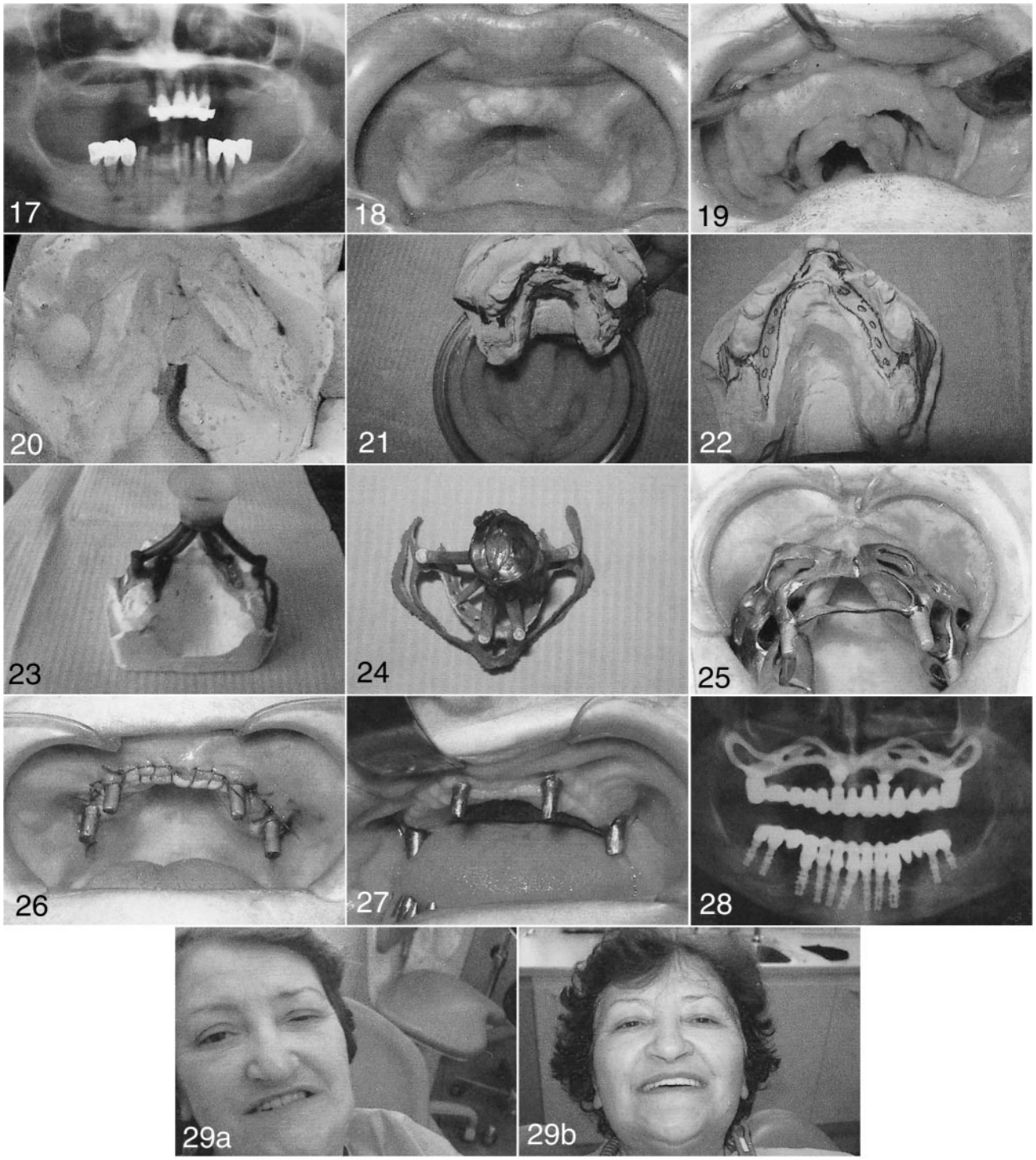
DESIGN CONSIDERATIONS

The peripheral or main struts must be designed to accommodate specific anatomic elements so that stability against vertical and lateral forces will be assured. The involved sites are the anterior nasal spine, the zygomatic buttresses, canine pillars, and the tuberosities. Selection of sites for primary strut placement must be limited to areas where the periosteum is firmly attached to the bone in order ensure early fixation of the implant. Implant castings should be as light as possible. Increasing the castings' weight contributes to decreasing success of the implant. The supporting struts (primary or peripheral) must be no greater than 2 mm in width or, if wider, contain fenestrations that will lighten the casting as well as offer additional areas for fiber ingrowth.

Struts must not be placed on exostoses, spinous or sharp bone angles, or other points of potential loss of vascularity in order to avoid irritation to the overlying soft tissues. Secondary struts, on which there are no abutments, must be at least 0.5 mm thick and 2 mm wide. Thinner widths of metal can cause bone resorption, wider widths may interfere with periosteal reattachment, and thicker widths may be responsible for metal dehiscence. Peripheral struts must be rigid, and if this characteristic contributes to greater width, then fenestrations are essential. In areas of high bone density, smaller and less numerous struts may be used.

Whenever possible in the anterior maxilla, individual vestibular extensions should be used, rather than the conventional type of continuous peripheral strut. With this design, each component remains somewhat independent. If a sectional problem arises, the individual portions may be resected, by simply cutting the connector, without jeopardizing the uninvolved remainder. In instances where secondary struts are not intimately adapted to bone, vital support areas may be grafted with hydroxyapatite or harvested bone.

Except for those rare patients without strong occlusal forces, or unusual esthetic demands, acrylic teeth should be chosen. Further, canine protection should be avoided and full cuspal guidance sought. It is not advisable to



FIGURES 17—30. FIGURE 17. Presurgical radiograph. FIGURE 18. Maxillary edentulous ridge. FIGURE 19. First-stage surgery: host bone after incision and reflection of the flaps. FIGURE 20. Silicone impression of the bone. FIGURE 21. Duplication of the master cast. FIGURE 22. The investment (refractory) model. FIGURE 23. The ''wax-up'' prepared for investment. FIGURE 24. The unfinished implant after casting. FIGURE 25. Placing the implant on the host bone. FIGURE 26. Postsurgical intraoral view. FIGURE 27. Intraoral view of the maxilla after removal of sutures. FIGURE 28. Radiograph after inserting the final fixed prostheses. FIGURE 29. The patient (a) pre- and (b) postsurgery.

restore subperiosteal implants using fixed prostheses, which can result in difficulty in performing oral hygiene, nonremovability, and lack of resilience during occlusion. The ideal occlusal anatomy employs acrylic teeth and utilizes 0° cuspal angulations. Anterior incisive guidance should be kept to a minimum.

In maxillae that have undergone significant resorption, the sinus, its membrane, and the posterior surface of the ridge form a triad that must be kept in balance. Bone resorption is arrested in the posterior maxilla when the infrastructure lies over the sinus wall. In the presence of significant bone resorption under a strut component, the region will become filled with dense avascular connective tissue, which may be curetted. If the tissue is difficult to reach, the overlying strut may be removed without threat to the entire device.

Tripodal implants, as devised by Wagner,[2] are of benefit in the mandible with dehiscent neurovascular bundles. The design embodies 3 separate islets: 1 on each side of the posterior mandible, depending on support from the external oblique ridge, often extending well lateral to it and covering some of the ramus cortex. The third islet is an anterior component designed to rest on the symphysis and genial tubercles. It is necessary to avoid the neurovascular bundles and mylohyoid ridges: the former because of the danger of dysesthesia, and the latter because of the fragile and poorly vascularized nature of the overlying mucosa. This design is of significant value for patients with exposed or dehiscent canals.

Surgical Procedures

The first stage of surgery involves taking a direct impression of the bone in order to create a model of the host's exposed implant site. The oral cavity is sterilized and appropriate anesthetic blocks are administered. The periosteum is incised by making a crestal incision fully around the arch. A vertical anterior relieving incision is required to facilitate reflection of the mucoperiosteal flaps. A sharp periosteal elevator is employed in order to reflect the flaps, thereby exposing the vital bearing areas. At this time small bone irregularities or protrusions may be corrected with bone files and rongeur forceps. After suitable retraction of the flaps, using cross tongue dorsum ligatures, an appropriate impression tray is made directly over the bone using autopolymerizing polymethyl methacrylate.

After the muscle is trimmed and trial seatings performed, an elastomeric impression is made of the potential bearing site. A counterimpression is made as well as a centric recording. The cast that is produced in stone from the impression is replicated in a refractory material (cristobalite) and mounted on a semianatomical articulator. The implant is designed as a wax-up. The model is then invested and the implant produced in a suitable metal. If the implant can be prepared for insertion on the same day, a second surgical procedure may be averted. If that is not possible, the tissues are irrigated with saline and the wound loosely closed with a continuous suture. Appropriate antibiotics and analgesics are provided, and standard home care instructions are issued.

The second stage of surgery is planned for 28 to 45 days after making the impressions in order to permit for placement of the implant casting. The patient is anesthetized using acceptable blocks after sterilization of the oral cavity, and the wounds are reopened using the same incision lines. After exposure of the host bone, the sterilized infrastructure casting is fitted. After the implant is completely seated, observation should indicate the precise relationship of its bearing points to the underlying cortex. At this point, careful suturing of the facial and lingual flaps will complete the procedure. In the regions of the abutments, purse string sutures are required to obtain intimate closure. This is essential in order to discourage retrograde infection or epithelial inversion. In many instances, a vertical or oblique relieving incision will be required to assure atraumatic reflections and to spare the tissues from traction-induced injuries. The appropriate positions for these incisions are generally just lateral to the midline in either jaw. If there are small defects between casting and bone, hydroxyapatite may be used to fill them; if there is a lack of retention, small screws may be used for primary fixation. When all remedial steps have been completed, closure may ensue using a continuous horizontal mattress suture with tight pursestrings at the abutment crevices. Postoperative antibiotics and analgesics are prescribed, and home care instructions provided. Postoperative care for implant patients should be conducted every day or 2 for the first 10 days, or at least until the sutures are removed.

Prosthetic Phases

Ten days after placement of the implant, sutures are removed and a temporary prosthesis may be inserted. At the end of 1 month, the final prosthesis may be placed. It should be comprised of an acrylic base, acrylic teeth, and retentive devices such as Hader or similar clips. Perfect occlusal relationships and balance are mandatory to ensure implant longevity. It is essential that the mucosal surface of the prosthesis does not come into contact with the soft tissues. If the denture becomes anything but completely implant-borne, there is significant risk of mucosal ulceration, dehiscence, and subsequent implant loss. Monthly checkups are required for the first 6 months, and less frequent examinations thereafter. The bite must be rebalanced when necessary and additional hygiene measures employed as needed.

Discussion

Currently in Rumania, the objective in subperiosteal implant treatment is the elimination of the first-stage surgery (ie, direct bone impression). Research has focused on bone replication with

the aid of the CAD-CAM method based on CT scanning. Some of the advantages of this approach are method simplification, the ability to obtain a simulation of the jaw bones, and the possibility of analyzing and using all of the true dimensions. However, in Rumania this method has had the disadvantage of a high degree of inaccuracy, with the resulting implants fitting poorly or not at all.

Subperiosteal implants have improved during the last few years; the percentage of success had risen dramatically thanks to new techniques and better implant design as well as a deeper understanding of the patterns of bone resorption. Especially important has been the development of techniques and materials that arose from the early chromium alloys to the present use of titanium, bringing with it the entire array of advantages that this material possesses.

CONCLUSION

In summary, the advantages of subperiosteal implants include the predictability of the results and the high success rate. This technique utilizes less invasive surgery and is therefore preferable to the use of iliac crest or tibial grafts. Alveolar ridges with severe atrophy can be reconstructed prosthetically. Partial subperiosteal implants can be used with endosseous implants and even natural teeth with fixed bridges. The surgical technique and clinical stages are not complicated, generally being mastered by implantologists in general dental practice.

Disadvantages include the frequent necessity for 2 surgical procedures and the initial complexity of the surgical procedures. This complexity presumes a certain level of experience that the practitioner can obtain only over a long period of time. The procedures require specialized technicians and a titanium smelting oven. Finally, removal of subperiosteal implants, although rarely indicated, can present difficulties. The importance and potential benefits of subperiosteal implants are undeniable, being at this time the only means of restoring jaws in situations where endosseous implants cannot be placed.

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