Remote implant anchorage for the rehabilitation of maxillary defects

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The rehabilitation of maxillary defects is a significant challenge in terms of creating retention and preserving existing dentition in an environment of expanded functional stress. The advent of osseointegration has enhanced the dental practitioner's capabilities in this regard with a remarkably improved potential for increasing prosthesis stability and preserving tissue. For patients with extensive prosthetic cantilevers, however, the opportunity for implant placement in defect areas is compromised unless remote bone sites are considered. Implants in the defect buttress zone through the maxillary sinus in non-defect sites (zygoma implants) can be valuable in providing a level of functional rehabilitation previously unattainable. (J Prosthet Dent 2001;86:377-81.)

Prosthetic anchorage for the restoration of patients with maxillary defects has been a consistent challenge for maxillofacial prosthetics. Residual dentition, when called on to support extensive cantilevers, can easily be traumatized to the point of premature failure if the off-axis load forces are not controlled. The subsequent loss of critical support for teeth can lead to a cyclic redistribution of adverse load patterns, which may eventually require searching for supplemental support to avoid creating an even more serious prosthetic complication for these patients. The edentulous defect patient, whether presenting with severe atrophy, a transoral defect, or both, can be especially difficult to treat because of the inherent limitations in retention options.[1-4] Aside from the liberal use of denture adhesives, extension into anatomic undercuts, vertical side wall engagement, and 2-piece magnet-retained obturators are the most effective means of creating stabilization, usually with limited success for these patients.

CONVENTIONAL IMPLANTS

The advent of osseointegration initially created a significant benefit in this area of rehabilitation through placement of implants in available maxillary bone.[5-9] Unfortunately, these anchorage sites are often limited because of resection or tissue loss, may be compromised by radiation of tissue beds, and may be localized in patterns that prohibit effective anterior-posterior spread and cross-arch stabilization (Fig. 1).[8,10-12] Subsequent investigation into the use of remote bone anchorage, either through the residual maxilla or in defect areas, has allowed more extensive bone support to be incorporated into prosthesis design, reducing cantilever stress and enhancing the cross-arch effect (Fig. 2). Unfortunately, these implants often project at divergent angles, which complicates impression and prosthesis construction procedures. The limitation in available implant lengths has also minimized the depth to which these implants can be placed through various tissue beds.

THE ZYGOMA IMPLANT

The zygoma implant is a product of the remote bone anchorage concept and originally was developed for use in patients with challenging maxillary defects. More than 12 years of follow-up at the Brånemark Osseointegration Center (Göteborg, Sweden) has demonstrated a remarkably high rate of success for this implant when it is used to support a variety of maxillary defect prostheses (Tables I and II). Although the life table analysis shows that the majority of these implants have been in place no longer than 6 years, the number of implants loaded and surviving in function is certainly encouraging. Both clinical experience and theoretical modeling suggest that effective axial loading of the zygoma implant is accomplished by cross-arch stabilization with a rigid splint framework using at least 4 implants with adequate anterior-posterior spread. While maxillary defect patients may not have ideal residual anatomy, it is important to attempt zygoma and standard implant placement in areas that will enhance the desired splinting effect of the bar assembly.

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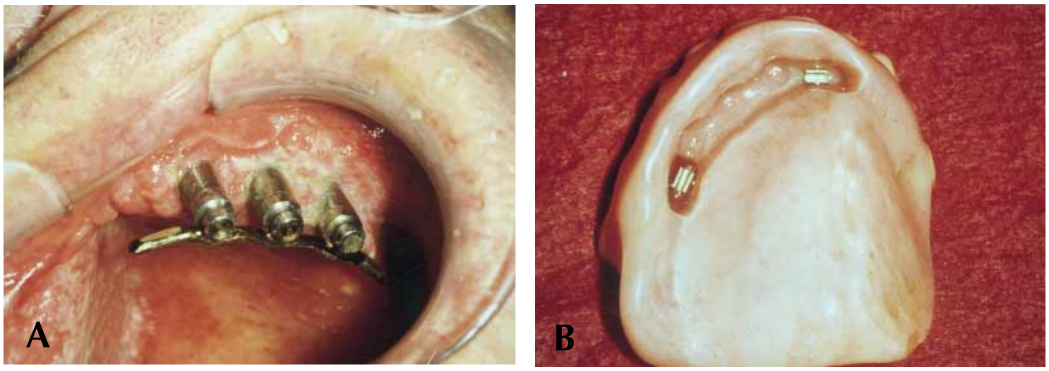

Fig. 1. A, Implants placed in residual ridge tissues can be effective in providing localized prosthesis retention. **B,** Unfortunately, because of large maxillary sinus and vascular flap over defect, it was impossible to use implants in posterior sites as means of extending retentive base without grafting.

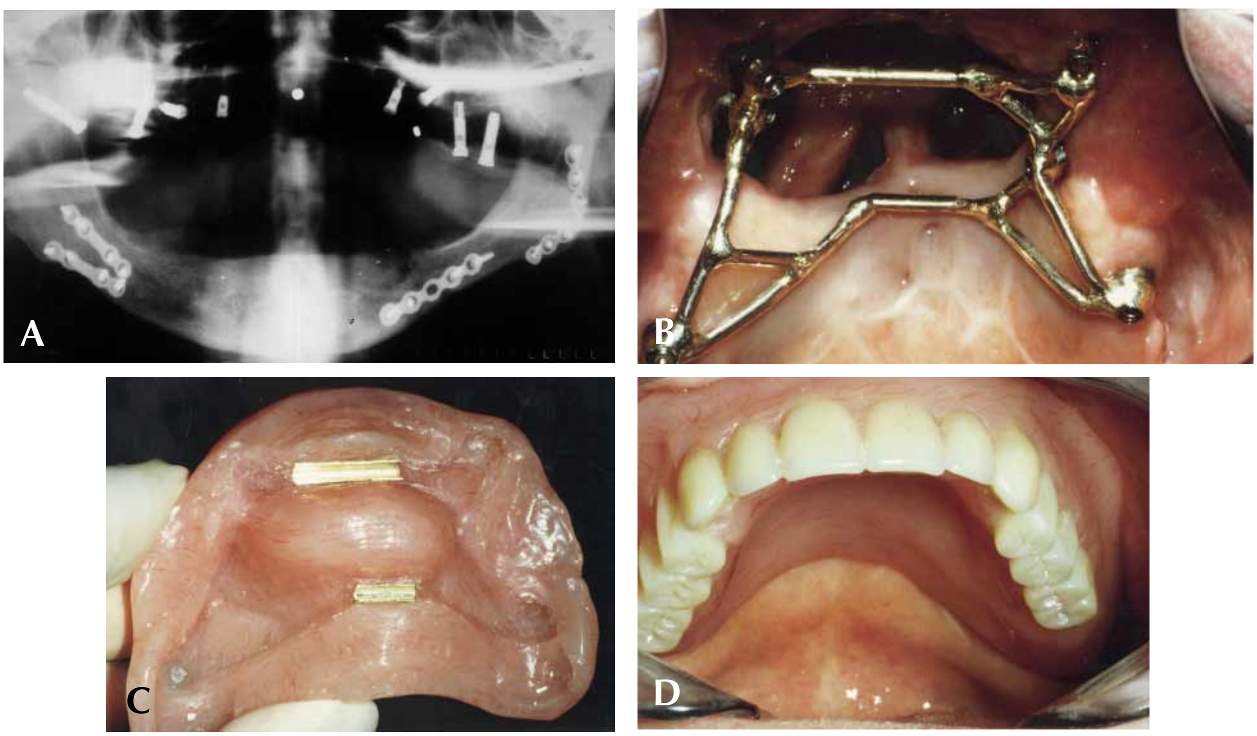

Fig. 2. A, Implants placed in remote bone areas such as zygoma and malar buttress can provide support for cantilevered prosthetic extensions and reduce stress to teeth or implants in native sites. **B,** Severe angulation may complicate prosthesis fabrication when conventional implants are used in available remote bone sites. Angled abutments may facilitate unencumbered path of insertion, or bar structures may need to be segmentally fabricated. This bar assembly was delivered in one piece by removing part of interfering gold cylinder contact area. **C,** Obturator was clip-retained in defect area and distally. Cross-arch stabilization of implants was accomplished with soldered, rigid bar structure design. **D,** Definitive prosthesis was stable, retentive, and significantly more functional than non–implant-retained edentulous obturator.

The zygoma implant requires intraoral access to the zygomatic buttress area through a trans-sinus approach. Once a suitable window has been created, piloting and implant placement are carried out with direct visualization of the receptor site from the sinus opening and tissue reflection to the exit area. Healing for inte-

Table I. Compromised maxilla data from Brånemark Osseointegration Center: implants placed in the zygoma region in patients with maxillary defects (24 maxillectomies, 3 cleft patients). Follow-up through June 2000.

Years	12	11	10	9	8	7	6	5	4	3	2	1	<1	Removed	Total
Implants	4	—	—	—	—	1	7	1	4	7	19	19	3	0	65*
Patients	1	—	—	—	—	1	4	1	3	3	7	6	1	0	27

*59 Implants, 25-60 mm in length.

Table II. Compromised maxilla data from Baylor College of Dentistry: implants placed in the zygoma region. Follow-up from April 1999 to September 2000.

Years	2	1	<1	Total	Loaded	Failed
Implants	2	1	1	4*	3	0
Patients	1	1	1	3	2	0

*4 Implants, 45-50 mm in length.

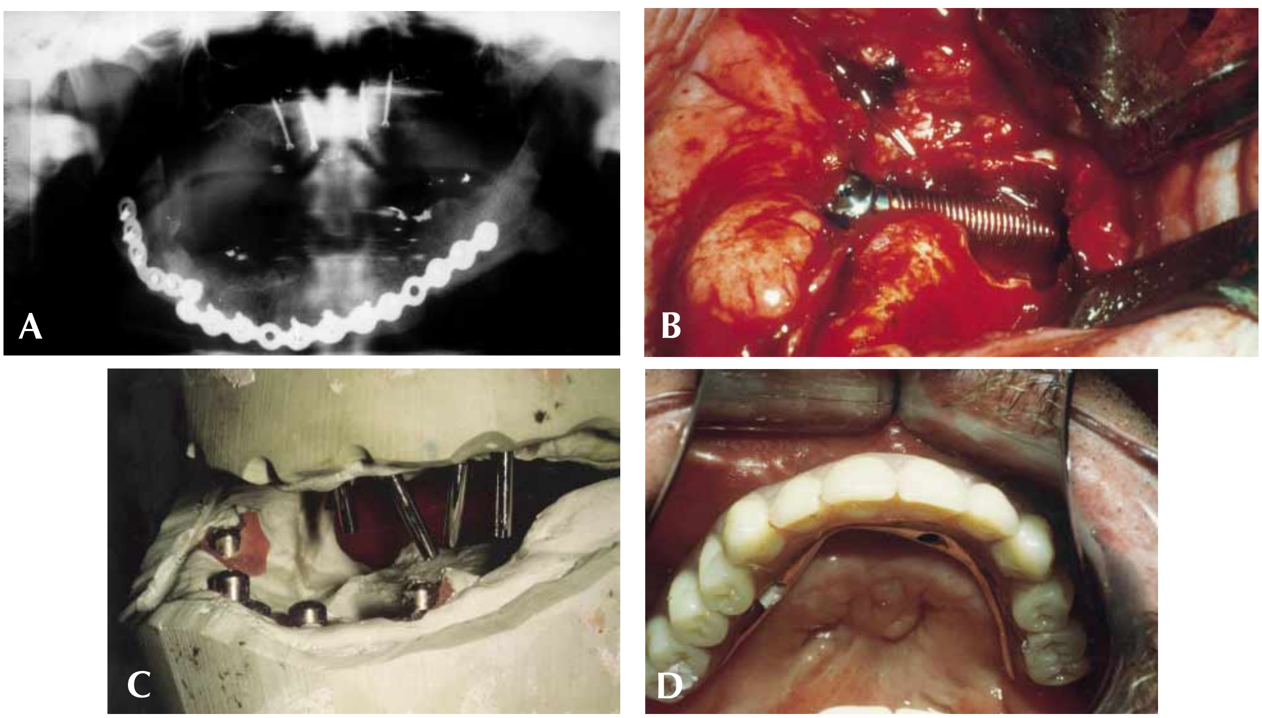

Fig. 3. A, This maxilla, severely altered by gunshot trauma and extensively grafted, was virtually unrestorable with conventional prosthetics. **B,** Zygoma implants were placed bilaterally with standard implants in available anterior sites. Alveolar bone anchorage was non-existent for left side zygoma implant. **C,** Although resultant angles were divergent, suitable path of insertion was made possible with use of standard abutments. Lateral jaw relation discrepancy was pre-existent. **D,** Definitive maxillary fixed prosthesis restored function with acceptable cosmetic result.

gration usually requires 5 to 6 months before impressions and subsequent prosthetic construction can be initiated. To minimize the complication of diverse angulations, the head of the zygoma implant has been engineered to allow prosthesis attachment at a 45° angle to the long axis of the implant. This creates the opportunity to keep the screw access sites relatively parallel throughout the span of the restoration. To avoid potentially damaging off-axis loading to these and the additional standard implants, it is important that a rigid bar or casting assembly be used to join the implants across the arch. Prosthetic

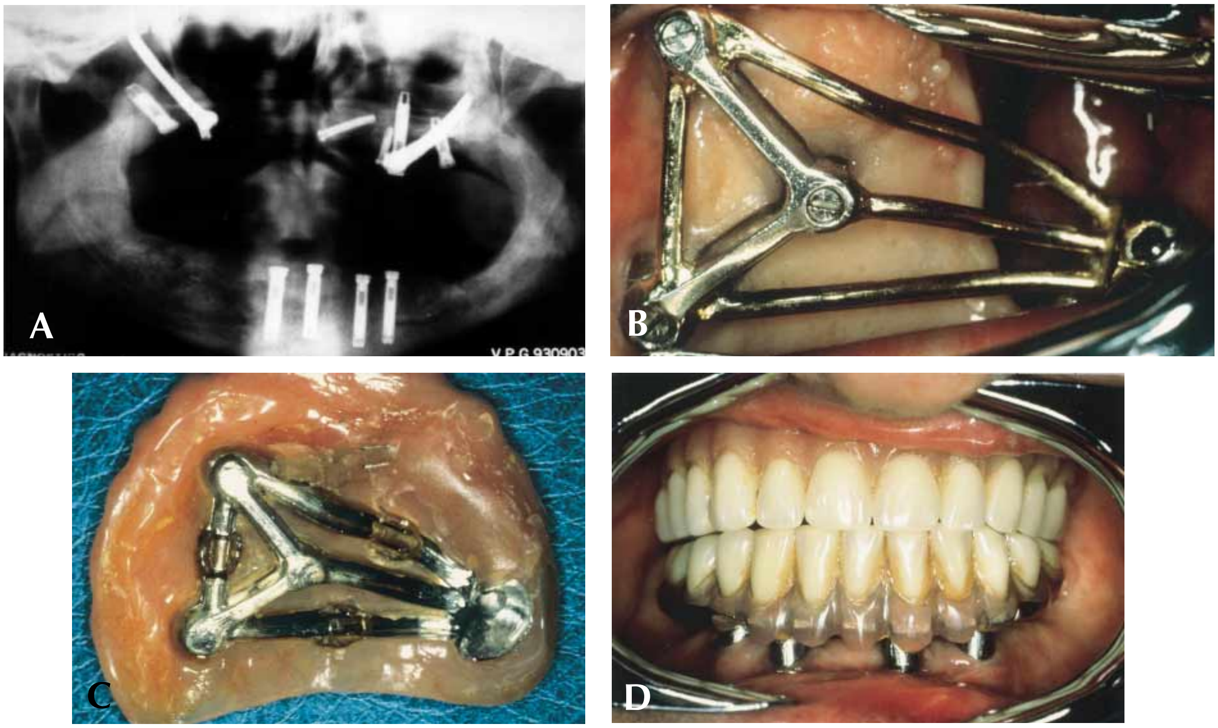

Fig. 4. A, Unilateral defect support was gained through combination of standard and zygoma implants in residual ridge and defect sites. **B,** Single piece bar splint was connected to implants with screw retention for cross-arch stabilization. **C,** Metal substructure housed clip assemblies in 3 sites for obturator retention. **D,** Completed maxillary obturator was opposed by implant-retained fixed prosthesis.

retention can be attained through a variety of mechanisms, which may include O-rings, precision or semi-precision attachments, magnets, or bar clips (Figs. 3 through 5).

SUMMARY

The evolution of osseointegrated implant concepts, as they apply to rehabilitation of maxillary defects, has been significantly enhanced with the use of implant support gained from osseous sites in remote locations. The most significant and immediate benefit of this approach is the ability to extend the prosthesis anchorage points into defect areas, thus minimizing the cantilever forces on teeth and implants in residual ridge tissue. The zygoma implant supplements this concept by creating effective retention in anatomic areas that might otherwise be unsuitable for implant placement without grafting.

Although continuing documentation of this concept with multicenter experience is still important in determining the specific applications and limitations of the zygoma implant, experience to date supports its effectiveness in the rehabilitation of this complex and challenging patient population.

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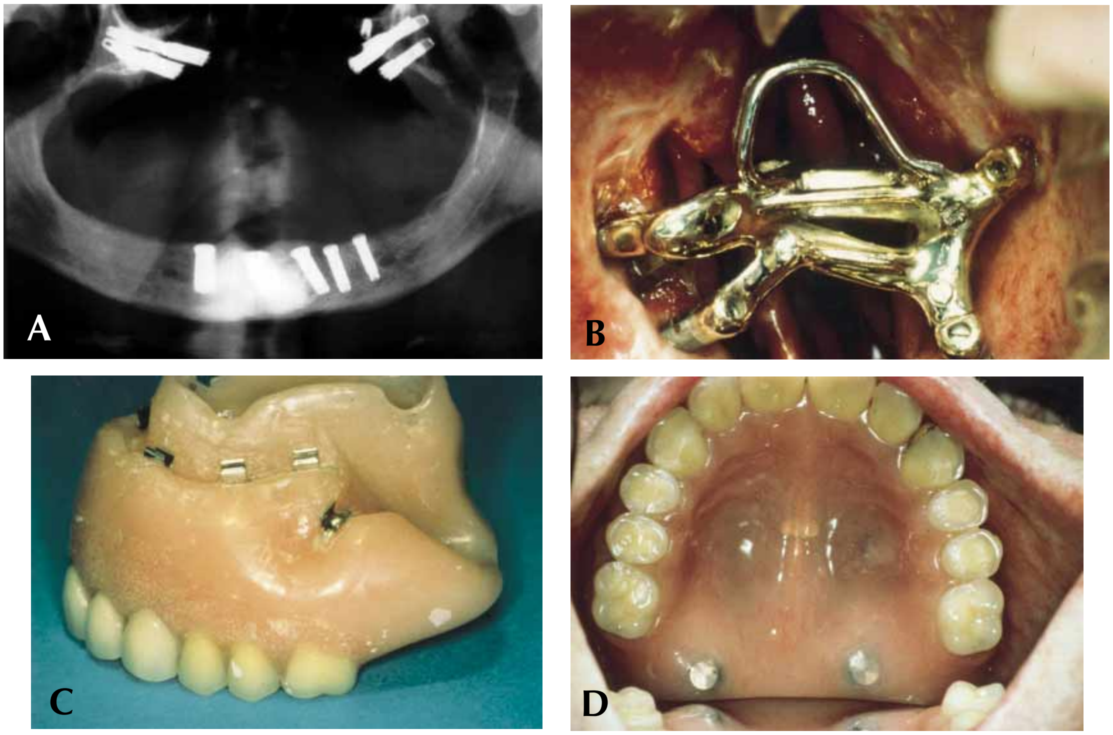

Fig. 5. A, Zygoma and standard implants were placed bilaterally in opposing buttress areas of large maxillary defect space created by tumor removal with subsequent radiation and site bone grafting. **B**, Extensive, rigid bar structure splinted implants and provided base for obturator retention. **C,** Prosthesis housed multiple bar clips in strategic locations for peripheral retention and effective defect obturation. **D**, Definitive result created functional effect that would not be possible in defect this size without implant retention.

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