



### A WORD OF CAUTION Osseointegration in Areas of Hydroxyapatite

By Thomas J. Balshi, D.D.S., F.A.C.P.

The occasional lengthy delay experienced in clinical data gathering, writing and publishing information in referred scientific journals can lead to outdated material at the time of printing. One such possibility is an article, authored by me entitled "Preventive Durapatite Ridge Augmentation for Esthetic Fixed Prosthodontics," *Journal of Prosthetic Dentistry*, September, 1987.

In an effort to establish the most ideal esthetics and improve function with prosthodontic treatment, and also provide patients with the most current scientific technology, the early 1980's led to the use of durapatite or hydroxyapatite as a form of pre-prosthetic and periodontal treatment. Many clinicians have used these materials for edentulous ridge augmentations, as well as treatment of infrabony pockets associated with periodontally compromised teeth.

The article reviews a very successful and practical use of the material and is illustrated with treatment that was typically performed for patients in the beginning years of this decade.

**A WORD OF CAUTION!!!** Most recently, however, the use of the Branemark method of osseointegration and the replacement of missing teeth with titanium submergible implants has proven extremely successful. The highly predictable prognosis is dependent on very specific surgical and prosthodontic requirements, in addition to an ideal biologic environment, the implant bed, in which the fixtures are placed.

continued on page 6

## International College of Prosthodontics— Scientific Session—Interlaken.

### ► Clinical and Fundamental Analysis Of a Newly Developed Magnetic Attachment

Yoshinobu Tanaka, D.D.S., Ph.D. and  
Kenji Hiranuma, D.D.S., Ph.D., Aichigakuin  
University, School of Dentistry, Nagoya, Japan

#### Introduction

Soon after the intervention of the rare earth magnets, Sasaki and his colleagues introduced them into dentistry. These small but very powerful permanent magnets were used in some ordinary and maxillofacial prosthetics for more than 10 years. However, conventional magnets such as ferrite or alnico were too large to obtain the appropriate attractive or repulsive force.

The development of the cobalt and samarium magnetic alloy has greatly extended magnetic retention in prosthodontics. In 1983, another rare earth magnet using *neodymium* was developed in Japan. This has proven to be even more powerful than the cobalt-samarium magnet.

#### Magnets With Caps

Since the rare earth magnets are made as a cylinder from a samarium, cobalt and iron alloy, or neodymium, iron and boron alloy, any size or form is possible. The attractive forces measured by static loads correspond to the size of the magnets.

The common problem to both is corrosion in the oral cavity. They tend to absorb hydrogen and are broken down, losing most of their attractive force.

This problem was solved by introducing a nickel-chromium encapsulating cover, 0.2 mm in thickness; however, the attractive force decreased by more than 40 percent. Because of its smaller size several pairs can be used to attain adequate retention.

#### Magnetic Attachment

The magnets used with simple protecting caps are the "open field" systems. Although it has the disadvantage of using only one pole of the magnet, this simple system is sufficiently effective.

The use of these magnets on teeth poses another problem. Generally, stronger forces are necessary for retainers of removable partial dentures. Since space for the magnet is limited, introducing a large magnet to obtain the adequate retentive force is impossible.

The "closed field" system is a method that uses both poles of the magnet for retention, thus more than doubling the attractive force.

Cylindrical neodymium magnets are encapsulated within a magnetizable alloy; for the yoke and keeper, 26 chromium ferrite metal was factory milled, and had continued on page 6

### ► Design of the Superstructure In Edentulous Cases Treated with Endosseous Oral Implants

Jorg R. Strub and Ueli Grunder,  
University of Zurich

Basically there are two different concepts of rehabilitation in edentulous patients treated with endosseous oral implants: The bone anchored fixed bridge (Branemark Method: T.I.P.), and the conventional designs were presented.

If patients are offered a luxurious solution, they not only have the right to good functional comfort but also to excellent esthetic results. After the abutment connection a temporary bridge (Conversion prosthesis described by Balshi) made out of acrylic used as a diagnostic tool helps to determine the position and the design of the final superstructure. This can continued on page 6

### ► New All Ceramic Crown Systems—An In-Vitro and In-Vivo Evaluation

Dr. Susanne Scherrer, University of Geneva

The CERESTORE®, DICOR®, and VITA HI-CERAM® systems have been subjected to an "in-vitro" and "in-vivo" analysis at the Geneva University Dental School. This comparative study consisted of measuring the cement film thickness on bucco-lingual cross-sections, evaluating the clinical marginal adaptation using an S.E.M. and replica technique, as well as observing the soft tissue response (crevicular fluid flow rate and SBI) to the different types of restorations. Each clinical group comprised between 22 and 26 units. Observation time was 3 years for CERESTORE crowns, 2 years for DICOR crowns, and 3 months for VITA HI-CERAM crowns.

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## Correlation of Dental Amalgam With Mercury in Brain Tissue

David W. Eggleston, D.D.S., and  
Magnus Nylander, D.D.S.

The mercury content of dental amalgam (approximately 50%) has created controversy regarding its safety for patients and dental personnel. Organic mercury compounds and elemental mercury vapor can cause central nervous system damage, and long-term exposure to mercury vapor from dental amalgam may increase the brain tissue concentration of this neurotoxic metal.

Examination of the cadaver dentition and collection of brain tissue specimens from nonrandomized, sudden, unexpected death subjects was conducted as part of routine autopsy procedures at the Los Angeles County Coroner's Office.

Data from this project demonstrate a positive correlation between the number of occlusal surfaces of dental amalgam and mercury levels in the brain.

Data demonstrate a 35% higher level of total mercury mean value in the gray matter (cortex) than in the total mercury mean value in the white matter.

The exposure of a 7-month-old fetus to mercury was documented by the analysis of brain tissue from a gravid cadaver. The cadaver dentition contained 14 total surfaces of dental amalgam with nine occlusal surfaces. Analysis of the mother's brain tissue revealed 6.7 ng/gm in white matter and 9.9 ng/gm in gray matter (cortex); analysis of the fetal brain tissue revealed 2.8 ng/gm in white matter and 6.7 ng/gm in gray matter (cortex).

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A 53-year-old, well-nourished, slightly obese white woman suffered multiple blunt-force traumas from an automobile accident, including a maxillary fracture and laceration of the mouth. A total of 30 surfaces (12.5 occlusal surfaces) of dental amalgam were present in the teeth. The victim survived approximately 1 hour after the accident. Duplicate samples measured the level of mercury approximately 1000 times the mean level of subjects in the cadaver study. Had this person survived the automobile accident, the level of mercury in the brain probably would have contributed to symptoms of erethism.

Emergency room physicians should be advised to check the blood levels of mercury in survivors of major trauma to the oral cavity associated with the presence of dental amalgam.

\**Journal of Prosthetic Dentistry*,  
Vol. 58, No. 6, December, 1987.

### Veterans Administration Cooperative Studies Project No. 147. Part IV: Biocompatibility of Base Metal Alloys

Participants of CSP No. 147  
Harold F. Morris, D.D.S., M.S.

Restorative alloys with a high percentage of nickel are relatively new to the field of fixed prosthodontics. These alloys have gained favor because of their strength and low cost. Although the problems with base metal alloys seem minor, there are concerns that longitudinal and epidemiologic studies may show biocompatibility problems in patient sensitivity, and carcinogenicity in the laboratory technician and dentist.

Nickel and chromium are known allergens. Sensitivity to nickel has been reported to vary from 0.8% to 20.7% in men and from 9% to 31.9% in women.

Intraoral exposure to allergens can be manifested in locations remote from dental restorations. The symptoms of the sensitivity range from urticaria, pruritis, xerostomia, eczema, or vesicular eruptions. These symptoms may cause the patient to visit a dermatologist who would be unaware of an intraoral source of the problem. Because a sizable percent of the population is already sensitized, the placement of these restorations without informed consent could have an unfavorable medicolegal impact on the dental profession.

The American Dental Association (ADA) has requested manufacturers place the following warning on all packages of base metal alloys.

**CAUTION:** As with all nickel-containing alloys, the use of this alloy should be avoided by persons with known nickel sensitivity.

In addition, the ADA has advised against the routine use of patch-testing of patients. The probable reason for this advice is that the patch test may cause a sensitivity reaction, and most dentists are not trained in the use of patch tests or their interpretation. Without this procedure at their disposal, the ability of dentists to identify sensitive individuals is severely

limited. Moreover, the cost of referral to dermatologists would counterbalance the economy of base metal restorations.

Some investigators have recommended that the dentist patch-test all patients who are to receive a base metal alloy. *The ADA does recommend* that all patients suspected of having a metal sensitivity be referred to a dermatologist. A patient who develops dermal lesions after insertion of base metal restorations may have legal grounds for court action if the patient was not informed of the possible problems of metal sensitivity. Therefore, it is the dentist's responsibility to inform patients who are to receive a base metal restoration of the alternatives to the use of base metal restorations. Each patient should sign an informed consent such as the following sample. (Check with your legal counsel for more detailed information.)

*Your doctor will be placing a crown that is made up of an alloy containing nickel and chrome. He is using this alloy because of its strength and economy. In some people, both nickel and chrome can cause allergic responses, which can appear as rashes and itching. These metals have also caused cancer in laboratory animals and have been implicated in the formation of lung cancer in humans.*

If the dentist still wishes to use base-metal alloys the following precautions should be followed:

1. Document the alloy in the patient's chart.
2. Screen patients by history.
3. Refer those with suspected sensitivities to a dermatologist.
4. Obtain an informed consent.
5. Wear a mask when adjusting metals, use high-speed suction, and have adequate ventilation.

\**Journal of Prosthetic Dentistry*, July, 1987,  
Vol. 58, No. 1.

### Two-Piece Cast Superstructure for Mandibular Osseointegrated Bridgework

Patrick J. Henry, B.D.Sc., M.S.D., F.R.A.C.D.S./  
Lorenz Schibli, C.D.T.

Because of the morphology of the edentulous jaw, it is not always possible to place the implants in an ideal position for the prosthesis. Surgical templates have been suggested (Balshi—*Journal of Oral + MaxFac. Surg.*, May, '87) as an aid in the placement of the dental implants. While some compromise is acceptable, situations do arise in which the resultant placement of the dental implants makes their subsequent prosthodontic management difficult, and in some cases impossible. Traditionally, dental implants that are unusable for prosthodontic restorations were submerged or removed.

The surgical positioning of dental implants and the prosthetic design of the replacement dentition superstructure must be coordinated.

The design of this superstructure can be developed and finalized through the use of a temporary acrylic resin fixed prosthe-

have been used for the restoration of the partially edentulous dentition, as well as the use of the Branemark tissue integrated prosthesis to restore the hemidentate arch.

The use of the tissue integrated prosthesis supported by Branemark fixtures for the restoration of the partially edentulous periodontally compromised dentition has been demonstrated with a patient study. Clinical and laboratory aspects of treatment include the diagnosis and treatment planning required for the use of the tissue integrated prosthesis to stabilize adjacent mobile teeth.

Laboratory points important to note include: casting design and fabrication, porcelain application, and especially the avoidance of porcelain particles in the access screw holes. Clinical points important to note include: the master impression technique, modification of the provisional restoration, verification of fit, delivery of the final tissue integrated prosthesis, and oral hygiene maintenance.

In the author's experience, all patients who have received a sectional tissue integrated prosthesis to restore partial edentulism have responded favorably to treatment and identify comfort and function as the most important aspects. In addition, many of these patients felt that the elimination of a removable prosthesis and its replacement with the osseointegrated fixed prosthesis had positive psychological benefits and a definite improvement in the quality of their lives.



Adjacent teeth stabilized with osseointegrated implants.

\* *Int. J. of Pros.* V1, #1; 1988:51-58.

## N.I.H. Consensus Development Conference

### Dental Implants—June, 1988

The use of dental implants to provide support for replacement of missing teeth is becoming an important component of modern dentistry. It has been estimated that the overall number of dental implants inserted in the United States increased fourfold from 1983 to 1987, and during that same period, the number of practitioners who perform implant therapy increased tenfold.

According to the 1985-1986 National Institute of Dental Research's (NIDR) national survey of oral health, approximately 42 percent of those 35 to 64 years of age are totally edentulous.

Traditional removable dentures or fixed bridges are not satisfactory for a significant number of individuals who have lost the tooth-bearing portions of the bone and simply cannot manage removable appliances. Moreover, there is a strong suggestion that a substantial number of patients prefer implant-supported prostheses over soft tissue supported prostheses.

The NIDR in conjunction with the National Institutes of Health (NIH) Office of Medical Applications of Research and the Food and Drug Administration convened a consensus development conference on June 13-15, 1988. They reported:

There is evidence from a number of case series studies that a large proportion of specific types of dental implants remain in place for periods of 10 years or more when inserted by clinicians experienced with the respective techniques. Additional knowledge about the biology of hard and soft tissues, coupled with technological advances in the construction and insertion of various implants, will likely result in a trend toward improved long-term success rates. The best reported long-term survival rates have been achieved with systems that have bone at the interface (such as the Branemark system of osseointegration\*).

With regard to indications for a specific implant type, the bone available to support the implant is the primary factor after prosthodontic diagnosis and treatment plan. Other factors affecting indications for implant type are the degree and location of the edentulism of the patient.

The panel recommends that the individual who assumes the surgical treatment phase be well prepared in accepted surgical methodologies. The panel also recommends advanced instruction in the prosthodontic phase of implantology.

This program also should include expertise in short and long-term tissue maintenance addressing gingival status as well as radiographic evaluation of tissue support.

Patient selection should be restricted to those patients who show a need and motivation for the implant procedures.

The panel supports the need for a multidisciplinary approach and recommended a pre-implant consultation involving professional participants with the patient. Post-implant procedures should include communication, monitoring, and collection of recorded data by the professional team. The panel recommended that the patient be thoroughly instructed in maintenance therapy with the understanding that the patient do oral self care.

Before surgery, a medical history should be taken to evaluate the history of the presenting problem and chief complaints. A review of the current status of the organ systems should be made. Factors related to prediction of health risks need to be continuously assessed before the surgical decision, after implantation, and at 6-month intervals throughout the followup period.

The release of constituent material from the implant may influence biocompatibility. To achieve a more complete understanding of tissue response to the implant, basic experiments in host implant physiology must be continued.

Among the factors involved in the design of an implant are the force components produced during loading, the dynamic nature of loading, and the mechanical and structural properties of the prosthesis. Such information is essential for appropriate design of implants.

The panel feels that one important method of accumulating accurate data on implant performance is to establish a National Dental Implant Registry, which will standardize reporting forms to collect information on this activity in the United States. Consideration also should be given to the establishment of centers for training, treatment, and research in dental implantology.

The public is entitled to educational materials that enable informed participation in implant treatment decisions.

The panel concluded that the indications and contraindications of various types of dental implants have been described. The complexity of the surgical, prosthodontic, and periodontal procedures used to successfully insert and maintain dental implants demonstrate the need for a multidisciplinary approach in this field. Long-term studies that concurrently compare various types of implants are needed to provide information beyond mere survival rates. Functional success of various implants should include such criteria as ability to support fixed or removable prostheses in the absence of discomfort, the presence of satisfactory esthetics, and clinical and radiographic evidence of tissue health.

\* Editor's comment.

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## Single Tooth Implant Supported Restorations

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Wynn P. Hornburg

The initial concept of the Branemark implant system provides adequate treatment designs for the edentulous mandible and maxilla with predictably successful results. However, the single tooth implant supported restoration has been an especially difficult one to achieve successfully because of problems of rotation and loosening, as well as esthetic compromises in the anterior region. The titanium abutment cylinder, as it emerges above the gingiva, is visible and often esthetically unacceptable.

A plastic cylinder that connects directly onto the Branemark implant fixture has been developed. Known as the "UCLA" abutment, this cylinder eliminates the use of the abutment cylinder and gold cylinder assembly. The plastic cylinder is incorporated within the wax pattern and allows the completed restoration to fit directly onto the implant fixture. The plastic abutment and wax pattern may be designed for porcelain-fused-to-metal, resin-to-metal, or an all-metal restoration.

The "UCLA" abutment allows placement of porcelain subgingivally on the final restoration and the final casting includes a hexagonal base to prevent rotation of the restoration.

The single tooth implant supported restoration fabricated with the "UCLA" abutment provides function and excellent esthetics, and maintains proper contours for oral hygiene.

When used appropriately, this technique can provide an extremely esthetic restoration with less opportunity for rotation and loosening when compared to the conventional method of connecting the restoration to the abutment cylinder.

\* *Int. J. Oral Maxillofacial Implants* 1988; 3:25-30.

## A Retrospective Multicenter Evaluation of Osseointegrated Implant Supporting Overdentures

Bo Engquist, D.D.S.  
Tom Bergendal, D.D.S., Ph.D.  
Thomas Kallus, D.D.S.  
Ulf Linden, D.D.S.

Fixed prostheses supported by osseointegrated implants ad modum Branemark have been used for many years in oral rehabilitation with excellent results. Varying clinical situations have also resulted in a demand for overdentures supported by fixtures.

An improvement in oral function, approaching the level of dentate individuals,

has been reported after rehabilitation of edentulous patients with fixed partial dentures supported by osseointegrated implants. In addition, the functional benefits of retaining and supporting complete dentures by radicular attachments have been clinically documented. Preliminary results indicate the functional benefits of this technique, by which it would be possible to provide the edentulous patient with a stable denture and increased load-bearing capacity with a limited clinical and financial effort. Furthermore, the overdenture concept may be advantageous in certain clinical situations, eg, severely resorbed upper jaws, unfavorable jaw relations, cosmetic enhancement, for phonetic reasons, and where maximal soft-tissue support is required.

This article summarizes the knowledge and clinical experience of different Swedish teams treating patients with overdentures supported by osseointegrated implants. It also constitutes a basis for further prospective studies on overdentures supported by fixtures. Eleven Swedish centers responsible for treating the majority of patients with overdentures supported by fixtures were invited to participate in this study. All teams were trained in the endosseous implant technique ad modum Branemark and used approximately the same follow-up routines.

The results indicate that the anatomic prerequisites are of utmost importance for the outcome of overdenture therapy. A lower and upper jaw with a resorption and bone quality gradation of 1 to 3 seems to be reasonably favorable. The development of more reliable diagnostic criteria for assessment of jawbone quantity and quality as a basis for implant treatment is therefore an important future project.

The results of the study showed that the investigated material exhibited a high occurrence of fixture losses prior to loading with prostheses and that failure rates on patients with inferior bone quality were considerably higher in overdenture therapy than earlier reported with fixed prostheses. However, in lower jaws, the failure rates were low, and well in accordance with failure rates reported for fixed prostheses. The study revealed that extreme bone resorption and poor bone quality were the reasons for choosing an overdenture as an alternative to fixed prostheses in two thirds of the cases. Unfortunately, the limited number of patients and length of the observation period did not permit a definite assessment of the success rate in relation to different attachment systems. As a complement to the investigation results, prospective comparative studies of different attachment systems for overdentures supported by fixtures are necessary.

\* *The International Journal Maxillofacial Implants* 1988; 3:129-134.

## Forces and Moments on Implant Pillars

B. Rangert, Mech. Eng., Ph.D.  
T. Jemt, D.D.S., Ph.D.  
L. Jorneus, Mech. Eng., M.Sc.

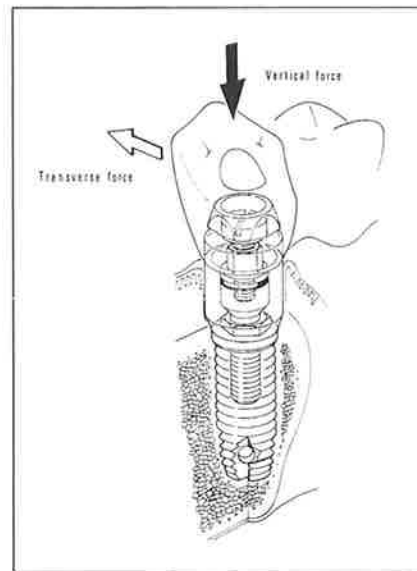
The dental implant developed by Branemark is extremely well documented as regards success rates. In order to maintain these good results when the system is used in an increased variety of clinical situations it is essential to consider the mechanical (engineering) aspects of the prosthetic bridgework.

The implant pillar consists of the fixture, the abutment and the gold cylinder, which are joined together by the abutment screw and the gold screw. This pillar has to transfer the occlusal forces into bone stresses. The design of the bridgework and the positions of the fixtures have a great influence on these stresses as well as on the stresses of the screws themselves.

In this article the fundamental mechanical parameters determining the load on the implant pillar are described. This paper concentrates on giving simple guidelines that can be used clinically, while taking the mechanical aspects of the system into account.

### Types of Load:

Mastication mainly induces vertical forces on the dentition. Transverse forces are also created due to the horizontal motion of the jaw and the inclination of the cusps.



### Two main types of loading of the pillar should be considered:

- (1) Axial force
- (2) Bending moment

The axial loading is the preferred type as it distributes the stresses more evenly throughout the pillar while the bending moment exerts stress gradients both on the gold and abutment screws as well as on the bone.

### Force and Bending Moment:

$$(1) \text{ Force} \times \text{Lever Arm} = \text{Bending Moment}$$

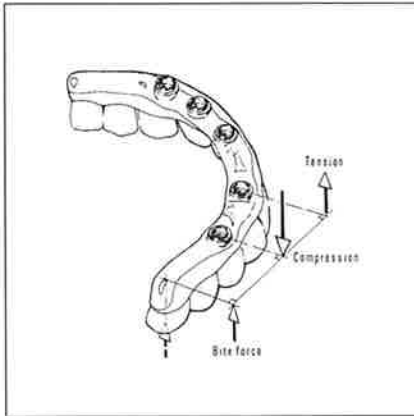
The resulting force on the pivot is the sum of the two forces acting on both sides.

To obtain an exact calculation of forces and moments on the implant pillar many mechanical parameters have to be considered. These include bridge, bone and implant rigidities. To solve such a problem a computer is needed.

Even if such a calculation should be carried out, one of the most important factors is still lacking in the analysis, namely the occlusion force itself.

The approach in this article is therefore to establish a basic approach by using the see-saw analogy so that a clinician can evaluate the fixture position and prosthetic design by simple means both prior to and during patient treatment. This simplification is conservative, which means that the real forces and moments are less than those estimated.

One design rule indicates that maximum leverage is about two times in the molar region corresponding to the clinical experience of approximately 20 mm extension in a full arch mandibular T.I.P. provided there is an inter-fixture distance in a posterior anterior direction of about 10 mm.



### Summary:

Important engineering concepts in implant prosthodontics:

1. With the use of the see-saw analogy, the loading of the implant pillar can easily be estimated.
2. If axial forces are mainly encountered, no component failures will normally occur.
3. If the loading mainly consists of bending moments, the mechanical load on the system may be excessive.
4. The placement of the fixtures is the key parameter for limiting the bending moments.
5. For well integrated fixtures, the weakest point in the system will be the gold or abutment screw, which should be regarded as a safety feature.

\* Submitted for publication.

### Chlorhexidine continued from page 1

Using chlorhexidine in each step of the process can help improve the long term success of the prosthesis, as well as make the procedure easier to perform.

The agent's clinical effectiveness against gingival inflammation is seen between the time patients agree to have crown or bridge treatment and the abutment preparation appointment. Since retraction cord placement is necessary to properly define the margins of the crown in the final impression, good tissue health is essential. Crown and bridge appointments are often set up at least two weeks in advance, which allows time to prescribe chlorhexidine to improve the gingival health of patients with inflammation and bleeding. This assistance in reducing disease prior to the crown preparation appointment reduces complications which saves time and frustration for both the patient and the clinician.

Provisional restorations can be a source of gingival irritation, which can increase the difficulty of cementing final crowns. Chlorhexidine can make the seating process easier and quicker by minimizing the plaque causing inflammation and bleeding around the provisionals. Patient use of Peridex during the time between the placement of the provisional crown and the final crown helps improve tissue health. This results in less discomfort

for the patient and a healthier and cleaner operating field. Upon procedure completion, prescribing an antimicrobial agent can help facilitate the return to optimal gingival health while the patient grows accustomed to proper plaque control methods around the new prosthesis.

Patients undergoing implant procedures can also benefit from chlorhexidine therapy. These patients can develop inflammation and plaque build up, which would increase the risk of implant failure. The formation of a biological seal is needed to seal off the endosseous part of the implant from the bacteria of the oral cavity, thus protecting the underlying bone and soft tissue. Since chlorhexidine is an excellent anti-plaque agent, regular use of the agent can help patients maintain their soft tissues while helping prevent plaque from accumulating on the titanium abutment. This regimen is especially applicable for patients who are unable or unwilling to perform adequate home care, such as those patients with poor hand-eye coordination or other disabilities.

In conclusion, oral antimicrobial agents such as chlorhexidine can provide the short term benefit to the prosthodontic practice of improving the quality of procedures, while providing the long term benefit of improved patient oral health and overall satisfaction with procedures.

### Composite Grafts continued from page 1

A review of 160 consecutive iliac crest bone grafting procedures found reduced donor site morbidity with the medial versus the lateral ilium harvesting approach, and found the bone quality, quantity and contours equal to the lateral iliac crest bone. In the immediate placement group, two of the five cases have been in function without complication for 10 months and 36 months respectively. A third patient has experienced loss of a portion of the bone graft and associated implants and is scheduled for re-operation in the near future. The fourth and fifth cases are without complication and scheduled for Stage II surgery in the near future.

The second maxillary group entitled "delayed placement" consists of five patients where interpositional iliac bone grafts were placed after LeFort I osteotomy down fracture of the residual maxilla.



*Interpositional bone graft*

Following 6 to 12 months of bone healing Branemark implants are placed through the residual ridge into the previously placed iliac bone grafts. Three out of five of these patients have been functioning without complication for over two years and a fourth patient is scheduled for Stage II surgery in the near future. A fifth patient has recently received her prosthesis.

Five mandibular patients were operated where iliac bone grafts and Branemark implants were placed in combination. Four of the five patients involve mandibular discontinuity which have been treated initially by blocks of iliac cortico-cancellous bone grafts followed in 6-9 months by Branemark implant placement. The fifth patient involves a severely atrophic mandible where simultaneous placement of an onlay bone graft and Branemark implants were placed. Three of the five patients have been in function without complication 12 months, 20 months and 36 months respectively. The remaining two patients are awaiting Stage II surgery.

In summary, 15 patients were operated where implants have been placed in combination with autogenous iliac bone grafts. In ten maxillary cases, only 10 of

*Continued on page 6*

**Composite Grafts** Continued from page 5

the 54 placed implants were removed. Five of the ten removed implants involved onlay type grafts with simultaneous implant placement where the implant did not extend into host bone. All of the patients where implants were removed were nonintegrated at State II surgery and all patients who lost implants are functioning well with a prosthesis on the remaining implants. Loss of the remaining five implants were in the delayed placement group and involved areas where the previously placed bone graft had undergone partial resorption prior to implant placement. The increased loss of implants in this group of grafted patients has justified the practice of placing an additional number of implants when feasible than generally placed in non-graft patients. It is important to also place implants through the bone graft into residual host bone whenever possible. To date, the author has lost all implants (5) which contacted only grafted bone.

In the five mandibular patients involving 28 implants, no implants were removed and three of the five patients have been in function 12, 20 and 36 months respectively.

In this group, the donor and recipient site surgical technique required a demanding and exacting attention to detail. Long operating time, increased graft handling and shaping, and excessive heat generation are all negative factors influencing bone graft survival. The grafted bone must be firmly fixed to the residual bone and covered with well vascularized soft tissue. The bone graft should ideally contain both cortical and medullary graft material and bone cutting must preserve vital cells in both the graft bone and residual jaw. Adequate healing time must be allowed prior to prosthetic loading, currently, 6-12 months healing time from bone grafting to implant placement (in the delayed placement group) and 6-12 months from the time the implants are placed in bone graft to uncovering and prosthetic loading. It is noted from previous clinical research in Goteborg, Sweden and this clinical study that implants which engage both the grafted and residual jaw bone appear to fare much better than the implants which engage only the grafted bone. In mandibular discontinuity cases, implant placement must be placed entirely in grafted material, which is one critical factor favoring the procedure where graft placement and implant placement are separated by a 6-12 month healing period. In contrast, onlay bone grafts for severely resorbed maxillary and mandibular ridges can be reconstructed in one step as the implant can engage both grafted and recipient site bone.

Initial results are optimistic in the belief that bone grafting and implant

placement into grafted bone if properly staged can give predictable results. The prosthetic success from the patients' viewpoint has been dramatically improved since implants have been added to the bone grafting protocol. Long term results await further study and follow up documentation.

\* Presented at the Annual Scientific Session of the Academy of Osseointegration, Dallas 1988.

.....  
**"Osseointegrated"** continued from page 1

radial and mandibular sites in mature dogs. Implants were left submerged in bone for 4-7 months to allow healing in the absence of direct loading. Half of the implants in each dog then were subjected to 5-7 days of cyclic axial loading, applied *in vivo* by computer controlled pneumatic devices. Axial loads (50 to 110 N) were applied at 1/2 Hz for 500 cycles/day. Fluorochrome bone labels were given pre- and post-loading. Interfacial tissues of loaded and control implants were studied via light microscopy and SEM (analysis done at approximately 3 weeks after the loading period). Histomorphometry of interfacial tissues were performed using hardware and

software developed for this purpose. Measurements were made of these descriptors of interfacial tissue morphology: % direct bone implant contact, % soft tissue in interfacial regions, and % interfacial bone having pre and post load fluorochrome.

All implants showed appreciable regions of close bone apposition to titanium without detectable interfacial soft tissue. On average, there were no statistical differences between loaded and control interfaces. Furthermore, there were no statistical differences between loaded vs. control cases in terms of the average % interfacial soft tissue and % labeled bone in the interfacial region. There was about 66 times more labeled bone at the interface compared to regions of bone a few millimeters away from the interface. In conclusion, the known biomechanical differences between loaded and control interfaces apparently were not sufficient to provoke differences in the measured descriptors on the interfaces, under the experimental conditions used in this study. Unanswered, however, is the question concerning interfacial responses to larger axial (and lateral) forces.

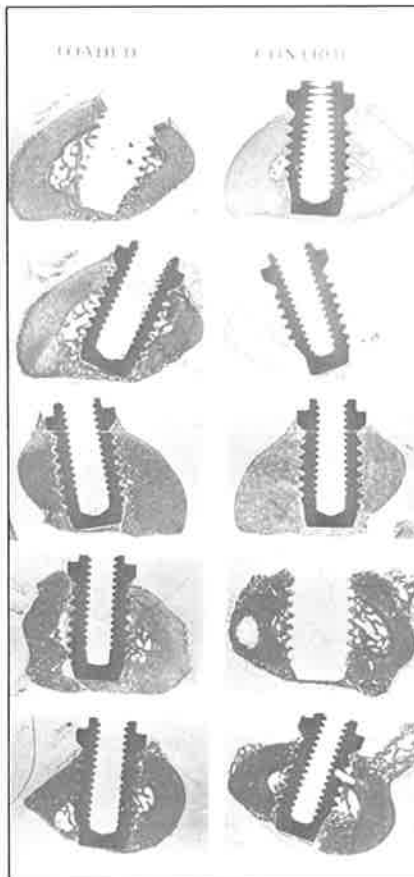
\* Presented at the Annual Scientific Session of the Academy of Osseointegration, Dallas 1988.

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**Biomaterial** continued from page 1

interaction properties with respect to water and biomolecules.

The surface chemical composition and microstructure can be analyzed down to atomic level resolution by employing state-of-the-art surface analysis instrumentation and electron microscopy. Preparation methods are available that can be used in combination with the analytical techniques to tailor implant surfaces for different applications. The major obstacle towards using this potential is the lack of knowledge about how different surface properties influence the tissue response. Systematic search for correlations between implant surface properties and tissue response is therefore one of the most important tasks in current implant/biomaterials research.

\* Presented at the Annual Scientific Session of the Academy of Osseointegration, Dallas 1988.



*Representative histologic sections of the interfacial regions of loaded and control fixtures in canine radii. The sections are made from embedded, undecalcified specimens using a modified hand grinding technique.*

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