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PROSTHODONTIC Insights

Osseointegrated Implants Used to Replace Failed Endosseous Implants

Thomas J. Balshi

As a continued effort to present valuable information regarding the use of osseointegrated implants for prosthodontic reconstruction, the following patient example illustrates several interesting aspects of care.

Upon initial clinical presentation this patient was 66 years old. She was in excellent general health. Her chief complaint was dental pain on function and poor esthetics. Her pain and swelling in the mandibular arch was associated with a failing Blade implant (figure #1) and a failing single crystal Sapphire implant and periodontally hopeless teeth in the maxilla (figure 2C).

In assessing this patient's condition, one should consider carefully the failing endosseous implants in the maxilla and mandible. The attachment mechanism of these implants appears to be the most logical reason for failure. Essentially, there are four basic mechanisms for the attachments of implants.

1. *Through a highly differentiated fibrous attachment.*
2. *Through a low differentiated fibrous attachment.*
3. *Through the use of artificial fixatives such as bone cement, typically, methyl methacrylate, as used in orthopedic procedures.*
4. *Direct anchorage to vital bone, which we now refer to as osseointegration.*

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Osseointegrated Implants In Edentulous Jaws: A 2-Year Longitudinal Study

J. Ahlqvist, et al

The most extensive long-term study of osseointegrated implants ad modum Branemark covers 1,997 implants in 284 patients. This report indicates persisting anchorage function of the implants in 81% of maxillary implants and in 91% of mandibular implants at observation periods of 5 to 9 years. Few follow-up studies of implants ad modum Branemark have been made outside the Branemark research group. The aim of the present investigation was to assess fixture survival, prosthesis stability, and marginal bone loss in a prospective study of patients treated at the University of Umea.

Osseointegrated implants in 50 edentulous jaws were studied during a 2-year observation period. The implant survival rate was 89% in the maxillae and 97% in the mandibles. No losses of osseointegration occurred in the mandibles, and it may be debated whether the five removed ossecintegrated implants should be recorded as failures. If not, the survival rate would be 100%. The marginal bone loss averaged 1.7 mm in the maxillae and 1.1 mm in the mandibles. Most of this bone loss occurred during the first year. The bone loss was greater in jaws with a preoperatively minor resorption of the alveolar ridge than in those with moderate or advanced resorption.

The bone loss was also greater at the medially positioned implants than at those more posterior. These findings suggest the need for considering the biomechanical effects of prosthesis extensions when planning prosthesis design.

Int J Oral Maxillof Implants 1990; 5; 155-163

Immediate Fixed Interim Prostheses Supported By Two-Stage Threaded Implants: Methodology and Results

P. A. Schnitman, et al

A stress-free healing period of from four to six months is considered to be one of the most important conditions required for osseointegration to occur between a dental implant and bone. During this healing period, the patient wears an interim, removable denture to restore masticatory function. This is unacceptable for many patients who may undergo significant psychological or functional trauma from wearing dentures during this interim phase. The discomfort, inconvenience and anxiety caused by dentures in this patient population can be of serious concern. Additionally, these interim dentures may, in fact, transmit undesirable pressure to the submerged implants.

An approach was developed that overcomes these limitations, offering an alternative to the transitional removable approach. Five or six Nobelpharma Branemark fixtures were placed between and two additional fixtures were placed distolingual to the foramina. Abutments were connected at implant insertion to these two fixtures and to one fixture in the symphyseal region. The remaining fixtures were allowed to heal in the conventional manner. A previously constructed mandibular denture was converted to a fixed bridge supported by these three implants. This method was successfully applied in seven patients who were reconstructed with mandibular fixed-detachable bridges without ever wearing a removable prosthesis. The overall, long-term implant therapy was not adversely affected by this technique.

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Integration of Titanium Implants in Irradiated Bone Histologic and Clinical Study

M. Jacobsson, MD, PhD, et al

A combination of radiotherapy and surgery is the treatment of choice for malignant tumors of the maxillofacial region and the ear. Since 1979, 61 patients have had fixtures installed in the maxillotemporal area at the University of Goteborg, Sweden. Of these patients, nine had undergone irradiation treatment prior to fixture installation. The time span between irradiation and insertion of the titanium fixture ranged from 9 months to 37 years.

Preoperatively, the head and neck surgeon, the prosthodontist, and the prosthodontic technician conferred to determine the best site and the best direction of the retention elements. A surgical technique to ensure minimal tissue trauma was used. The number of implants varied according to the demands of the host site, but in most cases three to five fixtures were used. The bone surface was exposed, the hole was gently threaded with a titanium tap, a titanium implant was inserted, the periosteum was sutured over the implant and the skin was closed. A minimum of 9 months was allowed before the second stage was performed. At that time subcutaneous tissue reduction was performed, a hole was punched over each implant through the skin and a

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Current Interface Research and Treatment of Peri-Implantitis

R. M. Meffert

In an attempt to determine the presence or absence of a perimucosal seal in dental implantology, Soileau et al seeded gingival epithelial cells at 75,000 cells/ml onto the surfaces of titanium, titanium alloy, plasma sprayed titanium, single crystal sapphire, smooth and rough hydroxyapatite with and without a collagen coating. When documented at 20 hours, an analysis of 10 fields, material concluded that human gingival epithelial cells adhered 3 times more frequently to the hydroxyapatite and sapphire surfaces than to metallic or titanium type implants. The addition of collagen seemed to enhance cellular growth and mitotic activity. Thomson-Neal evaluated the effects (in vitro) of various prophylactic modalities on different implant surfaces such as commercially pure titanium,

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Direct Bone Anchorage of Oral Implants: Clinical and Experimental Considerations of the Concept of Osseointegration

T. Albrektsson & L. Sennerby

The term osseointegration is analyzed in relation to its theoretical and clinical definitions, and comparisons are made to other implant modalities. The term osseointegration has a clear clinical meaning, but there is doubt about its precise usage in an experimental setting. From a clinical standpoint, there seems to be a clear reason to separate stable and unstable implants. The former have been shown, at least with some designs, to have acceptable success rates for follow up times of 5-15 years. At least in the case of mandibular implants and presumably with maxillary implants placed in good bone, it seems that a relatively steady state is reached. Very few implants

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Osseointegrated Implants in the Treatment of Partially Edentulous Patients: A Preliminary Study of 876 Consecutively Placed Fixtures

T. Jemt, et al

The object of this clinical study was to document the success rates obtained in the treatment of partial edentulism using the osseointegration technique. The study included all partially edentuluos patients treated and annually followed at the Branemark Clinic from April 1968 to December 31, 1988. A total of 876 consecutively placed fixtures was followed in 268 partially edentulous jaws of 244 patients. The majority of fixed prostheses and crowns were not mechanically connected to adjacent natural teeth and were allowed to assume the occlusal load independently from tooth-supported restorations. Twenty-four of 712 fixtures, exposed at the abutment connection, were lost (3%); the continuous prosthesis stability was 98.7%, as only four of 293 prostheses were removed. The results of this study indicate that the Branemark osseointegration procedure can be used to treat partially edentulous patients with the same positive results as previously documented for edentulous patients.

Abstracted by R. Seals for IJP:3:1:1990

Oral Function in Patients Treated with Prostheses on Branemark Osseointegrated Implants in Partially Edentulous Jaws: A Pilot Study

M. Tzakis, et al

Recordings of the masticatory efficiency and occlusal perception of thickness were performed to study the oral function of partially edentulous patients treated with fixed prostheses on osseointegrated implants. There are obvious methodological advantages when using patients treated with fixed retrievable prostheses supported by implants in studies related to masticatory function since these prostheses are easily removed. This allows immediate recording of the masticatory function after removing significant areas of support which represents a new study approach.

Participants in this study had a mean masticatory efficiency of 49.2% with an individual range from 23.8% to 67.1%. Results from a previous study on healthy, completely dentate individuals show a higher mean masticatory efficiency (70%). This difference is statistically significant ($P \leq 0.01$). The difference could be explained by the use of composite resin for the occlusal surfac of the prostheses, providing less pro nounced cusps, or by the implants themselves. However, the difference between naturally dentate persons and this study

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Implants In The Treatment of the Maxillofacial Patient

J. Anderson

The burden of illness among maxillofacial patients is based less on their numbers and more on the enormous impact of the anatomic and functional losses that affect virtually every aspect of these individual's lives. Whether through an accident of birth, trauma, or aggressive ablative surgery, these people present the prosthodontic community with its ultimate challenge. How successful have we been in the treatment of maxillofacial prosthetic patients? And can we document this success in a convincing manner?

Despite the apparent advantages pro vided by implants to the maxillofacia patient, complete documentation of these

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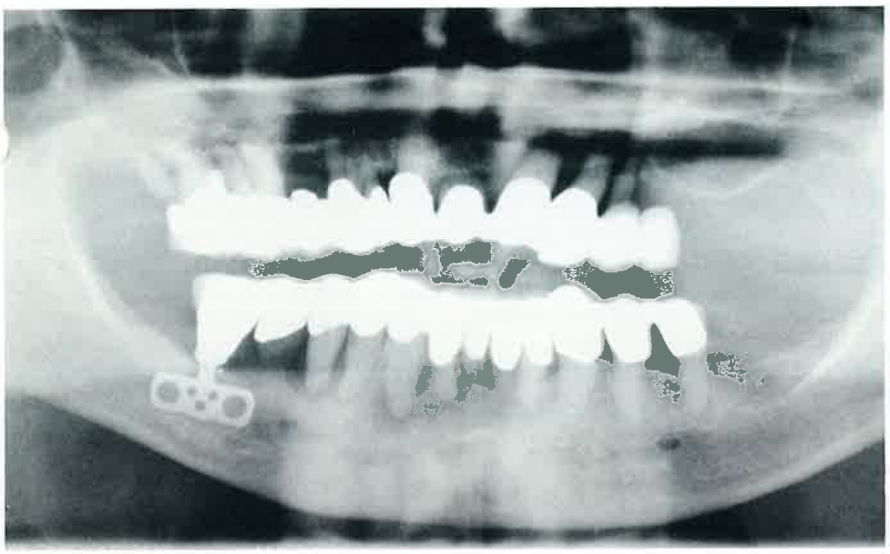

Figure 1: *Pre-operative panradiograph illustrating mandibular left failing implant and maxillary right single crystal Sapphire implant connected prosthetically to periodontally hopeless teeth.*

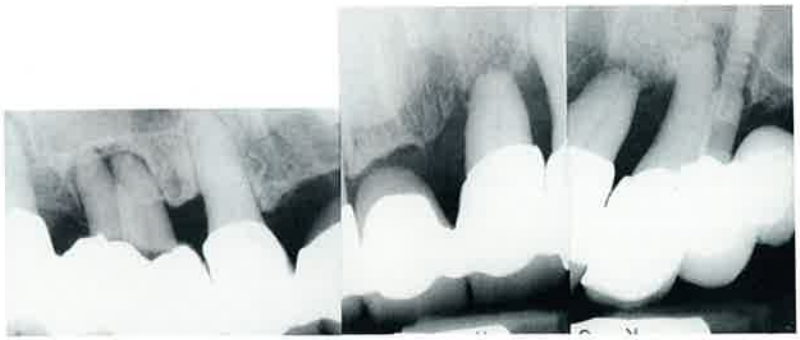

Figure 2 A-C: *Periapical radiograph showing periodontally hopeless condition of the maxillary dentition and the radiolucent lesion surrounding the failing single crystal Sapphire implant (2-C).*

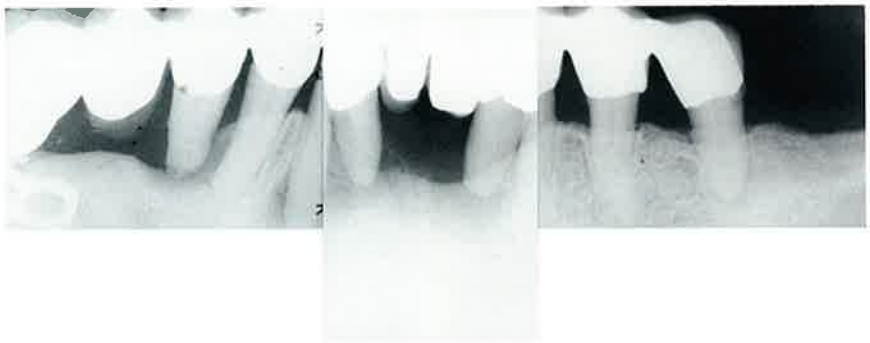

Figure 3 A-C: *Periapical radiographs illustrating the mandibular failing Blade implant (3-A) and periodontally hopeless dentition.*

Failed Endosseous *(continued)*

The history of the use of traditional implants, such as the Blade implant, tends to produce chronic complications. These include a rejection mechanism, evidenced by low differentiated connective tissue separating healthy bone and the implant. When a soft tissue interface occurs between a loaded implant and the bone, a local inflammatory reaction begins. The long term persistence of this can lead to osteitis and eventually severe bone loss.

Considering both arches, this patient's prime concern focused on the failing mandibular left posterior. In addition to the mobile Blade implant, the patient was suffering from chronic pain, and moderate swelling in conjunction with some parasthesia to her lower lip.

The Blade implant was apparently anchored by regenerated soft tissue creating an interface between the implant and bone. This simulated periodontal ligament, or fibro-osseous attachment, was not capable of withstanding the mechanical forces of occlusion.

In the maxillary arch, fractured roots and severe periapical lesions were evident (figures 2 A, B & C). In the maxillary right canine area, the failing single crystal Sapphire implant was providing no support and functioned as the focal point for chronic infection.

From a psycho/social standpoint, this patient strongly rejected the concept of wearing a complete removable denture and insisted on proceeding with osseointegration treatment under the Class III modification of the Branemark technique. Using this concept, the failing Blade implant was allowed to remain in place during the first stage of mandibular reconstruction. The treatment plan called for the placement of six titanium fixtures, five in the anterior mandible between the left mental foramen and the right canine. The sixth fixture was placed in the bicuspid region anterior to the right mental foramen (figure #4). First stage surgery was accomplished following the removal of most of the periodontally hopeless teeth and the placement of an acrylic provisional restoration (figure #5).

Similar treatment was performed in the maxillary arch. Three periodontally hopeless teeth were retained for an interim period to support a non-removable acrylic provisional restoration during the six months of osseointegration. In addition, the maxillary arch used a concept of pterygomaxillary fixture installation for posterior support distal to the maxillary antrum.

Three months following the placement of fixtures in the mandibular arch, second stage surgery was completed. A traditional Branemark fixed prosthesis

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Failed Endosseous *(continued)*
was fabricated for the mandibular arch. The distribution of the titanium fixtures was predicated on the position of the remaining failing Blade implant and the two periodontally hopeless abutment teeth used to stabilize the interim provisional restoration.

The maxillary reconstruction was accomplished six months following fixture placement. Unlike the traditional Branemark bone anchored bridge, this prosthesis was constructed of porcelain fused to gold.

Several minor complications occurred during the treatment process. Immediate post-op swelling and severe ecchymosis followed both first and second stage surgeries. Cheek and lip biting were evident for several weeks following the restoration of the patient's lost occlusal vertical dimension. This condition was readily resolved as the patient adapted to the rehabilitation.

During the first year post-op, the patient was scheduled for three month recalls at which time explicit hygiene procedures were performed and the patient was instructed on special oral home care techniques. The patient has continued on this quarterly recall during the three postoperative years and has had excellent soft tissue and osseous response to the rehabilitation. The patient often comments with an important psycho/social/medical/dental observation that: "This is the first time in 30 years" she is not embarrassed by bad breath, and unsightly bridges. It is the longest period of time (three years post-op) that she has been "pain free, without abscesses, swelling and gum infections"; and lastly, having her mouth "feel and look so good" has changed her total outlook on life.

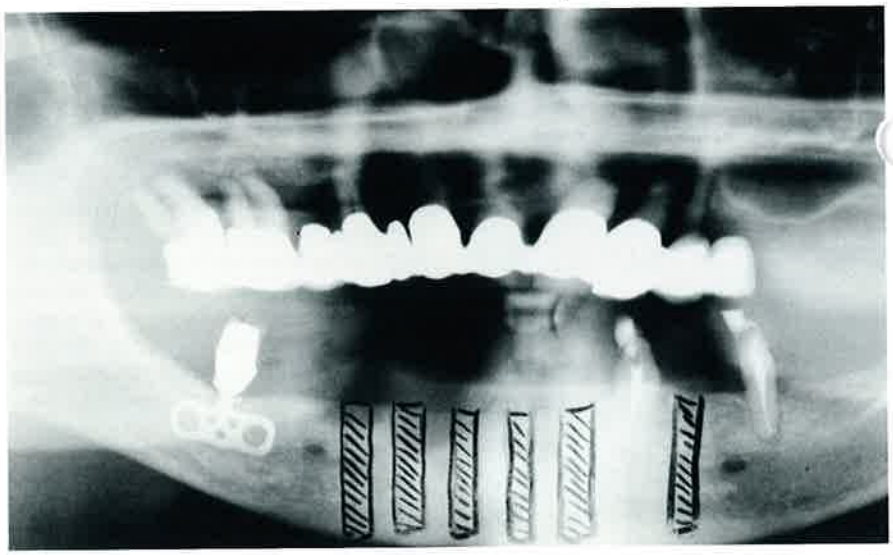

Figure 4: *Panradiograph illustrating the proposed fixture locations following the removal of the periodontally hopeless teeth and the placement of an acrylic provisional restoration supported by the failing Blade implant and periodontally compromised teeth #'s 27 & 29.*

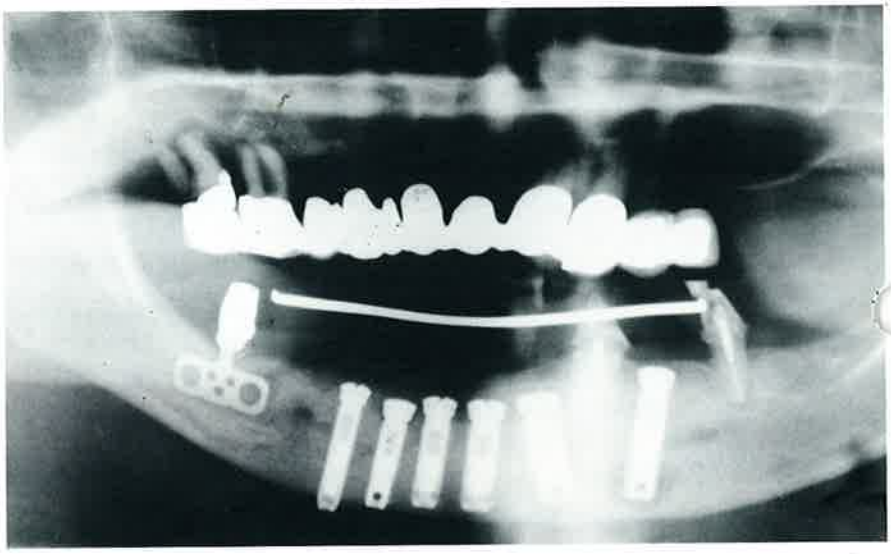

Figure 5: *Branemark fixtures placed beneath a wire reinforced implant/tooth supported provisional restoration.*

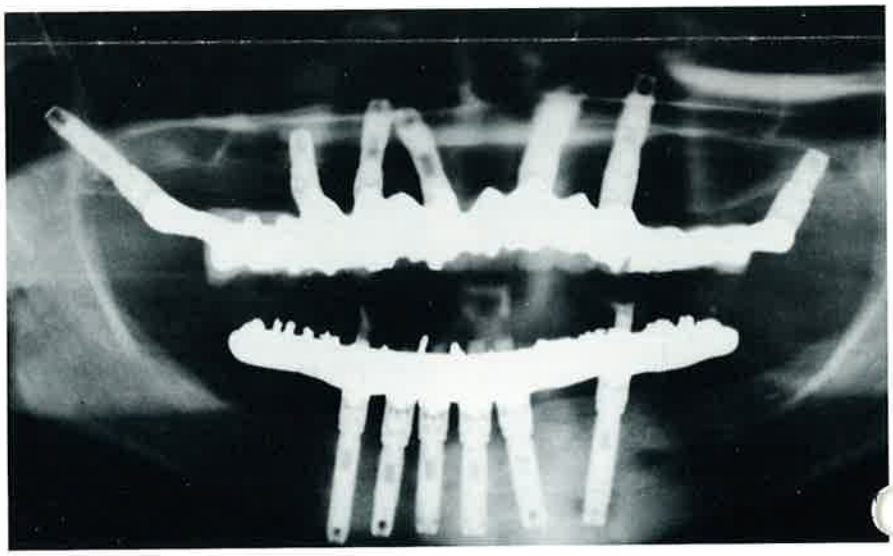

Figure 6: *Maxillary and mandibular fixed tissue integrated prosthesis supported by Branemark fixtures. Note the pterygomaxillary fixtures supporting the distal aspects of the maxillary prosthesis.*

Implant Your Skis in the French Alps!!

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Retention of Overdentures in Conjunction with Implants

P. Stevens

Although a fixed implant prosthesis has distinct advantages, it also has disadvantages associated with it. These disadvantages have been identified as:

1. Esthetic compromise
2. Oral hygiene access
3. Food trap
4. Tissue support neglected
5. Space limitation
6. Component breakage
7. Costly

as compared with removable implant prostheses.

Removable prostheses in conjunction with implants can be retained by a number of methods. These methods are listed as follows:

1. Bar-clip assemblies
2. O-ring attachments
3. Magnetic retention

Examples of these retentive systems were discussed and the conclusion drawn is that implant retained overdentures are a viable treatment option for many patients. The implant retained overdenture offers the following advantages:

1. Improved esthetics in certain patients
2. Removable for oral hygiene access
3. Laboratory and clinical phases are less complex
4. Less food entrapment
5. Tissue support from distal extensions
6. Less component breakage

Pacific Coast Society of Prosthodontists Newsletter V9, #2, 10/88

Immediate *(continued)*

Results of this study show that Nobelpharma implants placed into the mandibles of edentulous or partially edentulous patients can be used to support interim fixed bridges. This treatment strategy allows for an alternative treatment approach in selected cases. The technique of constructing a broad-based triangle of immediately loaded implants, one symphyseal and two posterior, does not compromise the long-term effectiveness of the implant therapy. Because four or five fixtures can be submerged anterior to the mental foramina and allowed to heal in the usual fashion, they can provide adequate support for the final, fixed bridge – even if all the immediately loaded implants were to fail at abutment connection. The immediately loaded implants can be thought of as temporary, or even disposable. If they osseointegrate, they can be incorporated into the final fixed bridge. If they do fail, they can be removed when the abutments are connected or at some later time, with no adverse effects.

We consider the use of threaded implants important due to their ability to achieve mechanical interlocking and significant immediate stabilization within cortical bone. On the basis of this patient population, it can be concluded that two-stage Branemark implants in the mandible can be placed into immediate function to support an interim, fixed bridge during a four month healing period while adjacent submerged fixtures osseointegrate.

J Oral Implantology V XVI #2 1990

Direct Bone *(continued)*

are lost after the first year of implant service. However, with unstable, soft-tissue-anchored implants, the situation differs. Here more and more implants are lost with increasing time. If stringent criteria for success are used, the outcome of soft-tissue-anchored implants has not been acceptable in any reported case and the survival percentage of the devices has been gradually lower with time. Therefore, from a clinical perspective it seems necessary to separate what have been referred to as "osseointegrated" and "fibrous-tissue-anchored" implants. It must be realized that the biologic background to osseointegration is insufficiently investigated and today we lack an acceptable definition of the term. In fact, from a theoretical background there is no obvious rationale to use any such term as osseointegration, as this concept seems to imply a connection between bone and implant in the form of stable bonds, the existence of which we have insufficient knowledge. The true anatomy of the CP titanium/bone interface at the resolving power of the light microscope is definitely one of a soft-tissue-free nature, provided, that certain conditions such as implant stability during the incorporation phase are guaranteed. Depending on the control of a series of previously described factors, various types of interfacial tissue reaction may be observed in the CP titanium/bone interface, one of those having been referred to as "osseointegration". There may be some type of "biochemical bonds" formed over the CP titanium/bone interface but the interfacial anatomy at the resolving power of the electron microscope is more unclear. There is only one study that indicates the possibility of establishing chemical bonds over the CP titanium/bone interface.

The term osseointegration should therefore be used with caution, if at all, in the experimental situation. However, there is clear clinical data speaking in favor of stable, "osseointegrated" implants in relationship to those that are soft-tissue-anchored.

Int J of Prosthodont 1990; 3:30:30-41

Educational Opportunities Sponsored By The Institute For Facial Esthetics – Pennsylvania's Official Branemark Training Center

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Integration *(continued)*

skin-penetrating abutment was applied and kept in place by an internal screw. Three to four weeks after the second stage the prosthodonists and the technicians started their work on the prosthesis. The aim of this effort was to supply the patient with a stable facial prosthesis.

A total of 35 fixtures were inserted. Twenty-nine of the fixtures were stable in the bone after an average follow-up time of 25 months. There have been no signs of adverse tissue reactions in these patients. No macroscopic signs of infection were observed in the bone tissue adjacent to any of the titanium fixtures. Thus, no implants had to be removed for reasons of soft tissue infection or osteomyelitis.

This study shows that titanium implants may become integrated in bone tissue and that titanium abutments may penetrate the skin in patients who have undergone previous radiotherapy at high dose levels. In the samples investigated with histology of intact tissue-to-metal specimens, it was demonstrated that a direct bone contact was achieved without any interposed soft tissue coats.

Ann Otol Rhinol Laryngol 07:1988,
Gothenburg, Sweden

Implants *(continued)*

benefits is lacking in the literature. This review uses existing published material as a basis to discuss the efficacy of implant use in maxillofacial prosthetics and the biologic rationale of the procedures. The use of implants with bone-anchored hearing aids; in maxillofacial surgery; and in maxilliary, mandibular, and facial defects is presented.

A major subgroup of maxillofacial patients has had therapeutic radiation in addition to surgery. Can implants safely and predictably be placed in radiated bone? Do implants already in bone represent an unacceptable risk when radiation is planned? Common sense suggests that the period between chemotherapy sessions would be the preferred time to place implants, but no long term clinical studies can be found to address this issue. Despite the lack of understanding and the risks involved, implants have been intelligently applied to provide enormous benefit among maxillofacial patients.

Implants originally developed in the dental context are finding their way into purely surgical applications. In orthopedic surgery, the principle of osseointegration has been applied to bone-fixation plate systems that replace the traditional AO plate, commonly used in mandibular reconstruction surgery. For those who cannot tolerate the conventional hearing aid, implant supported hearing aids become a medium for sound transmission through the skull to the inner ear.

We do not need sophisticated health measurement instruments to show that our maxillofacial patients are vastly improved with the help of implants. However, many of the other old problems remain and still limit long term success. The problems of facial prosthetic materials still cause patient dissatisfaction with the prosthesis, limit their psychological and social rehabilitation, and result in substantial costs in repeated remakes.

Reliable and valid patient-based evidence of treatment success is needed. Teachers and researchers in prosthodontics must use properly designed trials with valid, reliable, and responsive outcome measures.

Current Interface *(continued)*

hydroxyapatite coated titanium and the single crystal sapphire as the control. She found that water and air sonic/ultrasonic units roughened metal and single crystal sapphire surfaces and completely removed the hydroxyapatite from the metal substrate. Scalers of stainless steel and titanium tipped design were also contraindicated; it appeared that unitufted brushes and antimicrobials were the regimen of choice on the implant surface.

Bowman et al accomplished a study to evaluate histologically and with SEM the IMZ implant system unloaded and under function in terms of soft tissue attachment and the osseous reaction in the dog. Control implants (unloaded) showed bone on both the smooth and plasma sprayed surface but the loaded IMZ implants showed loss of crestal bone to the plasma sprayed surface with apical migration of the soft and hard tissues down to the junction of the smooth and plasma sprayed or rough surface. Gammage et al studied the difference between the loaded IMZ and Integral implant in a four month study (the same frame as used in Bowman's study). As with the IMZ study bone migrated apically to the smooth plasma sprayed junction but new coronal bone growth was noted in the HA coated specimens and there seemed to be more bone apposition to the implant surface with the HA coated Integral when compared to the metallic substrate (IMZ).

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March 3-4, 1989

Oral Function *(continued)*

group can be related to the difference in the number of teeth on the occlusal table. This has been shown to be an important factor in masticatory efficiency, and most of the patients in this study did not have second or third molars.

The removal of the partial implant-supported restorations resulted in a dramatic decrease of masticatory efficiency in all participants in the present study. This reduced function indicates that the partial prostheses are taking an active part during mastication. The partial prostheses in the present study were two-, three-, four-unit restorations, and all of them covered the areas of first and second premolars and first molars. The molar has been suggested to be of great importance during mastication. The decrease in masticatory efficiency after removing the prostheses confirmed the importance of those teeth in mastication. Furthermore, in those patients for whom the treatment included partial implant-supported prostheses on both sides of the jaw, the decrease of masticatory efficiency after removing the second partial prosthesis was even more obvious, indicating that the role of those prostheses in the patient's masticatory efficiency is of great importance. Hence, the masticatory system of these patients could possibly give better values of masticatory efficiency, if an adaptation period followed the new condition. However, it has been stated that the best guarantee for good masticatory efficiency is a reasonable number of healthy teeth. The superiority of fixed prostheses over conventional removable dentures in combination with the findings of this study confirms that fixed prostheses supported by osseointegrated implants could possibly be a better alternative for treating partially edentulous patients.

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