DENTAL IMPLANTS
PERIODONTAL CONSIDERATIONS

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(From the Table Clinic given by Dr. M. Arlin at the 1986 ODA convention.)

The success or failure of a dental implant is ultimately determined biologically at the cellular level. It follows, therefore, that one must examine the periodontal, or rather the "peri-implant", tissues when studying dental implants. While there are four connective tissues in the natural periodontium (gingiva, bone periodontal ligament and cementum), there are only three with dental implants (gingiva, bone and the peri-implant "ligament").

An ever-increasing number of implant systems are appearing on the market. One can loosely categorize their designs as follows: 1) supraosseous (e.g., subperiosteal), 2) intraosseous (e.g., Branemark osseointegrated system), 3) transosseous (e.g., mandibular staple), 4) intramucosal, and 5) intradental (e.g., endodontic stabilizers). This paper will address the periodontal considerations for some of the intraosseous dental implants.

Intraosseous type implants include bone pins, blades, core-vent and Branemark. The latter two differ significantly from the others in that the armamentarium and surgical technique employed allow for a less traumatic procedure as well as an increased precision fit between the implant and the surgical bone preparation. As well, a two-stage procedure is employed where the implant is completely "submerged" (covered completely by the gingiva) for an adequate healing period (usually three to six months). Thereafter, the implant is exposed for the second stage procedure when the suprastructural abutment is connected. In contrast, other implant systems are inserted into the bone with their trans-gingival portion being immediately available for prosthetic temporization. These latter systems generally allow fibrous tissue and epithelial downgrowth between the implant and bone, termed "fibrointegration". The goal of the core-vent and Branemark systems, on the other hand, is to achieve a firm, direct and long-lasting connection between vital bone and implant, termed "osseointegration". Thus when examining the bone-implant interaction, one may achieve (1) osseointegration, (2) fibrointegration or (3) rejection (when the epithelium totally encapsulates the implant).

The gingiva is capable of attaching to various implants via hemi-desmosomes.[1] Relatively little is known about the supracrestal connective tissue attachment to dental implants. This is primarily due to the technical difficulties encountered in preparing histological sections combining soft tissue and the very hard implant material. It is likely there is some sort of adhesion between the connective tissue and implant surfaces as thin hemidesmosomes can be found.[2] The question of the need for keratinized vs. mucosal tissue at the implant transmucosal area has not been extensively studied. The results of a recent study, however, have suggested keratinized gingiva may not be mandatory for implant success.[3]

It is not within the scope of this article to discuss implants in relation to the following parameters: patient selection; preoper-

TABLE I

Prerequisites to achieve osseointegration

a. Material biocompatibility
b. Macro-structural design of implant
c. Micro-surface structure of implant
d. Healthy bone status at the recipient bed
e. Proper surgical technique (see Table II)

TABLE II

Surgical technique to achieve osseointegration

a. Sharp drills
b. Gradual widening
c. Low pressure
d. Abundant irrigation
e. Intermittent pressure
f. Low r.p.m.
g. Proper placement of implant
h. Proper flap design

TABLE III

Evidence of osseointegration

a. No radiographic evidence of a periodontal ligament space
b. Implant is not removable
c. Implant cannot be moved orthodontically
d. Implant is immobile
e. Histologically, bone in direct contact with the implant
f. Clinically, lasting in the long term

The following photographs illustrate various types of intraosseous implants demonstrating varying periodontal responses.

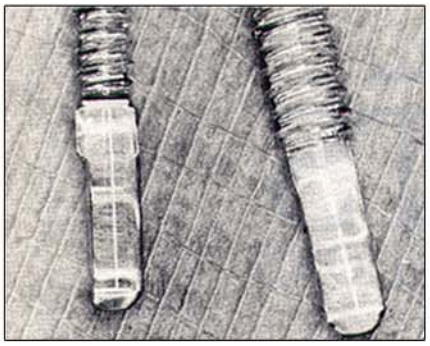

Fig. 1. Two different lengths and widths of bioceramic intraosseous implants. The threaded portion is inserted into the bone while the smooth portion is immediately available for prosthetic restoration.

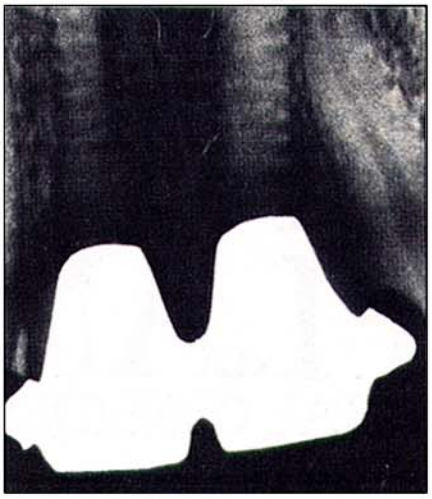

Fig. 2. Six months post-insertion, these implants exhibit extreme mobility. Notice the radiolucent peri-implant space totally encompassing the intraosseous component. This result should be considered to be a failure.

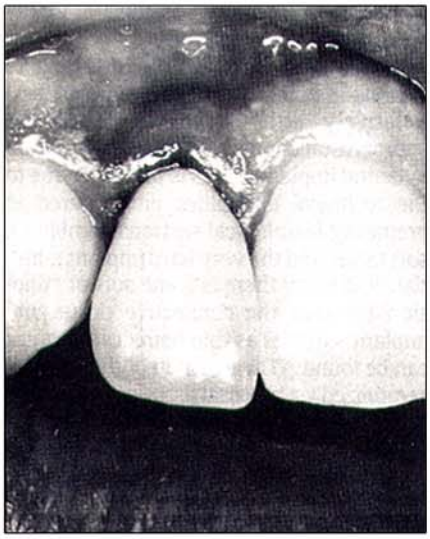

Fig. 3. A single-tooth blade implant after two years, without any signs of implant exposure.

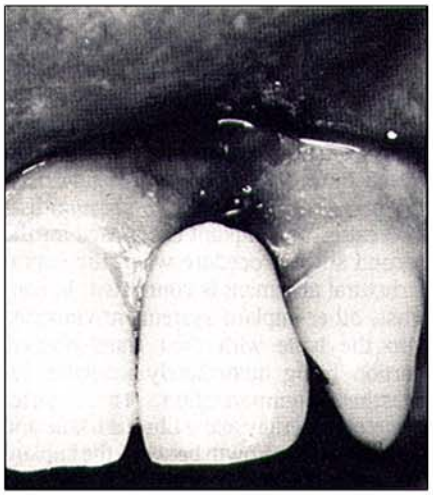

Fig. 4. Contralateral blade placed at the same time as in Fig. 3 demonstrates recession and "peri-implantitis" with blade exposure.

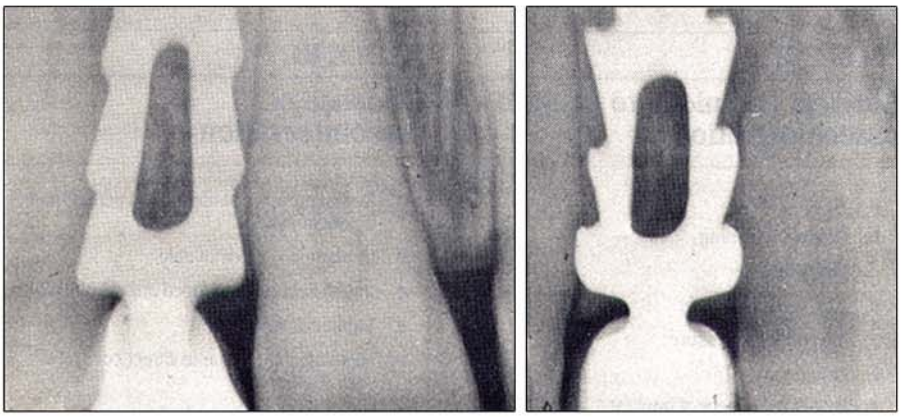

Fig. 5. Radiographs of both implants illustrating more advanced bone loss around the implant in the 2.2 position.

ative records, indications and contraindications; advantages and disadvantages; and surgical and prosthetic procedures.

CRITERIA FOR SUCCESS

With so many different implant systems available, one must try to determine which will be most predictable for each given clinical situation. The Harvard Consensus Development Conference, held in 1978 at the Harvard School of Dental Medicine, proposed that "an implant should provide safe and effective function for a minimum of five years in at least 75 per cent of the clinical cases.[4,5] Some very experienced clinicians in the field of implantology have claimed that in their hands a variety of implant systems such as subperiostials and one-piece blades, have been routinely successful. Others insist that only "osseointegrated implants" survive long term, and other systems are all doomed to failure eventually. For the inexperienced implantologist, it is difficult to get an accurate assessment of where the truth lies.

When one scrutinizes the literature, it becomes obvious that with the exception of the Branemark system, there are little or no well-controlled basic biological and clinical (animal or human) studies. The Branemark system stands alone in having published extensively on the biology of osseointegration and on their clinical results.[6] Indeed, their clinical success rates approach 100 per cent, which appears in large part to be related to the presence of osseointegration as opposed to fibrointegration.

The prerequisites of osseointegration and evidence that it has been achieved are presented in **Tables I, II and III**. The implant itself must not only be biocompatible but must be structurally sound from a mechanical point of view. The commercially pure titanium Branemark implants form an oxide layer onto which the bone adheres. It appears that the body recognizes this oxide layer as "self" rather than foreign. The bone site chosen for the recipient bed must not only be of adequate physical dimension but must be free of infection and clear of vital anatomical structures. Proper surgical technique is critical to assure immediate stabilization as a result of the accurate fit between the implant and bone, and minimal surgical trauma. Excess heat production during the surgical procedure will induce injury, resulting in bone tissue being replaced by fibrous tissue or fat cells, with resultant loss of osseointegration.[7]

It has been shown that 47° C for one minute seems to be the hottest temperature tolerable by bone, without impairing healing. Also, any movement during the initial healing period will result in implant move-

ment and subsequent fibrous tissue encapsulation and loss of holding power.[8]

In summary, from a periodontal standpoint, there seems to be a biological advantage with achieving osseointegration as opposed to fibrointegration, and a surgical technique employing a precision fit and submersion of the implant seem to be critical prerequisites in achieving osseointegration. Therefore, where applicable, the Branemark system would seem to be the implant of choice. Other similar systems such as the "core vent" have been criticized for their lack of scientific studies.[9] When a cylindrically-shaped implant cannot be anatomically accommodated, a submergible type blade may be more effective than utilizing a one-stage procedure. (The makers of the "core vent" market a submergible blade.)

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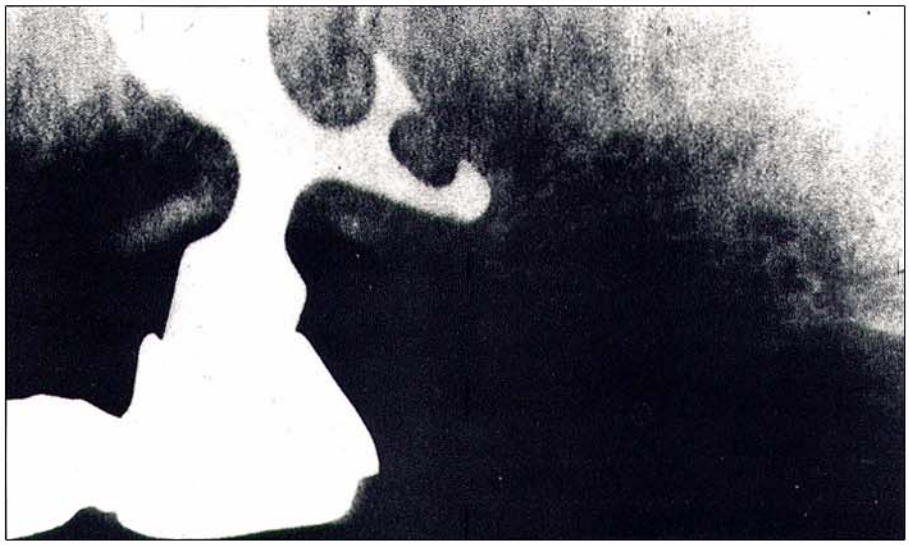
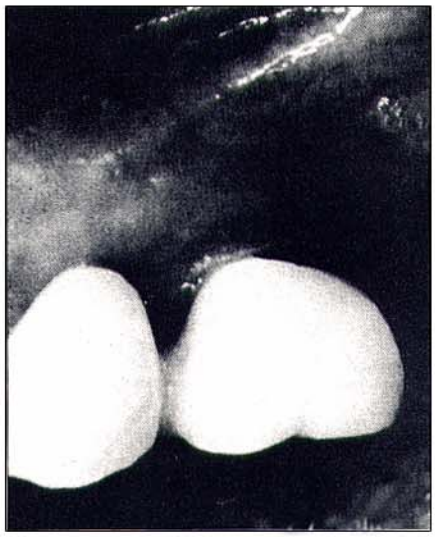


Figs. 6 and 7. Maxillary blade implant that has been functioning for 10 years without any radiographic or clinical signs of pathosis. There are no adverse symptoms or patient complaints.



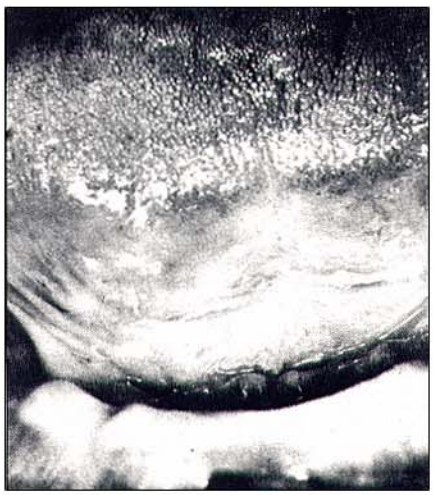


Fig. 8. Edentulous mandible.

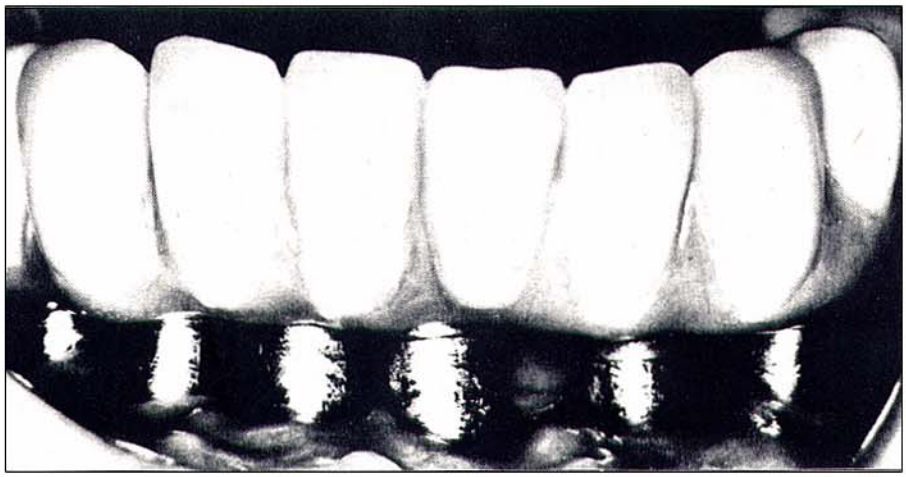


Fig. 9. Clinical photograph of six Branemark implants supporting a complete fixed denture. The denture is attached to the implants via six individual screws that can be easily removed by the dentist to allow implant and prosthetic maintenance. There are no signs or symptoms of pathosis.