Histologic evaluation of an immediately loaded titanium provisional implant retrieved after functioning for 18 months: A clinical report

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Histologic evaluation of a single immediately loaded titanium provisional implant that was in function for 18 months revealed 81.3% bone-to-implant contact of the surface evaluated, whereas 9.6% of the implant surface evaluated was opposed by marrow and 9.1% by connective tissue. The bone appeared to be in active remodeling stage and in close contact with the implant surface. (J Prosthet Dent 2003;89:331-4.)

Dental implants have become a valid treatment modality for the completely[1,2] or partially[3,4] edentulous patient. Immediate loading of dental implants[5-9] is a technique that has been described in the literature to eliminate the 3- to 6-month healing period that has been recommended before implants can be loaded.[10] Maintaining the patient in a provisional prosthesis during this healing period may become a challenge. A technique has been developed and described in which provisional implants are placed in conjunction with definitive implants.[11-13] The provisional implants are immediately loaded to support an interim implant-supported prosthesis and used until the definitive implants become osseointegrated. When the definitive implants can support the definitive prosthesis, the provisional implants are removed. Conventional protocol dictates a healing period of 3 months for the mandible and 6 months for the maxilla.[10]

Although immediate loading of dental implants has been shown to be clinically successful under long-term function,[6,7] limited knowledge exists regarding healing and remodeling of these implants. Animal studies have demonstrated the potential of immediately loaded definitive[14,15] and provisional[16] implants to become osseointegrated.

Nevertheless, it is difficult to obtain histologic evidence in human beings for definitive implants that are immediately loaded. Typically, nonintegrated dental implants are retrieved. Isolated histologic evaluations from immediately loaded integrated implants have shown a high degree of osseointegration under long-term function.[17,18] Similar observations for immediately loaded provisional implants have been made when evaluated under the microscope.[11-13] This clinical report provides a histologic and histomorphometric evaluation of an immediately loaded provisional implant after functioning for 18 months.

CLINICAL REPORT

A 52-year-old white woman was seen at the Center for Prosthodontics and Implant Dentistry at Loma Linda University (LLU) for treatment of partial mandibular edentulism. After extracting all remaining hopeless mandibular teeth, 5 threaded hydroxyapatite-coated root form implants (Steri-Oss; Nobel Biocare, Yorba Linda, Calif.) were placed in conjunction with 5 titanium provisional implants (TPI) (MTI; Dentatus, New York, N.Y.) that supported a fixed provisional prosthesis. The provisional prosthesis was fabricated from auto-polymerized acrylic resin (Jet acrylic; Lang Dental, Wheeling, Ill.) by use of a placement guide that represented a duplicate of a full-arch diagnostic wax pattern. All TPIs were immediately loaded on the day of implant surgery (November 1999).

The initial treatment plan programmed removal of the TPIs 3 to 4 months after placement, followed by use of the definitive implants to support and retain an implant-supported fixed prosthesis. The patient was unable to proceed with the definitive restoration according to the initial treatment plan for personal reasons. Therefore the provisional restoration was in function for 18 months when the patient was able to return to continue treatment. All provisional implants were retrieved with the proper instrumentation provided by the manufacturer, except for one randomly selected TPI that was removed with a 3-mm internal diameter trephine bur (ACE Surgical Supply Co, Brockton, MI). The patient signed the informed consent approved by the Institutional Review Board at LLU for this procedure. The TPI selected for histologic evaluation appeared clinically stable, which was verified by bidigital manipulation with the handles of 2 dental instruments and recordings obtained through the Perio-Test device (Siemens, Munich, Germany).[19] There was no radiographic sign of pathosis and no clinical sign of pathosis (redness, bleeding on probing, no probing depth exceeding 3 mm). The specimen was fixed in 10% buffered formalin.[20]

Histologic processing

The implant was sectioned in half and immediately dehydrated with a graded series of alcohols for 9 days.

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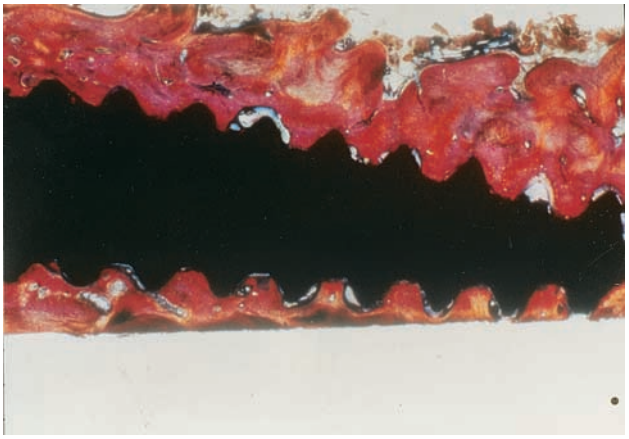

Fig. 1. Histologic overview. (Original magnification ×2.5.)

After dehydration, the specimen was infiltrated with a light-polymerizing embedding resin (Technovit 7200 VLC; Kulzer, Hanau, Germany). After 19 days of infiltration with constant shaking at normal atmospheric pressure, the specimen was embedded and polymerized by a 450-nm light (9W/71 blue; Osram Dulux, München, Germany) with the temperature of the specimens never exceeding 40°C. The specimen was then prepared with the cutting/grinding method described by Donath and Breuner[20] and Rohrer and Schubert.[21]

The specimen was cut to a thickness of 150 μm on an EXAKT cutting/grinding system (EXAKT Apparatebau, Norderstedt, Germany). Two slides were available for analysis. The slides were polished to a thickness of 50 μm with the EXAKT micro-grinding system followed by alumina polishing paste. The slides were stained with Stevenel's blue and Van Gieson's picro fuchsin as previously described[22-24] to evaluate bone-to-implant contact and soft tissue presence around the implant.

Histologic evaluation

Of the areas evaluated, bone appeared to surround the entire implant surface (Fig. 1). When observed under the high magnification level (original magnification ×10), contact between the implant and the surrounding bone was observed (Figs. 2 and 3). Polarized microscopy emphasized the remodeling activity of the surrounding bone (Fig. 4). Haversian canals were observed in close proximity to the surface of the implant (Figs. 3 and 4).

Histomorphometric analysis

Osseointegration (%) was measured on digitized images of the most central section of the implant. Analysis was performed on a Macintosh computer using the public domain NIH Image program developed at the US National Institutes of Health and available online at the NIH Image website. Of the areas evaluated, histomorphometric analysis revealed that 81.3% of the surface of the implant was in contact with bone, whereas 9.6% was in contact with marrow and 9.1% was in contact with connective tissue.

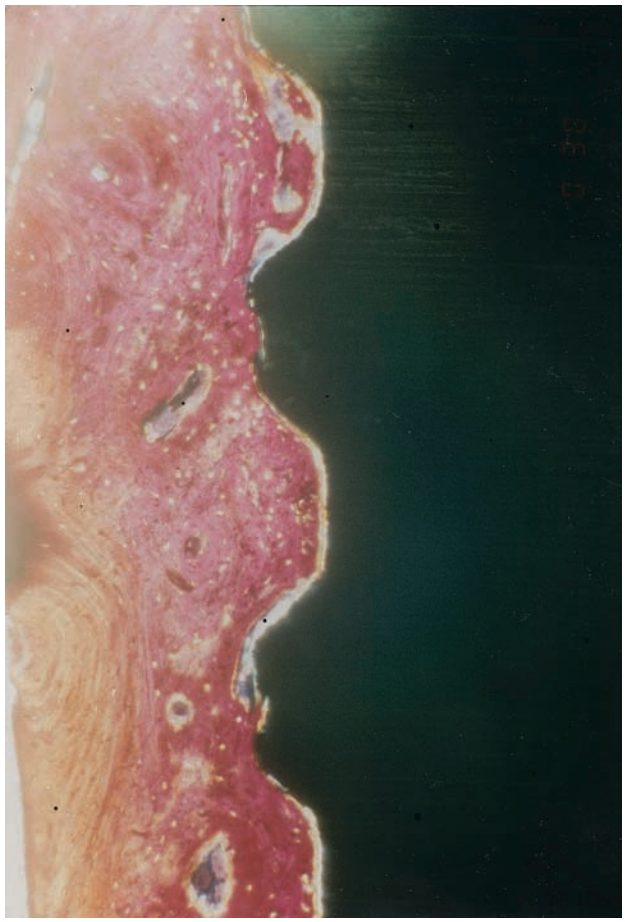

Fig. 2. Implant appears to have high degree of bone-to-implant contact. (Original magnification ×10.)

DISCUSSION

The histologic analysis of this clinical report demonstrated a very high degree of bone-to-implant contact for the areas evaluated. Piatelli et al[14] in an animal study demonstrated that immediately loaded implants achieved significantly higher bone-to-implant contact compared with implants loaded according to the conventional 2-stage protocol. Romanos et al[15] showed that increased bone density in the interthread area was observed in immediately loaded implants compared with implants loaded a few months after placement.

Lederman et al[17] published a clinical report in which 4 immediately loaded definitive implants received postmortem histologic evaluation and demonstrated a high (70% to 80%) bone-to-implant contact, as was observed in the presented clinical situation for the areas evaluated. Proussaefs and Lozada[18] reported a similarly high degree of osseointegration in blade-form implants that were immediately loaded and retrieved after functioning

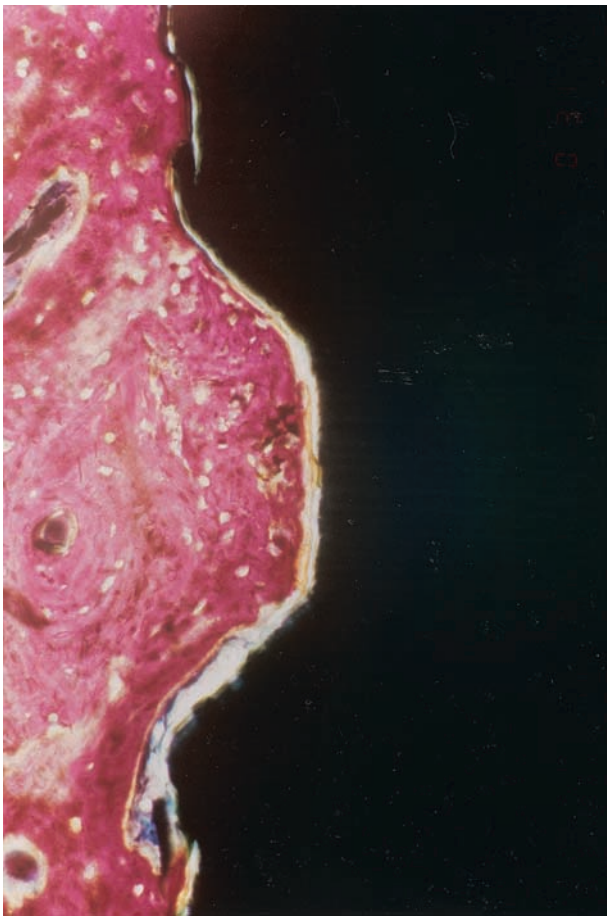

Fig. 3. At higher magnification level, close implant-bone proximity can be observed. (Original magnification ×20.)

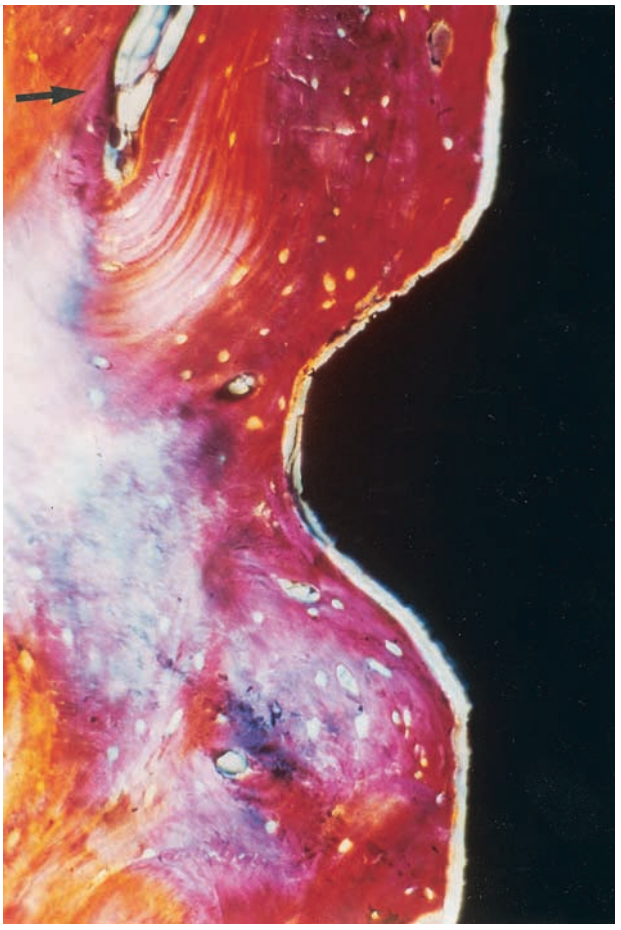

Fig. 4. Polarized microscopy emphasizes active remodeling pattern of bone around osseointegrated implant. Haversian canals were often observed in close proximity to implant surface *(arrow)*. (Original magnification ×20.)

for 11 to 21 years. However, these reports are limited because they evaluate only part of the implant surface. A portion of peri-implant tissue is lost during implant retrieval, whereas artifacts can be created during histologic preparation.

Petrugano,[11] Froum et al,[12] and Bohsali et al[13] have provided histologic evaluation in human beings regarding the potential of provisional implants to become osseointegrated when they are immediately loaded. The significance of this report is that TPIs functioned for 18 months, which exceeded the expected period for mandibular provisional implant loading (3 to 4 months). Within the limitations of a single clinical report with limited surface area evaluation, this suggests the potential for immediately loaded provisional implants to achieve and maintain a high degree of osseointegration for a longer than currently expected period of time.

The observations of this clinical report should be cautiously evaluated because they are based on a single situation with limited surface area histologic condition and histomorphometric evaluation. In addition, it is unknown whether similarly high degree of osseointegration can be consistently achieved in immediately loaded definitive implants.

SUMMARY

The histologic and histomorphometric evaluation of a retrieved TPI after functioning for 18 months demonstrated a high bone-implant contact for the surface area evaluated (81.3% of the surface area evaluated of the retrieved implant was in contact with bone).

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