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Immediately loaded blade implants. A histological and histomorphometrical evaluation after a long loading period. A retrospective 20 years analysis (1989-2009)

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ABSTRACT

Aim Although the presence of mineralized tissues at the interface with blade implants has been reported, the view that blade implants cannot integrate still persists. Blades are the immediately loaded implants with the longest clinical history, so their histological evaluation may give results applicable to root-form implants. The aim of the present retrospective study was a histological evaluation of the peri-implant tissues in immediately loaded human blade implants retrieved after a long loading history.

Materials and methods Thirty-one implants were included in the present report, after a loading history varying from 2 to 23 years, with a mean of 15 years. The implants were processed for histological examination.

Results Histologically, the bone was in close and tight contact with the implants surface and no gaps or connective fibrous tissues were present at the implant-bone interface. The peri-implant bone was compact, mature, with the presence of small marrow spaces and Haversian canals. Many osteons were in contact with the implant surface. Most Haversian systems ran perpendicular to the major axis of the blades. In some fields it was possible to observe the presence of a few osteoblasts. Remodelling areas were present. Mean bone to implant contact percentage was, for all 31 implants, 43±5.2%.

Conclusion The present report showed that immediately loaded blade implants can achieve and maintain osseointegration under long-term function (more than 20 years).

KEY WORDS Blade implants; Bone-implant interface; Immediately loaded implants: Retrieved human implants.

INTRODUCTION

Blade implants have been reported to have a lower survival rate, attributed to the formation of connective tissues around the implants (1). The presence of mineralized tissues at the interface with blade implants has already been reported (1-5); however, the view that blade implants cannot integrate still persists (1). Very high success and survival rates have been reported in immediately loaded dental root-form implants (6-11), and immediately loaded implants have shown a clinical long-term predictability similar to those of conventionally loaded implants (12, 13). Immediate loading determines an instant reduction of the oral handicap and shortens the total treatment time with increased patient satisfaction, decreased patient anxiety and discomfort, better function and esthetics, and avoidance of a conventional denture during the healing period (12, 14). When primary stability is achieved, and a proper prosthetic treatment plan is followed, immediate loading is a feasible concept (13).

Many clinicians probably are not aware that the concept of immediate loading was proposed more than 40 years ago when the endosseous blade implants were introduced (15). Histological evidence of osseointegration in clinically successfully osseointegrated implants in man can be found in the literature (16-35). Retrieved human implants are extremely important for long-term evaluation of implants subjected to functional loading (1-5). Blades are the immediately loaded implants with the longest clinical history, so their histological evaluation has an historical value and may certainly have some applications to root-form implants (1).

The aim of the present retrospective study was a histological evaluation of the peri-implant tissues in immediately loaded human blade implants retrieved after a long loading history.

MATERIALS AND METHODS

The archives of the Implant Retrieval Center of the

Dental School of the University of Chieti-Pescara, Chieti, Italy, were retrospectively searched (1989-2009) to look for retrieved human blade implants. The clinical and laboratory records were evaluated carefully, and only the blade implants that complied to the following inclusion criteria were analysed.

1) Presence of healthy peri-implant soft tissues, with no bleeding on probing.
2) Absence of mobility.
3) Absence of pain upon percussion.
4) No signs of bone or soft tissue pathology present during implant retrieval.
5) Absence of a peri-implant radiolucency and radiographical presence of mineralized tissues.
6) Fabrication and insertion of an interim implant-supported prosthesis on the day of implant surgery.

Out of 85 retrieved blade implants found, only 31 met all the inclusion criteria. Only these 31 implants were part of the present report, while the others were discarded. These 31 implants had been retrieved for different causes, mainly for a fracture of the abutment, for a fracture of the prosthesis or due to changes in the prosthetic rehabilitation of the patients, after a loading history varying from 2 to 23 years, with a mean of 15 years.
All the implants had been retrieved with a bur under abundant saline irrigation.

FIG. 1 Clinical view of a removed blade; hard tissues are present in direct contact with the implant.

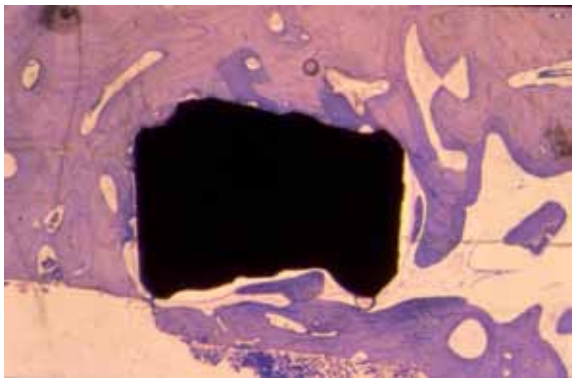

FIG. 2 At low magnification, it was possible to observe mineralized bone with the presence of small marrow spaces and Haversian canals in contact with the implant surface. Acid fuchsin-toluidine blue 50X.

Processing of specimens

The implants and the surrounding tissues were stored immediately in 10% buffered formalin and processed to obtain thin ground sections with the Precise 1 Automated System (36).
The specimens were dehydrated in an ascending series of alcohol rinses and embedded in a glycolmethacrylate resin. After polymerization the specimens were sectioned longitudinally along the major axis of the implants with a high-precision diamond disc at about 150 µm and ground down to about 30 µm. Three slides were obtained for each implant. The slides were stained with basic fuchsin and toluidine blue. A double staining with von Kossa and acid fuchsin was done to evaluate the degree of bone mineralization, and one slide, after polishing, was immersed in AgNO3 for thirty minutes, and exposed to sunlight; the slides were then washed under tap water, dried and immersed in basic fuchsin for five minutes, and then washed and mounted.
Histomorphometry of bone-implant contact percentage was carried out using a light microscope connected to a high resolution videocamera and interfaced to a monitor and PC. This optical system was associated with a digitizing pad and a histometry software package with image capturing capabilities.

RESULTS

All 31 implants were lined by mineralized tissues (Fig. 1). At low magnification, it was possible to observe mineralized bone in contact with the implant surface (Fig. 2). The bone was in close and tight contact with the implants surface and no gaps or connective fibrous tissues were present at the implant-bone interface. In some areas of the bone interface, an artefact was present because bone had been removed during the retrieval procedure. The peri-implant bone was compact, mature, with the presence of small marrow spaces and Haversian canals (Fig. 3). Some osteons were present

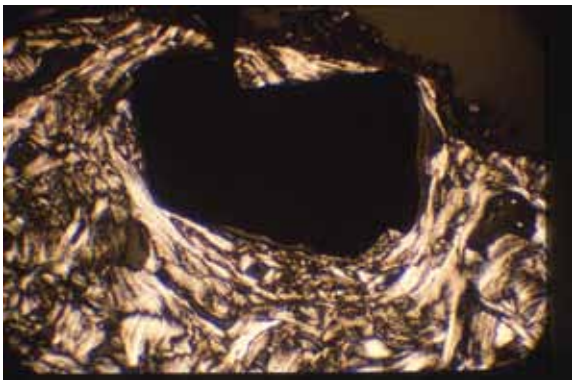

FIG. 3 Some osteons were present near the metal surface; each osteon was composed by a Haversian system and about 10 to 20 bone lamellae. Acid fuchsin-toluidine blue 50X. Polarized light.

near the metal surface; each osteon was composed by a Haversian system and about 10 to 20 bone lamellae. Most Haversian systems ran perpendicular to the major axis of the blade. In some fields it was possible to observe the presence of a few osteoblasts.
Remodeling areas were present (Fig. 4). Near some of the implants the bone lamellae tended to run parallel to the implant surfaces.
The newly-formed bone was more strongly stained with acid fuchsin and it was clearly separated from the old, pre-existing bone (Fig. 5).
No inflammatory infiltrate was present. No epithelial downgrowth was present. In the areas of remodelling bone it was possible to observe bone remodelling units with vessels, osteoblasts and osteoclasts. Lamellar and woven bone were separated by a well-defined irregular cement line. Some of the marrow spaces abutted on the implant surface and some of the Haversian systems were in direct contact with the implant surface.
Mean bone to implant contact percentage was for all 31 implants 43±5.2 %.

DISCUSSION AND CONCLUSION

Healing processes are strongly influenced by the local mechanical loading history (37). Mechanical loading of the skeleton regulates the attainment of peak bone mass in the growing animal and produces adaptive changes in the adult (38). An immediate loading protocol implies healing under loading and involves the risk of fibrous tissue encapsulation (39).
Histological examination provides the best evidence of the type of tissue at the interface with dental implants. Only rarely the histology of human retrieved immediately loaded implants have been reported in the literature (16-22, 30, 33). Even more rarely it is possible to find histological reports in the literature of immediately loaded implants with a long-term follow-up (1-3, 5, 24-26). The presence of mineralized tissues at the interface with blade implants, even after a long loading history, has already been reported (1-3).
In blade implants retrieved after 13 and 21 years of function, mature bone in tight contact with the implant surface was seen around most of the implant surface (1). In another report, about 40% of the blade implant interface was lined by mineralized tissue (4).
The present histological data showed that mineralized tissues were present at the interface with immediately loaded blade implants and that these tissues were successfully maintained over a very long time period (in some cases more than 20 years).
The response of the bone tissue appeared not to be disturbed by the stresses and strains transmitted at the interface. Minimal lateral forces exerted on the implants have been reported to be critical factors for success. Probably, the precise, intimate fit of the implants in the bone, obtained by a bone hole smaller than the implant diameter, was helpful in obtaining mineralized tissues at the interface. It has been reported that controlled implant micromotion had a positive effect on the bone formation at the interface (37).
The present histological results could be explained by the fact that functional loading appears to stimulate bone apposition (40-44). Wolff stated that there was a direct link between mechanical loading and bone form; Wolff's law would imply that increased stresses acted as a stimulus to new bone formation while reduced stress tended to produce bone loss (41-44).
In conclusion, the present report showed that immediately loaded blade implants can achieve and maintain osseointegration even under long-term function (more than 20 years).

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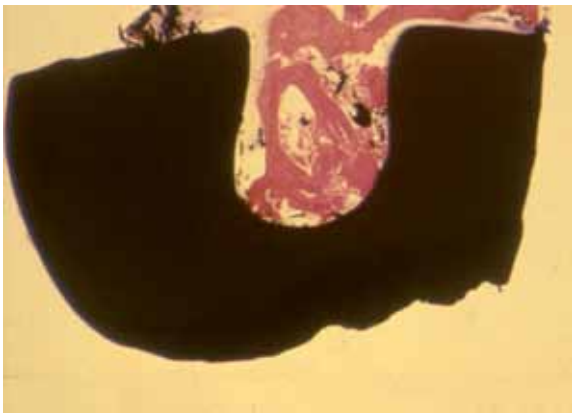

FIG. 4 Trabecular bone with large osteocyte lacunae is present in direct contact with the implant surface. Acid fuchsin-toluidine blue 50X.

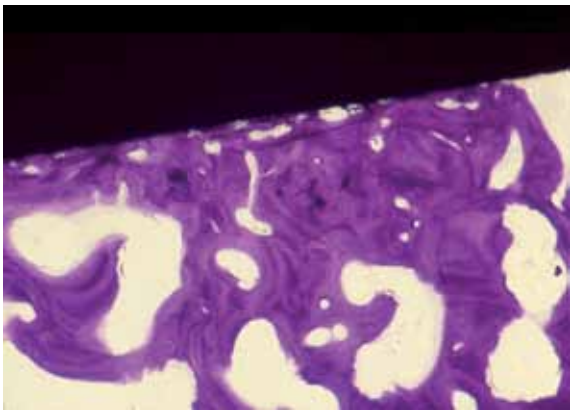

FIG. 5 Remodeling areas are present. A large osteocyte lacuna is present. Acid fuchsin-toluidine blue 50X.

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