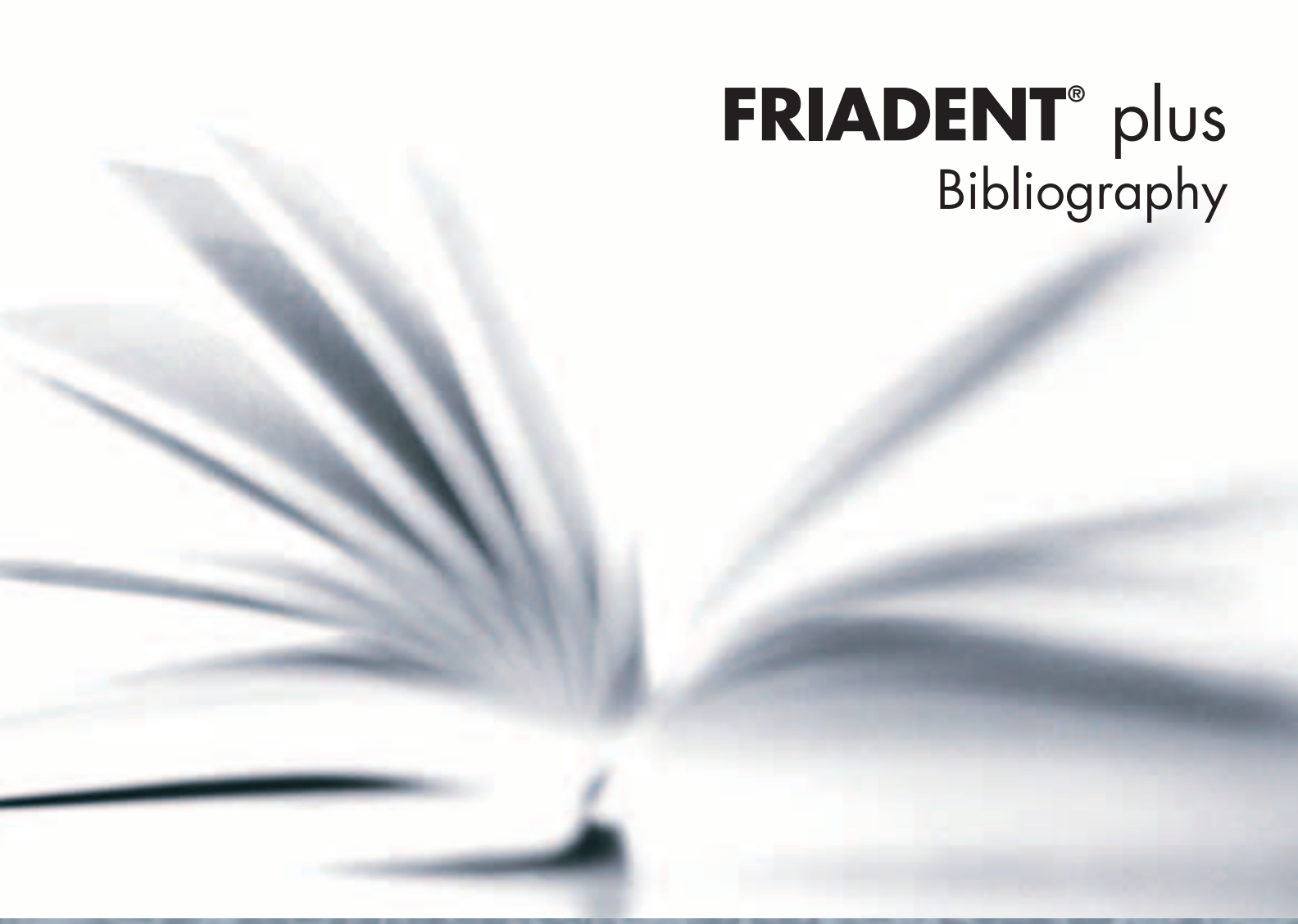
FRIADENT® plus
Bibliography



Treatment success –
clinically documented

DENTSPLY
FRIADENT

TABLE OF CONTENTS

Basic Research

Clinical and Pre-Clinical Documentation

Clinical Long-Term Success

Additional Publications

P1

Di Iorio D, Traini T, Degidi M, Caputi S, Neugebauer J, Piattelli A: Quantitative evaluation of the fibrin clot extension on different implant surfaces: An in vitro study.

J Biomed Mater Res 2005; 74 (1): 636 – 642.

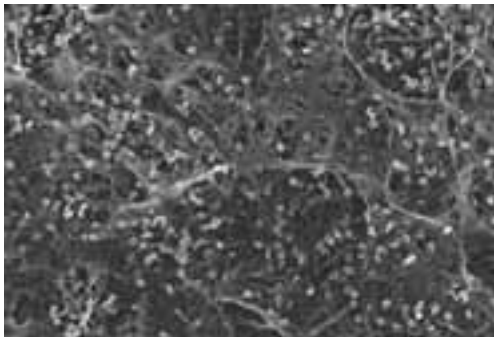
AIM:
The aim of the present study was a quantitative evaluation of the in vitro fibrin clot extension on different implant surfaces.

MATERIALS AND METHODS:
Forty-five disk-shaped commercially pure grade 2 titanium samples with three different surface topographies (machined, DPS, and FRIADENT® plus) were used in the present study. For the quantitative evaluation of the fibrin clot, 30 specimens were used (10 per group); human whole blood was employed. Venous blood was drawn from three healthy adult volunteers, and 0.2 ml were immediately dropped onto the surface of each specimen. Contact time was 5 min at room temperature; then the samples were rinsed with saline solution and fixed in a buffered solution of glutaraldehyde and paraformaldehyde. Samples were washed again with buffer and dehydrated in an ascending alcohol series. Specimens belonging to all groups were observed under SEM at a magnification of 1000x. From each sample, 50 random micrographs were collected in .tif format with an N x M 1024 x 768 grit of pixels.

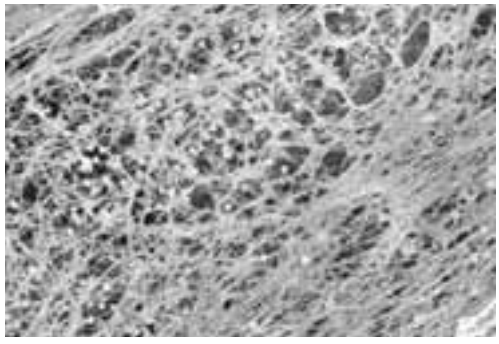
RESULTS:
Quantitative analysis of fibrin clot extension showed the following results: in machined samples fibrin clot extension was 345987.2 +/– 63747.7 pixels (mean +/– SD), in DPS samples fibrin clot extension was 375930.9 +/– 54726.86 pixels (mean +/– SD), and in FRIADENT® plus samples, fibrin clot extension was 612333.6 +/– 46268.42 pixels (mean +/– SD). With ANOVA it was possible to find that there were significant differences among the groups. The Turkey test revealed that the extension of the fibrin clot of FRIADENT® plus samples was statistically higher compared to both machined and DPS samples.

CONCLUSION:
The results of this in vitro study indicate that there is a correlation between implant surface morphology and fibrin clot extension. Improvement in surface micro texture complexity seems to determine the formation of a more extensive and three dimensionally complex fibrin scaffold. Further investigations are necessary to explain in more detail the mechanisms that regulate the fibrin clot formation on different implant surfaces.

Department of Applied Sciences of Oral and Dental Diseases, School of Dentistry, University of Chieti-Pescara, Italy.



Fibrin and red blood cells on DPS surface: Fibrin scaffold is thin (SEM image 1000x original magnification).



Fibrin and red blood cells on FRIADENT® plus specimen (SEM image 1000x original magnification).

P2

Geis-Gerstorfer J, Rupp F, Scheideler L, Lindemann W:
In vitro screening of micro-structured titanium implant surfaces.
Lecture (abstract available), 10th International FRIADENT Symposium, May 16 – 17, 2003.

INTRODUCTION:
In the past 25 years, numerous in vivo studies have demonstrated that titanium implants achieve osseointergration predictable. It has been claimed that microstructured titanium surfaces generated by etching processes are able to enhance healing processes and osseointegration even further. We investigated different new FRIADENT® experimental titanium surface modifications generated by etching with respect to surface morphology, protein/surface interactions and biocompatibility. The experimental surfaces were compared to implant surface FRIADENT® DPS.

MATERIALS AND METHODS:
Experimental surface treatments (M1 – M4 and M1 GE) consisted of sand-blasting with corundum, etching with HCl, H_2SO_4, HF and oxalic acid and different neutralizing and oxidizing steps. The surfaces were physicochemically and biologically characterized by profilometry, scanning electron microscopy (SEM), dynamic contact angle analysis (DCA) by means of the multiloop Wilhelmy technique and cell culture tests (cell vitality, metabolic activity, cell adhesion, spreading and proliferation) with SAOS-2 osteoblasts.

RESULTS:
DCA-Analysis: The microstructured modifications are initially hydrophobic but turn to a maximum in hydrophilicity in equilibrium. In contrast, the wetting behavior of FRIADENT® DPS is constantly moderate hydrophilic. The adsorption of bovine serum albumin (BSA) and fibronectin (Fn) changed the hydrophilic properties of the material/biosystem-interface in a dynamic way. Dependent on both, the etching process and the respective protein, the surface/protein-interaction results in a shift to either a hydrophilic or hydrophobic direction. Biocompatibility: Cytotoxicity tests in direct contact and with extracts of the samples showed no impairment of cell vitality or metabolic activity (XTT-Test) by the etching process and different subsequent treatments. Initial cell adhesion could be enhanced most significantly on M2 (= FRIADENT® plus), prepared by etching in combination with a subsequent neutralization step. The proliferation rate, measured by BrdU-incorporation, was stimulated up to 28% on M2 and 41% on M1GE in comparison to the DPS-reference during the logarithmic growth phase.

CONCLUSION:
DCA results suggest a delayed, but in equilibrium enhanced hydrophilicity of the microstructured surfaces compared to FRIADENT® DPS. The DCA data revealed that binding mechanisms of the serum proteins BSA and Fn are strongly influenced by the respective surface modifications. The etched surfaces, especially M 2, enhanced cell adhesion considerably in comparison to the commercial implant surface FRIADENT® DPS. The surface modifications tested show potential to enhance biocompatibility by reducing the healing time.

Department of Prosthodontics and Medical Materials, Section of Medical Materials and Technology, University of Tübingen, Germany.

P3

Rupp F, Rehbein D, Lindemann L, Scheideler L, Weber H, Geis-Gerstorfer J: Initial biological responses to newly developed microstructured titanium implant surfaces.

Scientific Poster, 81th General Session of the International Association for Dental Research, June 25 – 28, 2003.

OBJECTIVES:
The initial host response at the interface of osseo-implanted biomaterials is determined by their physicochemical surface characteristics, e.g. wettability. The purpose of this in vitro study was to evaluate hydrophilicity and surface/protein interactions of two newly developed micro structured titanium surfaces.

MATERIALS AND METHODS:
Cp titanium (grade 2) implant cylinders were modified by grit blasting and acid etching procedures (HCl/H_2SO_4 and $HF/HCl/H_2SO_4/C_2H_2O_4$), resulting in two different surface modifications Ml and M2. As a reference, the commercial deep profile surface (DPS) of the FRIALIT®-2 implant (FRIADENT GmbH, Mannheim, Germany) was used. The surface texture was analyzed by scanning electron microscopy (SEM). Water wettability and protein/surface-interactions with serum fibronectin (FN) were investigated by dynamic contact angle analysis (DCA) using the tensiometric multiloop Wilhelmy method.

RESULTS:
Ml and M2 show a similar microporous topography in SEM. In contrast, the deep profiled reference surface (DPS) shows no micropores. lO-loop Wilhelmy experiments show initially a strong hydrophobicity of Ml with mean contact angles of 120.1 ° +/– 15.2° and of M2 with 140.9° +/– 14.4° (n = 5). After the first immersion loop both modifications become strongly hydrophilic with mean equilibrium contact angles of 0°. The hydrophilicity of the reference surface is time-independent with constant mean water contact angles of 81.7° +/– 8.2° from loop 1 – 10. DCA-measurements revealed that serum protein (FN) adsorption increases the hydrophilicity of the reference, whereas the hydrophilicity is decreased on Ml and M2.

CONCLUSIONS:
Physicochemical surface characteristics of implants are subject of rapid changes due to interactions with water and serum proteins during implantation. The increased equilibrium wettability and differing FN-mediated hydrophilicity-shifts of the micro-structured surfaces compared to the reference suggest a surface-dependent variety of initial biological responses. Since FN influences the adhesion of osteoblasts, microstructuring may be of clinical relevance by modulating the osseointegration process.

Department of Prosthodontics and Medical Materials, Section of Medical Materials and Technology, University of Tübingen, Germany.

P4

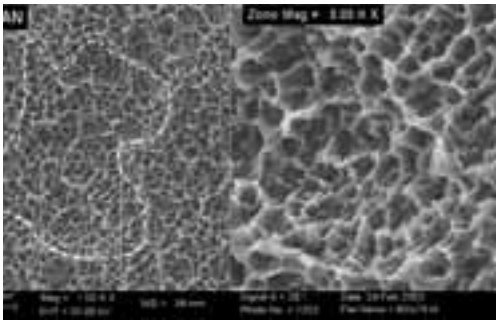
Rupp F, Scheideler L, Rehbein D, Axmann D, Geis-Gerstorfer J: Roughness induced dynamic changes of wettability of acid etched titanium implant modifications.
Biomaterials 2004; 25 (7-8): 1429 – 1438.

INTRODUCTION:
Dynamic contact angle analysis (DCA) was used to investigate time-dependent wettability changes of sandblasted and acid-etched commercially pure (cp) titanium (Ti) implant modifications during their initial contact with aqueous systems compared to a macrostructured reference surface. Surface topography was analyzed by scanning electron microscopy and by contact stylus profilometry.

RESULTS:
The microstructured Ti surfaces were found to be initially extremely hydrophobic. This hydrophobic configuration can shift to a completely wettable surface behavior with water contact angles of 0 degrees after the first emersion loop during DCA experiments. It is suggested that a hierarchically structured surface topography could be responsible for this unexpected wetting phenomenon. Roughness spatial and hybrid parameters could describe topographical features interfering with dynamic wettability significantly better than roughness height parameters. The Ti modifications which shift very sudden from a hydrophobic to a hydrophilic state adsorbed the highest amount of immunologically assayed fibronectin.

CONCLUSIONS:
The results suggest that microstructuring greatly influences both the dynamic wettability of Ti implant surfaces during the initial host contact and the initial biological response of plasma protein adsorption. The microstructured surfaces, once in the totally wettable configuration, may improve the initial contact with host tissue after implantation, due to the drastically increased hydrophilicity.

Department of Prosthodontics and Medical Materials, Section of Medical Materials and Technology, University of Tübingen, Germany.



SEM photograps of the microetched GAN surface (= FRIADENT® plus) revealing a hierarchically several level ordered structure. On the left photograph, the dotted line embraces some smaller, more round shaped grooves, each of which contains smaller grooves. This is highlighted with the photograph on the right, which is a magnification from the framed area on the left.

P5

Sammons R, Lumbikanonda N, Gross M, Cantzler P: Comparison of osteoblast spreading on microstructured dental implant surfaces and cell behavior in an explant model of osseointegration. A scanning electron microscopic study.

Clin Oral Impl Res 2005; 16 (6): 657 – 666

OBJECTIVES:
To compare interactions between rat calcarial osteoblasts and titanium dental implants with different microstructured surfaces.

MATERIALS AND METHODS:
Seven commercially available implants were used. Surfaces included plasma-sprayed, grit-blasted and/or acid-etched, smooth-machined and anodized titanium. Two methods were used to compare cell behavior:
(1) A cell-spreading assay in which percentages of cells at four different stages of attachment were identified by scanning electron microscopy and quantified within 30 min attachment period.
(2) Implants were placed in "pocket culture" within nylon mesh sacs in contact with explanted calvarial bone fragments for 2 and 4 weeks.

RESULTS:
Surfaces combining grit blasting and acid etching, of microporous topography, showed significantly enhanced rates of cell spreading in comparison with the others. Differential cell morphology was observed in both suspension assays and pocket cultures. In the latter, cells migrated onto all surfaces. Multicellular layers with extracellular matrix (ECM) were present between the layers and on the material surfaces after 2 weeks. After 4 weeks, cell layers were more consolidated, and microstructures were obscured by layers of cells and ECM. Mineralized tissue was seen in association with ECM on grit-blasted surfaces of rough and smooth microtopography.

CONCLUSION:
The two methods provided complementary information: a rough surface of porous microstructure may enhance the rate of cell spreading. Differentiation and calcification occurred on surfaces of both rough and smooth microstructure.

School of Dentistry, University of Birmingham, United Kingdom.

Implants used in the study

Manufacturer	DENTSPLY FRIADENT® (Mannheim, Germany)			Straumann (Basel, Switzerland)	3i (Palm Beach, FL, USA)	Nobel Biocare (Gothenburg, Sweden)	
Surface	DPS	Plus	TPS	SLA	Osseotite	TiUnite	Mk III
Surface treatment	Grit-blasted, acid-etched, neutralised		Plasma-sprayed	Grit-blasted, Acid-etched	Acid-etched	Anodised	Smooth-machined
R_a (µm)	2.41	2.75	3.5	2.93	0.86	0.76	0.81
St. dev.	0.32	0.46	0.47	0.46	0.14	0.14	0.08
Lot. no.	102189–310755	9990099	101619–110686	1118	157228	631748	632065

R_a, surface roughness. Arrows indicate the locations and direction of surface roughness measurements, determined as described in Material and methods.

P6

Sammons R, Lumbikanonda N, Cantzler P: In vitro comparison of mineralization on FRIALIT® and ANKYLOS® implant surfaces.

Scientific Poster, 11th International FRIADENT Symposium, April 22 – 23, 2005.

INTRODUCTION:
Titanium dental implant surfaces are grit-blasted to produce a rough primary structure in order to promote mechanical interlocking with bone, whilst subsequent acid-etching provides a textured secondary microstructure which may accelerate the rate of osseointegration. However, it is also known that a three dimensional, enclosed environment favors bone formation. Such an environment may be created by a rough implant microstructure enclosed by cells and collagen. Differentially microstructured implant surfaces may therefore influence the form, location and composition of mineralized tissue.

AIM:
The aim of this study was to investigate mineralization on grit blasted and acid-etched implants of different secondary microstructures.

MATERIALS AND METHODS:
Rat calvarial bone fragments were placed on implants as shown (n = 3) in nylon pockets (pocket method) for 2 – 4 weeks in culture medium, to allow bone cells to migrate onto the implant surfaces. Cultures were carried out in medium without and with ascorbic acid, ß-glycerophosphate and dexamethasone, to promote mineralization. After fixation and dehydration for scanning electron microscopy, nylon and bone fragments were removed and tissue beneath analysed by SEM and energy dispersive X-ray spectroscopy.

RESULTS:
Mineralization: Mineral occurred in at least 2 different forms: "nodules" of calcium phosphate were seen within the cell sheets and smaller discrete particles termed "calcospherites" were seen within collagen fibres or (on DPS) beneath collagen adherent to the implant surface.

CONCLUSION AND DISCUSSION:
This study demonstrated: Mineralization on FRIALIT® plus and ANKYLOS® plus and original surfaces in vitro. Mineral deposits occurred in two forms: nodules and calcospherites, both of which consisted mainly of calcium phosphate of variable phase composition. Similar deposits have been described by previous workers but have not previously been observed in vitro on actual dental implant surfaces. Implant surface microstructure influenced cell morphology and apposition, extracellular collagen matrix and associated mineral deposits relative to the surface. Evidence of fusion of collagen fibres was also seen and fusion of calcospherites within the extracellular matrix (as occurs with matrix vesicles) was observed. In addition, it demonstrated how cells and extracellular collagen matrix bind to the roughened surfaces of titanium dental implants to create a relatively enclosed three-dimensional environment. This could facilitate the local concentration of calcium and phosphate ions and regulatory molecules and thus promote crystal nucleation and growth. This could partially explain how grit-blasted and acid-etched surfaces may accelerate bone formation in addition to providing a means of promoting mechanical interlocking with bone.

School of Dentistry, University of Birmingham, United Kingdom.

P7

Sammons R, Lumbikanonda N, Cantzler P: Cell attachment to FRIALIT® and ANKYLOS® microstructured dental implant surfaces.

Scientific Poster, 13th Annual Scientific Meeting of the European Association of Osseointegration, September 16 – 18, 2004.

INTRODUCTION:
Initial interactions of proteins and cells with dental implant surfaces are thought to set the scene for subsequent events that eventually lead to osseointegration. Macro-roughness, produced by grit-blasting or plasma-spraying, produces crevasses in the surface several microns deep. This increases the surface area in contact with bone and promotes bone-interlocking with the implant surface. A further dimension of surface roughening, at the 1 – 5 micron level (microstructure), can influence osteoblast attachment and morphology, proliferation and differentiation to a mature osteoblastic phenotype. Optimization of surface properties is thought to be important to promote rapid osseointegration, especially in the case of early-loaded implants.

AIM:
of this study was to compare the rate of attachment of osteoblast cells on 4 implants of two designs and three different microstructured surfaces.

MATERIALS AND METHODS:
Roughness determination: 25 linear measurements were made on one implant of each type, randomly on all cutting grooves, parallel to the implant axis. Measuring section 1 mm. Equipment: Optical 3-D autofocus detection system Microfocus Compact with UBSoft Version 1.9 (UBM, Ettlingen, Germany). RC-filter size 0.2 mm.

RESULTS:
The results are consistent with those of previous experiments with XiVE® implants in which cells spread more quickly on plus than on DPS. The grit-blasted ANKYLOS® original surface showed a higher percentage of fully spread cells than the DPS surface. This is consistent with previous observations showing a faster rate of cell spreading on a grit-blasted surface compared with a "smooth" one. The rate of cell spreading is dearly related to the microstructure and not to surface macroroughness due to grit-blasting, since the FRIALIT® implants with plus and DPS surfaces are of identical macroroughness but differentially influence the rate of cell spreading. The reason for the faster rate of spreading on plus surface is at present unknown, although there are known to be relative differences in plus and DPS surface wettability. The unusual morphology of some of the cells on plus may be related to this and to the differential effect this surface has on protein (fibrin) adsorption in comparison with DPS.

CONCLUSIONS:
The rate of cell spreading on dental implant surfaces is influenced by microstructure, not surface roughness doe to grit blasting. Osteoblasts spread more quickly on the plus surface on FRIALIT® and ANKYLOS® implants than on the FRIALIT® DPS surface or ANKYLOS® original grit-blasted surface.

School of Dentistry, University of Birmingham, United Kingdom.

P8

Sammons R, Lumbikanonda N, Cantzler P:
Osteoblast responses to microstructured dental implant surfaces.
Scientific Poster, European Association for Osseointegration, October 9 – 12, 2003.

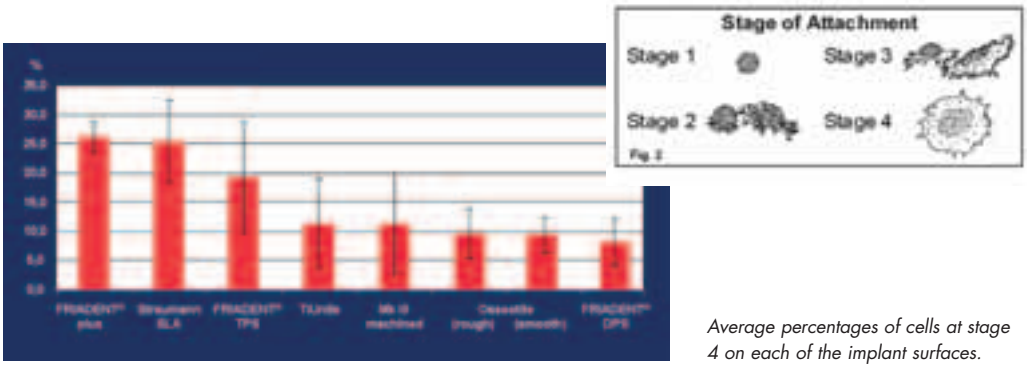
OBJECTIVES:
To evaluate the complementary use of a cell attachment assay and an organ "pocket" culture method for comparison of cell interactions with seven microstructured dental implant surfaces, as prepared for clinical use.

EXPERIMENTAL METHODS:
Six different commercially-available implants (FRIADENT® DPS,TPS, Straumann SLA, 3i Osseotite, Nobel Biocare TiUnite and Mk III) and one FRIADENT® implant with an experimental surface, including titanium plasma sprayed, grit blasted/acid etched/neutralized, solely acid etched, anodized and smooth machined surfaces, were exposed to suspensions of rat osteoblasts for 30 minutes and cells at four stages of attachment quantified by SEM in four separate experiments. Three implants of each type were also placed within nylon pockets in contact with rat calvarial bone fragments, to simulate an osseous implant site, for 2 or 4 weeks. The developed interface between migrated cells and surfaces in pocket cultures was compared by SEM.

RESULTS:
Analysis of variance showed significant differences in percentages of fully spread cells on the different surfaces, with highest percentages on Straumann and FRIADENT® experimental surface implants. The pocket method permitted qualitative but not quantitative comparisons of cell migration, proliferation, morphology, attachment, surface adaptation, haptotaxis, and synthesis of extra cellular matrix, in relation to surface roughness, microstructure and implant geometry.

CONCLUSIONS:
The "pocket culture method" is useful and potentially versatile organ culture model for comparison of cellular interactions with dental implant surfaces as prepared for clinical use, yielding complementary information to that obtained from cell attachment assays.

School of Dentistry, University of Birmingham, United Kingdom.



Average percentages of cells at stage 4 on each of the implant surfaces.

P9

Scheideler L, Rupp F, Lindemann W, Axmann D, Gómez-Román G, Geis-Gerstorfer J, Weber H:

Biocompatibility of microstructured titanium implant surfaces.

Scientific Poster, 81th General Session of the International Association for Dental Research, June 25 – 28, 2003.

OBJECTIVE:
Chemical surface modification by acid etching may be used to enhance the biocompatibility of titanium implants. The influence of several experimental surface modifications on protein/surface-interactions (binding strength of fibrin fibrils, fibronectin adsorption) and cellular reactions was investigated.

MATERIALS AND METHODS:
Experimental surface modifications (M1-M4 and M1GE) of cp titanium were achieved by sand-blasting with corundum, etching with HCl, H_2SO_4, HF and oxalic acid and different neutralizing and oxidizing steps. The commercial "deep profile surface" (DPS) of the FRIALIT®-2 implant (FRIADENT GmbH, Mannheim, Germany) served as a reference. The adhesion strength between the fibrin fibrils of freshly clotted blood and the implant surfaces was determined by tensile testing. Adsorption of human plasma fibronectin (FN) to the surfaces was determined by ELISA. Proliferation of SAOS-2 osteoblasts was tested by BrdU-incorporation in the logarithmic growth phase. Initial cell adhesion was determined microscopically. Statistical significance was evaluated by repeating experiments and calculation of 95% confidence intervals (CI) of means.

RESULTS:
The adhesion strength of fibrin fibrils increased from 4 (CI = 1.7) N/cm^2 for DPS to 15 (10 – 19) N/cm^2 for M2 and 22 (14 – 29) N/cm^2 for M1GE. The amount of adsorbed fibronectin on acid-etched surfaces was enhanced from 49 (CI = 43 – 55) µg/sample on DPS up to 70 (66 – 74) µg/cm^2 on M1. The proliferation rate of osteoblasts on micro structured surface modifications was enhanced 1.41fold (CI = 1.24 – 1.53) on modification M1GE and by a factor of 1.27 (1.16 – 1.40) on M2. Cell adhesion was enhanced up to 1.6 fold on M2.

CONCLUSIONS:
Acid microstructuring led to enhanced cell adhesion and proliferation. Variations of the treatment following acid etching influenced the biological response to a large extent. It is suggested that this is caused by physicochemical surface properties, which modulate initial protein/surface-interactions. The surface modifications tested may have the potential to enhance biocompatibility of implants in vivo.

Department of Prosthodontics and Medical Materials, Section of Medical Materials and Technology, University of Tübingen, Germany.

P10

Schmage P, Nergiz I, Siemann-Harms U, Houdek P, Cantzler C, Moll I, Platzer U:

Proliferation of gingival fibroblasts on microroughened implant surfaces.

Scientific Poster, 11th International FRIADENT Symposium, April 22 – 23, 2005.

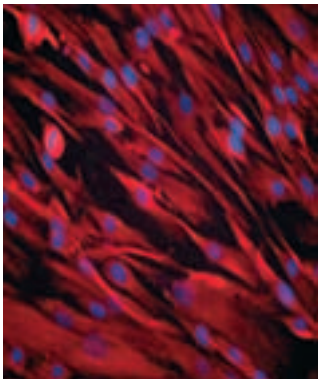
INTRODUCTION:
Soft tissue should attach to microroughened implant surfaces in the marginal region.

PURPOSE:
The purpose of this in vitro study was to compare the growth of fibroblasts on nine surface structures on cylindrical titanium specimens (FRIALIT®-2, DENTSPLY Friadent, Mannheim, Germany).

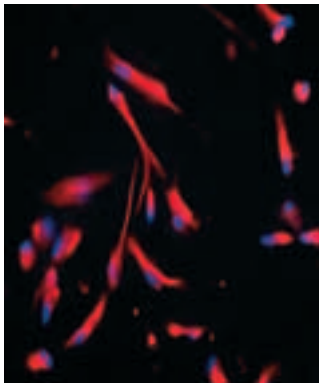
MATERIALS AND METHODS:
Nine surface structures were investigated. Groups of 10 specimens each were performed (n = 90). Human gingival fibroblasts were cultivated on the specimens for three days. The number of cells was counted (n = 45). P (polished surface) was used as control and set to 100%. The proliferation behavior was analyzed using a fluorescence microscope (n = 45). Statistically significant differences were calculated (Mann-Whitney U-test).

RESULTS:
Most cells were counted on P and M (machined) surfaces (100%), followed by DPS (deep profile surface) (88%). The lowest amount of cells was found on TPS (titan-plasma-sprayed) (27%) and GB (grit blasted) (29%). The number of cells on P surface amounted twice as much as on the CellPlus surface CGA (CellPlus grit blasted and acid etched) (50%) and CA (CellPlus acid etched) (44%). Except of TPS (titan-plasma-sprayed), GB (grit blasted) and EGA (experimental grit blasted and acid etched) surfaces fluorescence microscope showed differentiated fibroblasts with frequent cell contact on all surfaces but less compact on EA (experimental acid etched), CA and GCA.

Center of Dental and Oral Medicine, University of Hamburg, Germany.



Gingival fibroblast growth on the polished surface. (Magnification 25x).



Gingival fibroblast growth on the CellPLus grit blasted and acid ethced surface. (Magnification 25x).

P11

Degidi M, Scarano A, Iezzi G, Piattelli A: Histologic analysis of an immediately loaded implant retrieved after 2 months.

J Oral Implantol 2005; 31 (5): 247 – 254.

INTRODUCTION:
Human biopsy of immediately loaded implants is the most important way to determine the occurrence of osseointegration. Implants inserted in sites with poor bone quality have been associated with lower success rates.

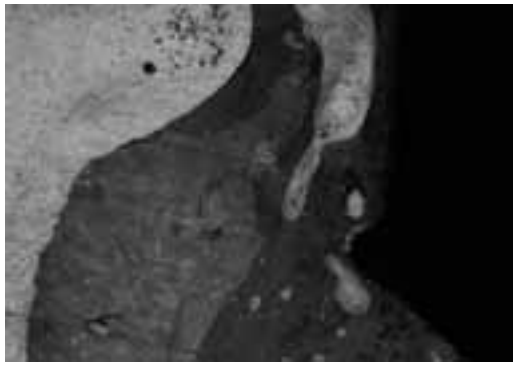
AIM:
The aim of this study is to document the early healing processes in a man around an immediately loaded implant retrieved after a 2-month loading period. MATERIALS and METHODS: An implant was inserted in the mandible of a 32-year-old patient and was loaded into a non-functional loading mode with a fixed provisional prosthesis the same day of the implant surgery. After 2 months, because the patient had difficulty accepting the implant, the implant was retrieved with a 5-mm trephine drill.

RESULTS:
Before retrieval, the implant appeared to be clinically osseointegrated, and no mobility was present. The pre-existing bone quality was type D 4. The implant was surrounded by newly formed bone lamellae with a width of 200 to 400/mm. In many areas it was possible to observe osteoblasts producing osteoid matrix directly on the implant surface. Bone-to-implant contact percentage was 71 % +/– 3.2%.

CONCLUSION:
Even in a poor bone site and after a healing period of only 2 months, we observed a high bone-to-implant contact percentage. We can confirm that immediately loaded implants placed in soft spongy bone after a 2-month healing period can present mineralized tissue at the interface.

Dental School, University of Chieti-Pescara, Chieti, Italy.

The implant (XiVE® plus) was surrounded by lamellar and woven bone. The bone was in close contact with the implant surface. At the coronal level, no infrabony pocket, Howship lacune, or osteoclasts were present (magnification x12).



Lamellar and woven bone were observed in direct contact with the implant surface; no gaps or connective tissue were present at the bone-implant interface. No apical epithelial migration was found. No inflammatory infiltrate was present around the implant (original magnification x100).

P12

Iezzi G, Degidi M, Scarano A, Periotti V, Piattelli A: Bone response to submerged, unloaded implants inserted in poor bone sites: A histological and histomorphometrical study of 8 titanium implants retrieved from man.

J Oral Implantol 2005; 31 (5): 225 – 233.

INTRODUCTION:
An important parameter that influences the long-term success of oral implants is the bone quality of the implant bed. Posterior areas of the jaws have been avoided in implant dentistry because of their poor bone quality, higher chewing forces, and presumed higher implant failure rates. Several researchers have deemed soft bone implant sites to be a great potential risk situation, and most failures have been found in sites where the bone density was already low. The inferior success rates in the posterior maxilla have been attributed to a lower bone density and a lesser bone-implant interface.

AIM:
The aim of the present study was a histological and histomorphometrical analysis of the bone response to submerged implants inserted in posterior areas of the human jaws and retrieved, for different causes, after healing periods varying from 6 weeks to 12 months.

MATERIALS AND METHODS:
Eight submerged implants that had been retrieved for different causes after different healing periods were evaluated in the present study. All implants were submerged and unloaded.

RESULTS:
Three implants had been removed for inadequate patient adaptation, 2 for inability of the implant to meet changed prosthetic needs, 1 for not optimal position from esthetic and hygiene aspects, and the last 2 for pain and dysesthesia. All the implants were retrieved with a 5-mm trephine bur. Newly formed peri-implant bone was found in all implants even after shorter healing periods. The bone-implant contact percentage varied from 30% to 96%.

CONCLUISION:
In conclusion, some surfaces have an improved characteristic of contact osteogenesis in soft bone, with coverage of the implant surface with a bone layer as a base for intensive bone formation and remodeling. We documented osseointegration of implants with a rough surface even after an insertion period of less than 2 months, both in the mandible and in the maxilla. From these results, we tentatively extrapolate that these implants might be carefully loaded after 2 months of healing, even when inserted in soft bone. A higher removal torque value might lead to a more predictable use of shorter implants, to a support of a prosthesis with fewer implants, or to shorter healing periods.

Dental School, University of Chieti-Pescara, Chieti, Italy.

Retrieval times, sites, types of implants, and bone-to-implant contact (BIC)*

Retrieval time	Site	Type of implant	BIC (in %)
6 wk	Mandible	*XiVE® plus*	*96*
7 wk	Mandible	*XiVE® plus*	*55*
8 wk	Maxilla	*XiVE® plus*	*68*
6 mo	Mandible	FRIALIT®-2 Synchro	70
6 mo	Mandible	XiVE® DPS	51
12 mo	Maxilla	XiVE® DPS	30

** This is an excerpt from the author's original table.*

P13

Jakse N, Tangl S, Haas R, Pertl C, Eskici A:
The potency of LLLT on bone regeneration and osseointegration.
Scientific Poster, 12th Annual Scientific Meeting of the European Association for Osseointegration, October 9 – 12, 2003.

INTRODUCTION:
Softlaser irradiation has become a widely used adjuvant therapy to enhance wound healing. In respect to bone healing experimental studies indicate, that softlaser irradiation is able to accelerate bone fracture healing. Furthermore, in vitro experiments confirmed a biostimulative effect of the laser light on osteoblasts.

AIM:
The aim of this experimental study on sheep was to evaluate, if softlaser irradiation enhances bone regeneration and osseointegration of dental implants in a sinus graft model.

MATERIALS AND METHODS:
Twelve female adult sheep underwent a bilateral two-stage sinus floor elevation procedure with cancellous bone from the iliac crest. Unilaterally the grafted sinus was treated intraoperatively and three times a week postoperatively with softlaser irradiation (3 – 4 Joule/cm^2). This treatment was repeated during and after the second stage surgery which was performed after 4 (6 sheep) and after 12 weeks (6 sheep). Sixteen weeks after implant insertion the animals were sacrificed. Biopsies of the augmented area were obtained in the course of second-stage surgery and the entire specimens of the grafted sinus including the implants were used after sacrifice.

RESULTS:
The study did not reveal any difference between the control and the test side in respect to bone regeneration within the sinus graft. Without any softlaser effect the overall mean percentage of newly formed bone was 28.9% 4 weeks after sinus grafting and 45.1% 12 weeks after sinus grafting. In respect to the osseointegration of the secondly inserted implants histomorphometric analysis revealed significant better values on the test side. The mean percentage of bone/implant contact was 24.3% (implant insertion 4 weeks after sinus grafting: 16.16% and 12 weeks after sinus grafting: 32.47%) on the control side and 31.3% (implant insertion 4 weeks after sinus grafting: 27.45% and 12 weeks after sinus grafting: 35.16%) on the test side with a p-value of 0.057.

Department of Oral Surgery, School of Dentistry, University of Graz, Austria.

P14

Jansen R, Kielhorn J, Schmenger K, Eisenmann E, Neugebauer J:
First clinical experience with stepped-cylinder design implants with high temperature etched surface for immediate implant placement and early loading.
Scientific Poster, 19th Annual Meeting of the Academy of Osseointegration, March 18 – 20, 2004.

INTRODUCTION:
The pre-requisite for de-novo-bone formation at the implant interface is the cell adhesion and proliferation. Recent studies have shown that the micro-morphology shows the most influence on the initial cell contact. Grit-blasting and high temperature etching for surface preparation has shown the best results.

AIM:
of the poster is to present the new handling during implant placement and the peri-implant bone parameters directly after reaching osseointegration and after 4 months recall. In 10 international implantological centers FRIALIT® plus implants (DENTSPLY Friadent, Mannheim, Germany) were placed in order to collect relevant clinical data.

MATERIALS AND METHODS:
The surface is achieved by blasting with large grit (Al_2O_3), thermal etching process (BPS) and neutralization. The data of 77 patients and 140 stepped-screw type implants with the new surface design were collected and evaluated. The implants were placed in immediate extractions sides, for delayed implant placement and late implantation. To enhance the clinical situation 29% of the patients underwent an augmentation procedure prior to the implant placement. In 49% of all cases an augmentation simultaneous to the implant placement was necessary. Concerning the medical history the patients in this investigation had not to meet special requirements, except the presence of absolute contraindications. Consequently bigger diameter and longer implants were chosen in most of the cases. After an average healing period of 7.8 weeks the implants were recovered, followed by soft tissue adaptation and prosthetic restoration.

RESULTS:
All implants showed an active wettability during the insertion procedure. Even if the surface seems to be rougher the insertion torque were similar to the standard implants with low temperature etching. All implants healed uneventful. 136 implants showed all signs of osseointegration after a prosthetic loading of 4 months only 3 implants out of 2 patients failed. The evaluation of the peri-implant soft tissue was also uneventful with an appropriate aesthetic result. The peri-implant parameters showed no signs of conspicuity.

DISCUSSION:
The insertion and the management of the implant with the new surface characteristics was not influenced by the new surface preparation. The initial results show a high confidence even in more critical indications like immediate extraction sides, early loading or after implant loss.

DENTSPLY Friadent, Mannheim, Germany.

P15

Karapetian VE, Neugebauer J, Zöller JE:
Immediate implant loading in augmented upper and lower jaw.
Scientific Poster, Academy of Osseointegration Annual Meeting, March 10 – 12, 2005.

INTRODUCTION:
Immediate loading in lower jaw is a common treatment method today. Immediate loaded implants after hipbone graft, let alone immediate loading of implants in the upper jaw with and without hipbone grafting have not been examined. The quality of implant sites prepared by bone grafts varies depending on the kind of the grafting material. The evaluation of the mechanical stability was done by the RFA method (Osstell®, Integration Diagnostic Inc).

PURPOSE:
The aim of this study was to show the success of immediate loading in upper and lower jaw and to compare success rates with and without hipbone graft. Primary stability and mechanical interlocking are stated as success factors for osseointegration. Also it should be shown, that immediate loaded implants show comparable stability in the upper jaw without and after lipbone grafting.

MATERIALS AND METHODS:
To evaluate the implant stability of immediate loaded compared to delayed loaded implants a group of 10 patients each was examined after implantation and 3 months after prosthetic loading. Within the group of immediate loaded patients we implanted a minimum of six implants in the upper and/or 4 implants in the lower jaw. If the mean insertion torque of the implants within one bar reconstruction was higher than 35 Ncm, immediate loading was performed and the bar-supported denture was inserted few hours post operationem.

RESULTS:
Comparison of the data did not show significant differences in implant stability between the regular loaded implant and the immediate loaded implants at implant placement and at recall. A mean of 77.25 ISQ (Implant Stability Quotient) was found in the immediate loaded group for the lower jaw implants and 70.53 ISQ in the upper jaw, compared to 75.67 ISQ in the upper and 83.50 ISQ for the lower jaw after 3 months of loading. Furthermore no clinical and radiological difference was visible. On the basis of the data collected, it can be shown that independent of augmentation a immediate loading can be realized with 6 connected implants in the upper and 4 connected implants in the lower jaw.

CONCLUSIONS:
The treatment results showed that the immediate loading treatment method in augmented upper and lower jaws is a treatment technique without any problems, if surgical and prosthetic treatment rules are followed correctly. The primary stability of the inserted implants should not undergo the 35 Ncm insertion torque. Also it has to be mentioned that the implant length stands in no correlation to the primary stability, which is explained by the bone density. The clinical and radiological success also showed that the osseointegration of the immediate loaded implants worked in upper and lower jaw.

Department of Craniomaxillofacial and Plastic Surgery, University of Cologne, Germany.

P16

Lehner B, Nkenke E, Roman FS, Thams U, Radespiel-Tröger M, Neukam FW: Immediate versus delayed loading of dental implants in the maxilla of mini-pigs. Follow-up of implant stability and implant failures.
Scientific Poster, European Association for Osseointegration, October 9 – 12, 2003.

INTRODUCTION:
It has been claimed that the process of osseointegration requires 5 to 6 months on average before loading can be considered in the maxilla (Brånemark 1983). Now there is an increasing need for shorter rehabilitation times. To date, there is no uniform opinion on immediate loading in the maxilla. Until now, neither clinical nor experimental studies have compared the effects of immediate and delayed loading of implants on their success.

AIM:
It has been the aim of the present study to compare the stability and survival rate of implants placed in the posterior maxilla after immediate loading or healing intervals of up to 5 months and an additional period of 6 months of functional loading.

MATERIALS AND METHODS:
In 9 mini-pigs, 3 premolars and the first molar were removed in the maxilla bilaterally. After 3 months, 6 implants (XiVE®, Friadent GmbH, Mannheim, Germany) were installed on each side of the maxilla either placed by a preparation with an osteotome technique or with spiral drills. Each maxilla received 6 implants. The implant stability was assessed by the resonance frequency analysis (RFA). The implants were loaded immediately in 2 mini-pigs with fixed provisional restorations. After 1 month another 2 animals, after 2, 3 and 4 months 1 mini-pig and after 5 months 2 mini-pigs received prosthetic supply.

RESULTS:
Implant placement with an osteotome technique led to a fracture along the alveolar crest in 5 animals. The insertion technique did not influence the initial implant stability ($P = 0.3605$). The implant stability was significantly influenced by the healing period ($P < 0.0001$). The implant stability decreased after 1 to 3 months of healing for both of the installation techniques and increased again after a healing period 4 and 5 months. After 6 months of loading, except for implant installation with an osteotome technique and a healing period of 1 – 3 months, which showed a slight increase, the implant stability further decreased. Implant failures occurred after implant site preparation by an osteotome technique after a healing period of 1 month (2 implants), after a healing period of 3 months (4 implants), after a healing period of 5 months (1 implant). After one month of loading 6 immediately loaded implants, 6 implants loaded after 1 month, 2 implants loaded after 2 and 3 months, respectively, were lost. After 2 months of loading, 2 implant had failed that were allowed to heal for 3 months. When spiral drills were used for the preparation of the implant sites, implant failures occurred after a healing periods of 2, 3 and 5 months (1 implant at each time interval). After 1 month of loading 7 immediately loaded implants, 3 implants loaded after a healing periods of 1, 2 and 3 months, respectively, and 1 implant loaded after a healing period of 4 months were lost. At the follow-up examination after 2 months of loading 1 implant was lost, that had healed for 2 months.

Department of Oral an Maxillofacial Surgery, University of Erlangen-Nürnberg, Erlangen, Germany.

P17

Neugebauer J, Traini T, Thams U, Piattelli A, Zöller JE: Peri-implant bone organization under immediate loading state: circularly polarized light analysis. A mini-pig study.

Accepted in 2005 for publication in J of Periodont.

BACKGROUND:
Immediate loading of dental implants is one of currently most examined topics in implant dentistry. Utilizing screw implants with a micro-structured surface and bone quality adapted insertion procedures, osseointegration is achieved when implants are initially stable and when splinted with the superstructure. Despite reported success, there is a shortage of information relating to remodeling and the peri-implant bone formation with immediately loaded implants.

MATERIALS AND METHODS:
Four to six immediately loaded and unloaded dental implants with a micro-structured surface were placed in the mandible and the maxilla in seven mini-pigs. A total of 85 implants were placed. After a four-months healing period all implants were retrieved. Histomorphometry was performed using a light microscope in transmitted polarized light connected to a high-resolution video camera interfaced to a monitor and PC. This optical system was associated with a digitizing pad and a histomorphometry software package with image capturing capabilities.

RESULTS:
Implants showed osseointegration if the average insertion torque of the implants within one bridge was above 35 Ncm. If the primary stability of the bridge was below 35 Ncm all implants of this quadrant were lost after four months. The multivariant discriminate analysis showed the highest correlation for implant stability by bridge insertion torque (BIT), localization (mandible or maxilla) and implant insertion torque (IIT) as success parameter. The loaded implants displayed collagen fibers, which were oriented in a more transverse way. In addition a higher quantity of secondary osteons was present. In comparison, the unloaded implants had collagen fibers with a more parallel orientation and a higher quantity of marrow spaces was present.

CONCLUSION:
When observed after four months, immediately loaded implants showed a higher degree of bone formation and remodeling in comparison to unloaded implants. Immediately loaded implants also demonstrated a prevalence of transversely oriented collagen fibers in the peri-implant bone. In this animal model, an average insertion torque of the implants within one bridge above 35 Ncm was used for the most successful implants.

Department of Oral and Maxillofacial Surgery, University of Cologne, Germany.

P18

Neugebauer J, Thams U, San Roman F, Cantzler P, Zöller JE, Traini T, Piattelli A:

Collagen fiber and osteons presence next to immediate loaded implants.

Scientific Poster, 12th Annual Scientific Meeting of the European Association for Osseointegration, October 9 – 12, 2003.

INTRODUCTION:

Micro-structured implants with enhanced thread design generated the base for immediate loading even in soft bone. Histological data on the course of osseointegration on such implants are available in only a small amount.

MATERIALS AND METHODS:

A study on six mini-pigs was performed to evaluate the peri-implant bone formation of these implants. In the mandible and maxilla 4 to 6 XiVE® implants (DENTSPLY Friadent, Mannheim, Germany) with FRIADENT® plus surface were placed. Control implants with and without loading and standard surface were used. Light microscopy with reflected polarized light (Laborlux S, Leitz, Wetzlar, Germany) was used to perform histomorphometry. The images were documented digitally. The analysis was done with a support by a digitizing pad (Matrix Vision GmbH) and a histomorphometry software package (Image-Pro Plus 4.5, MediaCybernetics, Immagini & Computer Snc, Milano, Italy).

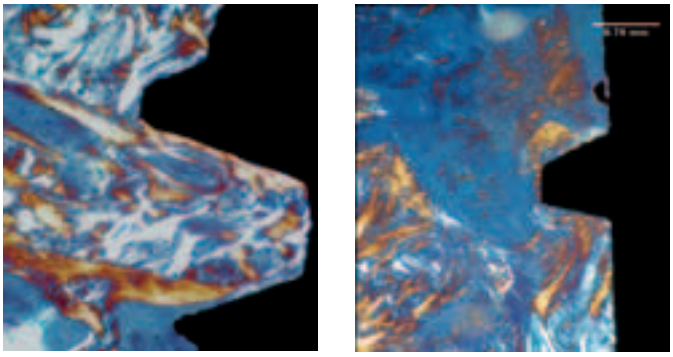
RESULTS:

The implants showed a high bone-to-implant contact, if primary stabilization was reached with an average insertion torque of 35 Ncm. The loaded implants showed collagen fibers, which were oriented in a more circular way; and a higher quantity of secondary osteons was present. The unloaded implants had collagen fibers with a more parallel orientation and a higher quantity of marrow spaces was present.

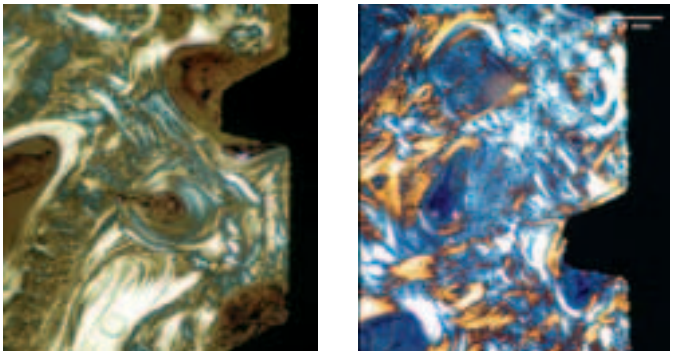
CONCLUSIONS:

This study demonstrates that immediate loaded implants with the FRIADENT® plus surface show a higher degree of bone formation with an improved bone-to-implant contact and remodeling with a large number of secondary osteons after 4 months in comparison to unloaded implants. The quality of bone remodeling under immediate loading with a microstructured surface is improved.

Department of Craniomaxillofacial and Plastic Surgery, University of Cologne, Germany.



4 months after immediate loading of XiVE® implants: Image of change of crestal to apical thread transverse collagen fibers appear yellow.



Unloaded XiVE® implants after four months healing: Image of crestal thread area with longitudinal fibers in white/grey.

P19

Neugebauer J, Thams U, Románm S, Steveling H: Clinical procedure and first results of immediately restored implants. A study in mini-pigs.

Scientific Poster, 10th Annual Congress European Association for Osseointegration, September 13 – 15, 2001.

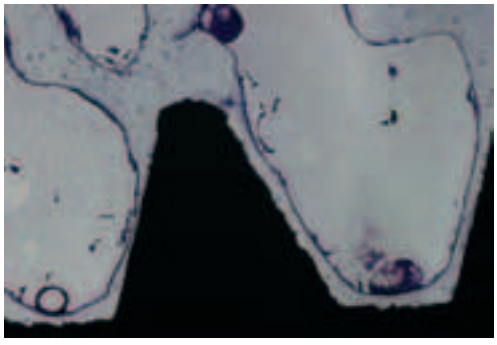
INTRODUCTION:
The immediate loading of dental implants in partially edentulous patients has not been widely investigated. Following the experience of the treatment of the anterior mandible, immediate loading requires pre-conditions such as immobilization of the implants with a superstructure and shortened surgical and prosthetic treatments. In soft bone, improvement of the bone quality can be achieved by BoneCondensing. Adaptation of the receptor site by "under-sizing" the osteotom relatively to the implant is another option to help achieve primary stability.

AIM:
An animal study on mini-pigs was performed to evaluate the clinical success and bone reaction during the course of osseointegration for implants in the mandible and maxilla.

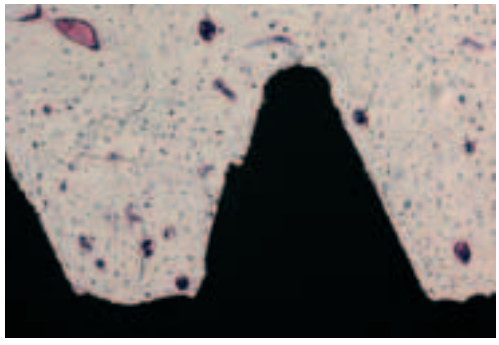
MATERIALS AND METHODS:
The premolars and the first molar were removed. After three months, implant placement and prosthetic temporization was performed for 61 XiVE® implants (FRIADENT GmbH, Mannheim, Germany). 49 implants were stabilized with prefabricated caps and glass fiber ribbons. The bridges were cemented onto the abutments at the end of surgery and controlled until the animals were sacrificed.

RESULTS:
Due to the adaptation of the receptor site preparation based on the bone quality, utilizing cortical drills in the mandible and bone condensing instruments in the maxilla, 92% of all implants were placed with an insertion torque (IIT) above 25 Ncm. The mean value of the insertion torque per bridge (BIT) was evaluated. If the BIT was less than 35 Ncm the bridges were not stable and the implants were lost after torque analysis loaded implants (failures) a few weeks prior to the first recall. In the mandible, of the directly loaded implants (N = 27) two failures occurred (92.6% success). The control implants in the mandible had a 100% success rate (N = 7). Three out of 22 directly loaded implants in the maxilla were stable after three months (13.6% rate). Two out of 5 control implants in the maxilla were stable (40% success rate).

Department of Craniomaxillofacial and Plastic Surgery, University of Cologne, Germany.



Toluidin blue of unloaded implant illustrates close bone-to-implant contact at the apical threads. The bone between the threads shows large marrow spaces.



Toluidin blue of loaded implant shows new bone formation within the threads. Active osteocytes are seen between the threads.

P20

Novaes AB, Papalexiou V, Grisi MFM, Souza SLS, Taba M, Kajiwara JK: Influence of implant microstructure on the osseointegration of immediate implants placed into periodontally infected sites. A histomorphometric study in dogs.

Clin Oral Impl Res 2004; 15 (1): 34 – 43.

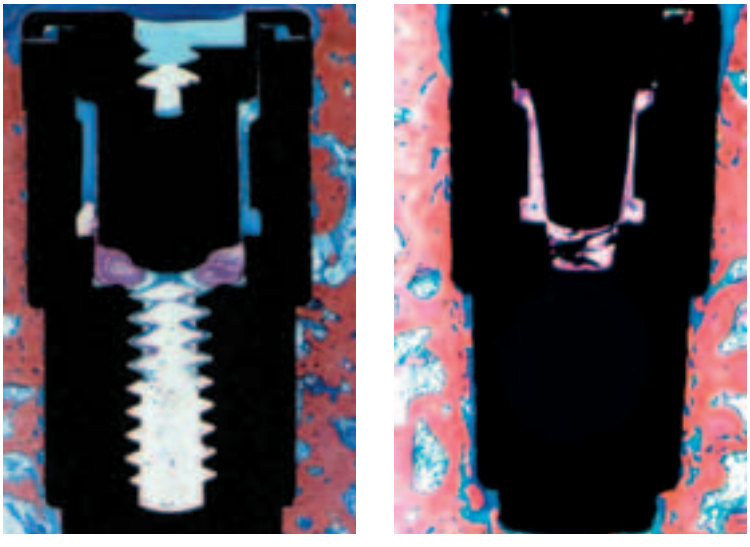
AIM:
The aim of this study was to evaluate the influence of implant microstructure on the osseointegration of immediate implants placed into infected sites.

MATERIALS AND METHODS:
During 12 weeks, periodontitis was induced in six dogs in the areas of the first to fourth mandibular premolars of both sides. The teeth were extracted and the implants were placed immediately. Implant placement was randomly assigned so that for each side in the mandible a different implant surface, a new grit-blasted/acid-etched group 1 or titanium plasma spray surface group 2 was used, totaling 36 implants in the experiment. The animals were killed 12 weeks after implant placement. Two histomorphometric analyses were performed: percentage of bone/ implant contact (BIC) and analyses of the bone density in adjacent and distant areas from the implant surface.

RESULTS:
The results showed that the percentages of BIC were 52.7% and 42.7% for groups 1 and 2, respectively. The bone density analysis revealed that the percentages of bone in the adjacent areas were 66.6% and 58.8%, and in the distant areas from the implants were 58.7% and 55.8% for groups 1 and 2, respectively. The mean differences of BIC were verified through the Mann-Whitney test and differences in bone density through the Kruskal-Wallis test. The differences were not statistically significant ($P > 0.05$).

CONCLUSIONS:
In conclusion, osseointegration of implants placed into a more challenging healing situation such as immediate implants into periodontally compromised sites was successful for both surfaces; however, the grit-blasted/acid-etched surface, although not statistically significant, had a slightly better performance when compared to the titanium plasma spray surface for all the parameters studied.

Department of Bucco-Maxillo-Facial Surgery and Traumatology and Periodontology, School of Dentistry of Ribeirão Preto, University of São Paulo, Ribeirão Preto, Brazil.



Bone-to-implant contact of the grit-blasted/acid-etched surface (experimental surface; left site) and of the titanium plasma sprayed surface (right site).

P21

Novaes AB, Marcaccini A, Souza SLS, Taba M, Grisi MFM: Immediate placement of implants into periodontally infected sites in dogs: A histomorphometric study of bone-implant contact.

Int J Oral Maxillofac Implants 2003; 18 (3): 391 – 398.

PURPOSE:
The placement of implants allows for re-establishment of function and esthetics following tooth loss. Immediate implant placement is a relatively recent procedure and has advantages, such as reduced number of surgical procedures, preservation of alveolar bone, reduction of cost and period of edentulism, and increased patient acceptance. However, there are some specific contraindications for the technique, such as the presence of an infection caused by periodontal disease and periapical lesions.

AIM:
The objective of this study was to evaluate the percentage of bone-implant contact of immediate implants placed in periodontally infected sites.

MATERIALS AND METHODS:
In the first phase, periodontitis was induced with ligatures in the mandibular premolars of 5 mongrel dogs, using the contra lateral teeth as controls (received prophylaxis only). After 3 months, in the second phase of the study, 40 implants were placed in the alveoli of both experimental and control teeth. After a healing period of 12 weeks, the animals were euthanized, and the hemimandibles were removed, dissected, fixed, and prepared for histomorphometric analysis of percentage of bone-implant contact. The Mann-Whitney test was used for statistical analysis.

RESULTS:
The results of the histomorphometric analysis indicated mean bone-implant contact of 62.4% in the control group and 66.0% in the experimental group, a difference that was not statistically significant.

DISCUSSION:
Histomorphometric results revealed similar bone-implant contact in both groups, with no signs of infection.

CONCLUSION:
It was concluded that periodontally infected sites may not be a contraindication for immediate implantation in this animal model system, if adequate pre- and postoperative care is taken.

Department of Bucco-Maxillo-Facial Surgery and Traumatology and Periodontology, School of Dentistry of Ribeirão Preto, University of São Paulo, Ribeirão Preto, Brazil.

P22

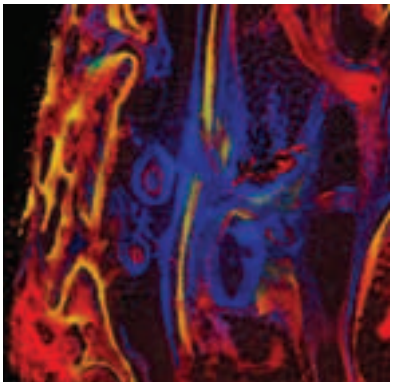
Papalexiou V, Novaes AB, Grisi MFM, Souza SLS, Taba M, Kajiwara JK: Influence of implant microstructure on the dynamics of bone healing around immediate implants placed into periodontally infected sites. A confocal laser scanning microscopic study.
Clin Oral Impl Res 2004; 15 (1): 44 – 53.

AIM:
This study evaluated by fluorescence analysis the influence of implant microstructure on the placement of immediate implants in periodontally infected sockets.

MATERIALS AND METHODS:
Periodontal disease was induced during 12 weeks bilaterally from P1 to P4 in six dogs. The teeth were extracted and immediate implants were placed. Each dog received six implants: three with FRIADENT® experimental surface (grit blasted/acid etched – FES group = plus surface) and three covered with titanium plasma spray (TPS group), for a total of 36 FRIALIT®-2 stepped cylinder implants. During the healing period, fluorescent bone markers were injected to study the bone remodeling around the implants. The dyes were injected in the following sequence: oxytetracyclin hydrochloride 3 days and 8 weeks, calcein green 4 weeks after the implantation and alizarin red S 3 days before killing. The animals were anesthetized and killed 12 weeks after implant placement. The mandibles were removed, dissected and processed for analyses of the percentage of newly formed bone surrounding the implant using a confocal laser scanning microscope.

RESULTS:
There were no significant statistical differences in bone formation (Mann-Whitney) between groups (FES group: 5.28% formation at 3 days, 10.3% at 4 weeks, 21.14% at 8 weeks and 6.98% at 12 weeks; TPS group: 3.36% at 3 days, 9.58% at 4 weeks, 14.57% at 8 weeks and 7.08% at 12 weeks). However, covariance analysis showed that the percent of marked bone was statistically greater for the FES group when compared to the TPS group, between the 3-day and 8-week periods of evaluation.

Department of Bucco-Maxillo-Facial Surgery and Traumatology and Periodontology, School of Dentistry of Ribeirão Preto, University of São Paulo, Ribeirão Preto, Brazil.



Projection images obtained by CLSM of the three fluorochromes administered 3 days, 4 weeks, 8 weeks after implant placement. The diferent colors show the bone formation that occurred at different time periods.

P23

Piattelli A, Traini T, Degidi M, Neugebauer J, Caputi S:
Bone collagen fibers orientation in the loaded osseointegrated XIVE® dental implants in human.
Scientific Poster, European Association for Osseointegration, October 9 – 11, 2003.

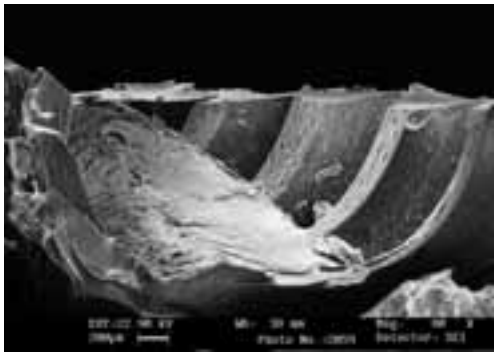
PURPOSE:
Immediate loading quite often shows higher risk for implants, if the preconditions are not clear and micro-movement disturb the course of osseointegration. The clinical experience shows a high success rate, if the appropriate protocol is used. This study investigates the birefringence in the human peri-implant bone after loading.

MATERIALS AND METHODS:
The osseointegrated XiVE® dental implants, retrieved from five patients were used in the present study. The implants, immediately loaded after surgical procedures, were left in function for 6 months before retrieving. Undecalcified cut sections were prepared by using the Precise automated system (Assing, Roma, Italy). One central section from each sample was ground the final thickness of 40 µm. Birefringence was measured as an indicator of transverse collagen fibers orientation using circularly polarized light (CPL). The measurements were performed on digitized images stored in format .tif with NxM = 768 x 1024 grit of pixles for a 24 bit, after converting in gray scale at 8 bit. A semi-quantitative digital densitometry of the black and white areas related to longitudinally or transverse collagen fibers was made by a software image analysis. The area of analysis was standardized for all implants in 9.707 mm^2 measured at 100x and restricted to the first two threads under cortical bone.

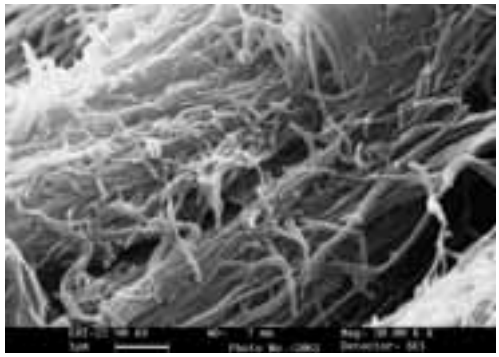
RESULTS:
A 33% (3.208 +/– 0.435 mm^2) of the examined area was composed of transverse collagen fibers while only a 20.1% (1.957 +/– 0.253) was composed of longitudinally collagen fibers. The difference was statistically significant ($P < .05$).

CONCLUSION:
The collagen fibers were more transversally orientated under the horizontally portion of the threads where the compression loads act.

Dental Practice, Chieti, Italy.



Bone block removed from XiVE® implant for SEM evaluation of collagen structure.



Collagen fibre orientation in transversal orientation. Macrostructure of thread is visible. (x30.000).

P24

Weinländer M, Lekovic V, Neugebauer J, Plenk H, Zöller JE:
Mechanical and histological evaluation of immediate loaded implants with various surfaces and designs.
Scientific Poster, 18th Annual Meeting of the Academy of Osseointegration, February 27 – March 1, 2003.

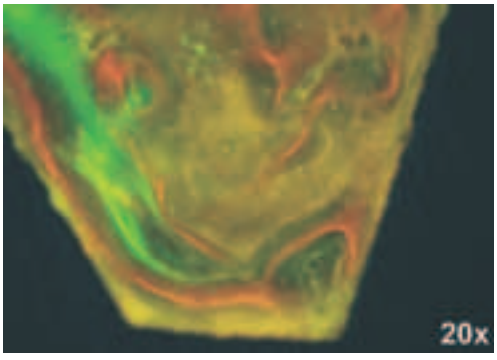
INTRODUCTION:
Immediate loading is stated to be the most innovative technique in implant therapy. Various designs claim to be beneficial for a time-reduced implant treatment protocol. Different implants are available with various modifications of the macro and micro-morphology.

AIM:
Different surgical approaches are discussed to reach osseointegration while performing immediate loading. To determine the relevant factors for implant success four different implants were placed in each quadrant on two mongrel dogs. Immediate loading was performed in the maxilla and the mandible. The RFA-values were documented, to compare the values with the results with the histological findings.

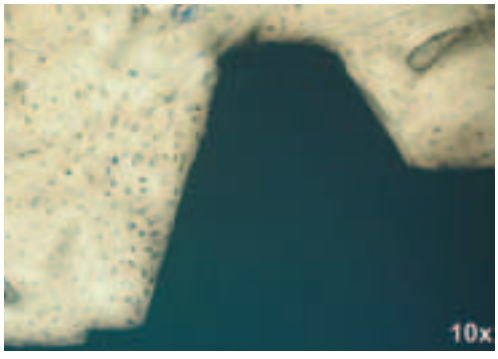
MATERIALS AND METHODS:
To prepare an edentulous alveolar ridge all premolars were removed in general anesthesia. After regeneration period of 3 months implant placement was performed. In each animal (mini-pig) four different implants were placed per quadrant and immediate loading with gold casted bridges was achieved a week post implantation. The ISQ-values (Osstell, Integration Diagnostic) were measured after implant placement and after sacrifice respectively.

RESULTS:
All 16 bridges were in function after a five months loading period. No implant was lost or did not show osseointegration. Crestal bone loss was observed in a small amount mainly up to the first threat. Depending on the surgical protocol this bone loss was different for each system. The ISQ values showed an increase between surgery and recall in average 9.25. In marrow bone early formation of new bone was observed. In cortical bone new bone formation was noticed mainly after 3 months of loading. At the loading area of the threats some less intensive bone contact is detectable by micro-radiography. All implants showed a good bone-to-implant contact.

Dental Practice, Vienna, Austria.



Intensive bone formation on implant surface at early stage.



Good bone contact along implant surface in region of change of thread designs.

P25

Degidi M, Piattelli A, Gehrke P, Carinci F: Clinical outcome of 802 immediately loaded and two-stage submerged implants with a new grit-blasted and acid-etched surface: A twelve months follow-up.

Submitted to Int J Oral Maxillofac Implants in April 2005.

BACKGROUND:
The texture of the implant surface has been recognized to be a decisive factor to achieve osseointegration. It has been claimed that implants with an enhanced surface roughness may promote the rate and degree of osseointegration and eventually improve the clinical success rate.

AIM:
of this study was an evaluation of the clinical outcome of three different implant macrodesigns with a new microstructured implant surface.

MATERIALS AND METHODS:
In the period between July 2003 and December 2003, 321 patients (128 men, 193 women, between the ages of 18 to 88) were enrolled. A total of 802 implants were placed, of which 255 (31.8%) in men and 547 (68.2%) in women. Immediate loading was chosen for 423 (52.7%) implants and delayed loading for 379 (47.3%) implants. In this case a submerged technique (two-stage) or single-stage procedure was used. The following variables were statistically analyzed: implant length (minimum length 8.0 mm), implant diameter (minimum diameter 3.0 mm), implant type (FRIALIT® plus, XiVE® S plus and XiVE® TG plus), receptor site (anterior and posterior region of maxilla and mandible: incisor, cuspid, premolar and molar region), IT (Insertion Torque) (minimum > 30 Ncm), RFA (Resonance Frequency Analysis) (minimum > 60 ISQ), CD (use of crestal drill) (minimum > 0), type of loading (immediate or delayed) and bone quality (D I – D IV).

RESULTS:
Only three of 802 implants failed to integrate. An implant success rate of 99.6% was achieved for a period of twelve months post placement. Four implants had a crestal peri-implant bone resorption higher than 1.5 mm during the first year. The mean crestal bone loss was 0.15 mm (ranging from +0.9 to –2.0). Only the type of implant, the RFA value, and the implant length showed statistically significant differences. A higher crestal bone loss has been observed in immediate post-extraction cases and in DIII – DIV bone quality.

DISCUSSION:
Beside defined surgical and prosthetic approaches, the good clinical outcome of the present study can be attributed to the use of implants with a microstructured surface.

CONCLUSION:
The results of this study provide evidence that immediate loading of dental implants represents a viable treatment alternative to classic delayed loading protocols. Within the limits of the present study, the preliminary data indicate that immediate loading of implants in the anterior and posterior maxilla and mandible can result in successful implant integration and stable peri-implant conditions up to one year.

Dental School, University of Chieti-Pescara, Chieti, Italy.

P26

Gehrke P, Jansen R, Eisenmann E, Dohm G, Neugebauer J: Preliminary results of a prospective clinical study on the FRIADENT® plus surface: A two year follow-up.

EDI Journal 2005: 2 – 6.

BACKGROUND:
Implant surfaces characteristics are widely recognized as being of fundamental importance in achieving long-term implant success. It has been suggested that implants with micro-roughened surfaces produce a more rapid bone response and more bone-to-implant contact.

AIM:
The aim of the present study was an evaluation of the clinical outcome of the new grit-blasted and high-temperature acid-etched FRIADENT® plus surface.

MATERIALS AND METHODS:
In the period between July 2003 and July 2005, 77 patients (36 men, 41 women, between the ages of 17.3 to 78.7) were enrolled in this study at 10 private and university centers. Informed written consent was obtained from patients to use their data for research purpose. Subjects were screened according to the following inclusion criteria: controlled oral hygiene, the absence of any lesion in the oral cavity, and sufficient residual bone volume to receive implants of at least 3.8 mm in diameter and 10 mm in length. Immediate loading was performed when implant insertion torque values were above 30 Ncm (26 implants). Alternatively a conventional two-stage surgical protocol with 3 to 6-month healing time was used (129 implants). In cases of insufficient bone volume, augmentation procedure were performed prior to (19 cases), and / or at the same time of implant placement (39 cases). Exclusion criteria were as follows: A high degree of bruxism or parafunction, smoking more than 20 cigarettes/day, excessive consumption of alcohol, localized radiation therapy of the oral cavity, anti-tumor chemotherapy, liver diseases, kidney diseases, blood diseases, immunosupressed patients, corticosteroid treatment, pregnancy, inflammatory and autoimmune diseases of the oral cavity, poor oral hygiene.

RESULTS:
Of the 155 implants placed, a total of 152 implants osseointegrated, 3 implants failed. One implant failed after 35 days, prior to loading, and was categorized as early implant failure. One implant failed at 4 months, and one at 8 months post loading. An implant success rate of 97.37% was achieved for a period of 24 months post placement. The mean crestal bone loss after one year was 0.99 mm, respectively 1.16 mm after two years.

CONCLUSIONS:
The two-year interim report indicates that FRIADENT® plus implants achieved a high rate of integration that remained stable during the course of implant function. In addition, the plus surface has provided a high level of prosthetic predictability. With an implant success rate of 97,37% and a mean marginal bone loss of 1,16 mm after two year post-loading recall visit, the investigated implants demonstrated a predictable clinical outcome of implant-supported treatment concepts for the rehabilitation of partially and totally edentulous patients.

Dental Practice, Ludwigshafen a. R., Germany.

P27

Hanser T, Neugebauer J, Khoury F:
Immediate loading of implants: Influence of surface characteristics.
Scientific Poster, 13th Annual Meeting of the European Association for Osseointegration, September 16 – 18, 2004.

INTRODUCTION:
Recent clinical studies indicate that an implant with a roughened surface may be loaded sooner than traditional healing protocols have recommended. The presentation reports the results of a study evaluating the clinical performance of immediate loading of dental implants with a porous microstructured grit blasted/acid etched/neutralized surface in different treatment modalities.

MATERIALS AND METHODS:
Between 1999 and 2003 273 XiVE® screw-type implants were consecutively placed with a placement torque of at least 35 Ncm in 82 patients and immediately loaded. 224 were placed in the mandible and 49 in the maxilla. 152 implants were inserted in the interforaminal area of the mandible and restored with a bar and overdenture, further 20 implants in the same region were restored with bridges and also functionally loaded. 101 implants mainly in the esthetic area of the maxilla and mandible were immediately restored but without functional loading (out of occlusion), for single tooth or bridge restoration.

RESULTS:
After a follow-up of 12 to 60 months (average 36.3 months) 3 implants failed in the edentulous mandible during the first 2 months of loading. All other implants are still in function with acceptable peri-implant parameters. Bone loss > 3mm was observed in 6 implants placed in the edentulous mandible and in 1 implant inserted in the maxilla. The 101 non-functionally loaded implants osseointegrated and were restored with a functionally loaded ceramic crown or screw-retained bridge 3 to 4 months after implant placement. Peri-implant probing depth and bone loss showed no significant difference between functional and non-functional implant loading.

DISCUSSION:
The data and the experience described of this 5-year analysis indicate that immediate loading beyond the proven and documented standard of splinting four implants in the anterior mandible can be a predictable technique for shortening dental rehabilitation time with relevant satisfaction for patients, in cases of implants with a high primary stability, using appropriate surgical and restorative techniques. The specific surface roughness on the endosseous section of the implant seems to enhance the regeneration potential at the interface, thus improving clinical implant osseointegration, allowing accelerate implant protocols.

Clinic Schloss Schellenstein, Olsberg, Germany.

P28

Jansen R, Kielhorn J, Schmenger K, Eisenmann E, Neugebauer J:
Clinical results after 2-year experience with a three-dimensional surface on screw-type implants.
Scientific Poster, 20th Annual Meeting of the Academy of Osseointegration, March 10 – 12, 2005.

INTRODUCTION:
Predictable osseointegration is one of the main goals in dental implantology. However the treatment should also focus on the long-term success. As demonstrated in recent studies the micro-morphology of the implant surface could influence the initial cell contact positively. The best results were shown with grit-blasted and high temperature etched surfaces. In addition the 3-dimensional surface appeared to have a positive effect on the implant-bone contact and the bone quality.
The histological investigation of unloaded implants with the FRIADENT® plus surface has shown a BIC after osseointegration that is comparable to loaded implants with conventional surfaces.
To verify this initial results the stability of the achieved situation after implant placement and restoration was the main objective in the second part of the investigation with FRIALIT® (DENTSPLY Friadent, Mannheim, Germany) implants with this new surface type. 10 international centers of implantology were involved in this follow-up trial.
The aim of this poster is to present the collected data and the clinical outcome 2 years after implant placement.

MATERIALS AND METHODS:
The documentation and evaluation contain the data of 150 implants and 77 patients. All surgical concepts were used in these investigations (as shown in the first poster publication at AO 2004). 78% of all patients underwent an augmentation treatment prior or simultaneous to the implant placement. The average healing time was 7.8 weeks before the implants were recovered. Subsequently the prosthetic restoration was fabricated and inserted. As prosthetic device different concepts were carried out in order to restore the osseointegrated implants. Depending on the required result solely functional restorations or additionally esthetic superstructures were fabricated. Fixed restorations like single crowns (26%) or bridgework (55% and 2% in combination with natural teeth) displays the majority of the treated cases (83%). Removable dentures (11% bar and 6% ball attachments) were used in only a few cases. In order to check the stability of the achieved initial situation the first recall was carried out after approximately 4 month.

RESULTS:
Besides the 3 non-osseointegrated implants no late failure occurs. At the first recall the average crestal bone loss was less than 1.5 mm. After 2 years the clinical situation has not changed. No differences in the outcome due to diverse regions of the jaws could be noted.

CONCLUSION:
The results show a high confidence even in more critical indications such as immediate extractions sides, early loading or after implant loss.

DENTSPLY Friadent, Mannheim, Germany.

P29

Khoury F, Becker C, Hanser T, Berger F-M, Degidi M, Piattelli A:
A prospective study on immediate loading of dental implants.
Scientific Poster, International Congress on Reconstructive Preprosthetic Surgery, April 5 – 7, 2003.

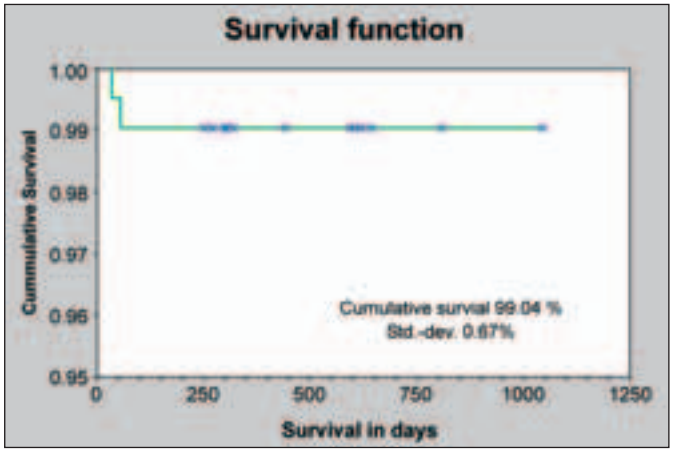
INTRODUCTION:
High success rates, progress in therapy and technical innovations provided cause for accelerate implant protocols. The presentation reports the results of a study evaluating the clinical performance of immediate loading of dental implants.

MATERIALS AND METHODS:
Between 1999 and 2001 210 XiVE® screw-type implants with a grit-blasted and acid-etched surface were consecutively placed in 62 patients and immediately loaded having a placement torque of minimum 35 Ncm. 186 were placed in the mandible and 24 in the maxilla. Most of these implants were inserted in the interforaminal area of the mandible (172 implants), restored with a bar and overdenture and functionally loaded. 31 implants mainly in the esthetic area of the maxilla were immediately restored but without functional loading (out of occlusion), most of them for single tooth restoration.

RESULTS:
After a follow-up of 12 to 36 months (average 27.3 months) 2 implants failed in the edentulous mandible, both during the first 2 months of loading. All other implants are still in function with acceptable peri-implant parameters. Bone loss > 3mm was observed in 6 implants placed in the edentulous mandible. The 31 non-functionally loaded implants osseointegrated and were restored with a functionally loaded ceramic crown 3 months after implant placement. Peri-implant probing depth and bone loss showed no significant difference between functional and non-functional implant loading.

DISCUSSION:
The data and the experience described of this 3-year analysis indicate that immediate loading of implants using appropriate surgical and restorative techniques can be a predictable technique for shortening dental rehabilitation time with relevant satisfaction for patients in restricted indications. Immediate restoration of implants in the esthetic area without functional loading seems to be a successful method in cases of implants with a high primary stability.

Clinic Schloss Schellenstein, Olsberg, Germany.



Gehrke P, Neugebauer J:
Implant surface design:
Using biotechnology to enhance osseointegration.
Dental Implantology Update 2003; 14 (8): 57 – 64.

P30

The successful osseointegration of dental implants depends on the types of implant-to-bone interactions that occur at the point of contact. Dental implant surfaces play a key role in these interactions. The initial migration of cells, and their adherence, proliferation, and differentiation directly affect how bone forms, as well as the quality of the bone. The FRIADENT® plus surface (DENTSPLY Friadent; Mannheim, Germany) possesses a homogenous surface morphology, which positively influences cell attachment and improves bone apposition to implants. BioPoreStructuring (an etching process derived from the semi-conductor and pharmaceutical industries) is used to create FRIADENT® plus. FRIADENT® plus represents the further development of the first micro-retentive grit-blasted/acid-etched titanium oxide surface introduced 15 years ago by FRIADENT. FRIADENT® plus also represents the latest developments in microdesign and production, opening new, innovative technologies, that until now were unavailable in implant dentistry. With the new FRIADENT® plus surface, FRIADENT fulfilled the requirements for dental implants arising from the latest scientific knowledge on surface morphology.

FRIADENT GmbH, Mannheim, Germany.

Gehrke P:
The influence of dental implant surfaces on tissue regeneration potential.
FRIADENT publication 1998.

P31

The long-term success of an implant treatment concept is dependent upon multiple factors; but it is primarily influenced by the volume of bone at the implant site, the implant design and the implant surface. Composition, roughness and topography of the implant surface at the interface play a major role in achieving primary stability and guaranteed osseointegration. Rough surfaces stimulate the cell activity in surrounding bone structures. Cell proliferation, differentiation, matrix synthesis, and production of the "Tissue Growth Factors" are enhanced and lead to an increased bone-to-implant metal interface contact. A structure machine polished surface on the implant collar margin influences the cellular contact guidance of soft tissue. It acts as a tight barrier against bacteria between the oral cavity and the implant site.

1. A specific surface roughness on the endosseous section of the implant enhances the regeneration potential at the interface, thus improving clinical implant osseointegration.
2. FRIADENT® surface structuring is achieved by an additive plasma coating of titanium (TPS), hydroxyapatite (HA) spraying or by subtractive surface treatment consisting of grit-blasting and acid-etching.
3. TPS, HA and grit-blasted/acid-etched surfaces lead to firmer bone fixation with statistically significant increases in removal torque and a higher percentage of bone-to-metal contact compared to machined implant surfaces.
4. A structure polished, cervical implant collar enhances soft tissue adaptation.

FRIADENT GmbH, Mannheim, Germany.

P32

Gross M, Jansen R, Gehrke P, Cantzler P:
Implant surface enhancement – Myth and reality. Comparative analysis of currently available implants.
Scientific Poster, European Association for Osseointegration, September 12 – 14, 2002.

INTRODUCTION:
Implant surface characteristics are considered to play a mayor role in accelerating the processes leading to osseointegration. Some manufacturers claim for a reduced healing time. Besides physical and chemical parameters like wettability, positive or negative surface charge and surface-free energy, the topography of dental implant surfaces can influence cell attachment and subsequent osseointegration. Several cell types are involved in the process of osseointegration, osteoblast-like cells and other anchorage-dependent cells, such as fibroblasts. These cells show similar morphologic behavior and affinity to rough titanium surfaces.

AIM:
The aim of this poster is to present the topographical aspects of currently available implant surfaces.

MATERIALS AND METHODS:
Different commercially available dental implants have been investigated to compare surface roughness and reproducibility of advertised properties. Scanning electron microscopy (SEM) was used for topographical evaluation, backscattered electron imaging (BEI) was used for density and/or atomic number analysis, and x-ray micro-analysis (XRM) was used for elemental analysis.

CONCLUSIONS:
Some marketing claims on implant surface characteristics should be critically evaluated and discussed on their clinical evidence. Embedded particles of the production process like grit particles can be observed as well as inhomogeneous structures. Nevertheless, within the range of state-of-the-art implant surfaces very high success rates have been documented. Topographical similarities of different implant surfaces can be observed. This could lead to the conclusion that reduced healing times claimed for a specific surface could also be related to surfaces with similar topographies. Surface roughness values are not clearly related to topographical appearance. Further development of enhanced implant surfaces should lead to morphologic structures which are homogeneously distributed to enable an allover high level of close cell attachment. Limited data on the influence of embedded production particles on the implant surface is available. However, Paolantonio et al. has demonstrated that no statistic evidence could be provided to support the hypothesis that surface inorganic contamination could affect osseointegration of titanium dental fixtures.

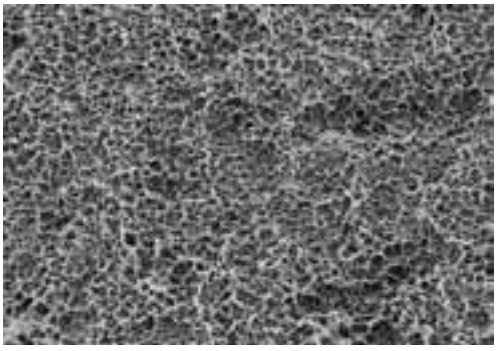
FRIADENT GmbH, Mannheim, Germany.

P33

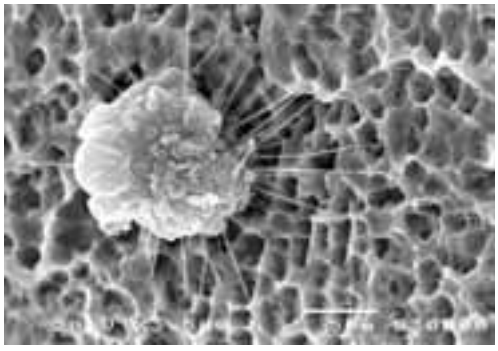
Neugebauer J, Cantzler P, Piattelli A:
15 years clinical experience with grid-blasted and acid etched surfaces – the further development to the CELLplus surface structure.
ZWR 2003; 112 (11): 490 – 498.

Microstructure surfaces on endosseous implants seem to be the standard in implant dentistry today. At the beginning of the modern implantology in the mid 80ties of the last century the major implant surfaces were either the smooth machined surface of the Branemark-type implant or the coating with TPS or HA mainly represented by ITI Straumann or IMZ® implants. Various techniques of enhancing the surface characteristic have been presented in the recent years as obviously new inventions. The most techniques of preparing the implant surface are done at the early time by adding different materials on the surface. In the last years more and more implant companies report about their innovative subtractive technology. The first implant, which had such a surface preparation, was the New Ledermann Screw. This further development of the ITI-TPS-screw was already introduced to the market in 1988. After 15 years of good clinical use a modification is now presented with an improved biological reaction especially for immediate and early loading by the special high temperature etching. Due to modern industrial technique a high temperature etching process could be developed, that was evaluated in several in-vivo and in-vitro studies for an improved osseointegration.

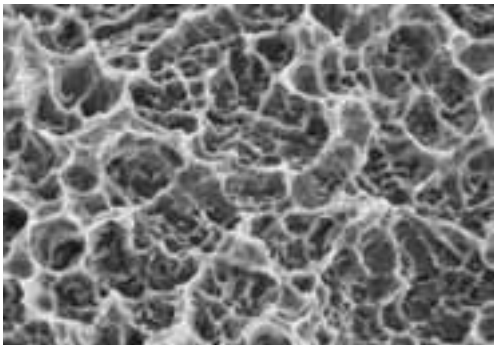
FRIADENT GmbH, Mannheim, Germany.



SEM 500fold magnification Cellplus (= FRIADENT® plus).



Initial osteoblast contact with formation of filiaepodia.



SEM 3000fold magnification Cellplus (= FRIADENT® plus).

P34

Piattelli A, Degidi M, Paolantonio M, Mangano C, Scarano A: Residual aluminum oxide on the surface of titanium implants has no effect on osseointegration.

Biomaterials 2004; 24 (22): 4081 – 4089.

INTRODUCTION:
The cleanliness of titanium dental implant surfaces is considered to be an important requirement for achieving osseointegration, and it has been hypothesized that the presence of inorganic contaminants could lead to lack of clinical success. Aluminum ions are suspected to impair bone formation by a possible competitive action to calcium.

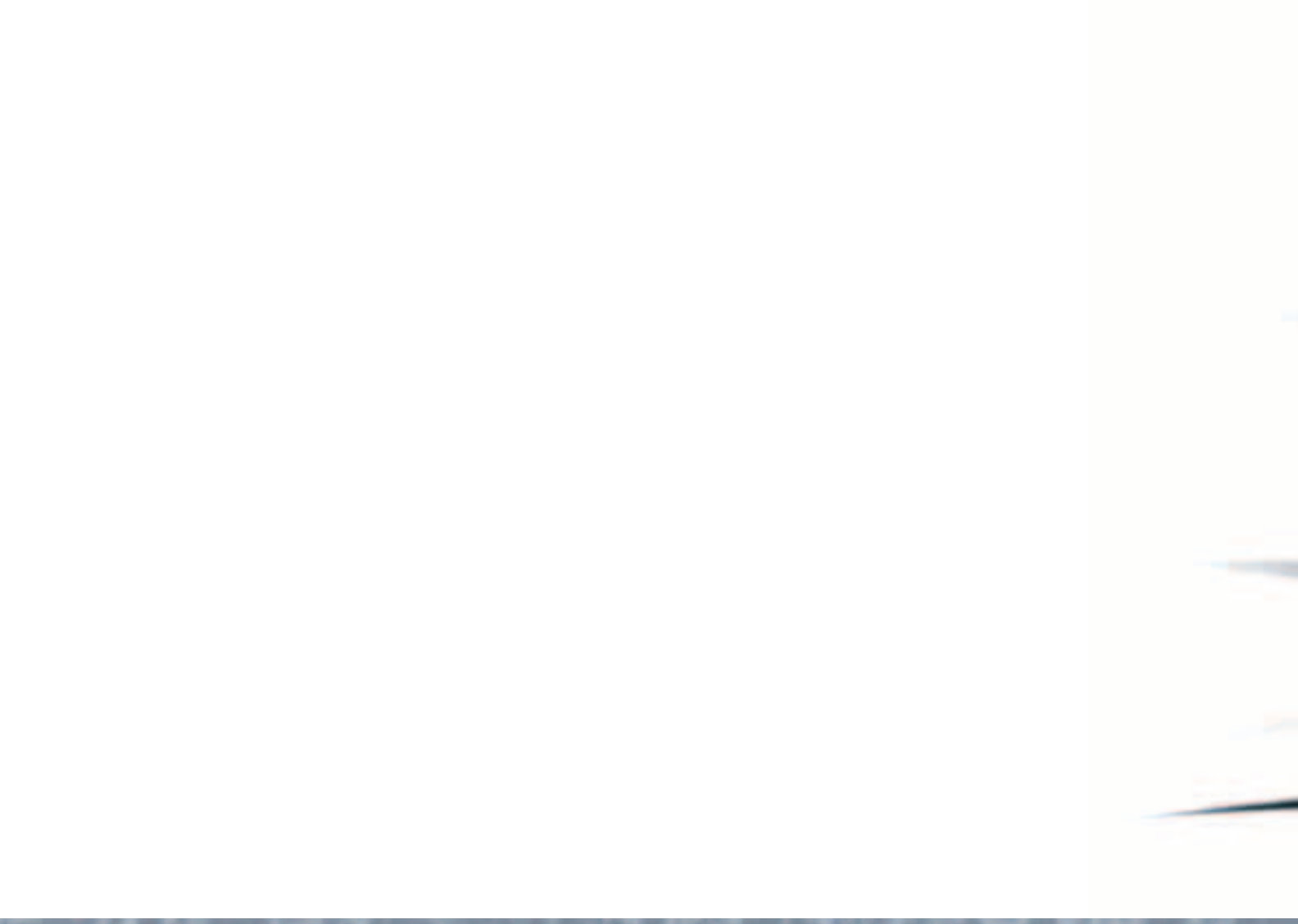
AIM:
The objective of the present study was to describe the effects of residual aluminum oxide particles on the implant surface on the integration of titanium dental implants as compared to decontaminated implants in a rabbit experimental model.

MATERIALS AND METHODS:
Threaded screw-shaped machined grade 3 c.p. titanium dental implants, produced with high-precision equipment, were used in this study. The implants were sandblasted with 100 – 120 µm $Al_2 O_3$ particles at a 5 atm pressure for 1 min, then 24 implants (control implants) underwent ASTM F 86 – 68 decontamination process in an ultrasonic bath. The other 24 implants (test implants) were washed in saline solution for 15 min. Both test and control implants were air-dried and sterilized at 120° C for 30 min. After sterilization the implants were inserted into the tibiae (two test and two control implants in each rabbit). Twelve New Zealand white mature male rabbits were used in this study. The protocol of the study was approved by the Ethical Committee of our University.

RESULTS:
No complications or deaths occurred in the postoperative period. All animals were euthanized, with an overdose of intravenous pentobarbital, after 4 weeks. A total of 48 implants were retrieved. The images were analyzed for quantitation of percentage of surface covered by inorganic particles, bone-implant contact, multinucleated cells or osteoclasts in contact with the implant surface and multinucleated cells or osteoclasts found 3 mm from the implant surface. The differences in the percentages between the two groups have been evaluated with the analysis of variance. The implant surface covered by inorganic particles on test implants was significantly higher than that of control implants ($p = 0.0000$). No statistically significant differences were found in the bone-implant contact percentages of test and control implants ($p = 0.377$). No statistically significant differences were found in the number of multinucleated cells and osteoclasts in contact with the implant surface ($p = 0.304$), and at a distance of 3 mm from the implant surface ($p = 0.362$).

CONCLUSON:
In conclusion, our histological results do not provide evidence to support the hypothesis that residual aluminum oxide particles on the implant surface could affect the osseointegration of titanium dental implants.

Dental School, University of Chieti, Italy.



FRIADENT Class I medical products CE

Class I medical products compliant with Directive 93/42/EEC are
– non-active, handheld surgical and prosthetic instruments for implant placement and grafting
– components for impression technique that do not remain in the patient's mouth
– non-active components for the planning phase

FRIADENT Class IIa, IIb, III medical products CE 0123

Class IIa, IIb and III medical products compliant with Directive 93/42/EEC are
– dental implants, membranes, membrane tacks and bone grafting materials
– active surgical instruments for implant placement and grafting
– components for impression technique and prosthetic restoration that remain in the patient's mouth

Order No. 2-002015/001

FRIADENT GmbH · P. O. Box 71 01 11 · D-68221 Mannheim/Germany
Phone: + 49 621 4302-1288 · Fax: + 49 621 47 13 06
e-Mail: info@friadent.de · Internet: http://www.friadent.de

030601/SB

EVIDENT SUCCESS®

DENTSPLY FRIADENT