IMPLADENT STI-Bio-C

BIOACTIVE TITANIUM since 1999

- **HYDROPHILIC**
- **NANO STRUCTURED**
- **OSSEOCONDUCTIVE**

The unique alkali-treated **bioactive surface** of the STI-Bio-C implant **accelerates** the process of **bone-implant contact formation**, providing the implant with increasing secondary stability at the earliest stages of healing. This phenomenon helps to reduce the healing time and enables **early and immediate loading** to become a predictable and safe treatment protocol.

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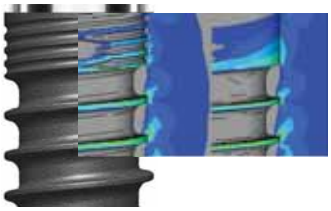
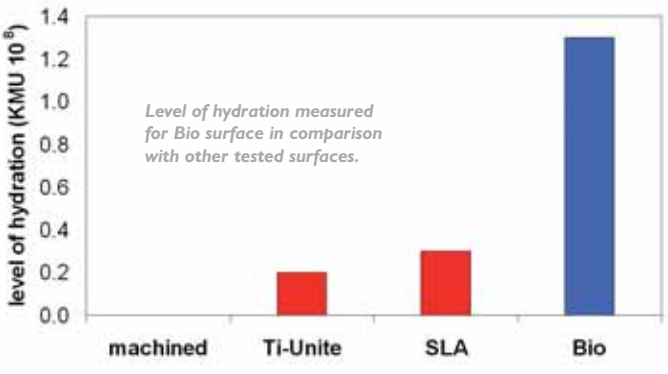
Original concept of bioactive surface



Bioactivity has been defined as the characteristics of an implant material that allows it to form a bond with living tissues[1]. It was first detected in the late sixties: in a group of materials called bioactive glasses, which bonded to bone within days. Machined-smooth titanium can be regarded as a bio-inert material that becomes encapsulated by soft tissue and forms a direct contact with bone (osseointegration) only under certain conditions and after long time periods[2]. Since the discovery of osseointegration, the history of dental implantology has been closely linked with efforts to modify the surface of titanium (e.g. by roughening) in order to bring the surface reactivity of titanium closer to bioactive materials - and thus enable titanium to form a stable and functional interface with bone in the shortest time. LASAK has developed a three-step surface treatment that combines mechanical- and chemical-treatment methods to achieve a unique, three-dimensional, macro-, micro- and nano-structured bioactive titanium surface - the Bio surface. The **Bio surface** stimulates cell attachment, differentiation and bone matrix synthesis leading to an increased bone-implant contact in a shorter time.

1



Level of hydration measured for Bio surface in comparison with other tested surfaces.

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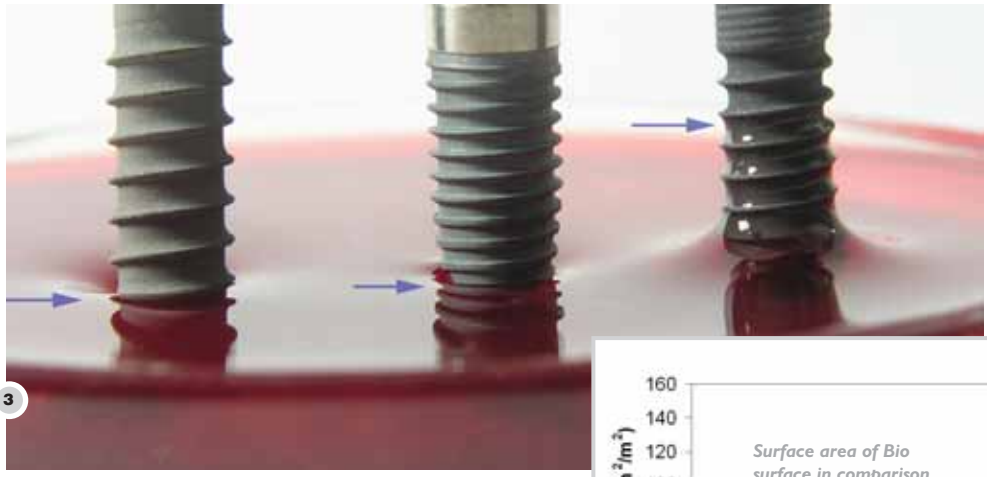
What makes Bio surface unique?



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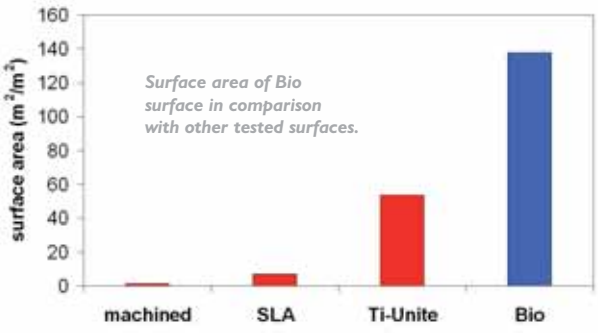
Contact of three implant surfaces with blood (left: sand-blasted large grit acid etched, center: anodized, right: Bio; arrows mark the level of the highest blood implant contact) [4,5,14]

4

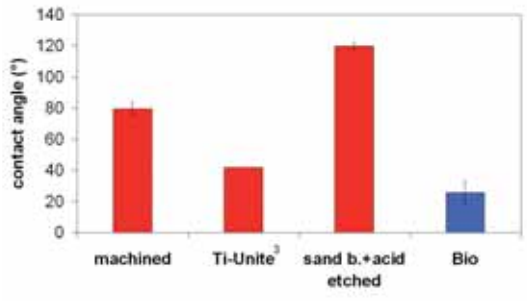


Surface area of Bio surface in comparison with other tested surfaces.

The surface treatment used in the preparation of the Bio surface increases the density of hydroxyl groups on the surface as compared to other measured surfaces [4,5,14]. The level of **hydration** of the Bio surface was higher by roughly an order of magnitude compared to that of other surfaces[5,14] (2)

The chemical modification of the Bio surface at the nano-scale makes the surface **hydrophilic (low contact angle)**[4,5,14] and enables an active ion interaction with the blood plasma long before the bone-forming cells can attach. Its excellent wetting properties enable the fast penetration of blood into the complex structure of the Bio surface (3).

2



Contact angle of Bio surface in comparison with other tested surfaces. Hydrophilicity is characterized by a low contact angle.

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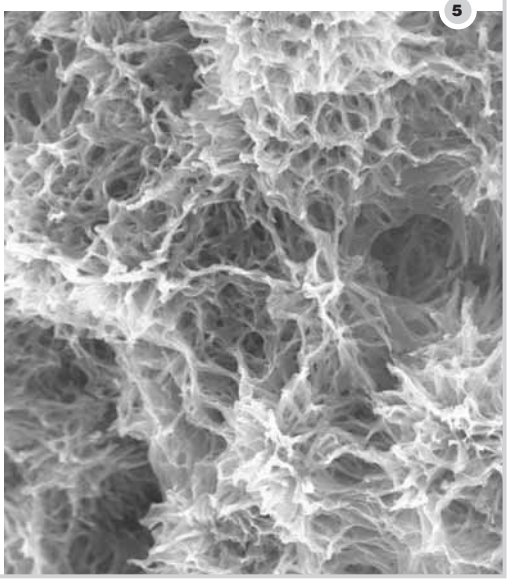
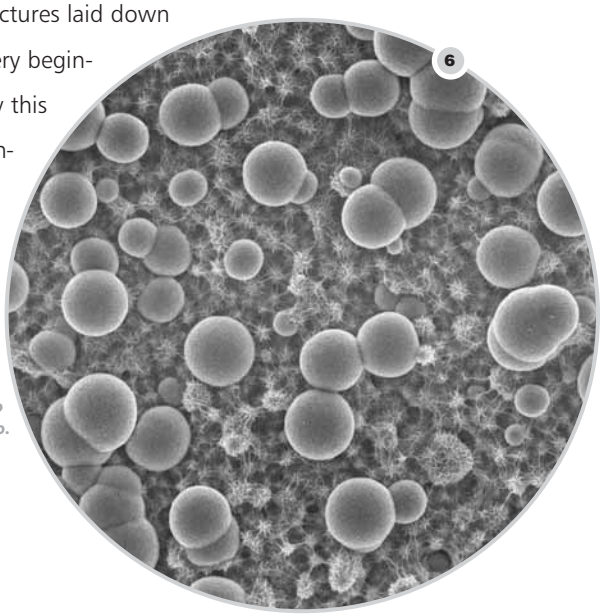
Bio surface - ideal substrate for new bone formation



Porous, hydrated structure of the Bio surface (SEM, magnification 10000x).

The surface modification creates a macro-rough, micro- and nano-porous surface structure, which exhibits a 138-fold **increase of surface** area compared to a smooth implant surface (4).
The presence of the hydroxyl groups is of great importance for the ion interaction of the implant surface (5) with blood. The Bio surface rich in active hydroxyl groups induces **calcium phosphate adsorption** (bone apatite formation) when in contact with blood plasma[6]. This property was also observed on fluoride treated titanium implants[7]. The natural bone mineral formed on the Bio surface represents an ideal substrate for the first calcium phosphate structures laid down by the osteogenic cells at the very beginning of new bone formation. By this mechanism the bone-implant contact formation is accelerated and the stability of the interface is secured [5,9,10,11,12,14].



Nucleation and crystal growth of the bone mineral (apatite) on the Bio surface in vitro.

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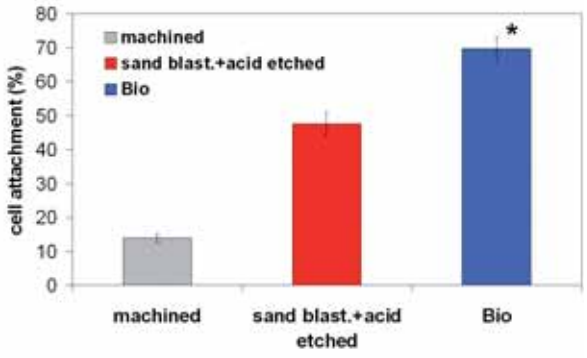
Cell response to the Bio surface

Cell response to three implant surfaces ('machined', 'sand-blasted+acid-etched', 'Bio')[8] was evaluated in an in vitro study using a cell culture of osteoblast-like cells. The results indicated the effect of the bioactive surface on cell attachment and osteoblastic differentiation. The Bio surface showed a significantly higher percentage of attached cells compared to sand-blasted+acid-etched and machined titanium surfaces (8). The ability of the Bio surface to attract and bind cells was further confirmed by the increased adsorption of fibronectin (a cell-binding protein) compared to other tested surfaces[8].

8

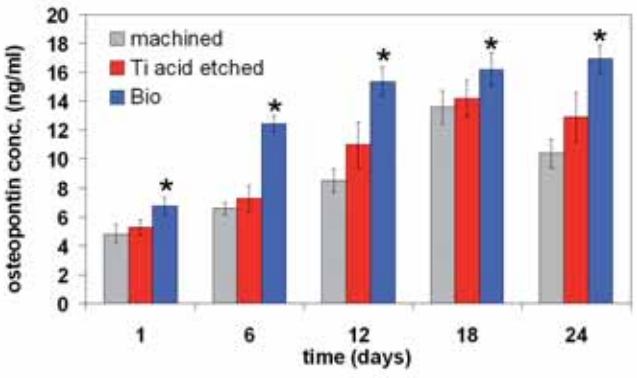


Cell attachment to the Bio surface in comparison with machined and sand-blasted+acid etched surface.

7

An osteoblastic cell spreading out over the Bio surface.

9



In comparison with other tested surfaces, cells cultivated on the Bio surface exhibited a significantly higher production of osteopontin, a major protein component of the first mineralized matrix formed by osteoblastic cells on the implant surface. (9)

Osteopontin production by osteogenic cells cultivated on Bio surface in comparison with machined and sand-blasted+acid etched surface.

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Bioactive surface clinically documented

STI-Bio-C represents a dental implant of a new bioactive generation. It entered the market in 1999 and since then its clinical success has been systematically documented. The accelerated bone-implant contact formation helps to reduce the healing time and enables a predictable and safe application of advanced treatment protocols, such as early and immediate loading:

Implant prosthetic treatment of edentulous mandible in 6 hours. (Immediate loading of STI-Bio implants)[9]

Šimůnek A. (Assoc. Professor, M.D., Ph.D., Stomatology Clinic Hradec Králové, Charles University Prague, Czech Republic.

This clinical study included 175 immediately loaded implants placed in 35 patients from March 2004. Acrylic-resin prostheses were prepared and placed within 6 hours after surgery. At the end of the monitored period in July 2005, all implants were functional. The survival rate within this period of 16 months reached 100%. In the case of 6 patients, implant stabilities were measured using resonance frequency analysis (RFA). After 36 weeks, the mean primary stability of 67.7 ± 2.3 ISQ increased to 71.8± 5.2 ISQ (10). The results showed that the functional immediate loading of the fixed bridge carried by STI-Bio implants in the mandible represented a predictable treatment option.

Early loading (4 weeks) of dental implants Impladent in maxilla and mandible -monitoring of the healing process using resonance frequency analysis[10].

Štěpánek A. (M.D., Private Dental Implantology Center, Třebíč, Czech Republic)

The aim of the study was to assess the impact of a reduced (4-week long) healing period following the application of an implant - Impladent STI BIO with a bioactive surface - in the maxilla and mandible using a statistical evaluation of the success rate. Statistical evaluation of the results showed that a healing period reduced to four weeks for Impladent STI BIO implants in both the maxilla and mandible does not reduce the implant success rate in the healing period (97.8%), nor does it increase the frequency of lost implants during the period of full loading (interval success rate 100%).

Bioactive surface clinically documented

Reduced healing time of Impladent implants with bioactive surface[11].

Šimůnek A. (Assoc. Professor M.D., Ph.D., Stomatology Clinic Hradec Králové, Charles University Prague, Czech Republic).

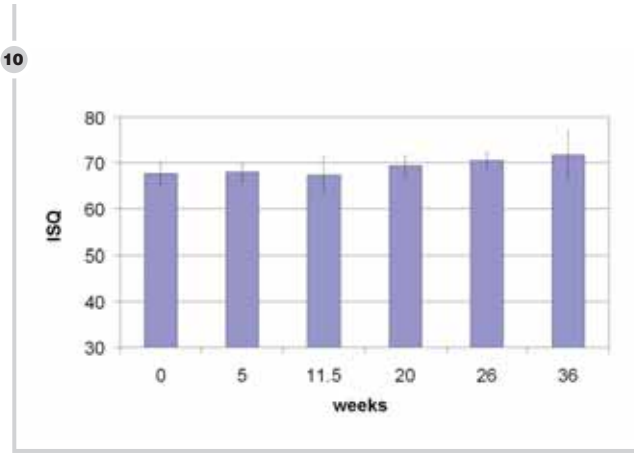
The purpose of the study was to evaluate the success rate of STI-Bio implants for which the standard healing time was reduced by half (6 weeks in the mandible, 12 weeks in the maxilla). During the monitored period (March 2002 to December 2003), a total of 1092 implants with Bio surface were introduced in 420 patients. The interval success rate for the first year of loading equalled 99.5%. The cumulative success rate for the entire monitored period was 98.3%. The results indicate that when using Impladent STI-Bio implants the reduced healing time represents a reliable and predictable treatment option.

Stability assessment of immediately loaded alkali-etched implants[12].

Nathanský Z. (M.D., Ph.D., Charles university, Ist Medical Faculty, Department of Stomatology, Prague, Czech Republic)

STI-BIO Impladent dental implants were placed in the mandible of patients ranging in age from 52 to 74 years. All implants were immediately loaded with ball attachments. Of the 18 inserted implants none was lost up to the end of the 2-year follow-up. A Periotest instrument was used for implant stability measurement. The results indicated the development of early secondary stability during the first 4 weeks after implantation and a statistically significant increase of implant stability after 6 weeks of healing. Based on the limited number of patients included, the implants with the alkali-etched surface offer predictable results for the immediate loading procedure in the edentulous mandible.

10



Implant stability after insertion and during loading (mean values and standard deviations).

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