

Mechanical and Histological Evaluation of Immediate-loaded Implants With Various Surfaces and Designs

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Introduction & Aim

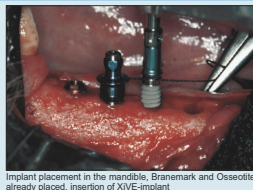
Immediate loading is stated to be the most innovative technique in implant therapy. Various designs claim to be beneficial for a time-reduced implant treatment protocol. Different implants are available with various modifications of the macro- and micro-morphology. Different surgical approaches are discussed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

Material and Methods

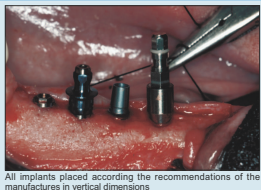
To prepare an edentulous alveolar ridge all premolars were removed in general anaesthesia. After regeneration period of 3 month implant placement was performed. In each animal four different implants were placed per quadrant and immediate loading with gold casted bridges was achieved a week post implantation. The following implants were placed three month after tooth extraction with an average insertion torque within one bridge above 35 Ncm.:
 • D3.75 L10 Mark 3, TiUnité, NobelBiocare
 • D4.1 L10 ITI-Screw, TPS-coating ITI-Straumann
 • D3.75 L10 3i-Osseotite, Implant Innovation
 • D3.4 L11 XiVE, experimental surface M2.1, FRIADENT

The ISQ-values (Osstell, Integration Diagnostic) were measured after implant placement and after regeneration period of 3 month respectively. The following staining for the flour chrome microscopy was performed
 • Oxyltetraacylin day 10 after surgery, 5 days after loading
 • Xylenol orange day 30 after surgery, 25 days after loading
 • Alizarin red day 90 after surgery, 85 days after loading
 • Calcein green day 110 after surgery, 105 days after loading

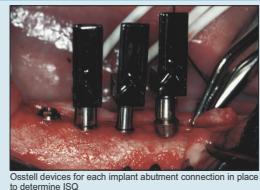
Treatment



Implant placement in the mandible, Branemark and Osseotite already placed, insertion of XiVE-implant



All implants placed according to the recommendations of the manufactures in vertical dimensions

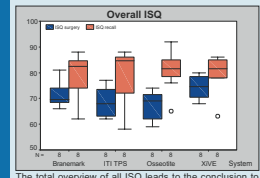


Osstell devices for each implant abutment connection in place to determine ISQ

Results

All 16 bridges were in function after a five month 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 thread. 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 with a std.-dev.8.94 (Min. = -10, Max = 27).
 In marrow bone early formation of new bone was observed. In the maxilla 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. Dental

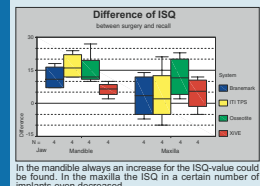
hygiene was not performed, but still no major infection or peri-implantitis was determined. The peri-implant mucosal tissue shows cellular signs of chronic inflammation with lymphocytes and plasma cells. The TPS-coated ITI implants showed wear of Titanium particles in the surrounding tissue.
All implants showed a good bone to implant contact. The remodelling starts at the marrow bone and in the later stage within the cancellous bone. Even if oral hygiene is not optimal only a chronic inflammation occurred. All surfaces used in this study showed similar bone to implant contact.



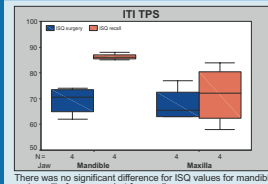
The total overview of all ISQ leads to the conclusion to have an increase between surgery and recall of the ISQ

Literature

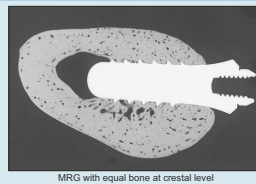
Bauer D, Nyström T, Ostlund T, Cochran DL, Schenk RK, Hill HP, Seshiv D, Nolle LP. Interface shear strength of titanium implants with a sandblasted and acid-etched surface: A biomechanical study in the maxilla of miniature pigs. *J Biomed Mater Res*. 45: 72-83, 1999.
 Knöfler W, Kurze P. Bone reactions to implants with spark-discharge-casing oxide layers and tetrafluoroethylene-mica layers in the rabbit tibia. *Zahn Mund Kieferheilkd Zentralbl* 1986; 11(2): 138-42
 Piattelli A, Corigliano M, Scarano A, Quaranta M. Bone reactions to early occlusal loading of two-stage titanium plasma-sprayed implants: a pilot study in monkeys. *Int J Periodontics Restorative Dent* 1997; 17(2): 162-9
 Plenk H Jr, Zitter H (1998). Material considerations. In: Endosseous implants: scientific and clinical aspects. Watzek G, editor. Carl Hanser, E. Quintessence, pp. 63-99.
 Weinländer M, Kenney EB, Lekovic V, Beumer J, Moy PK, Lewis S. Histomorphometry of bone apposition around three types of endosseous dental implants. *Int J Oral Maxillofac Implants*. 1992; 7(4):497-6.



In the mandible always an increase for the ISQ-value could be found. In the maxilla the ISQ in a certain number of implants even decreased.

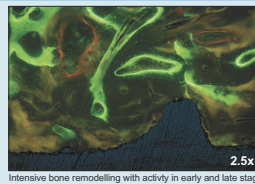


There was no significant difference for ISQ values for mandible and maxilla at surgery but for recall

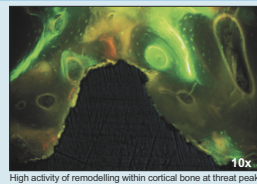


MRG with equal bone at crestal level

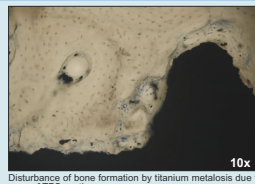
ITI-Straumann TPS



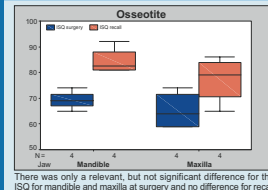
Intensive bone remodelling with activity in early and late stage



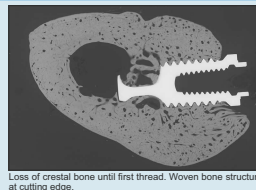
High activity of remodelling within cortical bone at threat peaks



Disturbance of bone formation by titanium metalosis due to wear of TPS coating

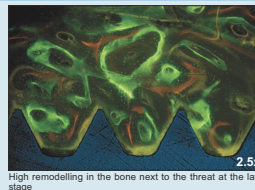


There was only a relevant, but not significant difference for the ISQ for mandible and maxilla at surgery and no difference for recall

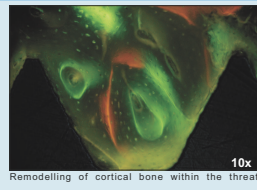


Loss of crestal bone until first thread. Woven bone structure at cutting edge.

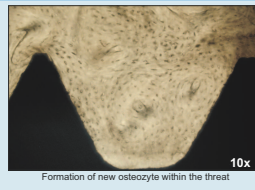
3i-Osseotite



High remodelling in the bone next to the threat at the late stage

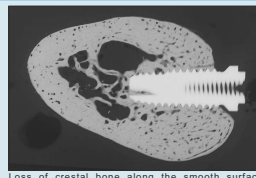


Remodelling of cortical bone within the threats

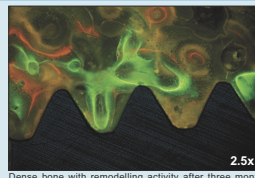


Formation of new osteocyte within the threat

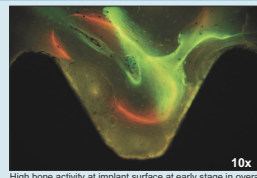
Branemark Ti-Unité



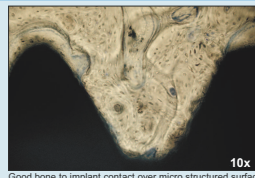
Loss of crestal bone along the smooth surface



Dense bone with remodelling activity after three month

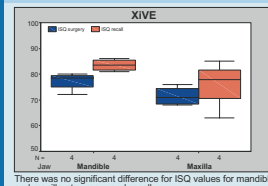


High bone activity at implant surface at early stage in overall dense bone.

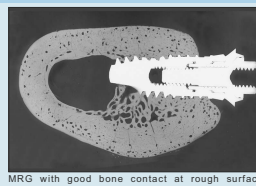


Good bone to implant contact over micro structured surface

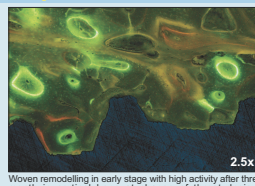
XiVE Experimental Surface M2.1



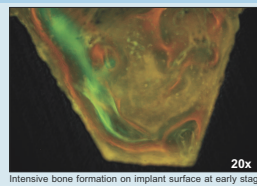
There was no significant difference for ISQ values for mandible and maxilla at surgery and recall



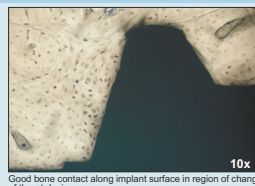
MRG with good bone contact at rough surface



Woven remodelling in early stage with high activity after three month in cortical bone at change of threat designs



Intensive bone formation on implant surface at early stage



Good bone contact along implant surface in region of change of threat designs