Early implant placement with simultaneous guided bone regeneration following single-tooth extraction in the esthetic zone: 12-month results of a prospective study with 20 consecutive patients.


Abstract

BACKGROUND: Early implant placement is one of the treatment options in postextraction sites in the anterior maxilla. Implant placement is performed after a soft tissue healing period of 4 to 8 weeks. Implant placement is combined with a simultaneous guided bone regeneration (GBR) procedure to rebuild esthetic facial hard and soft tissue contours.

METHODS: In this prospective case-series study, 20 consecutive patients treated with an implant-borne single crown were prospectively followed for 12 months. Clinical, radiologic, and esthetic parameters were recorded to assess treatment outcomes.

RESULTS: At the 12-month examination, all 20 implants were successfully integrated, demonstrating ankylotic stability and healthy peri-implant soft tissues as documented by standard parameters. Theesthetic outcomes assessed by a pink esthetic score (PES) and a white esthetic score (WES) demonstrated pleasing results overall. The WES values were slightly superior to the PES values. The periapical radiographs showed minimal crestal bone loss around the used bone level implants, with mean bone loss of 0.18 mm at 12 months. Only one implant showed >0.5 mm bone loss, combined with minor mucosal recession of 0.5 to 1.0 mm.

CONCLUSIONS: This prospective case series study evaluating the concept of early implant placement demonstrated successful tissue integration for all 20 implants. The short-term follow-up of 12 months revealed pleasing esthetic outcomes overall, as assessed by objective parameters. The risk for mucosal recession was low; only one patient showed minor recession of the facial mucosa. These encouraging results need to be confirmed with 3- and 5-year follow-up examinations.
Stability of Contour Augmentation and Esthetic Outcomes of Implant Supported Single Crowns in the Esthetic Zone. 3-Year Results of a Prospective Study With Early Implant Placement Post Extraction.

Buser D, Wittneben J, Bornstein MM, Grütter L, Chappuis V, Belser UC.

J Periodontol. 2010 Sep 10. [Epub ahead of print]

Abstract

Background: Early implant placement is one of the treatment options following extraction. Implant surgery is performed after a healing period of 4-8 weeks, and combined with a simultaneous contour augmentation using the GBR technique to rebuild stable esthetic facial hard and soft tissue contours.

Methods: In this prospective study, 20 patients were treated with an implant-borne single crown and followed for 3 years. Clinical, radiologic and esthetic parameters were recorded to assess treatment outcomes. Results: At the 3-year examination, all 20 implants were successfully integrated, demonstrating ankylosis stability and healthy peri-implant soft tissues as documented by standard clinical parameters. The esthetic outcomes assessed by a Pink and White Esthetic Scores (PES and WES) confirmed pleasing results overall. The WES values were slightly superior to the PES values. The periapical radiographs showed minimal crestal bone loss around the utilized bone-level implants, with mean bone loss of 0.18 mm at 3 years. Only two implants revealed bone loss between 0.5 and 1.0 mm. One of these had minor mucosal recession of less than 1.0 mm. Conclusions: This prospective study evaluating the concept of early implant placement demonstrated successful tissue integration for all 20 implants and stable bone crest levels around the implant-abutment interface according to the platform-switching concept. The mid-term 3-year follow-up revealed pleasing esthetic outcomes and stable facial soft tissues. The risk of mucosal recession was low, with only one patient showing minor recession of the facial mucosa. These encouraging results need to be confirmed with a 5-year follow-up examination.

The influence of non-matching implant and abutment diameters on radiographic crestal bone levels in dogs.

Jung RE, Jones AA, Higginbottom FL, Wilson TG, Schoolfield J, Buser D, Hämmerle CH, Cochran DL.


Abstract

BACKGROUND: It has been shown that different implant designs and different vertical implant positions have an influence on crestal bone levels. The aim of the present study was to evaluate radiographic crestal bone changes around experimental dental implants with non-matching implant-abutment diameters placed submucosally or transmucosally at three different levels relative to the alveolar crest.
METHODS: Sixty two-piece dental implants with non-matching implant-abutment diameters were placed in edentulous spaces bilaterally in five foxhounds. The implants were placed submucosally or transmucosally in the left or the right side of the mandible. Within each side, six implants were randomly placed at three distinct levels relative to the alveolar crest. After 12 weeks, 60 crowns were cemented. Radiographs were obtained from all implant sites following implant placement, after crown insertion, and monthly for 6 months after loading.

RESULTS: Radiographic analysis revealed very little bone loss and a slight increase in bone level for implants placed at the level of the crest or 1 mm above. The greatest bone loss occurred at implants placed 1 mm below the bone crest. No clinically significant differences regarding marginal bone loss and the level of the bone-to-implant contact were detected between implants with a submucosal or a transmucosal healing.

CONCLUSIONS: Implants with non-matching implant-abutment diameters demonstrated some bone loss; however, it was a small amount. There was no clinically significant difference between submucosal and transmucosal approaches.

**Bone response to loaded implants with non-matching implant-abutment diameters in the canine mandible.**

Cochran DL, Bosshardt DD, Grize L, Higginbottom FL, Jones AA, Jung RE, Wieland M, Dard M.


**Abstract**

BACKGROUND: One way to evaluate various implant restorations is to measure the amount of bone change that occurs at the crestal bone. The objective of this study was to histologically evaluate the alveolar bone change around a bone-level, non-matching implant-abutment diameter configuration that incorporated a horizontal offset and a Morse taper internal connection.

METHODS: The study design included extraction of all mandibular premolars and first molars in five canines. After 3 months, 12 dental implants were placed at three levels in each dog: even with the alveolar crest, 1 mm above the alveolar crest, and 1 mm below the alveolar crest. The implants were submerged on one side of the mandible. On the other side, healing abutments were exposed to the oral cavity (non-submerged). Gold crowns were attached 2 months after implant placement. The dogs were sacrificed 6 months postloading, and specimens were processed for histologic and histometric analyses.

RESULTS: Evaluation of the specimens indicated that the marginal bone remained near the top of the implants under submerged and non-submerged conditions. The amount of bone change for submerged implants placed even with, 1 mm below, and 1 mm above the alveolar crest was -0.34, -1.29, and 0.04 mm, respectively (negative values indicate bone loss). For non-submerged implants,
the respective values were -0.38, -1.13, and 0.19 mm. For submerged and non-submerged implants, there were significant differences in the amount of bone change among the three groups (P <0.05). The percentage of bone-to-implant contact for submerged implants was 73.3%, 71.8%, and 71.5%. For non-submerged implants, the respective numbers were 73.2%, 74.5%, and 76%. No significant differences occurred with regard to the percentage of bone contact.

CONCLUSIONS: Minimal histologic bone loss occurred when dental implants with non-matching implant-abutment diameters were placed at the bone crest and were loaded for 6 months in the canine. The bone loss was significantly less (five- to six-fold) than that reported for bone-level implants with matching implant-abutment diameters (butt-joint connections).

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**Chemical modification of an implant surface increases osteogenesis and simultaneously reduces osteoclastogenesis: an in vitro study.**

Mamalis AA, Markopoulou C, Vrotsos I, Koutsilieris M.


**Abstract**

Objectives: The present study investigated the effect of a chemical modification of the SLA surface (SLActive surface) on human periodontal ligament (hPDL) cell (1) adhesion, (2) proliferation, (3) osteogenic differentiation (core binding factor α-1 [Cbfa-1], bone morphogenetic protein-7 [BMP-7] gene expression and alkaline phosphatase [ALP] activity) and (4) osteoclast formation and activity (osteoprotegerin [OPG] and receptor activator of nuclear factor-κ B ligand [RANKL] gene expression). The above activities were based on the hypothesis that the expression of such molecules might be dependent on the characteristics of the implant surface.

Material and methods: hPDL cells were isolated and characterized for their mesenchymal origin, fibroblastic and osteoblastic phenotype. hPDL cells were cultured on smooth, SLA and SLActive implant surfaces (chemically modified). Cell attachment and proliferation were assessed for 5, 24, 72 h, 5 and 7 days. Cbfa-1, BMP-7, OPG and RANKL gene expression was assessed by RT-PCR and a colorimetric assay for ALP activity was applied.

Results: hPDL cells grown on SLActive surfaces demonstrated increased proliferation rates (24 h, 5 and 7 days of the incubation period), and ALP activity was found to be significantly upregulated (5, 72 h and 7 days) as compared with the SLA surfaces. After 7 days of culture, the gene expression of BMP-7, Cbfa-1 and OPG by hPDL cells was significantly upregulated, while RANKL gene expression was significantly downregulated in response to the SLActive surface.
Conclusion: Chemical modification of a previously roughened implant surface increases hPDL proliferation and upregulates osteoblastic differentiation. It can also suppress osteoclastogenesis regulating the RANKL-RANK-OPG axis. Hence, an osteoprotective microenvironment is created around chemically modified implants that may enhance osseointegration.

Analysis of osteoblastic gene expression in the early human mesenchymal cell response to a chemically modified implant surface: an in vitro study.
Mamalis AA, Silvestros SS.

Abstract
Objectives: The effect of a chemical modification of the SLA surface (SLActive surface) on human bone marrow-derived mesenchymal cells (hMSCs) on; (1) adhesion, (2) proliferation and (3) early transcriptional control of osteogenic differentiation was investigated. We are based on the hypothesis that expression patterns of genes responsible for osteogenesis might be dependent on the characteristics of the implant surface.

Material and methods: hMSCs were allowed to grow on smooth (SMO-control), SLA and SLActive implant surfaces (chemically modified). Cell attachment and proliferation were assessed at 3 and 24 h using a MTT dye reduction assay. At 24 h of culture, DNA microarray analysis examined alterations in early gene expression using a human osteogenesis gene array, including 109 cDNAs in quadruplicates of major regulatory genes for osteogenesis.

Results: Initial attachment and proliferation were found to be significantly reduced. Nineteen genes were significantly upregulated when hMSCs were cultured on the SLA surfaces and 27 genes were significantly upregulated when hMSCs were cultured on the SLActive surfaces. Upregulated genes control cell differentiation, signal transduction, cell cycle regulation, angiogenesis, cell adhesion and extracellular matrix and bone formation.

Discussion: Chemical modification decreases further cell attachment and proliferation and upregulates early osteoblastic differentiation genes. Hence, a microenvironment is created around chemically modified implants that may enhance osseointegration.
Modified titanium surfaces promote accelerated osteogenic differentiation of mesenchymal stromal cells in vitro.

Wall I, Donos N, Carlqvist K, Jones F, Brett P.

Abstract
Titanium (Ti) is the material of choice for dental and orthopaedic implants due to its highly biocompatible nature. Modification of the implant surface, either topographically (as roughness) or chemically, can promote accelerated osteogenesis in vivo and greatly increase bone-implant contact and bonding strength. In this paper, we sought to characterise the cellular and molecular responses of human bone marrow-derived mesenchymal stromal cells (hMSCs) to two modified Ti surfaces: a rough hydrophobic surface that was sandblasted and acid-etched (SLA) and an SLA surface of the same roughness that was chemically modified to have high wettability/hydrophilicity (SLActive). A smooth polished (SMO) Ti surface was used as a control. Whilst no differences in initial cell attachment to any of the surfaces were observed, we found that hMSCs cultured on the rough surfaces underwent a decrease in cell number early in culture, yet simultaneously expressed higher levels of the osteogenic markers SPP1, RUNX2 and BSP. Furthermore, deposits of calcified matrix were observed at earlier time points on both SLA and SLActive surfaces compared to SMO and this correlated with increased expression of the osteogenic promoter WNT5A in response to the rough surfaces. Osteogenic responses to SLActive were moderately better than the hydrophobic SLA surface and gene expression studies indicate that WNT5A activation may be responsible for this increased osteogenic differentiation.

Potential of chemically modified hydrophilic surface characteristics to support tissue integration of titanium dental implants.


Abstract
In the past, several modifications of specific surface properties such as topography, structure, chemistry, surface charge, and wettability have been investigated to predictably improve the osseointegration of titanium implants. The aim of the present review was to evaluate, based on the currently available evidence, the impact of hydrophilic surface modifications of titanium for dental implants. A surface treatment was performed to produce
hydroxylated/hydrated titanium surfaces with identical microstructure to either acid-etched, or sand-blasted, large grit and acid-etched substrates, but with hydrophilic character. Preliminary in vitro studies have indicated that the specific properties noted for hydrophilic titanium surfaces have a significant influence on cell differentiation and growth factor production. Animal experiments have pointed out that hydrophilic surfaces improve early stages of soft tissue and hard tissue integration of either nonsubmerged or submerged titanium implants. This data was also corroborated by the results from preliminary clinical studies. In conclusion, the present review has pointed to a potential of hydrophilic surface modifications to support tissue integration of titanium dental implants.

**Bone apposition around two different sandblasted and acid-etched titanium implant surfaces: a histomorphometric study in canine mandibles.**

Bornstein MM, Valderrama P, Jones AA, Wilson TG, Seibl R, Cochran DL.


**Abstract**

PURPOSE: The aim of this study was to evaluate bone apposition to a modified sandblasted and acid-etched (SLA) implant surface (modSLA) in the canine mandible as compared with the standard SLA surface.

MATERIAL AND METHODS: In this experimental study, all mandibular premolars and first molars were extracted bilaterally in five foxhounds. After a healing period of 6 months, each side of the mandible received six randomly assigned dental implants alternating between the standard SLA and modSLA surface. The dogs were sacrificed at 2 weeks (n=2) or 4 weeks (n=3) after implant placement. Histologic and histomorphometric analyses were then performed for each implant.

RESULTS: The microscopic healing patterns at weeks 2 and 4 for the two implant types with the standard SLA and modSLA surfaces showed similar qualitative findings. New bone tissue had already established direct contact with implant surfaces after 2 weeks of healing. The mean percentage of newly formed bone in contact with the implant (BIC) was significantly greater for modSLA (28.2+/−7.9%) than for SLA (22.2+/−7.3%) (P<0.05). This difference was no longer evident after 4 weeks. An increase in BIC for both implant surface types occurred from weeks 2 to 4. This increase was statistically significant when compared with SLA at 2 weeks (P<0.05), but not when compared with modSLA at 2 weeks.

CONCLUSION: The data from the present study demonstrate significantly more bone apposition for the modSLA surface than the standard SLA surface after 2 weeks of healing. This increased bone apposition may allow a further reduction of the healing period following
Implant placement for patients undergoing early loading procedures.

**Early loading after 21 days of healing of nonsubmerged titanium implants with a chemically modified sandblasted and acid-etched surface: two-year results of a prospective two-center study.**

Morton D, Bornstein MM, Wittneben JG, Martin WC, Ruskin JD, Hart CN, Buser D.

**Abstract**

PURPOSE: The aim of this two-center study was to evaluate screw-type titanium implants with a chemically modified, sandblasted and acid-etched surface when placed in the posterior maxilla or mandible, and loaded 21 days after placement.

MATERIAL AND METHODS: All 56 patients met strict inclusion criteria and provided informed consent. Each patient displayed either a single-tooth gap, an extended edentulous space, or a distal extension situation in the posterior mandible or maxilla. Eighty-nine dental implants (SLActive, Institut Straumann AG, Basel, Switzerland) were inserted according to an established nonsubmerged protocol and underwent undisturbed healing for a period of 21 days. Where appropriate, the implants were loaded after 21 days of healing with provisional restorations in full occlusion. Definitive metal ceramic restorations were fabricated and positioned on each implant after 6 months of healing. Clinical measurements regarding soft tissue parameters and radiographs were obtained at different time points up to 24 months after implant placement.

RESULTS: Of the 89 inserted implants, two (2.2%) implants failed to integrate and were removed during healing, and two (2.2%) additional implants required a prolonged healing time. A total of 85 (95.6%) implants were therefore loaded without incident after 21 days of healing. No additional implant was lost throughout the study period, whereas one implant was lost to follow-up and therefore left unaccounted for further analysis. The remaining 86 implants all exhibited favorable radiographic and clinical findings. Based on strict success criteria, these implants were considered successfully integrated 2 years after insertion, resulting in a 2-year success rate of 97.7%.

CONCLUSION: The results of this prospective two-center study demonstrate that titanium implants with a modified SLA surface can predictably achieve successful tissue integration when loaded in full occlusion 21 days after placement. Integration could be maintained without incident for at least 2 years of follow-up.
Bone density at implant sites and its relationship to assessment of bone quality and treatment outcome.

Bergkvist G, Koh KJ, Sahlholm S, Klintström E, Lindh C.

Abstract
PURPOSE: To investigate the relationship between bone mineral density (BMD) before implant placement, implant stability measures at implant placement, and marginal bone loss of immediately loaded implants after 1 year in situ.

MATERIALS AND METHODS: Consecutively recruited patients received Straumann SLActive implants loaded with fixed provisional prostheses within 24 hours. BMD was measured from computed tomographic images before implant placement. Alveolar bone quality was assessed during surgery. Implant stability—both rotational and as measured with resonance frequency analysis—and marginal bone height were assessed at implant placement and after 1 year. The Pearson correlation coefficient was used to calculate correlations, and significance was considered when P < .05.

RESULTS: Twenty-one patients received 137 implants (87 in maxillae and 50 in mandibles). BMD was significantly correlated with bone quality classification in both arches (P < .001). Mean BMD was also significantly correlated with stability values (P < .001). Mean marginal bone loss at implant surfaces differed, but not significantly, at the 1-year follow-up, regardless of BMD values (P = .086) and measured stability (rotational stability P = .34, resonance frequency analysis P = .43) at implant placement.

CONCLUSION: Within the limits of this study, it can be concluded that computed tomographic examination can be used as a preoperative method to assess jawbone density before implant placement, since density values correlate with prevailing methods of measuring implant stability. However, in the short time perspective of 1 year, there were no differences in survival rates or changes in marginal bone level between implants placed in bone tissue of different density.
Influence of titanium implant surface characteristics on bone regeneration in
dehiscence-type defects: an experimental study in dogs.
Schwarz F, Sager M, Kadelka I, Ferrari D, Becker J.

Abstract
OBJECTIVES: The aim of the present study was to compare bone regeneration in
dehiscence-type defects at titanium implants with chemically modified sandblasted/acidetched
(modSLA) or dual acid-etched surfaces with a calcium phosphate nanometre particle
modification (DCD/CaP).
MATERIALS AND METHODS: Buccal dehiscence-type defects were surgically created
following implant site preparation in both the upper and the lower jaws of 12 fox hounds. Both
types of implants were randomly allocated in a split-mouth design and left to heal in a
submerged position for 2 and 8 weeks. Dissected blocks were processed for
histomorphometrical analysis [e.g. new bone height (NBH), percentage of bone-to-implant
contact (BIC), area of new bone fill (BF), and area of mineralized tissue (MT) within BF].
RESULTS: At 2 and 8 weeks, both groups revealed comparable mean BF (2.3+/-0.6 to 2.5+/-
0.6 mm(2) versus 2.0+/-0.6 to 1.4+/-0.5 mm(2)) and MT (31.1+/-14.3-83.2+/-8.2% versus
38.9+/-15.9-84.4+/-6.3%) values. However, modSLA implants revealed significantly higher
mean NBH (2.4+/-0.8 to 3.6+/-0.3 mm versus 0.9+/-0.8 to 1.8+/-1.4 mm) and BIC (53.3+/-
11.3-79.5+/-6.6% versus 19.3+/-16.4-47.2+/-30.7%) values than DCD/CaP implants.
CONCLUSION: ModSLA implants may have a higher potential to support osseointegration in
dehiscence-type defects than DCD/CaP implants.

Bone regeneration in dehiscence-type defects at non-submerged and
submerged chemically modified (SLActive) and conventional SLA titanium
implants: an immunohistochemical study in dogs.
Schwarz F, Sager M, Ferrari D, Herten M, Wieland M, Becker J.

Abstract
OBJECTIVES: The aim of the present study was to evaluate bone regeneration in
dehiscence-type defects at non-submerged and submerged titanium implants with chemically
modified (mod) and conventional sandblasted/acid-etched (SLA) surfaces.
MATERIAL AND METHODS: Standardized buccal dehiscence defects were surgically
created following implant site preparation in both the upper and lower jaws of 12 beagle
dogs. Both types of implants were randomly assigned to either a non-submerged or a submerged healing procedure. After 1, 2, 4, and 8 weeks, dissected blocks were processed for histomorphometrical [e.g. new bone height (NBH), per cent linear fill (PLF)], percentage of bone to implant contact (BIC-D), area of new bone fill (BF) and immunohistochemical analysis.

RESULTS: At 8 weeks, non-submerged and submerged SLA implants revealed significantly lower mean NBH (1.1+/-.8-1.9+/1.2 mm), PLF (27.7+/-.20.3-46.0+/-28.5%), BIC-D (26.8+/-.10.4-46.2+/16.2%), and BF (1.3+/-.0.9-3.4+/2.8 mm(2)) values than respective modSLA implants [NBH (2.6+/-.8-4.3+/0.1 mm), PLF (64.2+/-.19.4-107.2+/-4.7%), BIC-D (67.5+/-.18.8-82.1+/14.8%), BF (2.9+/-.1.0-6.7+/1.1 mm(2))]. Within modSLA groups, significantly highest BF values were observed at submerged implants.

CONCLUSION: It was concluded that (i) modSLA titanium surfaces promoted bone regeneration in acute-type buccal dehiscence defects and (ii) a submerged healing procedure improved the outcome of healing additionally.

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**Bone apposition around two different sandblasted, large-grit and acid-etched implant surfaces at sites with coronal circumferential defects: an experimental study in dogs.**

Lai HC, Zhuang LF, Zhang ZY, Wieland M, Liu X.


**Abstract**

OBJECTIVE: The study was designed to evaluate bone apposition around SLA (sandblasted, large-grit and acid-etched) implants compared with modified SLA (modSLA) ones at sites with different sizes of circumferential gaps.

MATERIAL AND METHODS: All mandibular premolars and first molars of six beagle dogs were extracted. After a healing period of 3 months, three 10-mm-long implants were inserted in each side of the mandible. One implant was inserted with a 0.5-mm and one with a 1-mm gap between the implants and bone around the coronal 5 mm of the implants. The third implant was inserted without a gap as a control. The dogs were sacrificed respectively at weeks 2, 4 and 8 after implant placement for histological and histomorphometric analyses.

RESULTS: The histomorphometric results showed similar pattern of bone apposition for the two surfaces. At 2 and 4 weeks of healing, the percentage of newly formed bone-to-implant contact (BIC%), new bone fill (NBF%) and the distance between the most coronal position of BIC and the defect bottom (B-D) were significantly higher for modSLA (P<0.05). At 8 weeks of healing, this difference was not significant (P>0.05). With regard to the defect size, the
histological analyses showed no significant differences between the two defect sizes at all time points (P>0.05).

CONCLUSION: Significantly more bone apposition was found for the modSLA surface than for the SLA surface at early stage of healing, indicating that modSLA surface may enhance bone apposition in coronal circumferential defects at non-submerged implants. Gap size within 1 mm may not need any kind of regenerative procedures.

**Bone apposition around two different sandblasted and acid-etched titanium implant surfaces: a histomorphometric study in canine mandibles.**
Bornstein MM, Valderrama P, Jones AA, Wilson TG, Seibl R, Cochran DL.

Abstract
PURPOSE: The aim of this study was to evaluate bone apposition to a modified sandblasted and acid-etched (SLA) implant surface (modSLA) in the canine mandible as compared with the standard SLA surface.

MATERIAL AND METHODS: In this experimental study, all mandibular premolars and first molars were extracted bilaterally in five foxhounds. After a healing period of 6 months, each side of the mandible received six randomly assigned dental implants alternating between the standard SLA and modSLA surface. The dogs were sacrificed at 2 weeks (n=2) or 4 weeks (n=3) after implant placement. Histologic and histomorphometric analyses were then performed for each implant.

RESULTS: The microscopic healing patterns at weeks 2 and 4 for the two implant types with the standard SLA and modSLA surfaces showed similar qualitative findings. New bone tissue had already established direct contact with implant surfaces after 2 weeks of healing. The mean percentage of newly formed bone in contact with the implant (BIC) was significantly greater for modSLA (28.2+/−7.9%) than for SLA (22.2+/−7.3%) (P<0.05). This difference was no longer evident after 4 weeks. An increase in BIC for both implant surface types occurred from weeks 2 to 4. This increase was statistically significant when compared with SLA at 2 weeks (P<0.05), but not when compared with modSLA at 2 weeks.

CONCLUSION: The data from the present study demonstrate significantly more bone apposition for the modSLA surface than the standard SLA surface after 2 weeks of healing. This increased bone apposition may allow a further reduction of the healing period following implant placement for patients undergoing early loading procedures.
Histological and immunohistochemical analysis of initial and early osseous integration at chemically modified and conventional SLA titanium implants: preliminary results of a pilot study in dogs.

Schwarz F, Herten M, Sager M, Wieland M, Dard M, Becker J.

Abstract

OBJECTIVES: The aim of the present pilot study was to investigate initial and early tissue reactions to modified (mod) and conventional sand-blasted, large grit and acid-etched (SLA) titanium implants.

MATERIAL AND METHODS: Implantation of modSLA and SLA implants was performed bilaterally in both the mandible and maxilla of dogs. The animals were sacrificed after a healing period of 1, 4, 7 and 14 days, respectively. Peri-implant tissue reactions were assessed in non-decalcified tissue sections using conventional histology (Toluidine blue-TB and Masson Goldner Trichrome stain-MG) and immunohistochemistry using monoclonal antibodies to transglutaminase II (TG) (angiogenesis) and osteocalcin (OC). Bone density (BD) and bone to implant contact (BIC) were assessed histomorphometrically.

RESULTS: Day 1 revealed an early TG antigen reactivity in the provisional fibrin matrix adjacent to both implant surfaces. Day 4 was characterized by the formation of a collagen-rich connective tissue (MG), which revealed the first signs of OC synthesis adjacent to modSLA surfaces. Immunohistochemical staining for TG revealed a direct correlation between angiogenesis and new bone formation, which was clearly identifiable after 7 days by means of increasing BD, BIC and OC values. After 14 days, modSLA surfaces seemed to be surrounded by a firmly attached mature, parallel-fibered woven bone.

CONCLUSIONS: Within the limits of the present study, it might be concluded that the combination of immunohistochemical and conventional histological stainings in nondecalcified tissue sections is a valuable technique to evaluate the initial and early stages of wound healing around endosseous titanium implants.
Histological and immunohistochemical analysis of initial and early subepithelial connective tissue attachment at chemically modified and conventional SLA titanium implants. A pilot study in dogs.


Abstract
The aim of the present pilot study was to histologically/immunohistochemically investigate initial and early subepithelial connective tissue attachment at transmucosal parts of modified (mod) and conventional sandblasted, large grit and acid-etched (SLA) titanium implants. Implantation of modSLA and SLA implants was performed bilaterally in both the mandible and maxilla of four beagle dogs. The implants were submerged to prevent bacterial contamination. The animals were killed after 1, 4, 7 and 14 days. Peri-implant tissue reactions were assessed histologically (Masson Goldner Trichrome stain-MG) and immunohistochemically (IH) using monoclonal antibodies to fibronectin (FN) and proliferating cell nuclear antigen (PCNA). The surgical procedure of implant submerging resulted in the formation of an artificial gap in the transmucosal area of both types of implants. After 14 days of healing, MG stain revealed the formation of well-organized collagen fibres and numerous blood vessels in a newly formed loose connective tissue zone adjacent to modSLA. While some fibres were oriented in a parallel direction, others have started to extend and attach partially perpendicular to the implant surface. In contrast, SLA implants appeared to be clearly separated by a dense connective tissue zone with parallel-running collagen fibres and rare blood vessel formation. First signs of a positive FN and PCNA staining adjacent to both implant surfaces were observed at day 4. Within the limits of a pilot study, it might be concluded that modSLA titanium surfaces might possess the potential to promote subepithelial connective tissue attachment at the transmucosal part of the implant.
Effects of surface hydrophilicity and microtopography on early stages of soft and hard tissue integration at non-submerged titanium implants: an immunohistochemical study in dogs.


Abstract
BACKGROUND: The aim of the present study was to investigate the effects of surface hydrophilicity and microtopography on soft and hard tissue integration at non-submerged titanium implants.

METHODS: Implantation of conventional sand-blasted large grit and acid-etched (SLA) and chemically modified SLA (modSLA) titanium implants with differently structured transmucosal surfaces (SLA implants: machined [M-SLA] or SLA [SLA-SLA]; modSLA implants: mod acidetched [modA] [modA-modSLA] or modSLA [modSLA-modSLA]) was performed bilaterally in the upper and lower jaws of 15 beagle dogs. The animals were sacrificed after 1, 4, 7, 14, or 28 days. Tissue reactions were assessed histomorphometrically and immunohistochemically using monoclonal antibodies to transglutaminase II (angiogenesis) and osteocalcin.

RESULTS: Although the junctional epithelium commonly was separated from M-SLA and SLA-SLA implants by a gap, the epithelial cells appeared to be in close contact with modA-modSLA surfaces after 14 days of healing. Moreover, modA-modSLA and modSLA-modSLA groups showed a well-vascularized subepithelial connective tissue exhibiting collagen fibers that started to extend and attach partially perpendicular to the implant surface. The highest and statistically significant mean bone-to-implant contact areas were observed in the modA-modSLA and modSLA-modSLA groups at days 7, 14, and 28.

CONCLUSION: Within the limits of this study, it may be concluded that soft and hard tissue integration was influenced mainly by surface hydrophilicity rather than by microtopography.
Enhanced bone apposition to a chemically modified SLA titanium surface.


Abstract
Increased surface roughness of dental implants has demonstrated greater bone apposition; however, the effect of modifying surface chemistry remains unknown. In the present study, we evaluated bone apposition to a modified sandblasted/acid-etched (modSLA) titanium surface, as compared with a standard SLA surface, during early stages of bone regeneration. Experimental implants were placed in miniature pigs, creating 2 circular bone defects. Test and control implants had the same topography, but differed in surface chemistry. We created the test surface by submerging the implant in an isotonic NaCl solution following acid-etching to avoid contamination with molecules from the atmosphere. Test implants demonstrated a significantly greater mean percentage of bone-implant contact as compared with controls at 2 (49.30 vs. 29.42%; p = 0.017) and 4 wks (81.91 vs. 66.57%; p = 0.011) of healing. At 8 wks, similar results were observed. It is concluded that the modSLA surface promoted enhanced bone apposition during early stages of bone regeneration.

Biomechanical evaluation of the interfacial strength of a chemically modified sandblasted and acid-etched titanium surface.


Abstract
The functional capacity of osseointegrated dental implants to bear load is largely dependent on the quality of the interface between the bone and implant. Sandblasted and acid-etched (SLA) surfaces have been previously shown to enhance bone apposition. In this study, the SLA has been compared with a chemically modified SLA (modSLA) surface. The increased wettability of the modSLA surface in a protein solution was verified by dynamic contact angle analysis. Using a well-established animal model with a split-mouth experimental design, implant removal torque testing was performed to determine the biomechanical properties of
the bone-implant interface. All implants had an identical cylindrical shape with a standard thread configuration. Removal torque testing was performed after 2, 4, and 8 weeks of bone healing (n = 9 animals per healing period, three implants per surface type per animal) to evaluate the interfacial shear strength of each surface type. Results showed that the modSLA surface was more effective in enhancing the interfacial shear strength of implants in comparison with the conventional SLA surface during early stages of bone healing. Removal torque values of the modSLA-surfaced implants were 8-21% higher than those of the SLA implants (p = 0.003). The mean removal torque values for the modSLA implants were 1.485 N m at 2 weeks, 1.709 N m at 4 weeks, and 1.345 N m at 8 weeks; and correspondingly, 1.231 N m, 1.585 N m, and 1.143 N m for the SLA implants. The bone-implant interfacial stiffness calculated from the torque-rotation curve was on average 9-14% higher for the modSLA implants when compared with the SLA implants (p = 0.038). It can be concluded that the modSLA surface achieves a better bone anchorage during early stages of bone healing than the SLA surface; chemical modification of the standard SLA surface likely enhances bone apposition and this has a beneficial effect on the interfacial shear strength.

Treatment outcome of immediate, early and conventional single-tooth implants in the aesthetic zone: a systematic review to survival, bone level, soft-tissue, aesthetics and patient satisfaction.

den Hartog L, Slater JJ, Vissink A, Meijer HJ, Raghoebier GM.


Abstract

AIM:

This study evaluated, through a systematic review of the literature, the outcome of single-implant restorations in the aesthetic zone with natural adjacent teeth, thereby addressing immediate, early and conventional implant approaches.

MATERIAL AND METHODS:

MEDLINE (1950-2008), EMBASE (1966-2008), and CENTRAL (1800-2008) were searched to identify eligible studies. Two reviewers independently assessed the methodological quality using specific study-design-related assessment forms.

RESULTS:

Out of 86 primarily selected articles, 19 studies fulfilled the inclusion criteria. A meta-analysis showed an overall survival rate of 95.5% [95% confidence interval: (93.0-97.1)] after 1 year. A stratified meta-analysis revealed no differences in survival between immediate, early and conventional implant
strategies. Little marginal peri-implant bone resorption was found together with low incidence of biological and technical complications. No significant differences in outcome measures were reported in clinical trials comparing immediate, early or conventional implant strategies.

CONCLUSION:

The included literature suggested that promising short-term results could be achieved for immediate, early and conventional single-implants in the aesthetic zone. However, important parameters as aesthetic outcome, soft-tissue aspects, and patient satisfaction were clearly underexposed. The question whether immediate and early single-implant therapies would result in better treatment outcomes remained inconclusive due to lack of well-designed controlled clinical studies.

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**Marginal bone loss in dental implants subjected to early loading (6 to 8 weeks postplacement) with a retrospective short-term follow-up.**

Boronat A, Peñarrocha M, Carrillo C, Marti E.


**PURPOSE:**

To evaluate the success rate and marginal bone loss in dental implants loaded after 8 weeks in the maxilla and after 6 weeks in the mandible, after 1 year of follow-up.

**MATERIALS AND METHODS:**

A retrospective case series study was made. The sample was composed of subjects having 1 or more implants placed and loaded early between 2004 and 2006. Success rate was evaluated following Buser’s criteria. A protocol was made in which patient age, gender, implant location, diameter and length, type of bone, type of prosthesis, and the location of the opposing teeth were collected. Marginal bone loss was evaluated after 1 year of loading on intraoral x-ray findings. A statistical analysis was made to process the variables.

**RESULTS:**

A total of 106 dental implants were positioned in 30 patients, in whom 102 prostheses were placed. The fixation success rate was 98.1%; mean bone loss was 0.58 mm after 1 year of loading. The factors seen to exert a significant influence on bone loss were the zone of the arch and the teeth opposing the implant.

**CONCLUSION:**

The recorded success rate and bone loss were similar to the values reported in the literature, thus supporting early loading as a safe and predictable procedure that allows a reduction in treatment time.
Implant loading protocols for the partially edentulous esthetic zone.

Grütter L, Belser UC.


Abstract

PURPOSE:

The scientific evidence related to different or novel implant loading (primary objective) and directly associated implant placement (secondary objective) protocols developed for the anterior maxillae of partially edentulous patients was reviewed.

MATERIALS AND METHODS:

A comprehensive search of electronic databases and a hand search of six relevant journals was performed. The principal outcome variables were implant survival, implant success, and esthetic appearance. Concerning esthetic treatment outcomes, articles were specifically screened for the presence of objective evaluation parameters and patient satisfaction assessment.

RESULTS:

The analysis of the literature on immediately restored or conventionally loaded implants in the esthetic zone revealed an initial survival rate of 97.3% after 1 year (10 prospective cohort studies and one case series). For periods of 1 to 5 years, the survival rate was 96.7%. These survival rates are consistent with previous reports on more traditional loading modalities. However, for immediately placed implants with immediate restoration and occlusal loading, the survival rate dropped by approximately 10% (four studies). Success criteria such as stable crestal bone levels, soft tissue recession, and probing depth could not be evaluated on the basis of the available literature.

CONCLUSION:

There is a paucity of prospective cohort studies addressing patient-centered outcomes. No parameters specific to immediate loading protocols were available for evaluation. In order to validate or reject such implant protocols for use in the esthetically sensitive anterior maxilla, long-term clinical trials should routinely include objective esthetic criteria that comprehensively embrace the pertinent elements of "pink and white esthetics" in the form of readily used indices.

Consensus statements and recommended clinical procedures regarding loading protocols.

Weber HP, Morton D, Gallucci GO, Roccuzzo M, Cordaro L, Grutter L.


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