Platform switching for marginal bone preservation around dental implants: a systematic review and meta-analysis.

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Abstract

BACKGROUND: Platform switching for maintaining peri-implant bone levels has gained popularity among implant manufacturers over the last few years. However, the assumption that the inward shifting of the implant-abutment junction may preserve crestal bone was primarily based on serendipitous finding rather than scientific evidence. The objectives of the present study were to systematically review radiographic marginal bone-level changes and the survival of platform-switched implants compared to conventional platform-matched implants.

METHODS: A literature search of electronic databases (MEDLINE, EMBASE, The Cochrane Oral Health Group's Trials Register, The Cochrane Central Register of Controlled Trials, the U.K. National Research Register, the Australian New Zealand Clinical Trials Registry, the Database of Abstracts of Reviews of Effectiveness, and Conference Proceedings Citation Index) was performed up to March 15, 2010. Hand searches included several dental journals, and authors were contacted for missing information. Controlled trials that compared marginal bone-level changes around platform-switched dental implants with those restored with platform-matched prostheses were selected. The review and meta-analysis were done according to the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement. Data were analyzed using two meta-analytic statistical packages. Mean differences (MDs) were calculated for analyzing continuous data, and risk ratios (RRs) were used for dichotomous data with 95% confidence intervals (CIs).

RESULTS: Ten studies with 1,239 implants were included. The marginal bone loss around platform-switched implants was significantly less than around platform-matched implants (MD: -0.37; 95% CI: -0.55 to -0.20; P <0.0001). No statistically significant difference was detected for implant failures between the two groups (RR: 0.93; 95% CI: 0.34 to 2.95; P = 0.89). Subgroup analyses showed that an implant-abutment diameter difference > or= 0.4 was associated with a more favorable bone response.

CONCLUSIONS: The review and meta-analysis show that platform switching may preserve interimplant bone height and soft tissue levels. The degree of marginal bone resorption is inversely related to the extent of the implant-abutment mismatch. Further long-term, well-conducted, randomized controlled studies are needed to confirm the validity of this concept.
Radiographic evaluation of marginal bone levels around platform-switched and non-platform-switched implants used in an immediate loading protocol.

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Abstract

PURPOSE: The aim of this clinical study was to assess the marginal bone around two different types of implant-abutment junctions—a so-called platform-switched assembly and a conventional external-hexagon connection—after 24 months.

MATERIALS AND METHODS: Forty-five patients were included in this prospective study. All selected patients required the extraction of one or two hopeless teeth in maxillary and mandibular region monoradicular and second premolar teeth, and were randomly assigned to one of two groups. The first group received 34 implants with an external-hexagon junction with the abutment and the second group received 30 implants with platform-switched abutments. Implants were positioned immediately after tooth extraction and were loaded immediately.

RESULTS: After 24 months, a cumulative survival rate of 100% was reported for all implants. The platform-switching group showed a mean bone loss of 0.78 +/- 0.49 mm and the external-hexagon group showed a mean bone loss of 0.73 +/- 0.52 mm (no statistically significant difference between groups).

CONCLUSION: The results of this study indicate that implants placed immediately in fresh extraction sockets and loaded immediately represent a predictable procedure, with no differences in bone level changes between "platform-switched" and conventional external-hexagon implants after 24 months.

Influence of the size of the microgap on crestal bone changes around titanium implants. A histometric evaluation of unloaded non-submerged implants in the canine mandible.

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Abstract

BACKGROUND: Endosseous implants can be placed according to a non-submerged or submerged approach and in 1- or 2-piece configurations. Recently, it was shown that peri-implant crestal bone changes differ significantly under such conditions and are dependent on a rough/smooth implant border in 1-piece implants and on the location of an interface
between the implant and abutment/restoration in 2-piece configurations. Several factors may influence the resultant level of the crestal bone under these conditions, including movements between implant components and the size of the microgap (interface) between the implant and abutment. However, no data are available on the impact of possible movements between these components or the impact of the size of the microgap (interface). The purpose of this study was to histometrically evaluate crestal bone changes around unloaded, 2-piece non-submerged titanium implants with 3 different microgap (interface) dimensions and between implants with components welded together or held together by a transocclusal screw.

METHODS: A total of 60 titanium implants were randomly placed in edentulous mandibular areas of 5 hounds forming 6 different implant subgroups (A through F). In general, all implants had a relatively smooth, machined suprabony portion 1 mm long, as well as a rough, sandblasted, and acid-etched (SLA) endosseous portion, all placed with their interface (microgap) 1 mm above the bone crest level and having abutments connected at the time of first-stage surgery. Implant types A, B, and C had a microgap of < 10 microns, approximately 50 microns, or approximately 100 microns between implant components as did types D, E, and F, respectively. As a major difference, however, abutments and implants of types A, B, and C were laser-welded together, not allowing for any movements between components, as opposed to types D, E, and F, where abutments and implants were held together by abutment screws. Three months after implant placement, all animals were sacrificed. Non-decalcified histology was analyzed histometrically by evaluating peri-implant crestal bone changes.

RESULTS: For implants in the laser-welded group (A, B, and C), mean crestal bone levels were located at a distance from the interface (IF; microgap) to the first bone-to-implant contact (fBIC) of 1.06 +/- 0.46 mm (standard deviation) for type A, 1.28 +/- 0.47 mm for type B, and 1.17 +/- 0.51 mm for type C. All implants of the non-welded group (D, E, and F) had significantly increased amounts of crestal bone loss, with 1.72 +/- 0.49 mm for type D (P < 0.01 compared to type A), 1.71 +/- 0.43 mm for type E (P < 0.02 compared to type B), and 1.65 +/- 0.37 mm for type F (P < 0.01 compared to type C).

CONCLUSIONS: These findings demonstrate, as evaluated by non-decalcified histology under unloaded conditions in the canine mandible, that crestal bone changes around 2-piece, non-submerged titanium implants are significantly influenced by possible movements between implants and abutments, but not by the size of the microgap (interface). Thus, significant crestal bone loss occurs in 2-piece implant configurations even with the smallest-sized microgaps (< 10 microns) in combination with possible movements between implant components.

Crestal bone changes around titanium implants. A histometric evaluation of unloaded non-submerged and submerged implants in the canine mandible.

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Abstract

BACKGROUND: Today, implants are placed using both non-submerged and submerged approaches, and in 1- and 2-piece configurations. Previous work has demonstrated that peri-implant crestal bone reactions differ radiographically under such conditions and are dependent on a rough/smooth implant border in 1-piece implants and on the location of the interface (microgap) between the implant and abutment/restoration in 2-piece configurations. The purpose of this investigation was to examine histometrically crestal bone changes around unloaded non-submerged and submerged 1- and 2-piece titanium implants in a side-by-side comparison.

METHODS: A total of 59 titanium implants were randomly placed in edentulous mandibular areas of 5 foxhounds, forming 6 different implant subgroups (types A-F). In general, all implants had a relatively smooth, machined coronal portion as well as a rough, sandblasted and acid-etched (SLA) apical portion. Implant types A-C were placed in a non-submerged approach, while types D-F were inserted in a submerged fashion. Type A and B implants were 1-piece implants with the rough/smooth border (r/s) at the alveolar crest (type A) or 1.0 mm below (type B). Type C implants had an abutment placed at the time of surgery with the interface located at the bone crest level. In the submerged group, types D-F, the interface was located either at the bone crest level (type D), 1 mm above (type E), or 1 mm below (type F). Three months after implant placement, abutment connection was performed in the submerged implant groups. At 6 months, all animals were sacrificed. Non-decalcified histology was analyzed by evaluating peri-implant crestal bone levels.

RESULTS: For types A and B, mean crestal bone levels were located adjacent (within 0.20 mm) to the rough/smooth border (r/s). For type C implants, the mean distance (+/- standard deviation) between the interface and the crestal bone level was 1.68 mm (+/- 0.19 mm) with an r/s border to first bone-to-implant contact (fBIC) of 0.39 mm (+/- 0.23 mm); for type D, 1.57 mm (+/- 0.22 mm) with an r/s border to fBIC of 0.28 mm (+/- 0.21 mm); for type E, 2.64 mm (+/- 0.24 mm) with an r/s border to fBIC of 0.06 mm (+/- 0.27 mm); and for type F, 1.25 mm (+/- 0.40 mm) with an r/s border to fBIC of 0.89 mm (+/- 0.41 mm).

CONCLUSIONS: The location of a rough/smooth border on the surface of non-submerged 1-piece implants placed at the bone crest level or 1 mm below, respectively, determines the level of the fBIC. In all 2-piece implants, however, the location of the interface (microgap), when located at or below the alveolar crest, determines the amount of crestal bone resorption. If the same interface is located 1 mm coronal to the alveolar crest, the fBIC is located at the r/s border. These findings, as evaluated by non-decalcified histology under unloaded conditions, demonstrate that crestal bone changes occur during the early phase of healing after implant placement. Furthermore, these changes are dependent on the surface characteristics of the implant and the presence/absence as well as the location of an interface (microgap). Crestal bone changes were not dependent on the surgical technique (submerged or non-submerged).
The scientific basis for and clinical experiences with Straumann implants including the ITI Dental Implant System: a consensus report.

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Abstract

Successful endosseous implant therapy requires integration of the implant with bone, soft connective tissue and epithelium. This report from a consensus conference on Straumann dental implants including the ITI Dental Implant System documents the interaction of these nonsubmerged one-piece implants with the oral tissues and reviews clinical studies supporting the high success achievable with these implants in patients. Light and electron microscopy reveal that epithelial structures similar to teeth are found around the implants. A connective tissue zone exists between the apical extension of the junctional epithelium and the alveolar bone. This connective tissue comprises a dense circular avascular zone of connective tissue fibers surrounded by a loose vascular connective tissue. The histologic dimensions of the epithelium and connective tissue comprising the biologic width are similar to the same tissues around teeth. The nonsubmerged one-piece design of the Straumann implants, which have been used for over 20 years, has set a standard in implant dentistry, with other implants now being manufactured and placed using similar techniques. Straumann implants have an endosseous portion that is either coated with a well-characterized and well-documented titanium plasma-sprayed surface or is sandblasted and acid attacked. Both surfaces have been shown to have advantages for osseous integration compared to machined and other smoother implant surfaces. These advantages include greater amounts of bone-to-implant contact, more rapid integration with bone tissue, and higher removal torque values. The lack of component connection at or below the alveolar crest provides additional benefits. Component connection at the alveolar crest, as seen with submerged implants, results in microbial contamination, crestal bone loss and a more apical epithelial location. Numerous human clinical trials document the successful use of Straumann implants in a variety of indications and areas of the mouth. These include prospective long-term trials using strict criteria of success and life table analyses. Taken together, the clinical studies reveal that Straumann implants can be used predictably in partially edentulous and completely edentulous maxilla and mandibles with high success rates. Furthermore, the animal and microscopic studies reviewed provide a scientific basis for the integration of Straumann implants with bone, connective tissue and epithelium.

A prospective multicenter clinical trial comparing one- and two-stage titanium screw-shaped fixtures with one-stage plasma-sprayed solid-screw fixtures.


Abstract

BACKGROUND: Brånemark fixtures were originally placed in two stages, whereas titanium plasma-sprayed (TPS) solid-screws are placed in one stage. Long-term survival rates for both types of implants are excellent. Excellent survival rates have also been reported for machined screw-shaped (MS) titanium implants placed in one stage. A small number of studies have compared different implant systems and methods of implant placement.

PURPOSE: The purpose of this study is to report clinical outcomes from a prospective longitudinal, multicenter study comparing Brånemark MS fixtures (Nobel Biocare, Yorba Linda, California, USA) placed in either one or two stages with a one-stage TPS system (ITI Straumann, Waldenburg, Switzerland).

METHODS: A protocol was designed to compare implant survival rates, changes in crestal bone for titanium MS fixtures placed in one and two stages, and plasma-sprayed solid-screw fixtures placed in one surgical stage. Twenty-nine patients ranging in age from 24 to 82 years received MS fixtures in one stage. The average age for males was 58 years (n = 11), whereas the ages for females (n = 18) ranged from 15 to 84 years (average 58 years). Twenty-nine patients received machined titanium fixtures placed in two stages. There were 20 females ranging in age from 23 to 74 years (average 54 years) and 9 females ranging from 24 to 74 years (average 46 years). Twenty-five patients received TPS fixtures. There were 15 males, ranging in age from 57 to 79 (average 70), and 10 females, ranging in age from 40 to 83 years (average 62 years). Bone quality and quantity were determined from radiographs and during site preparation. Patient age, sex, location of implant placement according to jaw, length of fixtures, and number of lost fixtures were entered onto computer code sheets and continuously entered into a locked computer system. For one- and two-stage MS fixtures, nonstandardized periapical radiographs were taken at abutment connection and follow-up. Solid screws were x-rayed at prostheses connection and follow-up. The average time between implant restoration and radiographic follow-up was 15 months. The x-rays were scanned into a computer, and a program designed to measure radiographs was used to determine changes in crestal bone. Measurements for one- and two-stage MS fixtures were made from the top of the implant shoulder to the first bone to implant contact mesial and distally. Plasma-sprayed screws were measured from the bottom of the implant to the coronal most bone to implant contacts mesial and distally. Mesial-distal radiographic measurements were averaged and changes were compared using the t-test for related samples.

RESULTS: This report presents data from the 2- to 3-year follow-up examinations. Twenty-nine patients received 80 one-stage MS fixtures. Between 0 and 1 year, two fixtures were lost, resulting in a 97.5% cumulative survival rate (CSR). The CSR remained unchanged through the 2- to 3-year follow-up. Twenty-eight patients received 78 two-stage MS fixtures. One implant was lost prior to loading and two were lost between 0- and 1-year follow-up, yielding a 96.2% CSR at the end of 1 year. The CSR remained unchanged through the 2- to 3-year follow-up. Twenty-three patients received 78 solid-screw plasma-sprayed screws. One implant was lost prior to loading and one between the 0- to 1-year follow-up, accounting for a 97.4% CSR at the 2- to 3-year follow-up. Changes in bone crest measurements for one-stage titanium threaded fixtures were insignificant (-0.11 mm, p = .08, maxillary; 0.07 mm, p
Influence of the size of the microgap on crestal bone levels in non-submerged dental implants: a radiographic study in the canine mandible.

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Abstract

BACKGROUND: Accumulating evidence suggests that alveolar crestal bone resorption occurs as a result of the microgap that is present between the implant-abutment interface in dental implants. The objective of this longitudinal radiographic study was to determine whether the size of the interface or the microgap between the implant and abutment influences the amount of crestal bone loss in unloaded non-submerged implants.

METHODS: Sixty titanium implants having sandblasted with large grit, acid-etched (SLA) endosseous surfaces were placed in edentulous mandibular areas of 5 American fox hounds. Implant groups A, B, and C had a microgap between the implant-abutment connection of <10 microm, 50 microm, or 100 microm, respectively, as did groups D, E, and F, respectively. Abutments were either welded (1-piece) in groups A, B, and C or non-welded (2-piece screwed) in D, E, and F. All abutment interfaces were placed 1 mm above the alveolar crest. Radiographic assessment was undertaken to evaluate peri-implant crestal bone levels at baseline and at 1, 2, and 3 months after implant placement whereupon all animals were sacrificed.

RESULTS: The size of the microgap at the abutment/implant interface had no significant effect upon crestal bone loss. At 1 month, most implants developed crestal bone loss compared with baseline levels. However, during this early healing period, the non-welded group (D, E, and F) showed significantly greater crestal bone loss from baseline to one month (P <0.04) and 2 months (P < 0.02) compared with the welded group (A, B, and C). No significant differences were observed between these 2 groups at 3 months (P > 0.70).

CONCLUSIONS: Crestal bone loss was an early manifestation of wound healing occurring after 1 month of implant placement. However, the size of the microgap at the implant-
Bone response to loaded implants with non-matching implant-abutment diameters in the canine mandible.

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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).

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

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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 regeneration in dehiscence-type defects at non-submerged and submerged chemically modified (SLActive) and conventional SLA titanium implants: an immunohistochemical study in dogs.

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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+/−0.8-1.9+/−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+/−0.8-4.3+/−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.