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Dental implants
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PURPOSE: To investigate the effect of coating a titanium implant surface with a phosphorylated exopolysaccharide, pullulan, on the peri-implant bone formation and implant osseointegration.

MATERIALS AND METHODS: Implants were placed in the skull bone of 12 domestic pigs and healed for 1 or 3 months. Osseointegration of (un)coated implants was evaluated by quantitative histology (peri-implant bone fraction [BF] and bone-to-implant-contact [BIC]). The Wilcoxon-Mann-Whitney test with alpha = .05 was used to statistically compare BF and BIC of the coated and uncoated implants.

RESULTS: Significantly more BF was observed surrounding pullulan-coated implants compared with uncoated implants (P < .05) and for both healing periods (P < .05). BIC was positively affected by the exopolysaccharide coating, with significantly more BIC after the 3-month healing period compared with the uncoated implant (P < .05). Furthermore, BIC remained stable over time for the coated implants, while it significantly decreased for the uncoated ones (P < .05).

CONCLUSION: These findings reveal the capacity of functionalizing the titanium implant surface with phosphorylated pullulan to improve the mineralization of the implant-bone interface.


PURPOSE: The aim of this retrospective study was to evaluate implant survival rates (ISRs) for implants placed in grafted sinuses where a membrane perforation occurred during augmentation using exclusively anorganic bovine bone (ABB) by means of clinical and radiographic examinations. Histologic information of five biopsy specimens taken from large membrane perforations is also presented.

MATERIALS AND METHODS: Consecutive patients who underwent sinus augmentation procedures at a private practice Dental Institute between 2004 and 2013 were collected from a computer database. The following profiles were selected for data analysis: computed tomography prior to treatment; perforated membrane information according to size: not perforated, small (≤ 5 mm), medium (> 5 and < 10 mm), or large (≥ 10 mm); sinuses grafted exclusively with ABB and lateral window covered with a collagen membrane (CM); and implant survival after at least 2 years of functional loading placed in augmented sinuses. Implants were considered survivals in the absence of infection, mobility, or pain.

RESULTS: The sample in this retrospective study comprised 531 patients; 214 required bilateral sinus augmentation, and 317 required unilateral sinus augmentation (total = 745 sinuses). A total of 1,588 implants were placed. From 745 augmented sinuses, 237 (31.8%; 523 implants) were perforated during the procedure. Among these, 48 perforations were large (20.2%; 107 implants), 67 (28.3%; 150 implants) were medium, and 122 were small (51.5%; 266 implants). Of 523 implants placed in perforated sinuses, 15 were lost (ISR = 97.1%). Comparison of the ISRs for small (97.7%), medium (97.3%), and large (95.3%) perforations with 1,065 implants placed in nonperforated sinuses (ISR = 97.7%) was not statistically significant. The histomorphometric analysis of the five biopsy specimens showed 24.52% +/- 6.99% of new bone, 24.32% +/- 6.42% of marrow space, and 51.2% +/- 3.75% of the remaining ABB.

CONCLUSION: The difference in ISR for implants placed in perforated and nonperforated sinuses was not statistically significant. Within the limits of the histologic data, histomorphometric results with 24.52% +/- 6.99% of new bone formation in sinuses with large perforations showed similar bone formation
compatible with nonperforated sinuses described in the literature. The authors attributed the high ISR shown in perforated sinuses in this study to the proper management of the perforations.


**PURPOSE:** The prevalence of peri-implant infection in patients with dental implants has been shown to range from 28% to 56%. A nanotube-modified implant surface can deliver antibiotics locally and suppress periodontal pathogenic bacterial growth. The aim of this study was to evaluate the deliverability of antibiotics via a nanotube-modified implant.

**MATERIALS AND METHODS:** Dental implants with a nanotube surface were fabricated and loaded with doxycycline. Afterward, each dental implant with a nanotube surface was placed into 2-mL tubes, removed from solution, and placed in a fresh solution daily for 28 days. Experimental samples from 1, 2, 4, 16, 24, and 28 days were used for this evaluation. The concentration of doxycycline was measured using spectrophotometric analysis at 273-nm absorbance. The antibacterial effect of doxycycline was evaluated by supplementing Porphyromonas gingivalis (P gingivalis) growth media with the solution collected from the dental implants at the aforementioned time intervals for a period of 48 hours under anaerobic conditions. A bacterial viability assay was used to evaluate P gingivalis growth at 550-nm absorbance.

**RESULTS:** Doxycycline concentration varied from 0.33 to 1.22 mug/mL from day 1 to day 28, respectively. A bacterial viability assay showed the highest P gingivalis growth at day 1 (2 nm) and the lowest at day 4 (0.17 nm), with a gradual reduction from day 1 to day 4 of approximately 87.5%. The subsequent growth pattern was maintained and slightly increased from baseline in approximately 48.3% from day 1 to day 24. The final P gingivalis growth measured at day 28 was 29.4% less than the baseline growth.

**CONCLUSION:** P gingivalis growth was suppressed in media supplemented with solution collected from dental implants with a nanotube surface loaded with doxycycline during a 28-day time interval.


Digital technology has been widely used in the field of implant dentistry. From a surgical standpoint, computer-guided surgery can be utilized to enhance primary implant stability and to improve the precision of implant placement. From a prosthetic standpoint, computer-aided design/computer-assisted manufacture (CAD/CAM) technology has brought about various restorative options, including the fabrication of customized abutments through a virtual design based on computer-guided surgical planning. This case report describes a novel technique combining the use of a three-dimensional (3D) printed surgical template for the immediate placement of an implant, with CAD/CAM technology to optimize hard and soft tissue healing after bone grafting with the use of a socket sealing abutment.

5.
Bone Healing Around Dental Implants: Simplified vs Conventional Drilling Protocols at Speed of 400 rpm.  
PURPOSE: This study evaluated whether simplified drilling protocols would provide comparable histologic and histomorphometric results to conventional drilling protocols at a low rotational speed.  
MATERIALS AND METHODS: A total of 48 alumina-blasted and acid-etched Ti-6Al-4V implants with two diameters (3.75 and 4.2 mm, n = 24 per group) were bilaterally placed in the tibiae of 12 dogs, under a low-speed protocol (400 rpm). Within the same diameter group, half of the implants were inserted after a simplified drilling procedure (pilot drill + final diameter drill), and the other half were placed using the conventional drilling procedure. After 3 and 5 weeks, the animals were euthanized, and the retrieved bone-implant samples were subjected to nondecalcified histologic sectioning. Histomorphology, bone-to-implant contact (BIC), and bone area fraction occupancy (BAFO) analysis were performed.  
RESULTS: Histology showed that new bone was formed around implants, and inflammation or bone resorption was not evident for both groups. Histomorphometrically, when all independent variables were collapsed over drilling technique, no differences were detected for BIC and BAFO; when drilling technique was analyzed as a function of time, the conventional groups reached statistically higher BIC and BAFO at 3 weeks, but comparable values between techniques were observed at 5 weeks; 4.2-mm implants obtained statistically higher BAFO relative to 3.75-mm implants.  
CONCLUSION: Based on the present methodology, the conventional technique improved bone formation at 3 weeks, and narrower implants were associated with less bone formation.

6.  
Heckmann SM, Mortlbauer B, Rieder D, Wichmann M, Krafft T, Moralis A.  
Alveolar Ridge Dimension 6 Months After Implant Placement with Simultaneous Hard Tissue Augmentation.  
PURPOSE: When failing front teeth are replaced by implants, vestibular bone deficiencies frequently require augmentation, even though the amount of missing alveolar volume may vary. The objective of this study was to analyze the horizontal alveolar ridge dimension after implant placement and simultaneous augmentation, and to compare it to the condition at the contralateral natural site.  
MATERIALS AND METHODS: Forty-eight patients with a failing maxillary incisor received an immediate or early implant (Straumann Bone Level), according to a randomized study protocol. The vestibular wall of the implant site was reconstructed and moderately overcontoured with bovine hydroxyapatite and a collagen membrane (BioOss, BioGide, Geistlich). Provisional restoration followed either immediately, or after a 6-week healing period. To investigate the vestibular volume 6 months after surgery, a plaster model of the maxilla was scanned with cone beam computed tomography (CBCT; Morita 3D) and evaluated using coDiagnostiX software (Dental Wings). Statistical analysis comprised one- and two-sample t tests.  
RESULTS: The ridge volume was not significantly influenced by the treatment schedule. The vestibular segments had a mean +/- SD volume of 207.9 +/- 102.5 mm3 for the implant sites, and 202.1 +/- 101.5 mm3 for the corresponding natural sites (P = .28). The difference in vestibular volume between implant sites and natural tooth sites was 10.4 +/- 36.2 mm3 for immediate implantation, and 0.00 +/- 31.1 mm3 for early implantation (P = .32). Comparing immediate and early restoration, a difference of 0.4 mm3 and 12.5 mm3 between the implant and contralateral site was found (P = .23).  
CONCLUSION: Six months after treatment, no significant differences between the alveolar volumes at augmented implant sites and natural sites were found. Moderate buccal overcontouring may have been beneficial to achieve a symmetrical contour. Long-term follow-up investigation will document if the restored volume remains stable over time.
7.
Lima de Andrade C, Carvalho MA, Bordin D, da Silva WJ, Del Bel Cury AA, Sotto-Maior BS.
Biomechanical Behavior of the Dental Implant Macrodesign.
PURPOSE: The aim of this study was to evaluate the influence of implant macrodesign when using different types of collar and thread designs on stress/strain distributions in a maxillary bone site.
MATERIALS AND METHODS: Six groups were obtained from the combination of two collar designs (smooth and microthread) and three thread shapes (square, trapezoidal, and triangular) in external hexagon implants (4 x 10 mm) supporting a single zirconia crown in the maxillary first molar region. A 200-N axial occlusal load was applied to the crown, and measurements were made of the von Mises stress ($\sigma_{vM}$) for the implant, and tensile stress ($\sigma_{\text{max}}$), shear stress ($\tau_{\text{max}}$), and strain ($\epsilon_{\text{max}}$) for the surrounding bone using tridimensional finite element analysis. The main effects of each level of the two factors investigated (collar and thread designs) were evaluated by one-way analysis of variance (ANOVA) at a 5% significance level.
RESULTS: Collar design was the main factor of influence on von Mises stress in the implant and stresses/strain in the cortical bone, while thread design was the main factor of influence on stresses in the trabecular bone ($P < .05$). The optimal collar design able to produce more favorable stress/strain distribution was the microthreaded design for the cortical bone. For the trabecular bone, the triangular thread shape had the lowest stresses and strain values among the square and trapezoidal implants.
CONCLUSION: Stress/strain distribution patterns were influenced by collar design in the implant and cortical bone, and by thread design in the trabecular bone. Microthreads and triangular thread-shape designs presented improved biomechanical behavior in posterior maxillary bone when compared with the smooth collar design and trapezoidal and square-shaped threads.

8.
Maniewicz S, Buser R, Duvernay E, et al.
Short Dental Implants Retaining Two-Implant Mandibular Overdentures in Very Old, Dependent Patients: Radiologic and Clinical Observation Up to 5 Years.
PURPOSE: To describe the survival rate and peri-implant bone loss in very old patients dependent for their activities of daily living (ADL), treated with mandibular two-implant overdentures (IODs) in the context of a previously reported randomized controlled trial.
MATERIALS AND METHODS: A total of 19 patients received two interforaminal Straumann implants (Regular Neck, 4.1 mm diameter, 8 mm length) that were subsequently loaded with Locator attachments, transforming their preexisting inferior conventional denture into an IOD. The primary outcome measures were implant survival rate and radiographically assessed peri-implant bone loss. Secondary outcome measures included peri-implant probing depth and Plaque Index scores, as well as implant mobility. Nutritional state (body mass index and blood markers) and cognitive state (Mini-Mental State Examination) were also analyzed.
RESULTS: The patient cohort comprised eight men and 11 women with a mean age of 85.7 +/- 6.6 years. The implant survival rate up to 5 years was 94.7%, with one early and one late implant failure. The mean loss of peri-implant bone height was 0.17 mm per year (95% confidence interval: 0.09 to 0.24; $P < .001$). Peri-implant probing depth and Plaque Index scores were low and stable during the first 2 years, and thereafter increased continuously. Correlation analysis suggests that a reduced cognitive function and nutritional state are not a particular risk factor for accelerated peri-implant bone loss.
CONCLUSION: The high implant survival and acceptable peri-implant health suggest that neither age nor dependency for the ADLs is a contraindication for the placement of implants. Nevertheless, close monitoring of the patients concerning a potential further functional decline precluding denture management and performing oral hygiene measures is advised.


PURPOSE: The aim of this study was to compare the loosening of interchangeable one-piece abutments connected to internal-connection-type implants after cyclic loading.

MATERIALS AND METHODS: Four implant abutment groups (n = 7 in each group) with Straumann tissue-level implants were assessed: Straumann solid abutment (group S), Southern Implants solid abutment (group SI), Implant Direct straight abutment (group ID), and Blue Sky Bio regular platform abutment (group BSB). The implant was firmly held in a special jig to ensure fixation. Abutment screws were tightened to manufacturers' recommended torque with a digital torque gauge. The hemispherical loading members were fabricated for the load cell of a universal testing machine to evenly distribute the force on the specimens and to fulfill the ISO 14801:2007 standard. A cyclic loading of 25 N at 30 degrees to the implant's long axis was applied for a duty of a half million cycles. Tightening torques were measured prior to the loading. Removal torques were measured after cyclic loading. The data were analyzed with one-way analysis of variance (ANOVA), and the significance level was set at P < .05.

RESULTS: The mean removal torques after cyclic loading were 34.0 +/- 1.1 Ncm (group S), 25.0 +/- 1.5 Ncm (group SI), 23.9 +/- 2.1 Ncm (group ID), and 27.9 +/- 1.3 Ncm (group BSB). Removal torques of each group were statistically different in the order of group S > group BSB > groups SI and ID (P < .05). The mean reduction rates were -2.9% +/- 3.2% (group S), -21.9% +/- 4.8% (group SI), -20.2% +/- 7.2% (group ID), and -6.9% +/- 4.3% (group BSB) after a half million cycles, respectively. Reduction rates of groups S and BSB were statistically lower than those of groups SI and ID (P < .01). The standard deviation of group S was lower than group BSB.

CONCLUSION: The removal torque of the original Straumann abutment was significantly higher than those of the copy abutments. The reduction rate of the groups S and BSB abutments was lower than those of the other copy abutments.


PURPOSE: To report on a cohort of patients referred to a tertiary center because of neuropathic pain after dental implant placement.

MATERIALS AND METHODS: This retrospective study of pain after dental implant placement involved a minimum follow-up of 12 months after the initial diagnosis of neuropathic pain or persistent, uncontrolled postoperative pain at the Department of Oral and Maxillofacial Surgery, Leuven University, Leuven, Belgium, from January 2013 to June 2014.

RESULTS: Following clinical and radiologic examination, the cause of pain was established in 17 of 26 patients, while the cause was unknown in 9 of 26 patients. Regular implants were placed in the mandibles of 18 patients; in the remaining 8 patients, 6 received regular implants and 2 received a zygoma implant in the maxilla. Surgical management alone brought relief to 2 patients, surgical and pharmacologic management did so for 12 patients, and
pharmacologic management alone brought relief for 10 patients.

CONCLUSIONS: Early removal of an at-risk implant seems justified, preferably within 48 hours after placement. No treatment, either surgical or medical, seems to cure neuropathic pain, but amitriptyline appears to be associated with consistent improvement in symptoms.


Complications in medicine and dentistry are usually analyzed from a purely technical point of view. Rarely is the role of human behavior or judgment considered as a reason for adverse outcomes. When the role of human factors is considered, these are usually described in general terms rather than specifically identifying the factors responsible for an adverse event. The impact of cognitive and behavioral factors in the explanation of adverse events has been studied in other high-stakes areas such as aviation and nuclear power. Specific protocols have been developed to reduce rates of human error, and, where human error is unavoidable, to lessen its impact. This approach has dramatically reduced the incidence of accidents in these fields. This article aims to review how a similar approach may prove valuable in the reduction of complications in implant dentistry.


PURPOSE: To determine the bone regeneration potential of a ceramic biomaterial coated with fibronectin and adipose-derived stem cells covered in three-wall critical-size defects associated with dental implants.

MATERIALS AND METHODS: In a total of 18 dogs, four dehiscence-type and critical-size defects were created surgically in the edentulous alveolar ridge with the simultaneous placement of dental implants. Defects were randomly regenerated using biomaterials coated with particulate s-tricalcium phosphate (beta-TCP), beta-TCP with fibronectin (Fn) (beta-TCP-Fn), and beta-TCP with a combination of Fn and autologous adipose-derived stem cells (ADSCs) (beta-TCP-Fn-ADSCs), leaving one defect as the control. The animals were divided into three groups according to the time of euthanasia (1, 2, or 3 months). RESULTS: Statistically significant differences between the three study groups (beta-TCP, beta-TCP-Fn, beta-TCP-Fn-ADSCs) and the control group in the total area of bone regeneration and mineralized and nonmineralized tissue at 1, 2, and 3 months of healing were not observed. At 2 months, defects treated with beta-TCP-Fn-ADSCs showed a significant decrease in the percentage of bone-to-implant contact (BIC) as compared with the beta-TCP-Fn (P = .041) and control (P = .012) groups. At 3 months of healing, however, significant differences in BIC between the three study groups and controls were not found (P = .388).

CONCLUSION: The use of ADSCs in the bone regeneration processes of dehiscence-type defects associated with simultaneous implant insertion does not seem to improve the area of bone regeneration or the percentage of BIC compared with other biomaterials or the control alveolar defect.

13. Scarano A, Cholakis AK, Piattelli A.
Histologic Evaluation of Sinus Grafting Materials After Peri-implantitis-Induced Failure: A Case Series.  
**PURPOSE:** This human case series presents the clinical and histologic results of five cases of peri-implantitis with subsequent sinus graft infections. Complications may follow maxillary sinus augmentation procedures. It is possible to have an inflammatory reaction, movement of the implant inside the sinus, formation of an insufficient quantity of osseous tissue, and the production of an oroantral fistula. Complications following maxillary subantral augmentation procedures are relatively rare; however, the risks and benefits of any surgery must be carefully evaluated at the onset.  
**MATERIALS AND METHODS:** In this case series, bacterial proliferation from infected implants into the grafted biomaterial in sinus cavities was examined. In five cases, removal of infected implants from augmented sinuses did not result in resolution of the infection, but rather in persistence of the infection in the area of the sinus augmentation procedure. Intraoral examination revealed edema/redness in two cases and edema and sinus tract formation in another case. In all cases, surgical curettage of the affected maxillary sinuses was performed. The inserted biomaterials and the accompanying inflammatory tissue infiltrate were totally removed with curettes. The sample was sent for a histopathologic examination. The maxillary sinuses were filled with an autologous platelet gel.  
**RESULTS:** Necrotic bone was found lining the different biomaterial grafts. Macrophages were observed around the grafted particles. No blood vessels were observed.  
**CONCLUSION:** This case series is the first to document the spread of infection from an implant surface to the entirety of the graft in the maxillary antrum. Complete removal of all infected bone graft material is the treatment of choice in such cases.  

14. Tokar E, Uludag B, Karacaer O.  
Load Transfer Characteristics of Three-Implant-Retained Overdentures with Different Interimplant Distances.  
**PURPOSE:** Implant-retained overdentures are the first choice of rehabilitation for edentulous mandibles. Bone morphology and anatomical landmarks may be influenced by the location and angulation of implants and distances between the implants. The purpose of this study was to investigate stress distribution characteristics and to compare stress levels of three different attachment designs of three-implant-retained mandibular overdentures with three different interimplant distances.  
**MATERIALS AND METHODS:** Three photoelastic mandibular models with three implants were fabricated using an edentulous mandible cast with moderate residual ridge resorption. The center implants were embedded parallel to the midline, and the distal implants were aligned at a 20-degree angulation corresponding to the center implants. Distances between the center and distal implants were set at 11, 18, and 25 mm at the photoelastic models. Bar, bar-ball, and Locator attachment-retained overdentures were prepared for the models. Vertical loads were applied to the overdentures, and stress levels and distribution were evaluated by a circular polariscope.  
**RESULTS:** The greatest observed stress level was moderate for the tested overdenture designs. The Locator attachment system showed the lowest stress level for the 11-mm and 25-mm photoelastic models. The bar attachment design transmitted less stress compared with the other tested designs for the 18-mm photoelastic model.  
**CONCLUSION:** Stresses were observed on the loaded side of the photoelastic models. The lowest stress was found with the Locator and bar attachments for the 11-mm photoelastic model, which transmitted little or no discernible stress around the implants.  

15.
Toniollo MB, Macedo AP, Rodrigues RC, Ribeiro RF, de Mattos MG.
A Three-Dimensional Finite Element Analysis of the Stress Distribution Generated by Splinted and Nonsplinted Prostheses in the Rehabilitation of Various Bony Ridges with Regular or Short Morse Taper Implants.


**PURPOSE:** The aim of this study was to compare the biomechanical performance of splinted or nonsplinted prostheses over short- or regular-length Morse taper implants (5 mm and 11 mm, respectively) in the posterior area of the mandible using finite element analysis.

**MATERIALS AND METHODS:** Three-dimensional geometric models of regular implants (Ø 4 x 11 mm) and short implants (Ø 4 x 5 mm) were placed into a simulated model of the left posterior mandible that included the first premolar tooth; all teeth posterior to this tooth had been removed. The four experimental groups were as follows: regular group SP (three regular implants were rehabilitated with splinted prostheses), regular group NSP (three regular implants were rehabilitated with nonsplinted prostheses), short group SP (three short implants were rehabilitated with splinted prostheses), and short group NSP (three short implants were rehabilitated with nonsplinted prostheses). Oblique forces were simulated in molars (365 N) and premolars (200 N). Qualitative and quantitative analyses of the minimum principal stress in bone were performed using ANSYS Workbench software, version 10.0.

**RESULTS:** The use of splinting in the short group reduced the stress to the bone surrounding the implants and tooth. The use of NSP or SP in the regular group resulted in similar stresses.

**CONCLUSIONS:** The best indication when there are short implants is to use SP. Use of NSP is feasible only when regular implants are present.

Evaluation of the Mechanical Behavior and Marginal Accuracy of Stock and Laser-Sintered Implant Abutments.

**PURPOSE:** The aim of this study was to evaluate the marginal accuracy and mechanical behavior of implant-supported crowns restored with original stock abutments and nonoriginal computer-aided design/computer-assisted manufacture laser-sintered abutments.

**MATERIALS AND METHODS:** A total of 26 implants were divided in two groups (n = 13 each) as follows: implants connected to original stock abutments (OS) and implants connected to nonoriginal laser-sintered abutments (LS). Of these, 10 samples were cross-sectioned to measure the marginal accuracy under a scanning electron microscope. In addition, 16 samples were used to study the mechanical behavior. Two tests were performed: (1) static load and (2) dynamic load after thermocycling with artificial saliva.

**RESULTS:** OS exhibited the best marginal accuracy; however, the LS gap was within the clinically acceptable range of marginal discrepancy. No significant differences were found in the mechanical tests.

**CONCLUSIONS:** Both abutments are acceptable alternatives to restore implants, although the original abutments showed better fit than nonoriginals.

17. Grobecker-Karl T, Karl M.
Correlation Between Micromotion and Gap Formation at the Implant-Abutment Interface.

**PURPOSE:** This study aimed to correlate micromotion and gap measurements at the implant-abutment interface.

**MATERIALS AND METHODS:** A total of 10 implant-abutment assemblies were subjected to micromotion measurements under cyclic loading and
subsequently quartered and inspected under a light microscope to measure vertical and horizontal gaps between implant and abutment. Statistical analysis was based on Pearson product-moment correlations (alpha = .05).

RESULTS: Micromotion varied from 8.03 μm to 100.32 μm, while horizontal gaps ranged from 8.72 μm to 59.93 μm and vertical gaps ranged from 3.93 μm to 30.82 μm. No significant correlations were found (P > .05).

CONCLUSION: Simplistic gap measurements at the implant-abutment interface are inadequate for predicting micromotion.


PURPOSE: The aim of this study was to report the distribution of patients with early implant failures after implant treatment in the edentulous jaw with regard to age at surgery and association with patient mortality over a 15-year period.

MATERIALS AND METHODS: All consecutively treated patients treated in the edentulous jaw at a single specialist clinic from 1986 to 1997 were included and followed up for 1 year for implant failures and for 15 years with regard to patient mortality. Patients were arranged into age groups, and life tables for patients and reference groups of patients with comparable age (based on national population data) were calculated. Log rank test was used to test differences in patient survival between those with reported early implant failures and those with no early failures. Mantel-Haenszel chi-square test was used to test association between proportions of implant failures and age groups.

RESULTS: A total of 55 patients were excluded because they were not living in Sweden (nonresidents/emigrated). Altogether, 2,566 patients were included, with a mean age of 65 years (SD: 11). Of these, 988 patients were deceased during the 15 years of follow-up (38%), and 291 presented an early implant failure (11.3%), most of them before prosthesis placement (72%). Patients with early implant failures presented higher mortality rates than patients with no failures (P < .05), and failure rates decreased consistently from younger to higher age groups (P < .05).

CONCLUSION: Patients in the younger age groups showed an increased mortality compared with the reference group (P < .05) and a higher prevalence of early failures compared with older patients (P < .05). Older patients showed an opposing pattern of lower mortality compared with reference groups of comparable age (P < .05), but both younger and older patients with early failures showed a higher mortality compared to patients with no failures (P < .05).


PURPOSE: The aim of this study was to evaluate the effect of a computer-aided design/computer-assisted manufacturing (CAD/CAM) guide on drilling the screw-access channel for lingually placed implants.

MATERIALS AND METHODS: Screw-channel drilling guides were fabricated on lingually placed implant models using CAD/CAM technology. The screw channels were prepared with guided or freehand drilling by 20 dental graduates. The accuracy of each screw channel was assessed for drilling entry point, channel volume, and angulation (alpha = .05).

RESULTS: The guided drilling group showed smaller deviations than the freehand drilling group, and prosthesis position influenced the guide effect (P <
CONCLUSION: The CAD/CAM guide facilitated the screw channel preparation of cement-retained prostheses supported by lingually placed implants.

Rues S, Fugina M, Rammelsberg P, Kappel S.
PURPOSE: The aim of this study was to determine the influence of selected cements, abutment heights, and aging on the retention of zirconia crowns on zirconia abutments.
MATERIALS AND METHODS: Zirconia crowns and abutments (height: 4.0 or 5.5 mm) were sandblasted and retained using five different cements. Axial pull-off tests were performed after thermocycling or 3 days of water storage.
RESULTS: An increase in abutment height was associated with an increase in decementation force when permanent cementation was tested. The aging protocol showed that temporarily cemented crowns showed a significant retention decrease, while use of a permanent cement led to a moderate increase.
CONCLUSION: Only use of permanent cements ensures clinically adequate decementation forces.

Antoszewska-Smith J, Sarul M, Lyczek J, Konopka T, Kawala B.
INTRODUCTION: The aim of this systematic review was to compare the effectiveness of orthodontic miniscrew implants-temporary intraoral skeletal anchorage devices (TISADs)-in anchorage reinforcement during en-masse retraction in relation to conventional methods of anchorage.
METHODS: A search of PubMed, Embase, Cochrane Central Register of Controlled Trials, and Web of Science was performed. The keywords were orthodontic, mini-implants, miniscrews, miniplates, and temporary anchorage device. Relevant articles were assessed for quality according to Cochrane guidelines and the data extracted for statistical analysis. A meta-analysis of raw mean differences concerning anchorage loss, tipping of molars, retraction of incisors, tipping of incisors, and treatment duration was carried out.
RESULTS: Initially, we retrieved 10,038 articles. The selection process finally resulted in 14 articles including 616 patients (451 female, 165 male) for detailed analysis. Quality of the included studies was assessed as moderate. Meta-analysis showed that use of TISADs facilitates better anchorage reinforcement compared with conventional methods. On average, TISADs enabled 1.86 mm more anchorage preservation than did conventional methods (P <0.001).
CONCLUSIONS: The results of the meta-analysis showed that TISADs are more effective than conventional methods of anchorage reinforcement. The average difference of 2 mm seems not only statistically but also clinically significant. However, the results should be interpreted with caution because of the moderate quality of the included studies. More high-quality studies on this issue are necessary to enable drawing more reliable conclusions.
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Franzotti Sant'Anna E, Carneiro da Cunha A, Paludo Brunetto D, Franzotti Sant'Anna C.
Camouflage of a high-angle skeletal Class II open-bite malocclusion in an adult after mini-implant failure during treatment.
The treatment of skeletal anterior open-bite malocclusion requires complex orthodontic planning that considers its multifactorial etiology, treatment limitations, and high relapse rates. This case report illustrates a successful treatment approach for a skeletal high-angle Class II malocclusion in an adult with a severe open bite. The treatment consisted of a high-pull headgear therapy after mini-implants failure during fixed orthodontic therapy. Adequate esthetics and function were achieved. Despite its low probability, the unexpected event of mini-implant loosening during complex treatments should be considered. Therefore, classic orthodontic mechanics should be established, especially when treating patients for whom invasive procedures such as miniplates or orthognathic surgery are not available options.


Purpose: This study aimed to evaluate the radiographic bone level changes of implants positioned via the split-crest procedure both in the maxilla and mandible at a long-term follow-up.

Materials and Methods: Seventy-one patients were retrospectively enrolled in the study. The placement of 137 dental implants was performed in the edentulous premolar or molar region after a split-crest ridge expansion procedure. Implants followed a delayed loading protocol. Intraoral digital radiographs were performed at baseline, upon implant placement, at 70 days (following placement of the provisional prosthesis), and on a yearly basis during followup. Crestal bone levels were evaluated at the baseline, upon provisional prosthesis placement, at 12, 36, and 60 months, and at the long-term follow-up of healing from implant placement.

Results: The patients underwent a mean follow-up of 6.54 +/- 1.32 years, from which the implant survival rate was reported at 98.54%. Within the first year from implant placement, a bone loss resulted at a mean value of -1.11 +/- 0.44 mm. After almost 3 years from implant placement, a mean bone gain of +0.89 +/- 0.39 mm was reported, which was statistically significant compared with 12-month values (P < .05). From this point, bone levels remained stable, reporting similar values over time, with no significant differences (P > .05).

Conclusion: A mean vertical bone gain of +0.89 +/- 0.39 mm was observed after almost 36 months after implant positioning.

Compton SM, Clark D, Chan S, Kuc I, Wubie BA, Levin L.

Purpose: The objectives of this study were to evaluate implant survival and success in the elderly population and to assess indicators and risk factors for success or failure of dental implants in older adults (aged 60 years and older).

Materials and Methods: This historical prospective study was developed from a cohort of patients born prior to 1950 who received dental implants in a single private dental office. Implant survival and marginal bone levels were recorded and analyzed with regard to different patient- and implant-related factors.

Results: The study examined 245 patient charts and 1,256 implants from one dental clinic. The mean age at the time of implant placement was 62.18 +/- 8.6 years. Smoking was reported by 9.4% of the cohort studied. The overall survival rate of the implants was 92.9%; 7.1% of the implants had failed.
bone loss depicted by exposed threads was evident in 23.3% of the implants. Presenting with generalized periodontal disease and/or severe periodontal disease negatively influenced the survival probability of the implant. Implants placed in areas where bone augmentation was performed prior to or during implant surgery did not have the same longevity compared with those that did not have augmentation prior to implantation.

CONCLUSION: The overall findings concluded that implants can be successfully placed in older adults. A variety of factors are involved in the long-term success of the implant, and special consideration should be taken prior to placing implants in older adults to limit the influence of those risk factors.


**PURPOSE:** The aims of this study were to evaluate the ability of a stepped osteotomy to improve dental implant primary stability in low-density bone sites and to investigate possible correlations between primary stability parameters.

**MATERIALS AND METHODS:** The study was performed on fresh humid bovine bone classified as type III. The test group consisted of 30 Astra Tech EV implants inserted following the protocol provided by the manufacturer. The first control group consisted of 30 Astra Tech EV implants inserted in sites without the underpreparation of the apical portion. The second control group consisted of 30 Astra Tech TX implants inserted following the protocol provided by the manufacturer. Implant insertion was performed at the predetermined 30 rpm. The insertion torque data were recorded and exported as a curve; using a trapezoidal integration technique, the area underlying the curve was calculated: this area represents the variable torque work (VTW). Peak insertion torque (pIT) and resonance frequency analysis (RFA) were also recorded.

**RESULTS:** A Mann-Whitney test showed that the mean VTW was significantly higher in the test group compared with the first control and second control groups; furthermore, statistical analysis showed that pIT also was significantly higher in the test group compared with the first and second control groups. Analyzing RFA values, only the difference between the test group and second control group showed statistical significance. Pearson correlation analysis showed a very strong positive correlation between pIT and VTW values in all groups; furthermore, it showed a positive correlation between pIT and RFA values and between VTW and RFA values only in the test group.

**CONCLUSION:** Within the limitations of an in vitro study, the results show that stepped osteotomy can be a viable method to improve implant primary stability in low-density bone sites, and that, when a traditional osteotomy method is performed, RFA presents no correlation with pIT and VTW.


**PURPOSE:** To evaluate whether primary implant stability could be used to predict bone quality, the association between the implant stability quotient (ISQ) value and the bone type at the implant site was evaluated.

**MATERIALS AND METHODS:** Ninety-five implant sites in 50 patients were included. Bone type (categorized by Lekholm and Zarb) at the implant site was initially assessed using presurgical dental radiography. During the preparation of the implant site, a bone core specimen was carefully obtained. The bone type was assessed by tactile sensation during the drilling operation, according to the Misch criteria. The primary stability of the inserted implant was evaluated by resonance frequency analysis (RFA). The ISQ value was recorded. The bone core specimen was then examined by stereomicroscopy or microcomputed
tomography (micro-CT), and the bone type was determined by the surface characteristics of the specimen, based on Lekholm and Zarb classification. Agreement between the bone quality assessed by the four methods (ie, presurgical radiography, tactile sensation, stereomicroscopy, and micro-CT) was tested by Cohen's kappa statistics, whereas the association between the ISQ value and the bone type was evaluated by the generalized linear regression model.

RESULTS: The mean ISQ score was 72.6, and the score was significantly influenced by the maxillary or mandibular arch (P = .001). The bone type at the implant sites varied according to the assessment method. However, a significant influence of the arch was repeatedly noted when using radiography or tactile sensation. Among the four bone-quality assessment methods, a weak agreement existed only between stereomicroscopy and micro-CT, especially in the maxilla (kappa = 0.469). A negative association between the ISQ value and the bone type assessed by stereomicroscopy or by micro-CT was significant in the maxilla, but not in the mandible, after adjustments for sex, age, and right/left side (P = .013 and P = .027 for stereomicroscopy and micro-CT, respectively).

CONCLUSION: The ISQ value was weakly associated with the bone type when assessed by stereomicroscopy or micro-CT in the maxilla. Caution is necessary if RFA is used as a tool to evaluate bone quality at the implant site, especially in the mandible.


PURPOSE: Ultraviolet (UV)-mediated photofunctionalization has earned considerable attention for the enhancement of the biologic capabilities of titanium. The effects of photofunctionalization on bone augmentation and gap closure were examined using titanium implants and mesh in a rat femur model.

MATERIALS AND METHODS: An acid-etched titanium implant (4-mm length, 1-mm diameter) was placed in the gluteal tuberosity that resembles a knife-edge-like edentulous ridge. The lower half of the implant was located in a 2-mm-diameter defect created in the bone without cortical bone support; the upper half was exposed and covered with a titanium mesh to provide augmentation space. After 12 and 24 days of healing, specimens were subjected to microcomputed tomography (micro-CT)- and histology-based bone morphometry in three zones of analysis: augmentation, cortical bone-implant gap, and bone marrow. A biomechanical push-in test was performed to examine the strength of bone-implant integration. Photofunctionalization was performed by treating titanium implants and mesh with UV light for 12 minutes.

RESULTS: Photofunctionalized titanium mesh and implants were hydrophilic, whereas untreated controls were hydrophobic. Bone volume was significantly greater in photofunctionalized implants and mesh than in untreated implants in all zones on days 12 and 24. Bone-to-implant contact of photofunctionalized implants was greater than that of untreated implants, not just in the bone marrow but also in the gap and augmented zones. The strength of osseointegration was three times greater for photofunctionalized implants than for untreated implants.

CONCLUSION: Use of photofunctionalized titanium mesh and implants effectively enhanced vertical bone augmentation, cortical bone-implant gap closure, and osseointegration without innate bone support.

PURPOSE: This systematic review and meta-analysis was aimed at evaluating the longitudinal effect of platform switching on implant survival rates as well as on soft and hard tissue outcomes. 

MATERIALS AND METHODS: An electronic search of the databases of the National Center for Biotechnology Information, PubMed, Ovid (MEDLINE), EMBASE, Web of Science, and Cochrane Collaboration Library was conducted in February 2015. Studies published in English with at least 10 human participants and a 12-month post-loading follow-up were included. Random effects meta-analyses of selected studies were applied to compare the primary and secondary outcomes of platform-switched (PS) and regular-platform (RP) implants, as well as the experimental designs and clinical outcomes. 

RESULTS: A total of 26 studies involving 1,511 PS implants and 1,123 RP implants were evaluated. Compared to RP implants, PS implants showed a slight increase in vertical marginal bone loss (VMBL) and pocket depth reduction (weighted mean differences were -0.23 mm and -0.20 mm, respectively). The PS implants had a mean VMBL of 0.36 +/- 0.15 mm within the first year of service. The meta-regression suggested a trend of decreased bone resorption at sites with thick soft tissues at baseline. 

CONCLUSION: This study suggested that platform switching may have an indirect protective effect on implant hard tissue outcomes.

Keeve PL, Khoury F. 
Long-Term Results of Peri-implant Conditions in Periodontally Compromised Patients Following Lateral Bone Augmentation. 
PURPOSE: The aim of this retrospective study was to compare long-term (>= 5 years) outcomes of implants placed in patients treated for chronic periodontitis versus those placed in periodontally healthy patients. In both groups, the implants were placed in alveolar ridges that were laterally augmented with autogenous bone block grafts using a split bone block technique. 

MATERIALS AND METHODS: Two hundred ninety-two patients were screened in the course of supportive periodontal treatment examinations. Nonsmoking patients without any severe systemic diseases who had adhered to regular supportive periodontal treatment for a minimum of 5 years after undergoing autogenous lateral grafting (using the split bone block technique), implant placement, and prosthetic reconstructions were classified into two groups based on their presurgical status: periodontally healthy patients (PHP) and periodontally compromised patients (PCP). 

RESULTS: Clinical outcomes for 77 patients, 38 PHP and 39 PCP, were examined. All had been successfully treated for severe lateral atrophy and received a total of 241 endosseous implants between 2002 and 2008. At the final examination, mean bleeding on probing was 7.08% +/- 7.27% in PHP and 14.49% +/- 18.14% in PCP, a statistically significant difference. Significantly higher Plaque Index and more recession were associated with a narrow (< 2 mm) width of keratinized mucosa. 

CONCLUSION: Implants in alveolar ridges laterally augmented using a split bone block technique revealed similar clinical peri-implant conditions in both PHP and PCP. Using autogenous bone block grafts without biomaterials resulted in long-term peri-implant tissue stability.

Kronstrom M, Davis B, Loney R, Gerrow J, Hollender L. 
Satisfaction and Clinical Outcomes Among Patients with Immediately Loaded Mandibular Overdentures Supported by One or Two Dental Implants: Results of a 5-Year Prospective Randomized Clinical Trial. 
PURPOSE: The purpose of this study was to evaluate patient satisfaction and clinical outcomes among subjects with mandibular overdentures supported by
one or two immediately placed dental implants 5 years after loading.

MATERIALS AND METHODS: Thirty-six subjects (16 men and 20 women) received one or two dental implants in the anterior mandible, and all implants were loaded the day of surgery. Subjects were scheduled for follow-up 3-, 6-, and 12 months after implant placement and thereafter annually for 4 more years. Patient satisfaction scores were measured with the Oral Health Impact Profile-EDENT (OHIPEDENT) questionnaire.

RESULTS: Seventeen subjects (7 male and 10 female) with a mean age of 59.4 years (range, 44 to 74 years) were available for the 5-year follow-up examination. Nine subjects with 10 failing implants were excluded during the first year and nine subjects were lost to follow-up. No implants failed between the 12- and 60-month follow-up examinations, and the need for denture maintenance was low. Mean peri-implant bone change was 0.92 mm, and the Spearman test failed to show correlation between the insertion torque value and implant stability quotient. Patient satisfaction scores increased significantly when compared with baseline values and continued to be high for both groups, with no significant differences.

CONCLUSION: Ten implants in nine subjects failed early, but no failures were observed after the 12-month examination. No significant differences were found between subjects in the two groups with respect to implant survival rates and peri-implant bone loss, and patient satisfaction scores continued to be high. Although patient satisfaction and implant success were high during the 12- to 60-month period, the results should be interpreted with caution because of the high number of failing implants and patients lost to follow-up. More research is needed to study outcomes of treatment with immediately loaded mandibular implant overdentures.


PURPOSE: The aim of this prospective study was to establish if ultrashort implants are a reliable therapeutic solution by evaluating their effect on mean crestal bone loss and assessing their survival and success rates.

MATERIALS AND METHODS: Patients were treated using 6-, 9-, and 11-mm-long implants with sandblasted and acid-etched surfaces and fitted with fixed partial prostheses. Clinical and radiographic examinations were scheduled yearly. Data collected included the implant positioning site, implant length and diameter, peri-implant bone loss (PBL), and clinical and anatomical C/I ratios.

RESULTS: One hundred eleven implants (6-mm-long, 30.6%) were positioned; two implants were lost before loading. During the 36-month followup, no other implants were lost (98.2% survival rate, 100% from loading), but four implants did not meet the criteria for success, due to excessive crestal bone loss, resulting in a 94.6% success rate, 96.3% from loading. Success rates and peri-implant bone loss were not significantly different among implants with different lengths. No correlation was observed between implant length and bone resorption.

CONCLUSION: Six-millimeter-long implants did not show different results in comparison with 9- and 11-mm-long implants. They can be considered a reliable solution for implant prosthetic rehabilitation and a dependable and minimally invasive therapeutic option in areas showing severe bone resorption.

PURPOSE: To assess the influence of anodized titanium and zirconium dioxide abutments and peri-implant soft tissue thickness on the optical outcome of implant-supported lithium disilicate single crowns.

MATERIALS AND METHODS: Twenty patients with a missing maxillary single incisor, canine, or first premolar received an endosseous implant after a two-stage surgery protocol. After healing and soft tissue conditioning, peri-implant soft tissues were reproduced in the impression, and the thickness was measured. Customized abutments were made of titanium, gold-anodized titanium, pink-anodized titanium, and zirconium dioxide. The definitive prosthesis was a lithium disilicate crown stratified by feldspathic porcelain. Customized abutments were screwed (35 Ncm), and the crown was temporarily placed on the abutment with a try-in paste. Color measurements were made using a spectrophotometer. CIELab color scale was employed following the formula: \[ \text{DELTAE} = (\text{DELTAL})^2 + (\text{DELTAa})^2 + (\text{DELTAB})^2. \]

Data were analyzed using repeated-measures analysis of variance (ANOVA), Bonferroni and Pearson's correlation tests (alpha = .05).

RESULTS: Abutment material type significantly affected the DELTAE values at both the peri-implant soft tissue (P = .0001) and coronal level (P = .001). The lowest DELTAE values were obtained with zirconia abutments at both soft tissue (6.06 +/- 3.2) and coronal level (5.76 +/- 2.9) compared with those of other abutments (soft tissue: 8.96 +/- 3.1 to 11.56 +/- 3.4; coronal: 8.66 +/- 6.1 to 10.42 +/- 6.3). Mean soft tissue thickness (1.63 +/- 0.64 mm) affected the DELTAE values at the peri-implant soft tissue level for only titanium and pink-anodized titanium abutments (P = .024 and P = .048, respectively). In all conditions, correlation coefficients between DELTAE and the abutment materials were higher for titanium (r = -0.544; P = .024) and the least for zirconia (r = -0.313; P = .238) and gold-anodized titanium (r = -0.393; P = .119) abutments.

CONCLUSION: All abutment types demonstrated noticeable color difference at both the soft tissue and coronal levels. Zirconia abutments showed the lowest DELTAE values at both measurement zones. Soft tissue thickness did not affect the DELTAE values at the peri-implant soft tissue level.


PURPOSE: The objective of this study was to evaluate the osteogenic and osseointegration capability of the Ce-tetragonal zirconia polycrystal (TZP)-based nanostructured zirconia/alumina composite (Ce-TZP/Al2O3) that was treated with hydrofluoric acid (HF).

MATERIALS AND METHODS: Osteogenic MC3T3-E1 cells were cultured on acid-etched titanium (AETi) disks and Ce-TZP/Al2O3 disks without HF treatment (Zr[0%]), with 4% HF treatment (Zr[4%]), or with 55% HF treatment (Zr[55%]) for 24 hours, and biologic responses were compared among four conditions in vitro. Miniature implants of AETi and Zr(55%) were surgically placed in the femora of rats. Osseointegration was evaluated by a biomechanical push-in test after 2 and 4 weeks of healing.

RESULTS: The surface of Zr(55%) rendered nanofeatured topography with a greater surface area and roughness, and extensive geographical undercut as ceria-zirconia crystal disappeared from the superficial layer and was similar to the surface morphology of biomineralized matrices. Culture studies showed that the attachment, proliferation, spread, and functional phenotypes of osteogenic cells, such as alkaline phosphatase activity and bone-related gene expression, were remarkably increased on the Zr(55%) surface. The strength of osseointegration measured using the biomechanical push-in test in a rat model was stronger for Zr(55%) implants than for AETi implants by 1.6 fold.

CONCLUSION: The nanostructured Ce-TZP/Al2O3 surface substantially enhanced the osteogenic response in vitro and the osseointegration capability in vivo, which suggest its potential clinical application as a novel implant material.

PURPOSE: To examine early bone tissue healing in dental implants incorporating StemBios cell therapy.

MATERIALS AND METHODS: SLAffinity samples were examined by scanning electron microscopy and atomic force microscopy. The clinical trial comprised 11 patients, who each received a dental implant in the mandible. Only one of these 11 patients received StemBios cell therapy in combination with the dental implant. The patients continued to be observed over a 4-month period after implantation using computed tomography and resonance frequency analysis.

RESULTS: It was found that StemBios cell therapy promoted bone tissue healing in the case of the treated dental implant. The data indicated that stress altered more smoothly and declined faster in the patient who received the StemBios cell therapy than those without StemBios cell therapy over 4 months.

CONCLUSION: A dental implant with SLAffinity surface treatment, in combination with StemBios cell therapy, significantly promoted bone tissue healing, especially at early osseointegration compared with that of implants without StemBios cell therapy when monitored over a 4-month period.


Many clinical studies and literature reviews have suggested that bar and ball attachments in maxillary and mandibular implant-supported overdentures (ISOs) should be indicated only when there is sufficient interocclusal space (IOS; minimum = 30 mm). The aim of this clinical report was to present the prosthetic rehabilitation of a patient with adenoid cystic carcinoma associated with microstomia due to radiotherapy (IOS = 23 mm). ISOs offer superior retention and greater stability than conventional obturators, so that base extensions were kept to the minimum. Placing the balls parallel to the prosthesis path of insertion is much easier with this treatment modality.


PURPOSE: This study investigated the stability of titanium screws in implant-abutment connections by measuring the force necessary to induce unscrewing.

MATERIALS AND METHODS: A total of 60 implant-abutment couplings were assigned to two groups (n = 30 each). The sequence 10-20-32 Ncm was tested in Group 1; the sequence 10-20-32-32-32 Ncm was tested in Group 2. The force necessary to unscrew each abutment-implant sample was recorded and statistically analyzed. The significance level was set at P < .05.

RESULTS: Significant differences were found between the two sequences. Group 2 required higher forces than Group 1 to unscrew.

CONCLUSION: The stability of the implant-abutment joint may be improved by tightening with the sequence 10-20-32-32-32 Ncm.
Chng CK, Gandedkar NH.
Hemifacial microsomia is the second most frequently encountered congenital facial anomaly after cleft lip and palate. This case history report describes a two-implant-supported auricular prosthetic reconstruction in a young patient with an absent auricle and malpositioned lobule. The selected treatment protocol was chosen because of its superior retention when compared with alternative retention systems. Moreover, a clip-bar attachment system is more reliable and easier to use when availability of anatomical landmarks is limited, and especially in active adolescents.

38.
Gonda T, Kamei K, Maeda Y.
Determining Favorable Maxillary Implant Locations Using Three-Dimensional Simulation Software and Computed Tomography Data.
PURPOSE: Success rates for maxillary implant treatment are lower than for mandibular treatment because of the presence of poorer bone quality or quantity in the maxilla. The purpose of this study was to determine favorable implant positions in the maxilla using implant simulation software and clinical anatomical morphology together with bone quality data obtained by computed tomography (CT).
MATERIALS AND METHODS: A convenience research sample of 10 edentulous subjects was recruited, and research information from right and left edentulous sites was obtained from each subject. The height, width, angulation, and Hounsfield unit value of the maxillary alveolar bone were measured using CT data obtained from the subjects.
RESULTS: Bone height in the incisor area was significantly greater than in the molar area, and bone width in the incisor area was significantly narrower than in the molar area. The average bone quality in the maxillary molar area was significantly higher when compared with the premolar and incisor areas. The angle between the occlusal plane and the bisector of the alveolar bone in the incisor area was reduced when compared with the molar area.
CONCLUSION: The premolar region appears to be the most favorable area in the maxillary arch for implant placement with regard to bone height, width, angulation, and quality.

39.
Hirata K, Takahashi T, Tomita A, Gonda T, Maeda Y.
Influence of Abutment Angle on Implant Strain When Supporting a Distal Extension Removable Partial Dental Prosthesis: An In Vitro Study.
PURPOSE: This study evaluated the impact of angled abutments on strain in implants supporting a distal extension removable partial denture.
MATERIALS AND METHODS: An in vitro model of an implant supporting a distal extension removable partial denture was developed. The implant was positioned with a 17- or 30-degree mesial inclination, with either a healing abutment or a corrective multiunit abutment. Levels of strain under load were compared, and the results were compared using t test (P = .05).
RESULTS: Correcting angulation with a multiunit angled abutment significantly decreased strain (P < .05) when compared with a healing abutment.
CONCLUSION: An angled abutment decreased the strain on an inclined implant significantly more than a healing abutment when loaded under a distal extension removable partial denture.
40.
Layton D.
A Critical Review of Search Strategies Used in Recent Systematic Reviews Published in Selected Prosthodontic and Implant-Related Journals: Are Systematic Reviews Actually Systematic?
PURPOSE: The aim of this study was to outline how search strategies can be systematic, to examine how the searches in recent systematic reviews in prosthodontic and implant-related journals were structured, and to determine whether the search strategies used in those articles were systematic.
MATERIALS AND METHODS: A total of 103 articles published as systematic reviews and indexed in Medline between January 2013 and May 2016 were identified from eight prosthodontic and implant journals and reviewed. The search strategies were considered systematic when they met the following criteria: (1) more than one electronic database was searched, (2) more than one searcher was clearly involved, (3) both text words and indexing terms were clearly included in the search strategy, (4) a hand search of selected journals or reference lists was undertaken, (5) gray research was specifically sought, and (6) the articles were published in English and at least one other language. The data were tallied and qualitatively assessed.
RESULTS: The majority of articles reported on implants (54%), followed by tooth-supported fixed prosthodontics (13%). A total of 23 different electronic resources were consulted, including Medline (by 100% of articles), the Cochrane Library (52%), and Embase (37%). The majority consulted more than one electronic resource (71%), clearly included more than one searcher (73%), and employed a hand search of either selected journals or reference lists (86%). Less than half used both text words and indexing terms to identify articles (42%), while 15% actively sought gray research. Articles published in languages other than English were considered in 63 reviews, but only 14 had no language restrictions. Of the 103 articles, 5 completed search strategies that met all 6 criteria, and a further 12 met 5 criteria. Two articles did not fulfill any of the criteria.
CONCLUSION: More than 95% of recent prosthodontic and implant review articles published in the selected journals failed to use search strategies that were systematic, and this undermines the conclusions. Many resources are available to help investigators design search strategies for systematic reviews that minimize the risk of omitting important data, including the simple criteria presented in this paper.

41.
Passia N, Abou-Ayash S, Bender D, et al.
Single Mandibular Implant Study: Recruitment Considerations.
PURPOSE: The aim of this multicenter single mandibular implant study was to compare the clinical outcome of an immediately loaded implant placed in the midline of an edentulous mandible with the clinical outcome when closed healing and delayed loading is chosen. Here, the patient recruitment period and the main reasons for exclusion were analyzed.
MATERIALS AND METHODS: Patient recruitment was performed at nine German universities. Rather conservative inclusion and exclusion criteria, including denture satisfaction, denture status, a psychologic symptom checklist, and a defined bone height in the posterior mandible, had to be fulfilled. It was initially calculated that 230 persons would have to be screened within 13 months to include 180 persons in the trial.
RESULTS: Within 13 months (December 2012 to December 2013), 201 patients were screened for possible inclusion in the trial and 148 met the inclusion criteria. Finally, after the recruitment period was extended by 2.5 months, 224 patients were screened and 169 were included. Of those screened, 55 (24.6%) did not meet the inclusion criteria and were excluded. Another 4 patients (1.8%) were excluded based on their psychologic symptom checklist score, while 5 others (2.8%) showed signs of noncompliance. A further 8 patients (4.4%) decided not to participate and withdrew their informed consent, and another 3
(1.3%) were no longer available after screening. Another 2 patients were excluded due to medical contraindications and 1 due to an insufficient mandibular denture. In 34 cases (15.2%), the residual bone height did not comply with McGarry type II or III.

CONCLUSION: Within the limitations of this patient recruitment period, it can be concluded that residual bone height is the most important factor when considering elderly edentulous patients for implant therapy. The psychologic symptom checklist score was less important.

42.
Yoda N, Sun J, Matsudate Y, Hong G, Kawata T, Sasaki K.
Effect of Configurations of Implants Supporting a Four-Unit Fixed Partial Denture on Loading Distribution.
This study aimed to evaluate the effect of the configuration of implants supporting a four-unit fixed partial denture on load distribution. An epoxy resin model missing teeth from the first premolar to the second molar was used. Three-dimensional piezoelectric force transducers were set on implants placed in the missing teeth area with a four-unit experimental superstructure. Three-dimensional loads on the implants were measured with four different implant configurations when a static load of 100 N was applied. The loads on the implants changed significantly depending on the implant number and position and the applied loading points.

43.
Polo M.
Bone resorption under chin implants: The orthodontist's role in its diagnosis and management.
Alloplastic chin implants have been a valuable treatment modality for the correction of microgenia. Their use has provided satisfactory esthetic results by improving facial balance. However, bone resorption under these implants can occur. Case reports of 4 patients with the incidental radiographic finding of the presence of chin implants are presented. All 4 subjects had lateral cephalograms and panoramic x-rays taken as part of their orthodontic evaluation. One had a normal mandibular symphyseal contour, and 3 had bone resorption under the implants. One subject had severe resorption. In addition to panoramic and cephalometric x-rays, the subject with severe resorption also had magnetic resonance imaging and computerized tomography as part of the evaluation workup.
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44.
Kalia AJ.
Treatment of Anterior Open Bite with a Mini-Implant-Supported Tongue Crib.

45.
Pieralli S, Kohal RJ, Jung RE, Vach K, Spies BC.
Clinical Outcomes of Zirconia Dental Implants.
To determine the survival rate and marginal bone loss (MBL) of zirconia dental implants restored with single crowns or fixed dental prostheses. An electronic search was conducted up to November 2015 (without any restriction regarding the publication time) through the databases MEDLINE (PubMed), Cochrane Library, and EMBASE to identify randomized controlled clinical trials and prospective clinical trials including >15 patients. Primary outcomes were survival rate and MBL. Furthermore, the influence of several covariates on MBL was evaluated. Qualitative assessment and statistical analyses were performed. This review was conducted according to preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines for systematic reviews. With the applied search strategy, 4,196 titles could be identified. After a screening procedure, 2 randomized controlled clinical trials and 7 prospective clinical trials remained for analyses. In these trials, a total of 326 patients received 398 implants. The follow-up ranged from 12 to 60 mo. Implant loss was mostly reported within the first year, especially within the healing period. Thereafter, nearly constant survival curves could be observed. Therefore, separate meta-analyses were performed for the first and subsequent years, resulting in an implant survival rate of 95.6% (95% confidence interval: 93.3% to 97.9%) after 12 mo and, thereafter, an expected decrease of 0.05% per year (0.25% after 5 y). Additionally, a meta-analysis was conducted for the mean MBL after 12 mo, resulting in 0.79 mm (95% confidence interval: 0.73 to 0.86 mm). Implant bulk material and design, restoration type, and the application of minor augmentation procedures during surgery, as well as the modes of temporization and loading, had no statistically significant influence on MBL. The short-term cumulative survival rates and the MBL of zirconia implants in the presented systematic review are promising. However, additional data are still needed to confirm the long-term predictability of these implants.


The aim of the present critical review is to summarize recent evidence on the prevalence of peri-implant diseases and their similarities and differences with periodontal diseases with a focus on their pathogenetic mechanisms. Reports on the extent and severity of peri-implant diseases are influenced by different case definitions. The prevalence of peri-implant diseases is reported at the subject or implant level and affected by the type of population samples analyzed (e.g., randomly selected population samples or convenience samples). The outcomes of studies on animals and humans indicate that experimental biofilm accumulation leads to a higher frequency of bleeding sites around implants as compared with teeth. Despite the proof of principle that experimentally induced mucositis may be reversible, early diagnosis and management of naturally occurring peri-implant mucositis are clinically relevant. Tissue destruction at experimental peri-implantitis sites is faster and more extensive when compared with that at experimental periodontitis sites. Although human periodontitis and peri-implantitis lesions share similarities with respect to etiology and clinical features, they represent distinct entities from a histopathologic point of view. To avoid implant loss, patients diagnosed with peri-implantitis should be treated without delay.


Tissues surrounding dental implants and teeth develop clinical inflammation in response to microbial stimuli. However, the literature suggests that differences exist in the microbial insult and inflammatory responses leading to gingivitis and peri-implant mucositis. In this pilot study, the authors use for the first time a systems biology approach to comprehensively evaluate clinical parameters, selected inflammatory markers, and the microbiome of subject-matched tooth
and implant sites during native inflammation and in response to experimental plaque accumulation. Fifteen subjects with 2 posterior implants and corresponding contralateral teeth were examined at enrollment; at day 0, after reinstitution of gingival/mucosal health; at days 7, 14, and 21, during stent-mediated oral hygiene (OH) abstention; and at day 42, after resumption of OH. The subgingival microbiome was evaluated via 16S rRNA gene sequencing and 8 selected inflammatory markers measured in crevicular fluid. Comparison of teeth and implants via general linear models based on orthogonal polynomials showed similar responses in clinical parameters, inflammatory mediators, and proportions of individual microbial taxa during OH abstention. Implants, however, accumulated less plaque and underwent more heterogeneous shifts in microbiome structure. A multilevel, within-group, sparse partial least squares analysis of covariation of microbial, inflammatory, and clinical parameters throughout all study visits found inflammation around teeth and implants positively correlated with IL-1 alpha and IL-1 beta and with the proportions of Selenomonas, Prevotella, and 5 species-level phylotypes. Gingivitis, however, showed a stronger positive correlation with lactoferrin and IL-1ra and a stronger negative correlation with Rothia. Peri-implant mucositis, on the contrary, correlated positively with certain microbial taxa not associated with gingivitis by a previous study or the current one. In summary, differences existed between implants and tooth sites in microbiome evolution during OH abstention and in the correlation of specific inflammatory mediators and microbial taxa with clinical inflammation. Common biological features, however, were also identified for gingivitis and mucositis.

48.
Hupp JR.
Implant Dentistry: Growing Our Opportunities.

49.
Presurgical evaluation of bony implant sites using panoramic radiography and cone beam computed tomography-influence of medical education.
OBJECTIVES: The aim of this study was to compare the subjective quality rating of panoramic radiography (PAN) and CBCT in the planning of dental implant procedures by clinicians with different educational backgrounds.
METHODS: Radiographic images (PAN and CBCT) of 42 patients were examined as follows: the maxillary (MX) anterior region of patients, the MX posterior region of 16 patients and the mandibular (MD) posterior region of 16 patients. These sites were used for planning of dental implant insertion. Data sets were analyzed by examiners with different training backgrounds: three general practitioners (GP), three oral surgeons (OS) and three maxillofacial surgeons (MS). A standardized questionnaire in a standardized setting was answered by participants.
RESULTS: The majority of participants rated an additional CBCT as "required" (14.0%) or "reasonable" (56.1%). These ratings depended strongly on the area of interest (MX anterior region: 31.1 and 58.9%; MX posterior region: 14.6 and 62.5%; and MD posterior region: 2.8% and 47.9%). MS classified CBCT as required more often than GP and OS (23.8 vs 10.3 and 7.9%; p<0.001). With the additional information of CBCT, "therapy affecting" ratings were stated high in all groups.
CONCLUSIONS: Especially in the anterior and posterior MX, significant subjective benefits for an additional CBCT were seen for planning of dental implant procedures. Participants with fundamental medical education asked for CBCT more often. The results indicate that an improved education in three-dimensional dental radiology is necessary.

**OBJECTIVES:** To analyze and evaluate imaging artefacts induced by zirconium, titanium and titanium-zirconium alloy dental implants.

**METHODS:** Zirconium, titanium and titanium-zirconium alloy implants were embedded in gelatin and MRI, CT and CBCT were performed. Standard protocols were used for each modality. For MRI, line-distance profiles were plotted to quantify the accuracy of size determination. For CT and CBCT, six shells surrounding the implant were defined every 0.5 cm from the implant surface and histogram parameters were determined for each shell.

**RESULTS:** While titanium and titanium-zirconium alloy induced extensive signal voids in MRI owing to strong susceptibility, zirconium implants were clearly definable with only minor distortion artefacts. For titanium and titanium-zirconium alloy, the MR signal was attenuated up to 14.1 mm from the implant. In CT, titanium and titanium-zirconium alloy resulted in less streak artefacts in comparison with zirconium. In CBCT, titanium-zirconium alloy induced more severe artefacts than zirconium and titanium.

**CONCLUSIONS:** MRI allows for an excellent image contrast and limited artefacts in patients with zirconium implants. CT and CBCT examinations are less affected by artefacts from titanium and titanium-zirconium alloy implants compared with MRI. The knowledge about differences of artefacts through different implant materials and image modalities might help support clinical decisions for the choice of implant material or imaging device in the clinical setting.


Patients' aesthetic expectations are increasing, and the options of the prosthetic pathways are currently evolving. The objective of this randomized multicenter clinical trial was to assess and compare the aesthetic outcome and clinical performance of anterior maxillary all-ceramic implant crowns (ICs) based either on prefabricated zirconia abutments veneered with pressed ceramics or on CAD/CAM zirconia abutments veneered with hand buildup technique. The null hypothesis was that there is no statistically significant difference between the 2 groups. Forty implants were inserted in sites 14 to 24 (FDI) in 40 patients in 2 centers, the Universities of Bern and Geneva, Switzerland. After final impression, 20 patients were randomized into group A, restored with a 1-piece screw-retained single crown made of a prefabricated zirconia abutment with pressed ceramic as the veneering material using the cut-back technique, or group B using an individualized CAD/CAM zirconia abutment (CARES abutment; Institut Straumann AG) with a hand buildup technique. At baseline, 6 mo, and 1 y clinical, aesthetic and radiographic parameters were assessed. Group A exhibited 1 dropout patient and 1 failure, resulting in a survival rate of 94.7% after 1 y, in comparison to 100% for group B. No other complications occurred. Clinical parameters presented stable and healthy peri-implant soft tissues. Overall, no or only minimal crestal bone changes were observed with a mean DIB (distance from the implant shoulder to the first bone-to-implant contact) of -0.15 mm (group A) and 0.12 mm (group B) at 1 y. There were no significant differences at baseline, 6 mo, and 1 y for DIB values between the 2 groups. Pink esthetic
score (PES) and white esthetic score (WES) values at all 3 examinations indicated stability over time for both groups and pleasing esthetic outcomes. Both implant-supported prosthetic pathways represent a valuable treatment option for the restoration of single ICs in the anterior maxilla (ClinicalTrials.gov NCT02905838).


**PURPOSE:** The use of cone-beam computed tomography (CBCT) for evaluation of patients for dental implants has gained considerable popularity. This retrospective cohort study was designed to determine whether using a clinical examination and a panoramic radiograph (Panorex) for implant selection and determining the need for bone grafting would be comparable to using CBCT in routine implant cases.

**PATIENTS AND METHODS:** Implant size and need for bone grafting were initially determined in 82 patients using a panoramic radiograph and clinical examination. These patients subsequently underwent CBCT and their treatment was re-planned by the same surgeon using Simplant treatment planning software (DENTSPLY Implants, Molndal, Sweden) in addition to clinical examination. The length and width of implants selected by each method and the need for bone grafting were recorded and the results were compared statistically with each other and with the actual treatment subsequently rendered.

**RESULTS:** The Panorex method and the CBCT method accurately predicted implant width to within 1.5 mm of the implant actually placed in 100% of cases and length to within 1.5 mm in more than 95% of cases. For bone graft prediction, the results indicated that neither the Panorex method nor CBCT method differed substantially from the actual treatment rendered.

**CONCLUSIONS:** The results of this study indicate that the CBCT is more accurate in predicting implant length and width and the need for bone grafting procedures. However, for routine unguided implant placement in sites where anatomic structures and bone grafting are not a concern, the use of a panoramic radiograph could be adequate for determining the length and width of the implant.

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The aims of this study were to assess 1) differences in perceptions of dental implant training between dental students who received didactic training alone (control group) and those who received didactic plus simulation training (test group); 2) differences in response between students with and without clinical experience in implant dentistry; and 3) the interaction effect of simulation training and clinical experience on students’ satisfaction. A survey was distributed to the control group in 2014 and to the test group in 2015; both groups were at the same U.S. dental school. Data were collected on confidence levels with various implant restorative procedures along with overall satisfaction and number of implant restorations performed by each student. The response rate was 78.7% in the control group and 81.3% in the test group. In the control group, 85.7% of students reported being satisfied with implant training compared to 90.8% of students in the test group. The interaction effect of simulation training and clinical experience on overall student satisfaction was OR=1.5 at 95% CI: 0.8, 3.0. The students who had clinical experience with implant restorative procedures had significantly greater satisfaction than those who did not (OR=4.8, 95% CI: 2.1, 11.1, p<0.01). This study found that both the simulation and clinical experience affected these students’ confidence and satisfaction levels with
Implant education: they were almost five times more satisfied with implant training when clinical experience in implant restorative procedures was a part of their implant education.


Cellular adhesion is essential for successful integration of dental implants. Rapid soft tissue integration is important to create a seal around the implant and prevent infections, which can commonly cause implant failure and result in bone loss. In addition, soft tissue management is important to obtain good dental aesthetics. Previous studies have shown that the salivary peptide histatin 1 (Hst1) causes a more than 2-fold increase in the ability of human adherent cells to attach and spread on a glass surface. Cells treated with Hst1 attached more rapidly and firmly to the substrate and to each other. In the current study, we examine the potential application of Hst1 for promotion of dental implant integration. Our results show that Hst1 enhances the attachment and spreading of soft tissue cell types (oral epithelial cells and fibroblasts) to titanium (Ti) and hydroxyapatite (HAP), biomaterials that have found wide applications as implant material in dentistry and orthopedics. For improved visualization of cell adhesion to Ti, we developed a novel technique that uses sputtering to deposit a thin, transparent layer of Ti onto glass slides. This approach allows detailed, high-resolution analysis of cell adhesion to Ti in real time. Furthermore, our results suggest that Hst1 has no negative effects on cell survival. Given its natural occurrence in the oral cavity, Hst1 could be an attractive agent for clinical application. Importantly, even though Hst1 is specific for saliva of humans and higher primates, it stimulated the attachment and spreading of canine cells, paving the way for preclinical studies in canine models.


Bone condensation is thought to densify interfacial bone and thus improve implant primary stability, but scant data substantiate either claim. We developed a murine oral implant model to test these hypotheses. Osteotomies were created in healed maxillary extraction sites 1) by drilling or 2) by drilling followed by stepwise condensation with tapered osteotomes. Condensation increased interfacial bone density, as measured by a significant change in bone volume/total volume and trabecular spacing, but it simultaneously damaged the bone. On postimplant day 1, the condensed bone interface exhibited microfractures and osteoclast activity. Finite element modeling, mechanical testing, and immunohistochemical analyses at multiple time points throughout the osseointegration period demonstrated that condensation caused very high interfacial strains, marginal bone resorption, and no improvement in implant stability. Collectively, these multiscale analyses demonstrate that condensation does not positively contribute to implant stability.