Scientific Highlights
SHORT OVERVIEWS ON RECENTLY PUBLISHED SCIENTIFIC EVIDENCE.

Issue 3/2020

Edited by Dr. Pooja Nair
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EDITOR’S CHOICE

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**Editor’s choice**

*(Pariente L et al. 2020)*

AND

Maxillary sinus floor elevation surgery with biooss mixed with enamel matrix derivative: a human randomized controlled clinical and histological study.
*(Vincent-Bugnas S et al. 2020)*

Digital Versus Conventional Full-Arch Implant Impressions: A Prospective Study on 16 Edentulous Maxillae.
*(Chochlidakis K et al. 2020)*

Stability of screw-retention in two-piece zirconia implants: An in vitro study
*(Joos M et al. 2020)*

Pariente L, Dada K, Daas M, Cok S, Dard M.

Study objectives and methods

The aim of this study was to assess, over a period of 24 months, the clinical and radiographic outcomes in partially edentulous patients receiving bone level tapered (BLT) implants. 33 partially edentulous patients and 50 implants were evaluated. Subjects received single or multiple implants in the posterior maxilla. Clinical and radiographic measurements of vertical bone levels were assessed at surgery, at 3, 6, 12 and 24 months after surgery. The success and survival rates of the implants were also evaluated.

Results

• Within the 24-month follow-up, only one implant failed (2.0%).
• Other biological or technical complications were not observed. The mean insertion torque was 34±5.3 Ncm.
• Bone level changes of 0.35±0.23mm were found between surgery and 12 months after surgery, and 0.03±0.05 mm between 12 months and 24 months after surgery.
• The overall change from surgery to 24 months after implant placement was 0.38±0.24 mm. Most of the bone loss occurred between surgery and 3 months (0.28±0.19mm; p<0.001), thereafter the loss was minimal and statistically non-significant.
• BLT implants yielded a high survival and success rate with minimal bone level changes.

Conclusions

Within the limitations of this study, bone level tapered implants presented high survival and success rates without mechanical or biological complications after loading and minimal marginal bone. These observations indicate that tapered implants seem to be suitable for different clinical scenarios.
Maxillary sinus floor elevation surgery with biooss mixed with enamel matrix derivative: a human randomized controlled clinical and histological study.

Vincent-Bugnas S, Charbit Y, Charbit M, Dard M, Pippenger B.

Abstract

Xenograft bone substitutes are commonly used to increase bone volume and height in the deficient posterior maxilla. The addition of enamel matrix derivate (Emdogain®) could increase the efficiency of the bone healing process. The aim of this prospective randomized, controlled split-mouth design study was to compare the percentage of newly formed bone in sinus floor augmentation with deproteinized bovine bone mineral with or without the addition of enamel matrix derivative after 6 months of healing.

Sixteen bilateral sinus floor augmentation procedures were performed. Deproteinized bovine bone mineral combined with enamel matrix derivative (test) and deproteinized bovine bone mineral alone (control) groups were randomly allocated within each patient.

Six months after augmentation and concurrent to implant placement, bone biopsies were taken for histomorphometric analysis. Additionally, implant survival and peri-implant bone levels were radiographically assessed at baseline and 24 months after functional loading.

Results

- Histomorphometric analysis revealed a significantly higher amount of newly formed bone in the test group compared to the control group (22.6% and 15.5%, p=0.033 respectively).
- No significant differences in the amount of remaining graft or connective tissue was found.

Conclusions

Enamel matrix derivative added to deproteinized bovine bone mineral particles significantly increased new bone formation in sinus lift procedures in edentulous or partially edentulous patients with deficient bilateral posterior alveolar ridges requiring augmentation for implant placement.

Adapted from Vincent-Bugnas S et al., J Oral Implantol. 2020 Apr 16, for more info about this publication click HERE
Digital Versus Conventional Full-Arch Implant Impressions: A Prospective Study on 16 Edentulous Maxillae.


Abstract

A prospective clinical study to compare for the first time the accuracy of digital and conventional maxillary implant impressions for completely edentulous patients. Sixteen patients received maxillary implant supported fixed complete dentures. After the verification of the conventional final casts, the casts were scanned with a desktop (extraoral) scanner. Intraoral full-arch digital scans were also obtained with scan bodies and STL files. Extraoral and intraoral scans were superimposed and analyzed with reverse engineering software. The primary outcome measure was the assessment of accuracy between scans of the verified conventional casts and digital full-arch impressions. The secondary outcome was the effect of the implant number on the 3D accuracy of impressions with Spearman's rank correlation coefficient.

Results

- The 3D deviations between virtual casts from intraoral full-arch digital scans and digitized final stone casts generated from conventional implant impressions were found to be 162 ± 77 μm.
- In the 4-implant group, 5-implant group, and 6-implant group the 3D deviations were found to be 139 ± 56 μm, 146 ± 90 μm, and 185 ± 81 μm, respectively.
- There was a positive correlation between increased implant number and 3D-deviations, but there was no statistically significant difference (p = 0.191).

Conclusions

The 3D accuracy of full-arch digital implant scans lies within previously reported clinically acceptable threshold. Full-arch digital scans and a complete digital workflow in the fabrication of maxillary fixed complete dentures may be clinically feasible.

Adapted from Chochlidakis K et al., J Prosthodont. 2020 Apr;29(4):281-286., for more info about this publication click HERE
Stability of screw-retention in two-piece zirconia implants: An in vitro study
Joos M, Sailer I, Filippi A, Mukaddam K, Rosentritt M, Kühl S

Study objectives and methods

To compare the stability of a screw-retained connection in a novel two-piece zirconia implant to a conventional titanium-based connection in an in vitro chewing simulation including artificial ageing.

Incisor (I) and molar (M) shaped monolithic zirconia crowns were screw-retained on either two-piece zirconia (test) or two-piece titanium (control) implants resulting in 4 groups of 8 samples (titanium implants with incisor-shaped crowns (T-I), titanium implants with molar-shaped crowns (T-M), zirconia implants with incisor-shaped crowns (Z-I) and zirconia implants with molar-shaped crowns (Z-M)). These were subjected to artificial ageing by thermal cycling (TC: 2 × 3000 × 5°C/55°C cycles of 2 min) and mechanical loading (ML: 1.2 × 106 cycles of 50 N, f = 1 Hz). Surviving samples additionally underwent a fracture force test. Kaplan-Meier plots were drawn, and two-way ANOVA was calculated taking anatomical localisation and material variables as factors.

Results

- The mean corresponding survival times were lower for T-M (0.86 × 106 ± 0.31 × 106 cycles) and Z-I (0.84 × 106 ± 0.21 × 106 cycles) compared to T-I (1.14 × 106 ± 0.10 × 106 cycles) and Z-M (1.20 × 106 ± 0.10 × 106 cycles).
- In one-way ANOVAs for survival time dependent on either location or material, no statistically significant differences could be found (location: p = .31; material: p = .62) in one-way ANOVAs. The interaction of location and material showed significant differences (F = 21.3, p < .001).

Conclusions

The connection of the tested screw-retained zirconia crowns in two-piece zirconia implants is comparable to standard titanium implants in the specific in vitro testing.

Adapted from Joos M et al., Clin Oral Implants Res 2020 Mar 17, for more info about this publication click HERE
Titanium implant surface properties enhance osseointegration in ovariectomy induced osteoporotic rats without pharmacologic intervention.

Lotz EM, Cohen DJ, Schwartz Z, Boyan BD.

Study objectives and methods

This study determined whether implant surfaces that promote osseointegration in normal rats can promote osseointegration in osteoporotic rats without pharmacologic intervention. Virgin female 8-month-old CD Sprague Dawley rats (N = 25) were ovariectomized. At 6 weeks, microstructured/non-nanostructured/hydrophobic, microstructured/nanostructured/hydrophobic, or microstructured/nanostructured/hydrophilic Ti implants (Ø2.5 × 3.5 mm; Institut Straumann AG, Basel, Switzerland) were placed in the distal metaphysis of each femur. At 28 days, bone quality and implant osseointegration were assessed using microCT, histomorphometrics, and removal torque values (RTVs). Calvarial osteoblasts were isolated and cultured for 7 days on Ø15 mm Ti disks processed to exhibit similar surface characteristics as the implants used for the in vivo studies. The phenotype was assessed by measuring the production of osteocalcin, osteoprotegerin, osteopontin, BMP2, VEGF, and RANKL.

Results

• Microstructured/nanostructured/hydrophilic implants promoted increased bone-to-implant contact and RTVs in vivo and increased osteoblastic marker production in vitro compared to microstructured/non-nanostructured/hydrophobic and microstructured/nanostructured/hydrophilic implants, suggesting that osseointegration occurs in osteoporotic animals, and implant surface properties improve its rate.

Conclusions

Although all modified implants were able to osseointegrate in rats with OVX-induced osteoporosis without pharmacologic intervention, the degree of osseointegration was greater around microstructured/nanostructured/hydrophilic implant surfaces. These results suggest that when appropriate microstructure is present, hydrophilicity has a greater influence on Ti implant osseointegration compared to nanostructures. Moreover, modified implant surfaces can exert their control over the altered bone turnover observed in osteoporotic patients to stimulate functional osseointegration. These results provide critical insight for developing implants with improved osseointegration in patients with metabolic disorders of bone remodeling.

Adapted from Lotz EM et al., Clin Oral Implants Res. 2020 Apr 31(4):374-387 for more info about this publication click HERE.
Elemental analysis of commercial zirconia dental implants - Is "metal-free" devoid of metals?

Gross C, Bergfeldt T, Fretwurst T, Rothweiler R, Nelson K, Stricker A

Study objectives and methods

The interest in ceramic dental implants made of yttria-stabilized tetragonal zirconia polycrystals (Y-TZP) or alumina toughened zirconia (ATZ) has increased in recent years. However, in the light of aging, corrosion, and potential impurities of zirconia ceramics, the material composition of these implants and the associated term "metal-free" is persistently questioned. Thus, the present study aimed to conduct an elemental analysis of commercial zirconia dental implants to specify their elemental composition and to identify contaminants.

Nine commercial zirconia dental implant systems and corresponding material samples were analyzed using inductively coupled plasma-mass spectrometry (ICP-MS) and optical emission spectrometry (ICP-OES).

Results

- While the elemental composition was dominated by the main components Zr, Y and Al (in ATZ samples), all investigated samples contained impurities with Hf and contamination with alkali and alkali earth elements (Na, K, Mg, Ca), essential trace elements (e.g. Fe, Cu, Zn) but also potentially noxious metal elements (e.g. Ni, Cr). Furthermore, ultra-trace level contamination with the radionuclides U-238 and Th-232 was found in the majority of samples.

Conclusions

The results indicate that, although all the investigated Y-TZP and ATZ dental implants meet the currently relevant ISO standards and manufacturer's specifications, from an elemental point of view, they are not devoid of metals. Due to the lack of a universal definition and thresholds for the term "metal-free", the question of whether the examined zirconia dental implants can be holistically classified as "metal-free" or not remains a controversial, philosophical one.

Adapted from Gross C et al., J Mech Behav Biomed Mater. 2020 Jul 107:103759, for more info about this publication click HERE
Effect of implant surface material and roughness to the susceptibility of primary gingival fibroblasts to inflammatory stimuli.


Study objectives and methods

The impact of the implant surface material and roughness on inflammatory processes in peri-implantitis is not entirely clear. Hence, we investigated how titanium and zirconia surfaces with different roughness influence the susceptibility of primary human gingival fibroblasts to different inflammatory stimuli.

Primary human gingival fibroblasts were isolated from 8 healthy individuals and cultured on following surfaces: smooth titanium machined surface (TiM), smooth zirconia machined surface (ZrM), moderately rough titanium surface (SLA), or moderately rough zirconia surface (ZLA). Subsequently, stimulation with one of the following stimuli was performed: Porphyromonas gingivalis lipopolysaccharide (LPS), tumor necrosis factor (TNF)-α, interleukin (IL)-1β. The resulting production of IL-6, IL-8, and monocyte chemoattractant protein (MCP)-1 was measured by qPCR and ELISA.

Results

- P. gingivalis LPS induced IL-6 and MCP-1 production was slightly higher on titanium surfaces compared to zirconia surfaces. IL-1β induced IL-6 production was not affected by any surface characteristic.
- The production of MCP-1 in response to IL-1β was higher on smooth compared to rough surfaces and was not affected by the material.
- The production of IL-6 and MCP-1 in response to TNF-α was most strongly affected by surface characteristics.
- Higher production of these cytokine was observed on smooth compared to rough surfaces and on titanium compared to zirconia surfaces. Surface characteristics had only minor effects on IL-8 production.

Conclusions

The susceptibility of primary gingival fibroblasts to inflammation depends on various factors, such as surface material, surface roughness and the nature of inflammatory stimuli. All these factors might determine susceptibility to peri-implantitis.

Adapted from Andrukhov O et al., Dent Mater. 2020 Jun;36(6):e194-e205, for more info about this publication click HERE
Bisphosphonates inhibit surface-mediated osteogenesis.
Lotz EM, Lohmann CH, Boyan BD, Schwartz Z.

Study objectives and methods
Bisphosphonates (BPs) target osteoclasts, slowing bone resorption thus providing rationale to support osseointegration. However, BPs may negatively affect osteoblasts, impairing peri-implant bone formation. The goal of this study was to assess the effects BPs have on surface-mediated osteogenesis of osteoblasts. MG63 cells were cultured on 15-mm grade 2 titanium disks: smooth, hydrophobic-microrough, or hydrophilic-microrough (Institut Straumann AG, Basel, Switzerland). Tissue culture polystyrene (TCPS) was used as a control. At confluence, cells were treated with 0, 10^-8, 10^-7, and 10^-6 M of alendronate, zoledronate, or ibandronate for 24 hr. Sprague Dawley rats were also treated with 1 μg/kg/day ibandronate or phosphate-buffered saline control for 5 weeks. Calvarial osteoblasts (rat osteoblasts [rOBs]) were isolated, characterized, and cultured on surfaces. Osteogenic markers in the media were quantified using ELISAs. BP treatment reduced osteocalcin, osteoprotegerin, osteopontin, bone morphogenetic protein-2, prostaglandin E2, transforming growth factor β1, interleukin 10, and vascular endothelial growth factor in MG63 cells.

Results
The effect was more robust on rough surfaces, and higher concentrations of BPs stunted production to TCPS/PT levels. Ibandronate conditioned rOBs produced less osteogenic markers similar to direct BP treatment.

Conclusions
These results suggest that BP exposure jeopardizes the pro-osteogenic response osteoblasts have to microstructured surfaces. Their effects persist in vivo and negatively condition osteoblast response in vitro. Clinically, BPs could compromise osseointegration.

Adapted from Lotz EM et al., J Biomed Mater Res A. 2020 Apr, for more info about this publication click HERE.
Local application of enamel matrix derivative prevents acute systemic inflammation after periodontal regenerative surgery: A randomized controlled clinical trial


Study objectives and methods

The aim of this study was to compare surgical treatment of periodontal intra-bony defects (IBD) with or without the adjunct of enamel matrix derivative (EMD) in terms of acute-phase responses in healthy patients. Thirty-eight periodontitis-affected subjects, one IBD each, were randomized to minimally invasive periodontal surgery (MIS) with or without EMD. Periodontal parameters were recorded at baseline and 6-months. Blood samples were collected at baseline, 1, 7 and 180 days after treatment.

Results

- At 24 hr, the group treated MIS with EMD showed lower values of C-reactive protein (CRP; p < .01) as no inflammatory perturbation was noticed.
- Conversely, MIS group resulted in an acute inflammatory response at 24 hr (p < .05) that regressed to its baseline values at day 7.
- The EMD group showed a higher number of cases without residual BOP or PPD ≥ 5mm 6 months after surgery (p < .05), and post-surgical gingival recession was lower (p < .05).

Conclusions

The adjunctive application of EMD during surgical treatment resulted in a minor increase in serum CRP 24-hr after surgery. These findings suggest a possible systemic anti-inflammatory effect of EMD. Within its limitations, this pilot trial confirmed better clinical periodontal outcomes in the EMD group.

Adapted from Graziani F et al., J Clin Periodontol. 2020 Mar 12, for more info about this publication click HERE
Effect of high glucose levels and lipopolysaccharides-induced inflammation on osteoblast mineralization over sandblasted/acid-etched titanium surface.

Ramenzoni LL, Bösch A, Proksch S, Attin T, Schmidlin PR.

Study objectives and methods

Poorly controlled diabetes mellitus has been related to higher risk of implant treatment complications due to increased susceptibility to infection and delayed wound healing. Lipopolysaccharides (LPS) stimulate cytokine production leading to chronic inflammation and immunological host response that accentuates the destruction of periodontal tissues. This study aimed to evaluate the effect of different glycemic conditions on secretion and mineralization of bone matrix under sterile inflammation induced by LPS on osteoblasts seeded over sandblasted/acid-etched (SLA) titanium surface.

Osteoblast cell viability was performed to determine the influence of different glucose concentrations (5.5, 8, 12, and 24 mM), which were chosen to reflect normal, postprandial, and high glucose values, similar to those typically seen in Diabetes mellitus under clinical conditions. Cells were seeded on titanium SLA discs (Straumann AG, Waldenburg, Switzerland) and exposed to glucose concentrations and LPS (1μg/mL) in order to test inflammatory response (qPCR) and mineralization (Alizarin Red staining).

Results

- Osteoblast viability was severely decreased when exposed to higher glucose levels (≥12 mM) and LPS (P < .05) compared to control. When the osteoblasts were exposed to LPS and glucose at ≥8 mM, the gene transcripts of inflammatory cytokines were ≈2.5-fold upregulated,
- while ≤8 mM glucose elicited no significant change compared to control without glucose treatment (P > .05). Osteoblasts exposed to LPS produced sparse extracellular matrix mineralization, especially combined with higher glucose values (≥12 mM), together with decreased calcium deposition compared to control (P < .05).

Conclusions

High glucose levels combined with LPS inflammatory stimulation elicited an adverse effect on the volume and quality of mineralized hard tissue formation on SLA titanium surfaces in vitro.

Hence, both normal glucose levels and infection control including low levels of circulating LPS during initial osseointegration period may be required to increase the success rate of dental implants.

Adapted from Ramenzoni LL et al., Clin Implant Dent Relat Res. 2020 Apr;22(2):213-219, for more info about this publication click HERE
Peri-implant Soft Tissue Management: Cairo Opinion Consensus Conference


Abstract

Peri-implant soft tissues play a role of paramount importance, not only on the esthetic appearance, but also on the maintenance and long-term stability of implants. The present report presents the conclusions from the Consensus Conference of the South European North African Middle Eastern Implantology & Modern Dentistry Association (SENAME) (4-6 November 2016, Cairo, Egypt).

The conference focused on the topic of the soft tissue around dental implants, and in particular, on the influence of implant configurations on the marginal soft tissues, soft tissue alterations after immediate, early or delayed implant placement and immediate loading, the long-term outcomes of soft tissue stability around dental implants, and soft tissue augmentation around dental implants. Thirty world experts in this field were invited to take part in this two-day event; however, only 29 experts were in the final consensus voting process.

Adapted from Del Amo et al., Int J Environ Res Public Health. 2020 Mar 28;17(7), for more info about this publication click HERE.
Histological characteristics of advanced peri-implantitis bone defects in humans.

Study objectives and methods
Inflammatory osteolysis is the clinical hallmark of peri-implantitis. The morphology of the remaining peri-implant bone and the level of osseointegration, however, remain unknown. Our aim was to characterize advanced peri-implantitis bone defects in humans.
Four patients (3 female and 1 male) were diagnosed with peri-implantitis. A total of 5 implants with machined surfaces and a mean loading time of 12 ± 6 years were removed due to advanced bone loss. The defect extension, the peri implant bone density (bone area per tissue area in percentage), bone-to-implant contact (%), and the number of filled and empty osteocyte lacunae were calculated based on undecalcified histological specimens.

Results
- The defect extension was on average 4.2 mm (95% CI 0.8-3.4).
- Remaining peri-implant bone showed a high density of 85.5% (95% CI 79.1-91.3) and covered in total 74% (95% CI 70.5-77.5) of the implant surface.
- Filled and empty osteocyte lacunae density was on average 191 and 165/mm² (95% CI 132-251;103-225), respectively.
- Histology further revealed signs of ongoing bone formation and resorption.

Conclusions
There are signs that suggest that once the original cortical bone is lost due to peri-implantitis, the remaining apical trabecular bone is reinforced and transformed into cortical bone that might take over the functional load.

Adapted from Galárraga-Vinueza ME et al., Int J Implant Dent. 2020 Mar 25;6(1):12, for more info about this publication click HERE.
Abstract
The digital transformation in dental medicine, based on electronic health data information, is recognized as one of the major game-changers of the 21st century to tackle present and upcoming challenges in dental and oral healthcare.
This opinion letter focuses on the estimated top five trends and innovations of this new digital era, with potential to decisively influence the direction of dental research:
(1) rapid prototyping (RP),
(2) augmented and virtual reality (AR/VR),
(3) artificial intelligence (AI) and machine learning (ML),
(4) personalized (dental) medicine, and
(5) tele-healthcare.

Digital dentistry requires managing expectations pragmatically and ensuring transparency for all stakeholders: patients, healthcare providers, university and research institutions, the medtech industry, insurance, public media, and state policy. It should not be claimed or implied that digital smart data technologies will replace humans providing dental expertise and the capacity for patient empathy.
The dental team that controls digital applications remains the key and will continue to play the central role in treating patients. In this context, the latest trend word is created: augmented intelligence, e.g., the meaningful combination of digital applications paired with human qualities and abilities in order to achieve improved dental and oral healthcare, ensuring quality of life.

Adapted from Joda T et al., J Clin Periodontol. 2020 Mar 12, for more info about this publication click HERE
Association of prosthetic features and peri-implantitis: A cross-sectional study.

Yi Y, Koo KT, Schwarz F, Ben Amara H, Heo SJ.

Study objectives and methods
To identify the influence of prosthetic features through a comprehensive analysis with other known risk factors.
A total of 169 patients (n = implants: 349) was retrospectively included in the present study. Peri-implantitis was diagnosed based on peri-implant bone loss and probing depth. Using radiographs taken 1 and 5 years following prosthesis insertion, the following features were determined: peri-implant marginal bone loss (MBL), emergence angle (EA), emergence profile (EP) and crown/implant ratio (CIR). The splinted position of prosthesis was also recorded. Multivariable generalized estimating equation was used to analyse the influence of each feature on the prevalence of peri-implantitis. The final prediction model was constructed by Cox proportional hazard regression analysis.

Results
• The EA showed a significant correlation with MBL. A statistically greater prevalence of peri-implantitis was observed if EA ≥ 30 degrees, when EP is convex and in middle implant splinted with both mesial and distal adjacent implants in bone-level implant.
• A similar correlation was not observed in tissue-level implants. CIR had no significant effect on the prevalence of peri-implantitis.

Conclusions
Over-contoured implant prosthesis is a critical local confounder for peri-implantitis. The implant splinted to both mesial and distal adjacent implant has a higher risk of peri-implantitis.

Adapted from Yi Y et al., J Clin Periodontol. 2020 Mar;47(3):392-403, for more info about this publication click HERE

References

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