Risk factors for implant failure (Diabetes)

1. TN Shi Q, Xu J, Huo N, Cai C, Liu H. Does a higher glycemic level lead to a higher rate of dental implant failure?: A meta-analysis. J Am Dent Assoc. 2016 Nov;147(11):875-881.
2. ES Shang R, Gao L. Impact of hyperglycemia on the rate of implant failure and peri-implant parameters in patients with type 2 diabetes mellitus: Systematic review and meta-analysis. J Am Dent Assoc. 2021 Mar;152(3):189-201.e1.
3. BT Chrcanovic BR, Albrektsson T, Wennerberg A. Diabetes and oral implant failure: a systematic review. J Dent Res. 2014 Sep;93(9):859-67.
4. AK Andrade CAS, Paz JLC, de Melo GS, Mahrouseh N, Januário AL, Capeletti LR. Survival rate and peri-implant evaluation of immediately loaded dental implants in individuals with type 2 diabetes mellitus: a systematic review and meta-analysis. Clin Oral Investig. 2022 Feb;26(2):1797-1810.
5. TV Ormianer Z, Block J, Matalon S, Kohen J. The Effect of Moderately Controlled Type 2 Diabetes on Dental Implant Survival and Peri-implant Bone Loss: A Long-Term Retrospective Study. Int J Oral Maxillofac Implants. 2018 Mar/Apr;33(2):389-394.
6. DL Saito N, Mikami R, Mizutani K, Takeda K, Kominato H, Kido D, Ikeda Y, Buranasin P, Nakagawa K, Takemura S, Ueno T, Hosaka K, Hanawa T, Shinomura T, Iwata T. Impaired dental implant osseointegration in rat with streptozotocin-induced diabetes. J Periodontal Res. 2022 Apr;57(2):412-424.
7. CM Latimer JM, Roll KL, Daubert DM, Zhang H, Shalev T; ABCD study collaborators; Wolff LF, Kotsakis GA. Clinical performance of hydrophilic, titanium-zirconium dental implants in patients with well-controlled and poorly controlled type 2 diabetes: One-year results of a dual-center cohort study. J Periodontol. 2022 May;93(5):745-757.
8. VX Oates TW, Huynh-Ba G, Vargas A, Alexander P, Feine J. A critical review of diabetes, glycemic control, and dental implant therapy. Clin Oral Implants Res. 2013 Feb;24(2):117-27.
9. TN Eskow CC, Oates TW. Dental Implant Survival and Complication Rate over 2 Years for Individuals with Poorly Controlled Type 2 Diabetes Mellitus. Clin Implant Dent Relat Res. 2017 Jun;19(3):423-431.

Topic: Diabetes

Authors: Shi Q, Xu J, Huo N, Cai C, Liu H.

Title: Does a higher glycemic level lead to a higher rate of dental implant failure?: A meta-analysis.

Source: J Am Dent Assoc. 2016 Nov;147(11):875-881.
DOI: 10.1016/j.adaj.2016.06.011.

Type: Meta analysis
Reviewer: Trisha Nguyen-Luu

Keywords: uncontrolled diabetes, dental implant failure, glycemic control, meta-analysis

Background:

- Evidence that diabetes has negative influence of bone formation + remodeling
    - Microvascular disease, susceptibility to infection and delayed wound healing due to hyperglycemia that can affect implant osseointegration

Purpose: To determine if the there is a higher implant failure rate in patients with poor-controlled diabetes vs. well controlled diabetes

Material and methods:

- Electronic and manual search about studies that compare implant failure rate between patients that have poor and well controlled diabetes
- Used relative risk (RR) + 95% confidence interval (CI) to estimate the relative effect on glycemic level of implant failures

Results:

- 7 studies were included in the meta analysis 252 pts, 587 DIs
- Well controlled diabetes: HbA1C was < 8% with a fasting plasma glucose < 6.1 mmol/L
- Poorly controlled diabetes: HbA1C 7-13.8% with a fasting plasma glucose 6.2 – 8.3 mmol/L
- NSSD in RR (0.620) for implant failure btw patient with well controlled (0.620) vs poorly controlled
    - Total rate of implant failure in patients with poorly controlled diabetes= 5.32%
    - Total rate of implant failure in patients with well controlled diabetes = 3.15%

    - A 2% difference
- NSSD in early or late failure btw patients with well and poorly controlled diabetes
    - Early failure RR: 0.817
    - Late failure RR: 0.572

Conclusions

- There is no direct association btw glycemic level in patients with diabetes and implant failure rate
- Poorly controlled diabetes could achieve adequate osseointegration but needed longer healing period after surgery. "The meta analysis failed to show a significant difference btw glycemic level in patients with diabetes and implant failure rate. Yet there was a measurable difference of 2%"

Topic: diabetes and DI failure
Author: Shang R, Gao L
Title: Impact of hyperglycemia on the rate of implant failure and peri-implant parameters in patients with type 2 diabetes mellitus: Systematic review and meta-analysis.
Source: J Am Dent Assoc. 2021 Mar;152(3):189-201.e1.
DOI: 10.1016/j.adaj.2020.11.015
Type: Systematic review and meta-analysis.
Reviewer: Erin Schwoegl
Keywords: type 2 diabetes mellitus; dental implant failure; peri-implant parameters

Purpose: To compare rates of DI failure and peri-implant BOP, PD, and peri-implant bone loss (PIBL) in pts with and w/o type 2 diabetes mellitus

Materials and methods:

- The following question was used to guide the search, "Do patients with type 2 diabetes mellitus (T2DM) have a higher rate of implant failure and higher peri-implant parameters (BOP, PD, and PIBL) than nondiabetic (ND) patients?"
- Included studies clearly noted HbA1c of diabetic pts as >6% and 6% for nondiabetic pts
- Excluded studies where pts were smokers or had other confounding variables like untreated perio or CVD 1 yr follow up. well-controlled glycemic levels (WC-T2DM) (HbA1c, 6%-8%) or poorly controlled glycemic levels (PC-T2DM) (HbA1c, > 8%). A total of 415 patients with T2DM and 301 ND patients were enrolled, with 500 and 363 implants, respectively.

Results:

- 9 studies met inclusion criteria
- NSSD btwn rates of DI failure btwn diabetic and nondiabetic pts.
- We found a significant difference in BOP between patients with T2DM and ND patients, Greater in DM patients
- No significant difference in PD was observed between patients with T2DM and ND patients
- We found a statistically significant difference in PIBL between patients with T2DM and ND patients, Greater in DM patients

Conclusion:

- Pts w type 2 DM had similar rates of DI survival similar to healthy pts.
- Pts w type 2 DM had higher BOP and PIBL, indicating hyperglycemia as an important risk factor for peri-implant inflammation.
- No association found btwn peri-implant parameters and glycemic level among pts with type 2 DM, when OH was strictly maintained

Topic: diabetes mellitus and implants
Authors: Chrcanovic BR, Albrektsson T, Wennerberg A.
Title: A. Diabetes and oral implant failure: a systematic review.
Source: J Dent Res. 2014 Sep;93(9):859-67. 68.
DOI: 10.1177/0022034514538820
Type: systematic review
Reviewer: Brook Thibodeaux

Keywords: Diabetes mellitus, blood glucose, dental implants, infection, periodontal bone loss, meta-analysis.

Purpose: To present the influence of diabetes on implant failure rates.
Material and methods: Systematic review including 14 articles, meta-analysis including 7 controlled clinical trials. followed Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement guidelines. Outcomes measured: implant failure and postoperative infection.
Results:

- 1260 DI inserted in diabetic patients; 11,476 DI inserted in non-diabetic patients
- 49/1260 DI failed (3.89%) in diabetic patients
- 555/11476 DI failed (4.84%) in non-diabetic patients
- 5 studies found NSSD for DI failure between nondiabetic and diabetic patients, the other studies did not inform if there was SSD or not.
- Two studies included patients lacking glycemic control (one defined as >10% HbA1c the other >9%), 5 studies reported patients' diabetes as under control but did not mention the level of control. 1 study did not assess for diabetes control, and 4 studies did not mention any information about glycemic control.
- Meta-analysis: placing DIs in diabetic vs non-diabetic patients showed NSSD on DI failure rate. MBL showed SSD between diabetic and non-diabetic patients favoring non-diabetic patients.
- Tissue hyperglycemia affects aspect of wound healing by adversely affecting the immune system, including neutrophil and lymphocyte function/chemotaxis/ phagocytosis leading to a greater predisposition to infection of wound.

Conclusions: Due to limitations of this study, the results of the study should be interpreted with caution. NSSD was found on failure rate between DIs placed in non-diabetic and diabetic patients. Studies are lacking in patient type, sample size, and reported outcomes separately for each group.

Topic: diabetes
Authors: Andrade CAS, Paz JLC, de Melo GS, Mahrouseh N, Januário AL, Capeletti LR.
Title: Survival rate and peri-implant evaluation of immediately loaded dental implants in individuals with type 2 diabetes mellitus: a systematic review and meta-analysis.
Source: Clin Oral Investig. 2022 Feb;26(2):1797-1810
DOI: 10.1007/s00784-021-04154-6
Reviewer: Amber Kreko
Type: systematic review
Keywords: immediate dental implant loading, diabetes mellitus, edentulism

Purpose: To evaluate the survival rate, success rate, and peri-implant biological changes of immediately loaded dental implants (ILs) placed in type 2 diabetc patients (DM2)

Material and methods:

- Electronic search up to January 2021 was done for clinical trials, cohort studies, case-control, cross-sectional, or case series.
- PICO:
    - P – type 2 diabetic patients treated with dental implants, and restoration was immediately loaded
    - I – placement of immediately loaded dental implants
    - C – non-diabetic patients and/or conventional loaded dental implants.
    - O – survival, success rate, and/or peri-implant health status.

Results:

- 7 studies included for qualitative analysis and 5 of those were used for quantitative analysis
- Survival rate – in five studies, no dental implants lost (100%). NSD found between diabetic and nondiabetic patients even if patient had poor glycemic control. The results disagree with the majority of studies regarding unsatisfactory outcomes in uncontrolled diabetics.
- Success rate – four studies reported success rates and all had a 100% rate.

- MBL – compared to conventional loading in diabetic patients - NSD

Conclusions: Type 2 diabetes does not seem to be a risk factor for immediately loaded implants if the glycemic level is controlled, oral hygiene is satisfactory, and technical steps are strictly followed.

Topic: Diabetes
Authors: Ormianer Z, Block J, Matalon S, Kohen J
Title: The Effect of Moderately Controlled Type 2 Diabetes on Dental Implant Survival and Peri-implant Bone Loss: A Long-Term Retrospective Study
Source: Int J Oral Maxillofac Implants. 2018 Mar/Apr;33(2):389-394
DOI:10.11607/jomi.5838
Reviewer: Tam Vu
Type: Clinical
Keywords: Type 2 diabetes, survival rates, peri-implant, bone loss, dental implants, failure

- **Purpose**: to assess implant survival rates and long-term peri-implant bone loss in moderately controlled type 2 diabetic patients

Material and methods:
- Pts were 18 year old or older, with good oral hygiene who required dental implant to replace missing or unsalvageable teeth and were moderately controlled HbA1c: between 7.0 – 8.0% and glucose level below 150 mg/dL (<7.0% = well controlled)
- Recall of at least once annually for prophylaxis and monitoring implant health

Results:
- 169 pts, 1,112 implants placed
- 5 types of implants placed: spiral implants (SPI), Dual fit implants (DFI), Affor implants (Alpha-BioTec), Tapered Screw-Vent (Zimmer), Maestro (BioHorizons)
- Mean follow up: 8.7 years
- 94% implant survival rate
- Failures:
    - Immediate insertion: 44/705 (66%)
    - Early: 18/225 (27%)
    - Delayed: 5/182 (7%)
    - All failures were within 40 months after provisional restoration
- Overall mean bone loss: 1.98 mm
    - Anterior > posterior
    - Delayed had least amount of bone loss
- NSD between **diabetic** and nondiabetic group in terms of:
    - Implant survival rate (**94** vs 95.6%)
    - Peri-implant bone loss (**1.98** vs 2.03 mm)
- NSD found between implant types

Conclusion:
- Moderately controlled type 2 diabetic patients had similar implant survival rates and bone loss compared to nondiabetic patients.
- Less bone loss found in implants place in posterior region and with delayed placement

Topic: Risk Factor-Diabete
Authors: Saito N, Mikami R, Mizutani K, Takeda K, Kominato H, Kido D, Ikeda Y, Buranasin P, Nakagawa K, Takemura S, Ueno T, Hosaka K, Hanawa T, Shinomura T, Iwata T.**Title**:
Source: J Periodontal Res. 2022 Apr;57(2):412-424
DOI: 10.1111/jre.12972
Reviewer: Daeoo Lee
Type:
Keywords: diabete, mesenchymal stem cells, osseointegration, acetylcysteine, oxidative stress, reactive oxygen species

Purpose: To investigate how hyperglycemia-induced oxidative stress affects osseointegration in vitro and in vivo, using a dental implant model in the maxillae of diabetic animals.

Background:

- Oxidative Stress: Oxidative stress refers to an imbalance between the production of reactive oxygen species (ROS) and the body's ability to detoxify them or repair the resulting damage. It occurs when there is an excessive amount of ROS, which can lead to cellular damage and dysfunction. Oxidative stress has been implicated in various diseases and conditions, including diabetes, where it can impair osseointegration and lead to implant failure.
- Streptozotocin (STZ): is a naturally occurring alkylating antineoplastic agent that is particularly toxic to the insulin-producing beta cells of the pancreas in mammals. It is used in medicine for treating certain cancers of the islets of Langerhans and used in medical research to produce an animal model for hyperglycemia and Alzheimer's in a large dose, as well as type 2 diabetes or type 1 diabetes with multiple low doses.

Material and methods:

- Titanium surface preparation
    - In vivo setting: titanium (rods) 1x2mm, acid-etched, average roughness (4.35 μm*)
    - In vitro setting: titanium (discs) 19x1mm, acid-etched, average roughness (4.35 μm*)
        - *1-2 micron - moderately rough
- In vivo experiment (26 male rats)
    -
        - Induction of DM, teeth extraction, and implant surgery
            - Randomly induce diabetes by injecting Streptozotocin (STZ) to (n/2 of the population)
            - Flap, bone level implant
        - Histological and histomorphometric analysis
            - The animals were sacrificed by deep anesthesia 3 days (n = 12) and 28 days (n = 14) after implantation
        - Implant push-out test: to assess the biomechanical strength of bone-implant integration.
            -
        - mRNA expression analysis
            - To measure factors, interleukin, marks, protein, enzymes, etc.
        - Immunohistochemical analysis
            - Detect SOD1 expression to assess its involvement in reducing reactive oxygen species (ROS) and protecting cells from oxidative damage.
- In vitro experiments
    - Rat Bone marrow-derived mesenchymal stem cells (BMMSCs) culture and characterization
        - Multipotentiality assessed; differentiation assays.
    - Cell culture and induction of oxidative stress
    - NAC treatment: antioxidant treatment
    - Intracellular ROS level: high glucose induced oxidative stress examined by ROS expression

    - Cell proliferation evaluated to assess rate of cell division and multiplication
    - Cell calcification to evaluate bone formation and mineralization.
- Statistical analysis

Results:

- In vivo study
    - Systemic characteristics of control and DM rats
        - DM group showed significantly higher fasting blood glucose levels and significantly decreased body weight than those in the control group immediately before and 4 weeks after the surgery
        - Plasma insulin level was significantly lower in the DM group, 2 mo after STZ injection/diabetes induction.
    - Observation of postsurgical healing
        - The implant survival rate was 92.9% (13 out of 14 implants) in the control group and 75.0% (9 out of 12 implants) in the DM group
    - Histological and histomorphometric analysis
        - Control group had direct bone integration while in the DM group, non-calcified tissue was predominantly observed between the implant and bone in all specimens
        - BIC was significantly higher in the control group than in the DM group ($p < .001$)
        - Push-out-test: s significantly greater in the control group than in the DM group
    - In vivo mRNA expression
        - Expression of bone formation markers (Alp, Col1), transcription factor for bone development(Runx2), and Sod1 higher in control group;
        - Expression of Inflammatory cytokines (Tnfa, Il-6, iNos), and oxidative stress marker (Nox2) higher in DM group;
    - Immuohistochemistry
        - The ratio of SOD1 positive cells per total cells was smaller in the DM group than in the control group.
            - SOD1 is known to downregulate ROS production and to be involved in bone metabolism. It has been shown that SOD1 gene knockout mice exhibit reduced bone strength, and that insulin and antioxidants can partially ameliorate osteogenesis.
- In vitro study
    - Characterization of rat BMMSCs
        - possessed multipotent differentiation properties as mesenchymal stem cells (MSCs)
    - Intracellular ROS level of BMMSCs under high-glucose condition
        - Significant accumulation of ROS was detected in the HG group
    - Cell proliferation under high-glucose condition
        - significant decrease in cell proliferation in the HG group after 24 h of exposure to a high-glucose environment, as compared to the control group
    - Calcification under high-glucose condition
        - ALP activity decreased in the HG group after being exposed to the high-glucose environment for 4 days, but NSS.

Discussion/Conclusions:

- Hyperglycemia could cause the failure of oral implants in diabetic rats via oxidative stress
- In vitro experiments revealed that oxidative stress induced by hyperglycemia inhibits the proliferative and osteogenic potential of BMMSCs in the culture on titanium discs.
- Histological findings include weakened osseointegration on the coronal side of the implant in the DM group.
    - Only 1mo
- Possible mechanism:

    - Systemic chronic inflammation due to hyperglycemia that increases apoptosis, leads to reduced bone formation.
    - Increased formation of AGEs, which bind to the receptor for AGE (RAGE) and induce inflammatory cytokines, leads to increasing bone resorption and simultaneous reduction in the number of osteoblasts.
    - Systemically produced ROS in hyperglycemia induce receptor activator of nuclear factor kappa-B ligand (RANKL) and RAGE expression, leading to osteoclast formation and inhibition of osteoblastic differentiation.
    - Enhancement of oxidative stress by overexpression of ROS was shown to induce apoptosis of bone marrow stromal cells and osteoblasts, suppressing their differentiation and calcification ability
    - Overexpression of ROS is also known to induce apoptosis of osteocytes and to activate osteoclasts, leading to bone loss and bone deterioration.
- In the present in vivo model, inflammatory markers, such as TNF-α, IL-6, and iNOS, and oxidative stress markers, such as p47 and Nox2, were significantly increased and SOD1 was significantly decreased in the bone adjacent to the implant in the DM group.
- Lack of protection from the oxidative stress by SOD1 is involved in bone metabolism associated with impaired osseointegration due to DM.
- BMMSCs showed increased expression of ROS and decreased proliferative capacity under hyperglycemic conditions.
    - HG condition may inhibit the process of calcification of BMMSCs and in the expansion of collagen fibers as a scaffold for extracellular calcification, not in the formation of hydroxyapatite.

Topic: Poorly controlled diabetes and implant success
Authors: Latimer, JM., Roll KL., Daubert DM., Zhang H., Shalev T., ABCD study collaborators, Wolff LF., Kotsakis GA.
Title: Clinical performance of hydrophilic, titanium-zirconium dental implants in patients with well-controlled and poorly controlled type 2 diabetes: One-year results of a dual-center cohort study
Source: J Periodontol. 2022;93:745–757.
DOI: 10.1002/JPER.21-0015
Reviewer: Cyrus J Mansouri
Type: Cohort study
Keywords: dental implants, diabetes, hyperglycemia, Ti-Zr alloy

Purpose:
To assess the clinical integration, success, and survival of modSLA Ti-Zr dental implants in patients with type II diabetes mellitus (DMII).

Material and methods:
Pts with DMII for ≥ 2 years were stratified into groups of well-controlled (WC; HbA1c ≤ 7.0%) or poorly-controlled (PC; 7.5% < HbA1c < 10%) diabetes. Each subject received a single titanium-zirconium (Ti-Zr; 15% Zr and 85% Ti) 4.1 x 10 mm implant with a chemically-modified hydrophilic surface (modSLA) in the posterior mandible or canine sites. Post-op intervals were 1-, 2-, 4-, 8-, and 12-weeks. At 12 weeks, a digital impression was made for fabrication of customized Ti abutment and cement-retained monolithic zirconia crown. Clinical and radiographic parameters of implant success and patient-reported outcomes were collected, including marginal bone levels (primary outcome, assessed by superimposed periapical radiographs) and patient-reported outcomes. Implant success was defined as the absence of mobility, persistent pain, or infection, or peri-implant radiolucency, per Cochran et al.

Results:
A total of 21 patients completed the study with a 1-year implant success rate of 100%. Marginal bone loss was 0.15 mm at 1-year without statistical difference found between groups. Post-op pain was minimal at

1-week and an overall improved perception of oral health was found following implant therapy.

Conclusion:
Elevated HbA1c levels did not compromise 1-year implant success rates. Dental implants may be used to successfully rehabilitate patients with poorly controlled diabetes up to 10% HbA1c to achieve improved oral function.

Topic: Glycemic control and implants
Author: Oates TW, Huynh-Ba G, Vargas A, Alexander P, Feine J.
Title: A critical review of diabetes, glycemic control, and dental implant therapy.
Source: Clin Oral Implants Res. 2013 Feb;24(2):117-27.
DOI: 10.1111/j.1600-0501.2011.02374.x.
Type: Systematic Review
Reviewer: Veronica Xia
Keywords: dental implants, diabetes, glycemic control

Purpose:
- To examine the evidence guiding the use of implant therapy relative to glycemic control for patients with diabetes
    - Consider potential for both implant therapy to support diabetes management and hyperglycemia to compromise implant integration

Materials and Methods:
- Electronic search with applied inclusion and exclusion criteria

Results:
- 16 studies included
- Glycemic control
    - HbA1c is frequently used diagnostic/therapeutic measure of blood glucose control
        - % of glycated A1c hemoglobin in RBCs
        - Long term levels over 2-3 months
        - Diabetic patient maximum HbA1c: 6.5-7.0%
- Masticatory function and diabetes
    - Diabetes significantly increased levels of periodontal disease and tooth loss compromise patient's health and quality of life compromised masticatory function leading o alterations in diet, impacting glycemic control
    - Diminished chewing function leads to reductions in healthy food consumption malnutrition
    - Implant-based oral rehabilitation is shown to improve chewing ability and nutrition
    - Benefits on diabetes remain to be determined
- Bone metabolism and diabetes mellitus
    - Type 1 diabetes: decreased bone mass, alterations in bone turnover, and increased risk of bone fractures
        - Decreased levels of implant osseointegration in hyperglycemic animals (consistent with untreated diabetes type 1)
    - Women with type 2 diabetes had higher fractures rates than non-diabetic women, even with higher bone mineral density in diabetes patients
        - Differences in bone quality
        - No association between bone density and HbA1c
    - Diabetes leads to decreased bone turnover (decreased resorption and formation)
- Diabetes and implant integration
    - 13 included studies had variation in implant failure in patients with diabetes (0-14.3%)
        - Rate at which diabetic patients experienced at least one failed implant was highly variable (0-31.3%)

- Study included diabetic patients with HbA1c of 8.1%+ □ failed to identify any implant failures over the initial 4 month healing period prior to loading
  - Significant delay in implant integration for patients with HbA1c >8.0%
- In patients who initiated implant therapy with HbA1c <7.2% followed by changes in HbA1c over time (>9%) □ cumulative 2.9% implant failure rate
- Patients with HbA1c between 8.1-10.0% □ implant survival evaluated after 1 year of restoration □ no implant failures

Conclusion:

- Good glycemic control may be dependent in part on proper masticatory function
- Diabetes contributing to tooth loss □ tooth replacement by implants □ improve patient's overall well-being
- No clean clinical data supporting increased implants failures for patients lacking good glycemic control

Topic: Diabetes
Authors: Eskow CC, Oates TW.
Title: Dental Implant Survival and Complication Rate over 2 Years for Individuals with Poorly Controlled Type 2 Diabetes Mellitus.
Source: Clin Implant Dent Relat Res. 2017 Jun;19(3):423-431.
DOI: 10.1111/cid.12465.
Type: Observational Study
Reviewer: Trisha Nguyen-Luu
Keywords: Diabetes mellitus, hyperglycemia, implant success, implant survival, type 2 diabetes
Purpose: To determine the effect of poor glycemic control on the biological complications + implant failure after 2 years
Material and methods:

- 24 patients diagnosed with poorly controlled type 2 DM (HbA1B ≥ 8.0%) reviewed 2 or more implants (Straumman Standard Plus 4.1 mm x 8/10 mm + 1.8 polished collar) – 72 implants placed
- Implant support fixed dental prosthesis was delivered at 16 weeks
- Patients were seen 13-16 weeks to evaluate implant complication + HbA1c level + recalled btw 21 – 34 months to assess Implant survival + success

Results:

- 98.6% of implants survived the first year (1 person dropped out)
  - 1 early failure between week 4- 6 which was replaced + restored without complications
- 96.7% survival rate after 2 years
  - HbA1c levels btw 6.3 – 13.1% (decreased form baseline)
  - 1 implant lost 26 months post-restoration
- Total 2 implants within the study failed
- 29.4% biological complications
  - 21.6% peri-implant mucositis (most common)
  - 3 implants had bone loss within the first few months after placement + had little to no changes over the follow 2 years (bone loss to the first thread)
- Total number of implants per HbA1c category is positively correlated with number of correlatio ??
- No correlation between HbA1c and the occurrence of complications or mucositis

Conclusions

- Little relationship between glycemic levels + implant related clinical complications in type 2 diabetes patient with a HbA1C btw 6.3 – 13.1%
- 1 implant that failed 31 months after placement pt had an HbA1c of 12.4% but had 4 other implants succeed.
  - Failure may be due to local factors and not systemic factors.