RISK FACTORS FOR IMPLANT FAILURE vol. 1

Risk factors for implant failure (Smoking)

1. TN Chrcanovic BR, Albrektsson T, Wennerberg A. Smoking and dental implants: A systematic review and meta-analysis. J Dent. 2015 May;43(5):487-98.
2. ES Moraschini V, Barboza Ed. Success of dental implants in smokers and non-smokers: a systematic review and meta-analysis. Int J Oral Maxillofac Surg. 2016 Feb;45(2):205-15.
3. BT Heitz-Mayfield LJ, Huynh-Ba G. History of treated periodontitis and smoking as risks for implant therapy. Int J Oral Maxillofac Implants. 2009;24 Suppl:39-68.
4. AK Hinode D, Tanabe S, Yokoyama M, Fujisawa K, Yamauchi E, Miyamoto Y. Influence of smoking on osseointegrated implant failure: a meta-analysis. Clin Oral Implants Res. 2006 Aug;17(4):473-8.
5. TV Strietzel FP, Reichart PA, Kale A, Kulkarni M, Wegner B, Küchler I. Smoking interferes with the prognosis of dental implant treatment: a systematic review and meta-analysis. J Clin Periodontol. 2007 Jun;34(6):523-44.
6. DL Naseri R, Yaghini J, Feizi A. Levels of smoking and dental implants failure: A systematic review and meta-analysis. J Clin Periodontol. 2020 Apr;47(4):518-528
7. CM Javed F, Rahman I, Romanos GE. Tobacco-product usage as a risk factor for dental implants. Periodontol 2000. 2019 Oct;81(1):48-56.

Risk factors for implant Failure (Periodontal disease)

1. VX Guarnieri R, Di Nardo D, Di Giorgio G, Miccoli G, Testarelli L. Longevity of Teeth and Dental Implants in Patients Treated for Chronic Periodontitis Following Periodontal Maintenance Therapy in a Private Specialist Practice: A Retrospective Study with a 10-Year Follow-up. Int J Periodontics Restorative Dent. 2021 Jan-Feb;41(1):89-98.
2. TN Safii SH, Palmer RM, Wilson RF. Risk of implant failure and marginal bone loss in subjects with a history of periodontitis: a systematic review and meta-analysis. Clin Implant Dent Relat Res. 2010 Sep;12(3):165-74.
3. ES Sgolastra F, Petrucci A, Severino M, Gatto R, Monaco A. Periodontitis, implant loss and peri-implantitis. A meta-analysis. Clin Oral Implants Res. 2015 Apr;26(4):e8-e16.
4. BT Sousa V, Mardas N, Farias B, Petrie A, Needleman I, Spratt D, Donos N. A systematic review of implant outcomes in treated periodontitis patients. Clin Oral Implants Res. 2016 Jul;27(7):787-844.
5. AK Quirynen M, Abarca M, Van Assche N, Nevins M, van Steenberghe D. Impact of supportive periodontal therapy and implant surface roughness on implant outcome in patients with a history of periodontitis. J Clin Periodontol. 2007 Sep;34(9):805-15.
6. TV Levin L, Ofec R, Grossmann Y, Anner R. Periodontal disease as a risk for dental implant failure over time: a long-term historical cohort study. J Clin Periodontol. 2011 Aug;38(8):732-7.
7. DL Carra MC, Rangé H, Swerts PJ, Tuand K, Vandamme K, Bouchard P. Effectiveness of implant-supported fixed partial denture in patients with history of periodontitis: A systematic review and meta-analysis. J Clin Periodontol. 2022 Jun;49 Suppl 24:208-223.

8. CM Roccuzzo A, Imber JC, Marruganti C, Salvi GE, Ramieri G, Roccuzzo M. Clinical outcomes of dental implants in patients with and without history of periodontitis: A 20-year prospective study. J Clin Periodontol. 2022 Dec;49(12):1346-1356.

9. VX Monje A, Alcoforado G, Padial-Molina M, Suarez F, Lin GH, Wang HL. Generalized aggressive periodontitis as a risk factor for dental implant failure: a systematic review and meta-analysis. J Periodontol. 2014 Oct;85(10):1398-407.

10. TN Smith MM, Knight ET, Al-Harthi L, Leichter JW. Chronic periodontitis and implant dentistry. Periodontol 2000. 2017 Jun;74(1):63-73.

Risk factors for implant failure (Smoking)

Topic: Risk factors for implant failures (Smoking)
Authors: Chrcanovic BR, Albrektsson T, Wennerberg A.
Title: Smoking and dental implants: A systematic review and meta-analysis.
Source: J Dent. 2015 May;43(5):487-98.
DOI: 10.1016/j.jdent.2015.03.003
Type: Review
Reviewer: Trisha Nguyen-Luu
Keywords: dental implants, smoking, implant failure rate, postoperative infection, marginal bone loss
Purpose: To examine the difference in implant failure rate, risk of post-operative infection and marginal one loss of smokers vs. non-smokers"
Material and methods:

- Electronic and manual search for clinical studies related dental implant failures in smokers and non-smokers
- 107 studies were included in the final meta analysis

Results:

- Implant failure in smokers are 2.23 times more likely to happen than implant failures in non-smokers
- Implants placed in smokers has a 123% increased risk for failure +2.01 x more likely to have post-operative infection + 0.32 mm more marginal bone loss
- Implants placed in the maxilla of smokers SS affected failure rate
- Implants placed in the mandible of smokers had no SS affect on failure rate
- Smoking sig affected implants with turned, acid etched, sandblasted + acid etched, sandblasted + fluoride modified + oxidized surfaces
    - Higher risk for implants with roughed surfaces vs turned implants

Conclusions

- Increase risk of failure in smokers due to the effect of smoking in osteogenesis + angiogenesis
- Nicotine inhibits gene expression of several enzymes that regulate osteoblast proliferation, differentiation + apoptosis affecting bone formation + remodeling
- Nicotine causes vasoconstriction which decreases blood perfusion → decrease nutrients + O2 to bone tissue affecting bone formation/ remodeling + vascularization
- Smoking sig affects survival of implants in the maxilla + no sig affect on mandible
    - Possible that the neg. affect of smoking is more prominent in areas with loose trabecular bone vs. areas with "good bone"
- Smoking sig affects implants irrespective of the type of surface modification
- Interpret results with caution due to uncontrolled confounding factors + limitations

Topic: Risk factors for DI failure- smoking
Authors: Moraschini V, Barboza Ed
Title: Success of dental implants in smokers and non-smokers: a systematic review and meta-analysis
Source: Int J Oral Maxillofac Surg. 2016 Feb;45(2):205-15.
DOI: 10.1016/j.ijom.2015.08.996.
Type: systematic review and meta-analysis
Reviewer: Erin Schwoegl
Keywords: dental implants; implant survival; marginal bone loss; meta-analysis; smoking; tobacco.

Purpose: To compare marginal bone loss (MBL) and DI failure in smokers and non-smokers

Material and methods:
- Electronic search conducted to include prospective and retrospective cohort studies, and RCTs that compared MBL and failure rates of smoking and non-smoking implant pts
- A total of 15 studies met criteria and were included in meta-analysis

Results:
MBL
- MBL ranged 0.07- 2.7mm in smokers and ; 0.04- 3.13mm in non-smokers
- Analysis using random-effects modeled performed due to high heterogeneity btwn studies
    - SSD in favor of non-smokers
    - Smoker pts only: mandible sig less MBL vs maxilla.

DI failure rate
- Avg survival varied 65.3-97% in smokers and 82.7-98.8% in non-smokers
    - SSD in favor of non-smokers for different follow-up timepoints
    - Incr in follow-up time did not result in incr in DI failure

Conclusions:
- Smokers sig greater MBL compared to non-smokers
- Smokers sig greater risk for DI failure vs non-smokers at all follow-ups from <1 to >5 years

Topic: Periodontitis, Smoking and Implants
Authors: Heitz-Mayfield LJ, Huynh-Ba
Title: History of treated periodontitis and smoking as risks for implant therapy
Source: Int J Oral Maxillofac Implants. 2009;24 Suppl:39-68.
DOI: n/a
Type: Systematic Review
Reviewer: Brook Thibodeaux
Keywords: n/a

Purpose: To determine adverse events of dental implants risk factor when placed in patients who have a history of periodontitis, smoking, or a combination of the two.

Material and methods: articles were included. An electronic search took place to find included articles. Factors analyzed were implant survival, implant success, peri-implantitis occurrence and MBL.

Results: A dental implant survival rate of >90% was found in most studies for patients treated with a history of periodontitis. An odds ratio of 3.1- 4.7 was reported for high risk of peri-implantitis development in patients with a history of periodontitis versus those without. 75% of studies found SS risk of adverse outcomes for implants in patients who smoke. Smokers' DI survival rate was between 80-96%, which was determined to be SS lower compared to nonsmokers.

Conclusions: Patients with a combination of smoking and previously treated periodontitis have an increased risk of adverse outcomes with dental implant placement, including increased risk of implant failure and increased risk of peri-implant bone loss.

Topic: smoking
Authors: Hinode D, Tanabe S, Yokoyama M, Fujisawa K, Yamauchi E, Miyamoto Y
Title: Influence of smoking on osseointegrated implant failure: a meta-analysis
Source: Clin Oral Implants Res. 2006 Aug;17(4):473-8.
DOI: 10.1111/j.1600-0501.2005.01244.x
Reviewer: Amber Kreko
Type: meta-analysis
Keywords: implant failure, meta-analysis, smoking

Purpose: To examine the influence of smoking on osseointegrated implant failure by performing a meta-analysis.

Material and methods:
- Electronic search from 1993- August 2004 for case-control and cohort studies
- Search terms were smoking, smoke, and tobacco in combination with implant.
- Implant was considered failure when it had been removed for any reason, and showed progressive bone loss assessed by radiograph.

Results:
- 19 chosen for detailed review – 12 case-control and 7 cohort
- Smokers vs. nonsmokers – OR for implant failure was significantly elevated (2.17)
- Maxillary vs. mandibular arch – OR was elevated for maxillary (2.06) and mandibular did not have a significant increased risk (1.32)

Conclusions: Smoking has significant negative effects on the survival rate of dental implants, particularly implants in maxillary arch.

Topic: Smoking
Authors: Strietzel FP, Reichart PA, Kale A, Kulkarni M, Wegner B, Küchler
Title: Smoking interferes with the prognosis of dental implant treatment: a systematic review and meta-analysis.
Source: J Clin Periodontol 2007 Jun;34(6):523-44.
DOI: 10.1111/j.1600-051X.2007.01083.x
Reviewer: Tam Vu
Type: Systematic review and meta-analysis
Keywords: smoking, dental implant, augmentation, complications

Purpose: To review risk of implant failure in smokers.

Material and methods: An electronic database search focused on dental implant treatment outcomes of smokers.

Results:
Sixty four publications were included in the systematic review and meta-analysis. The studies reported on implant failures, biologic complications, and findings known to negatively influence implant therapy related to smoking. Smoking was significantly associated with implant failure, increased by 2.25 times up to 5 years. Implant loss was also significantly higher in augmented sites of smokers. Increased risk of peri-implant soft tissue complications and significantly more marginal bone loss in smokers. On the contrary, a few studies found no significant different between smokers and non-smokers with microstructured surface treatment by particle blasting, acid-etching, or anodic oxidation.

Discussion: Smoking reduction and cessation is advised due to smoke-associated risks for implant and augmentation outcomes. A survey showed that implant therapy for smokers were recommended more in public and private practice and with older dentists compared to dental schools and younger practicing dentists. Smoking as a risk factor may differ among dentists. The biological component includes vasoconstrictive effects, decreased neutrophil elastase activity, and also reduced inflammatory reaction. There is also a negative effect of peri-implant inflammation and peri-implant bone loss, which can patient can benefit from strict recall to detect early implant complications.

Conclusion: Smoking is a significant risk factor for dental implant therapy.

Topic: Implant Risk Factor-Smoking

Authors: Naseri R, Yaghini J, Feizi A

Title: Levels of smoking and dental implants failure: A systematic review and meta-analysis

Source: J Clin Periodontol. 2020 Apr;47(4):518-528
DOI: 10.1111/jcpe.13257

Reviewer: Daeoo Lee
Type: Systematic Review/Meta

Keywords: implant, failure, smoking, meta-analysis

Purpose: To investigate if there was a significantly enhanced risk of dental implant failure due to the increased number of cigarettes smoked per day.

Material and methods: In accordance with PRISMA. Electronic search (PubMed, EMBASE, Web of Science, Scopus upto January 2019)

Results: 23 studies in both qualitative and quantitative study

- Meta-analysis based on implant-related data (higher implant failure rate)
  - Group I (none, <10, or >10):
    - SS, (>10) > (<10) > non-smoker
  - Group II (none, <15, or >15):
    - No SS b/t <15 and non-smoker
    - SS, (>15) > non-smoker
    - No SS b/t <15 and >15
  - Group III (None, <20, or >20):
    - SS, (<20) > non-smoker
    - SS, (>20) > non-smoker
    - No SS, <20 and >20
  - Group IV (None, 1-10, 10-20 or >20):
    - SS, (<10) > non-smoker
    - SS, 10-20 > non-smoker
    - SS, (>20) > non-smoker
    - No SS, (<10) and (10-20)
    - SS, (>20) > (10-20)
- Meta-analysis based on patient-related data (at least one implant in a patient failed)
  - Group I (None, <10 or >10):
    - No SS, (<10) and non-smoker
    - SS, (>10) > non-smoker
    - No SS, (<10) and (>10)
  - Group II (None, <15 or >15):
    - No SS, (<15) and non-smoker
    - SS, (>15) > non-smoker
    - No SS, (<15) and (>15)
  - Group III (None, <20 or >20):

- SS, ((<20) or (>20)) > non-smoker
- No SS, (<20) and (>20)

Results: Having additional information supplied by the authors, 23 articles were selected for final analysis. The meta-analyses based on implant- and patient-related data showed a significant increase in the RR of implant failure in patients who smoked >20 cigarettes per day compared with non-smokers (implant based: p = .001; RR: 2.45; CI: 1.42-4.22 and patient based: p < .001; RR: 4; CI: 2.72-5.89).

Conclusion: The risk of implant failure was elevated with an increase in the number of cigarettes smoked per day.

Discussion:

- Based on the findings
  - Study demonstrated an increase in the Relative Risks of implant failure in all smoker subgroups than in non-smokers. The findings showed the more cigarettes smoked daily, the more probable was the dental implant failure.
  - Smoking <10 cigarettes/day can be "recommended" tolerated with caution as a safe level against dental implant failure.
  - Smoking more than one pack/day can be considered a risk factor for implant failure.
    - The domain of 10–20 cigarettes smoked per day is an uncertain range for implant failure. It seems that **implant failure operates along a continuum with no apparent threshold** of smoking level. It is recommended that cigarette consumption data be analyzed as a continuous rather than as a categorical variable in the future studies
- Patient-related analysis confirms implant-related analysis.
  - When implant failure is calculated with the patient as the statistical unit, the statistical methodology can overestimate the outcome
    - More negative outcome for patients with multiple implants because when one implant is failed in a patient with multiple implants, the patient's treatment outcome is considered a failure
- Half of the papers included in the meta-analysis had short-term follow-up period, lower than 2 years.

Topic: Implants and tobacco use
Authors: Javed F., Rahman I., Romanso GE.
Title: Tobacco-product usage as a risk factor for dental implants
Source: Periodontol 2000. 2019 Oct;81(1):48-56.
DOI: 10.1111/prd.12282
Reviewer: Cyrus J Mansouri
Type: Review article
Keywords: alveolar bone loss, dental implant, inflammation, osseointegration, smoking

Review:

Tobacco use: A risk factor for peri-implant diseases

- Along with poor OH, hx perio disease, immunocompromised status, and occlusal loading, habitual use of tobacco products is a significant risk factor for peri-implant diseases.
- Several investigations have demonstrated that:
  - Smoking is a SS predictor of implant failure.
  - Smokers experience SS higher rates of implant failure, post-op infection, and crestal bone loss.
  - Type IV bone is more commonly found in smokers.

Nicotine: Definition and its deleterious effects on oral and systemic health

- 90% of nicotine is metabolized by the liver, lungs, and kidneys.

- Conc of nicotine in GCF 300x higher than serum.
- Nicotine has vasoconstrictive effects, which may result in reduced BOP in smokers.
- High conc of nicotine and cotinine inhibit proliferation of gingival fibroblasts and their adhesion to root surfaces, compromising CAL, while enhancing proliferation of osteoclasts, increasing alveolar bone loss.
- Increased glycation in periodontal tissues may compromise outcomes of periodontal surgical interventions.
- Nicotine has also been associated with several systemic diseases (acute cardiac ischemia, atherosclerosis, coronary artery disease, HTN, thrombosis).

Effect of nicotine on osseointegration: Lessons from animal studies

A limited number of animal studies demonstrate:

- A SS decrease in bone-to-implant contact at 4 weeks in rats exposed to nicotine.
- Deceased bone volume around implants in rats receiving subcutaneous nicotine injections.
- Several studies demonstrate no differences in bone-to-implant contact.
    - However, these results should be interpreted carefully, as nicotine was delivered subcutaneously, and nicotine absorption has been shown to faster via inhalation.

Success and survival of implants and tobacco product usage

1. Cigarette smoking
    - A classical risk factor for both peri-implant diseases and implant failure.
        - Peri-implant marginal bone loss SS higher in smokers due to upregulation of inflammatory cytokines.
    - Controversial results have also been reported, demonstrating no significant differences in smokers.
        - One study showed 97% vs 99% implant survival for immediately loaded platform-shifted implants placed in smokers and non-smokers, respectively.
2. Waterpipe smoking (hookah)
    - HTN, tachycardia, oxidative stress, lung cancer, oral cancer, periodontal disease, and alveolar bone loss have been associated with waterpipe smoking.
    - Individuals are exposed to the same toxic chemicals as cigarette smoking
        - No studies have directly studied waterpipe smoking and implant related outcomes, however waterpipe smoking is likely a significant risk factor for peri-implant diseases.
3. Pipe and cigar smoking
    - Similar to waterpipe smoking, pipe and cigar smoking exposes individuals to the same toxic chemicals as cigarettes.
        - Studies have demonstrated pipe/cigar smoking to be less detrimental than cigarette smoking; however, poor systemic and oral health and an association with periodontitis has been shown.
4. Electronic cigarette vaping
    - No clinical studies exist examining periodontal or peri-implant outcomes.
    - Experimental evidence indicates e-cigarettes may negatively influence outcomes of dental implant therapy similar to conventional smoking.
5. Smokeless tobacco use
    - An abundance of evidence shows a direct association between smokeless tobacco products and oral malignancies.
    - All types of smokeless tobacco have been shown to be equally hazardous to periodontal health.
    - It is hypothesized that peri-implant PDs and marginal bone levels are worse in smokeless tobacco users than nonsmokers, and implant placed proximal to the placement of the smokeless tobacco product exhibit worse clinical parameters.

Tobacco products and dampening of innate immune responses in survival/failure of dental implants

- Tobacco use has been shown to dampening of innate immunity by activation of the nuclear factor kappa B pathway and toll-like receptors, which triggers various inflammatory mediators and

oxidative stress.

- This culminates in damage to the peri-implant tissues and may lead to per-implant diseases and implant loss if untreated.
- Pt education on the effects of all tobacco products is the responsibility of healthcare providers.

Conclusion:
While evidence on the success and survival of dental implant in tobacco users is scarce in volume, the demonstrated deleterious effects of tobacco use cannot be ignored and must be highlighted in patient care. Routine pt education is highly recommended.

The last article is a 2019 article. There are 2023 lit articles on Vaping and peri-implant concerns. Here is the best I could find.

The effect of electronic cigarette use on peri-implant conditions in men: (guess women don't count?) a systematic review and meta-analysis. Moustafa Youssef , Tamer Marzouk, et al. Oral Surg Oral Med Oral Pathol Oral Radiol. 2023 Apr;135(4):492-500.DOI: 10.1016/j.oooo.2022.08.010

Objective: To systematically review the effect of electronic cigarette (e-cigarette) use on clinical, radiographic, and immunologic peri-implant parameters in males.

Study design: A comprehensive search of indexed databases was conducted to identify studies reporting data on both e-cigarette users and nonsmokers with implant-supported prosthesis with ≥1-year in function, up to May 2022. Marginal bone loss (MBL), probing depth (PD), plaque index (PI), and bleeding on probing (BOP) were recorded. Peri-implant sulcular fluid volume (PISF), tumor necrosis factor alpha (TNF-α) and interleukin 1β (IL-β) levels were also assessed. A meta-analysis was performed using random-effect models to determine the effect of e-cigarette use in primary and secondary outcomes.

Results: Four cross-sectional studies were included with a total of 327 participants (165 e-cigarette users and 162 nonsmokers). All studies showed greater MBL, PI, and PD, in e-cigarette users compared with never smokers. The meta-analysis indicated significant heterogeneity for all outcomes except MBL for distal implant surfaces, with the mean difference between e-cigarette users and nonsmokers of 0.89 mm (95% CI: 0.67-1.11, P < .01). The PISF volume, TNF-α, and IL-1β levels were increased in e-cigarette users (P < .01) with no heterogeneity present between studies.

Conclusions: E-cigarette use shows a negative effect on clinical, radiographic, and immunologic parameters of dental implants.

Risk factors for implant Failure (Periodontal disease)

Topic: Survival of teeth vs dental implants
Author: Guarnieri R, Di Nardo D, Di Giorgio G, Miccoli G, Testarelli L.
Title: Longevity of Teeth and Dental Implants in Patients Treated for Chronic Periodontitis Following Periodontal Maintenance Therapy in a Private Specialist Practice: A Retrospective Study with a 10-Year Follow-up.
Source: Int J Periodontics Restorative Dent. 2021 Jan-Feb;41(1):89-98.
DOI: 10.11607/prd.4674.
Type: Clinical Study
Reviewer: Veronica Xia
Keywords: teeth, dental implants, chronic periodontitis, periodontal maintenance

Purpose:

- Assess the progression of periodontal disease and the onset of peri-implant disease over a long-term period in a cohort of patients with chronic periodontitis
    - Assess rates of tooth and implant loss, in addition to associated risk factors

Materials and Methods:

- 58 patients who had receive active periodontal therapy and at least 10 years of maintenance
- All patients exhibited generalized moderate-to-severe chronic periodontitis
- Active periodontal therapy included initial therapy, periodontal/implant surgery
- Primary outcomes: tooth and implant loss
- Secondary outcomes: changes in periodontal and peri-implant clinical parameters and radiographic bone levels.

Results:

- Average tooth loss during periodontal maintenance: 0.07 teeth/patient/year
    - Due to periodontal reasons: 0.04 teeth/patient/year
    - 78 teeth extracted (1.3/patient)
    - 90% survived
- 12 implants removed from 12 patients during periodontal maintenance: 0.4 implants/patient/year
    - Overall implant failure: 10.08%
    - Due to biologic reasons: 9.8%
- Overall mean values of PPD, CAL, FMPS and PPD % of 1-4mm/5-6mm->6mm significantly decreased from baseline to 10 years follow-up
    - Significant decrease mostly during active periodontal therapy
- Mean bone loss
    - Teeth: 1.5mm
    - Implants: 3.1mm
- % of implant loss in patients with vs without recurrent periodontal disease: 83.3% vs 16.7%
- Increase risk for tooth/implant loss
    - Age, smoking habit, number of pockets 5-6mm and full mouth bleeding score >25%

Conclusion: Active periodontal therapy with long-term maintenance is successful in keeping the majority of periodontally compromised teeth. In those same patients, higher tendency for implant loss was found

Topic: Risk factors for implant failures (Periodontal disease)
Authors: Safii SH, Palmer RM, Wilson RF.
Title: Risk of implant failure and marginal bone loss in subjects with a history of periodontitis: a systematic review and meta-analysis.
Source: Clin Implant Dent Relat Res. 2010 Sep;12(3):165-74.
DOI:10.1111/j.1708-8208.2009.00162.x
Type: Review
Reviewer: Trisha Nguyen-Luu
Keywords: Bone loss, dental implants periodontitis, systematic review

Purpose: To determine the risk for implant failure and marginal bone loss around implants in patients with a history of periodontitis vs patients who are periodontally healthy
Material and methods:

- Electronic and manual search for prospective and retrospective clinical studies related to periodontal and perio-implant variables in patients with periodontitis and those who were periodontally healthy with a follow up of 3- 10 years

Results:

- 17 studies were included in the review.
- 1.6-11.2% implant loss in patients with history of periodontitis vs 0-3.3% in healthy patients
- 2.2 mm bone loss around implants in patients with history of periodontitis vs 1.7 mm bone loss in healthy patients
- Patients with a history advanced periodontitis or aggressive periodontitis had disease progression around teeth (increase PD + BOP)
- Sig association between poor plaque control + peri-implant disease
    - OR 14.3 for prevalence of peri-implantitis with very poor plaque scores
    - OR 2.9 for peri-implant mucositis with very poor plaque scores

Discussion:

- NSSD but more favorable implant survival rate in healthy patients vs those with a history of periodontitis
    - History of periodontitis is not a contraindication for implant placement.
    - Periodontally heathy patients were 3.02 times more likely to have better implant survival than previously treated periodontitis patients
- SS greater marginal bone loss in patients with a history of periodontitis vs healthy patients
    - Standardized mean difference 0.61 mm
- increase susceptibility to implant failure in more progressive formed of periodontitis but not for mild periodontitis.
- Acceptable implant outcome in periodontitis patients with comprehensive supportive care+ good plaque control even in aggressive cases

Conclusion: The systematic review revealed with a moderate level of evidence that periodontitis patients exhibit a higher risk of implant failure and experience greater marginal bone loss when compared to periodontally healthy subjects.

Topic: Risk factors for DI failure- perio
Authors: Sgolastra F, Petrucci A, Severino M, Gatto R, Monaco A.
Title: Periodontitis, implant loss and peri-implantitis. A meta-analysis.
Source: Clin Oral Implants Res. 2015 Apr;26(4):e8-e16.
DOI: 10.1111/clr.12319
Type: meta-analysis
Reviewer: Erin Schwoegl
Keywords: aggressive periodontitis, chronic periodontitis, dental implants, meta-analysis peri- implantitis, periodontitis

Purpose: To evaluate perio disease as a risk factor for DI loss, peri-implantitis, peri-DI bone loss

Material and methods:

- Literature search conducted to include only prospective cohort studies that compared pts w perio to periodontally healthy pts and that reported data on DI loss, peri-implant bone level changes, or peri-implantitis
- 14 studies met inclusion criteria for meta-analysis

Results:
Meta-analysis

- Sig higher risk for DI loss in pts affected by perio had sig higher risk for DI loss (RR: 1.89), peri-DI bone loss, and peri-implantitis (RR: 2.21) vs periodontally healthy pts

Subgroup analysis

- Pts w aggressive and chronic perio had incr risk of DI loss, but incr more w aggressive (RR:4.04) vs chronic (RR. 1.59)
- For chronic perio pts, pts w severe perio had incr risk of DI loss (RR: 1.89)

Conclusions:

- Perio disease is a risk factor for DI loss, peri-implantitis, and higher levels of peri-DI bone loss

Topic: Periodontitis and Implants
Authors: Sousa V, Mardas N, Farias B, Petrie A, Needleman I, Spratt D, Donos N.
Title: A systematic review of implant outcomes in treated periodontitis patients.
Source: Clin Oral Implants Res. 2016 Jul;27(7):787-844.
DOI: 10.1111/clr.12684.
Type: Systematic Review
Reviewer: Brook Thibodeaux
Keywords: clinical assessment, clinical research, clinical trials, diagnosis, epidemiology, patient centered outcomes, Periodontology, statistics

Purpose: To examine the difference in outcomes that treated periodontitis patient's have with implant placement versus periodontally healthy patients.

Material and methods: 27 articles were included. The focused question was: "What are the survival and success rates (including bone-level change or bone loss) and incidence of peri-implantitis for dental implants placed in partially dentate patients who have been treated for periodontitis ('treated periodontitis') compared with patients without a history of clinical or radiographic evidence of periodontitis ('non-periodontitis')?" An electronic search took place excluding those that did not match the inclusion criteria.

Results: Implant success and survival was SS higher in periodontally healthy patients versus patient's with a history of periodontitis. Patient's with a history of periodontitis ihad an increase in bone loss and incidence of peri-implantitis. Patient's who were treated for severe periodontitis had a high rate of implant loss and biologic complications. Appropriate data between studies was not available for a meta-analysis to take place.

Conclusions: In patients with a history of periodontitis, lower implant success and survival wee observed, as were an increase in biologic complications compared to periodontally healthy patients. Patients with a history of severe periodontitis experienced a greater frequency of implant loss.

Topic: periodontitis
Authors: Quirynen M, Abarca M, Van Assche N, Nevins M, van Steenberghe D.
Title: Impact of supportive periodontal therapy and implant surface roughness on implant outcome in patients with a history of periodontitis
Source: J Clin Periodontol. 2007 Sep;34(9):805-15.
DOI: 10.1111/j.1600-051X.2007.01106.x.
Reviewer: Amber Kreko
Type: systematic review
Keywords: attachment loss, bone loss, implants, peri-implantitis, periodontitis, plaque, smoking, susceptibility

Purpose: To search for a relationship between susceptibility to periodontitis and peri-implantitis, with implant outcome as the primary outcome variable and SPT and implant surface roughness as confounding factors.

Material and methods:
- Electronic search up to June 2006
- PICO question: Is the outcome of implants in patients with a history of periodontitis similar as for periodontitis free patients, and are SPT and implant surface roughness confounding variables?"
- Outcome variables: implant loss, marginal bone, attachment level/probing depth, BOP, peri-implantitis

- Primary outcome was variable was implant outcome but special attention was paid to the impact of SPT and implant surface roughness as possible confounding factors.

Results:
- 16 papers selected: 11 prospective and 5 retrospective studies
- Early implant loss – history of periodontitis impact was negligible (0.8%)
- Late implant loss and/or marginal bone loss – higher incidence reported (mean 6.0% with 0-41% range)
- Highest for implants with very rough surface and one study where SPT was not given to patients (3x higher)
- Aggressive periodontitis patients more prone to implant loss even with minimally rough implants and SPT given.

Conclusions: Patients with a history of periodontitis can be successfully treated with minimally/moderately rough implants with regular SPT.

Topic: Periodontal status
Authors: Levin L, Ofec R, Grossmann Y, Anner R.
Title: Periodontal disease as a risk for dental implant failure over time: a long-term historical cohort study
Source: J Clin Periodontol. 2011 Aug;38(8):732-7
DOI: 10.1111/j.1600-051X.2011.01745.x
Reviewer: Tam Vu
Type: Comparative Study
Keywords: periodontitis, risk factor, smoking, implant failure

Purpose: to evaluate patient's periodontal status and long-term implant survival rate

Material and methods:

- Prospective cohort study on 736 pts from 1996 to 2006 at a periodontal clinic
- Pt's periodontal diagnosis classified and updated to current classification (excluded aggressive periodontitis):
    - None
    - Moderate chronic
    - Severe chronic
- All perio pt's underwent periodontal procedures prior to implant placement
- Other variables of interest were diabetic status, smoking status, and supportive periodontal therapy
- Cumulative survival rates calculated

Results:

- Follow up time was up to 144 mo, avg of 54 mo
- Sig correlation between periodontal status and diabetes, smoking, and SPT
    - Higher proportion of diabetic/smoker/SPT pt's observed in severe chronic periodontitis group
- Higher implant failure rates seen in severe chronic periodontitis group (5.2%)
    - compared to moderate chronic periodontitis (3.3%) and healthy pts (3.0%)
- Cumulative survival rate stabilized
    - Healthy pts: 0.96 around 60 mo
    - Moderate chronic perio: 0.95 at 72 mo
    - Severe chronic perio: 0.88 at 108 mo

- Severe chronic perio is stable up to 50 mo, but is a strong risk factor for implant failure after 50 mo
- Same with smoking, with non-significant effect up to 50 mo, and increased risk after 50 mo

Conclusion: Periodontal status and smoking are significant risk factors for late implant failures. (The risk is not constant throughout follow up, with increased risk of failure after 50 mo.)

Topic: Risk Factor (Perio dx)
Authors: Carra, M., Rangé, H., Swerts, P., Tuand, K., Vandamme, K., Bouchard, P.
Title: Effectiveness of implant-supported fixed partial denture in patients with history of periodontitis: A systematic review and meta-analysis
Source: J Clin Periodontol. 2022 Jun:49 Suppl 24:208-223
DOI: 10.1111/jcpe.13481
Reviewer: Daeoo Lee
Type: Systematic Review/Meta
Keywords: bridges, implant supported fixed partial dentures, periodontitis,

Purpose: Effectiveness of implant-supported fixed partial dentures (IS-FPD) in patients with history of periodontitis (HP) vs. patients with no history of periodontitis (NHP)

Material and methods: Followed PRSIMA. Electronic database (MEDLINE (through PubMed), EMBASE, Cochrane Central Library, ProQuest Dissertations and Thesis, Open Access Thesis and Dissertation, openthesis.org, OpenGrey database and ClinicalTrials.gov) search.

*Statistical definition:
Hazard ratio (HR) can be considered as an estimate of relative risk, which is the risk of an event (or of developing a disease) relative to exposure.
Relative risk (RR) is a ratio of the probability of the event occurring in the exposed group versus the control (non-exposed) group.

Results: 7 Prospective and 10 retrospective studies.

- Survival rate (hazard ratio)
    - Significantly higher in the NHP group than HP group
    - No SS difference between severe periodontitis and moderate periodontitis
    - Reasons for implant failure
        - Most frequent complication leading to implant loss was peri-implantitis
        - Other reasons
            - Implant fracture or trauma
            - Lack/loss of osseointegration
            - Implant mobility
            - Pain or paresthesia
- Success rate:
    - Heterogeneity in reporting
        - No pooled data analysis possible
    - Individual reports
        - Degidi et al: 10 year prospective follow-up -> 62.6% for overall study population
        - Gatti et al: 5 year prospective follow-up -> 97.9% for severe periodontitis group and 100% for moderate periodontitis or periodontally healthy
        - Ormianer et al: retrospective of 9.5 years -> 90.9%
- Peri-implantitis rate:
    - Patients with HP had RR of 3.3 of developing peri-implantitis over the follow-up period compared to NHP patients.
- MBL changes
    - no difference in MBL between implants placed in HP and NHP patients

Discussion:

- HP patients have a poorer long-term survival and a greater risk of peri-implantitis compared to IS-FPDs placed in NHP patients.
- No differences between the HP and NHP groups are detected for MBL changes over time
- No conclusion can be drawn on IS-FPD overall success rate

Topic: Implants and hx periodontitis
Authors: Roccuzzo A., Imber JC., Marruganti C., Salvi GE., Gamieri G., Roccuzzo M.
Title: Clinical outcomes of dental implants in patients with and without history of periodontitis: A 20-year prospective study
Source: J Clin Periodontol. 2022;49:1346–1356.
DOI: 10.1111/jcpe.13716
Reviewer: Cyrus J Mansouri
Type: Prospective study
Keywords: dental implants, peri-implantitis, periodontitis, supportive periodontal therapy, tooth loss

Purpose:
To compare 20-year clinical outcomes of tissue-level implants placed in pts previously treated for periodontitis and in periodontally healthy pts.

Material and methods:
The study population was 149 partially edentulous pts rehabilitated in a private practice setting with tissue level SLA dental implants.

- Divided into three groups:
  - periodontally healthy pt (PHP)
  - moderately periodontally compromised pts (mPCP)
  - severely periodontally compromised pts (sPCP)
- After periodontal/implant interventions, subjects were enrolled in individualized supportive periodontal care (SPC) programs.

Results:
A total of 84 pts rehabilitated with 172 implants completed the 20-year examination.

- 22 PHP, 29 mPCP and 33 sPCP subjects, corresponding to 39, 59 and 71 implants, respectively.

12 implants were removed (11 biological complications, 1 implant fracture)

- Overall implant survival rate of 93%
  - 94.9% for PHP
  - 91.8% for mPCP
  - 93.1% for sPCP

FMPS and FMBS were SS difference among groups at baseline.

- At 20-years, FMPS and FMBS decreased for all groups and failed to show statistical differences at this point.

Implant loss:

- PCP compliant with SPC did not experience higher odds of implant loss compared to PHP compliant with SPC.
- PCP not compliant with SPC experienced implant loss with OR of 14.59
  - In comparison PHP not compliant with SPC experienced implant loss with an OR of 8.55.

Conclusion:
PHP compliant with SPC experience fewer biological complications in the long-term than patients with a hx periodontitis. Pts with a history of periodontitis may achieve excellent implant survival if compliant with SPC. However, patients not compliant with SPC are at a significantly higher risk for biological complications and implant loss.

Topic: Periodontitis effects on implant failure
Author: Monje A, Alcoforado G, Padial-Molina M, Suarez F, Lin GH, Wang HL
Title: Generalized aggressive periodontitis as a risk factor for dental implant failure: a systematic review and meta-analysis.
Source: J Periodontol. 2014 Oct;85(10):1398-407.
DOI: 10.1902/jop.2014.140135
Type: Systematic Review
Reviewer: Veronica Xia
Keywords: generalized aggressive periodontitis, dental implant, failure

Purpose:

- Assess whether patients who suffer from generalized aggressive periodontitis (GAgP) have a higher implant failure rate and MBL in implant prostheses when compared with patients with chronic periodontitis (CP) and/or healthy patients (HP)

Materials and Methods:

- Electronic search
- Focus question: Do edentulous patients restored with implant-supported prostheses have a higher or similar implant survival rate (SR) and/or MBL among patients with a history of GAgP and/or HPs and/or patient with CP?

Results:

- 6 articles included: comparative prospective controlled traisl assessing implant treatment outcome in patients with GAgP compared with HP/CP
- GAgP on SR of implants
    - GAgP: 83.3% to 100%
    - CP: 96.4%-100%
    - HP: 96.9%-100%
    - When looking at failure rate
        - AgP vs HP: overall risk ratio of 4.00
        - AgP vs CP: overall risk ratio of 3.97
- GAgP on MBL
    - HP vs CP: WMD of 0.15mm favoring CP
    - HP vs GAgP: WMD -0.28mm favoring HP
    - CP vs GAgP: WMD -0.43mm favoring CP
- Effect of follow-up period on SR of GAgP
    - Length of follow-up period did not significantly influence the outcome in either HP vs GAgP or CP vs GAgP

Conclusion:

- Patients with a history of GAgP had similar SR when compared with CP and HP groups
    - Implant placement viable in patienst with history of GAgP
- When comparing failure rates, GAgP vs HP (risk ratio 4.0) and GAgP vs CP (3.97)
    - Comprehensive implant maintenance program is important

Topic: Risk factors for implant failures (Periodontal disease)
Authors: Smith MM, Knight ET, Al-Harthi L, Leichter JW
Title: Chronic periodontitis and implant dentistry.
Source: Periodontol 2000. 2017 Jun;74(1):63-73.
DOI:10.1111/prd.12190
Type: Review
Reviewer: Trisha Nguyen-Luu
Background:

- Short term studies show similar survival rates in patients with or without a hx of chronic periodontitis.
- Long term studies > 10 years show a sig increase incidence of peri-implant complications in patients with periodontitis.
    - **Poor plaque control, history of periodontitis + cigarette smoking are the strongest risk indicators for peri-implantitis**
    - Other factor affecting plaque accumulation + removal → design of prosthesis + excess cement

Keywords: dental implants, periodontitis, chronic periodontitis
Purpose: To review the evidence that a history of periodontitis is a risk factor for implant success + survival
Discussion:

- Implants in patients with a history of periodontitis
    - Limited evidence for lower success + survival of dental implants in patients with a history of periodontitis
        - Evidence to support this is very weak due to different definition of success or treatment of periodontitis, study quality + design
    - **Nevins + Langer**: >97% implant survival in patients with recalcitrant periodontitis (continued periodontal bone loss despite active management
        - The main study quoted as evidence to place implants in patients with a history of periodontitis but Follow up varied including only up to 3 years
    - Recent studies provide evidence that patients with a history of periodontitis have a greater risk for implant loss + peri-implantitis (min of 5 year post-op)
    - Peri-implant disease is slow, chronic + cyclical similar to chronic periodontitis
- Implant survival and history of periodontitis
    - Long term follow up > 9 years showed patients with a history of severe periodontitis is associated with higher implant failure rate
    - Patients with severe bone loss > 30% before implant tx had sig higher rates (12%) of implant failure than those with less bone loss (3%)
    - No criteria for implant removal → depends on clinician assessment of bone loss + mobility
    - Risk of periimplantitis for periodontitis pts is 14 x higher compared to periodontally healthy pts.
    - Deeper mean full mouth PD + greater full mouth attachment loss is associated with greater attachment loss around implants.
    - Periodontally compromised patients who had at least 1 periodontal pocket of ≥ 6 mm are more likely to have a greater degree of bone loss + deeper PD at implants
    - Periodontally compromised patients who did not have at least 1 periodontal pocket of ≥ 6 mm had peri-implant measurements similar to periodontally healthy patients
- Supportive peri-implant therapy for patients with a history of periodontitis:
    - Lack of supportive peri-implant therapy is associated with a greater incidence of peri-implant bone loss in pt over 10 yrs
    - Patients with a history of periodontitis even if they are treated and considered periodontally healthy at the outset of implant treatment may benefit from greater emphasis on self-performed plaque control + more frequent supportive peri-implant therapy recall visits
    - More patients who did not adhere to their supportive peri-implant therapy required a larger number of treatment with systemic ABS and or surgery for peri-implant disease
    - Patients with no structured peri-implant therapy had 77% peri-implant mucositis + 15% peri-implantitis
    - **Serino**: even with surgical intervention + supportive peri-implant therapy 42% of implants continued to exhibit characteristics of peri-implant disease
    - In patients with history of periodontitis, peri-implant bone loss is not linear + accelerated sig after 7 yr of function
        - Surface roughness is suggested to be a contributing factor to peri-implant disease when surface is exposed to the oral enviro
- Protocol for Implant supportive peri-implant therapy
    - No evidence to recommend optimal frequency of recall interval or regimen for prevention for

peri-implant disease
    - Patients treatment planned for implants should already have an established effective OHI to prevent early implant failure
    - Recommends increasing antibacterial potential depending on the severity + the extent of the disease
- Smoking cessation
    - Cigarette smoking is associated with a greater risk of developing peri-implant diseases + implant loss
    - After 10 yr in function, approx. 1 mm greater mean radiographic peri-implant bone loss in smokers with a history of periodontitis
    - Cigarette is associated with a 2.8 fold increased risk of have peri-mucositis + 10 fold increased risk of bone loss to ≥ 3 threads + a 4.6 fold increased risk of peri-implantitis
    - Higher implant survival rate in those who quit smoking 1 week before + 8 weeks after implant surgery

Conclusion:

- Risk factors for destructive periodontal disease + peri-implant disease are:
    - Bacterial plaque, factors that hinger plaque removal + impaired healing (ie. Smoking)
- Management of periodontally involved teeth or implants in periodontally susceptible patients relies on **plaque control**
- Preventative program should be based on risk assessment for each patient