International Journal of Medical Toxicology & Legal Medicine Volume 27, No. 3, 2024
e-ISSN: 0974-4614
p-ISSN: 0972-0448

Management of Peri-Implantitis: Current Approaches and Future Direction

Zahra Mohammed Hassan Maran[1], Abdullah Mufarrih AlGahtani[2], Aisha Abdullah AlAssiri[3], Sheikah Mohammad Albreek[4], Monirah Zaid Alaqeeli[5], Reem Mohammed Alhowel[6], Alhanouf Nasser Alabdullah[7], Mohammad osama ghannam[8], Nuha Abdullah Rashid Alnemer[9], Feras hamoud alshehri[10], Alwah Muhammad Alshmrani[11]

[1]Dental Assistant,Dental Clinics Complex, West Riyadh,Saudi Arabia, Email: Rose_1_4_0_0@hotmail.com
[2]General Dentist,West Riyadh Dental Complex,Saudi Arabia, Email: AbdullahKatani@gmail.com
[3]Dental Assistant,West Riyadh Dental Complex,Saudi Arabia, Email: Aisha11aass1122@gmail.com
[4]Dental Assistant,West Riyadh Dental Complex,Saudi Arabia, Email: Sh.m.7albreek@gmail.com
[5]General dentist,West Riyadh dental complex,Saudi Arabia, Email: Monirahalaqeeli@gmail.com
[6]Dental Assistant,West Riyadh Dental Complex,Saudi Arabia, Email: Reem.reem6067@gmail.com
[7]Dental Assistant,Dental Clinics Complex West of Riyadh,Saudi Arabia, Email: Alnaalabdullah@moh.gov.sa
[8]General dentist,West Riyadh Dental Complex,Saudi Arabia, Email: Dr.edogh@gmail.com
[9]Dental Consultant,West Riyadh Dental Complex,Saudi Arabia, Email: Nalnemer@moh.gov.sa
[10]General Dentist,West Riyadh Dental Complex,Saudi Arabia, Email: Firas.al.shehri@gmail.com
[11]Dental assistant, Dental clinic complex west of Riyadh, Saudi Arabia, Email: lwlhalshmrany4@gmail.com

Received: 15.08.2024 Revised: 10.09.2024 Accepted: 24.10.2024

ABSTRACT
Dental implants have become a widely accepted treatment option for tooth replacement, but their long-term success can be compromised by peri-implantitis, a progressive inflammatory condition affecting the supporting tissues around implants. Peri-implantitis is characterized by progressive bone loss and can potentially lead to implant failure if not properly managed. This paper provides a comprehensive overview of the current approaches to managing peri-implantitis, including risk factor identification, non-surgical and surgical treatment modalities, and potential future directions.
Several local and systemic factors, such as implant surface characteristics, excess cement, smoking, history of periodontitis, diabetes, and osteoporosis, have been associated with an increased risk of peri-implantitis development and progression. Non-surgical management, involving mechanical debridement, antimicrobial therapy, and chemical decontamination, aims to disrupt biofilms and reduce inflammation. Surgical interventions, including open flap debridement, regenerative procedures, implantoplasty, and resective surgery, may be necessary for advanced cases.
Ongoing research efforts are exploring adjunctive therapies, such as antimicrobial photodynamic therapy, probiotics, bioactive molecules, and implant surface modifications, as well as preventive strategies and risk factor management. The identification of reliable biomarkers and the development of targeted therapies based on molecular diagnostics hold promise for improving early detection and personalized treatment approaches. A multidisciplinary approach combining preventive measures, appropriate interventions, and continued research is crucial for addressing the challenges of peri-implantitis and ensuring the long-term success of dental implants.

INTRODUCTION

Dental implants have become an increasingly popular treatment option for replacing missing teeth, offering a functional and esthetic solution for partially or completely edentulous patients. However, the long-term success of dental implants can be compromised by peri-implant diseases, particularly peri-implantitis, which is a progressive inflammatory condition affecting the supporting tissues around dental implants (Ting & Suzuki, 2024). Peri-implantitis is characterized by progressive bone loss around the implant, potentially leading to implant failure and the need for surgical intervention or implant removal (Lang et al., 2004; Pjetursson et al., 2007).
The prevalence of peri-implantitis varies widely in the literature, with reported rates ranging from 1% to over 40% (Srinivasan et al., 2014; Klinge & Meyle, 2012; Zitzmann &Berglundh, 2008). This variation can be attributed to differences in case definitions, study populations, implant systems, and follow-up periods (Berglundh et al., 2018). Nonetheless, the high prevalence of peri-implantitis highlights the importance of effective prevention, early detection, and appropriate management strategies.

This paper aims to provide a comprehensive overview of the current approaches to managing peri-implantitis, including risk factor identification, non-surgical and surgical treatment modalities, and potential future directions in the prevention and management of this challenging condition.

Risk Factors for Peri-Implantitis

Identifying and addressing risk factors for peri-implantitis is crucial for successful implant therapy. Several local and systemic factors have been associated with an increased risk of peri-implant disease development and progression.

Local Factors

1. Implant Surface Characteristics: Implant surface roughness and micro-topography can influence bacterial adhesion and biofilm formation, potentially increasing the risk of peri-implantitis (Misch et al., 2005; Misch, 2007).
2. Excess Cement: Residual cement left around implant restorations can act as a nidus for bacterial colonization and subsequent peri-implant inflammation (Staubli et al., 2017; Giovannoli et al., 2019).
3. Implant Positioning and Design: Improper implant positioning, angulation, or emergence profile can compromise oral hygiene practices and increase the risk of peri-implant disease (Giovannoli et al., 2019).
4. Occlusal Overload: Excessive occlusal forces on implants can lead to micro-movements and disruption of the implant-bone interface, potentially contributing to peri-implant bone loss (Misch et al., 2005; Misch, 2007).

Systemic Factors

1. Smoking: Smoking is a well-established risk factor for peri-implantitis, as it impairs wound healing, immune response, and increases the risk of bacterial colonization (Guney et al., 2024; Sgolastra et al., 2015).
2. History of Periodontitis: Individuals with a history of periodontitis are at higher risk for developing peri-implantitis, as they may harbor periodontal pathogens and demonstrate an exaggerated inflammatory response (Sousa et al., 2016; Ramanauskaite et al., 2014; Zangrando et al., 2015).
3. Diabetes Mellitus: Poor glycemic control in patients with diabetes mellitus has been associated with an increased risk of peri-implantitis, likely due to impaired wound healing and altered immune response (Javed & Romanos, 2009; Nibali et al., 2022; Tan et al., 2021).
4. Osteoporosis and Antiresorptive Medications: Patients with osteoporosis or those taking antiresorptive medications, such as bisphosphonates, may be at an increased risk for peri-implantitis due to altered bone metabolism and impaired bone remodeling (Camacho et al., 2020; Yip et al., 2012; Ting & Suzuki, 2023).
5. Genetic Factors: Emerging evidence suggests that genetic variations in immune response and inflammatory pathways may influence an individual's susceptibility to peri-implantitis (Corrêa et al., 2019).

Identifying and managing these risk factors is crucial for the prevention and successful management of peri-implantitis. A comprehensive evaluation of patient-specific risk factors should be performed prior to implant placement and during follow-up visits, allowing for appropriate preventive measures and treatment modifications.

Current Approaches to Peri-Implantitis Management

The management of peri-implantitis involves a combination of non-surgical and surgical approaches, aimed at reducing inflammation, eliminating or controlling bacterial biofilms, and promoting regeneration of the peri-implant tissues.

Non-Surgical Management:

Non-surgical therapy is typically the initial approach for managing peri-implantitis and includes mechanical debridement, antimicrobial therapy, and chemical decontamination of the implant surface.

1. Mechanical Debridement: This involves the removal of plaque, calculus, and inflammatory tissues from the implant surface and peri-implant pockets using hand instruments, ultrasonic devices, or air abrasives (Ting et al., 2018; Heitz-Mayfield, 2008).
2. Antimicrobial Therapy: Local or systemic antimicrobial agents, such as chlorhexidine, tetracycline, or antibiotics, may be used as adjuncts to mechanical debridement to reduce the bacterial load and control inflammation (Murray et al., 2013; Ting & Suzuki, 2021).
3. Chemical Decontamination: Various chemical agents, including citric acid, hydrogen peroxide, or laser therapy, have been investigated for their ability to decontaminate the implant surface and remove biofilms (Ting et al., 2018; Ting & Suzuki, 2021).

Non-surgical therapy aims to disrupt the biofilm, reduce inflammation, and promote tissue healing. However, its effectiveness may be limited in cases of advanced peri-implantitis with significant bone loss or complex implant surface topographies (Ting et al., 2018; Heitz-Mayfield, 2008).

Surgical Management:
When non-surgical therapy is insufficient or in cases of advanced peri-implantitis, surgical interventions may be necessary to achieve implant surface decontamination, access to the defect site, and promote regeneration of the peri-implant tissues.

1. Open Flap Debridement: This involves raising a mucoperiosteal flap to gain access to the peri-implant defect, followed by mechanical debridement and decontamination of the implant surface (Pjetursson et al., 2012; Naert et al., 2002).
2. Regenerative Procedures: Guided bone regeneration (GBR) techniques, using bone grafts and barrier membranes, aim to promote the regeneration of lost peri-implant bone and support tissues (Roccuzzo et al., 2012; Serino et al., 2013).
3. Implantoplasty: This procedure involves smoothening the implant surface to reduce surface roughness and facilitate plaque removal, potentially combined with regenerative procedures (Suárez-López del Amo et al., 2018).
4. Resective Surgery: In cases of advanced peri-implantitis with extensive bone loss, resective surgery may be performed to reduce the peri-implant pocket depth and facilitate oral hygiene maintenance (Derks & Tomasi, 2015).
5. Explantation: In cases of severe, non-responsive peri-implantitis or advanced bone loss, implant removal (explantation) may be the only viable option (de Waal et al., 2013; Ting & Suzuki, 2021).

The choice of surgical approach depends on the extent and pattern of peri-implant bone loss, implant surface characteristics, and patient-specific factors (Ting et al., 2018; Sgolastra et al., 2015). Regenerative procedures aim to restore the lost peri-implant tissues, while resective approaches prioritize the establishment of a maintainable implant-supported restoration.

Adjunctive Therapies and Future Directions
While current treatment modalities for peri-implantitis have shown varying degrees of success, ongoing research is focused on exploring adjunctive therapies and novel approaches to improve treatment outcomes and prevent disease recurrence.

1. Antimicrobial Photodynamic Therapy (aPDT): aPDT involves the use of a photosensitizing agent and low-intensity light to induce the production of reactive oxygen species, which can inactivate pathogenic bacteria and disrupt biofilms (Ting & Suzuki, 2021).
2. Probiotics and Bioactive Molecules: The use of probiotics or bioactive molecules, such as antimicrobial peptides, anti-inflammatory agents, or growth factors, may modulate the peri-implant microbiome and promote tissue regeneration (Ting & Suzuki, 2021).
3. Implant Surface Modifications: Ongoing research is exploring the development of implant surfaces with enhanced antimicrobial properties, improved osseointegration, or the ability to modulate the host-bacteria interaction (Ting & Suzuki, 2021).
4. Molecular Diagnostics and Targeted Therapies: Advances in molecular diagnostics and the identification of specific microbial and host signatures associated with peri-implantitis may enable the development of targeted therapies tailored to individual patient profiles (Scapoli et al., 2012; Benachinmardi et al., 2015; Pérez-Chaparro et al., 2016; Padial-Molina et al., 2016).
5. Preventive Strategies: Emphasis is being placed on preventive measures, such as optimizing implant design, surface characteristics, and patient education to promote effective oral hygiene and early detection of peri-implant diseases (Ting & Suzuki, 2021).
6. Risk Factor Management: Ongoing research aims to develop strategies for managing systemic risk factors, such as smoking cessation programs, glycemic control in diabetic patients, and optimizing antiresorptive medication regimens (Turri et al., 2016; Nibali et al., 2022; Tan et al., 2021; Romanos & Vazquez, 2022; Wu et al., 2014).
7. Peri-Implant Biomarkers: The identification and validation of reliable biomarkers in peri-implant crevicular fluid or saliva may facilitate early detection and monitoring of peri-implant diseases, enabling timely intervention (Duarte et al., 2016; Rakic et al., 2016).

These ongoing research efforts highlight the multifaceted approach required to address the complex challenges of peri-implantitis and improve long-term implant success rates.

CONCLUSION
Peri-implantitis is a significant challenge in implant dentistry, with potentially severe consequences for implant longevity and patient well-being. Effective management of peri-implantitis requires a comprehensive approach,

encompassing risk factor identification, preventive measures, and appropriate non-surgical and surgical interventions.

Current treatment modalities aim to reduce inflammation, disrupt biofilms, and promote tissue regeneration, but their long-term efficacy remains variable, particularly in cases of advanced peri-implantitis. Ongoing research efforts are focused on exploring adjunctive therapies, novel approaches, and preventive strategies to improve treatment outcomes and reduce the risk of disease recurrence.

Future directions in peri-implantitis management include the development of targeted therapies based on molecular diagnostics, implant surface modifications, and the identification of reliable biomarkers for early detection and monitoring. Additionally, addressing systemic risk factors and promoting preventive measures through patient education and optimized implant design are crucial for reducing the overall burden of peri-implant diseases.

REFERENCES

1. Atieh, M.A., Alsabeeha, N.H.M., Faggion, C.M., Jr., & Duncan, W.J. (2013). The frequency of peri-implant diseases: A systematic review and meta-analysis. Journal of Periodontology, 84(11), 1586-1598. https://doi.org/10.1902/jop.2012.120592
2. Benachinmardi, K.K., Nagamoti, J., Kothiwale, S., &Metgud, S.C. (2015). Microbial flora in chronic periodontitis: Study at a tertiary health care center from north karnataka. Journal of Laboratory Physicians, 7(1), 49-54. https://doi.org/10.4103/0974-2727.154785
3. Berglundh, T., Armitage, G., Araujo, M.G., Avila-Ortiz, G., Blanco, J., Camargo, P.M., Chen, S., Cochran, D., Derks, J., Figuero, E., Hämmerle, C.H.F., Heitz-Mayfield, L.J.A., Huynh-Ba, G., Iacono, V., Koo, K.T., Lambert, F., McCauley, L., Quirynen, M., Renvert, S., ... Zitzmann, N.U. (2018). Peri-implant diseases and conditions: Consensus report of workgroup 4 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. Journal of Clinical Periodontology, 45(Suppl 20), S286-S291. https://doi.org/10.1111/jcpe.12957
4. Camacho, P.M., Petak, S.M., Binkley, N., Diab, D.L., Eldeiry, L.S., Farooki, A., Harris, S.T., Hurley, D.L., Kelly, J., Lewiecki, E.M., Luckey, M.M., Palmieri, R., Pavlik, V.N., &Werschler, W.P. (2020). American Association of Clinical Endocrinologists/American College of Endocrinology clinical practice guidelines for the diagnosis and treatment of postmenopausal osteoporosis-2020 update. Endocrine Practice, 26(Suppl 1), 1-46. https://doi.org/10.4158/GL-2020-0524SUPPL
5. Corrêa, M.G., Pimentel, S.P., Ribeiro, F.V., Cirano, F.R., & Casati, M.Z. (2019). Host response and peri-implantitis. Brazilian Oral Research, 33(Suppl 1), e066. https://doi.org/10.1590/1807-3107bor-2019.vol33.0066
6. de Waal, Y.C.M., van Winkelhoff, A.J., Meijer, H.J.A., Raghoebar, G.M., & Winkel, E.G. (2013). Differences in peri-implant conditions between fully and partially edentulous subjects: A systematic review. Journal of Clinical Periodontology, 40(3), 266-286. https://doi.org/10.1111/jcpe.12050
7. Derks, J., & Tomasi, C. (2015). Peri-implant health and disease. A systematic review of current epidemiology. Journal of Clinical Periodontology, 42(Suppl 16), S158-S171. https://doi.org/10.1111/jcpe.12334
8. Duarte, P.M., Serrão, C.R., Miranda, T.S., Zanatta, L.C.S., Bastos, M.F., Faveri, M., Figueiredo, L.C., & Feres, M. (2016). Could cytokine levels in the peri-implant crevicular fluid be used to distinguish between healthy implants and implants with peri-implantitis? A systematic review. Journal of Periodontal Research, 51(6), 689-698. https://doi.org/10.1111/jre.12345
9. Giovannoli, J.-L., Roccuzzo, M., Albouy, J.-P., Duffau, F., Lin, G.-H., & Serino, G. (2019). Local risk indicators—Consensus report of working group 2. International Dental Journal, 69(Suppl 2), 7-11. https://doi.org/10.1111/idj.12505
10. Guney, Z., Altingoz, S., Has, H., Serdar, M.A., & Kurgan, S. (2024). The impact of electronic cigarettes on peri-implant health: A systematic review and meta-analysis. Journal of Dentistry, 143, 104883. https://doi.org/10.1016/j.jdent.2024.104883
11. Heitz-Mayfield, L.J.A. (2008). Peri-implant diseases: Diagnosis and risk indicators. Journal of Clinical Periodontology, 35(Suppl 8), 292-304. https://doi.org/10.1111/j.1600-051X.2008.01275.x
12. Javed, F., & Romanos, G.E. (2009). Impact of diabetes mellitus and glycemic control on the osseointegration of dental implants: A systematic literature review. Journal of Periodontology, 80(11), 1719-1730. https://doi.org/10.1902/jop.2009.090283
13. Klinge, B., & Meyle, J. (2012). Peri-implant tissue destruction. The Third EAO Consensus Conference 2012. Clinical Oral Implants Research, 23(Suppl 6), 108-110. https://doi.org/10.1111/j.1600-0501.2012.02555.x
14. Lang, N.P., Pjetursson, B.E., Tan, K., Bragger, U., Egger, M., & Zwahlen, M. (2004). A systematic review of the survival and complication rates of fixed partial dentures (FPDs) after an observation period of at

least 5 years. II. Combined tooth-implant-supported FPDs. Clinical Oral Implants Research, 15(6), 667-676. https://doi.org/10.1111/j.1600-0501.2004.01117.x
15. Misch, C.E., Perel, M.L., Wang, H.-L., Sammartino, G., Galindo-Moreno, P., Trisi, P., Steigmann, M., Rebaudi, A., Palti, A., Pikos, M.A., Schwartz-Arad, D., Choukroun, J., Gutierrez-Perez, J.L., Marenzi, G., & Valavanis, D.K. (2008). Implant success, survival, and failure: The International Congress of Oral Implantologists (ICOI) Pisa Consensus Conference. Implant Dentistry, 17(1), 5-15. https://doi.org/10.1097/ID.0b013e3181676059
16. Misch, C.E., Suzuki, J.B., & Misch-Dietsh, F.M. (2005). A positive correlation between occlusal trauma and peri-implant bone loss: Literature support. Implant Dentistry, 14(2), 108-116. https://doi.org/10.1097/01.id.0000157560.59798.8e
17. Misch, C.E. (2007). Misch's Contemporary Implant Dentistry (3rd ed.). Mosby.
18. Murray, C.M., Knight, E.T., Russell, A.A., Tawse-Smith, A., & Leichter, J.W. (2013). Peri-implant disease: Current understanding and future direction. New Zealand Dental Journal, 109(2), 55-62.
19. Naert, I., Koutsikakis, G., Quirynen, M., Duyck, J., van Steenberghe, D., & Jacobs, R. (2002). Biologic outcome of implant-supported restorations in the treatment of partial edentulism. Part 2: A longitudinal radiographic study. Clinical Oral Implants Research, 13(4), 390-395. https://doi.org/10.1034/j.1600-0501.2002.130406.x
20. Nibali, L., Gkranias, N., Mainas, G., & Di Pino, A. (2022). Periodontitis and implant complications in diabetes. Periodontology 2000, 90(1), 88-105. https://doi.org/10.1111/prd.12445
21. Padial-Molina, M., López-Martínez, J., O'Valle, F., & Galindo-Moreno, P. (2016). Microbial profiles and detection techniques in peri-implant diseases: A systematic review. Journal of Oral & Maxillofacial Research, 7(3), e10. https://doi.org/10.5037/jomr.2016.7310
22. Pérez-Chaparro, P.J., Duarte, P.M., Shibli, J.A., Montenegro, S., Lacerda, C., Heluy, S.L., Figueiredo, L.C., & Feres, M. (2016). The current weight of evidence of the microbiologic profile associated with peri-implantitis: A systematic review. Journal of Periodontology, 87(11), 1295-1304. https://doi.org/10.1902/jop.2016.160184
23. Pjetursson, B.E., Tan, W.C., Tan, K., Brägger, U., Zwahlen, M., & Lang, N.P. (2007). A systematic review of the survival and complication rates of resin-bonded bridges after an observation period of at least 5 years. Clinical Oral Implants Research, 18(Suppl 3), 131-141. https://doi.org/10.1111/j.1600-0501.2007.01451.x
24. Pjetursson, B.E., Thoma, D., Jung, R., Zwahlen, M., &Zembic, A. (2012). A systematic review of the survival and complication rates of implant-supported fixed dental prostheses (FDPs) after a mean observation period of at least 5 years. Clinical Oral Implants Research, 23(Suppl 6), 22-38. https://doi.org/10.1111/j.1600-0501.2012.02546.x
25. Rakic, M., Grusovin, M.G., &Canullo, L. (2016). The microbiologic profile associated with peri-implantitis in humans: A systematic review. International Journal of Oral & Maxillofacial Implants, 31(2), 359-368. https://doi.org/10.11607/jomi.4149
26. Ramanauskaite, A., Baseviciene, N., Wang, H.L., &Tozum, T.F. (2014). Effect of history of periodontitis on implant success: Meta-analysis and systematic review. Implant Dentistry, 23(6), 687-696. https://doi.org/10.1097/ID.0000000000000160
27. Romanos, G.E., & Vazquez, J. (2022). Drug-associated bone resorption with potential dental and implant implications. Periodontology 2000, 90(1), 236-246. https://doi.org/10.1111/prd.12454
28. Roccuzzo, M., Bonino, F., Gaudioso, L., Zwahlen, M., & Meijer, H.J. (2012). What is the optimal number of implants for removable reconstructions? A systematic review on implant-supported overdentures. Clinical Oral Implants Research, 23(Suppl 6), 229-237. https://doi.org/10.1111/j.1600-0501.2012.02544.x
29. Scapoli, L., Girardi, A., Palmieri, A., Testori, T., Zuffetti, F., Monguzzi, R., Lauritano, D., & Carinci, F. (2012). Microflora and periodontal disease. Dental Research Journal, 9(Suppl 2), S202-S206.
30. Serino, G., Turri, A., & Lang, N.P. (2013). Probing at implants with peri-implantitis and its relation to clinical peri-implant bone loss. Clinical Oral Implants Research, 24(1), 91-95. https://doi.org/10.1111/j.1600-0501.2012.02470.x
31. Sgolastra, F., Petrucci, A., Severino, M., Gatto, R., & Monaco, A. (2015). Smoking and the risk of peri-implantitis. A systematic review and meta-analysis. Clinical Oral Implants Research, 26(4), e62-e67. https://doi.org/10.1111/clr.12333
32. Sousa, V., Mardas, N., Farias, B., Petrie, A., Needleman, I., Spratt, D., &Donos, N. (2016). A systematic review of implant outcomes in treated periodontitis patients. Clinical Oral Implants Research, 27(7), 787-844. https://doi.org/10.1111/clr.12684
33. Srinivasan, M., Vazquez, L., Rieder, P., Moraguez, O., Bernard, J.P., & Belser, U.C. (2014). Survival rates of short (6 mm) micro-rough surface implants: A review of literature and meta-analysis. Clinical Oral Implants Research, 25(5), 539-545. https://doi.org/10.1111/clr.12166

34. Staubli, N., Walter, C., Schmidt, J.C., Weiger, R., & Zitzmann, N.U. (2017). Excess cement and the risk of peri-implant disease - A systematic review. Clinical Oral Implants Research, 28(10), 1278-1290. https://doi.org/10.1111/clr.12954
35. Suárez-López del Amo, F., Garaicoa-Pazmiño, C., Fretwurst, T., Castilho, R.M., &Squarize, C.H. (2018). Dental implants-associated release of titanium particles: A systematic review. Clinical Oral Implants Research, 29(11), 1085-1100. https://doi.org/10.1111/clr.13372
36. Tan, S.J., Baharin, B., Nabil, S., Mohd, N., & Zhu, Y. (2021). Does glycemic control have a dose-response relationship with implant outcomes? A comprehensive systematic review and meta-analysis. Journal of Evidence Based Dental Practice, 21(1), 101543. https://doi.org/10.1016/j.jebdp.2020.101543
37. Ting, M., Craig, J., Balkin, B.E., & Suzuki, J.B. (2018). Peri-implantitis: A comprehensive overview of systematic reviews. Journal of Oral Implantology, 44(3), 225-247. https://doi.org/10.1563/aaid-joi-D-16-00122
38. Ting, M., & Suzuki, J.B. (2021). Peri-implantitis: How to reduce risk and manage implant failure? Oral Health Journal. https://www.oralhealthgroup.com/features/peri-implantitis-how-to-reduce-risk-and-manage-implant-failure/
39. Ting, M., & Suzuki, J.B. (2023). Antiresorptive medication effects on dental implant survival and implant-related jaw osteonecrosis. Oral Health Journal. https://www.oralhealthgroup.com/features/antiresorptive-medication-effects-on-dental-implant-survival-and-implant-related-jaw-osteonecrosis/
40. Ting, M., & Suzuki, J.B. (2024). Peri-Implantitis. Dentistry Journal, 12(8), 251. https://doi.org/10.3390/dj12080251
41. Turri, A., Rossetti, P., Canullo, L., Grusovin, M., & Dahlin, C. (2016). Prevalence of peri-implantitis in medically compromised patients and smokers: A systematic review. International Journal of Oral & Maxillofacial Implants, 31(1), 111-118. https://doi.org/10.11607/jomi.4149
42. Wu, X., Al-Abedalla, K., Rastikerdar, E., Abi Nader, S., Daniel, N.G., Nicolau, B., & Tamimi, F. (2014). Selective serotonin reuptake inhibitors and the risk of osseointegrated implant failure: A cohort study. Journal of Dental Research, 93(11), 1054-1061. https://doi.org/10.1177/0022034514550039
43. Yip, J.K., Borrell, L.N., Cho, S.C., Francisco, H., & Tarnow, D.P. (2012). Association between oral bisphosphonate use and dental implant failure among middle-aged women. Journal of Clinical Periodontology, 39(4), 408-414. https://doi.org/10.1111/j.1600-051X.2011.01848.x
44. Zangrando, M.S., Damante, C.A., Sant'Ana, A.C., Rubo de Rezende, M.L., Greghi, S.L., &Chambrone, L. (2015). Long-term evaluation of periodontal parameters and implant outcomes in periodontally compromised patients: A Systematic review. Journal of Periodontology, 86(2), 201-221. https://doi.org/10.1902/jop.2014.140390
45. Zitzmann, N.U., &Berglundh, T. (2008). Definition and prevalence of peri-implant diseases. Journal of Clinical Periodontology, 35(Suppl 8), 286-291. https://doi.org/10.1111/j.1600-051X.2008.01274.x