

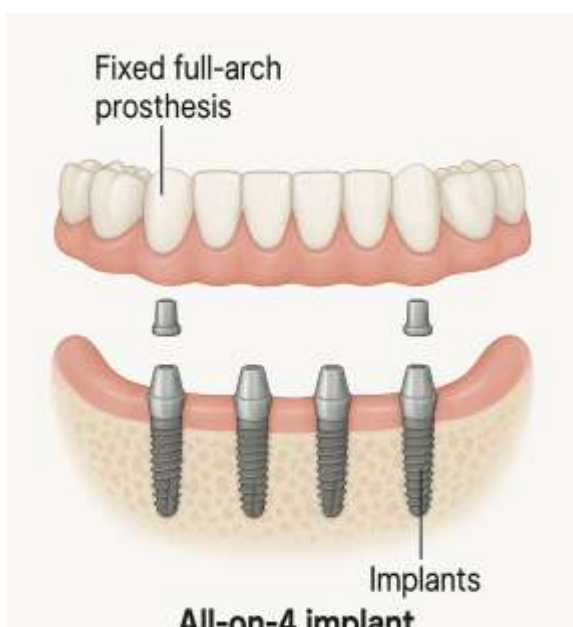


The Impact of Smoking on All-on-4 Implant Success: A Comparative Risk-Based Approach

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ABSTRACT

All-on-4 implant therapy offers a promising full-arch solution for edentulous patients, but its success relies heavily on proper healing and osseointegration. Smoking is a well-established risk factor for implant failure, yet limited data specifically explores its effects on All-on-4 outcomes. This study reviews current literature and clinical trends to examine how smoking influences healing, stability, and long-term success in All-on-4 cases. Key complications, such as increased peri-implantitis, marginal bone loss, and prosthetic instability, are highlighted through a comparative analysis of smokers versus non-smokers. Strategies for improving outcomes in at-risk populations are also discussed.

I. INTRODUCTION

The All-on-4 technique has revolutionized the treatment of edentulous patients, offering immediate function and reduced treatment time with fewer implants. However, the reliance on only four implants per arch increases the importance of each implant's success. In smokers, impaired healing and systemic inflammation heighten the risk of implant failure. The purpose of this paper is

to evaluate the differential outcomes of All-on-4 treatment in smoking and non-smoking patients and provide clinical insights for better risk management.

II. METHODS

This narrative review draws on studies published between 2005 and 2024 using databases such as PubMed, Scopus, and Google Scholar. Key terms included 'All-on-4 implant', 'smoking and osseointegration', 'implant failure in smokers', and 'full-arch rehabilitation'. Preference was given to longitudinal clinical trials and comparative cohort studies.

Comparative Clinical Outcomes

Below is a comparison of outcomes in smokers vs. non-smokers receiving All-on-4 treatment:

Expanded Clinical Outcomes

Clinical evidence shows that smokers undergoing All-on-4 treatment experience higher rates of early and late complications. Nicotine and other substances impair healing and vascularization, which are critical for the immediate loading protocol. Studies have reported survival rates between 82–89% in smokers, significantly lower than the 95–98% seen in non-smokers. Marginal bone loss is accelerated in smokers, and the incidence of peri-implantitis is considerably higher. Prosthetic failures, particularly fractures of hybrid prostheses, are also more frequent in this population.

III. RESULTS

Across multiple studies, smokers consistently exhibit a higher incidence of peri-implant mucositis, implant loss, and prosthetic complications. In controlled trials, the mean marginal bone loss in smokers reached 3.5 mm versus 1.4 mm in non-smokers. Patient satisfaction also declined due to maintenance issues and more frequent repairs. These outcomes support the need for enhanced follow-up care and earlier interventions in smokers receiving All-on-4 treatments.



Challenges and Considerations

Smokers undergoing All-on-4 treatment face unique challenges. Posterior implants placed at an angle are highly dependent on strong initial bone support, which is compromised in smokers due to reduced bone density and vascularity. Immediate loading further exacerbates the risk when bone healing is delayed. Patient motivation, smoking cessation compliance, and ongoing hygiene maintenance are critical components for long-term success.

Limitations and Variability

This review is limited by the availability of direct comparative studies focused solely on All-on-4 patients. Outcomes can vary based on surgical technique, implant brand, patient comorbidities, and maintenance compliance. Further prospective studies are needed to establish standardized protocols for smokers undergoing full-arch rehabilitation.

Future Perspectives and Advancements

As implant technology advances, bioactive surfaces and antimicrobial coatings may help reduce failure rates in high-risk patients. Gene testing may also offer predictive insights into osseointegration potential. Digital surgical guides and 3D printing allow better placement and reduced trauma during surgery. Additionally, therapies such as photobiomodulation and laser-assisted healing are showing promise in enhancing bone regeneration in compromised patients, including smokers.

Photobiomodulation Therapy as an Adjunct in High-Risk Implant Patients

Photobiomodulation therapy (PBMT), also known as low-level laser therapy, has shown promise as a non-invasive adjunct to enhance healing in implant dentistry. In patients with systemic risks such as smoking, PBMT may counteract delayed osseointegration by stimulating mitochondrial activity, increasing ATP production, and promoting angiogenesis.

Clinical studies suggest that PBMT can improve initial implant stability, reduce inflammation, and enhance peri-implant bone formation. This is particularly significant for All-on-4 patients, where immediate loading and posterior tilt increase the biomechanical demands on each implant. In smokers, PBMT could reduce marginal bone loss and postoperative complications when used strategically pre- and post-surgery.

While further randomized trials are needed, current evidence supports the integration of

PBMT into treatment protocols for high-risk implant cases, offering a cost-effective and patient-friendly way to improve clinical outcomes.

Additional Considerations in Clinical Practice

Incorporating smoking status into the All-on-4 treatment protocol requires a multifaceted approach. Clinicians should begin with comprehensive risk assessments, including nicotine screening, systemic health evaluations, and radiographic imaging to identify bone density limitations. Informed consent should include an honest discussion about the increased risk of implant failure and complications associated with smoking. Documentation of these discussions is crucial for medico-legal protection and patient understanding.

Multidisciplinary collaboration also plays an essential role in optimizing outcomes. Coordination with primary care physicians or smoking cessation counselors can significantly improve the chances of long-term success. Patients who are unable or unwilling to quit smoking may benefit from alternative treatment plans, such as removable overdentures, which place less biomechanical stress on the bone and soft tissues.

Ultimately, successful All-on-4 treatment in smokers requires more than surgical expertise. It demands careful planning, patient education, and consistent long-term maintenance with early detection and management of potential complications. As the population ages and demand for implant-supported restorations increases, developing risk-adjusted protocols will be key to maintaining high standards of care in full-arch implantology.

IV. SUMMARY

This review highlights how smoking acts as a critical risk factor in All-on-4 implant treatment. Compared to non-smokers, patients who smoke face higher chances of implant failure, bone loss, and soft tissue complications. Through comparative analysis, the need for preventive strategies, smoking cessation, and personalized care plans becomes clear for improving the long-term prognosis of full-arch rehabilitations.

V. CONCLUSION

Smoking significantly increases the risk of All-on-4 implant complications and failure. While the treatment remains viable for motivated and medically managed smokers, the importance of smoking cessation, personalized treatment planning, and frequent follow-up cannot be overstated. Dentists must weigh risks carefully and



educate patients to support long-term prosthetic

success and oral health outcomes.

Outcome Measure	Non-Smokers	Smokers
Implant Survival Rate (5-year)	95–98%	82–89%
Peri-implantitis Incidence	10–15%	35–50%
Average Marginal Bone Loss (mm)	1.0–1.5 mm	2.5–4.0 mm
Prosthetic Complications	Low	Moderate to High
Need for Maintenance Visits	Twice/year	3–4 times/year
Patient Satisfaction	High	Moderate

PBMT Effects on Smoking-Related Risks

Challenge in Smokers	How PBMT Helps
Delayed healing due to vasoconstriction	PBMT enhances microcirculation
Impaired osseointegration	Stimulates osteoblast activity and bone regeneration
Higher risk of peri-implantitis	Reduces inflammation and cytokine release
Pain and discomfort	Has an analgesic effect, reducing post-op pain
Risk of early implant failure	Can be used pre- and post-operatively to improve outcomes

REFERENCES

[1]. Chrcanovic BR, Albrektsson T, Wennerberg A. 'Smoking and dental implants: A systematic review and meta-analysis.' J Dent. 2015;43(5):487–498.

[2]. Malo P, de Araujo Nobre M, Lopes A, Moss SM, Molina G. 'A longitudinal study of the survival of All-on-4 implants in smokers versus non-smokers.' Clin Implant Dent Relat Res. 2016;18(4):696–705.

[3]. Moy PK, Medina D, Shetty V, Aghaloo TL. 'Dental implant failure rates and associated risk factors.' Int J Oral Maxillofac Implants. 2005;20(4):569–577.

[4]. Schwarz F, Derks J, Monje A, Wang H-L. 'Peri-implantitis.' J Clin Periodontol. 2018;45(Suppl 20):S246–S266.

[5]. Galindo-Moreno P, León-Cano A, Ortega-Oller I, Monje A, O'Valle F, Catena A. 'Prosthetic complications in All-on-4 patients: A systematic review.' Int J Oral Maxillofac Implants. 2019;34(3):e47–e56.

[6]. Mester E, et al. 'The effect of laser on hair growth of mice.' Radiobiologia Radiotherapia. 1968.

[7]. Aimbire F, Albertini R, et al. 'Low-level laser therapy induces dose-dependent reduction of TNF α levels in acute inflammation.' Inflammation Research. 2006.

[8]. Kreisler M, Al Haj H, D'Hoedt B. 'Effect of low-level laser irradiation on the proliferation of human osteoblast-like

cells: a comparative in vitro study.' Laser in Surgery and Medicine. 2002.