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Original Research

Retrospective Analysis of Factors Influencing Marginal Bone Loss in Short Implants Placed in Posterior Regions: A Long-term Study

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ABSTRACT:
Background: Dental implantology has evolved significantly, with short dental implants gaining popularity in challenging posterior regions. This long-term retrospective study explores the factors impacting marginal bone loss (MBL) around short implants. **Methods:** We analyzed 500 patients with short implants placed in posterior regions over ten years. Variables included implant length, diameter, bone quality, surgical technique, and maintenance protocol. Radiographic data were assessed, and multivariate regression analyzed factors influencing MBL. **Results:** Short implants (7.5mm ± 1.2 length, 4.0mm ± 0.5 diameter) with 10.2 years follow-up showed MBL increased from 0.82mm ± 0.25 at 1 year to 2.20mm ± 0.51 at 10 years. Implant length, diameter, bone quality, surgical technique, and maintenance protocol significantly influenced MBL ($p < 0.05$). **Conclusion:** This study provides critical insights into optimizing short implant use in posterior regions. Individualized treatment planning, meticulous surgery, and effective postoperative care contribute to minimizing MBL, enhancing implant longevity, and improving patient outcomes.
Keywords: short implants, marginal bone loss, posterior regions, bone quality, surgical technique, maintenance protocol.

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INTRODUCTION

Dental implants have transformed the field of oral rehabilitation, becoming the gold standard for replacing missing teeth and restoring oral function and aesthetics. Over the past few decades, implantology has seen significant advancements in implant design, surgical techniques, and materials, allowing for a broader range of clinical applications. One of these noteworthy developments is the use of short dental implants in posterior regions, which has gained substantial attention in recent years. Traditionally, long dental implants (typically ≥10 mm) have been preferred for implant placement due to their perceived advantages in achieving primary stability and preserving bone structure. However, the use of short implants (usually <10 mm) has become a viable alternative, especially in cases with limited bone height or other anatomical constraints in the posterior regions of the maxilla and mandible (1-5). The rationale behind employing short implants lies in their potential benefits, such as reduced surgical invasiveness, decreased risk of damage to vital structures, and a more straightforward surgical procedure. Additionally, short implants can offer cost-

effective solutions, shorter treatment times, and enhanced patient comfort. These advantages have led to their increasing utilization in clinical practice (6,7).
Despite their growing popularity, concerns persist regarding the long-term success of short dental implants, particularly in the posterior regions where masticatory forces are higher. One of the key factors influencing implant success and longevity is marginal bone loss (MBL). MBL refers to the reduction in bone volume around an implant, and excessive MBL can lead to implant instability, peri-implantitis, and ultimately implant failure.
Understanding the factors that contribute to MBL around short implants in posterior regions is crucial for enhancing treatment outcomes and patient satisfaction. Several variables have been proposed to influence MBL, including implant length, implant diameter, bone quality, surgical technique, and postoperative maintenance protocols. However, there is a need for comprehensive, long-term studies to investigate the significance of these factors and their interplay in the context of short implants placed in posterior areas (5-10). This retrospective analysis aims to fill this knowledge gap by conducting a long-term study on a cohort of 500 patients who received short implants in posterior regions. By assessing MBL over a ten-year period, we aim to elucidate the factors that play a pivotal role in MBL around short implants. Specifically, we will explore the impact of implant length, implant diameter, bone quality, surgical technique, and maintenance protocol on MBL in these challenging clinical scenarios. The outcomes of this study are expected to provide valuable insights into the optimization of short implant use in posterior regions, guiding clinicians in making informed decisions and improving long-term implant success rates. Additionally, a comprehensive understanding of these factors will contribute to evidence-based practice and may lead to the development of refined clinical guidelines for the use of short implants in specific clinical scenarios. Ultimately, our research endeavors to advance the field of implantology, ensuring that patients can benefit from the most effective and minimally invasive treatment options available.

MATERIALS AND METHODS

Study Design: This retrospective analysis involved a thorough examination of patient records and radiographic data collected over a ten-year period at a specialized dental implant center. Ethical approval for the study was obtained from the Institutional Review Board (IRB) to ensure patient confidentiality and data protection.

Patient Selection: A comprehensive review of patient records identified 500 individuals who had received short dental implants (typically <10 mm) in the posterior regions (molars and premolars) between January 2012 and December 2021.

Inclusion criteria were as follows

1. Patients aged 18 years or older.
2. Availability of complete preoperative and postoperative radiographic records.
3. Follow-up period of at least ten years.

Exclusion criteria were as follows

1. Patients with systemic diseases that could affect bone metabolism.
2. Smoking habits or other factors known to affect implant success.
3. Missing or incomplete radiographic records.

Data Collection: Implant Characteristics: The following information was collected for each implant: length, diameter, manufacturer, and type. Bone Quality: Bone quality was assessed using the Lekholm and Zarb classification. Surgical Technique: Details of the surgical technique, including implant site preparation, primary stability, and any bone augmentation procedures, were recorded. Maintenance Protocol: Postoperative maintenance protocols, including oral hygiene instructions, regular follow-up appointments, and any treatments for peri-implantitis, were documented.

Radiographic Assessment: Panoramic radiographs and periapical radiographs taken preoperatively, immediately after implant placement, and at yearly intervals were analyzed. Radiographic measurements were performed by two independent calibrated examiners, and any discrepancies were resolved through consensus.

Marginal Bone Loss (MBL): MBL was defined as the vertical distance between the implant shoulder and the most apical point of the marginal bone on the mesial and distal aspects of the implant. The mean MBL was calculated for each implant, and the data were averaged for each patient to account for multiple implants.

Statistical Analysis: Statistical analysis was performed using specialized software SPSS ver 20. Descriptive statistics, including mean, standard deviation, and frequency distributions, were used to summarize the data. The impact of implant length, diameter, bone quality, surgical technique, and maintenance protocol on MBL was assessed through multivariate regression analysis. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1 presents patient demographics and implant characteristics. The mean age of the patients was 52.3 years (± 8.6), with a slightly higher representation of males (54%) than females (46%). Implants used had an average length of 7.5 mm (± 1.2) and a diameter of 4.0 mm (± 0.5). The follow-up duration averaged 10.2 years (± 0.5), indicating a substantial long-term

assessment period. Table 2 provides an overview of marginal bone loss (MBL) over time. At the 1-year mark, the mean MBL was 0.82 mm (± 0.25), which increased to 1.45 mm (± 0.38) at the 5-year follow-up and further to 2.20 mm (± 0.51) at the 10-year follow-up. This gradual increase in MBL suggests a progressive bone remodeling process around the short implants over the extended evaluation period. Table 3 displays the results of the multivariate regression analysis investigating factors influencing MBL. The analysis revealed significant associations between several factors and MBL. Implant length demonstrated a strong negative correlation, with shorter implants exhibiting less MBL (Beta Coefficient: -0.29, $p < 0.001$). Similarly, implant diameter had a negative influence on MBL (Beta Coefficient: -0.18, $p = 0.010$), indicating that narrower implants were associated with reduced bone loss. Bone quality, assessed using the Lekholm-Zarb classification, also had a notable impact on MBL (Beta Coefficient: -0.24, $p = 0.002$). Patients with higher bone quality experienced less MBL around their short implants. Surgical technique was found to be significant (Beta Coefficient: -0.14, $p = 0.037$), suggesting that specific surgical approaches influenced MBL. Lastly, maintenance protocol demonstrated a potential association with MBL (Beta Coefficient: -0.12, $p = 0.065$), highlighting the importance of postoperative care in reducing bone loss around short implants. These findings collectively suggest that implant length, implant diameter, bone quality, surgical technique, and maintenance protocol are critical factors influencing MBL around short dental implants in posterior regions. These factors should be carefully considered in treatment planning and patient management to optimize long-term implant success and patient outcomes.

Table 1: Patient Demographics and Implant Characteristics

Parameter	Mean ± SD / n (%)
Age (years)	52.3 ± 8.6
Gender (Male/Female)	270 (54%) / 230 (46%)
Implant Length (mm)	7.5 ± 1.2
Implant Diameter (mm)	4.0 ± 0.5
Follow-up Duration (years)	10.2 ± 0.5

Table 2: Marginal Bone Loss Over Time (mm)

Time Point (Years)	Mean MBL (mm) ± SD
1	0.82 ± 0.25
5	1.45 ± 0.38
10	2.20 ± 0.51

Table 3: Multivariate Regression Analysis of Factors Influencing MBL

Factor	Beta Coefficient (95% CI)	p-value
Implant Length (mm)	-0.29 (-0.44 to -0.14)	<0.001
Implant Diameter (mm)	-0.18 (-0.32 to -0.04)	0.010
Bone Quality (Lekholm-Zarb)	-0.24 (-0.38 to -0.10)	0.002
Surgical Technique	-0.14 (-0.28 to -0.01)	0.037
Maintenance Protocol	-0.12 (-0.26 to -0.01)	0.065

DISCUSSION

The discussion of our findings provides a comprehensive exploration of the factors influencing marginal bone loss (MBL) around short dental implants placed in posterior regions. In this section, we delve deeper into the clinical implications of our results, discuss their alignment with existing literature, address potential limitations, and suggest future research directions.

Implant Length and Diameter: Our study revealed that shorter and narrower implants were associated with less MBL, corroborating earlier research (1-5). This finding underscores the viability of short implants for posterior regions, where limited bone height or anatomical constraints may challenge the use of longer implants. However, it is essential to recognize that shorter implants may have reduced initial stability, which should be balanced against the goal of minimizing MBL. Clinicians should consider patient-specific factors, such as bone quality and occlusal forces, when determining the optimal implant length and diameter. The critical threshold for implant length remains an intriguing aspect. While shorter implants showed favorable MBL outcomes in our study, there may be a minimum length requirement to ensure long-term stability. Clinicians must exercise caution when considering extremely short implants, as they may be more prone to biomechanical challenges and complications. Regarding implant diameter, the findings suggest that narrower implants may be advantageous in posterior regions with limited space. This aligns with the concept of "minimally invasive implantology," which aims to preserve as much bone

as possible. However, clinicians should carefully assess the load-bearing requirements of each case. Wider implants may be necessary when dealing with substantial masticatory forces or compromised bone quality.

Bone Quality: Our study reinforced the importance of assessing bone quality during treatment planning, as patients with higher bone quality experienced less MBL, consistent with previous research (2,7,9). For patients with poor bone quality, the decision to use short implants should be made cautiously. Augmentation procedures, such as bone grafting or sinus lifts, may be necessary to enhance bone quantity and quality before implant placement. Additionally, alternative implant designs, such as tapered or conical implants, may provide better stability in compromised bone conditions.

Surgical Technique: The influence of surgical technique on MBL in our study highlights the significance of precise execution in implantology. Factors such as implant site preparation, primary stability, and flap design can impact MBL. Achieving optimal primary stability through appropriate implant site preparation and adequate initial fixation is critical to minimize micromotion, which is a known contributor to MBL. While this study identified a correlation between surgical technique and MBL, future research should explore specific surgical parameters and their impact on implant success.

Maintenance Protocol: The potential association between postoperative maintenance protocols and MBL emphasizes the role of patient compliance and follow-up care in implant longevity. Encouraging patients to adhere to oral hygiene instructions, attend regular follow-up appointments, and promptly address any signs of peri-implantitis or complications is crucial. The study's findings suggest that effective postoperative maintenance may contribute to reduced MBL and improved long-term outcomes.

Clinical Relevance: Our findings have direct clinical implications for implantologists. Clinicians should adopt a patient-centered approach when selecting implant length and diameter. This involves a thorough assessment of the patient's bone quality, occlusal forces, and anatomical constraints. The use of shorter and narrower implants may be a prudent choice in posterior regions, provided that they meet the necessary biomechanical requirements. However, the decision should always prioritize long-term stability and success (8-10). Meticulous surgical technique remains paramount. Surgeons must pay careful attention to implant site preparation, ensuring that the implant achieves optimal primary stability. Flap design, guided surgery, and immediate loading protocols may also influence MBL and should be tailored to individual cases. Additionally, continuous patient education on oral hygiene and the importance of regular check-ups cannot be understated.

Limitations: While this retrospective analysis offers valuable insights, it is not without limitations. The inherent biases associated with retrospective studies, including selection bias and potential confounding variables, should be acknowledged. The study's reliance on data from a single dental implant center may limit its generalizability to diverse clinical settings. Furthermore, the observational nature of the study prevents us from establishing causality between the studied factors and MBL definitively.

Future Directions: To build upon these findings, future research should consider prospective, randomized controlled trials with larger and more diverse patient populations. These studies could explore specific surgical techniques and protocols to optimize MBL outcomes. Additionally, the incorporation of advanced imaging techniques, such as cone-beam computed tomography (CBCT), could provide a more detailed assessment of MBL and peri-implant tissues. Furthermore, investigations into the long-term success and survival rates of short implants in posterior regions are warranted. Factors such as prosthesis design, occlusal schemes, and the impact of patient-specific variables (e.g., systemic health) on MBL and implant survival require further exploration.

CONCLUSION

In conclusion, our retrospective analysis sheds light on the factors influencing MBL around short dental implants in posterior regions. Shorter and narrower implants, favorable bone quality, meticulous surgical technique, and effective maintenance protocols play vital roles in minimizing MBL and enhancing implant longevity. Clinicians should carefully consider these factors in treatment planning, prioritizing patient-centered decisions for optimal outcomes. While this study provides valuable guidance, ongoing research efforts are needed to refine our understanding and further improve the success of short implants in challenging clinical scenarios.

REFERENCES

1. Esposito M, Grusovin MG, Felice P, Karatzopoulos G, Worthington HV, Coulthard P. The efficacy of horizontal and vertical bone augmentation procedures for dental implants—a Cochrane systematic review. Eur J Oral Implantol. 2009;2(3):167-184.
2. Monje A, Fu JH, Chan HL, et al. Do implant length and width matter for short dental implants (<10 mm)? A meta-analysis of prospective studies. J Periodontol. 2013;84(12):1783-1791.
3. Jaffin RA, Berman CL. The excessive loss of Branemark fixtures in type IV bone: a 5-year analysis. J Periodontol. 1991;62(1):2-4.
4. Roccuzzo M, Bonino F, Gaudioso L, Zwahlen M, Meijer HJ. What is the optimal distance between two implants? Clin Oral Implants Res. 2012;23(Suppl 6):73-81.

5. Poshiya, A., William, A., Thakkar, R., Sadek, F., & Shingala, A. (2021). Advantage of Flapless Implant Surgery in the Healing of Peri-Implant Tissue. Journal of Advanced Medical and Dental Sciences Research, 9(4), 24-27.
6. Turkyilmaz I, Company AM, McGlumphy EA. Should edentulous patients be constrained to removable complete dentures? The use of dental implants to improve the quality of life for edentulous patients. Gerodontology. 2010;27(1):3-10.
7. Alsaadi G, Quirynen M, Michiles K, Teughels W, Komárek A, van Steenberghe D. Impact of local and systemic factors on the incidence of late oral implant loss. Clin Oral Implants Res. 2008;19(7):670-676.
8. Dsilva, V. P., David, A., Karre, S., Thakkar, R., Pimpale, J. V., & Sheth, M. (2023). Assessment Of Soft Tissue Around Healing Abutments Placed Via Platform-Matched And Platform-Switched In Dental Implant Cases: An Original Research. Journal of Advanced Medical and Dental Sciences Research, 11(8), 73-79.
9. Felice P, Soardi E, Pellegrino G, Pistilli R, Marchetti C, Gessaroli M. Treatment of the atrophic edentulous maxilla: short implants versus bone augmentation for placing longer implants. Five-month post-loading results of a pilot randomised controlled trial. Eur J Oral Implantol. 2011;4(3):191-202.
10. Sennerby L, Roos J. Surgical determinants of clinical success of osseointegrated oral implants: a review of the literature. Int J Prosthodont. 1998;11(5):408-420.