https://doi.org/10.14368/jdras.2026.42.3.181
ISSN 2384-4353 eISSN 2384-4272

Original Article

Comparison of marginal bone loss using different abutment engagement techniques: a clinical study

So-Yee Ahn[1,2,3,4], Soo-Hwan Byun[2,3,4,5], Su-Min Cho[1,2,3,4], Hyun-Sook Han[1,2,3,4], Byoung-Eun Yang[2,3,4,5]*, Lee-Kyoung Kim[1,2,3,4]*

[1]*Department of Prosthodontics, Hallym University Sacred Heart Hospital, Anyang, Republic of Korea*
[2]*Department of Artificial Intelligence and Robotics in Dentistry, Graduate School of Clinical Dentistry, Hallym University, Chuncheon, Republic of Korea*
[3]*Institute of Clinical Dentistry, Hallym University, Chuncheon, Republic of Korea*
[4]*Dental Artificial Intelligence and Robotics R&D Center, Hallym University Medical Center, Anyang, Republic of Korea*
[5]*Department of Oral and Maxillofacial Surgery, Hallym University Sacred Heart Hospital, Anyang, Republic of Korea*

Purpose: This study aimed to compare marginal bone loss between two different abutment engagement techniques—fully engaging abutments versus hemi-engaging abutments (one engaging and one non-engaging)—in 3-unit implant supported fixed dental prostheses. **Materials and Methods:** A total of 28 patients treated at Hallym University Sacred Heart Hospital between 2021 and 2025 were retrospectively reviewed. All patients received two implants to support a 3-unit fixed dental prosthesis (FDP), resulting in a total of 28 prostheses evaluated. Prostheses were divided into two groups: the control group used two engaging abutments (n = 14), and the experimental group used one engaging and one non-engaging abutment (n = 14). Marginal bone loss (MBL) were evaluated via standardized periapical and panoramic radiographs at 3, 6, and 12 months after prosthesis delivery. Statistical analysis was conducted using independent t-tests with a significance level set at $P < 0.05$. **Results:** While numerical differences in MBL were observed between the two groups at all time points, none were statistically significant ($P > 0.05$). Both groups demonstrated MBL values within the clinically acceptable range (< 1.5 mm at 1 year). **Conclusion:** No statistically significant difference in MBL was observed between the hemi-engaging and fully engaging techniques. Further longitudinal studies with larger sample sizes are warranted to evaluate long-term mechanical complications and prosthetic outcomes. **(J Dent Rehabil Appl Sci 2026;42(3):181-9)**

Key words: implant prosthesis; dental implant-abutment design; alveolar bone loss; retrospective studies

Introduction

Dental implants provide a predictable solution for partially edentulous patients.[1] One of the critical goals in implant therapy is the preservation of marginal bone stability.[2] While some degree of marginal bone loss (MBL) is expected over time, minimizing this loss is essential for the long-term success of

*Correspondence to: Byoung-Eun Yang
Professor, Department of Oral and Maxillofacial Surgery, Hallym University Sacred Heart Hospital, 22, Gwanpyeong-ro 170beon-gil, Dongan-gu, Anyang, 14068, Republic of Korea
Tel: +82-31-380-3870, Fax: +82-31-380-1726, E-mail: face@hallym.ac.kr
*Correspondence to: Lee-Kyoung Kim
Professor, Department of Prosthodontics, Hallym University Sacred Heart Hospital, 22, Gwanpyeong-ro 170beon-gil, Dongan-gu, Anyang, 14068, Republic of Korea
Tel: +82-31-380-5978, Fax: +82-31-380-1726, E-mail: 2gyoung2@naver.com
*Contributed equally to this work as corresponding authors.
Received: April 23, 2026/Last Revision: May 15, 2026/Accepted: June 5, 2026

Copyright© 2026 The Korean Academy of Stomatognathic Function and Occlusion.
©It is identical to Creative Commons Non-Commercial License.

implant treatments.[3] Stress from the interaction between the implant and prosthesis is known to be one of the main causes of bone loss, and these loads are influenced by the way the prosthesis is connected.[4]

The method of prosthesis fixation, including cement-retained and screw-retained designs, may influence stress transmission to the peri-implant bone and subsequently affect marginal bone stability.[5]

Abutment-implant connections also influence the mechanical and biological stability of implant-supported prostheses. Internal connections with anti-rotational features may improve mechanical stability and reduce micromovement at the implant-abutment interface.[6-8] Non-engaging abutments, while lacking these mechanical interlocks, are commonly used in splinted multi-unit restorations to accommodate implant non-parallelism.[9]

To address the challenges posed by non-parallel implants, Megagen introduced a modified non-engaging abutment for the Blue Diamond implant system (Megagen Implant Co., Ltd., Daegu, Korea).[10] By eliminating octa structure and shortening the internal connection length, prosthetic divergence tolerance is improved.[11] Fig. 1 illustrates the difference between engaging and non-engaging abutments. However, the reduced mechanical interlocking of non-engaging abutments may increase stress concentration on the abutment screw and potentially increase the risk of mechanical complications.[12,13]

The hemi-engaging concept, which uses a combination of engaging and non-engaging abutments, was introduced to balance stability and prosthetic manageability. This design aims to maintain partial internal connection stability while enhancing retrievability. The advantages of this technique are most evident for short-span (fewer than 5 units), screw-retained, implant-supported fixed dental prostheses (FDPs).[14]

Although several studies have reported the potential benefits of the hemi-engaging technique, clinical comparative data regarding MBL between hemi-engaging and fully engaging techniques remain limited. This study aims to evaluate the MBL in 3-unit implant-supported FDPs using either fully engaging abutments or a hemi-engaging configuration. In addition, subgroup analysis was performed to investigate the influence of engaging abutment location on MBL within the hemi-engaging group. Follow-up

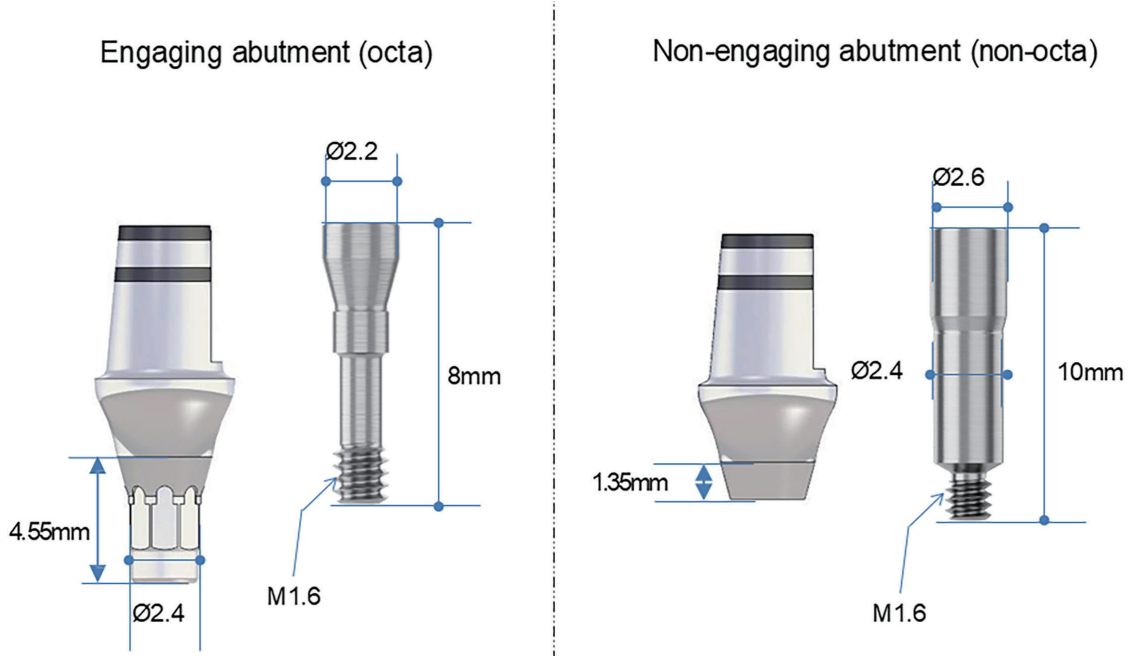

Fig. 1. Comparison of engaging and non-engaging abutment designs in the Megagen BlueDiamond (BD) system.

periods included assessments at 3, 6, and 12 months. The null hypothesis was that there would be no significant difference in MBL between the two abutment engagement strategies.

Materials and Methods

This study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Hallym University Sacred Heart Hospital Institutional Review Board (IRB No. 2024-09-003-002).

Patients were screened retrospectively from those treated between 2021 and 2025 at Hallym University Sacred Heart Hospital. Inclusion criteria included patients who received 3-unit implant-supported fixed dental prostheses using two implants and had at least 1 year of follow-up after prosthesis delivery. Patients were excluded if they had insufficient radiographic records, incomplete follow-up data, uncontrolled systemic conditions, a history of radiation therapy to the head and neck region, anti-resorptive medication use, active periodontal disease, severe periodontitis, or uncontrolled peri-implant inflammation.

A total of 28 patients who satisfied the study criteria were ultimately included in the final analysis. Due to the retrospective nature of this study, the sample size was determined based on the availability of eligible cases during the study period. All surgeries were performed by two experienced oral surgeons, and prosthetic treatments were carried out by two prosthodontists.

Implants were divided into two groups: Control Group: Two engaging abutments (n = 14), Experimental Group: One engaging and one non-engaging abutment (n = 14). All cases involved two implants supporting a 3-unit screw-retained FDP using the Megagen Blue Diamond implant system (Megagen Implant Co., Ltd.).

Standardized periapical radiographs using XCP holders and panoramic radiographs were obtained immediately after prosthesis delivery (baseline) and at 3, 6, 12 months post-restoration. Marginal bone level measurements were primarily performed using standardized periapical radiographs. Panoramic radiographs were used only as supplementary references when standardized periapical radiographs were unavailable or insufficient for evaluation. To minimize the influence of magnification and distortion across different imaging modalities, all measurements were calibrated using the known length of the implant as an internal reference using M6 PACS software (INFINITT Healthcare, INFINITT Co. Ltd., Seoul, South Korea).[15,16] MBL was defined as the vertical distance from the implant platform to the most coronal point of bone-to-implant contact. Measurements were performed at both mesial and distal aspects of each implant, and the average value was used for analysis. Fig. 2 illustrates the reference lines and points utilized in the measurements. All measurements were performed by a single calibrated examiner to reduce inter-examiner variability.

All data were analyzed using SPSS version 27.0 (IBM, Armonk, USA). Data were analyzed for normality using the Shapiro-Wilk test. Independent t-tests were used to compare MBL between the two groups at each time point. Statistical significance was set at $P < 0.05$.

Results

Demographic characteristics such as age, sex, and implant location were balanced across both groups. All implants survived during the observation period.

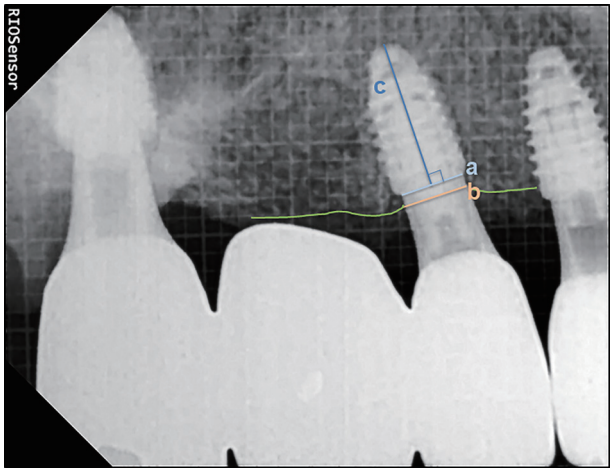

Fig. 2. Reference points and measurement lines used for marginal bone level assessment. (A) implant platform, (B) coronal point of bone-to-implant contact, (C) implant height.

Table 1 shows the characteristics of study participants. A total of 28 patients were included in the study, comprising 10 males and 18 females, with a mean age of 64.42 ± 17.02 years. Sex, mean age, restoration type and implant placement site were balanced between the two groups. No implant failures were observed during the observation period.

Table 2 presents the mean absolute MBL values at each follow-up time point (3 months, 6 months, and 1 year), whereas Table 3 summarizes the changes in MBL during each follow-up interval (3 - 6 months, 6 - 12 months, and 3 - 12 months). Although numerical differences were observed between the groups at each time point, none reached statistical significance. All values remained within the clinically acceptable range for MBL (< 1.5 mm during the first year).[3]

As seen in Table 4, within the hemi-engaging group, a subgroup analysis was conducted comparing prostheses with the engaging abutment positioned mesially versus distally. The mean MBL was 1.16 ± 0.82 mm in the mesial engaging subgroup (n = 6) and 0.82 ± 0.21 mm in the distal engaging subgroup (n = 5). The difference between the two subgroups was not statistically significant (t = 0.973, *P* = 0.369).

Table 1. Participant characteristics

	Hemi-engaging	Fully Engaging	Total	*P*-value
Male	6	4	10	0.683
Female	8	10	18	
Age (Mean ± SD)	69.79 ± 10.27	58.17 ± 21.32	64.42 ± 17.02	0.105
Restoration type: SCRP	8	5	13	0.112
Restoration type: CEM	6	9	15	
Site (implant location)				
1 = 1	0	1	1	
1 = 3	0	2	2	
2 = 1	0	1	1	0.412
2 = 4	1	0	1	
4 = 6	5	4	9	
5 = 7	8	6	14	

SD: standard deviation; SCRP: screw- and cement-retained prosthesis; CEM: cement-retained prosthesis.

Table 2. Mean marginal bone loss (MBL) values at each follow-up time point

Time point	Hemi-engaging Mean MBL (mm)	Fully Engaging Mean MBL (mm)	t-statistic	*P*-value
3 months	+0.056	-0.0008	+0.686	0.501
6 months	-0.219	+0.045	-1.187	0.276
1 year	-0.125	-0.014	-0.771	0.454

MBL; marginal bone loss.

Table 3. Changes in marginal bone loss (MBL) during each follow-up interval

Time interval	Hemi-engaging Mean MBL (mm)	Fully Engaging Mean MBL (mm)	t-statistic	*P*-value
3 - 6 months	-0.264	+0.046	-1.465	0.192
6 - 12 months	+0.019	-0.049	+0.532	0.613
3 - 12 months	-0.206	+0.026	-1.617	0.145

MBL: marginal bone loss.

Table 4. Comparison of marginal bone loss (MBL) according to engaging abutment location within the hemi-engaging group

	Mesial engaging (n = 6)	Distal engaging (n = 5)
Mean MBL (mm)	1.16	0.82
Standard Deviation (SD)	± 0.82	± 0.21
t-statistic	0.973	
P-value	0.369	

MBL: marginal bone loss.

Discussion

In multi-implant-supported splinted prostheses, achieving parallel alignment of all implants is rarely possible.[17] Many internal connection systems have long, nearly parallel engagement zones that enhance the implant-abutment joint's stability but create challenges in establishing a proper path of insertion for multiunit restorations. To overcome this, non-engaging abutments are commonly used; however, this approach increases stress on the abutment screws, potentially increasing the risk of screw loosening or fracture.[18]

The proposed hemi-engaging FDP concept utilizes a combination of engaging and non-engaging abutments. This hybrid strategy may help maintain the mechanical stability of the internal connection while simplifying intraoral handling.[14]

The findings did not demonstrate a statistically significant difference in MBL between the two groups. Within the limitations of this study, hemi-engaging prosthetic designs showed MBL values within clinically acceptable ranges. The partial use of engaging components may help maintain internal connection stability while improving prosthetic retrievability in non-parallel implant configurations.

With engaging abutments alone, the prosthesis may be less retrievable and may be difficult to remove for extraoral cement removal. The hemi-engaging technique, on the other hand, may improve retrievability, allowing more reliable removal of excess cement after cementation of the implant prosthesis. Excess cement has been recognized as a potential risk factor for peri-implant disease in previous studies.[19-21] Fig. 3 shows excess cement extending beyond the implant margin, which may pose a biological risk to peri-implant tissues. This finding is also relevant to screw- and cement-retained prosthesis (SCRP) concepts, in which retrievability facilitates extraoral cement removal before final fixation.

One case of horizontal fracture occurred in the experimental group at the non-engaging abutment site. This complication may have been associated with parafunctional loading and the reduced structural thickness of the modified non-engaging abutment design. However, because only one fracture occurred, this finding should be interpreted cautiously. This finding may be partially consistent with previous biomechanical studies suggesting that abutment connection design can influence stress distribution and micro-movement patterns around implants.[22]

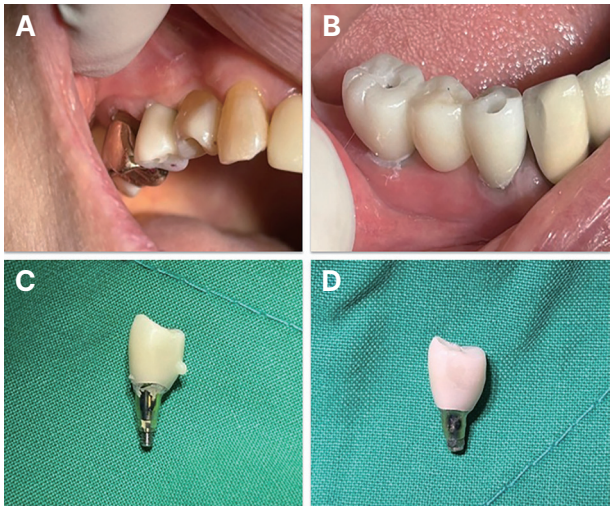

Fig. 3. Representative images demonstrating residual cement associated with implant prostheses. (A, B) Residual cement leakage beneath peri-implant soft tissue, (C) SCRP-type prosthesis removed after cementation showing excess cement beyond the abutment margin, (D) Clean removal of excess cement.

Engaging prostheses have the advantage of a more stable internal connection, which is favorable for stress distribution.[18] The hemi-engaging approach, on the other hand, simplifies the insertion path of the multiunit prosthesis by having one abutment non-engaged, but this may increase stress concentration on the abutment screws and microscopic movement.[14] In the present study, the hemi-engaging group showed an average MBL of −0.26 mm over 3 - 6 months, whereas the engaging group showed a slight bone remodeling trend of 0.04 mm. This pattern may reflect early bone remodeling or biomechanical adaptation during the initial period after prosthesis delivery. However, long-term follow-up (6 - 12 months) showed stabilization in both groups.

Although not statistically significant, opposite temporal trends in MBL were observed between the hemi-engaging and fully engaging groups during the first year after prosthesis delivery. One possible explanation is that the two engagement designs may differ in the manner and timing of force transmission to the implant-abutment interface. In the hemi-engaging configuration, the presence of a non-engaging component may permit a small degree of prosthetic accommodation, potentially reducing initial stress concentration and allowing an apparent improvement in radiographic bone levels during the early loading period. Conversely, the fully engaging configuration may provide greater mechanical rigidity, potentially resulting in greater initial load transfer to the peri-implant bone and subsequent early remodeling. As functional adaptation progresses, however, both designs may eventually reach a similar biomechanical equilibrium, which could explain the convergence of MBL values over time. Nevertheless, because the observed differences were not statistically significant and the sample size was limited, these findings should be interpreted with caution.

Analysis of differences in 1-year MBL by engagement location within the hemi-engaging group also showed no significant differences. Therefore, the null hypothesis that there would be no significant difference in MBL between the two groups was not rejected.

Mesial engagement exhibited a greater mean MBL of 0.34 mm compared with distal engagement; however, the difference was not statistically significant (P = 0.369). Therefore, the null hypothesis regarding the influence of engagement location on MBL was not rejected.

Despite the lack of statistical significance, the observed tendency toward higher MBL in the mesial engaging group may suggest a biomechanical influence related to load distribution. When the engaging abutment is positioned mesially, occlusal forces generated in the posterior region may produce a longer lever arm relative to the point of fixation, potentially increasing bending moments and stress concentration at the implant-abutment interface. In contrast, distal engagement may allow occlusal loads to be transferred more directly along the implant axis, thereby reducing non-axial loading and minimizing stress concentration.[22,23] However, further studies with larger sample sizes are required before any clinical implications can be established.

The hemi-engaging group showed the greatest bone loss in the 3 to 6 month period, followed by a relatively stable pattern in the 6 to 12 month period. This may be due to occlusal stress and early bone remodeling during the initial period of prosthesis placement. The engaging group, on the other hand, showed a stable trend with small overall changes, which may be related to the superior microgap level and stress distribution provided by the internal connections.

Limitations of this study include the small sample size, relatively short observation period, and the retrospective study design, which may have introduced selection bias and limited statistical power. In addition, potential confounding factors such as implant location, bone quality, prosthesis design, parafunctional habits, and opposing dentition were not fully controlled. Radiographic measurement errors should also be considered when interpreting the results, as all measurements were performed by a single calibrated examiner without evaluation of intra-examiner reliability. Furthermore, although longitudinal follow-up data were included, repeated-measures statistical methods were not applied, and correlations among repeated measurements from the same pa-

tient may not have been fully reflected in the analysis. Therefore, further studies with larger sample sizes, longer follow-up periods, and more robust statistical approaches, such as repeated-measures ANOVA or mixed-effects models, are required to validate these findings and evaluate long-term mechanical complications.

Another limitation of this study is that all prosthetic treatments were performed using a specific implant system, which features a uniquely modified non-engaging abutment design with a shortened internal connection. This distinctive geometry may influence stress distribution patterns and mechanical behavior. Therefore, the findings of this study may not be directly generalizable to other implant systems with different abutment designs, and caution should be exercised when extrapolating these results.

In addition, the mechanical characteristics of non-engaging abutments warrant further investigation. Due to the shortened internal connection and the absence of anti-rotational features, a greater proportion of functional load may be transferred to the abutment screw. This may increase the risk of mechanical complications such as screw loosening or fracture. Therefore, further studies focusing on the long-term mechanical stability and complication rates of non-engaging abutments are necessary.

In this study, the hemi-engaging design maintained a clinically acceptable level of MBL at 1-year follow-up without showing a statistically significant difference compared to the fully engaging design. These findings should be interpreted with caution, as the absence of statistical significance does not imply equivalence between the two approaches.

Conclusion

Within the limitations of this study, no statistically significant difference in MBL was observed between the hemi-engaging and fully engaging configurations. Both approaches demonstrated MBL within clinically acceptable limits. Further studies with larger sample sizes and longer follow-up periods are required to determine any potential differences between the two techniques.

ORCID

So-Yee Ahn https://orcid.org/0009-0002-7812-1948
Soo-Hwan Byun https://orcid.org/0000-0003-0739-7971
Su-Min Cho https://orcid.org/0009-0003-5356-1653
Hyun-Sook Han https://orcid.org/0000-0002-6801-3671
Byoung-Eun Yang https://orcid.org/0000-0002-4446-6772
Lee-Kyoung Kim https://orcid.org/0009-0004-0989-3308

References

1. Weber HP, Sukotjo C. Does the type of implant prosthesis affect outcomes in the partially edentulous patient? Int J Oral Maxillofac Implants 2007; 22 Suppl:140-72.
2. Fu PS, Lan TH, Lai PL, Chen CH, Chen JH, Wang JC, Liu CT, Chen WC, Hung CC. Implant stability and marginal bone level changes: a 2-year prospective pilot study. J Dent Sci 2023;18:1272-9.
3. Albrektsson T, Zarb G, Worthington P, Eriksson AR. The long-term efficacy of currently used dental implants: a review and proposed criteria of success. Int J Oral Maxillofac Implants 1986;1:11-25.
4. Choi S, Kang YS, Yeo IS. Influence of implant-abutment connection biomechanics on biological response: a literature review on interfaces between implants and abutments of titanium and zirconia. Prosthesis 2023;5:527-38.
5. de Brandão ML, Vettore MV, Vidigal GM Jr. Peri-implant bone loss in cement- and screw-retained prostheses: systematic review and meta-analysis. J Clin Periodontol 2013;40:287-95.
6. Caricasulo R, Malchiodi L, Ghensi P, Fantozzi G, Cucchi A. The influence of implant-abutment connection on peri-implant marginal bone loss: a systematic review and meta-analysis. Clin Implant Dent Relat Res 2018;20:653-64.
7. Norton MR. Assessment of cold welding properties of the internal conical interface of two commercially available implant systems. J Prosthet Dent 1999;81:159-66.
8. Jeong KW, Kim JC, Yeo IS. Clinical significance of internal friction connection and microthreads in implant-supported prostheses: a literature review. Recent Prog Mater 2020;2:024.

9. Alzoubi FM, Sabti MY, Alsarraf E, Alshahrani FA, Sadowsky SJ. Engaging vs. non-engaging abutments: an in vitro study evaluating changes in microgap and screw morphology. Dent J (Basel) 2024;12:265.
10. Byun SH, Seo JH, Cho RY, Yi SM, Kim LK, Han HS, On SW, Kim WH, An HW, Yang BE. Finite element analysis of a new non-engaging abutment system for three-unit implant-supported fixed dental prostheses. Bioengineering (Basel) 2022;9:483.
11. Cho SM, Byun SH, Ahn SY, Han HS, On SW, Park SY, Yi SM, Park IY, Yang BE, Kim LK. Biomechanical evaluation of a novel non-engaging abutment and screw in internal implant systems: comparative fatigue and load testing. J Funct Biomater 2025;16:107.
12. Tribst JPM, Dal Piva AMO, da Silva Concílio LR, Ausiello P, Kalman L. Influence of implant-abutment contact surfaces and prosthetic screw tightening on stress concentration, fatigue life and microgap formation: a finite element analysis. Oral 2021;1:88-101.
13. Alzoubi FM, Sabti M, Alsarraf E, Alshahrani FA, Sadowsky SJ. Evaluation of two implant-supported fixed partial denture abutment designs: influence on screw surface characteristics. J Prosthodont 2024;33:443-51.
14. Schoenbaum TR, Stevenson RG, Balinghasay E. The hemi-engaging fixed dental implant prosthesis: a technique for improved stability and handling. J Prosthet Dent 2018;120:17-9.
15. Koo SM, Kang DY, Hieu PD, Shin HS, Park JC. A retrospective study on the factors affecting the early marginal bone loss of tissue-level implants. J Implantol Appl Sci 2021;25:158-169.
16. Nandal S, Ghalaut P, Shekhawat H. A radiological evaluation of marginal bone around dental implants: An in-vivo study. Natl J Maxillofac Surg 2014;5:126-137.
17. Wee AG, Aquilino SA, Schneider RL. Strategies to achieve fit in implant prosthodontics: a review of the literature. Int J Prosthodont 1999;12:167-78.
18. Savignano R, Soltanzadeh P, Suprono MS. Computational biomechanical analysis of engaging and nonengaging abutments for implant screw-retained fixed dental prostheses. J Prosthodont 2021;30:604-9.
19. Linkevicius T, Puisys A, Vindasiute E, Linkeviciene L, Apse P. Does residual cement around implant-supported restorations cause peri-implant disease? A retrospective case analysis. Clin Oral Implants Res 2013;24:1179-84.
20. Wilson TG Jr. The positive relationship between excess cement and peri-implant disease: a prospective clinical endoscopic study. J Periodontol 2009;80:1388-92.
21. Korsch M, Obst U, Walther W. Cement-associated peri-implantitis: a retrospective clinical observational study of fixed implant-supported restorations using a methacrylate cement. Clin Oral Implants Res 2014;25:797-802.
22. Siripru J, Puengpaiboon U, Sukjamsri C, Mahardawi B, Aimjirakul N. Impact of type and position of abutment connection on microstrain distribution: an in vitro study. J Adv Prosthodont 2024;16:290-301.
23. Flanagan D. Bite force and dental implant treatment: a short review. Med Devices (Auckl) 2017;10:141-8.

지대주 결합 방식에 따른 변연골 소실량 비교: 임상 연구

안소이[1,2,3,4] 전공의, **변수환**[2,3,4,5] 교수, **조수민**[1,2,3,4] 전공의, **한현숙**[1,2,3,4] 교수, **양병은**[2,3,4,5*] 교수, **김이경**[1,2,3,4*] 교수

[1]한림대학교 성심병원 보철과
[2]한림대학교 임상치의학대학원 치과 인공지능 및 로보틱스학과
[3]한림대학교 임상치의학연구소
[4]한림대학교 의료원 치과 인공지능 및 로보틱스 연구개발센터
[5]한림대학교 성심병원 구강악안면외과

목적: 본 연구의 목적은 3본 임플란트 지지 고정성 보철물에서 두 가지 지대주 연결 방식, 즉 fully engaging과 hemi-engaging방식 간의 변연골 소실량을 비교하는 데 있다.
연구 재료 및 방법: 2021년부터 2025년까지 한림대학교 성심병원에서 치료받은 총 28명의 환자를 대상으로 후향적 분석을 시행하였다. 모든 환자에서 3본 고정성 보철물을 지지하기 위해 두 개의 임플란트가 식립되었으며, 총 28개의 보철물이 평가에 포함되었다. 보철물은 두 군으로 나누어 분석하였다. 대조군은 두 개의 engaging 지대주를 사용한 군(n = 14)이며, 실험군은 하나의 engaging 지대주와 하나의 non-engaging 지대주를 사용한 군(n = 14)이다. 변연골 소실량(Marginal Bone Loss, MBL)은 보철물 장착 후 3개월, 6개월, 12개월 시점에서 표준화된 치근단 방사선 사진 및 파노라마 방사선 사진을 이용하여 평가하였다. 통계 분석은 독립표본 t-검정을 사용하였으며, 유의수준은 $P < 0.05$로 설정하였다.
결과: 모든 관찰 시점에서 두 군 간 MBL의 수치적 차이는 관찰되었으나 통계적으로 유의하지는 않았다($P > 0.05$). 두 군 모두 임상적으로 허용 가능한 범위(1년 기준 < 1.5 mm) 내의 MBL 값을 보였다.
결론: 본 연구의 한계 내에서, hemi-engaging 연결방식과 fully engaging 연결방식 간 MBL에서 통계적으로 유의한 차이는 관찰되지 않았으며, 두 군 모두 임상적으로 허용 가능한 범위를 보였다. 향후 장기적인 기계적 합병증 및 보철적 결과를 평가하기 위해서는 더 큰 표본 수를 포함한 장기 추적 연구가 필요하다.

(구강회복응용과학지 2026;42(3):181-9)

주요어: 임플란트 보철; 임플란트-지대주 설계; 치조골 소실; 후향적 연구

*교신저자: 양병은
(14068)경기도 안양시 동안구 관평로 170번길 22 한림대학교 성심병원 구강악안면외과
Tel: 031-380-3870 | Fax: 031-380-1726 | E-mail: face@hallym.ac.kr
*교신저자: 김이경
(14068)경기도 안양시 동안구 관평로 170번길 22 한림대학교 성심병원 보철과
Tel: 031-380-5978 | Fax: 031-380-1726 | E-mail: 2gyoung2@naver.com
*이 연구의 교신저자로 동일한 기여를 하였음.
접수일: 2026년 4월 23일 | 수정일: 2026년 5월 15일 | 채택일: 2026년 6월 5일