

Case Series

Evaluation of the occlusal scheme of posterior implant-supported single crowns for patients treated by university students in Riyadh: case series

Abdulaziz Abdullah Alabood*

Department of Dentistry, College of Dentistry, King Saud University, Riyadh, Saudi Arabia

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*Correspondence:

Dr. Abdulaziz Abdullah Alabood,
E-mail: abdulaziz438101@gmail.com

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ABSTRACT

Dental implant-supported crowns have become the standard of care for replacing missing teeth due to their predictable outcomes and high success rates. As a result, they become a routine treatment in dental practice, necessitating a thorough understanding of implant restoration principles and maintenance. However, long-term implant survival is significantly influenced by the forces exerted on the implant restoration. Excessive occlusal forces beyond the physiological limits of the bone can lead to crestal bone loss, peri-implantitis, and increased pocket depth. The objectives of this study is to assess the occlusion contact, cuspal inclination, table width of posterior implant-supported single crowns, and its impact on bone loss around the implant among patients treated by King Saud University fifth year undergraduate students between 2020 and 2022 at the Dental University Hospital Clinics, King Saud University. Analysis of the examined (n=8 patients), indicates the majority of implant crowns did not adhere to the recommended standards for prosthetic single implant-supported crown design, specifically regarding table width, cuspal inclination, and occlusal contact. Notably, no clear evidence of bone loss was observed in the examined patients. A significant number of implant crown placed by dental students in this study exhibit deviation from recommended prosthetic design. This highlight a potential area for improvement in students training and clinical practice related to single-implant restoration. However, no definitive bone loss was observed around implant during the short-term period. Therefore, further studies are needed to re-evaluate these findings over the long term for confirmation.

Keywords: Implant crowns, Occlusal scheme, University students, Riyadh

INTRODUCTION

Dental implant-supported crowns have become the stander of care for replacing missing teeth due to their predictable outcomes and high success rates.¹ As a result, they have become a routine treatment in dental practice, necessitating a thorough understanding of implant restoration principles and maintenance.² In this vein, osseointegration, the complete integration of a dental implant with the surrounding bone, is crucial for initial implant success. However, long-term implant survival is significantly influenced by the forces exerted on the implant restoration. Excessive occlusal forces beyond the physiological limits of the bone can lead to crestal bone loss, peri-implantitis,

and increased pocket depth. Consequently, meticulous attention to implant restoration design and patient oral hygiene is essential.¹⁻⁴

Natural teeth and dental implants exhibit distinct properties under functional forces. The periodontal ligament (PDL) surrounding natural teeth acts as a shock absorber, dissipating occlusal forces and protecting the underlying bone. In contrast, dental implants lack this protective mechanism, resulting in direct force transmission to the bone and increased risk of crestal bone loss.^{4,5} Axial displacement of natural teeth under load is significantly greater (25-100 micrometers) compared to dental implants (3-5 micrometers). Furthermore, natural teeth undergo two distinct loading phases: a nonlinear, complex phase within

the PDL, followed by a linear, elastic phase involving the alveolar bone. Dental implants, however, exhibit only a linear, elastic response determined by bone stiffness.^{4,5} Lateral forces are also tolerated differently. Natural teeth can withstand lateral forces, distributing them to the apical third of the root. Dental implants, however, are more susceptible to lateral forces, which are concentrated around the implant crest.⁴

Mutually protected articulation is considered the ideal occlusal scheme for implant-supported crowns in the posterior region. This concept based on preventing the posterior implant crowns from contacting opposing teeth during lateral or protrusive movements, relieving the implants from excessive lateral forces.² Moreover, by eliminating these non-axial forces, the risk of technical complications, such as screw loosening or ceramic chipping is significantly reduced.³ This means that the direction of occlusal forces on implant-supported restoration is crucial. Axial or vertical occlusal loads, aligned with the implant's long axis, are considered favorable as they distribute forces evenly to the surrounding bone.⁴ Conversely, lateral or off-axis occlusal forces generate shear stresses at the bone-implant interface, increasing the risk of crestal bone loss and implant complications.¹

In addition to the direction of occlusal forces, the width of the occlusal table of implant-supported crowns and cusp angle play critical roles. The width of the occlusal table of implant-supported crowns influences implant longevity. A narrower occlusal table reduce the leverage effect and lateral forces exerted on the implant, thereby decreasing the risk of technical and biological complications.² To optimize implant success, it is recommended to create occlusal tables for implant crowns that are narrower than those of natural teeth.³ Reduced cusp angles, typically between 20 and 30 degrees, are generally preferred over steeper cusp angles, as they help to distribute occlusal forces more evenly, minimizing the risk of lateral forces on the implant-bone interface.¹

Given these critical roles, the main objectives of this study are to assess the occlusal contact position of posterior implant-supported single crowns for patients treated by King Saud University students between 2020 and 2022, the width of the occlusal table and cuspal inclination in relation to natural adjacent and contralateral teeth, and to assess any crestal bone loss associated with evaluated crown.

CASE SERIES

Case 1

A 58-year-old medically fit male presented with a previously placed implant-supported crown at the maxillary left first molar (#26), which was restored in 2020. Clinical occlusal evaluation revealed a group function scheme. Articulation paper applied during heavy

occlusion showed passive contact, indicating acceptable occlusal height. The implant crown's cuspal inclination appeared less steep than that of the adjacent natural teeth. Using a Boley gauge, the occlusal table width of the implant crown measured 12 mm, consistent with the contralateral tooth. Periodontal examination using a plastic probe showed a maximum probing depth of 4 mm, although signs of peri-mucositis were present around the implant. A bitewing radiograph was obtained and showed stable crestal bone levels with no signs of bone loss compared to the baseline image taken at the time of crown delivery.

Case 2

A 53-year-old medically fit male was reviewed for the assessment of an implant-supported crown placed in 2022 at the maxillary right first molar (#16). The patient demonstrated a group function occlusion. Upon evaluation with articulation paper during heavy bite, a high contact was identified at the distal aspect of the crown. The cuspal inclination was found to match the adjacent natural tooth. Occlusal table width was measured at 11 mm, which was consistent with the opposing and neighboring teeth. Periodontal probing indicated a maximum depth of 5 mm, with healthy peri-implant tissue and no signs of inflammation. Radiographic evaluation with bitewing imaging confirmed the absence of bone loss when compared to the crown delivery baseline.

Case 3

A 47-year-old female with a medical history of diabetes mellitus presented for examination of her mandibular right first molar implant crown (#46), placed in 2022. The patient exhibited a mutually protected occlusal scheme. Articulation paper revealed a high contact area on the mesial surface of the implant crown during maximal occlusion. The cuspal inclination was in harmony with the adjacent tooth. Measurement with a Boley gauge indicated the crown had an occlusal table width of 9.5 mm, slightly narrower than the neighboring natural tooth, which measured 10.5 mm. Periodontal evaluation showed a maximum pocket depth of 3 mm, with no signs of peri-implant disease. Bitewing radiography demonstrated stable bone levels around the implant, consistent with the initial records.

Case 4

A 45-year-old medically fit female was evaluated for an implant-supported restoration placed in 2022 at the mandibular left first molar (#36). The occlusal relationship was found to be mutually protected. Heavy bite assessment revealed high contact on both the mesial surface and the mesiolingual cusp of the implant crown. The crown's cuspal inclination was comparable to the adjacent natural dentition. Occlusal table width measured 10.5 mm, slightly wider than the adjacent tooth (9.5 mm). Periodontal probing depths were within normal limits, with a

maximum of 3 mm and no signs of peri-implant inflammation. Radiographs confirmed the absence of any peri-implant bone loss compared to the baseline.

Case 5

A 65-year-old male with no significant medical history attended a follow-up for his mandibular left first molar implant crown (#36), which had been placed in 2021. The occlusion was mutually protected. Articulation paper revealed high contact areas on the distal aspect and distolingual cusp of the crown during heavy bite. The cuspal inclination was appropriate and aligned with adjacent teeth. Table width measured 11 mm, as same as the molar contralateral natural tooth. Periodontal assessment showed a maximum probing depth of 5 mm; tissues were otherwise healthy with no bleeding or inflammation. Radiographic examination using bitewing imaging demonstrated no evidence of crestal bone loss.

Case 6

A 46-year-old medically fit male was reviewed for his implant crown at the maxillary right first molar site (#16), placed in 2021. The occlusion exhibited a mutually protected scheme. Clinical assessment using articulation paper under heavy bite revealed high contact points at both the mesial and distobuccal aspects of the crown. The crown's cuspal inclination appeared slightly flatter than the adjacent natural tooth. Occlusal table width was measured at 12 mm, consistent with the neighboring tooth. Periodontal probing showed a maximum depth of 5 mm. Despite the probing depth, peri-mucositis was noted, with minor soft tissue inflammation. Bitewing radiograph showed stable bone levels when compared with the initial crown delivery radiograph.

Case 7

A 43-year-old medically fit female presented for evaluation of her mandibular right first molar implant crown (#46), placed in 2021. Occlusal assessment confirmed a mutually protected scheme. Articulation paper testing during maximal occlusion revealed a high contact area on the distal surface of the implant crown. The cuspal inclination matched the natural neighboring tooth. The occlusal table width was 11 mm, consistent with surrounding teeth. Periodontal probing revealed a maximum depth of 4 mm, with no signs of inflammation or peri-implant disease. Radiographic imaging showed no crestal bone changes when compared to the baseline.

Case 8

A 51-year-old medically fit female underwent evaluation for her maxillary left first molar implant crown (#36), which was restored in 2021. The patient demonstrated a mutually protected occlusion. No high occlusal contact was noted with articulation paper during heavy bite. The cuspal inclination same as adjacent tooth. Occlusal table

width measured 10.5 mm, which was comparable to the natural contralateral molar. Periodontal probing was within normal limits with healthy peri-implant tissues. A bitewing radiograph showed stable crestal bone, with no changes from the crown placement baseline.

DISCUSSION

Implant-supported single crowns represent one of the most widely accepted treatment modalities for the replacement of missing teeth, owing to their high success rates and predictable clinical outcomes. The construction of the occlusal scheme in such restorations follows well-established guidelines aimed at preserving peri-implant health and enhancing the longevity of the prosthesis.⁴⁻¹⁰ These clinical protocols generally recommend that the occlusal table be narrower than that of natural teeth, cuspal inclinations be shallower, and passive occlusal contact occur during heavy biting. These measures are intended to minimize occlusal overload, thereby reducing the risk of peri-implant bone loss or periodontal diseases. Our study aims to evaluate the occlusal scheme of posterior implant-supported single crowns placed by undergraduate dental students at King Saud University (KSU) in Riyadh. Specifically (occlusal table, cusp inclination, and occlusion contact) and their potential impact on peri-implant bone loss. Our study revealed that a significant number of implant-supported crowns placed by dental students deviate from established prosthetic design standards, likely due to insufficient understanding of implant crown construction principles for students or poor handling by universal hospital lab technicians with student cases. Interestingly, clinical examinations showed no detectable bone loss in these students treated under a short-term period. This highlights a potential area for improvement in student training and clinical practice related to single-implant restorations. And to validate these observations, further longitudinal studies are warranted to assess the influence of occlusal design parameters—specifically occlusal table, cusp inclination, and contact pattern—on peri-implant bone stability over extended periods.

While no directly comparable studies exist, most of the current literature reports marginal bone loss associated with implant-supported restorations primarily after long-term follow-up (typically beyond 10 years). In contrast, evidence of measurable bone loss during short-term observation periods remains limited.⁶⁻⁹

The results of this study should be interpreted with respect to its limitations: the sample size was small and findings are may not accurately represent the overall performance of undergraduate dental students. Furthermore, the study was limited to fifth-year undergraduate students at King Saud University (KSU), where a certain level of error is expected—even upon completion of the study—due to the limited clinical experience and knowledge. These mistakes are likely attributable to insufficient practice and familiarity with implant-supported single crowns, unlike

what might be expected from consultants or specialists. The scope of this study was further limited to implant-supported single crowns placed specifically in the first molar region. Premolars and incisors were excluded, as these are considered part of the esthetic zone, where immediate provisional crowns are often placed and implants may be subjected to functional loading before complete osseointegration occurs. This early loading can potentially lead to increased marginal bone loss. Additionally, the occlusal guidelines for anterior teeth differ significantly from those for posterior teeth, as occlusal contact in anterior teeth is typically limited to protrusive movements only. Additionally, baseline periodontal data—such as probing pocket depth measurements—were not documented in the dental records, limiting our assessment to the standard implant pocket depth threshold of less than 5 mm. Furthermore, radiographic evaluation was conducted using vertical bitewing radiographs, which do not provide three-dimensional imaging. As a result, the accuracy of detecting peri-implant bone defects or bone loss may be limited due to the inability to assess the buccal and lingual aspects of the implant site.

CONCLUSION

A significant number of implant-supported crowns placed by dental students exhibit deviations from recommended prosthetic design standards. This highlights a potential area for improvement in student training and clinical practice related to single-implant restorations.

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