

## Clinical and periodontal outcomes of conventional versus CAD-CAM fabricated anterior crowns in diabetic patients: A comparative case series.

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### Abstract

**Background:** Diabetes mellitus adversely affects periodontal health, wound healing, and overall prosthodontic outcomes. Marginal discrepancies and plaque accumulation around restorations may exacerbate gingival inflammation in such patients.

**Aim:** To evaluate and compare gingival response, marginal adaptation, and clinical outcomes of conventional versus computer-aided design and computer-aided manufacturing (CAD-CAM) fabricated anterior crowns in controlled diabetic patients.

**Methods:** Two patients with controlled Type 2 diabetes ( $HbA1c \leq 7\%$ ) requiring anterior crowns were treated using two different fabrication techniques. One patient received a conventional crown, while the other underwent CAD-CAM based crown fabrication.

**Results:** CAD-CAM crowns demonstrated superior gingival response, improved marginal adaptation, and better papillary fill compared to conventional crowns.

**Conclusion:** CAD-CAM restorations offer enhanced periodontal outcomes and clinical precision, making them a preferable option in medically compromised patients such as diabetics.

**Keywords:** CAD-CAM, Crown Restoration, Diabetes Mellitus, Digital Dentistry, Gingival Response, Periodontal Outcome.

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### Introduction

Diabetes mellitus is a chronic systemic disorder characterized by metabolic dysregulation that significantly affects oral and periodontal health. Altered immune response, impaired collagen metabolism, and delayed wound healing increase susceptibility to periodontal destruction in affected individuals.<sup>[1-3]</sup> The relationship between diabetes and periodontal disease is widely recognized as bidirectional, with each condition influencing the onset and progression of the other.<sup>[4]</sup>

In prosthodontics, the long-term success of restorative procedures depends not only on

mechanical durability and esthetic outcomes but also on biological compatibility with surrounding periodontal tissues. The integrity of the restoration margin is particularly critical, as discrepancies at this interface can promote plaque accumulation and subsequent gingival inflammation.<sup>[5]</sup> This effect is more pronounced in diabetic patients due to altered host response mechanisms and exaggerated inflammatory reactions.<sup>[6,7]</sup>

Conventional crown fabrication techniques, although widely practiced, involve multiple clinical and laboratory steps that are inherently technique-sensitive. Errors related to impression materials, dimensional changes,

and laboratory processing may compromise marginal accuracy and overall fit of the restoration.<sup>[8,9]</sup> These limitations can negatively influence periodontal health and long-term clinical outcomes.

The advent of computer-aided design and computer-aided manufacturing (CAD-CAM) technology has introduced a digital workflow that enhances precision, standardization, and reproducibility in restorative dentistry.<sup>[10,11]</sup> Digital impressions combined with computer-assisted milling have been shown to improve marginal adaptation and reduce variability when compared with conventional techniques.<sup>[12-14]</sup> Improved marginal accuracy is associated with reduced plaque retention and better gingival response, particularly in patients with systemic conditions such as diabetes. Additionally, CAD-CAM workflows reduce chairside time and minimize procedural steps, thereby decreasing soft tissue manipulation and enhancing patient comfort during treatment.<sup>[15]</sup> These advantages make digital restorative approaches particularly relevant in medically compromised patients with impaired healing capacity. In this context, evaluating the clinical and periodontal outcomes of different crown fabrication techniques is of considerable importance. Therefore, the present study aims to compare gingival response, marginal adaptation, and overall clinical outcomes of conventional and CAD-CAM-fabricated anterior crowns in patients with controlled type 2 diabetes mellitus.

### Case presentation

Two patients diagnosed with controlled Type 2 diabetes mellitus ( $HbA1c \leq 7\%$ ) presented with the need for anterior crown restoration.

- No active periodontal disease at baseline.
- Good oral hygiene status.
- No contraindications for prosthodontic treatment.

### Study Design

#### Group A: Conventional Crown Technique

Tooth preparation performed following standard prosthodontic principles. Gingival retraction achieved using retraction cord. Elastomeric impression made (Fig. 1). Cast poured and crown fabricated in laboratory and cemented to the prepared teeth (Fig. 2).

#### Group B: CAD-CAM Crown Technique

Tooth preparation similar to conventional protocol. Intraoral scanning performed. Digital design using CAD software (Fig. 3). Milling of crown using CAM system. Finishing, glazing, and cementation was done (Fig. 4).

### Outcome Measures

The following parameters were evaluated at T0 (baseline), T1 (1 week) and T2 (1 month):

- Gingival Index
- Plaque Index
- Marginal Adaptation
- Papillary Fill

### Results

Gingival index scores showed an initial increase at 1 week in Group A (1.2 to 1.5), followed by a slight reduction at 1 month (1.3). In contrast, Group B demonstrated a progressive decrease from baseline (1.1) to 1 week (0.9) and 1 month (0.6), indicating improved gingival health (Table.1). Similarly, plaque index scores increased in the conventional group at 1 week (1.4) and remained relatively higher at 1 month (1.2). Group B showed a continuous reduction from baseline (1.0) to 1 week (0.8) and 1 month (0.6), reflecting reduced plaque accumulation (Table.2). Marginal adaptation and Papillary fill were better Group B (Table. 3).

### Discussion

The findings of the present case series indicate that CAD-CAM fabricated crowns demonstrate superior periodontal and clinical

outcomes compared to conventionally fabricated restorations in patients with controlled type 2 diabetes mellitus. Improvements were observed in gingival response, plaque accumulation, marginal adaptation, and papillary fill, suggesting a more favorable biological interaction with surrounding tissues.

Marginal adaptation remains a critical determinant of both mechanical success and periodontal health. In the present study, CAD-CAM restorations exhibited more precise marginal integrity, which can be attributed to the elimination of multiple manual steps inherent in conventional techniques. Previous investigations have similarly reported enhanced marginal accuracy in digitally fabricated restorations.<sup>[16,17]</sup> In contrast, conventional methods are susceptible to inaccuracies arising from impression distortion, material shrinkage, and laboratory variability.<sup>[18]</sup>

The observed reduction in plaque index and gingival index scores in the CAD-CAM group may be explained by improved marginal fit, which limits plaque-retentive areas. This finding is consistent with studies demonstrating a direct association between marginal discrepancies and increased plaque accumulation, leading to periodontal inflammation.<sup>[19]</sup> In diabetic patients, this relationship assumes greater clinical significance due to altered host defense mechanisms and an exaggerated inflammatory response.

Another notable observation in the present study was improved papillary fill associated with CAD-CAM restorations. This may be attributed to enhanced control over crown contours, emergence profile, and proximal contact design within the digital workflow. CAD-CAM systems allow for greater precision in designing restorations that support optimal soft tissue architecture.

In addition to biological advantages, CAD-CAM workflows offer procedural benefits,

including reduced chairside time and fewer clinical steps. The elimination of conventional impression techniques minimizes soft tissue manipulation, which may further contribute to improved periodontal outcomes, particularly in patients with compromised healing capacity.

Despite these encouraging findings, certain limitations must be acknowledged. The present study is based on a small sample size and short follow-up duration, which restricts the generalizability of the results. Long-term clinical trials with larger patient cohorts are necessary to validate the observed advantages of CAD-CAM restorations and to assess their durability over time.

### Conclusion

In this comparative case series, CAD-CAM-fabricated anterior crowns demonstrated superior clinical and periodontal outcomes compared to conventional crowns in patients with who have control over type 2 diabetes Mellitus. Enhanced marginal adaptation, reduced plaque accumulation, and improved gingival response observed with CAD-CAM restorations highlight their favourable biological integration with surrounding tissues.

The improved papillary fill and soft tissue adaptation further suggest that digitally fabricated restorations may better preserve periodontal health in patients with compromised healing capacity. In contrast, conventional techniques, although clinically acceptable, exhibited greater variability and were associated with comparatively less favourable periodontal outcomes.

Therefore, CAD-CAM may be considered a more predictable and biologically advantageous approach for anterior crown rehabilitation in diabetic patients. However, in future studies should include larger samples for comparison and longer follow-up periods are to be established to have conclusive evidence in this particular field.

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## Tables

### Gingival and Plaque Index Scores

**Table.1: Gingival Index scores (Loe and Silness, 0-3)**

Time Point	Conventional Crown	CAD-CAM Crown
T0	1.2	1.1
T1	1.5	0.9
T2	1.3	0.6

**Table.2: Plaque Index Scores (Silness and Loe, 0-3)**

Time Point	Conventional Crown	CAD-CAM Crown
T0	1.1	1.0
T1	1.4	0.8
T2	1.2	0.6

**Table.3: Marginal adaptation and Papillary fill:**

Parameter	Conventional Crown	CAD-CAM Crown
Marginal adaptation	Slight marginal discrepancies observed	Precise fit with minimal discrepancy
Plaque Retention	Increased plaque accumulation	Reduced plaque accumulation
Gingival Response	Mild localized inflammation	Improved gingival health
Papillary Fill	Slight deficiency in interdental fill	Optimal/complete papillary fill
Overall Outcome	Acceptable but less favourable	Superior biological and clinical outcome

**FIGURES**



Figure 1



Figure 2

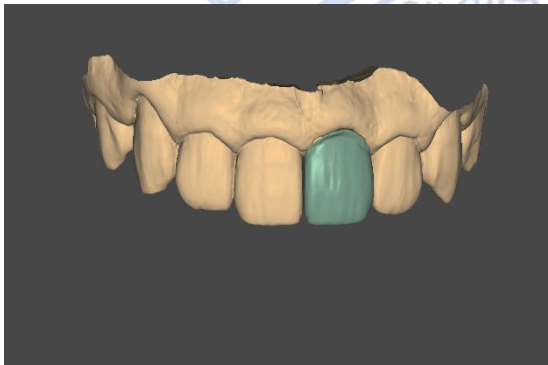


Figure 3



Figure 4