Comparative Evaluation OF Esthetic Outcomes Between Zirconia Crowns AND Porcelain-Fused-TO-Metal (Pfm) Crowns

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Keywords:
Zirconia Crowns, PFM Crowns, Esthetic Outcomes.

Abstract

Background: The use of crowns and bridge prostheses is a common and essential procedure in modern dental practice, providing both reliable functional outcomes and enhanced esthetic appearance. Therefore, the purpose of the study is to compare the esthetic outcomes, patient satisfaction, and complication rates of zirconia crowns versus porcelain-fused-to-metal (PFM) crowns.

Aim of the study: The aim of the study was to compare the esthetic outcomes, patient satisfaction, and complication rates of zirconia crowns versus porcelain-fused-to-metal (PFM) crowns.

Methods: This prospective comparative study was conducted at the Department of Prosthodontics, Bangabandhu Sheikh Mujib Medical University (BSMMU) and beau-dent, Dhaka, Bangladesh (June 2021–July 2022) included 80 single-unit crowns (zirconia n = 40; PFM n = 40). Crowns were fabricated (zirconia: CAD/CAM; PFM: conventional) and cemented. Esthetic outcomes (USPHS/FDI), patient satisfaction (VAS 0–10), and complications were recorded. Data were analyzed in SPSS v23.0; $p < 0.05$ was significant.

Results: In 80 participants, zirconia and PFM groups were comparable in age, gender, and tooth location. Zirconia crowns showed higher color match (95% vs 72.5%, $p = 0.006$), translucency (90% vs 70%, $p = 0.025$), and patient satisfaction (VAS 9.4 ± 0.8 vs 8.1 ± 1.2, $p < 0.0001$), while smooth surface texture and marginal adaptation were similar. Complications occurred only in PFM crowns: chipping 17.5% and gingival discoloration 15% ($p = 0.006$ and 0.026).

Conclusion: Zirconia crowns provide superior esthetic outcomes, higher patient satisfaction, and fewer complications compared to PFM crowns, supporting their preferred use in restorative dentistry.

Introduction

The use of crowns and bridge prostheses represents a frequently performed procedure in dental practice. When appropriately planned and executed, fixed dental prostheses provide reliable functional outcomes while also improving esthetic appearance [1]. Traditional metal-ceramic restorations have long been regarded as a dependable option and continue to demonstrate good long-term clinical performance. These restorations remain integral to modern prosthodontics, where achieving both functional stability and satisfactory esthetic results is crucial for patient satisfaction [2].

Although PFM crowns are considered the standard for single-tooth restorations requiring both strength and esthetics, they are not without drawbacks. For several decades, PFM crowns have been considered the gold standard for implant-supported restorations because they offer strong mechanical performance and pleasing aesthetic results [3]. By contrast, monolithic zirconia (MZ) crowns—made from a single zirconia block without a veneering layer—have become increasingly popular because of their superior flexural strength, wear resistance, and enhanced fracture toughness [4]. The inclusion of gold or other metal alloys can negatively impact the optical characteristics of the restoration, often leading to grayish discoloration of adjacent tissues and potential allergic or toxic reactions [5,6]. Rising esthetic expectations and the high cost of precious metals have contributed to a decline in the use of cast-metal restorations. Zirconia-based ceramics, in comparison, appear to meet both mechanical and esthetic requirements [7,8]. Nonetheless, veneered zirconia restorations may present technical complications such as porcelain chipping, which can influence overall survival and clinical success [9].

Despite their widespread acceptance, fixed dental prostheses can still result in short- and long-term biological changes, including marginal caries, periodontitis of abutment teeth, and mechanical issues like loss of retention or fracture of the prosthetic superstructure [10,11]. Most clinical studies have focused on zirconia fixed partial dentures in posterior teeth [12,13], whereas single-unit zirconia crowns remain underrepresented in the literature [14]. Consequently, assessing esthetic outcomes, patient satisfaction, and complication rates of single-unit zirconia and PFM crowns is essential to inform restorative treatment planning.

Although several studies have evaluated the clinical performance of zirconia and PFM restorations, most have concentrated on posterior fixed partial dentures, with limited data available on single-unit crowns, particularly in terms of esthetic outcomes and patient-centered satisfaction. Additionally, direct comparisons of complication rates, such as porcelain chipping and gingival changes, between single-unit zirconia and PFM crowns remain scarce. This paucity of evidence makes it challenging for clinicians to make fully informed decisions when selecting the optimal restorative material for both anterior and posterior teeth. Therefore, the purpose of the study is to compare the esthetic outcomes, patient satisfaction, and complication rates of zirconia crowns versus porcelain-fused-to-metal (PFM) crowns.

Objective

- To compare the esthetic outcomes, patient satisfaction, and complication rates of zirconia crowns versus porcelain-fused-to-metal (PFM) crowns.

Methodology & Materials

This prospective comparative clinical study was conducted at the Department of Prosthodontics, Bangabandhu Sheikh Mujib Medical University (BSMMU) and beau-dent, Dhaka, Bangladesh, from June 2021 to July 2022. A total of 80 single-unit crowns were evaluated, selected from patients based on specific inclusion criteria. Data were collected to analyze and compare the esthetic outcomes, patient satisfaction, and complication rates between zirconia and porcelain-fused-to-metal (PFM) crowns.

Inclusion Criteria:

- Patients aged 18–65 years.
- Requirement for a single-unit full-coverage crown on a vital abutment tooth.
- Good oral hygiene and healthy periodontal status.
- Willingness to participate in the study and attend follow-up appointments.

Exclusion Criteria:

- Presence of parafunctional habits (e.g., bruxism, clenching).

- Severe periodontitis.
- Uncontrolled systemic medical conditions.
- Pregnancy.
- History of allergy to dental materials used in the study.

All crowns were fabricated following standard prosthodontic procedures. Zirconia crowns were designed using CAD/CAM technology and sintered according to the manufacturer's instructions, while PFM crowns were conventionally fabricated with a metal substructure veneered with porcelain. Occlusion was adjusted, and crowns were cemented using resin-modified glass ionomer cement. Baseline demographic and clinical characteristics, including age, gender, and tooth location, were recorded prior to crown placement. Esthetic outcomes were assessed using modified USPHS/FDI criteria, evaluating parameters such as color match, translucency, surface texture, and marginal adaptation. Patient satisfaction was measured using a 0–10 visual analog scale (VAS), and postoperative complications, including chipping of veneering porcelain and gingival discoloration, were monitored during follow-up. Data were analyzed using SPSS version 23.0. Continuous variables were expressed as mean ± standard deviation (SD) and compared using independent t-tests, while categorical variables were presented as frequencies and percentages and analyzed using Chi-square or Fisher's exact tests. A p-value <0.05 was considered statistically significant.

Results

Table 1: Baseline Characteristics of Study Participants (n = 80)

Variable	**Zirconia (n = 40)**	**PFM (n = 40)**	**p-value**
Mean age (years)	48.2 ± 9.7	50.1 ± 11.3	0.42
Gender			
Male	18 (45.0%)	16 (40.0%)	0.65
Female	22 (55.0%)	24 (60.0%)	
Tooth location			
Anterior	26 (65.0%)	25 (62.5%)	0.82
Posterior	14 (35.0%)	15 (37.5%)	

The baseline characteristics were comparable between the two groups. The mean age was 48.2 ± 9.7 years in the zirconia group and 50.1 ± 11.3 years in the PFM group (p = 0.42). Gender distribution was similar, with 45.0% males and 55.0% females in the zirconia group compared to 40.0% males and 60.0% females in the PFM group (p = 0.65). Tooth location also showed no significant difference, with anterior teeth accounting for 65.0% of zirconia crowns and 62.5% of PFM crowns, while posterior teeth comprised 35.0% and 37.5%, respectively (p = 0.82).

Table 2: Clinical Esthetic Evaluation of Zirconia and PFM Crowns (n = 80)

Parameter	**Zirconia (n = 40)**	**PFM (n = 40)**	**p-value**
Excellent color match (%)	38 (95%)	29 (72.5%)	0.006
Good translucency (%)	36 (90%)	28 (70%)	0.025
Smooth surface texture (%)	40 (100%)	39 (97.5%)	1.000
Excellent marginal adaptation (%)	39 (97.5%)	38 (95%)	1.000

Zirconia crowns demonstrated superior esthetic outcomes compared to PFM crowns. Excellent color match was observed in 95% of zirconia crowns versus 72.5% of PFM crowns (p = 0.006), and good translucency was reported in 90% of zirconia crowns compared to 70% of PFM crowns (p = 0.025). Smooth surface texture was nearly uniform in both groups (zirconia 100%, PFM 97.5%, p = 1.000), and excellent marginal adaptation was recorded in 97.5% of zirconia crowns and 95% of PFM crowns (p = 1.000), indicating comparable surface finish and marginal fit between the two crown types.

Table 3: Patient-Reported Satisfaction (VAS Scores) for Zirconia and PFM Crowns (n = 80)

Group	Mean VAS ± SD	Range	p-value
Zirconia	9.4 ± 0.8	8–10	<0.0001
PFM	8.1 ± 1.2	6–10	

Patient-reported satisfaction, measured using a 0–10 visual analog scale (VAS), was significantly higher for zirconia crowns compared to PFM crowns. The mean VAS score for zirconia crowns was 9.4 ± 0.8 (range 8–10), whereas PFM crowns had a mean score of 8.1 ± 1.2 (range 6–10), with the difference reaching statistical significance (p < 0.0001).

Table 4: Complications Observed in Zirconia and PFM Crowns (n = 80)

Complication	Zirconia (n = 40)	PFM (n = 40)	p-value
Chipping of veneering porcelain	0 (0%)	7 (17.5%)	0.006
Gingival discoloration	0 (0%)	6 (15.0%)	0.026

Complications were significantly more frequent in PFM crowns compared to zirconia crowns. Chipping of veneering porcelain occurred in 7 PFM crowns (17.5%) and none in zirconia crowns (0%), reaching statistical significance (p = 0.006). Gingival discoloration was also observed exclusively in the PFM group, affecting 6 crowns (15.0%) with no cases in the zirconia group (0%, p = 0.026).

Discussion

Esthetic outcomes, patient satisfaction, and complication rates associated with single-unit zirconia and porcelain-fused-to-metal (PFM) crowns in restorative dentistry. Achieving optimal esthetics and functional stability remains a critical concern in modern prosthodontics, as crown restorations directly influence patient perception and long-term oral health. The findings highlight differences between the two crown types, with zirconia crowns showing superior color match and translucency, higher patient-reported satisfaction, and fewer technical complications. These results emphasize the importance of material selection in ensuring both clinical success and patient-centered outcomes in fixed dental prostheses.

The baseline demographic characteristics in the present study were comparable between the zirconia and PFM groups, with a mean age of 48.2 ± 9.7 years and 50.1 ± 11.3 years, respectively, consistent with the findings of Soleimani et al.[15], who included patients aged 18–65 years and reported similar distributions of anterior and posterior crowns, as well as Mohammadulla et al.[16], who reported a mean age of 41.53 ± 10.83 years. Gender distribution was balanced across groups (zirconia: 45.0% males, 55.0% females; PFM: 40.0% males, 60.0% females), aligning with reports from Tariquzzaman et al.[17], where 55% were male and 45% were female. Similarly, the distribution of anterior and posterior crowns in the present study (zirconia: 65.0% anterior, 35.0% posterior; PFM: 62.5% anterior, 37.5% posterior) corresponds with

observations by Vigolo et al.[18], who also reported posterior teeth as a common location for crown placement. These similarities across studies reinforce the representativeness and comparability of the current sample with previously published literature.

The esthetic evaluation demonstrated that zirconia crowns outperformed PFM crowns in several key parameters. Excellent color match was observed in 95% of zirconia crowns compared to 72.5% of PFM crowns ($p = 0.006$), and good translucency was reported in 90% versus 70% ($p = 0.025$), indicating significantly better overall esthetic performance of zirconia. These findings align with Min et al.[19], who compared implant-supported zirconia and PFM crowns in the anterior maxilla and found that, although objective color differences (ΔE) were slightly larger for zirconia, subjective evaluations showed satisfactory color match for both crown types, supporting the clinical relevance of zirconia's favorable esthetic outcomes. Smooth surface texture and excellent marginal adaptation were comparable between groups (zirconia 100% vs PFM 97.5% and 97.5% vs 95%, respectively, $p = 1.000$), indicating that both crown types provided acceptable surface finish and marginal fit. Collectively, these results suggest that zirconia crowns offer superior subjective esthetic appeal without compromising functional fit.

Patient-reported satisfaction, assessed using a 0–10 visual analog scale (VAS), was significantly higher for zirconia crowns (9.4 ± 0.8, range 8–10) compared to PFM crowns (8.1 ± 1.2, range 6–10, $p < 0.0001$), indicating a clear preference for zirconia in terms of overall esthetic and functional satisfaction. While Shi et al.[20] reported mean VAS scores of 8.18 for zirconia and 8.46 for high-noble PFM crowns with no statistically significant difference ($p = 0.34$), their study demonstrates the methodological approach for comparing patient satisfaction using VAS and highlights that satisfaction with both crown types is generally high. The present findings extend this understanding by showing a statistically significant advantage for zirconia crowns in our sample, suggesting that zirconia may provide superior patient-perceived esthetic and functional outcomes in anterior and posterior restorations.

In the present study, PFM crowns showed significantly higher complication rates than zirconia crowns, with chipping of veneering porcelain observed in 7 cases (17.5%) versus none in zirconia (0%, $p = 0.006$), and gingival discoloration occurring in 6 cases (15.0%) compared to none in zirconia (0%, $p = 0.026$). The higher incidence of chipping in PFM crowns is consistent with earlier reports attributing this drawback to the brittle nature of the porcelain veneer and the mismatch in thermal expansion between metal and porcelain [21], while gingival discoloration has been frequently described as a consequence of gingival recession and exposure of the metal substructure [22]. By contrast, zirconia crowns demonstrated no such complications, supporting previous findings of their superior structural durability and stable esthetic performance [23,24].

Limitations of the study
This study had several limitations:

- Sample size may limit the generalizability of the findings.
- The study was conducted in a tertiary care setting, which may limit the generalizability of the results.
- The study's limited geographic scope may introduce sample bias, potentially affecting the broader applicability of the findings.

Conclusion
Zirconia crowns demonstrated superior esthetic outcomes, higher patient satisfaction, and a lower incidence of complications compared to PFM crowns. Although both groups were comparable in baseline characteristics such as age, gender, and tooth location, zirconia crowns consistently provided better color match, translucency, and overall patient preference. In contrast, PFM crowns were more prone to chipping of the veneering porcelain and gingival discoloration. These findings indicate that zirconia crowns offer a

more favorable combination of esthetic appeal, functional performance, and clinical reliability, supporting their preferred use over PFM crowns in restorative dental practice.

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