

## Original Research

### Comparison of Porcelain-Fused-to-Metal (PFM) and Zirconium Crowns on Posterior Fixed Partial Dentures: A Comparative Study

<sup>1</sup>Pragya Bali, <sup>2</sup>Poonam Parmar, <sup>3</sup>Shivangi Bali, <sup>4</sup>Harsh Bali

<sup>1</sup>Prosthodontist, M.O, Dental Civil Hospital, Sundernagar, Himachal Pradesh, India;

<sup>2</sup>Senior Lecturer, Luxmi Bai College, Patiala, Punjab, India;

<sup>3</sup>BA Honors(Psychology) Student, MCM DAV College, Chandigarh, India;

<sup>4</sup>S.M.O, BBMB Hospital, Sundernagar, Himachal Pradesh, India

#### ABSTRACT:

**Objective:** This study aimed to compare the clinical performance and longevity of Porcelain-Fused-to-Metal (PFM) crowns and Zirconium crowns in posterior Fixed Partial Dentures (FPDs). **Methods:** A total of 80 patients requiring posterior FPDs were randomly divided into two groups: PFM and Zirconium. Clinical assessments, including survival rates, marginal integrity, and complications, were conducted at specified intervals post-crown placement. Statistical analysis was performed to compare the outcomes between the two groups. **Results:** Zirconium crowns exhibited slightly higher survival rates at 1, 3, and 5 years compared to PFM crowns. Marginal integrity scores favored Zirconium initially, although both groups maintained clinically acceptable marginal fit over time. Complications such as chipping, fractures, and discoloration were minimal in both groups, with Zirconium crowns showing fewer instances of chipping and fractures but slightly increased discoloration. **Conclusion:** While Zirconium crowns demonstrated slightly superior survival rates and marginal integrity, considerations regarding discoloration were noted. These findings support Zirconium as a viable alternative to PFM in posterior FPDs but warrant careful consideration based on patient-specific requirements and longevity expectations.

**Keywords:** PFM, Zirconium, crowns, Fixed Partial Dentures, posterior, survival rates, marginal integrity, complications.

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**Corresponding author:** Pragya Bali, Prosthodontist, M.O, Dental Civil Hospital, Sundernagar, Himachal Pradesh, India

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#### INTRODUCTION

Dental prosthetics have undergone significant evolution, enhancing the restoration of oral function and aesthetics for patients with missing or damaged teeth. Among the various options available, the selection of materials for posterior Fixed Partial Dentures (FPDs) plays a critical role in achieving long-term success and patient satisfaction. This introduction delineates the historical context, clinical significance, and evolving trends surrounding Porcelain-Fused-to-Metal (PFM) and Zirconium crowns in posterior FPDs, laying the foundation for the comparative study conducted.

#### HISTORICAL EVOLUTION AND CLINICAL SIGNIFICANCE

Porcelain-Fused-to-Metal (PFM) crowns have long been the conventional choice for dental restorations due to their favorable combination of strength and

esthetics [1]. The robustness of metal substructures combined with the aesthetic appeal of porcelain overlay contributed to their widespread use in both anterior and posterior restorations [2]. However, despite their established success, concerns regarding potential drawbacks such as metal visibility at the gingival margins and the development of underlying dark lines have driven the exploration of alternative materials [3].

In recent years, Zirconium-based restorations have gained attention as an alternative to PFM crowns. Zirconium, a ceramic material known for its high biocompatibility and excellent mechanical properties, emerged as a promising choice in restorative dentistry [4]. Its tooth-like translucency, superior strength, and resistance to corrosion have positioned it as a potential substitute for metal-based restorations, particularly in areas demanding optimal esthetics and strength [5].

## EVOLVING TRENDS AND CLINICAL CONSIDERATIONS

The evolution of dental materials has been significantly influenced by patient demands for improved aesthetics, biocompatibility, and longevity. Advancements in manufacturing techniques, particularly Computer-Aided Design and Computer-Aided Manufacturing (CAD/CAM), have facilitated precise and customized restorations using Zirconium, further enhancing its appeal in modern dental practices [6]. Moreover, the biocompatibility of Zirconium eliminates concerns related to potential allergic reactions or metal sensitivities commonly associated with traditional metal alloys used in PFM crowns [7].

The preference for Zirconium-based restorations in posterior FPDs has been fueled by studies showcasing its promising clinical performance. Reports highlighting its superior fracture resistance, minimal wear on opposing dentition, and excellent long-term outcomes have reinforced its role as a viable alternative to PFM crowns [8][9]. Nonetheless, controversies persist, particularly regarding potential complications such as fracture susceptibility of monolithic Zirconium restorations and concerns about discoloration over time [10].

## STUDY RATIONALE AND OBJECTIVES

Amidst the evolving landscape of dental materials, comprehensive comparative studies analyzing the clinical performance and longevity of PFM and Zirconium crowns in posterior FPDs are essential. This study aims to fill this crucial gap by providing an in-depth comparison based on specific parameters such as survival rates, marginal integrity, and identification of complications over a specified duration post-crown placement.

By elucidating the comparative clinical performance of PFM and Zirconium crowns in posterior FPDs, this research endeavors to contribute empirical evidence to aid clinicians in evidence-based decision-making regarding the selection of the most suitable material for posterior restorations. Understanding the strengths and limitations of these materials is imperative in delivering optimal patient care and achieving durable, aesthetically pleasing, and functional dental prostheses.

The historical significance, evolving trends, and clinical considerations surrounding PFM and Zirconium crowns in posterior FPDs set the stage for this comparative study. The exploration of their respective strengths, limitations, and clinical performance underscores the importance of this research in advancing the field of dental prosthetics and aiding clinicians in making informed choices for their patients' oral health and well-being.

## MATERIAL AND METHODS

The study was conducted following a prospective design to compare the clinical performance of

Porcelain-Fused-to-Metal (PFM) crowns and Zirconium crowns in posterior Fixed Partial Dentures (FPDs).

### Study Population

A total of 80 patients requiring posterior FPDs were recruited from tertiary care center. Informed consent was obtained from all participants before their inclusion in the study. Patients were randomly assigned to two groups: the PFM group and the Zirconium group, based on predetermined inclusion criteria.

### Treatment Procedure

For patients in the PFM group, the conventional PFM crowns were fabricated. Patients in the Zirconium group received Zirconium crowns. The fabrication of both types of crowns was performed by experienced dental technicians following standardized protocols.

### Clinical Assessments

The clinical assessments were conducted at regular intervals of 1,3,5 years post-crown placement. These assessments included evaluation of survival rates, marginal integrity, and identification of any complications such as chipping, fractures, or discoloration. The evaluations were carried out by calibrated and blinded examiners to minimize bias.

### Statistical Analysis

Statistical analysis was performed using SPSS ver 25. Survival rates were calculated using Kaplan-Meier analysis, and comparisons between the PFM and Zirconium groups were conducted using ANOVA. Significance was set at  $p < 0.05$ .

## RESULTS

### Table 1: Survival Rates of Crowns

The survival rates of Porcelain-Fused-to-Metal (PFM) and Zirconium crowns were assessed at specific time intervals: 1 year, 3 years, and 5 years post-placement. The values indicated in Table 1 represent the percentage of crowns that remained intact and functional at each respective time point. For instance:

- **1 year:** 95% of PFM crowns and 98% of Zirconium crowns remained intact.
- **3 years:** The survival rates decreased to 88% for PFM crowns and 92% for Zirconium crowns.
- **5 years:** Further reduction in survival rates showed 80% for PFM crowns and 85% for Zirconium crowns.

These findings suggest a trend of gradual reduction in survival rates over time for both types of crowns. Zirconium crowns exhibited slightly higher survival rates compared to PFM crowns at all evaluated time intervals.

### Table 2: Marginal Integrity Scores

The table represents the mean scores for the marginal integrity of PFM and Zirconium crowns at different time points post-placement. Marginal integrity was

assessed using a scoring system where lower scores indicate better marginal fit.

- **1 year:** PFM crowns demonstrated a mean score of 1.2, indicating excellent marginal integrity, while Zirconium crowns displayed an even slightly better mean score of 1.1.
- **3 years:** Marginal integrity scores slightly increased for both types of crowns, with PFM crowns showing a mean score of 1.5 and Zirconium crowns with a mean score of 1.3.
- **5 years:** Further marginal degradation was observed, with PFM crowns averaging a score of 1.8 and Zirconium crowns at a mean score of 1.6.

Despite minor variations, both PFM and Zirconium crowns maintained clinically acceptable marginal integrity over time, with Zirconium crowns demonstrating marginally better scores compared to PFM crowns.

**Table 1: Survival Rates of Crowns**

Time Point	PFM Crowns (%)	Zirconium Crowns (%)
1 year	95	98
3 years	88	92
5 years	80	85

**Table 2: Marginal Integrity Scores**

Time Point	PFM Crowns (Mean Score)	Zirconium Crowns (Mean Score)
1 year	1.2	1.1
3 years	1.5	1.3
5 years	1.8	1.6

**Table 3: Incidence of Complications**

Complication	PFM Crowns (Number of Cases)	Zirconium Crowns (Number of Cases)
Chipping	5	2
Fractures	3	1
Discoloration	2	3

**Table 3: Incidence of Complications**

Table 3 displays the occurrence of specific complications—chipping, fractures, and discoloration—in both PFM and Zirconium crowns.

- **Chipping:** PFM crowns experienced 5 instances of chipping, while Zirconium crowns encountered 2 cases.
- **Fractures:** PFM crowns reported 3 cases of fractures, whereas Zirconium crowns showed only 1 case.
- **Discoloration:** PFM crowns had 2 instances of discoloration, while Zirconium crowns displayed 3 cases.

These findings suggest that while both types of crowns exhibited minimal complications, Zirconium crowns had fewer instances of chipping and fractures. However, a slightly increased occurrence of discoloration was noted in Zirconium crowns compared to PFM crowns.

## DISCUSSION

### Survival Rates

The observed survival rates of PFM and Zirconium crowns over the study period align with previous literature [1][2]. The slightly higher survival rates of Zirconium crowns at 1, 3, and 5 years are consistent with the material's known durability and resistance to wear [3]. These findings corroborate with studies highlighting the favorable longevity of Zirconium crowns in various dental applications [4].

### Marginal Integrity

The marginal integrity scores of both crown types indicate excellent marginal fit initially, with a gradual increase over time. Despite minor differences favoring Zirconium crowns, both groups maintained clinically acceptable marginal integrity throughout the study [5][6]. The marginal adaptation of Zirconium crowns has been praised in the literature, attributing it to the CAD/CAM manufacturing process [7].

### Complications

The incidence of complications, such as chipping, fractures, and discoloration, was relatively low in both groups. Although Zirconium crowns exhibited fewer instances of chipping and fractures, discoloration was slightly more prevalent compared to PFM crowns. These findings are consistent with previous reports highlighting the susceptibility of Zirconium to discoloration over time [8][9].

### Clinical Implications

The superior survival rates and marginal integrity of Zirconium crowns observed in this study support their viability as an alternative to PFM crowns in posterior FPDs, aligning with the growing trend favoring Zirconium due to its biocompatibility and aesthetics [10]. However, the increased susceptibility to discoloration warrants careful consideration, especially in patients with specific aesthetic demands.

### Limitations and Future Directions

Several limitations should be acknowledged, including the relatively short-term follow-up and the sample size. Long-term studies with larger cohorts are essential to ascertain the definitive longevity and performance of these crowns. Additionally, investigating newer Zirconium formulations or surface treatments may address concerns regarding discoloration.

### CONCLUSION

In conclusion, this study provides valuable insights into the clinical performance of PFM and Zirconium crowns in posterior FPDs. While Zirconium crowns demonstrated slightly superior survival rates and marginal integrity, considerations regarding discoloration must be weighed. This study contributes to the ongoing discourse on selecting optimal materials for posterior FPDs, advocating for further long-term investigations.

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