DOI: https://doi.org/10.53350/pjmhs020231712635

**ORIGINAL ARTICLE**

# The Clinical Outcomes of Monolithic Zirconia and Porcelain Fused to Metal in the Posterior Teeth

MUHAMMAD AFZAL KHAN[1], NUZHAT AYUB[2], NASIR ALI[3], PALWASHA RAUF[4], KAISAR KHAN[5], SAJID ALI[6]
[1]*Assistant Professor & Consultant Prosthodontist, Department of Prosthodontics, Rehman College of Dentistry, Peshawar.*
[2]*Assistant Professor Department of Prosthodontics, Peshawar Dental College, Peshawar.*
[3]*Hayat Abad Medical Complex Peshawar*
[4]*Police Services Hospital Peshawar*
[5]*Ex Demonstrator KMU IDS, Prosthodontics, Kohat.*
[6]*Associate Professor & Consultant Prosthodontist, Department of Prosthodontics, Rehman College of Dentistry, Peshawar.*
*Correspondence to: Kaisar Khan, Email: Drmalakqaiser@gmail.com, Cell: 03339151505.*

## ABSTRACT

**Objective:** To evaluate and compare the clinical outcomes and patient satisfaction associated with monolithic zirconia(MZ) and porcelain fused to metal (PFM) crowns in posterior teeth.

**Material & Methods:** A cross sectional study was conducted amongst 120 patients restored with either MZ (n=60) or PFM (n=60) crowns in posterior teeth. Clinical assessment was done using Modified United State Public Health Service (Modified USPHS). Patient satisfaction was measured using a 10 questionnaire based on a 5-point Likert scale. Data were analyzed using SPSS 23.0 version. A p-value <0.05 was considered statistically significant.

**Results:** Monolithic zirconia showed a significantly better outcomes in marginal adaptation (p<0.01), fracture resistance (p<0.01) and esthetic (p<0.05) as compared to PFM crowns. Zirconia restorations also showed a higher patient satisfaction score especially regarding comfort, appearance and hygiene. PFM crowns exhibit more frequent chipping and marginal discoloration as compared to zirconia.

**Conclusion:** This study concluded that Monolithic Zirconia crowns showed a superior clinical performance and patients satisfaction than PFM crowns in posterior teeth.

**Keywords:** Monolithic zirconia, porcelain-fused-to-metal, posterior teeth, crown survival, patient satisfaction.

## INTRODUCTION

The main objective of prosthetic rehabilitation is functional and esthetic restoration. There is a limit availability of such restorations which have both functional as well as esthetic restorative ability.[1] The most common restoration method for broken or cracked teeth is ceramic restoration. When the strength and esthetic is required the most accepted restoration in posterior teeth are metal ceramic crowns.[2] During the past decades the use of cast metals have been decreasing and the demand of tooth colour restorations have been increasing due to esthetic.[3] The other reason could be due to the upturned rise of precious casting metals.[4] The advancement of digital technology it is zirconia crowns that replaced single teeth that require complete coverage.[5] When the strength and esthetic is required the most accepted restoration in posterior teeth are metal ceramic crowns.[6] During the past decades the use of cast metals have been decreasing and the demand of tooth colour restorations have been increasing due to esthetic.[7] The other reason could be due to the upturned rise of precious casting metals.[3] The advancement of digital technology it is zirconia crowns that replaced single teeth that require complete coverage.[4] Monolithic zirconia are fabricate from high strength yttria stabilized tetragonal zirconia polycrystal (Y-TZP) and consists of single material instead of traditional layered ceramics which eliminates the interface between core and veneering ceramic and that is the site of failure in bilayered system. The trend of Zirconia based fixed prosthesis and crowns has been increasing over time due to excellent esthetics, biocompatibility and mechanical properties.[8,9,10] Over a period of 5 years the survival of zirconia crowns are 90% while the estimated success after 10 years is 68%.[8] The metal ceramic restorations showed a greater survival rate of 92% after 10 years and 75% at 15 years.[12,13] In another study it has been shown that the survival rate of zirconia based crown are greater and comparable with metal ceramic crowns.[11] The study on zirconia based crowns survival rate are limited to 05 years study with many studies showed bias and poor quality of evidence.[12]

Despite a greater advancement in the technology in the past decades metal ceramic restorations are still the gold standard in fixed prosthesis. [6]However the patients increasing demand of esthetic restoration has led to the predictability and popularity of all ceramic restoration and results in replacing metal ceramics in almost all clinical applications.[1,7] Monolithic zirconia crowns are processed by means of computer added design and computer added manufacturing (CAD-CAM). A systemic review showed that laboratory fabrication was improved using CAD-CAM technology.[14] A clinical study evaluating PFM crowns on tooth supported found no difference in the final quality whether its CAD-CAM or conventional fabricated crowns.[15] Several in vitro studies compared PFM and zirconia crowns flexural strength, fracture resistance, and marginal adaptation clinical evidence remain doubtful. The esthetic satisfaction and functional perception are still underreported. The posterior zone which is functionally demanding and less visibility often required balance between strength and appearance.[5,7,10,15]

The objective of the study was to determine the technical complications of monolithic zirconia crown and PFM crown. The study hypothesis was that CAD-CAM zirconia crown shows less technical complications than conventional PFM crown.

Received on 02-10-2023
Accepted on 27-11-2023

## MATERIAL AND METHODS

A descriptive cross sectional study was carried at the Department of Dentistry, Rural Health Center, Hospital, Sherpao, Charsadda from January 2023 to September 2024. Ethical approval was obtained from the hospital (ERC Ref. No.38/8/2021) Patients who received either PFM or Monolithic Zirconia crown in posterior teeth (premolars and molars) between 1 and 5 years prior to evaluation were considered. Records from hospital database were screened for eligible patients to be identified. Informed consent was taken from the patients.

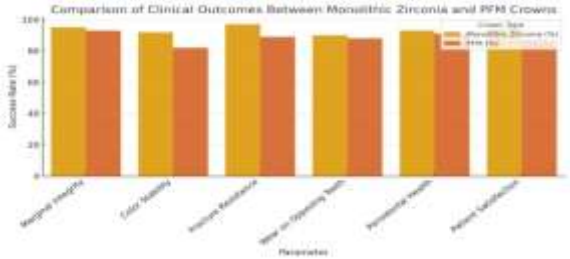


Figure 1: The percentage of clinical evaluation of MZ and PFM.

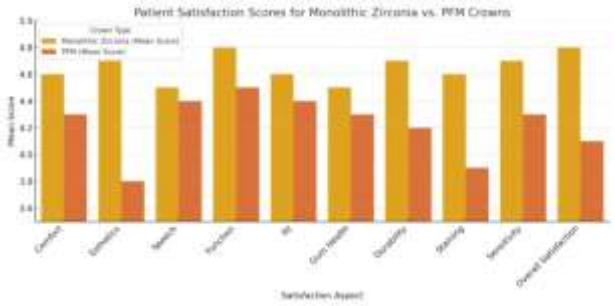


Figure 2: The mean score of patient satisfaction for MZ and PFM

Patient aged selected were 18-70 years. Those patients with satisfactory oral hygiene (plaque index ≤1), single posterior crown, crown in function for 1 year and those agreed on close follow up were selected in this study. Those patients with parafunctional habits/ bruxism, periodontal diseases and patients having systemic diseases were excluded from this study. The patients were assigned two groups:

Figure 1: Patients receiving monolithic zirconia crowns

Figure 2: Patients receiving PFM crowns.

A total of 120 crowns, 60 in each group were selected using survival rate of 95% for group 1 and 85% for group 2.

Two trained prosthodontists performed evaluation, caliberated for intra and inter-examiner reliability (kappa=0.85). Modified United State Public Health Service (Modified USPHS) was use to assess;

**Marginal Integrity:**

1. Acceptable (Alpha) or defective (Bravo/Charlie)
2. Colour stability: Using shade guide
3. Fracture/Chipping: Visual and tactile examination
4. Wear on opposite dentition: classified as none, slight, moderate or severe
5. Periodontal response: probing depth, bleeding on probe or plaque index.

Patient satisfaction assessment was carried out using 10-item questionnaire regarding esthetic, functional and psychological (comfort, esthetics, speech, function, fit, gum health, durability, staining, sensitivity and overall satisfaction) on a 5-point lickert scale (1=Strongly Disagree,2=Disagree,3=Neutral, 4=Agree and 5=Strongly agree). Score were categorized as low (1), moderate (2-3) high (4-5).

Data were analyzed using SPSS 23.0 version. Descriptive statistics were used for demographic and clinical data. Chi-square tests assessed categorical differences between groups. Independent t-tests were used for continuous variables (satisfaction scores). A p-value <0.05 was considered statistically significant.

## RESULTS

The mean age presentation was 42.3 ± 12.7 years. Gender distribution was balanced, with 52 males and 68 females overall. There were no significant differences in age or gender between groups (p > .05).

The clinical evaluatuion result is given in figure 1.

The marginal integrity of 96.7% of MZ and 91.7% of PFM crowns showed excellent (Alpha) marginal adaptation. The difference was not statistically significant (p = .18). The color stability of MZ crowns maintained shade fidelity better than PFM crowns. 98.3% of MZ crowns were rated as excellent vs 85.0% for PFM (p = .02), indicating a statistically significant advantage. Fracture/Chipping of only 1 MZ crown (1.7%) showed signs of minor fracture. In contrast, 6 PFM crowns (10.0%) showed porcelain chipping, with a statistically significant difference (p = .04). Wear on opposing dentition showed moderate wear was noted in 5.0% of MZ and 13.3% of PFM cases. Though more frequent in the PFM group, the difference was not statistically significant (p = .07). Amongst periodontal response showed both groups exhibited comparable periodontal health with no significant difference in probing depth or bleeding indices (p = 0.65).

The patient satisfaction outcomes are given in figure 02.

Regarding esthetic satisfaction, 96.6% of MZ crown recipients reported high satisfaction compared to 83.3% in the PFM group (p = .03).

Functional Satisfaction were observed between groups (p > .05), with >90% of participants rating their crown function as satisfactory. Overall Satisfaction Score were higher for the MZ group (4.7 ± 0.3) than the PFM group (4.2 ± 0.5), and this difference was statistically significant (p = .01).

## DISCUSSION

This study aimed to assess the clinical outcomes of monolithic zirconia MZ and porcelain fused to metal PFM crowns placed in posterior teeth. This was a cross-sectional study and analysis of 120 crowns who were in function for at least one year was carried out. This study showed MZ crowns have superior colour stability and lower incidence of chipping while maintain outcomes in marginal integrity wear on opposite dentition and periodontal health. Regarding esthetic outcomes, MZ crowns were highly associated with patient satisfaction which is an increasingly factor in patient- centered dental care.

For the longevity of restoration marginal integrity is crucial, influencing plaque accumulation, microleakage and recurrent caries. In the present study both MZ and PFM crown showed a high rates of acceptable marginal adaptation (96.7% and 91.7% respectively) with no statistical significant difference. The study is in consistent with study done by Juntavee et al[16]. The reason could be that marginal adaptation is more function of laboratory and operator expertise than the material used.

In terms of color stability and esthetic outcome MZ crowns were outperforming PFM crowns. However, both crowns showed a high acceptability rate. Only 1.75 MZ crown showed discoloration while that of PFM crowns exhibit 15% discoloration. This study result is similar to that of Alqutaibi et al[17] which documented superior translucency and esthetics of zirconia crowns as compared to PFM crowns. This is due to the inherent optical properties of zirconia crowns absence of underlying metal which causing greyish color in the gingival margins.

The findings of this study showed that 10% of PFM crowns exhibit chipping or fracture than 1.7% of MZ crowns. This supports the premise that monolithic designs offer enhanced mechanical stability by eliminating weak interfaces and PFM crowns are known to be vulnerable to porcelain veneer chipping, a consequence of the mismatch in thermal expansion coefficients and the layered structure. While PFM crowns benefit from a long history of clinical success, their longevity is often compromised by porcelain fractures, especially in high-stress posterior zones. Beuer et al[18] and Arsalani et al[19] in their study demonstrate that PFM crowns are more vulnerable to fracture. In contrast to PFM crowns, MZ crowns resist the forces and high flexural strength (900-1200 MPa).

In this study, both groups demonstrated acceptable wear patterns, with slightly higher wear observed in the PFM group (13.3% vs 5.0%, p = .07). Although not statistically significant, the trend suggests that polished monolithic zirconia is relatively gentle on opposing enamel. Gseibat et al[20] have shown that polished zirconia produces wear patterns similar to natural enamel and even less than roughened porcelain surfaces. Our findings align with this view, highlighting the importance of proper occlusal adjustments and surface finishing techniques.

This study revealed that PFM and MZ crowns have no statistically significant periodontal response suggested that both materials, when properly finished and seated with accurate margins, are biocompatible and maintain periodontal health. Padbury et al[21] and Cattoni et al[22] demonstarted that well-contoured restorations and patient compliance with oral hygiene contribute more to periodontal status than whether the crown is

metal-ceramic or ceramic-based. A high esthetic and overall satisfaction was found in patients having MZ crowns than PFM crowns. This suggests a shift of trend towards esthetically pleasing metal free restorations in the posterior teeth. The reduced risk of discoloration, natural translucency and absence of visible metal of MZ crowns were likely contributors. Soleimani et al[23] demonstrated that patient perceptions often drive clinical success as much as functional performance.

Clinical evaluation of functioning crowns, use of standardized clinical criteria (Modified-USPHS), objective and subjective inclusion measures and balanced comparison with a matched sample were the strength of this study. The limitations of the study are study design, different laboratory techniques and clinicians, crown function evaluated for 1-5 years and no radiographic assessment of periapical or subgingival tissues. Future study may be considered for prospective study, long term follow up and inclusion of radiograph. Esthetics, durability, minimal maintenance, high color stability and decreased chipping of crown make MZ crowns robust alternative to PFM.

## CONCLUSION

The findings of this study concluded that MZ crowns are clinically effective and patient preferred alternative to PFM crowns for posterior restorations. These findings support the growing preference of MZ in maxillofacial prosthodontics.

## REFERENCES


1. Sailer I, Makarov NA, Thoma DS, Zwahlen M, Pjetursson BE. All-ceramic or metal-ceramic tooth-supported fixed dental prostheses (FDPs)? A systematic review of the survival and complication rates. Part I: Single crowns (SCs). Dental materials. 2015 Jun 1;31(6):603-23.
2. Ottawa ON. Porcelain-fused-to-metal crowns versus allceramic crowns: a review of the clinical and cost-effectiveness. Canadian Agency for Drugs and Technologies in Health. 2015.
3. Wang B, Fan J, Wang L, Xu B, Wang L, Chai L. Onlays/partial crowns versus full crowns in restoring posterior teeth: a systematic review and meta-analysis. Head & face medicine. 2022 Nov 21;18(1):36.
4. Øilo M, Nesse N, Lundberg OJ, Gjerdet NR. Mechanical properties of cobalt-chromium 3-unit fixed dental prostheses fabricated by casting, milling, and additive manufacturing. J Prosthet Dent. 2018; 120(1): 156.e1-156.e7.
5. Tajti P, Solyom E, Czumbel LM, Szabó B, Fazekas R, Németh O et al. Monolithic zirconia as a valid alternative to metal-ceramic for implant-supported single crowns in the posterior region: A systematic review and meta-analysis of randomized controlled trials. J Prosthet Dent. 2023; 132(5):881-9.
6. Pietruski JK, Skurska A, Bernaczyk A, Milewski R, Pietruska MJ, Gehrke P, Pietruska MD. Evaluation of concordance between CAD/CAM and clinical positions of abutment shoulder against mucosal margin: an observational study. BMC Oral Health. 2018 Dec;18:1-6.
7. Pjetursson BE, Sailer I, Makarov NA, Zwahlen M, Thoma DS. Corrigendum to" All-ceramic or metal-ceramic tooth-supported fixed dental prostheses (FDPs)? A systematic review of the survival and complication rates. Part II: Multiple-unit FDPs"[Dental Materials 31 (6)(2015) 624-639]. Dental materials. 2017;33(1):e48-51.
8. Gehrke P, Bleuel K, Fischer C, Sader R. Influence of margin location and luting material on the amount of undetected cement excess on CAD/CAM implant abutments and cement-retained zirconia crowns: an in-vitro study. BMC Oral Health. 2019 Dec;19:1-2.
9. Zarone F, Di Mauro MI, Ausiello P, Ruggiero G, Sorrentino R. Current status on lithium disilicate and zirconia: a narrative review. BMC oral health. 2019 Dec;19:1-4.
10. Alfadhli R, Alshammari Y, Baig MR, Omar R. Clinical outcomes of single crown and 3-unit bi-layered zirconia-based fixed dental prostheses: An upto 6-year retrospective clinical study: Clinical outcomes of zirconia FDPs. Journal of Dentistry. 2022 Dec 1;127:104321.
11. Näpänkangas R, Raustia A. Twenty-year follow-up of metal-ceramic single crowns: a retrospective study. International Journal of Prosthodontics. 2008 Jul 1;21(4).
12. Schwarz S, Schröder C, Hassel A, Bömicke W, Rammelsberg P. Survival and Chipping of Zirconia-Based and Metal–Ceramic Implant-Supported Single Crowns. Clinical implant dentistry and related research. 2012 May;14:e119-25.
13. Derafshi R, Khorshidi H, Kalantari M, Ghaffarlou I. Effect of mouthrinses on color stability of monolithic zirconia and feldspathic ceramic: an in vitro study. BMC oral health. 2017 Dec;17:1-8.
14. Mühlemann S, Kraus R D, Hämmerle CHF, Thoma DS. Is the use of digital technologies for the fabrication of implant-supported reconstructions more efficient and/or more effectivethan conventional techniques: A systematic review. Clin Oral Implants Res. 2018(b); 29 Suppl 18: 184-95.
15. Mühlemann S, Benic GI, Fehmer V, Hämmerle CHF, Sailer I. Clinical quality and efficiency of monolithic glass ceramic crowns in the posterior area: digital compared with conventional workflows. Int J Comput Dent.2018(a); 21:215-23.
16. Juntavee N, Sirisathit I. Marginal accuracy of computer-aided design-and computer-aided manufacturing-fabricated full-arch zirconia restoration. Clin Cosmet Investig Dent. 2018;10:9-17.
17. Alqutaibi AY, Ghulam O, Krsoum M, Binmahmoud S, Taher H, Elmalky W et al. Revolution of Current Dental Zirconia: A Comprehensive Review. Molecules. 2022 Mar 4;27(5):1699.
18. Beuer F, Aggstaller H, Edelhoff D, et al. (2009). Clinical performance of full-coverage restorations made of zirconia. Int J Prosthodont, 22(5), 449–456.
19. Alsarani M, Souza G, Rizkalla A, El-Mowafy O. Influence of crown design and material on chipping-resistance of all-ceramic molar crowns: An in vitro study. Dent Med Probl. 2018 Jan-Mar;55(1):35-42.
20. Gseibat M, Sevilla P, Lopez-Suarez C, Rodriguez V, Pelaez J, Suarez MJ. Performance of posterior third-generation monolithic zirconia crowns in a complete digital workflow: A three-year prospective clinical study. J Dent Sci. 2024 Apr;19(2):871-877.
21. Padbury A Jr, Eber R, Wang HL. Interactions between the gingiva and the margin of restorations. J Clin Periodontol. 2003 May;30(5):379-85.
22. Cattoni F, Tetè G, D'orto B, Bergamaschi A, Polizzi E, Gastaldi G. Comparison of hygiene levels in metal-ceramic and stratified zirconia in prosthetic rehabilitation on teeth and implants: a retrospective clinical study of a three-year follow-up. J Biol Regul Homeost Agents. 2021 Jul-Aug;35(4 Suppl. 1):41-49.
23. Soleimani F, Jalali H, Mostafavi AS, Zeighami S, Memarian M. Retention and Clinical Performance of Zirconia Crowns: A Comprehensive Review. Int J Dent. 2020 Oct 15;2020:8846534.


**This article may be cited as:** Khan MA, Ayub N, Ali N, Rauf P, Khan K, Ali S: The Clinical Outcomes of Monolithic Zirconia and Porcelain Fused to Metal in the Posterior Teeth. Pak J Med Health Sci, 2023;17(12):635-637.