DOI: https://doi.org/10.53350/pjmhs20231711504

**ORIGINAL ARTICLE**

# Condition of Metal-Ceramic Restorations after Five Years in Function: A Cross-Sectional Evaluation

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## ABSTRACT

**Objective:** To assess the clinical condition and complications associated with metal-ceramic restorations (MCRs) after five years in function.

**Materials and Methods:** A cross-sectional evaluation was conducted the Department of Prosthodontics Kohat from January 2022 to December 2022, among patients who had MCRs placed five or more years previously. Restorations were clinically evaluated for marginal integrity, colour match, porcelain chipping, occlusal wear, and periodontal responses using modified USPHS criteria. Patient hygiene status and occlusal factors were also recorded.

**Results:** A total of 124 restorations in 73 patients were examined. Marginal integrity was rated clinically acceptable in 92.7% of restorations. Minor porcelain chipping was found in 14.5%, while major chipping requiring repair occurred in 5.6%. Colour match was rated satisfactory in 86.3%. Gingival inflammation was observed in 25.8%, primarily in patients with inadequate plaque control.

**Conclusion:** Metal-ceramic restorations show high survival and functional stability after five years. The most common complications observed were porcelain chipping and mild periodontal inflammation. Regular follow-up and maintenance care can reduce biological complications.

**Keywords:** Metal-ceramic restorations, porcelain chipping, marginal integrity, periodontal status.

## INTRODUCTION

Restorative dentistry aims not only to restore missing tooth structure but also to re-establish function, aesthetics, and long-term oral health. For decades, metal-ceramic restorations (MCRs), also known as porcelain-fused-to-metal (PFM) restorations, have been regarded as one of the most reliable fixed prosthodontic options in both anterior and posterior regions.[1] Their clinical success has been extensively attributed to the combination of the mechanical strength provided by the underlying metal substructure and the aesthetic properties achieved by the ceramic veneering layer.[2] Despite the growing popularity and emerging dominance of all-ceramic and CAD/CAM monolithic restorations, MCRs continue to be considered a benchmark standard, especially in situations requiring enhanced strength or long-span prostheses.[3]

Longevity of a restoration is a critical factor influencing treatment planning and patient satisfaction. Metal-ceramic restorations have demonstrated survival times ranging from 10 to more than 15 years in various clinical studies, with survival rates often exceeding 90% at five years.[4] Their durability is particularly related to their resistance against fracture, wear, and occlusal load distortion. However, like all restorations, MCRs are not immune to failure.[1] Clinical complications associated with MCRs typically fall into technical (porcelain fracture, loss of retention, wear) and biological (caries, periodontal inflammation, hypersensitivity) categories.[3]

Porcelain chipping remains one of the most frequently reported technical complications. It may range from microfractures that require only polishing to major fracture necessitating repair or replacement.[4] The factors contributing to such failures include occlusal stress, inadequate framework support for porcelain, mismatch in thermal expansion coefficients, parafunctional habits such as bruxism, and trauma.[5] Additionally, marginal adaptation plays a crucial role in the success of restorations. Marginal gaps predispose to plaque accumulation, microleakage, secondary caries, and gingival inflammation.[2] The periodontal response to fixed restorations is also an essential parameter in evaluating long-term success. Inadequate contour, overhangs, and deficiencies in marginal fit can disturb the gingival architecture. Therefore, assessing periodontal status adjacent to these restorations helps in identifying whether the restoration design supports long-term oral health.[1]

Although advances in digital dentistry and ceramic materials have increased the popularity of zirconia and lithium disilicate restorations, many clinicians still prefer metal-ceramics for their reliability, especially in high-load regions. In many developing regions, MCRs remain the most used fixed prosthodontic option due to their cost-effectiveness, strength, and long-established clinical performance.[6] Given this context, evaluating the clinical performance of MCRs after several years in function provides valuable insight into treatment prognosis and helps clinicians refine material selection, design principles, and patient follow-up protocols. This study aimed to evaluate the clinical condition of metal-ceramic restorations after at least five years of service life using standardized clinical evaluation criteria.

## METHODOLOGY

This cross-sectional study was conducted at the Department of Prosthodontics Kohat from January 2022 to December 2022, involving patients who had received metal-ceramic restorations five or more years previously. Patients were selected through purposive sampling during routine follow-up visits. Restorations included both single crowns and short-span fixed partial dentures. Each restoration was examined clinically under standardized conditions with dental loupes, an explorer, and appropriate lighting. Parameters evaluated included marginal integrity, colour match, porcelain chipping, occlusal wear, and periodontal response. The modified USPHS (United States Public Health Service) criteria were used, categorizing each parameter as clinically acceptable (Alpha/Bravo) or unacceptable (Charlie/Delta). Oral hygiene status was assessed using the simplified plaque index. Data were recorded and analysed using SPSS version 24.

## RESULTS

A total of 124 metal-ceramic restorations in 73 patients were evaluated. The cohort included both single crowns and short-span fixed partial dentures placed in anterior and posterior regions. Clinical parameters assessed included marginal integrity, colour match, porcelain chipping, occlusal wear, and periodontal response. Table 1 summarizes the overall clinical performance of

Received on 25-06-2023
Accepted on 23-10-2023

MCRs after five years. Most restorations maintained acceptable marginal adaptation (92.7%), indicating minimal risk for plaque accumulation or secondary caries. Colour match was satisfactory in 86.3%, suggesting that aesthetic stability is preserved over time, though some restorations exhibited slight discoloration, likely due to aging or staining. Porcelain surfaces remained intact in 83.9% of restorations, highlighting the durability of the ceramic veneer. Occlusal wear was minimal in most cases (95.1%), confirming the ability of MCRs to withstand masticatory forces over an extended period. Overall, these results demonstrate that most restorations maintained functional and aesthetic integrity after five years.

Table 1: Clinical Evaluation of Restorations (n = 124)

| Parameter | Clinically Acceptable n (%) | Clinically Unacceptable n (%) |
|---|---|---|
| Marginal Integrity | 115 (92.7%) | 9 (7.3%) |
| Color Match | 107 (86.3%) | 17 (13.7%) |
| Porcelain Surface Intact | 104 (83.9%) | 20 (16.1%) |
| Occlusal Wear Minimal | 118 (95.1%) | 6 (4.9%) |

Table 2 illustrates the prevalence and severity of porcelain chipping in the evaluated restorations. Most restorations (77.4%) showed no chipping, confirming the structural reliability of MCRs. Minor chipping, which could be corrected with simple polishing, occurred in 14.5% of cases. Moderate chipping, requiring localized repair with composite, was observed in 7.3% of restorations. Only 0.8% experienced major chipping necessitating replacement. These results suggest that while minor technical complications are relatively common, catastrophic failures are rare, and most restorations remain functional without major intervention.

Table 2: Porcelain Chipping Severity

| Chipping Category | Frequency n (%) |
|---|---|
| No Chipping | 96 (77.4%) |
| Minor Chipping (Polishing Adequate) | 18 (14.5%) |
| Moderate Chipping (Composite Repair) | 9 (7.3%) |
| Major Chipping (Replacement Required) | 1 (0.8%) |

Table 3 shows the periodontal response adjacent to MCRs. Most sites (74.2%) exhibited healthy gingival conditions, indicating that properly contoured and maintained restorations do not adversely affect periodontal tissues. Mild inflammation was noted in 25.8% of restorations, mostly associated with patients demonstrating poor oral hygiene practices rather than design flaws. No cases of moderate or severe inflammation were observed, suggesting that MCRs are generally compatible with long-term periodontal health when combined with routine maintenance.

Table 3: Periodontal Status Adjacent to Restorations

| Periodontal Parameter | Healthy n (%) | Mild Inflammation n (%) | Moderate/Severe Inflammation n (%) |
|---|---|---|---|
| Gingival Health | 92 (74.2%) | 32 (25.8%) | 0 (0%) |

## DISCUSSION

The findings of the present study reaffirm that metal-ceramic restorations (MCRs) demonstrate excellent clinical durability and stability after five years of function. The high percentage of restorations with acceptable marginal integrity (92.7%) indicates that MCRs continue to provide reliable adaptation between the restoration and tooth structure over medium-term clinical service. Marginal adaptation is critical, as poorly adapted margins are associated with plaque accumulation, secondary caries, and periodontal inflammation. Previous studies have reported similar outcomes; Galindo-Moreno et al. (2022)[7] observed a 90–95% rate of clinically acceptable marginal integrity for MCRs over five years, confirming the mechanical and biological reliability of these restorations. The consistency across multiple studies emphasizes that careful planning, proper tooth preparation, and meticulous laboratory fabrication are key determinants of restoration longevity.[8]

Porcelain chipping, one of the most reported technical complications, was observed in 22% of restorations in this study, with minor chipping constituting 14.5% and moderate chipping 7.3%. Only 0.8% of restorations required complete replacement due to major chipping. These findings align with the literature, where porcelain fractures are often reported in 10–25% of cases over similar time periods. Factors contributing to chipping include occlusal overload, parafunctional habits (e.g., bruxism), insufficient thickness of the porcelain veneer, and mismatched thermal expansion coefficients between the metal substructure and ceramic. Sailer et al. reported that anterior crowns were more prone to minor chipping due to aesthetic demands and thinner porcelain layers, whereas posterior restorations with higher occlusal loads were more susceptible to moderate fractures. In the current study, both anterior and posterior restorations were evaluated, suggesting that while minor chipping is relatively common, careful design and occlusal management can minimize its impact on function and aesthetics.

Occlusal wear, assessed in this study, was minimal in 95.1% of restorations. Wear of the occlusal surfaces is a critical factor in long-term functional stability, particularly for patients with parafunctional habits. The low prevalence of significant occlusal wear may be attributed to the inherent hardness and resistance of the ceramic fused to the metal substructure. Previous longitudinal studies have confirmed that metal-ceramic restorations maintain occlusal integrity over five to ten years, provided that occlusal adjustments are performed at regular intervals. Regular follow-up visits allow clinicians to identify and manage early wear or interference, preserving both the restoration and opposing dentition.[8-11]

Periodontal response is another essential aspect of restoration success. In this study, mild gingival inflammation was observed in 25.8% of restorations, predominantly associated with patients exhibiting poor oral hygiene rather than intrinsic restoration defects. This observation is consistent with findings from Newaskar et al. (2022)[12], who highlighted that the biological response to fixed prostheses depends more on plaque control, contouring, and emergence profile than on material type. Overhanging margins, subgingival placement, and rough surfaces can exacerbate periodontal problems; however, when restorations are well-contoured and patients maintain adequate oral hygiene, MCRs are compatible with long-term periodontal health.

Another notable observation is the high patient satisfaction reported during clinical assessments. Although not quantitatively measured in this study, qualitative feedback indicated satisfaction with both aesthetics and function. This aligns with previous studies, which have shown that MCRs provide acceptable aesthetic outcomes while offering superior strength compared to some all-ceramic alternatives, particularly in posterior regions where masticatory forces are high.

From a clinical perspective, the results of this study underscore the importance of maintenance-oriented follow-up care. Regular evaluations allow early identification of minor porcelain fractures, marginal deterioration, or occlusal discrepancies, preventing progression to major failures. Furthermore, patient education on oral hygiene practices and habits such as bruxism management can significantly reduce biological complications and enhance long-term outcomes. For dental practitioners, meticulous attention to framework design, porcelain thickness, occlusal adjustments, and margin placement is paramount in reducing technical and biological failures.[1]

In addition, the longevity of MCRs in this study reinforces their continued relevance despite advances in all-ceramic and CAD/CAM technologies. While newer ceramic systems offer superior translucency and aesthetic potential, metal-ceramic restorations remain indispensable in situations requiring exceptional strength, such as long-span bridges or restorations in patients with heavy occlusal loading.[13,14] The combination of high

survival rates, manageable complications, and predictable aesthetic outcomes makes MCRs a cornerstone of fixed prosthodontics.

Finally, this study highlights the importance of evidence-based treatment planning. By documenting clinical outcomes after five years, clinicians can make informed decisions regarding material selection, restorative design, and patient follow-up. Future research could focus on longitudinal multicentre studies comparing MCRs with contemporary all-ceramic systems to provide a broader understanding of their relative performance over extended periods.

## CONCLUSION

the study confirms that metal-ceramic restorations are highly durable, functionally stable, and generally biologically compatible after five years of clinical service. Minor technical complications, primarily porcelain chipping, and mild periodontal inflammation are manageable and do not significantly compromise restoration success. Emphasis on proper restorative design, occlusal management, and patient maintenance can further enhance long-term outcomes and patient satisfaction.

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**This article may be cited as:** Khan H, Hussain Y, Syed A, Afridi S, Uddin KA, Sabir S: Condition of Metal-Ceramic Restorations after Five Years in Function: A Cross-Sectional Evaluation. Pak J Med Health Sci, 2023;17(11):504-506.