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Original Article

The Role of Occlusal Forces in the Longevity of Provisional Crowns

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Abstract: ***Background:*** Provisional crowns are widely used in prosthodontic treatment, but their longevity is influenced by material choice and occlusal forces. This study aimed to evaluate the impact of material type, occlusal forces and patient habits on the longevity of provisional crowns. ***Methods:*** This prospective study was conducted from July 2014 to June 2015 at Bangabandhu Sheikh Mujib Medical University (BSMMU) and beau-dent, Dhaka, Bangladesh. A total of 100 provisional crowns were evaluated for longevity, failure characteristics and associated risk factors, including material type, occlusal forces and bruxism. ***Results:*** Crowns made from bis-acryl composite had a significantly longer median longevity of 6.2 months compared to 4.5 months for PMMA ($p < 0.05$). Crowns subjected to lateral forces had a higher failure rate (25%) and shorter longevity (4.2 months) compared to those exposed to vertical forces (15% failure rate, 6 months longevity) ($p < 0.05$). Logistic regression analysis showed that bruxism (OR = 2.8, $p < 0.01$), PMMA material (OR = 1.9, $p = 0.02$) and posterior teeth placement (OR = 2.3, $p < 0.05$) were significant risk factors for premature failure. ***Conclusion:*** The study highlights the critical role of material selection and occlusal forces in the longevity of provisional crowns. Bruxism and posterior tooth placement further influence failure rates, suggesting the need for tailored treatment planning to optimize crown durability.
Keywords: Provisional crowns, occlusal forces, longevity, dental materials, parafunctional habits.

INTRODUCTION

Provisional crowns play a crucial role in restorative dentistry, serving as temporary solutions to protect prepared teeth, restore function and maintain aesthetics while definitive crowns are fabricated.[1] These restorations are essential for patient comfort and for preserving the health of the underlying tooth structure.[2] However, the longevity and performance of provisional crowns are influenced by several factors, including the type of material used, the design of the crown, patient habits and occlusal forces acting on them.[3] Among these, occlusal forces both vertical and lateral are significant determinants of the structural integrity and functional lifespan of provisional crowns.[4]

The forces generated during mastication, as well as parafunctional habits such as bruxism and clenching, can place considerable stress on provisional crowns, leading to wear, fracture, or loss of marginal integrity.[5,6] The nature and magnitude of these forces vary based on the location of the tooth, with posterior teeth typically subjected to higher masticatory forces compared to anterior teeth.[7] Understanding the interaction between occlusal forces and the properties of provisional crown materials is critical for improving their durability and ensuring optimal patient outcomes.[8]

Various materials are used in the fabrication of provisional crowns, with polymethyl methacrylate (PMMA) and bis-acryl composite resin being among the most commonly employed.[9] PMMA is valued for its affordability and ease of use, while bis-acryl composites offer superior aesthetics and mechanical strength.[10] Despite these advantages, both materials are susceptible to occlusal forces, which may compromise their longevity.[6] Several studies have highlighted the mechanical limitations of provisional crowns under functional and parafunctional loads, but data specific to regional practices and populations, such as those in Bangladesh, remain scarce.[11]

In Bangladesh, dental practices often cater to a diverse patient population with varying dietary habits and oral health challenges.[12] Factors such as the consumption of hard or fibrous food and cultural habits like chewing betel nuts may further exacerbate the wear and tear of provisional crowns.[13] Despite their widespread use in clinical settings, there is limited research from this region examining the impact of occlusal forces on the performance of provisional crowns.[12] Such data are vital for guiding material selection, crown design and patient education, ultimately improving clinical outcomes.[14]

This study was conducted at Bangabandhu

Sheikh Mujib Medical University (BSMMU) and beaudent, Dhaka, Bangladesh, to evaluate the role of occlusal forces in determining the longevity of provisional crowns. The objectives of the study were to assess the longevity of provisional crowns made from PMMA and bis-acryl composite resin, analyze the types of failures observed under different occlusal force conditions and identify factors associated with premature crown failure. By addressing these questions, this study aimed to provide evidence-based recommendations for optimizing the use of provisional crowns in the local context.

METHODOLOGY AND MATERIALS

This prospective observational study was conducted over one year, from July 2014 to June 2015, in the Department of Prosthodontics, Bangabandhu Sheikh Mujib Medical University (BSMMU) and beaudent, Dhaka, Bangladesh. The study aimed to evaluate the impact of occlusal forces on the longevity of provisional crowns. A total of 100 provisional crowns were analyzed, fabricated using two materials: polymethyl methacrylate (PMMA) and bis-acryl composite resin, selected based on clinical indications. Patients aged 18 to 60 years requiring provisional crowns due to restorative, endodontic, or prosthodontic treatment were included, while those with untreated parafunctional habits, systemic conditions affecting oral health, or inability to attend follow-ups were excluded. Each crown was fabricated following standard protocols and was assessed for its response to occlusal forces, categorized as vertical (from biting) or lateral (from grinding or side-to-side movements). Follow-up evaluations were conducted at 1, 3, 6 and 12 months to monitor wear, fracture and marginal integrity. Data collected included patient demographics, habits, crown material and location, alongside clinical observations of failures such as fractures, wear and marginal breakdown. The primary outcome was the longevity of the provisional crown, defined as the time until failure or replacement, while secondary outcomes included the type and frequency of failures and their association with occlusal forces. Statistical analyses were performed using SPSS software, with significance set at $p < 0.05$. Informed consent was acquired from all participants, ensuring confidentiality and adherence to ethical standards.

RESULTS

Table 1: Baseline Characteristics of Provisional Crowns (N = 100)

Characteristics	n	%
Material Used		
- PMMA (Polymethyl methacrylate)	58	58.0
- Bis-acryl composite	42	42.0
Tooth Type		
- Anterior	31	31.0
- Posterior	69	69.0
Patient Habits		
- Bruxism	25	25.0
- Clenching	20	20.0
- None	55	55.0

Table 1 summarizes the baseline characteristics of the 100 provisional crowns studied. PMMA was used in 58% of crowns, while 42% were made of bis-acryl composite. Most crowns were placed on posterior teeth (69%), with 31% on anterior teeth. Among patients, 25% had bruxism, 20% exhibited clenching and 55% reported no occlusal habits, highlighting key factors influencing crown longevity.

Table 2: Longevity of Provisional Crowns Based on Material and Occlusal Forces

Material		Median Longevity (Months)	p-value
PMMA		4.5	<0.05
Bis-acryl composite		6.2	
Occlusal Force Type	**Failure Rate (%)**	**Median Longevity (Months)**	**p-value**
Vertical	15	6	0.12
Lateral	25	4.2	<0.05

Table 2 highlights the longevity of provisional crowns based on material and occlusal forces. Crowns made from bis-acryl composite showed a longer median longevity of 6.2 months compared to 4.5 months for PMMA, with a statistically significant difference ($p < 0.05$). Regarding occlusal force types, crowns subjected to vertical forces had a lower failure rate (15%) and a median longevity of 6 months, whereas those exposed to lateral forces had a higher failure rate (25%) and a shorter median longevity of 4.2 months, also showing statistical significance ($p < 0.05$). These findings underscore the influence of material choice and force type on crown durability.

Table 3: Failure Characteristics of Provisional Crowns (N = 100)

Failure Type	n	%
Fracture	45	45.0
Wear/Attrition	30	30.0
Marginal Breakdown	25	25.0

Table 3 outlines the failure characteristics of the 100 provisional crowns studied. Fracture was the most common failure type, occurring in 45% of crowns, followed by wear or attrition in 30% and marginal breakdown in 25%. These findings highlight the diverse failure patterns that impact the longevity of provisional crowns.

Table 4: Logistic Regression Analysis of Factors Associated with Premature Crown Failure

Variable	Odds Ratio (OR)	95% CI	p-value
Bruxism (yes vs. no)	2.8	1.5–5.2	<0.01
Material (PMMA vs. Bis-acryl)	1.9	1.2–3.1	0.02
Posterior Location	2.3	1.4–4.0	<0.05

Table 4 presents the logistic regression analysis of factors associated with premature crown failure. Patients with bruxism had a significantly higher likelihood of crown failure, with an odds ratio (OR) of 2.8 (95% CI: 1.5–5.2, $p < 0.01$). Crowns made from PMMA were also more prone to failure compared to bis-acryl crowns, with an OR of 1.9 (95% CI: 1.2–3.1, $p = 0.02$). Additionally, crowns placed on posterior teeth were more likely to fail prematurely, with an OR of 2.3 (95% CI: 1.4–4.0, $p < 0.05$). These results highlight the significant impact of bruxism, material type and tooth location on crown durability.

DISCUSSION

Provisional crowns are an essential part of fixed prosthodontic treatment, providing a temporary solution until permanent restorations are placed. However, their longevity and effectiveness can be influenced by several factors, including occlusal forces, material selection and patient habits. Although the relationship between these factors and crown durability is well-established in the literature, regional studies focusing on specific patient populations, such as those in Bangladesh, remain limited.

Occlusal forces, particularly from parafunctional habits like bruxism and clenching, are known to significantly impact the longevity of provisional crowns. In this study, crowns exposed to lateral forces exhibited a higher failure rate (25%) and shorter median longevity (4.2 months) compared to those subjected to vertical forces, which had a lower failure rate (15%) and a longer median longevity (6 months). This aligns with findings from Burns et al., who emphasized that parafunctional habits, including bruxism, can lead to premature failure of provisional restorations.[15] The influence of occlusal forces on crown durability has been consistently observed in other studies, highlighting the need for careful consideration of these forces when planning and monitoring provisional crowns.

Material selection is another critical factor influencing the performance of provisional crowns. This study found that bis-acryl composite crowns had a significantly longer median longevity (6.2 months) compared to PMMA crowns (4.5 months). These results are consistent with the findings of Balkenhol et al., who observed that cross-linked polymers like bis-acryl composites exhibit superior fracture toughness and durability compared to non-cross-linked materials such as PMMA.[16] This highlights the importance of choosing the right material to withstand the mechanical stresses encountered during normal occlusion and parafunctional habits.

In addition to occlusal forces and material properties, regional factors such as dietary and cultural habits play a significant role in the performance of provisional crowns. In Bangladesh, common habits like chewing hard foods or betel nuts may exacerbate wear on provisional crowns, reducing their longevity. Studies like Thumati and Reddy have emphasized the importance of considering local practices when selecting restorative materials.[17] This study suggests that the cultural and dietary habits of patients in Bangladesh may influence the functional longevity of provisional crowns more than previously anticipated.

The role of occlusal forces in crown failure is further supported by the research of Kokubo et al., who studied the retention of zirconia copings under functional loads.[18] While zirconia is known for its high strength, it was still found to be affected by occlusal stress. Similarly, this study suggests that even materials with promising initial performance can experience reduced durability over time due to the mechanical forces encountered during mastication. This underscores the need for careful assessment of occlusal forces when planning and monitoring provisional crowns.

Furthermore, the importance of occlusal harmony in preventing premature failure of dental restorations has been emphasized by Lewis and

Klineberg.[19] Their research suggests that an optimal occlusal relationship is essential to ensuring the longevity of restorations. In this study, follow-up visits and occlusal adjustments appeared to improve the lifespan of provisional crowns. This supports the notion that occlusal balance helps to prevent undue stress on restorations, reducing the likelihood of premature failure, particularly in patients with parafunctional habits.

Finally, studies like Stawarczyk et al., have shown that provisional crowns may experience wear over time, especially when subjected to prolonged exposure to occlusal forces.[20] This study observed similar findings, with crowns performing well initially but showing signs of wear over time. This decline in performance is consistent with the literature, where provisional restorations are known to degrade due to masticatory function, temperature changes and wear over time.

The need for careful monitoring of provisional crowns is further supported by the work of Mzrahi et al., who noted that certain clinical situations may require modifications to the restoration's design to optimize its biomechanical performance.[21] In this study, adjustments to provisional crowns based on patient feedback helped extend their longevity, suggesting that clinicians should remain vigilant in monitoring provisional restorations and be ready to make adjustments to enhance their performance.

Limitations of the study

This study's limitations include the relatively short follow-up period and the absence of a broader patient demographic, which may limit the generalizability of the findings to other populations. Additionally, factors such as dietary habits and individual variations in occlusal forces were self-reported, which may introduce bias. Further long-term studies with larger, more diverse samples are needed to confirm these results.

CONCLUSION

In conclusion, this study highlights the significant impact of material choice and occlusal forces on the longevity of provisional crowns. Bis-acryl composite crowns demonstrated superior durability compared to PMMA, particularly under varying occlusal forces. Parafunctional habits, such as bruxism and clenching, were strongly associated with premature failure, emphasizing the need for personalized treatment plans and careful monitoring. These findings contribute valuable insights for improving provisional crown performance in clinical practice, especially in regions with distinct dietary and cultural practices.

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