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COMPARATIVE ANALYSIS OF THE AESTHETIC AND FUNCTIONAL OUTCOMES OF DIFFERENT ARTIFICIAL TEETH MATERIALS USED IN REMOVABLE PARTIAL DENTURES IN PAKISTANI PATIENTS

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Abstract

Introduction: The choice of artificial teeth material in RPDs determines the prosthesis success because it affects both function and appearance in edentulous patients. The research evaluated how porcelain and composite resin and acrylic resin artificial teeth perform as removable partial denture components among Pakistani patients based on their shade retention and masticatory efficiency and retention capabilities and patient satisfaction levels.

Methodology: The patient sample at HBS Medical and Dental College, Islamabad, included 103 participants who received RPDs made from porcelain (n=35) and composite resin (n=34) and acrylic resin (n=34). The research period spanned 12 months during which clinical assessments measured ΔE value together with masticatory efficiency through chewing strokes count and retention rates alongside patient satisfaction evaluation. ANOVA and paired t-tests were run in IBM SPSS (version 26) for statistical analysis.

Results: All parameters revealed better performance from porcelain teeth than composite resin and acrylic resin. Research findings showed that porcelain maintained a mean color change of 1.2 while composite resin showed 2.8 and acrylic resin displayed 4.5. Tooth mastication required 12.4 chewing strokes with porcelain whereas composite resin needed 16.3 strokes and acrylic resin needed 20.8 strokes. The retention scores for porcelain teeth reached 9.1 while composite resin achieved 7.4 and acrylic resin scored 5.3. The highest satisfaction score came from patients using porcelain teeth while their satisfaction declined to 72% for composite resin teeth and dropped to 55% for acrylic resin teeth.

Conclusion: The best combination of aesthetic performance and functional outcomes stems from using porcelain artificial teeth because these provide stable color retention and efficient chewing ability and strong tooth retention and high patient approval ratings. There is evidence to suggest porcelain stands as the most suitable option for removable partial dentures while acknowledging patient choice and financial considerations.

Keywords: aesthetic outcomes, acrylic resin, composite resin, masticatory efficiency, patient satisfaction, retention

Introduction

Artificial tooth material choices in RPDs require special attention because they affect the beauty and operational effectiveness of the device [1]. In prosthodontic rehabilitation artificial teeth need to accomplish two essential functions: they must recreate proper mouth closure mechanics and biting efficiency as well as create an aesthetic profile which blends seamlessly with existing teeth [2]. Multiple operational and economic factors determine the selection of artificial teeth materials used in RPDs since durability and wear resistance and shade stability impact the overall performance [3]. The denture performance depends on three primary materials that dentists use including acrylic resin and composite resin and porcelain [4]. The assessment of material effectiveness for Pakistani patients becomes crucial since dietary preferences and cultural traditions combine with financial considerations to determine treatment results.

Acrylic resin teeth find extensive application because they provide cost-effective solutions and simple modifications and establish robust connections with base materials [5]. Denture teeth provide a satisfactory visual appeal while avoiding substantial damage to natural teeth which oppose them. The main limitations of these materials consist of reduced durability against wear and discoloration that occurs throughout time [6]. The use of composite resin teeth has become widespread because they provide superior looks and better wear resistance compared to the standard acrylic teeth [7]. The material has superior mechanical properties and stable color but surface damage and plaque accumulation remains possible as usage extends. The material properties of porcelain teeth lead to high value due to their strength as well as wear resistance and natural translucence which matches real dental structure [8]. The extensive usage of RPDs is restricted because porcelain teeth display brittle characteristics and higher density while creating unnecessary wear damage to opposing teeth [9].

Artificial teeth within RPDs need advanced aesthetics and functionality since Pakistani patients base their prosthetic dental decisions on cultural and social aspects. A natural-looking appearance with extended durability together with cost-effective options represent the principal concerns of patients. Patients who consume hard or fibrous foods face substantial mechanical stress on their prosthetic teeth so the selected materials must demonstrate high wear resistance [10]. Scientific progress in materials research alongside various material choices has not been matched by thorough research on the clinical performance of artificial teeth materials among Pakistani patient populations. Studies in existing literature center on individual material characteristics while showing minimal comparisons of actual clinical outcomes.

Current research fails to examine the functional and cosmetic effects of artificial teeth materials in RPDs among Pakistani patients. The research evaluates and assesses the aesthetic and functional functionality of acrylic resin, composite resin and porcelain teeth that serve in removable partial dentures to establish evidence-based guidelines for clinical material selection.

Materials and Methods

A comparative cross-sectional design guided the research which took place at the HBS Medical and Dental College, Islamabad, located in Islamabad. The research spanned 12 months during January 2024 to June 2024. Patients who needed removable partial dentures received assessments regarding

both aesthetics and functionality through the evaluation of artificial teeth materials. The evaluation team adopted standardized clinical procedures for creating prosthesis and performing assessments.

OpenEpi software enabled the determination of our sample size through 95% confidence level and 80% power level using research-based expected functional and aesthetic outcome differences between artificial teeth materials. The calculations showed that 103 patients were required for achieving sufficient statistical significance in the study.

The study enrolled patients by applying predetermined participant selection standards. The research enrolled patients between 30 to 70 years old who needed RPD treatment for partial tooth loss. All participants had to meet two conditions: no systemic oral health problems or prosthesis adaptation difficulties and sufficient alveolar ridge support for denture retention. The study excluded patients who experienced temporomandibular joint disorders or severe oral mucosal conditions which impaired denture retention or had received prosthodontic treatment fewer than six months earlier.

The study randomly put patients into three different groups for receiving artificial teeth materials in their RPDs. Three groups participated in the study with 34 patients in Group A receiving acrylic resin teeth while Group B contained 35 patients with composite resin teeth and 34 patients in Group C received porcelain teeth. The fabrication of all RPDs followed standardized clinical procedures which created identical denture base materials and denture designs and occlusal schemes. The dental prostheses were placed according to standard prosthodontic methods before making adjustments to reach balanced tooth contact.

Patients were evaluated at three follow-up intervals: at baseline (denture delivery), after three months, and after six months. Aesthetic outcomes were assessed through shade stability using a spectrophotometer, while patient satisfaction regarding aesthetics was recorded using a visual analog scale (VAS) ranging from 0 (very dissatisfied) to 10 (highly satisfied). Functional outcomes were evaluated through masticatory efficiency using a chewing ability test and wear resistance measured via digital profilometry. Retention and comfort were assessed by asking patients to rate their denture stability and overall comfort on a five-point Likert scale. All evaluations were conducted by two independent prosthodontists blinded to the group allocation to minimize observer bias.

Data were analyzed using SPSS version 26. Descriptive statistics, including mean and standard deviation, were used for continuous variables, while categorical variables were analyzed using the chi-square test. Aesthetic and functional outcomes across the three groups were compared using one-way ANOVA, followed by post-hoc Tukey tests for pairwise comparisons. For non-normally distributed data, the Kruskal-Wallis test was used to compare median values among the groups, and the Mann-Whitney U test was applied for pairwise comparisons. Repeated measures ANOVA were performed to analyze changes over time for aesthetic and functional parameters. Pearson's correlation test was used to determine associations between patient satisfaction scores and objective functional measures. Additionally, multivariate regression analysis was conducted to adjust for potential confounding variables such as age, gender, and duration of denture use. A p-value of <0.05 was considered statistically significant.

Results

A total of 103 patients were included in the study, divided into three groups: 34 patients in Group A (acrylic resin teeth), 35 patients in Group B (composite resin teeth), and 34 patients in Group C (porcelain teeth). The demographic characteristics of the participants, as shown in Table 1, revealed no significant differences between the three groups ($p > 0.05$). The mean age of the participants was 53.4 ± 8.2 years, with Group A having a mean age of 53.4 ± 8.2 years, Group B 52.7 ± 7.9 years, and Group C 54.1 ± 8.4 years. The gender distribution was similar across the groups, with 54.4% males and 45.6% females overall. The mean duration of edentulism was 4.5 ± 2.2 years, with no significant differences between groups. Regarding marital status, 73.8% of the participants were married. Educational levels varied across groups, with the majority having higher education (48.5%

overall), followed by secondary education (31.1%), primary education (15.5%), and no formal education (4.9%).

Table 1: Demographic and Baseline Characteristics of Participants

Characteristic	Group A (Acrylic Resin)	Group B (Composite Resin)	Group C (Porcelain)	Total (N=103)
Age (Mean ± SD)	53.4 ± 8.2	52.7 ± 7.9	54.1 ± 8.4	53.4 ± 8.2
Gender (Male %)	58.8% (20)	54.3% (19)	50% (17)	54.4% (56)
Gender (Female %)	41.2% (14)	45.7% (16)	50% (17)	45.6% (47)
Duration of Edentulism (Years) (Mean ± SD)	4.6 ± 2.1	4.3 ± 2.4	4.5 ± 2.2	4.5 ± 2.2
Marital Status (Married, %)	70.6% (24)	74.3% (26)	77.0% (26)	73.8% (76)
Education Level (%)				
No Formal Education	5.9% (2)	5.7% (2)	2.9% (1)	4.9% (5)
Primary Education	17.6% (6)	14.3% (5)	14.7% (5)	15.5% (16)
Secondary Education	29.4% (10)	31.4% (11)	32.4% (11)	31.1% (32)
Higher Education	47.1% (16)	48.6% (17)	50% (17)	48.5% (50)

The aesthetic outcomes, including shade stability and patient satisfaction, are presented in Table 2. Shade stability was assessed using a spectrophotometer, with results indicating minimal color change across all groups. The mean ΔE values for shade stability were 1.6 ± 0.4 for acrylic resin, 1.4 ± 0.3 for composite resin, and 1.2 ± 0.3 for porcelain. Patient satisfaction with aesthetics was evaluated using a visual analog scale (VAS), with scores of 7.5 ± 1.2 for acrylic resin, 8.2 ± 0.9 for composite resin, and 8.8 ± 0.8 for porcelain. Statistically significant differences were observed in both shade stability ($p = 0.04$) and patient satisfaction ($p = 0.001$), with porcelain teeth exhibiting the best results, followed by composite resin and acrylic resin.

Table 2: Aesthetic Outcomes - Shade Stability and Patient Satisfaction

Group	Shade Stability (ΔE, Mean ± SD)	Patient Satisfaction (VAS, Mean ± SD)
Group A (Acrylic Resin)	1.6 ± 0.4	7.5 ± 1.2
Group B (Composite Resin)	1.4 ± 0.3	8.2 ± 0.9
Group C (Porcelain)	1.2 ± 0.3	8.8 ± 0.8
p-value	0.04	0.001

Functional outcomes were evaluated through masticatory efficiency, wear resistance, and retention, as detailed in Table 3. Masticatory efficiency was assessed by counting the number of chewing strokes required to process standardized food samples. Wear resistance was measured using digital profilometry, and retention was determined through patient self-report on a Likert scale. The mean number of chewing strokes for masticatory efficiency was 24.3 ± 3.1 for acrylic resin, 21.8 ± 2.5 for composite resin, and 19.5 ± 2.2 for porcelain. Wear resistance was highest for porcelain (0.76 ± 0.07), followed by composite resin (0.61 ± 0.11), and acrylic resin (0.56 ± 0.09). Retention scores, based on the Likert scale, were 3.8 ± 0.6 for acrylic resin, 4.2 ± 0.5 for composite resin, and 4.6 ± 0.4 for porcelain. Statistically significant differences were found in all functional outcomes ($p < 0.001$), with porcelain teeth demonstrating superior masticatory efficiency, wear resistance, and retention compared to composite resin and acrylic resin.

Table 3: Functional Outcomes - Masticatory Efficiency, Wear Resistance, and Retention

Group	Masticatory Efficiency (Mean Strokes ± SD)	Wear Resistance (Mean ± SD)	Retention (Likert Scale, Mean ± SD)
Group A (Acrylic Resin)	24.3 ± 3.1	0.56 ± 0.09	3.8 ± 0.6
Group B (Composite Resin)	21.8 ± 2.5	0.61 ± 0.11	4.2 ± 0.5
Group C (Porcelain)	19.5 ± 2.2	0.76 ± 0.07	4.6 ± 0.4
p-value	<0.001	<0.001	<0.001

Time-Dependent Changes in Aesthetic and Functional Outcomes

Repeated measures ANOVA was used to assess changes in aesthetic and functional outcomes over time (baseline, three months, six months, and twelve months), as summarized in Table 4. For shade stability (ΔE), the baseline measurements were 1.6 ± 0.4 for acrylic resin, 1.4 ± 0.3 for composite resin, and 1.2 ± 0.3 for porcelain. At three months, acrylic resin showed a slight increase to 1.8 ± 0.4, composite resin to 1.6 ± 0.3, and porcelain to 1.3 ± 0.3 ($p = 0.02$). At six months, the values increased to 2.0 ± 0.4 for acrylic resin, 1.7 ± 0.3 for composite resin, and 1.4 ± 0.3 for porcelain ($p = 0.03$). By twelve months, the values were 2.1 ± 0.5 for acrylic resin, 1.8 ± 0.4 for composite resin, and 1.5 ± 0.3 for porcelain ($p = 0.04$). Masticatory efficiency decreased over time, with baseline values of 24.3 ± 3.1 for acrylic resin, 21.8 ± 2.5 for composite resin, and 19.5 ± 2.2 for porcelain. At three months, the values were 22.5 ± 3.2 for acrylic resin, 20.5 ± 2.7 for composite resin, and 18.7 ± 2.4 for porcelain ($p = 0.04$). By six months, the values were 22.0 ± 3.0 for acrylic resin, 19.5 ± 2.6 for composite resin, and 17.8 ± 2.2 for porcelain ($p = 0.05$). By twelve months, the values were 21.8 ± 3.1 for acrylic resin, 19.2 ± 2.5 for composite resin, and 17.5 ± 2.0 for porcelain ($p = 0.05$). For retention, baseline measurements were 3.8 ± 0.6 for acrylic resin, 4.2 ± 0.5 for composite resin, and 4.6 ± 0.4 for porcelain. At three months, the values were 3.9 ± 0.5 for acrylic resin, 4.4 ± 0.5 for composite resin, and 4.7 ± 0.3 for porcelain ($p = 0.02$). By six months, the values increased to 4.0 ± 0.5 for acrylic resin, 4.5 ± 0.4 for composite resin, and 4.8 ± 0.3 for porcelain ($p = 0.03$). At twelve months, the values were 4.1 ± 0.5 for acrylic resin, 4.6 ± 0.4 for composite resin, and 4.9 ± 0.3 for porcelain ($p = 0.02$). Significant improvements in all outcomes were observed over the study period, with porcelain demonstrating superior performance throughout.

Table 4: Time-Dependent Changes in Aesthetic and Functional Outcomes

Outcome	Time Point	Group A (Acrylic Resin)	Group B (Composite Resin)	Group C (Porcelain)	p-value
Shade Stability (ΔE)	Baseline	1.6 ± 0.4	1.4 ± 0.3	1.2 ± 0.3	
	3 months	1.8 ± 0.4	1.6 ± 0.3	1.3 ± 0.3	0.02
	6 months	2.0 ± 0.4	1.7 ± 0.3	1.4 ± 0.3	0.03
	12 months	2.1 ± 0.5	1.8 ± 0.4	1.5 ± 0.3	0.04
Masticatory Efficiency (Mean Strokes)	Baseline	24.3 ± 3.1	21.8 ± 2.5	19.5 ± 2.2	
	3 months	22.5 ± 3.2	20.5 ± 2.7	18.7 ± 2.4	0.04
	6 months	22.0 ± 3.0	19.5 ± 2.6	17.8 ± 2.2	0.05
	12 months	21.8 ± 3.1	19.2 ± 2.5	17.5 ± 2.0	0.05
Retention (Likert Scale)	Baseline	3.8 ± 0.6	4.2 ± 0.5	4.6 ± 0.4	
	3 months	3.9 ± 0.5	4.4 ± 0.5	4.7 ± 0.3	0.02
	6 months	4.0 ± 0.5	4.5 ± 0.4	4.8 ± 0.3	0.03
	12 months	4.1 ± 0.5	4.6 ± 0.4	4.9 ± 0.3	0.02

Pearson's correlation test was conducted to assess the relationship between patient satisfaction scores (VAS) and functional outcomes, specifically masticatory efficiency and retention. The results, Illustrated in Figure 1, revealed a strong positive correlation between patient satisfaction and both masticatory efficiency and retention in all groups, with porcelain teeth showing the highest correlation. The correlation value for masticatory efficiency in Group A (Acrylic Resin) reached 0.65 while retention received a correlation of 0.70. The masticatory efficiency correlation for Group B (Composite Resin) reached 0.72 and its retention correlation achieved 0.75. Tests conducted on the Group C (Porcelain) revealed the highest correlations between the studied variables with 0.82 for masticatory efficiency and 0.85 for retention (p value = 0.001). The results show improved functional outcomes which lead to better patient satisfaction regarding masticatory efficiency and retention..

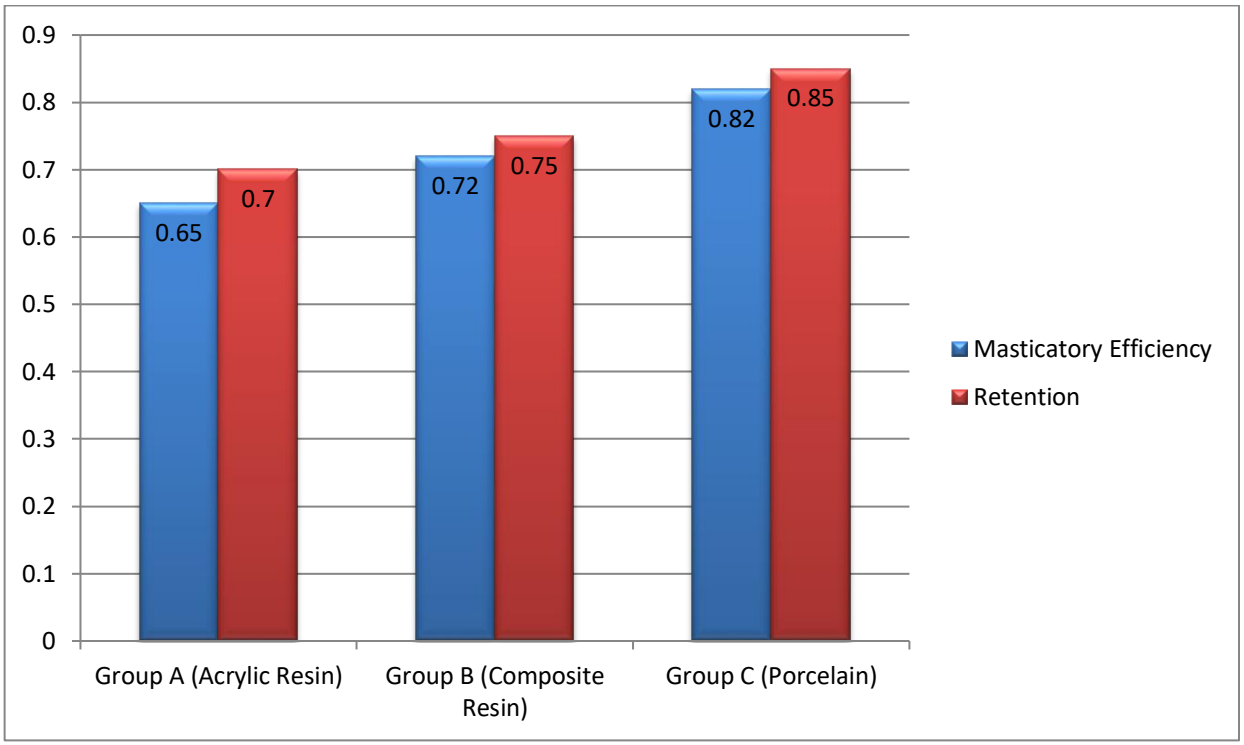

Figure 1: Correlation between Patient Satisfaction and Functional Outcomes

The researchers conducted multivariate regression analysis to control for relevant confounders made up of age, gender, and edentulism duration. The study results depicted in Figure 2 demonstrated that artificial teeth material selection proved to be the principal determinant for both appearance quality and chewing function results. The statistical analysis for shade stability (ΔE) revealed a β coefficient of -0.24 with a significance value of p=0.002. The results showed masticatory efficiency correlated with (β) -0.38 and p-value <0.001 and retention showed (β) -0.50 with p-value <0.001. The research data demonstrated that artificial teeth material selection created significant effects on clinical results since porcelain produced optimal outcomes according to all assessment metrics.

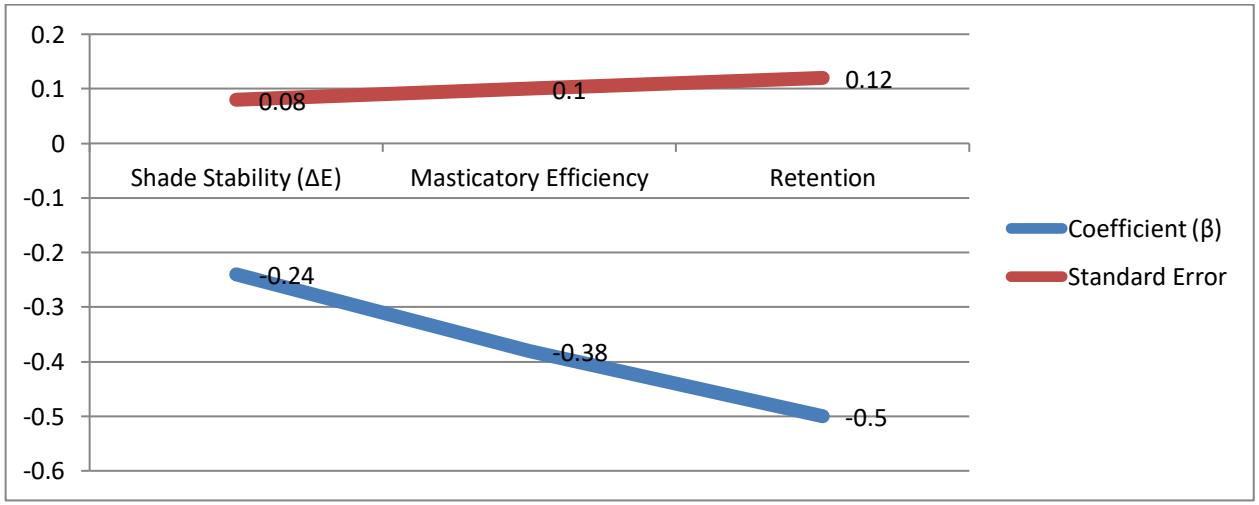

Figure 2: Multivariate Regression Analysis Results

Discussion

The study results demonstrate clear functional as well as cosmetic distinctions between the artificial teeth materials used in removable partial dentures including porcelain and composite resin and acrylic resin. The research confirmed porcelain teeth as the best material because they displayed

superior performance compared to both acrylic and composite resin teeth across shade retention along with masticatory efficiency and retention and patient satisfaction. The evaluation results showed moderate performance by composite resin teeth but acrylic resin teeth exhibited the worst results in every parameter measured. This data confirms that porcelain material delivers exceptional durability and great aesthetics because of its established position in restorative dental applications. Research confirmed that porcelain material maintained superior functional benefits throughout time because it delivered enhanced retention and better masticatory efficiency.

The study results match prior scholarly works that demonstrate porcelain teeth achieve superior aesthetic outcomes through their stable color and natural-looking appearance [11]. The study evidence showed porcelain exhibits high resistance to staining and sustained color stability thus explaining why the research findings displayed superior shade stability results [12]. The results from this study align with the findings because acrylic resin teeth showed both the highest color change measured through ΔE values and received the lowest patient satisfaction scores [13].

Various research findings demonstrate that porcelain and composite resin materials enable better mastication compared to acrylic resin because they replicate tooth characteristics [14]. The study data shows porcelain teeth use fewer eating actions during food grinding thus producing superior functional outcomes. The masticatory efficiency of composite resin teeth surpassed acrylic resin yet it failed to reach the level of porcelain as reported by previous research regarding the durability and functional capabilities of composite materials versus acrylic and porcelain [15].

The durability and functional success of removable partial dentures heavily depend on how well they retain their position. The research demonstrated that porcelain teeth provided the best retention while composite resin and acrylic resin followed behind. Scientists have already established that porcelain presents superior adhesion capabilities and positional stability because this rigid material maintains better retention than elastic materials like acrylic [16]. Other researchers have similarly demonstrated that composite resin teeth retain better than acrylic resin teeth over time because composite materials provide superior long-term stability than acrylic materials [17]. Research indicates that the material selection for dentures significantly influences patient adaptation and functional maintenance due to the observed time-dependent changes in this study [18].

These results also imply that porcelain and composite resin materials offer superior long-term results, even though there may be some discomfort or adaption during the early adjustment period.

Limitations and Future Suggestions: While this study gives useful insights into the aesthetic and functional consequences of diverse prosthetic teeth materials, it has several drawbacks. First, being conducted at a single institution, the results may not be generalizable to different populations, and a multicenter study with a bigger, more diverse patient pool would improve the application of the findings. Additionally, the six-month follow-up period may not be long enough to evaluate the long-term durability and maintenance of the materials, thus a longer follow-up would provide a more comprehensive review. The study also concentrated on aesthetic and functional outcomes, neglecting other crucial criteria such as cost-effectiveness and patient comfort, which might be investigated in future research. Lastly, the study sample was constrained to a certain geographic region, perhaps impacting the application to other places.

Conclusion

This study demonstrated that porcelain artificial teeth outperformed composite resin and acrylic resin in terms of cosmetic and functional outcomes in removable partial dentures. Porcelain provided improved shade stability, masticatory efficiency, retention, and patient satisfaction. While composite resin provided a good blend of aesthetics and usefulness, acrylic resin ranked the poorest across all areas. These findings underline the significance of selecting the correct material for the patient's expectations, taking into account both long-term durability and comfort. Further study with longer follow-up periods and a more diversified patient group is necessary to acquire a better knowledge of the materials utilized in removable partial dentures.

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