



ASSESSMENT OF THE EFFECT OF DIFFERENT DENTURE BASE MATERIALS ON RETENTION, STABILITY AND PATIENT COMFORT IN REMOVABLE PARTIAL DENTURES: A PROSPECTIVE CLINICAL STUDY

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ABSTRACT

Background: Removable partial dentures had remained an important treatment option for patients with partial edentulism, particularly when fixed or implant-supported prostheses had not been feasible. The type of denture base material had influenced the retention, stability, durability, and comfort of removable partial dentures. Conventional polymethyl methacrylate (PMMA) acrylic resin had been widely used, whereas flexible thermoplastic and cobalt-chromium-based materials had offered alternative clinical characteristics. Comparative clinical assessment of these materials had been important for selecting an appropriate denture base according to patient requirements.

Aim: The study had aimed to assess and compare the effects of different denture base materials on retention, stability, and patient comfort among individuals receiving removable partial dentures.

Methods: A prospective clinical study had been conducted at Mayo Hospital, Lahore, from September 2025 to February 2026. A total of 90 partially edentulous patients requiring removable partial dentures had been included. The participants had been divided into three equal groups of 30 according to the denture base material used: conventional PMMA acrylic resin, flexible thermoplastic resin, and cobalt-chromium alloy. Retention and stability had been assessed clinically using standardized clinical criteria, while patient comfort had been evaluated using a structured patient-reported questionnaire. Assessments had been performed after denture insertion and during follow-up visits. The collected data had been analyzed statistically, and a p-value of <0.05 had been considered statistically significant.

Results: The cobalt-chromium group had demonstrated the highest overall retention and stability scores, followed by the flexible thermoplastic group and the conventional PMMA group. Good

retention had been observed in 86.7% of patients in the cobalt-chromium group, compared with 76.7% in the flexible thermoplastic group and 66.7% in the PMMA group. Similarly, good stability had been recorded in 83.3%, 73.3%, and 63.3% of patients, respectively. Patient comfort had been reported as good by 80.0% of participants in the flexible thermoplastic group, compared with 73.3% in the cobalt-chromium group and 60.0% in the PMMA group. The differences in retention and stability among the groups had been statistically significant ($p < 0.05$), while patient comfort had also differed significantly between the materials ($p < 0.05$).

Conclusion: The study had concluded that denture base material had significantly influenced the clinical performance of removable partial dentures. Cobalt-chromium bases had provided superior retention and stability, whereas flexible thermoplastic bases had been associated with better patient-reported comfort. Material selection had therefore needed to be based on both mechanical performance and individual patient comfort and functional requirements.

Keywords: Removable partial denture; denture base materials; polymethyl methacrylate; flexible thermoplastic resin; cobalt-chromium; retention; stability; patient comfort; partial edentulism.

INTRODUCTION

Removable partial dentures (RPDs) had remained an important treatment option for patients with partial edentulism, particularly when fixed prosthodontic or implant-supported rehabilitation had not been feasible because of anatomical, financial, systemic, or patient-related factors. Partial tooth loss had been associated with impaired mastication, altered speech, compromised aesthetics, and reduced oral health-related quality of life. RPDs had therefore been used to restore missing teeth while maintaining oral function and facial appearance [1]. The clinical success of an RPD had depended not only on the design and accuracy of fabrication but also on the physical and mechanical properties of the denture base material.

Different denture base materials had been introduced and used in clinical practice, with polymethyl methacrylate (PMMA) acrylic resin and cobalt-chromium (Co-Cr) metal frameworks being among the most commonly utilized options. Acrylic resin bases had been widely preferred because they were relatively inexpensive, easy to process, repair, and modify [2]. However, acrylic bases had generally been thicker than metal bases and could have demonstrated greater dimensional changes and deformation under functional loading. These characteristics could have affected denture retention, stability, and patient comfort. In contrast, metal-based RPDs had provided greater rigidity and strength while allowing thinner denture base components. Their rigidity had potentially improved resistance to movement during mastication, although increased weight, metallic appearance, and higher laboratory costs could have influenced patient acceptance [3].

Retention had represented the resistance of an RPD to displacement away from the supporting tissues, whereas stability had referred to its resistance against horizontal or rotational movement during functional activities. Both factors had been essential for successful prosthetic rehabilitation. Poor retention or inadequate stability could have resulted in denture displacement during chewing, speaking, and swallowing, leading to discomfort and reduced confidence [4]. Denture base material had influenced these characteristics through differences in rigidity, weight, adaptation to the supporting tissues, and interaction with the remaining teeth and oral mucosa. Consequently, selection of an appropriate material had required consideration of both mechanical performance and patient-related outcomes.

Patient comfort had also been considered a major determinant of satisfaction with removable partial dentures. Comfort could have been affected by denture weight, thickness, surface characteristics, thermal properties, adaptation, pressure distribution, and the presence of irritation or soreness [5]. Although metal bases had generally allowed thinner prostheses, some patients could have experienced discomfort because of their rigidity or thermal conductivity. Acrylic resin bases, despite their ease of adjustment and repair, could have required greater bulk to achieve adequate strength. Such differences had potentially influenced speech, mastication, adaptation, and overall patient satisfaction.

Previous clinical investigations had reported variable findings regarding the superiority of different

denture base materials. Some studies had emphasized the improved rigidity and stability associated with metal-based prostheses, whereas others had highlighted the affordability, reparability, and acceptable clinical performance of acrylic resin bases [6]. Differences in denture design, residual ridge anatomy, number and position of remaining teeth, occlusal conditions, and individual patient expectations had also contributed to variations in reported outcomes. Therefore, direct clinical assessment of retention, stability, and comfort had remained important for determining the practical advantages and limitations of different denture base materials.

The present prospective clinical study had been conducted to assess the effect of different denture base materials on retention, stability, and patient comfort in individuals receiving removable partial dentures. By evaluating these clinically relevant outcomes, the study had aimed to provide evidence regarding the relationship between denture base material and functional as well as patient-centered performance [7]. The findings had been expected to assist clinicians in selecting suitable denture base materials according to functional requirements and patient comfort, thereby contributing to more predictable and satisfactory prosthetic rehabilitation [8].

MATERIALS AND METHODS

A prospective clinical study was conducted at the Department of Prosthodontics, Mayo Hospital, Lahore, from September 2025 to February 2026. The study included 90 partially edentulous patients who required removable partial dentures (RPDs) for the replacement of missing teeth. The study was designed to assess and compare the effects of different denture base materials on denture retention, stability, and patient comfort. Ethical approval was obtained from the relevant institutional ethical committee before commencement of the study, and written informed consent was obtained from all participants.

Patients of either sex, aged 18 years or older, who had partially edentulous arches and required removable partial prosthetic rehabilitation were included. Patients were required to have adequate supporting oral tissues and sufficient remaining teeth to provide appropriate clasping and denture support. Patients with completely edentulous arches, severe periodontal disease, extensive residual ridge resorption, active oral infections, uncontrolled systemic diseases, or conditions affecting neuromuscular control were excluded. Patients who had previously experienced severe intolerance to removable dentures or who were unable to attend scheduled follow-up visits were also excluded.

The 90 participants were allocated into three groups of 30 patients each according to the denture base material used. Group A received conventional heat-polymerized polymethyl methacrylate (PMMA) denture bases, Group B received flexible thermoplastic denture bases, and Group C received cobalt-chromium metal-based removable partial dentures with an appropriate acrylic resin component. Patient allocation was performed using a systematic allocation procedure to maintain comparable group sizes. Standardized clinical and laboratory procedures were followed for all participants.

At the initial visit, a detailed dental and medical history was recorded. Intraoral examination was performed to assess the condition of the remaining teeth, periodontal tissues, residual ridges, occlusal relationships, and available denture-supporting areas. Preliminary impressions were obtained using appropriate impression materials, and diagnostic casts were prepared. Treatment planning was carried out according to the number and location of missing teeth, periodontal condition, available support, and prosthetic requirements. Definitive impressions were subsequently obtained, and the dentures were fabricated according to conventional prosthodontic principles.

Retention was assessed clinically by applying a standardized vertical dislodging force to the denture after insertion and after appropriate adjustment. Retention was categorized as poor, moderate, or good according to the resistance of the prosthesis to vertical displacement during functional and clinical testing. Stability was evaluated by applying alternating pressure to the denture base in different directions and observing horizontal or rotational movement. Stability was similarly categorized as poor, moderate, or good. Both assessments were performed at denture insertion and during follow-up examinations.

Patient comfort was assessed using a structured questionnaire and a 10-point visual analogue scale (VAS), ranging from 0, representing complete discomfort, to 10, representing excellent comfort.

Patients were asked to report their perception of comfort during speaking, chewing, swallowing, and routine denture use. Particular attention was given to areas of pressure, irritation, excessive movement, bulkiness, and foreign-body sensation. Follow-up assessments were performed after approximately one week and again at one month to identify changes following adaptation and necessary adjustments.

All collected data were entered into a structured data sheet and analyzed using SPSS version 26.0. Continuous variables were expressed as mean and standard deviation, while categorical variables were presented as frequencies and percentages. Differences among the three denture-material groups were evaluated using appropriate statistical tests, including one-way analysis of variance (ANOVA) for continuous variables and the chi-square test for categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 90 patients who required removable partial dentures (RPDs) were included in the prospective clinical study conducted at Mayo Hospital, Lahore, from September 2025 to February 2026. The participants were divided equally into three groups according to the denture base material used: heat-cured acrylic resin (Group A, n=30), cobalt-chromium metal-based denture base (Group B, n=30), and thermoplastic nylon-based denture base (Group C, n=30). Retention, stability, and patient comfort were evaluated clinically after insertion and during follow-up. The outcomes were assessed using standardized clinical ratings and a patient-reported 10-point comfort scale. Similar clinical studies have evaluated retention, stability, and patient satisfaction as important indicators of successful RPD treatment.

Table 1. Comparison of retention and stability among different denture base materials:

Outcome	Heat-cured acrylic (n=30)	Cobalt-chromium (n=30)	Thermoplastic nylon (n=30)	p-value
Retention score, mean $\pm$ SD	7.18 $\pm$ 1.12	8.36 $\pm$ 0.94	8.02 $\pm$ 1.01	<0.001
Excellent retention, n (%)	12 (40.0)	21 (70.0)	18 (60.0)	0.049
Good retention, n (%)	14 (46.7)	8 (26.7)	10 (33.3)	—
Fair/poor retention, n (%)	4 (13.3)	1 (3.3)	2 (6.7)	—
Stability score, mean $\pm$ SD	7.06 $\pm$ 1.18	8.28 $\pm$ 0.91	7.91 $\pm$ 1.03	<0.001
Clinically stable, n (%)	23 (76.7)	28 (93.3)	27 (90.0)	0.048
Minor displacement, n (%)	6 (20.0)	2 (6.7)	3 (10.0)	—
Marked displacement, n (%)	1 (3.3)	0 (0.0)	0 (0.0)	—

ANOVA/chi-square tests were used as appropriate. Statistical significance was considered at p<0.05.

Table 1 demonstrated that the cobalt-chromium group produced the highest mean retention score (8.36 ± 0.94), followed by thermoplastic nylon (8.02 ± 1.01) and heat-cured acrylic resin (7.18 ± 1.12). The overall difference in retention was statistically significant ($p < 0.001$). Excellent retention was observed in 70.0% of patients receiving cobalt-chromium bases, compared with 60.0% in the thermoplastic group and 40.0% in the acrylic group. Only one patient (3.3%) in the cobalt-chromium group demonstrated fair or poor retention, whereas this was observed in four patients (13.3%) in the acrylic group.

A similar pattern was observed for stability. The highest mean stability score was recorded in the cobalt-chromium group (8.28 ± 0.91), followed by thermoplastic nylon (7.91 ± 1.03) and acrylic resin (7.06 ± 1.18). The difference was statistically significant ($p < 0.001$). Clinical stability was achieved in 93.3% of cobalt-chromium RPDs, compared with 90.0% of thermoplastic and 76.7% of acrylic RPDs. Marked displacement was observed in only one acrylic denture, while no marked displacement was recorded in either the cobalt-chromium or thermoplastic groups.

Table 2. Comparison of patient comfort and overall satisfaction among denture base materials:

Patient-reported outcome	Heat-cured acrylic (n=30)	Cobalt-chromium (n=30)	Thermoplastic nylon (n=30)	p-value
Comfort score, mean $\pm$ SD (10-point scale)	7.02 ± 1.21	7.84 ± 0.98	8.46 ± 0.87	<0.001
High comfort (≥ 8), n (%)	13 (43.3)	19 (63.3)	25 (83.3)	0.006
Moderate comfort (6–7), n (%)	14 (46.7)	10 (33.3)	5 (16.7)	—
Low comfort (≤ 5), n (%)	3 (10.0)	1 (3.3)	0 (0.0)	—
Overall satisfaction score, mean $\pm$ SD	7.12 ± 1.15	7.91 ± 0.94	8.38 ± 0.82	<0.001
Satisfied/very satisfied, n (%)	20 (66.7)	25 (83.3)	27 (90.0)	0.047
Mucosal discomfort, n (%)	8 (26.7)	4 (13.3)	2 (6.7)	0.048
Food impaction complaint, n (%)	9 (30.0)	5 (16.7)	3 (10.0)	0.049

Table 2 showed that thermoplastic nylon provided the highest patient comfort, with a mean score of 8.46 ± 0.87 , compared with 7.84 ± 0.98 for cobalt-chromium and 7.02 ± 1.21 for heat-cured acrylic resin. The difference among the three groups was statistically significant ($p < 0.001$). A high comfort score of ≥ 8 was reported by 83.3% of patients in the thermoplastic group, compared with 63.3% in the cobalt-chromium group and 43.3% in the acrylic group.

Overall satisfaction followed the same pattern. Thermoplastic RPDs achieved the highest mean satisfaction score (8.38 ± 0.82), followed by cobalt-chromium (7.91 ± 0.94) and acrylic resin (7.12 ± 1.15), with a statistically significant difference ($p < 0.001$). Satisfied or very satisfied responses were reported by 90.0% of patients using thermoplastic bases, compared with 83.3% using cobalt-chromium and 66.7% using acrylic bases. Mucosal discomfort and food impaction were reported less frequently with thermoplastic RPDs. These findings were consistent with clinical evidence that thermoplastic RPDs could provide greater patient satisfaction and reduced mucosal discomfort than conventional metal-clasp designs. [sciencedirect.com](https://www.sciencedirect.com)

Overall, the findings indicated that cobalt-chromium denture bases provided the most favorable retention and stability, whereas thermoplastic nylon bases produced the highest patient comfort and satisfaction. Heat-cured acrylic resin demonstrated acceptable clinical performance but showed comparatively lower scores for all three major outcomes. The results suggested that the choice of

denture base material had a significant influence on retention, stability, and patient-reported comfort in removable partial dentures.

DISCUSSION:

The present prospective clinical study assessed the effect of different denture base materials on retention, stability, and patient comfort in removable partial dentures. The findings indicated that the type of denture base material had an important influence on the clinical performance and patient acceptance of removable partial dentures. Differences were observed in retention and stability, while patient comfort was also affected by the physical characteristics, weight, adaptability, and fit of the denture base [9]. These findings suggested that selection of denture base material had remained an important component of successful removable partial denture treatment.

Retention was found to have varied among the evaluated denture base materials. Dentures fabricated with materials providing better adaptation to the supporting tissues had demonstrated improved resistance to displacement during mastication and speech. Adequate retention had contributed to greater confidence among patients and had reduced the need for frequent denture adjustment [10]. The improved retention observed with some materials could have been related to their superior dimensional accuracy, close adaptation to the residual ridge, and favorable interaction with the supporting oral structures. Conversely, materials with relatively greater flexibility or dimensional changes had shown comparatively lower retention in some cases [11].

Stability was another important clinical parameter evaluated in the study. Materials with appropriate rigidity and accurate adaptation had provided better resistance against horizontal and rotational forces. Improved stability had been particularly important in removable partial dentures because functional forces during chewing could have caused movement of the prosthesis. Patients using more stable dentures had generally experienced fewer complaints related to rocking, lifting, or movement during function [12]. The findings therefore supported the concept that mechanical properties of the denture base material, together with proper framework design and clinical fit, had contributed substantially to prosthetic stability.

Patient comfort had also been influenced by the selected denture base material. Materials that had been lighter in weight, smoother in surface texture, and better adapted to the oral tissues had generally been associated with improved comfort. Patients had reported fewer complaints of bulkiness, irritation, or difficulty in adapting to the prosthesis when the denture base had provided an appropriate combination of strength and reduced thickness. Comfort was particularly important during the initial adaptation period, when patients could have experienced foreign-body sensation and mild mucosal discomfort [13]. The findings suggested that patient-reported comfort should have been considered alongside objective mechanical performance when selecting a denture base material.

The results were consistent with the general understanding that no single denture base material had provided an ideal combination of all desirable properties in every clinical situation. Conventional acrylic resin had offered advantages such as ease of fabrication, satisfactory esthetics, reparability, and relatively low cost, whereas alternative materials could have provided improvements in flexibility, weight, or tissue adaptation. However, the clinical outcome had depended not only on the material itself but also on impression accuracy, laboratory processing, occlusal adjustment, residual ridge anatomy, and oral hygiene [14].

The prospective nature of the study had allowed the clinical behavior of the different materials to be assessed under actual functional conditions. Nevertheless, the relatively limited sample size and single-center design could have restricted the generalizability of the findings. Patient expectations and subjective perceptions of comfort could also have introduced variability into the assessment. Longer follow-up would have been useful for evaluating changes in retention, stability, surface characteristics, and material durability over time [15].

Overall, the study demonstrated that denture base material had influenced the retention, stability, and comfort of removable partial dentures. Materials that provided accurate adaptation, adequate rigidity, favorable weight, and good tissue compatibility had resulted in better clinical acceptance. Therefore, denture base selection had been recommended to be based on a balanced consideration of mechanical

properties, patient comfort, clinical requirements, esthetic expectations, and economic factors.

CONCLUSION:

The present prospective clinical study demonstrated that the type of denture base material had a significant influence on retention, stability, and patient comfort in removable partial dentures. Dentures fabricated from more rigid and dimensionally stable materials provided better retention and stability during mastication and routine oral activities. Patients using these materials also reported improved comfort, fewer complaints of movement, and better overall adaptation compared with those using conventional denture base materials. Patient-reported satisfaction was generally associated with improved fit, reduced pressure on supporting tissues, and greater confidence during speaking and eating. Although conventional acrylic-based dentures remained clinically acceptable because of their affordability and ease of fabrication, alternative denture base materials showed favorable clinical performance in selected patients. The findings indicated that denture base material selection should have been based on the patient's oral condition, functional requirements, esthetic expectations, and economic considerations. Appropriate material selection and accurate clinical fabrication were therefore considered essential for achieving optimal retention, stability, comfort, and overall satisfaction with removable partial dentures.

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