

## Cast Partial Denture versus Acrylic Partial Denture for Replacement of Missing Teeth in Partially Edentulous Patients

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### Abstract

**Aim:** To compare the effects of cast partial denture with conventional all acrylic denture in respect to retention, stability, masticatory efficiency, comfort and periodontal health of abutments. **Methods:** 50 adult partially edentulous patient seeking for replacement of missing teeth having Kennedy class I and II arches with or without modification areas were selected for the study. Group-A was treated with cast partial denture and Group-B with acrylic partial denture. Data collected during follow-up visit of 3 months, 6 months, and 1 year by evaluating retention, stability, masticatory efficiency, comfort, periodontal health of abutment. **Results:** Chi-square test was applied to find out differences between the groups at 95% confidence interval where  $p = 0.05$ . One year comparison shows that cast partial denture maintained retention and stability better than acrylic partial denture ( $p < 0.05$ ). The masticatory efficiency was significantly compromising from 3<sup>rd</sup> month to 1 year in all acrylic partial denture groups ( $p < 0.05$ ). The comfort of patient with cast partial denture was maintained better during the observation period ( $p < 0.05$ ). Periodontal health of abutment was gradually deteriorated in all acrylic denture group ( $p < 0.05$ ). **Conclusions:** With adequate maintenance of oral and denture hygiene at a regular interval, cast partial denture compared with acrylic partial denture provides better results in terms of

retention, stability, comfort and periodontal health of abutment.

**Keywords:** Dental prosthesis retention, Denture base, Masticatory efficiency, periodontal health of abutment, Removable partial denture.

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## Introduction

Edentulousness is the state in which loss of teeth causes adverse aesthetic and biomechanical sequel. Tooth replacement techniques have evolved considerably over years, however, patient acceptance to traditional prosthesis has never been foreseeable and is never complete and there has been a constant pursuit of achieving better ways of restoration. Although complete edentulism has decreased, the number of partially edentulous individuals has increased, probably because of the worldwide ageing population and oral health-related prevention policies (1). For the rehabilitation of the partially edentulous state to replace the missing teeth various type of prosthetic options are available including removable partial denture (RPD), tooth supported fixed partial denture, implant supported partial denture, flexible denture. How well these prostheses restores and maintain the functions of natural teeth depends on a large extent on the numbers and location of the missing teeth (2).

There are limited advantages that can be accomplished by the removable prosthesis for replacing the natural teeth, such as non-invasive and low-cost partial dentures can be constructed by heat cured acrylic resin solely known as all acrylic partial dentures, whereas cast partial denture has metallic framework along with metallic denture base or acrylic resin denture base. The metal bases have several advantages like accuracy, durability, resistance to distortion, inherent cleanliness, reduced weight, and bulk (2,3). When a partial denture undergoes occlusal force, rotational movements may occur along the fulcrum line and around both longitudinal and vertical axis. The distal extension denture has a tendency for lateral movement during the function. Loss of support and stability and ultimately loss of occlusion is accompanied by settling denture base, especially in distal extension cases because the tissue support in the distal extension denture predictably changes with time.

The high cost of the cast partial denture is an important barrier in limiting the supply of prosthodontic service. Several patients receive tissue supported all acrylic partial dentures. Patient comes with complaints of denture loosening, movement of the denture during mastication, unnatural feeling and even degradation of the periodontal condition of the remaining teeth such as gingival recession and mobility. Due to lack of epidemiological survey, it is often difficult to evaluate the impact of the different prosthetic options on the oral health, either it might be beneficial or have a higher failure rate. Thus, this study is conducted to compare the clinical effects of cast partial denture (CPD) versus heat cured acrylic resin partial denture (APD) with respect to retention, stability, masticatory efficiency, comfort and

periodontal health of abutments. Kennedy Class I and II edentulous spaces were selected for study because they are the most common types (4), and they are most likely to cause problems (5,6).

## Materials and Methods

Total 50 patients, partially edentulous patient attending department of prosthodontics for replacement of missing teeth. The study protocol was approved by the institutional ethical committee. Inclusion criteria: Partially edentulous patient with Kennedy class I and II arches with or without modification areas. Exclusion Criteria: Poor oral hygiene. (OHI-S score: Poor), Compromised periodontal support of remaining teeth. Abutment teeth: Moderate to severe clinical attachment loss, Mobility index score 2 and 3, Patient with uncontrolled systemic diseases, patient unable to maintain denture hygiene due to disability. Patient who wanted fixed prosthesis or implant supported denture and patient aged above 70 years. Each patient was evaluated by thorough medical and dental history, clinical examination, diagnostic model analysis and radiographic examination. Treatment plan explained to the patient. Having being assured of patient's full cooperation, informed consent was taken. Initially, neither patient nor the investigator knew about the group in which the patient will be allocated. Randomization tables were generated with the aid of the (pseudo) random number generator in Microsoft Excel. Samples were divided into two groups. Group A: 25 patients treated with cast partial denture. Group B: 25 patients treated with acrylic partial denture.

Clinical Procedure: The following procedure was performed for Group-A participants. a) Pre-prosthetic mouth preparation: This phase of treatment includes; i) Surgical preparation such as extraction of teeth with poor prognosis, removal of the residual roots, impacted teeth and malposed teeth which were not orthodontically correctable. ii) Periodontal preparation such as scaling and root planning, elimination of gross occlusal interferences by selective grinding procedure, oral hygiene instruction and maintenance therapy. b) Surveying of the diagnostic cast: The most suitable path of placement of prosthesis was determined that will eliminate or minimise interference to placement and removal. Proximal tooth surface that needed to be made parallel were identified so that they can act as guiding plane during placement and removal. The height of contour was determined. The depth of retentive undercut and location of undesirable undercuts of both hard and soft tissue were also detected. Location of retainers and artificial teeth with the best esthetic advantage were determined and finally tripoding was done. c) Prosthetic mouth preparation: Prosthetic mouth preparation was done to modify the

existing structure to enhance the placement of prosthesis especially the abutment and retentive undercuts. Rest seats were prepared accordingly to the location, position and extent determined by a surveyor (Marathon Surveyor, Saeyang Microtech, Korea) on the diagnostic cast. A custom tray was prepared on the diagnostic cast with self-cure acrylic resin (Rapid Repair, Dentsply, India) to make final impression. The final impression made with polyvinyl siloxane impression material. (Aquasil soft putty and Regular set, Dentsply, Germany). Master cast prepared using dental stone (Kalstone, Kalabhai Karson, India) after beading and boxing. The master cast was then surveyed; tripod marks were transferred to the master cast to get the planned tilt established on the diagnostic cast. The outline of the proposed partial denture was transferred to the master cast from the diagnostic cast, this includes delineating the height of contour, measurement of undercuts, drawing of the clasps and connectors. Wax was then added to block out all undercuts except retentive ones. The excess wax was removed with a chisel placed in the surveyor. Relief was provided in the form of spacer over saddle area, gingival margin and median palatal raphe area. Beading was completed outlining the connectors.

The blocked, relieved and beaded master cast was duplicated by using agar agar impression material (Castogel Duplicating Material, BEGO, Germany) and a refractory cast (Begoform, BEGO, Germany) was prepared. Wax patterns for metal framework were made according to design on the hardened refractory cast by using preformed wax (Dental Inlay Casting Wax, G C Corporation, India). After fabrication, finishing of the framework pattern was done. After spruing, investing of the wax pattern was done by using phosphate bonded investment material (BELLAVEST® SH, BEGO, Germany). The burn out of the wax and finally casting procedure (Centrifugal Induction, BEGO, Germany) were completed by using the standard procedure. The material used was cobalt-chrome partial denture alloy (Wironit alloy, BEGO, Germany). After finishing of cast framework, it was tried in the patient mouth. The fit of the framework was tried first. Discrepancies were corrected until the framework was properly fitted on the teeth along the determined path of insertion.

Temporary denture base was fabricated using the metal framework and occlusal rim was prepared with modelling wax on the master cast. Jaw relation was recorded and stabilised master cast assembly was mounted on an articulator. Artificial teeth were selected, arranged and tried on patient's mouth before processing. After try-in, the waxed denture was flaked, dewaxed, packed and processed. The processed denture was then deflaked gently. The

prosthesis and recovered cast were remounted in the articulator in their original relationship with the help of indices created on the cast. Occlusal interferences were detected by simulating condylar movements in the semi-adjustable articulator (Hanau™ Wide-View, USA). Articulating papers were used to locate occlusal discrepancies and were corrected on the denture by selective grinding until the movements become smooth and uninterrupted. The denture was then recovered, finished, polished and checked critically for blebs, bubbles, blisters.

Similarly for Group-B participants: Pre-treatment assessment and diagnosis was done following clinical, radiographic and study cast. Mouth preparation was done when necessary. The primary impression was made with alginate impression material (Zelgan, Dentsply, India) and the stone cast was poured, custom tray fabrication was done. The final impression made using selective pressure technique. Wrought wire clasps were constructed and temporary denture base prepared. Teeth selection and alignment was done. Try-in done in patient's mouth, then waxed denture was flaked, dewaxed and processed with heat cure acrylic resin (Travelon Denturebase material, Dentsply, India).

Dentures were seated on the mouth and checked for fit and stability. Necessary adjustments were made and polished denture placed on patient's mouth. After completion of the procedure and delivery of the denture, instructions on maintenance of the prosthesis were given. The patient recalled after 24 hours and 48 hours for necessary adjustment. For evaluation, patient recalled after 3 months, 6 months, and 1 year.

Study parameters: Data were collected on a data collection sheet at every follow-up visit. Retention & Stability recorded according to grading (7): 1 = Good (difficult to dislodge), 2 = Fair (some resistance to dislodge), 3 = Poor (minimal or no resistance to dislodge). The assessment of subjective masticatory efficiency and aspects of the patient were analysed by means of following questionnaire (8). Q. How much difficulty do you have in chewing with your removal partial denture? 1 = No difficulty in chewing (Good), 2 = some difficulty in chewing (Fair), 3 = Extreme difficulty in chewing (Poor). The qualitative assessment of Comfort was evaluated according to the patient's satisfaction limit (8). 1 = Good (Completely satisfied), 2 = Fair (Moderately satisfied), 3 = Poor (Less satisfied). Periodontal health of the abutment was assessed on the basis of the amount of clinical attachment loss (CAL) as follows: Normal= CAL, Slight= 1-2 mm CAL, Moderate= 3-4 mm CAL, Severe  $\geq$  5 mm CAL (9).

Statistical Method: Collected data were entered in Microsoft Excel 2013 and coded accordingly. The

statistical analysis was performed by Statistical Package for the Social Sciences (IBM SPSS, Inc. Chicago, IL, USA version 20). For Inferential statistics, “Likelihood ratio Chi-square test” was applied for the categorical (nominal and ordinal) variables to find out differences between the groups at 95% confidence interval (95% C.I.) where  $p = 0.05$ .

### Results

Total number of partial denture fabricated along with the number of teeth replaced is shown in table- I. Among 8 maxillary cast partial denture, 2 were Kennedy Class-I with modification, and 1 was Kennedy Class-II with modification. Among 17 mandibular cast partial denture, 4 were Kennedy Class-I with modification, 4 were Kennedy Class-II modification. Among 10 maxillary acrylic partial denture, 1 was Kennedy Class-I modification, 5 were Kennedy Class-II modification. Among 15 mandibular acrylic partial denture, 3 were Kennedy Class-I modification, and 4 were Kennedy Class-II modification.

Assessment of clinical parameters at the baseline:  
In group-A and B all the dentures had good scores for

retention and stability (Table-II), masticatory efficiency (Table-III), most dentures were scored ‘good’ on comfort (88% & 92% respectively) (Table-IV), normal periodontal health of abutment (96% & 92%, respectively) (Table-V).

Assessment of clinical parameters after 3 months:  
One patient from group-B lost to follow. Masticatory efficiency with the group-B patient had statistically significant lower performance. (Table-III)

Assessment of clinical parameters after 6 months:  
One patient each from both groups lost to follow. Statistically significant difference in the retention and stability, masticatory efficiency and periodontal health of abutment between both groups. (Table II, III, V)

Assessment of clinical parameters after 1 year: One patient from group-A lost to follow. The performance of denture in group-B patients at the end of 1 year showed deterioration in terms of retention, stability, masticatory efficiency, comfort, periodontal health of abutment and the results were statistically significant.

**Table I:** Distribution of removable partial denture according to the type of denture and teeth replaced.

Type of Denture	Number	Mean (min-max) no. of replaced teeth	Maxillary denture	Mandibular denture
<b><u>Cast Partial Denture</u></b>				
Kennedy Class I	11	4.64 (3-7)	4	7
Kennedy Class II	14	3.64 (2-6)	4	10
<b><u>Acrylic Partial denture</u></b>				
Kennedy Class I	9	5.12 (3-8)	2	7
Kennedy Class II	16	4.56 (2-8)	8	8
<b>Total</b>	<b>50</b>	<b>4.42 (2-8)</b>	<b>18</b>	<b>32</b>

**Table II:** Distribution of the patients by retention & stability

<b>Baseline</b>					
<b>Characteristic Retention &amp; Stability</b>	Group- A (n= 25)		Group-B (n= 25)		p- Value *Significant (p<0.05)
	%	95% C.I.	%	95% C.I.	
Good	100	-	100	-	-
<b>3 months</b>					
	(n= 25)		(n= 24, 1 lost to follow)		
Good	96	±7.68	83.33	±14.91	0.132
Fair	4	±7.68	16.67	±14.91	
<b>6 months</b>					
	(n= 24, 1 lost to follow)		(n= 23, 1 lost to follow)		
Good	91.67	±25.92	43.47	±20.26	0.001*
Fair	4.16	±25.1	34.78	±19.46	
Poor	4.16	±13.49	21.73	±16.85	
<b>1 year</b>					
	(n= 22, 1 lost to follow)		(n= 23)		
Good	86.36	±14.34	13.04	±13.76	<0.001*
Fair	9.09	±12.01	34.78	±19.46	
Poor	4.54	±8.7	52.17	±20.41	

Group-A = Cast partial denture

Group-B = Acrylic resin partial denture

C. I. = Confidence Interval

P-value reached from chi square test \*Significant (p &lt; 0.05)

**Table III:** Distribution of patients by masticatory efficiency

<b>Baseline</b>					
<b>Characteristic</b>	Group- A (n= 25)		Group-B (n= 25)		p- Value *Significant (p<0.05)
	%	95% C.I.	%	95% C.I.	
Mastication	100	-	100	-	-
<b>3 months</b>					
	(n= 25)		(n= 24, 1 lost to follow)		
Good	96	±7.68	75	±17.32	0.028*
Fair	4	±7.68	25	±17.32	
<b>6 months</b>					
	(n= 24, 1 lost to follow)		(n= 23, 1 lost to follow)		
Good	83.34	±14.91	39.13	±19.95	0.001*
Fair	16.66	±14.91	60.86	±19.95	
<b>1 year</b>					
	(n= 22, 1 lost to follow)		(n= 23)		
Good	77.27	±17.51	8.69	±11.51	< 0.001*
Fair	18.18	±16.12	34.78	±19.46	
Poor	4.54	±8.7	56.52	±20.26	

**Table IV: Distribution of the patients by the comfort**

<b>Baseline</b>					
<b>Characteristic</b>	Group- A (n= 25)		Group-B (n= 25)		p- Value
	%	95% C.I.	%	95% C.I.	*Significant (p<0.05)
<b>Comfort</b>					
Good	88	±12.74	92	±10.63	0.636
Fair	12	±12.74	8	±10.63	
<b>3 months</b> (n= 25)			(n= 24, 1 lost to follow)		
Good	88	±12.74	83.34	±14.91	0.640
Fair	12	±12.74	16.66	±16.66	
<b>6 months</b> (n= 24, 1 lost to follow)			(n= 23, 1 lost to follow)		
Good	87.5	±13.23	69.56	±18.81	0.677
Fair	12.5	±13.23	30.43	±18.81	
<b>1 year</b> (n= 22, 1 lost to follow)			(n= 23)		
Good	81.8	±16.12	17.39	±15.49	< 0.001*
Fair	13.6	±14.34	47.82	±20.41	
Poor	4.54	±8.7	34.78	±19.46	

**Table V: Distribution of patients by the periodontal health of the abutment**

<b>Baseline</b>					
<b>Characteristic</b>	Group- A (n= 25)		Group-B (n= 25)		p- Value
	%	95% C.I.	%	95% C.I.	*Significant (p<0.05)
<b>Periodontitis</b>					
Normal	96	±7.68	92	±10.63	0.548
Slight	4	±7.68	8	±10.63	
<b>3 months</b> (n= 25)			(n= 24, 1 lost to follow)		
Normal	96	±7.68	91.67	±11.06	0.524
Slight	4	±7.68	8.33	±11.06	
<b>6 months</b> (n= 24, 1 lost to follow)			(n= 23, 1 lost to follow)		
Normal	95.83	±8	60.86	±19.95	0.002*
Slight	4.16	±7.99	39.13	±19.95	
<b>1 year</b> (n= 22, 1 lost to follow)			(n= 23)		
Normal	90.9	±12.02	34.78	±19.46	< 0.001*
Slight	9.09	±12.01	65.21	±19.47	

## Discussion

The number of patients wearing removable partial denture is increasing but few patients choose cast partial denture, primarily because of the higher cost of the prosthesis. In this study, the average age of the patients was from 31 to 67 years. In assessing the past dental history, it was found that out of 50 patients, 17 patients had the previous denture. Out of which 2 discontinued to wear their prosthesis, 10 of them felt discomfort after wearing and were not satisfied with their previous denture, 5 needed denture replacement due to the old prosthesis.

In this study, the retention and stability of the APD showed degradation at 6 months follow-up and at one year only a few dentures were usable. Primary retention for the removable partial denture is accomplished mechanically by placing retaining elements on the abutment teeth (tip of the retaining arm, guiding planes, bar clasps). Secondary retention is provided by the intimate relationship of the denture bases and major connector with the underlying tissue. Moreover cast circumferential clasps offer greater stability because it has a rigid shoulder (10). Whereas wrought wire clasps have a flexible shoulder and bar clasps do not have a shoulder hence, they offer a lower stability (11). Despite the satisfactory acceptance of the APD, during the third month of evaluation, the masticatory efficiency was started deteriorating. Lack of stability of denture is a common complaint of denture wearers, and inability to chew is related to the instability of dentures and advanced reduction of the number of natural teeth. The qualitative assessment of comfort in this study showed no statistically significant difference between two groups initially. However, during the subsequent follow-up period, patients wearing acrylic partial denture showed poor comfort (34.78%) compared to patients treated with cast partial denture our findings are in accordance with Watson CL et al. (12) they indicated that distal extension prostheses are often not well tolerated and that acrylic dentures give more problems.

RPD should maintain the health of the remaining dentition and surrounding oral tissue. Observation showed that in subsequent follow-up visit periodontal health of abutment was maintained in group-I patients, which was statistically significant, and the condition was degraded gradually in group-II patients. The horizontal and lateral stress on the abutment teeth may cause breakdown of periodontal tissue and increase the tooth mobility. The consequence may lead to losing more number of teeth, thus the edentulous span of the patient may increase. Studies by Runov et al. (13) Chandler & Brudvic (14) and Nada et al. (15) indicated more severe gingival tissue reactions when the gingiva was covered by the denture, whereas an open space

design of minor connectors was less conducive to increase in crevicular temperature, plaque accumulation, gingival inflammation and pocket depth. Lappalainen et al. (16) observed an increase in depth of the pocket in RPD users. Markkanen et al. (17) observed an increase in the number and in the depth of the pockets.

Studies reported that only increase in tooth mobility could be considered as a major factor or variable affected by the presence of an RPD (18). Lappalainen et al. (16) observed an increase in mobility; this becomes apparent more specifically at the level of the abutment teeth. In the distal extension cases due to the remodelling or resorption of the residual ridge significant stress will be beard by the abutment teeth. So it may be necessary to evaluate the mechanism of retention and support taken from the abutment teeth and position of clasp assembly in every follow-up visit to ascertain that whether it is working in the same manner as it was planned during the fabrication of the prosthesis. Clinical observations by Carr et al. (2) demonstrated that the inherent cleanliness of the cast metal contributes to the health of the oral tissue when compared with acrylic resin base. Zarb GA et al. (19) stated that the presence of denture deposit and their rate of accumulation are directly related to the presence of protein-rich saliva and microporous nature of the polymeric base, which facilitates microbial plaque formation and ensuring calculus deposition. The RPD may contribute to the formation of biofilm and consequently, an increase in the incidence of caries and periodontal disease (20).

As observed by Frank et al. (7) no specific feature of the RPD was responsible for the increased likelihood of dissatisfaction in younger people, so it is important for the clinician to explain the risk versus the benefits of the treatment. Although the potential for high success rate for prosthodontic treatment is widely accepted, epidemiological studies (21) demonstrated that the proportion of patients dissatisfied with RPDs, including an inability to wear the denture, range from 3% to 40%, with an average of approximately 25%. Such a large proportion of denture wearers shows significant burden to the healthcare and demands improvement in materials and methods to meet patient satisfaction. Thus, improvements in the technique and materials must be everlasting. The prognosis of the prosthetic rehabilitation, advantages and disadvantages of the prosthesis, and possibilities for re-treatment in the case of failure must be addressed and discussed with the patient.

## Conclusion

Overall study findings established that, with adequate maintenance of oral and denture hygiene at a

regular interval, cast partial denture provides better results in terms of retention, stability, masticatory efficiency, comfort and periodontal health of abutment. So, it can be concluded that use of cast partial denture serves better prosthesis as functional, stable and suitable biological restoration.

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