

Designing Cast Partial Dentures in Relation to Partial Edentulism

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ABSTRACT

Objective: To determine the pattern of partial edentulism and the cast removable dental prosthesis design in relation to the Classes recorded.

Study Design: Cross-sectional study.

Place and Duration of Study: Department of Prosthodontics, Armed Forces Institute of Dentistry (AFID), Rawalpindi Pakistan, from Apr to Sep 2021.

Methodology: A total of 67 partially dentate male and female patients presenting to the Prosthodontics Department requiring partial cast dentures were included in the study. Visual inspection of the master casts and partial denture frameworks was carried out in the laboratory. Kennedy's Classification, modification areas, type of major connector, direct retainer, rest and use of indirect retention were recorded.

Results: The most prevalent Class of partially dentate arch was Kennedy Class-II in maxilla 10 (45.5%) and Class-I and III in mandible 15 (33.3%) each. Major connectors most frequently encountered were anteroposterior palatal strap (59.1%) and lingual bar (57.8%). Circumferential clasp (35.8%) was the most used retainer type in Classes II and III, whereas RPI was mostly found in Classes I and II (32.1%). Occlusal rests were most commonly used (72.4%). Indirect retention was mostly used in Class-I and II denture frameworks (95.9%).

Conclusion: The most commonly encountered partial edentulism pattern was Kennedy's Class I and II. Following basic principles of RPD design can help elevate the standards of removable denture treatment.

Keywords: Dental prosthesis design, Edentulous, Partial, Removable partial denture.

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INTRODUCTION

The topographical distribution of partially edentulous arches dictates the eventual design of a removable cast partial denture framework.¹ In one of the studies, it was reported that a possible combination of 65,000 may exist, that is, missing dentition to opposing arch edentulous ridge.² Therefore, clinicians have developed many Classification systems to accommodate such variations in the patterns of partially edentulous states, of which Kennedy's method with Applegates' modifications is the most commonly used.³ The introduction of the Prosthodontic Diagnostic Index (PDI) by the American College of Prosthodontists has assessed partially dentate patients based on specific diagnostic and objective criteria.⁴

Formulating a prosthodontic need-based design and meticulous component selection is paramount to the effectiveness of a partial removable denture (RPD).⁵ An RPD metal framework incorporates the following key design features, namely connectors

(major and minor), metallic rests, direct retainers and indirect retainers.^{3,6}

A major connector unifies all the cardinal components of a removable dental prosthesis.⁶ Variation in the choice of a major connector is greater in the maxilla since the hard palate offers a larger coverage area.⁷ Although clinicians have a variety of options, including palatal bars, palatal straps, palatal plates and U-shaped connectors, all with their peculiar indications,^{3,6,7} the preference is usually limited to two or three major connectors as evident in a study by Al-Angari *et al.*⁸ where the most frequently encountered connector in the maxilla was anteroposterior palatal strap (76.8%).

The required retention to an RPD assembly is provided by direct retainers. Literature has delineated various clasp assemblies to be used depending upon diverse clinical situations,^{3,6,9} including those indicated in tooth-supported RPDs such as circumferential clasps and those preferred in distal extension partial dentures counter functional prosthesis movement, for instance, RPI system. Vertical support, additional

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stability and provision of indirect retention to the partial denture are ascribed to the usage of rests.¹⁰

Epidemiological studies concerning patterns of edentulous states in jaws and varied aspects of RPD framework design help ameliorate the standards of oral health care services, but such data tends to remain underexplored in our country. Hence, this study was aimed at assessing the prevalence of partially edentulous states in jaws, type of prostheses support, distribution of major connectors, type of retentive elements used and exploring the relationship between the design and recorded Classes of partially edentulous arches to ascertain the gap between what is theoretically optimal and practically achieved. In addition, it will help assess the quality of removable dentures being provided and serve educational and teaching purposes.

METHODOLOGY

This cross-sectional was conducted at the Prosthodontics department at Armed Forces Institute of Dentistry (AFID), Rawalpindi Pakistan, from April to September 2021. Ethical approval for conducting the study and data collection was taken from the Ethical and Research Committee (AFID/ERC/2020/22). A Sample Size of 67 patients was selected using WHO Calculator, with a confidence level of 95%, anticipated population proportion of 11 (64.1%) and absolute precision of 10% (calculated sample size was 63). The sampling technique utilized was non-probability consecutive sampling technique.

Inclusion Criteria: Partially dentate patients, of either gender in the age group between 40-70 years were included in the study.

Exclusion Criteria: Patients whose treatment plan had been modified after the initiation of treatment and patients unwilling to removable partial dentures as a treatment were excluded from the study.

The working casts and denture frameworks were

collected over six months. A proforma was designed to record the pattern of partial edentulism and all fundamental components of RPDs. In addition, the denture framework components of each RPD were examined. The terms used to categorize each case were based on the Class of partial edentulism, Kennedy's Classification, type of major connector, rests, and retainers, that were, direct retainers in the form of the clasp and indirect retainers.

Statistical Package for Social Sciences (SPSS) version 23.0 was used for the data analysis. Frequency and percentages were calculated for variables like gender, Kennedy Classification, major connectors, rests, direct retainers and indirect retainers. For quantitative variables like age, mean+SD were calculated. Chi-square test and t-test were used. The *p*-value of ≤ 0.05 was considered significant.

RESULTS

A total of 67 subjects, their casts and cast partial denture frameworks were examined with a mean age of 54.42±6.439 years. Of these 67 patients, 36 (53.7%) were males, and 31 (46.3%) were females. Maxillary and mandibular casts accounted for 22 (32.8%) and 45 (67.2%), respectively. Table-I depicted the comparison of the age of the patients with arches.

Table-I: The comparison of age of the patients with maxilla and mandible (n=67)

	Age of the Patient (Years)		<i>p</i> -value
	n	Mean±SD	
Maxilla	22	54.86±6.56	0.695
Mandible	45	54.20±6.44	

The most frequent type distinguished in the partially dentate maxilla was Kennedy's Class II, whereas in the mandible were Kennedy's Classes I and III. The least frequent type encountered in both the arches was Class IV. Table-II depicted the frequency of Kennedy Classes and the distribution of modification spaces in each Class in both arches.

Table-II: Frequency of Kennedy Classes and Modification Areas in Maxilla and Mandible (n=67)

Arch Involved	Kennedy's Class I n (%)	Kennedy's Class II n (%)	Kennedy's Class III n (%)	Kennedy's Class IV n (%)	Significance n (%)
Maxilla (n=22)	8 (36.4%)	10 (45.5%)	4 (18.2%)	0(0)	0.462
Mandible (n=45)	15 (33.3%)	14 (31.1%)	15 (33.3%)	1 (2.2%)	
Modification Areas					
Kennedy Classes	No Modification n (%)	Anterior Modification n (%)	Posterior Modification n (%)	Anterior and Posterior Modification n (%)	Extensive Modification n (%)
Class I (n=23)	14 (60.8)	7 (30.4)	0(0)	2 (8.7)	0(0)
Class II (n=24)	4 (16.7)	0(0)	14 (58.3)	6 (25.0)	0(0)
Class III (n=19)	1 (5.1)	3 (15.7)	11 (57.8)	3 (15.7)	1 (5.3)
Class IV (n=1)	1 (100.0)	0(0)	0(0)	0(0)	0(0)

A total of 4 (18.2%) RPDs were tooth-supported, and 18 (81.9%) were tooth-and-tissue-supported in the maxilla. Likewise, 15 (33.3%) RPDs had tooth-borne support in the mandibular arch, and 30 (66.7%) had tooth-and-tissue-borne support.

Considering the distribution of major connectors, the anteroposterior palatal strap was the most frequently noted connector in the partially dentate maxillary arch (59.1%), and the lingual bar was the most extensively used major connector in the partially dentate mandibular arch (57.8%). Table-III illustrated the distribution of major connectors in both the jaws.

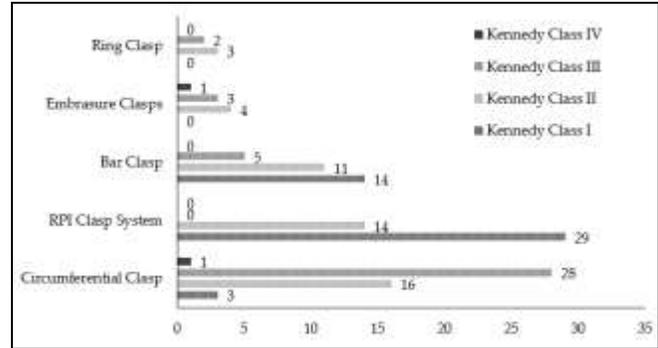


Figure: Frequency of Clasps used in Relation to Kennedy Classification (n=67)

Table-III: Frequency of Maxillary and Mandibular Major Connectors in relation to Kennedy Classification (n=67)

Maxillary Major Connectors Per Kennedy Class (n=22) Frequency (%)				
Type of Connector	Kennedy Class I (n=8)	Kennedy Class II (n=10)	Kennedy Class III (n=4)	Kennedy Class IV (n=0)
Single palatal strap	0(0.0)	1 (10.0)	0(0.0)	0(0.0)
Anterior-posterior palatal strap	4 (50.0)	5 (50.0)	4 (100.0)	0(0.0)
Single broad palatal connector	2 (25.0)	4 (40.0)	0(0.0)	0(0.0)
U-shaped connector	2 (25.0)	0(0.0)	0(0.0)	0(0.0)
Mandibular Major Connectors Per Kennedy Class (n=45) Frequency (%)				
Type of Connector	Kennedy Class I (n=15)	Kennedy Class II (n=14)	Kennedy Class III (n=15)	Kennedy Class IV (n=1)
Lingual Bar	6 (40.0)	8 (57.1)	11 (73.3)	1 (100.0)
Linguo-plate	7 (46.7)	6 (42.9)	3 (20.0)	0(0.0)
Kennedy Bar	2 (13.3)	0(0.0)	1 (6.7)	0(0.0)

Each cast partial denture consisted of two primary abutments on which clasp and rest would be provided. The type of clasp assembly and rest for each primary abutment was noted, accounting for 34 clasps and 134 rests. Figure showed the frequency of different types of clasps used for Kennedy's Classification of edentulism. Of the total clasps 134, 48 (35.8%) of the primary abutments employed circumferential type clasps, whereby 16 (33.3%) of them were used in Kennedy Class II and 28 (58.3%) in Kennedy Class III. RPI clasp system was used in 43 (32.1%) of the abutments, and 29 (67.4%) of them were found in Kennedy Class I and 14 (32.5%) in Kennedy Class II. Bar clasps were noted in 30 (22.4%) of the abutments. Of these, 14 (46.7%) were found in Kennedy Class I and 11 (36.7%) in Kennedy's Class II. The interproximal/embrassure clasps represented 5.98% of total retainers occurring more commonly in Kennedy Classes II and III RPD designs. Ring clasps encountered were 5 (3.73%) of total clasps, occurring more commonly in Kennedy Classes II and III RPD. Out of 134 rests used, 97 (72.38%) were occlusal rests, 28 (20.8%) lingual rests, 7 (5.2%) interproximal rests and 2 (1.49%) incisal rests. Lingual rests occurred more frequently in Kennedy Class I (50%) and Class II (32.1%).

Indirect retainers were found in 49 (73.1%) out of 67 RPD frameworks. Of these, 30 (61.2%) RPDs belonged to the mandible and 19 (38.7%) to the maxilla. Among the indirect retainers, 47 (95.9%) were used for free-end saddle RPDs (23 (46.9%) in Class I and 24 (48.9%) in Class II, and 2 (4.08%) in tooth-supported RPDs.

DISCUSSION

RPDs are deemed a cost-effective treatment option in several clinical situations such as long edentulous spans, extreme bone resorption, periodontally compromised abutments, and interim prostheses to restore the esthetics of the compromised oral structures, to overcome biomechanical and surgical risks with the use of dental implants and financial constraints.^{11,12}

Several methods have aided clinicians in recording the Classes of partial edentulism and key features of metal framework designs, including clinical examination,¹³ cast inspections,¹⁴ instruction forms, and photographic images.^{15,16} In this study, we used casts and metal frameworks fabricated in the institutional laboratory since this technique allows the data to be easily assessed outside the clinic at any given time.

Our findings suggest that mandibular cast partial dentures are more prevalent than maxillary (67.2% and 32.8%, respectively). In another paper, Abdel-Rahman *et al.*¹⁷ examined 963 patients, of which 478 (49.63%) had missing dentitions in the maxilla and 485 (50.36%) in the mandible. In 2019, Bastukar *et al.*¹⁸ evaluated 450 patients, 45.18% concerned with the maxilla, while 54.82% the mandible. Our results contradict those of Al-Dwairi *et al.*¹³ who reported that of the 350 instruction proformas filled out by dental technicians, maxillary RPDs represented 193 (55.14%) and 157 (44.86%) the mandibular ones. These studies with varying results do not allow us to arrive at any clear conclusion as to which category is more prevalent. In our population, it could be accredited that teeth in the mandibular arch erupt earlier in the oral cavity and are more predisposed to caries.

The frequency of Kennedy Class II was found to be the highest (35.8%) compared to the other Classes in both the arches (45.5% maxilla and 31.1% mandible), in contrast to the reports by Abdel-Rahman *et al.*¹⁷ Basutkar *et al.*¹⁸ and Patel *et al.*¹⁹ who reported the most frequent Class to be Kennedy Class III with the percentages 49.8%, 40.7% and 56.7%, respectively.

A total of 19 (28.4%) RPDs were tooth-supported, and 48 (71.6%) were tooth-and-tissue supported, which is in accordance with the results of a survey done in the United States by Pun *et al.*²⁰ where out of a total of 903 subjects, 63.4% had RPDs with tooth-and-tissue borne support and 36.6% were tooth-borne RPDs.

The results reveal that the frequency of anterior-posterior strap major connector (59.1%) is higher in the maxillary arch, which is similar to the studies of Gad *et al.*²¹ in which 41.7% of the major palatal connectors used were anterior-posterior palatal straps and Keyf *et al.*²² in which out of 233 RPDs in the maxilla, 110 used AP-palatal strap.

The lingual bar type major connector was found to be the commonly used connector in the mandibular arch, with a percentage of 57.8%. Though each connector has its precise indications, the specifications are often neglected as a few types of connectors seem to be routinely used for any Class of partial edentulism. For instance, although a palatal plate is recommended in Kennedy Class I and extensive maxillary edentulous spans, the results of this study show that the anterior-posterior strap type connector is the mostly used. This could be attributed to the fact that dental prosthetic laboratory technicians are well-acquainted with the construction of this connector. It can also be deduced

that dental practitioners must agree to their patients' demands for minimal palate coverage by the metal framework. The use of the lingual bar is favoured in more than half the cases in mandibular partial dentures not only because its usage allows ease of oral hygiene maintenance but also suggests the habituation of dental prosthetic laboratory technicians with the fabrication of this major connector.²³ It must be highlighted that although dental students are comprehensively educated on the subject of partial cast dentures, it appears that they entitle laboratory technicians to denture framework designing in their clinical practice.

Our study reported that the circumferential clasps were the most commonly used clasp assembly in both the arches, followed by the RPI clasp system. Stress-breaking systems are recommended for tooth-tissue-supported RPDs, whereas circumferential clasps are favoured in tooth-supported partial dentures.²³ This relation between partial edentulism and clasps was also established in this study, in which a higher prevalence of RPI clasp assembly was observed in Kennedy Classes I and II and circumferential clasps were noted in Classes II, III and IV. For Classes II and III RPDs with no modification spaces, embrasure clasps were used on the contralateral side of the edentulous area.

The results of this study provide a useful insight into the quality of removable prostheses given to the patients. It is also helpful for incorporating progressive changes into the educational and clinical training programs. However, acquiring data from one institution with relatively smaller sample size is a study limitation. Therefore, further research is required, and those from different areas of the region with larger sample sizes can better represent this area's population.

CONCLUSIONS

The present study concluded that the most commonly encountered partial edentulism pattern was Kennedy's Kennedy's Class I and II. It has to be assumed that the need for prosthodontic care is expected to increase with age. The basic RPD designing principles are followed in the fabrication of dentures. Positive reinforcement, effective communication and thorough knowledge of denture designing principles are important prerequisites to the long-term success of removable partial dentures. Further studies on a larger population may be required to estimate the partial edentulism pattern better.

Conflict of Interest: None.

Author's Contribution:

SA: Study conception and design, data acquisition, data analysis, manuscript drafting, IK: Manuscript drafting,

critical revision, MS: Data analysis and interpretation, critical revision, AAB; MA: Results and critical revision, MK: Statistical analysis, results and discussion.

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