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FİLİZ KEYF

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Filiz KEYF

Frequency of the Various Classes of Removable Partial Dentures and Selection of Major Connectors and Direct/Indirect Retainers

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Department of Prosthodontics, Faculty of Dentistry, Hacettepe University, Sıhhiye 06100, Ankara - TURKEY

Abstract: Selecting the individually suitable form of and location for the major connectors in partially edentulous patients is important. The purpose of classifying removable partial dentures (RPDs) is to simplify identification. Classification also allows for a longitudinal comparison of various classes of RPDs as well as the determination of whether the teaching of RPD design is consistent with the relative frequencies of RPD use. This study surveyed the various types of RPDs being fabricated in a dental laboratory and compared those findings with the data from a previous study. Results indicated that mandibular RPDs are more common than maxillary RPDs, and the class I mandibular RPD is the most commonly used type of RPD for the mandibular arch, while the class II maxillary RPD is the most commonly used type of RPD for the maxillary arch. A combination of anterior and posterior palatal strap-type major connectors was the most frequently used maxillary major connector, and in the mandibular arch the lingual plate was used approximately three times more often than a lingual bar. Cast circumferential clasps were used two times more often than cast bar clasp designs. The percentage of Kennedy class I RPDs was 43.37%, class II 38.44% and class III 18.18%. Class IV was not seen. Comparisons with Curtis' study have revealed that the percentage of Kennedy class I and IIs have increased, whereas the proportion of class III RPDs has not changed. Findings of the study indicate that the frequency of the various types of RPDs has not changed in the past ten years.

Key Words: Removable partial denture, major connectors, direct/indirect retainers

Introduction

Several methods have been proposed to classify the partially edentulous arches on the basis of the potential combinations of teeth to ridges. At present, Kennedy's classification is probably the most widely accepted one (1, 2). Kennedy divided all partially edentulous arches into four main types. In his classification, edentulous areas, other than those determining the main types, were designated as modification spaces. The Kennedy classification is as follows (1):

Class I. Bilateral edentulous areas located posterior to the remaining natural teeth.

Class II. A unilateral edentulous area located posterior to the remaining natural teeth.

Class III. A unilateral edentulous area with natural teeth remaining both anterior and posterior to it.

Class IV. A single, but bilateral (crossing the midline) edentulous area located anterior to the remaining natural teeth.

The literature shows that most studies have been about removable partial dentures (RPD) (3-10). Campbell (7) provided a reasonable basis for comparison by allowing intraoral evaluation of multiple RPD designs in test patients. LaVere and Krol (8) studied the selection of a major connector for the extension-base RPD. Wagner and Traweek (9) compared major connectors for RPDs. Fisher (10) studied the factors that influence the base stability of mandibular distal-extension RPDs. Curtis et al. (2) have reported that few recent studies have evaluated the incidence of the various types of RPD.

This study has surveyed the types of RPDs made by a dental laboratory at Hacettepe University, and has evaluated the selection of maxillary and mandibular major connectors and direct/indirect retainers, the distribution of patients, teeth and selection of clasp types that could have been used and has compared the findings with the data from previous studies. This study presents extraoral evaluation of RPD designs.

Materials and Methods

A total of 528 RPD frameworks were collected from the clinics of the Faculty of Dentistry at Hacettepe University during 1999. The RPDs were fabricated in cobalt-chromium alloy and sent to the commercial dental laboratory. Frameworks for repairs, modifications of existing prostheses, unilateral RPD frameworks, metal bases for complete dentures and the framework in which the design was not clear were all deleted. Distribution according to the Kennedy classification, of direct/indirect retainers and of RPD major connectors, as well as the distribution of modification areas, were recorded on the stone cast by research assistants and assistant and associate professors.

Our study evaluated 362 patients (156 men and 206 women) and 528 RPDs, 233 of which were maxillary and 295 mandibular. The mean age of the patients was 55 years (range 29-81 years). Of the total, 171 patients wore RPDs in both jaws. Those patients with opposing dentition were divided into a group with a natural dentition (eventually restored with a fixed or removable partial denture) and another group consisting of complete dentures and complete overdentures was created. The total number and percentage of each class of RPD were compared with previous studies.

Results

A total of 528 metal frame RPDs were examined. Of the 528 frameworks, 233 were for the maxilla and 295 were for the mandible. Their distribution, based on the Kennedy classification, is listed in Table 1.

Of the 528 frameworks, 135 exhibited one or more modification areas for the maxilla, while 139 exhibited one or more modification areas for the mandible.

The types and distribution of major connectors are listed in Table 2. Lingual plate and combination anterior and posterior palatal strap-type connectors were the most commonly used major connectors. Interestingly, neither a labial bar nor a swing-lock framework were used.

Table 3 shows the number and type of direct retainers and attachments used in the maxilla. Table 4 shows the number and type of direct retainers and precision attachments used in the mandible. Also, Table 5 shows the distribution of indirect retainers according to tooth type and Table 6 shows the distribution of indirect retainers according to various classes. Approximately 41.5% of the class II and 35.9% of the class I RPDs included indirect retainers in the design. Indirect retention was used more often for class II frameworks.

Table 1. Distribution of RPDs by the Kennedy classification

Arch	Class I	Mod -	Mod 1	Mod 2	Mod 3	Class II	Mod -	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5	Class III	Mod -	Mod 1	Mod 2	Mod 3	Mod 4	Total
Mandible	148	97	40	10	1	109	42	41	25	1	_	_	38	17	17	1	3	_	295
Maxilla	81	44	26	9	2	94	28	31	23	9	2	1	58	26	18	6	4	4	233
Total	229	141	66	19	3	203	70	72	48	10	2	1	96	43	35	7	7	4	528

Table 2. Type and distribution of major connectors

Mandible Type of Major Connector	Number	Maxilla Type of Major Connector	Number
Lingual bar	84	Single palatal strap	9
Lingual bar with continuous bar retainers	2	Combination anterior and posterior palatal strap-type connector	110
Lingual plate	209	Palatal plate-type connector	17
Labial bar	-	U-shaped palatal connector	97
Total	295	Total	233

Table 3. Number and type of direct retainers in the maxilla

Type of clasp	Right incisor	Right lateral	Right canine	Right first premolar	Right second premolar	Right first molar	Right second molar	Right third molar	Left incisor	Left lateral	Left canine	Left first premolar	Left second premolar	Left first molar	Left second molar	Left third molar
Circumferential clasp	_	1	34	28	48	31	91	6	3	2	34	19	52	33	71	7
Bar clasp	7	11	41	22	21	_	_	_	6	10	43	15	23	1	1	_
Embrasure clasp	_	_	_	_	4	4	_	_	_	_	_	_	_	1	2	1
Ring clasp	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_	_
Precision attachments	_	_	2	_	_	_	_	_	_	_	2	_	_	_	_	_

Table 4. Number and type of direct retainers in the mandible

Type of clasp	Right incisor	Right lateral	Right canine	Right first premolar	Right second premolar	Right first molar	Right second molar	Right third molar	Left incisor	Left lateral	Left canine	Left first premolar	Left second premolar	Left first molar	Left second molar	Left third molar
Circumferential clasp	_	1	52	46	68	20	68	10	_	1	38	41	57	26	67	8
Bar clasp	_	2	39	31	41	_	_	1	_	3	40	41	41	3	_	_
Embrasure clasp	_	_	_	_	_	1	1	_	_	_	_	_	2	5	3	_
Ring clasp	_	_	_	_	_	_	3	1	_	_	_	_	_	_	4	2
Precision attachments	_	_	1	_	_	_	_	_	_	_	_	_	1	_	_	_

Table 5. Number and distribution of the indirect retainers according to tooth type

JAWS	Right incisor	Right lateral	Right canine	Right first premolar	Right second premolar	Right first molar	Right second molar	Right third molar	Left incisor	Left lateral	Left canine	Left first premolar	Left second premolar	Left first molar	Left second molar	Left third molar
MANDIBLE	6	21	225	112	108	21	77	13	4	21	205	123	109	34	71	10
MAXILLA	39	33	162	69	73	29	97	7	42	38	156	55	71	43	67	9
TOTAL	45	54	387	181	181	50	174	20	46	59	361	178	180	77	138	19

Table 6. Distribution of indirect retainers according to various classes.

Arch	Class I	Mod -	Mod 1	Mod 2	Mod 3	Class II	Mod -	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5	Class III	Mod -	Mod 1	Mod 2	Mod 3	Mod 4	Total
Mandible	471	293	126	44	8	473	183	169	116	5	_	_	195	87	84	4	20	_	1139
Maxilla	284	135	96	44	9	399	101	126	121	36	9	6	278	109	87	38	24	20	961
Total	755	428	222	88	17	872	284	295	237	41	9	6	473	196	171	42	44	20	2100

A class I RPD is the most frequently used RPD, followed in numerical order by the other classes (Figure). Mandibular RPDs are more common than maxillary RPDs.

Approximately twice as many circumferential clasps were used in comparison to bar clasp assemblies. Other types of extracoronal direct retainers were used less frequently.

Discussion

The primary purpose in using a classification for RPDs is to simplify the description of potential combinations of teeth to ridges. In the present study, the Kennedy classification was preferred to fulfill this purpose. One of the principal advantages of the Kennedy classification is that it permits the immediate visualization of the partially edentulous arch, and enables a logical approach to the problems of design. In addition, it makes possible the application of sound principles of partial denture design, and is therefore a logical method of classification (1). Framework structure design is required to make a denture that will not break or deform and will maintain a restored occlusion over a long time period (3).

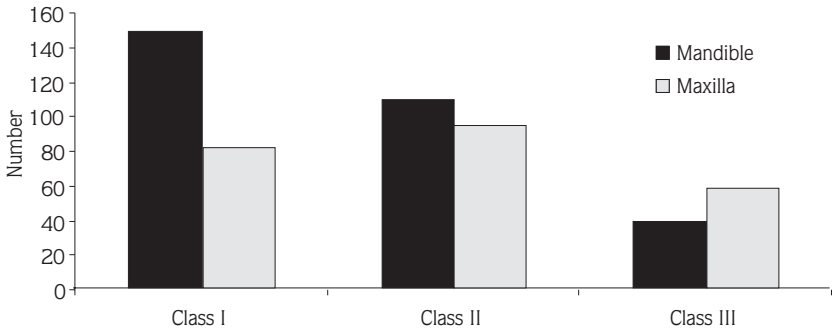

Figure Graphical distribution of RPDs by the Kennedy classification

The designs of 528 frameworks constructed by a dental laboratory according to doctors' requests were reviewed. The present study has investigated a greater number of patients and frameworks than the study of Curtis et al. (2) that reviewed many other studies. Mandibular RPDs were found to be more common than maxillary RPDs, as in the review by Curtis et al. (2).

Ulusoy and Pamir (11) analyzed the distribution of partial edentulous patients who sought treatment RPD clinics using Kennedy classifications through the diagnosis cards between the years 1974 and 1977. This study evaluated 1,535 patients. Class I had a large distribution (36%), while class IV exhibited a 6% distribution. Class II was 28% and class III was 30%. Class I was for the mandible. This article was the first study to examine the distribution for Turkish patients. Our present study was in line with Ulusoy and Pamir's (11) study.

Class I RPDs made up 43.37% of the study sample. The present study revealed an increase in the incidence of class II patients and no change in the incidence of class III patients. The rise in the incidence of class II RPDs is consistent with trends in the prevention of tooth loss. The percentage of Kennedy class II RPDs was 38.44% and was class III 18.18%. Class III was less than class I and II because of the fixed prosthodontic approach. The incidence of class I RPDs showed a rather small rise in comparison to class II. Class IV was not seen at all. Curtis et al. (2) did not evaluate the presence of direct/indirect retainers according to tooth type.

The percentage of class I in the mandible was 50.16%, class II 36.94%, class III 13.1% and in the maxilla, class I was 34.76%, class II 40.34%, class III 24.89%. In the study by Curtis et al. (2) the percentage of classes for the maxilla and mandible was not determined.

It is logical to use the circumferential clasp with all tooth-supported partial dentures because of its retentive and stabilizing ability (1). In the present study, the circumferential clasp formed 66.78% of all clasps (Table 3 and 4) and right-left second molars were the most commonly preferred locations to place them in.

The circumferential-type clasp may be used in several forms. One is the ring-type clasp, which encircles nearly all of a tooth from its point of origin (1). The ring-type clasp should be used on protected abutments whenever possible because it covers such a large area of the tooth's surface. Aesthetics do not usually need to be considered on such a posteriorly located tooth (1). The present study has shown that only ten ring-type clasps were used. All of them were on the second and third molar in the mandible. Due to aesthetic reasons and limitations, it was never used in the maxilla.

In the fabrication of an unmodified class II or class III partial denture, the embrasure clasp is used where no edentulous space exists. Both retentive clasp arms are located on the buccal surface with the nonretentive arms on the lingual surface (1). In the present study, a total of 24 embrasure clasps were on the second premolar, and on the molars of both jaws.

The bar clasp arms are identified as I type or modified Y type. In the present study, they constituted 30.72% of all clasps. They were the most commonly used clasps on both side canine teeth in the maxilla and on both side premolars in the mandible.

The combination clasp consists of a wrought-wire retentive clasp arm and a cast reciprocal clasp arm (1). The combination clasp was used in only one patient.

Rests were designated by the surface of the tooth prepared to receive them, that is, occlusal rest, lingual

rest and incisal rest. The incisal rest was not used as an auxiliary rest or as an indirect retainer.

Many prosthodontists advise the use of an indirect retainer for class I and class II RPDs because maintaining stability, support and retention are the most important factors in their long-term success. To reach this goal, retainers play an essential role. Indirect retention is required on all extension-base partial dentures retained by clasps (4). In the present study, indirect retention was incorporated into the design in 35.95% of class I, 41.52% of class II RPDs and 22.5% of class III RPDs. The use of a higher percentage of indirect retention for class II designs was probably related to the accepted practice of rest placement on either side of an edentulous space. In both jaws, indirect retainers were most commonly used for unmodified class I. Indirect retainers were fabricated more commonly for the mandible than the maxilla.

Anterior teeth were used to support indirect retainers. A canine was preferred over an incisor for this purpose. When a canine was not present, multiple rests spread over several incisor teeth were preferred over the use of a single incisor. The most frequently used indirect retainers were occlusal rests located on an occlusal surface as far away from the distal extension base as possible. Canine extensions were used for indirect retention.

The major connector is the unit of the partial denture that connects the parts of the prosthesis located on one side of the arch to those on the opposite side. There are no methods for selecting the most suitable form and location of RPD major connectors for individual patients. Although some general selection standards have been reported, severe vomiting reflex, presence of palatal tori, unusual palatal form, and similar problems have made it difficult to select the most acceptable design and location for major connectors (5, 6). Failure of the major connector may result in damage to the periodontal support of abutment teeth, injury to residual ridges, or impingement on underlying tissues. Because of this, the selection of major connectors, and direct/indirect retainers are important in their long-term success. LaVere and Krol (8) preferred maxillary major connectors (posterior palatal strap, anteroposterior palatal strap, complete palatal plate) and non-preferred maxillary major connectors (anteroposterior palatal bar, posterior palatal bar, anterior palatal strap). Type and distribution of major connectors in our study was harmonious with LaVere and Krol (8).

The responsibility for the design and fabrication of a RPD is vested in the dentist. He must understand the biomechanical principles of different RPD designs and prescribe appropriately for each patient. Perfect design increases success.

Correspondence author:
Filiz KEYF
Department of Prosthodontics
Faculty of Dentistry, Hacettepe University
Sıhhıye 06100, Ankara - TURKEY

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