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Evaluation of the Defects of Removable Partial Dentures' (RPD) Frameworks Made in Prosthodontics Department Of Qazvin Dentistry School Regarding Retention, Stability, and Support

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Abstract

Background: The metal framework of a removable partial denture includes various parts and metal components that supply strength, retention, stability, and support of partial denture. The purpose of this study is assessing the quality of the frameworks made in the department of prosthodontics, Qazvin school of dentistry, regarding their causes of malfunction, retention, stability, and support.**Materials and Methods:** Evaluation forms of removable partial denture metal frameworks for upper and lower jaws were separately designed. According to the forms, 39 frameworks were fitted and assessed on encoded casts and after that in oral cavity. **Results:** 11 males and 28 females (44±4.8 years old) were recruited in the study; 17 frameworks belonged to maxilla and 22 to mandible. In maxillary frameworks, 10 cases (58.8%) had good retention, 6 (35.3%) had low and 1 (5.9%) had high retention. Moreover, 15 cases (88.2%) and 11 cases (71.64%) showed good support and stability, respectively, in all 3 hypothetical axes. In mandibular frameworks, retentions in 14 cases (63.3%) were good, in 7 (8.31%) were low and in 1 (4.6%) was high. Furthermore, 16 cases (72.7%) and 12 cases (54.5%) showed good support and stability, respectively, in all hypothetical axes.**Conclusion:** The retention, stability and support of metal frameworks were approximately acceptable and appropriate. Most of the malfunctions and structural problems seem to be due to lack of experience and expertise. However, further studies and more training courses are needed to enhance the quality of these frameworks.**[GMJ. 2014;3(1):46-53]**

Keywords: Removable partial denture; Framework; Retention; Support; Stability; Malfunction

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Introduction

Nowadays, prosthodontics reconstruction, also known as dental prosthetics or prosthetic dentistry, has reduced the destructive changes occurring in oral cavity; yet, they can sometimes increase or accelerate these negative processes [1]. Fixed and removable partial dentures (RPDs) are two types of prosthodontics which play roles in rehabilitation of oral health and restoring the systemic health of edentulous patients [2]. In spite of progression which were made in fixed partial dentures, RPDs still remain more advantageous which can be due to lower costs as well as easier hygiene control [2]. Besides the biological, mechanical, and psychological factors in acceptance of prosthesis which lasts in a successful treatment, a high qualitative design of such prosthodontics plays an important role in their good prognosis [2,3]. A removable partial denture framework consists of various metals with different shapes, textures, and anatomical structures which play roles in its stability, support, and retention [4,5]. Thus, a good design, adapting with the patients' needs, seems to be essential for achieving a beneficial RPD [6]. Otherwise, it can be harmful and can have negative impacts on various aspects of oral health [7]. Various studies were performed in order to investigate the positive and negative effects of RPDs on oral and systemic edentulous patients' health. In a study conducted by Preshaw *et al.* it was achieved that RPD can increase the risk of plaque, gingivitis, and caries especially root ones, in patients who wear them; however, the risk of periodontitis is not obviously increased by them [7]. Akaltan *et al.* in a 30 months follow up study concluded that adequate and regular oral hygiene conditions checkups can improve periodontal health in RPDs' users; yet, it was also observed that tooth mobility was decreased in patients who used lingual plate-type RPDs; this can be related to the possibility of plaque accumulation in these RPD types [8]. Another survey by Cosme *et al.* manifested that the oral health state is satisfactory for who used RPDs. They concluded that this was mostly related to the retention, mastication comforts, and stability of them, not to their hygiene [2]. In a study done by Janaina *et al.* it was concluded that RPDs enhanced tooth mobility, diminished prevalence of caries and did not induce the fractures of abutments [9]. Another survey revealed that design and fabrication standards for RPDs are two main factors in patients' acceptance and their satisfaction [10]. Moreover, Koyama *et al.* mentioned the patient's age, location of edentulous area, number of occluding pairs of teeth, pain while using RPDs, color of the artificial teeth, and tooth shape and set-up as factors determining the continuous use and satisfaction of patients who used RPDs [11]. Another survey done by Abuzar *et al.* also revealed that denture performance preservation, RPDs materials and having experience in their use are the variables associated with oral health as well as patients' satisfaction [12]. Few studies were also found which had focused on the quality of RPDs' frameworks' designs. In a study by Neto *et al.* they found few RPDs' (3% for mandibular arch and 12% for the maxillary arch) were appropriately designed by the senior dental students [13]. Another survey, assessing the rests and rest seats preparation by general dental students, revealed that only 30% of prepared rests were appropriate for their seats [14]. In order to design RPDs frameworks easier, Wu *et al.* introduced a computer-aided design and manufacture (CAD/CAM) application [15]; furthermore, Laith Mahmoud *et al.* also presented a new digital system for achieving higher qualitative RPD framework designs [16]. Among the studies done on evaluation of RPDs, few studies can be found which mostly focused on the quality of RPDs' frameworks designs. As it was mentioned in previous surveys, this factor can ultimately play an important role in satisfying the patients and treatment success. Thus, this study has the aim to investigate the quality of removal partial dentures frameworks, their instability, tissue support, and retention, in Qazvin school of dentistry in 2013. Results will help us detect the RPDs design defects and malfunctions and manage to resolve them.

Materials and Methods

This survey was performed during the first semester of 2013 in School of Dentistry, Qazvin university of medical sciences, Qazvin, Iran. During this period, 46 RPDs were created for about 42 patients, among them 39 RPDs were evaluated. In order to collect the data, evaluation forms were designed which consisted of two parts; the first part focused on the demographic data as well as edentulous stats of the patients; the second part focused on the characteristics of metal frameworks of RPDs. The ones with impaired frameworks and stability in oral cavity were exclused. After the frameworks were fitted on the casts and assessed, another survey was done by a prosthodontist who was oriented to the methods. This time, the frameworks were adjusted in the oral cavity and their stability, support, and retention were assessed. The frameworks which were fitted or not fitted to the cast and those which were fitted or not fitted in the mouth were recorded as well.

The protocol of the study was approved by medical ethics committee of Qazvin university of medical sciences. Each patient was given an informed consent form before participating in the study. Data were gathered and analyzed and were described and exhibited as mean± standard deviation and percentages.

Results

In 2013, 46 RPDs were designed for 42 patients; 39 of them were finally evaluated and data were gathered from them, 11 males and 28 females aging 25-60 years old (44±4.8). According to Kennedy's classification, in maxillary arch, class III with modes 0, I AND II were the most prevalent states and class I mod I, class II mod I and class III mode III and V were the least prevalent ones. In the mandibular arch, class I mod 0 was the most prevalent and class I mod II and class III mod II were the least prevalent ones. The most impaired tooth in maxillary arch was left upper first molar (26.7%) and in mandibular arch was the right upper first molar (30%).

From the second part of the forms which was focused on the quality of RPDs frameworks, it was seen that in 94.9% of the participant frameworks were seated properly on casts and just 5.1% of them had impaired cast seat. On the other hand, 76.9% of the frameworks could not place properly in the oral cavity and only 23.1% were adjusted properly there.

The maxillary arch

Rest seats and rests

In maxillary arch of the patients, 76 rest seats and rests were prepared; among them 53 rests (69.74%) were seated properly in rest seats and 23 of them (30.26%) were not seated appropriately. By evaluating the casts, it was concluded that from 76 prepared rests and rest seats, 55 rests (72.37%) were seated properly on rest seats of the casts, 21 of them (27.63%) were not fitted.

Among 17 patients for who maxillary arch frameworks were prepared, just for 4 patients the frameworks were placed properly in the mouth. For these 17 patients, 20 rest and rest seats were prepared; among them 17 rests (85%) were fitted in rest seats.

Among the participants of this survey, for 22 of them mandibular RPDs were inserted. For these patients, 90 rest seats were totally prepared. Evaluation of the rests and rest seats on casts showed that 69 rests (76.7%) were seated properly in their seats while 21 (23.3%) were not. Examining the rests in the patients' mouths, 13 complete sets of them (59.1%) were fitted in the oral cavity. Five frameworks were tested in the mouth before adjusting with casts. Twenty rest seats were prepared for these 5 ones; 18 of them (90%) had a proper connection with their rest seats. From the 5 frameworks, 4 of them had a good connection with their seats.

Tissue stop

After evaluating the frameworks for the existence and efficacy of tissue stops, it was achieved that there were totally 9 tissue stops for maxillary arch frameworks, 8 of them (88.9%) had good efficacy and just one of them was impaired.

Among 22 prepared frameworks, 24 tissue stops were designed which ultimately resulted in 16

frameworks with tissue stops. From 24 prepared stops, 22 of them (91.67%) had efficacy.

Clasps

For 17 maxillary frameworks, 69 clasps were prepared. Most of them (66.7%) were simple circumferential types. Embrasure clasps and hair pin types were not used in this survey (chart-1). After that, the clasps were assessed for their proper placing in undercut. The results were manifested that 61 ones (88.4%) were placed properly in undercut; yet, 8 ones (11.6%) were seated improperly and their arms were situated out of the undercut. Among the frameworks which seated properly in the mouth before adjusting, 18 clasps were assessed. Only one clasp was not seated properly in undercut.

For 22 participants with mandibular frameworks, 68 clasps were totally prepared for the patients; among them, 31 (45.6%) were simple circumferential types which were the most common ones. Ringer and hair pin clasps were not used. Assessing the prepared clasps on the casts showed that 51 ones out of 68 (75%) were placed properly in undercuts and 17 of them (25%) could not be adjusted appropriately. Evaluating the prepared clasps for those 5 patients in whom the frameworks were examined before adjusting with the casts, 12 clasps were used, 9 of them (75%) were adjusted appropriately in undercuts.

Table-1 shows the data on the stability, retention, support, and size distribution of the rests regarding the frameworks used in this survey.

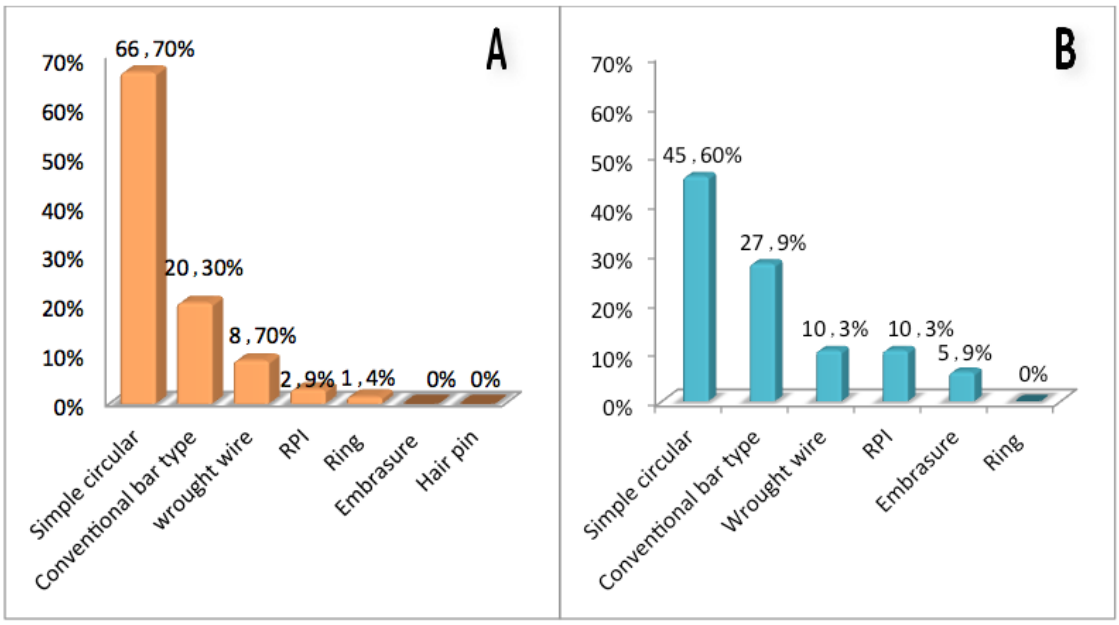

Chart 1. The Frequency of Different Types of Clasps Used for Maxillary (A) and Mandibular (B) Arches.

Table 1. The Stability, Retention, Support, and Size Distribution of the Rests Regarding the Frameworks Prepared in Qazvin School of Dentistry.

	Retention			Stability		Support		Size	
	Proper	Weak	Strong	Appropriate	Inappropriate	Proper	Improper	Equal to rest	Unequal to rest
Mandibular Arch	63.30%	31.80%	4.90%	54.50%	45.50%	72.70%	27.30%	70%	30%
Mandibular Arch	58.80%	35.29%	5.91%	64.71%	35.29%	82.20%	11.80%	71.13%	28.97%

Discussion

In spite of the promotion which is induced nowadays in repairing and rehabilitation of edentulous stats, RPDs still are being more acceptable by the patients [2]. Several reasons can be distributed to RPDs popularity, among them, lower costs as well as better control over the oral hygiene can be mentioned [17]. Preparing a RPD depends on accurate diagnosis, management as well as designing appropriate partial dentures' frameworks. Thus, evaluating the quality of RPDs' frameworks preparation seems to be necessary in achieving the higher qualities and more acceptable RPDs. Most of the previous studies were insisted on assessing the patients' satisfaction, RPDs' complications and the efficacy of RPDs. Yet, few studies were done over the assessing of RPDs designing quality. In a study, Rice *et al.* examined the preparation of Occlusal and cingulum rest seats for cobalt–chromium removable partial dentures (RPDs) by general dental practitioners (GDPs).They evaluated 68 casts, among them, 35 ones had rest seats. They, totally, evaluated 81 rests and manifested that only 30% of them were appropriate for their rest seats [14]. Another survey conducted in England, Ireland, and Wales manifested that written communication and master impression for cobalt chromium RPDs by general dental practitioners was inadequate [18]. A trial performed in Brazil, the senior Brazilian dental students' performances were evaluated on mouth preparation and RPDs' designs. After assessing the RPDs designed by 266 students, it was shown that only 12% of maxillary arch RPDs and 3% of mandibular ones were appropriate [13]. A study by Lynch *et al.* investigated the quality of written instructions for dental laboratories in order to design a chrome-cobalt RPDs in Ireland. They concluded that most of the instructions had no references for the designs' variables [19]. In a study designed by Viswambaran *et al.* which was done on 40 refractory casts, it was concluded that round sprues with reservoirs can be effective in producing appropriate castings with minimal internal and external defects, in other words, they can enhance the quality of cobalt-chromium cast removable partial denture frameworks [20]. Some other studies have introduced new methods of designing for preparing higher quality RPDs. Wu *et al.* were introduced a laser scan technology and commercial reverse engineering software named as Rapid Prototyping (RP) for creating the digital casts with minimal dentinal defects [15]. After that, a new digital system was introduced which had paradigm for designing the RPDs besides the useful instructions for teachers as well as references for dental students [16]. In this study among the vast features of RPDs, we mostly focused on their retention, support and stability. These 3 features can confirm the quality of prepared RPDs which were offered to the patients. On the basis of that, we prepared evaluation forms for maxillary and mandibular arches. In order to evaluate the RPDs qualities, we examined them on casts before their adjustment in mouth. Besides gathering data of edentulous stats of patients and missed teeth, we also assessed the rests and rest seats, clasps and their adjustment with undercut as well as existence of tissue stops on prepared dentures. Furthermore, after adjusting RPDs in the mouth, the space between rest and rest seats, retention, support, and stability of the frameworks were checked. Evaluating the frameworks with casts it was shown that most of them seated properly on the casts; consequently, it can be said that the frameworks were prepared appropriately. Yet, adjusting the frameworks in mouth showed that only 23.1% of them were seated correctly. This can be related to the faults in their preparations in laboratory (inappropriate final cast preparation, inadequate parallel block out, improper casting, and wrong casting) which may be ignored due to the resistance of cast against abrasion or the clinicians' fault such as improper impression making, unfitting frameworks' designs and inadequate reshaping of dentures in the mouth. Overall, among the 42 RPDs designed in prosthesis ward of Qazvin dentistry school, 39 of them were weighed in this survey. The proportion of rests which were seated perfectly in their rest seats on casts indicted the accuracy of laboratory works in preparing the rests and

rest seats. After adjusting the rests in mouth, 72.37% of maxillary arch's dentures and 67.8% of mandibular ones were seated properly in their seats in mouth which were near the estimated percent of adjusted rests on casts. This is indicated that preparing an appropriate rests which are seated on rest seats on casts can be ensured their proper adjustments in mouth. The proportion of effective tissue stops in this study also indicted the good technician's performance in preparing them which played an important role here. Assessing the retention of frameworks in the mouth revealed several reasons that can be named in preparing the frameworks with proper retention such as appropriate clasps designs, deposition of clasps' tips in undercuts, choosing proper undercuts for clasps and complete seating of the frameworks. Acceptable retention, suitable support, and proper stability seem to be related to accuracy and expertise of the technicians and having proper casts with precise adjustments may help in providing useful functional frameworks in prosthodontics

Conclusion

In conclusion, for preparing fitting RPDs, it seems to be essential to adjust the frameworks before placing them in the mouth. Yet, due to some constraints in this survey, more studies are needed for evaluating the prepared frameworks by technicians as well as practitioners to increase the quality of prepared RPDs.

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Conflicts of Interest

None declared

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Appendix 1. The Questionnaire of Patients who are Clients for Removable Partial Dentures

Maxillary O Mandibular O

A. Demographic data and edentulous state:
1. Name:
2. Sex: female○ male○
3. Age:
4. Educational state:
5. Job:
6. Edentulous classification:
class I(mode?) ○ class II (mode??) ○
class III (mode??) ○ class IV○
7. Missing teeth:
8. Is framework seated properly on cast?
YES ○ NO ○
9. Is framework seated properly in mouth?
YES○ NO ○

B. Major connector:
10. Types of major connectors
a. single palatal bar ○
b. single palatal strap ○
c. anterior palatal strap ○
d. posterior palatal bar ○
e. full palatal plate ○
f. anterior-posterior palatal strap ○
g. anterior-posterior palatal bar ○
h. horse shoe ○
i. closed horse shoe ○

C. Rests and Rest seats:
11.Do rests have good connection with rest seats on casts? YES ○ NO ○ NUMBERS…
12.Do rests have good connection with rest seats in mouth? YES ○ NO ○ NUMBERS…
13.How much is the space between the rests and their seats on casts?
a. the rests are larger than the rest seats ○ numbers…
b. the rests are smaller than the rest seats ○ numbers…
c. the rests are fitted with rest seats ○ numbers…
14. How much is the space between the rests and their seats in mouth?
a. the rests are larger than the rest seats ○ numbers…
b. the rests are smaller than the rest seats ○ numbers…
c. the rests are fitted with rest seats ○ numbers…
15. Does the framework have tissue stop?
YES ○ NO ○ numbers…
16. Does tissue stop have efficacy?
YES ○ NO ○ numbers…

D. Clasps:
Simple circular clasp:
17. Is clasp tip placed in undercut on cast? YES○ NO ○ numbers…
18. Is clasp tip placed in undercut in mouth? YES○ NO ○ numbers…
Wrought Wire:
19. Is clasp tip placed in undercut on cast? YES ○ NO ○ numbers…
20. Is clasp tip placed in undercut in mouth? YES ○ NO ○ numbers…
Embrasure clasp:
21. Is clasp tip placed in undercut on cast? YES ○ NO ○ numbers…
22. Is clasp tip placed in undercut in mouth? YES ○ NO ○ numbers…
Ring clasp:
23. Is clasp tip placed in undercut on cast? YES ○ NO ○ numbers…
24. Is clasp tip placed in undercut in mouth? YES ○ NO ○ numbers…
Hair pin clasp:
25. Is clasp tip placed in undercut on cast? YES ○ NO ○ numbers…
26. Is clasp tip placed in undercut in mouth? YES ○ NO ○ numbers…
RPI:
27. Is clasp tip placed in undercut on cast? YES ○ NO ○ numbers…
28. Is clasp tip placed in undercut in mouth? YES ○ NO ○ numbers…
Conventional bar type:
29. Is clasp tip placed in undercut on cast?
YES ○ NO ○ numbers…
30. Is clasp tip placed in undercut in mouth? YES ○ NO ○ numbers…

After adjustment:
31. Is framework seated appropriately on abutments? YES ○ NO ○ numbers…
32.How is the retention of framework? Proper ○ Weak ○ Strong ○
33.How is the stability of framework in horizontal mobility on 3 vertexes? Appropriate ○ Inappropriate ○ axis…
34.How is the support of framework? Appropriate ○ Inappropriate ○
35. How much is the space between rests and rest seats in mouth?
a. They are larger than the rest seats numbers…
b. They are smaller than the rest seats numbers…
c. They have appropriate size numbers…
appropriate size ○ numbers…