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Patient Satisfaction and Stress Distribution of Flexible and Cobalt Chromium Partial Dentures

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ABSTRACT

Aim of study: was to evaluate patient's satisfaction and stress distribution of flexible versus Cobalt-chromium (Co-Cr) denture base material in Kennedy class I partially edentulous patients. **Materials and methods:** Eight partially edentulous patients with ages ranged from 45-55 years. All patients had mandibular Kennedy class I classification with the second premolars as last standing abutment teeth;Patients were divided into two groups, (Group I)four patients received Co-Cr lower removable partial denture and use it for 3 months then received flexible lower removable partial denture and(Group II).Another four patients received flexible lower removable partial denture and used it for 3months, then received Co-Cr lower removable partial denture.Stress on the two second premolar natural teeth abutments and patient satisfaction were evaluated for group I and group II after each three months of delivery of each dentures. **Results:**The results of this study showed that there were significant increases in satisfaction level for assessed variables (general satisfaction, aesthetics, mastication, comfort and retention) of the patients after wearing flexible acrylic resin denture base than they wearingCo-Crremovable partial denture recorded statistically significant higher strain mean value than flexible group .**Conclusion:** Patient satisfaction for wearing flexible partial denture was higher than that for those wearing Co-Cr partial denture. The flexible lower removable partial denture is much better to decrease the applied load on the abutment than Co-Cr partial denture.

KEYWORDS

Distal extension base removable partial denture,
patient satisfaction,
stress distribution.

INTRODUCTION

The distal extension base of removable partial denture has inherent problems of support, retention and stability, affecting not only the integrity of the denture bearing tissue and associated structures but also

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patient acceptance and compliance. Most of these problems could be attributed to lack of posterior abutment may lead to many problems; such as lack of adequate posterior support which is main problem of Kennedy class 1 and 2 partial denture, the basic problem of partial denture stabilization is to equalize the resilient and no resilient support[1].

Many options for the restoration of partially edentulous mouth are suggested, like removable partial dentures (RPD), fixed bridges and dental implants.Conventional metallic removable partial dentures use rigid metal clasps to anchor onto the remaining teeth for support, retention and stability, some display of metal during smile may be unavoidable which are not aesthetically pleasing, and also damage the natural dentition as it engages undercut[2].

Acrylic partial dentures offer a relative ease of fabrication as compared to the metal frame fabrication. The cast partials require accurate tooth preparations for guide planes and placement of occlusal rest. Very accurate surveying is required on the diagnostic cast to help inform about the tooth preparation. However, the main limitations from these materials come from a steady loss of function as the edentulous ridge undergoes a natural process of resorption and the obvious non-aesthetic visible metal clasps[3].

Patients' satisfaction with removable partial denture is an important part of the treatment which is associated with biomechanical factors of RPDs including retention, stability and ability to chewing and speaking, as well as, some of main disadvantages of removable partial dentures (e.g. risk to local damage of the remaining teeth, plaque accumulation, etc.) have a great impact on the patient satisfaction with their prosthesis [4].

The stress distribution in the rigid partial denture is controlled by structural elements of the design; specifically the cooperative relationship of the retentive clasp, occlusal rests, reciprocating clasps, minor connectors, and guide planes, if used. The stress distribution of the flexible partial is accomplished by flexibility in the major connector behaving as a stress breaker. The tissue-supported saddles float on the edentulous ridge independently, without placing a stress load on the abutment teeth. In distal extension partials, the free end saddle equally distributes force at all points along the edentulous ridge[5].

Thus, the question to which, this study tries to answer is, whether flexible and cobalt- chromium denture base materials in partially edentulous patients have any effect on the patients satisfaction and stress distribution.

MATERIAL AND METHODS

Eight partially edentulous patients were selected (Fig 1).Patient's ages ranged from 45-55 years.All patients had mandibular Kennedy class 1 classification with the second premolars as last standing abutment teeth.A minimum of 7 to 8 mm. of space between the floor of mouth and gingivalmargin should be available. The edentulous area of the mandible had enough width and height and covered with a firm and healthy mucosa.All patients accepted this dental treatment and informed about the steps of this study and signed a written informed consent.

Patients were divided into two groups;

Group I: Four patients receivedCo-Cr lower removable partial denture and use it for 3 months then received flexible lower removable partial denture.

Group II: Four patients received flexible lower removable partial denture and used it for 3months, then received Co-Cr lower removable partial denture.

After mouth andAbutment preparation, Co-Cr lower removable partial denturewasconstructed. The partial dentures were designed with bilaterally placed combined bases, cross linked acrylic teeth set on the crest of the ridge, lingual bar major connector, a triangle saucer shaped mesiooclusal rest linked through a minor connector, a proximal plate and a buccal retentive element in a form of I-bar (RPI) on second premolar and indirect retainer in the form of occlusal rest seats were prepared on the

adjacent teeth. After patients of(group **I**) received dentures and usedthem for 3 months then they received flexible lower removable partial denture. While patients of (group II) received flexible lower removable partial dentures (Fig 2) and after 3 months of using dentures, Co-Cr lower removable partial dentures were delivered (Fig 3).Each patient took resting period for about 1 week, and then received the other denture for another 3 months.

A partial mandibular edentulous acrylic model that fabricated for educational purposes with moderate size ridge was used as a master model with second premolar teeth abutments. Strain gauge was used to record micro-strain transmitted to four strain gauges that were placed on labial and lingual surfaces of second premolar.Loading points were prepared on teeth; one loading magnitude (100N) and four positions were tested.

1. Evaluation of patient satisfaction

Each patient was asked to answer a questionnaire to determine his/her satisfaction with the prosthesis that was delivered. This questionnaire consisted of seven questions about general denture satisfaction. Each question was answered in three scores that represent the degree of satisfaction with the dentures. The three answers of each question were scored as follows:

Score 1: patient is not satisfied.

Score 2: patient is satisfied.

Score 3: patient is very satisfied.

2. Evaluation of stress distribution

A computerized universal testing machine was used to produce standardized static load within physiologic limits of 100 Newton. Two loading points were placed on occlusal surface of each first molar. The distance between the two loading points was divided equally by the vertical arm with T-shaped bar of the loading device. A multi-channel digital strain indicator with a built-in amplifier was used to measure the developed strains. Each loading condition entailed applying a vertical static load of 100 N on the desired loading entailed applying a vertical static load of 100 N on the desired loading point the readings were recorded in micro strain units from the multi-channel strain indicator.

Fig. (1): Mandibular partially edentulous ridges class1.

Fig. (2): Final flexible Partial denture.

Fig. (3): Final Co-CrPartial denture.

RESULT

All patients sharing in this study were well motivated to complete the follow-up schedule. There were two study groups of removable partial dentures to compare between patient satisfaction and stress distribution.Descriptive statistics of the patient satisfaction and stress distribution for all groups and their statistical analysis were tabulated in tables (1-2) and graphically illustrated in (Fig 4-5).

Table (1): Frequent distribution (%) of answers to overall satisfaction with both denture types.

		Score 1	Score 2	Score 3	Chi square test	
		Not satisfied	satisfied	Very satisfied	Chi value	p value
Overall	Co-Cr	25	25	50	15.909	0.0000
	Flexible	5	35	60		

**; significant (p<0.05) ns; non-significant (p>0.05)*

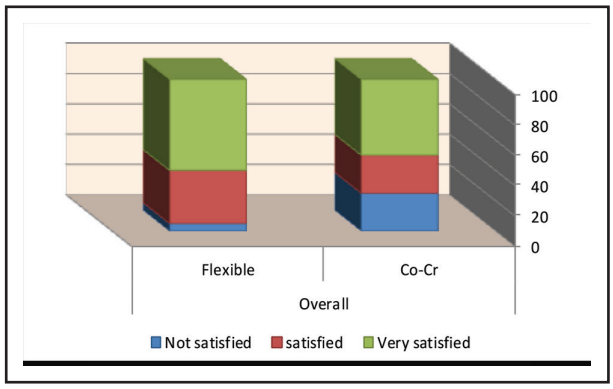

Fig. (4). Stacked column chart showing frequent distribution (%) of answers to overall satisfaction with both denture types

Table (2). *Comparison of total strains developed at both flexible and Co-Crgroup.*

Item	Flexible group	Co-Cr	p-value	
	Mean ±SD	Mean ±SD		
Total strain	12.09± 2.88	22.34± 1.59	F= 12.79	p=.001*

**; significant (p<0.05) ns; non-significant (p>0.05)*

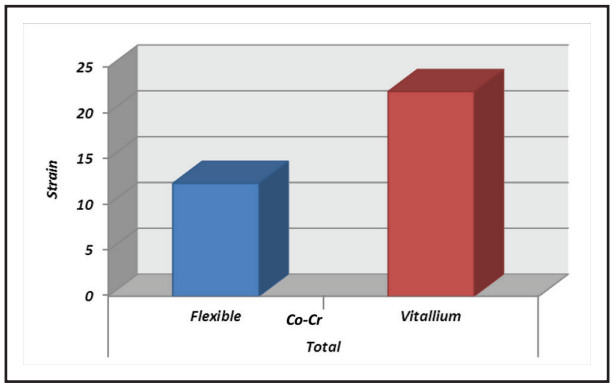

Fig. (5). Column chart comparing total strain mean values developed at both flexible and Co-Cr group

DISCUSSION

This study dealt with the use of two different denture base materials, flexible versus Co-Cr denture base material, in partially edentulous patient by evaluation patient satisfaction and stress distribution.

All Patients' ages ranged from 45-55 years to eliminate the possible effect of age-related changes and hormonal-related changes on teeth, periodontium, mucosa, and muscles. Also to eliminate its effect on biting force and bone metabolism and to avoid bone loss which is a common finding in old age to create a relative homogeneity of the patient population [6,7].

This study was carried out on patients having mandibular Kennedy class I with the second premolar as last standing abutment bilaterally. Crown morphology of the mandibular second premolar generally displays features favorable to design of metal-framework elements related to this tooth. First, the non-occluding mesiolingual portion of the occlusal table of this tooth allows for a convenient mesial rest seat with minimal tooth preparation. Second, the crown is tilted lingually and is usually smaller compared with the mandibular frist premolar. These factors favor a simplified clasp assembly design for this tooth in the form of mesial rest, distal

guiding plate and buccal retentive element in form of I-bar [8].

In an attempt to carry out a fair comparison, all patients contributing to this study received removable partial dentures constructed following the same procedures, and using the same materials. Also all removable partial dentures were similarly designed and exhibited the same components. The only difference was in the type of the denture. Thus, the types of the denture base materials were the only variable. This is done to avoid interaction of other variables that may result from the different designs and affect the supporting structure was considered in this study.

The occlusal rest seats prepared on the second premolars were triangular in shape, to provide adequate bulk for the metal, and the depth was slightly increased towards the center in order to direct the occlusal forces along the long axis of the abutment tooth and to prevent the proximal slippage[9,10].

The mesially placed occlusal rest offered several advantages including forward tipping of the abutments, allowing the neighboring teeth to share the load, altering the length of the lever arm, consequently, the denture base was subjected to more vertical movement and the stresses transmitted to the abutments were decreased in addition to the loads were evenly distributed on the saddle[11,12].

The RPI clasps used in this study fulfilled the criteria of stress releasing action and were among the clasps recommended for distal extension bases to disengage the abutments on function. Indirect retention prevents the retentive clasp tips from becoming a fulcrum about which the prosthesis could rotate when forces move the denture base away from the tissue[13,14].

The metal framework design with lingual bar major connector offered a simple design and minimal contact with the remaining teeth and soft tissues .The simplicity of the design of the partial denture was considered in this study to offer long term maintenance of teeth and soft tissues [15,16]. The altered cast impression technique for distal extension removable partial denture attempts to accommodate the difference in resiliency of soft tissue overlying the edentulous ridges and periodontium of abutment teeth [17,18].

Co-Cr alloy is the most commonly used for casting metallic dentures. They are an economically important alternative to gold alloy, owing to decreased cost and improved mechanical properties, metal base denture display excellent strength to volume ratios and can be cast in thin sheets maintaining rigidity and fracture resistance. The metallic denture bases are more "tissue tolerant" [19].

The most recent preference in denture materials has been the use of valplast material for the fabrication of removable dental appliances. This material generally replaces the metal and the methyl methacrylate denture base material used conventionally to build the framework for standard removable partial dentures. It is nearly unbreakable, esthetically acceptable being colored like the gums, can be fabricated quite thin, and can form not only the denture base but the clasps as well. Since, the clasps are built below the height of contours of teeth, they are practically indistinguishable from the gums that normally surround the teeth [20,21].

Questionnaire assessed the accommodation of patients to new dentures which is often an indicator for positive or negative treatment outcome. Patients' satisfaction with removable partial denture associated retention, stability and ability to chewing and speaking and comfort of the prosthesis in place is a commonly recognized prerequisite for positive adjustment to new denture. The data gathering and analysis is easy. The method is inexpensive and the data is easy to interpret [22,23].

Electric resistance strain gauge technology was used as it is widely used in experimental mechanics for evaluation of strain because it could be easily used experimentally and it is more practical than other devices in studies of tooth deformation. Moreover,

strain gauges are considered to be highly sensitive and if used correctly it could yield accurate results[24].

The present study was carried out in-vitro on a model rather than an in-vivo because of the difficulties that could be encountered with the use of in-vivo strain gauges which include; difficulty in isolation of the gauges from saliva and blood to prevent short circuits, difficulty to stick the gauges firmly to the teeth surfaces in order to obtain correct strain measurements, and the unavoidable movement of the strain gauge wire caused by patient movement which is of great importance regarding the accuracy of the results. In-vitro studies could be considered more valid as the test was repeated under the same conditions where the subject under study would be the only variable[25,26].

The results of this study showed that there were significant increases in satisfaction level for assessed variables (general satisfaction, aesthetics, and mastication, Comfort and retention of the patients after wearing flexible acrylic resin denture base. This could be explained by the fact that the flexible resin has a sufficiently high resilience and modulus of elasticity to allow its use in the manufacture of retentive clasps, connectors, and support elements for RPDs. Retention of clasps could be excellent with retainer that lock the remaining dentition[4].

Stress distribution of the partial denture is accomplished by flexibility of the major connector, behaving as a stress-breaker. The tissue-supported saddles float on the edentulous ridge independently, without placing a stress load on the abutment teeth. In the long term, the flexibility of the complete or partial denture also appears to act as a tissue conditioner. Leverage is the critical component of the conventional RPD design that can be controlled using flexible materials. Therefore, a flexible partial denture reduces the leverage effects of its extensions without compromising good retention and support [27-28].

CONCLUSION

Within the limitation of the laboratory testing condition of this study, the following conclusions could be obtained:Patient satisfaction for wearing flexible partial denture was higher than that for those wearing cobalt chromium partial denture. The flexible lower removable partial denture is much better to decrease the applied load on the abutment than cobalt chromium partial denture.

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