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Thermoplastic Removable Partial Dentures versus Metal Cobalt-Chromium.

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ABSTRACT

Recently thermoplastic resins have been used for esthetic partial denture rehabilitation. However, the clinical evaluation of the effect of thermoplastic partial dentures on the supporting abutments in the literate not abundant. Twenty partially edentulous male patients had mandibular kennedy class I and complete edentulous maxilla were selected for this study. Patients were divided into two equal groups; group I received removable partial dentures with metallic framework constructed from cobalt-chromium alloy. Group II received removable partial dentures with metal free framework (Thermoplastic resin). Epithelial pocket depth, bone height and bone density were measured around the main abutments at time of insertion, 3, 6, and 12 months after insertion. Data were collected and statistically analyzed. Significantly higher reductions in the bone height and bone density in the first group than that of the second group, however no statistically significant difference between both groups in pocket depth at different time intervals. Thermoplastic removable partial dentures were superior to Cobalt -Chromium dentures esthetically and produced less reduction in the bone height and density around the abutment teeth.

Keywords: Thermoplastic resins, Removable partial dentures, periodontal pockets depth, Bone height and density.

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INTRODUCTION

The main functions of Removable Partial Dentures (RPDs) are restoring the facial form and masticatory function after teeth loss. Since 1929 the Cobalt -Chromium (Co- Cr) alloy was the material of choice traditionally used in the fabrication of definitive cast RPDs [1]. One of the main disadvantages of the conventional metallic RPDs is the display of metallic clasps retainer. As the increased awareness of esthetics in dentistry, the need for removable partial dentures that reveal little or no metal supporting structures or retentive elements has been increased [2].

In the last decade the usage of thermoplastic resins has significantly grown in the medical field. Thermoplastic resins were used in dentistry to produce preformed clasps, metal-free removable dentures, occlusal splints etc. [3].

Thermoplastic resins are formed by the polymerization of formaldehyde and have been considered as an alternative material for patients who were allergic to Co-Cr RPDs framework [4]. Thermoplastic resins are sufficiently have high resilience and modulus of elasticity, high impact strength and resistance to organic solvents, oils, and hot and cold water [5,6] This properties allow its use in the manufacturing of retentive clasps, connectors, and support elements for RPDs [4,7].

The most important goal of all prosthodontic restoration of the partially edentulous arch is to protect and preserve the supporting tissues and to equalize the distribution of functional load to the abutments and to the supporting edentulous ridge. It is well known that RPDs have some damaging effects on the supporting structures [8-10]. These damaging effects are either due to excessive stresses that exceed the physiologic tolerance of the abutment teeth or due to biological factors related to the design of the clasp itself, or the material from which it is constructed [11].

When metals and metal alloys exposed to fatigue and repeated stress they undergo permanent deformation. The mechanical properties of RPDs after repeated loading is one of most important consideration in metal selection of the removable prosthesis. [10]. Vallittu and Kokkonen, “using a constant deflection test, concluded that clasp fatigue affected the retentive properties of removable partial denture and loss of retention may be caused by the permanent deformation of clasps” [12].

Direct retainers fabricated in a tooth-colored thermoplastic material are more esthetic than the metal clasp retainer of conventional RPD but The functions of any RPD is affected by the physical properties of its direct retainers [13,14], Because thermoplastic resin has a modulus of elasticity lower than that of metal alloys, the effectiveness of RPD direct retainers fabricated in this material may be inadequate [15,16].

In the researches field there was a few clinical investigations compering the thermoplastic and metallic removable partial dentures direct retainer on the supporting bony structure and abutment teeth so, this clinical study was done to evaluate and compare the effect of two different types of RPDs (Cobalt-Chromium and Thermo-plastic) on the abutment teeth and the supporting bony structures.

MATERIALS AND METHODS

Twenty partially edentulous patients were selected in this study. The patients had maxillary completely edentulous arch opposed by partially edentulous mandibular ridge, exhibiting Kennedy class I classification. Patients were free from any systemic or oral diseases that may affect the alveolar bone condition.

Edentulous areas were comprised of a well-formed ridge shape covered with healthy, dense mucosa that was firmly attached to the underlying bone. The abutment teeth have good bony support, free from caries, mobility or periodontal diseases. Full clinical examination was made for the remaining teeth and residual ridges to detect the required mouth preparation necessary to make an environment free from pathological condition necessary to fulfill the experimental criteria.

Periapical radiographs were made for the proposal abutment teeth to evaluate the crown-root ratio, the apical condition of the abutment and their alveolar bone support. In properly selected stock tray, upper

and lower alginate impressions (Alginate chroma done, Ultradent products Inc. Jordan) were made. The impressions were poured with type VI dental stone (Prima-Rock; Whip mix, Louisville, Ky) to obtain diagnostic castes. On a fixed condylar path articulator (Rational, Detery, Germany), diagnostic casts were mounted in centric occlusion according to interocclusal wax wafer record [17], to detect the need for any teeth modification. The deflective occlusal contacts were corrected intraorally, by enamoloplasty, and the ground enamel surfaces were smoothed, polished and topically painted with sodium fluoride (Bifluorid 12 single use, Germany).

The selected patients were divided randomly into two equal groups according to the type of the material used for construction of the removable partial denture framework.

Group I: Patients in this group were received conventional RPDs (metal cobalt-chromium). While Group II received thermoplastic RPDs.

The metallic RPDs design Fig (1) was I bar clasp assembly as retainer on the major abutments. Mesial occlusal rest acts as support for RPD and Vertical minor connectors on the lingual surface provided reciprocation. Major connector in form of extended lingual plate was used and acts as indirect retainer through the terminal rests.

Thermo-press (Bredent, Senden, Germany) was used to construct the metallic free removable partial dentures Fig (1), which uses the retention-grip tissue-bearing technique for retention. No teeth or tissue preparation is needed. Simply a master cast poured promptly and carefully from an alginate impression along with opposing model and bite registration.

Patients were instructed to return after one week to eliminate any complaints arising after settling of RPD. Patients were recalled after three, six and twelve month for evaluation of the prosthesis and collection of data. Pocket depth, bone height and density were measured around partial denture abutments.

Figure 1: Thermo-plastic and metal Cr-Co RPD.

Evaluation of pocket depth

The level of the epithelial attachment of the abutment teeth was evaluated using graduated periodontal probe. Fixed reference points in the form of small slits were done with bur at the middle of each abutment surface. The periodontal probe was inserted gently in the gingival crevice parallel to the long axis of the abutment tooth at four locations (mid-buccal, mesio-buccal, mid-distal, and mid-lingual). The average of the four measurements was calculated and considered the attachment level for the corresponding abutment.

Evaluation of marginal bone height and bony density using Digora system

First a Periapical parallel radiographic of the abutment teeth were taken by the aid of XCP (Rinn Corporation, XCP instruments for extension cone paralleling technique. USA). The XCP instrument was constructed from duplicating the partial denture of the patient and having the imprints of the Rinn bite plate fabricating a radiographic acrylic template.

Radiographs were taken using Trophy X-ray machine (Trophy Radiology, type 6510, France) and an automatic processor was used to process the radiographic films for standardization.

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Radiographs were taken for abutments at day of denture insertion, three, six, and twelve month after denture insertion. Second all radiographic films were scanned using digital scanner and processed to the Digora® software (DIGORA, Orion corporation, Soredex medical system, Helsinki, Finland, version 1.51 for windows). The scanned images saved on computer for measuring the marginal bone height and bone density on the mesial and distal side of the main abutment, then the average of the both sides was considered the value of the corresponding abutment.

Data obtained from radiographic and clinical evaluation were collected, tabulated and statistically analyzed.

RESULTS

Statistical analysis was performed using Statistical analysis system program (SAS) Paired t-test was used at a probability level of ($p \leq 0.05$) to assess the changes in epithelial attachment level, marginal bone height and bone density within each group. Student t-test was used to compare between the two groups. The results of this study were represented in 3 Tables.

Table 1: The effect of time on pocket depth level among different time intervals.

Time interval	Group I		Group II		P value
	Mean	SD	Mean	SD	
At insertion - 3months	0.000	0.000	0.000	0.000	*Ns*
3 -6 months	0.035	0.090	0.031	0.085	*Ns*
6 -12 months	0.035	0.090	0.031	0.085	*Ns*
At insertion-12 m	0.035	0.090	0.031	0.085	*Ns*

S.D: standard deviation, P: probability level, Ns = not significant.

Group I: Cr-Co RPDs, Group II thermoplastic RPDs

The results of statistical analysis revealed no statistically significant difference between both groups in pocket depth at different time interval.

Table 2: The effect of time on bone height among different time intervals

Time interval	Group I		Group II		P value
	Mean	SD	Mean	SD	
At insertion - 3months	-0.267	0.135	0.185	0.073	**
3 -6 months	-0.035	0.139	0.234	0.096	**
6 -12 months	-0.456	2.217	0.362	0.125	**
At insertion-12 m	-0.585	0.259	0.394	0.132	**

S.D: standard deviation, P: probability level, ** Significant at P≤ 0.01.

Group I: Cr-Co RPDs, Group II thermoplastic RPDs

Table (3): The effect of time on bone density among different time intervals

Time interval	Group I		Group II		P value
	Mean	SD	Mean	SD	
At insertion - 3months	-3.855	1.735	- 2.550	0.803	**
3 -6 months	- 4.433	2. 011	- 3. 766	1.435	**
6 -12 months	- 6.500	2. 328	- 5. 226	1.379	**
At insertion-12 m	- 8.350	3.312	- 6.388	1.288	**

S.D: Standard deviation, P: probability level, ** Significant at P≤ 0.01

Group I: Cr-Co RPDs, Group II thermoplastic RPDs

There were statistical significantly difference between the two groups.

Group I showed increased bone resorption and decrease in bone density level when compered to group II.

DISCUSSION

The ideal removable partial denture design principle is to transfer forces that are applied to removable partial dentures to the supporting teeth and tissue in atraumatic fashion [18]. Distal extension partial dentures are subjected to great stresses because their support is a combination of tooth and soft tissues and are subjected to rotations. Therefore, during the formulation of a design for a distal extension partial denture, all the possible movements that may take place must be kept in mind and all the components of the dentures may then be positioned to counteract or prevent as much of the rotation as possible [19].

Material of choice for removable partial denture should have enough flexibility for clasp and rigidity for other components of partial denture [20]. Retentive clasp arms must be capable of flexing and returning to their original form and should retain a denture in its place satisfactorily, and yet not stress the tooth excessively or be distorted permanently during service and should provide good esthetic results [15].

Thermoplastic resins have been used in dentistry for over 50 years. During that time the applications have continued to grow, and the interest in these materials of both the profession and the public has been increased. The thermoplastic resins RPDs offer elimination of metal display, providing the patients with a partial denture with superior tissue fit, colored esthetics and maximum patient comfort.

Thermoplastic resins exhibit high creep and fatigue resistance and little or almost no free monomer in the material so, it is a safe treatment alternative for patients allergic to monomer. All of these factors are very important when producing a long-term provisional prostheses during implant or complex restorative cases, or when used for permanent removable appliance. [21]

For epithelial attachment loss in the first and second groups, there was no significant change in the attachment loss measurements at the different follow-up intervals. This was in agreement with the studies made by (Bergmanetal 1982, Chandler and Brudvik 1984, and Petridis and Hempton 2001) [22-24], who mentioned that, removable partial dentures did not cause any periodontal reaction, provided that pre prosthetic periodontal health had been established and maintained with meticulous oral hygiene. On the other hand, this finding was in disagreement with the study made by (Tuominenetal 1989) [25] who mentioned that wearing of removable partial denture significantly increased the possibilities of having periodontal pocket or increasing the depth of the already presented one.

Regarding the marginal bone height in both groups at the different follow up intervals there was significant difference between the two groups. This finding was in agreement with the studies made by (Rissinetal 1979 and Yusof and Isa 1994)[26,27] who mentioned that, the periodontal conditions of the main abutments were poorer than the other teeth used in construction of RPDs due to food stagnation and difficult oral hygiene caused by the removable partial denture components. In addition, RPDs might sink into the soft tissues causing bone resorption. The reduction in the bone height measurements for the group I was significantly higher than that of the group II at the different follow-up intervals. This could be due to the fact that the rigid Co-Cr partial denture transferred more stresses to the abutment teeth than the flexible one.

The result of the bone density in this study was similar to previous studies [19,21], stated that the reduction of bone density of the thermoplastic resin group was fewer than the metallic group due to reduced load distribution over abutment teeth as the thermoplastic resin clasp transmit less stress to the abutment when compared to metal clasp. This could be due to the fact that the rigid cobalt chromium partial denture transferred more stresses to the abutment teeth than the flexible one and simplifying design and enabling the flexible thermoplastic resins in to act as a built-in stress- breaker in order to provide superior function and stress distribution in a removable partial denture as well as the force required to remove thermoplastic clasp was significantly lower than that with Cr-Co clasp. [21,29]

During this study it was observed that the fabrication of cast RPDs involves a complicated, time

consuming mouth preparation procedures which includes precise preparation of guide planes, rest seats, re-contouring of abutment to relocate the survey lines and modification of undercuts. Impression making procedures for the cast RPDs were also more complicated when compared to the flexible RPDs. Also laboratory steps followed for fabrication of the cast Cr-Co alloy RPDs were more complicated, technique sensitive and time consuming.

CONCLUSION

Within The limitation of this study it could be concluded that, the thermoplastic RPDs were superior to Co-Cr dentures esthetically and produced less reduction in the bone height and density around the abutment teeth.

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