



Effect of the functional impression on the alveolar resorption beneath the flexible acrylic resin bases for the partial removable dentures patients of class I of Kennedy

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Abstract

Introduction: Alveolar bone resorption, under free end removable partial dentures bases, has been considered one of most common problems for both of the dentist and the patient, though the multiple studies and techniques have been achieved to reduce this problem.

Aim of The Study: this research aimed to measure the alveolar bone resorption under cast metal removable partial dentures with flexible acrylic resin bases, according to class I Kennedy depending on two different methods of final impression.

Materials and Methods: (15) mandibular removable partial dentures of class I Kennedy have been made for (15) patients using McLean physiologic impression and Selective pressure single impression, then a digital panoramic radiography was made for each patient while was wearing the denture, after artificial tooth had been restored by dental Amalgam to be a reference point for measurement. After (6) months the panoramic image has been taken again and the measurement has been done by the Adobe photoshop program.

Results: Within the limits of the study showed; The occurrence of alveolar bone resorption with time in dissimilar rate between patients, whatever the method of functional impression was used, but with no statistically significant differences, and showed the recalcification of resorption in the most distal area from the distal abutment in selective pressure single impression group comparing to Mclean physiologic impression group with statistically significant differences.

Conclusions: There is no effect of the method of the functional impression in alveolar bone resorption under cast metal removable partial dentures with flexible acrylic resin base, with preferable to use the Mclean physiologic impression for this type of dentures.

Keywords: alveolar bone Resorption, removable partial dentures, class i kennedy, flexible acrylic resin, functional impression

1. Introduction

Alveolar bone resorption under free end removable partial dentures bases has been considered one of most common problems for both of the dentist and the patient, though the multiple studies and techniques have been achieved to reduce this problem [1, 2].

Several solutions have been suggested to minimize the occlusal force on surface unit and to distribute between tooth and alveolar bone in a homogeneous manner, thus alleviating the problem, such as:

▪ Final impression method

The objective of any functional impression technique is to Provide maximum support for the removable partial denture Bases. This allows for the maintenance of occlusal contact between natural and artificial dentition and, at the same time [3].

There are several methods of Final Impression such as

- McLean Physiologic Impression and modified impression [4].
- Selective Pressure Single Impression method [5].
- Functional Reline Method [4].
- Selective Tissue Placement Impression Method (Altered cast) [3].

The first two methods were used in the study, because the

ease of them and Availability of materials compared to the remaining two methods for the place where the study was conducted.

▪ Using of materials achieve the accuracy of the fit of the base denture

Support of the distal extension base is enhanced by intimacy of contact of the tissue surface of the base and the tissues that cover the residual ridge [3]. Some researchers have suggested using titanium alloys instead of Chrome-Cobalt alloys [6], another researchers have suggested to use Injection Pressing Acrylic Resin instead of traditional Heat Polymerized Acrylic Resin [7] because they have a better properties of Accuracy of fit.

▪ Design of the Removable Partial Denture Framework

The design of the RPD has always been the subject of many biomechanics studies, Many previous studies suggested that the rigid major connectors can reduce the stress concentration on the abutment teeth and the residual ridges by distributing the occlusal forces across the dental arch, higher stress in the abutment teeth and on the residual ridge was observed with an RPD design with polyacetal resin framework (due to the nonrigid characteristics of the polyacetal resin) than an RPD design with a conventional metal framework [8].

The use of a lingual plate as a major connector has been suggested so that it can stabilize the abutment teeth by altering the direction of the occlusal forces ^[8]

The design of a direct retainer is considered as an important factor on the force transmitted to the abutment teeth and the residual ridges ^[8]. The reason of the reduction of the stress concentration on the residual ridges for the rigid design was related to the transmission of the force along the long axis of the abutment teeth. Moreover, an RPI clasp design (with mesial rest seat and buccal I-bar) has been shown to produce less torque on the abutment teeth than the circumferential clasp. In addition, in experimental model studies, was found to have an association with an increased buccal movement of the abutment tooth than the rigid designed retainers ^[8].

▪ Reducing the occlusal table

The total occlusal load applied may be reduced by using comparatively smaller posterior teeth represented. Less muscular force will be required to penetrate a food bolus with a reduced occlusal table, thereby reducing Forces to supporting oral structures ^[3].

▪ Using soft lining materials

soft lining materials work as a pillow reduce the pressure of alveolar bone and distributes forces in a homogeneous manner across the entire support area ^[2, 9].

▪ Improved support by dental implants

Implants may help preserving the residual bone especially around the implants through the mechanism of osseointegration and continuous bone remodeling after functional loading which may enhance bone to implant contact ^[8, 10].

Implants may reduce the load beneath the denture base and improve the support for the removable partial denture ^[11], including dental implants presents many advantages compared to a conventional one such as ^[4]:

- Improved stability.
- Increased retention.
- Improved esthetics.
- Increased patient comfort.
- Enhanced patient satisfaction.
- Improved patient confidence.
- Decreased need for relines.
- Reduced risk of combination syndrome.

2. Materials and Methods

The research sample consists of 20 patients with mandibular Kennedy- Applegate class I partially edentulous situation and full upper edentulous were randomly selected for the study out of those who reported to the removable prosthodontics department at school of dentistry at Hama university, without regard to the age and gender of the patients, medically fit, having an average oral health status and without any significant deleterious habits. Approval of ethical committee was taken. Patients were divided into two groups equally:

1. Group (1): 10 removable partial dentures were made with the use of McLean Physiologic Impression.
2. Group (2): 10 removable partial dentures were made with the use of Selective Pressure Single Impression method.

The upper complete denture was made for each of them

during the research stages from traditional Heat polymerized acrylic resin.

Treatment Steps

- a) Patient acceptance after clinical and radiology examination (Fig 1).



Fig 1: clinical and radiology examination.

- b) Periodontal therapy when the condition is required and extraction of hopeless teeth.
- c) Endodontic therapy when necessary.
- d) Making primary impression with Irreversible Hydrocolloids material (Hygident, HygidentInc, china) to obtain the study cast which were Surveyed by Ney surveyor (J.M. Ney Co, Bloomfield, Conn.).
- e) Lingual plate was adopted as a major connector and nonrigid wire clasp as a direct retainer for all cases.
- f) Preparation of abutments as the design required (guide plate, path of insertion, rest seats and retentive areas) in a conservative manner or with fixed prosthodontics. A C-silicon impression material (Zeta plu, Zhermak, Italy) was used for fixed prosthetic impression after that the fixed prosthetic had surveyed by (Orthoflex, Pidental, Hungary) (Fig 2).



Fig 2: preparation of abutments with fixed prosthodontics.

- g) Making individual tray that belongs to each functional impression using Auto Polymerized Acrylic Resin

(Respal, Mulazzano, Italy) for making the final impression (Fig 3), (Fig 4).

▪ McLean Physiologic Impression^[4]:

The need for physiologic impressions was first proposed by McLean and others. They realized the need for recording the tissues of the residual ridge in a functional form while capturing the remaining teeth in the anatomic form. As a result, they developed a dual impression technique to accomplish their objectives, these practitioners constructed a custom tray on a diagnostic. A functional impression was made using this tray and a suitable impression material. A hydrocolloid "over impression was then made while maintaining the functional impression in its intended position. The greatest weakness of the technique was that practitioners could not produce the same functional displacement generated by occlusal forces.

In response to this shortcoming, Hindels and others developed modified impression trays for the second impression procedure. These trays had large holes in their posterior segments. As a result, the operator could apply finger pressure to the functional impression as the hydrocolloid impression was being made. The finished impression was a reproduction of the anatomic surface of the ridge and the surfaces of the teeth. The two were related to each other, however, as if masticating forces were taking place on the denture base. Disadvantages of these techniques are closely related to direct retention. If the action of the retentive clasps is sufficient to maintain a denture base in its intended position the tissues of the ridge will be in the functional form. This may result in compromised blood flow with adverse soft tissue reaction and resorption of the underlying bone. If the action of the retentive clasps is not sufficient to maintain that functional relationship of the denture base to the soft tissues, the denture base will be occlusally positioned when the soft tissues are at rest. This results in premature contact of the artificial teeth, which may be objectionable to many patients (Fig 3).

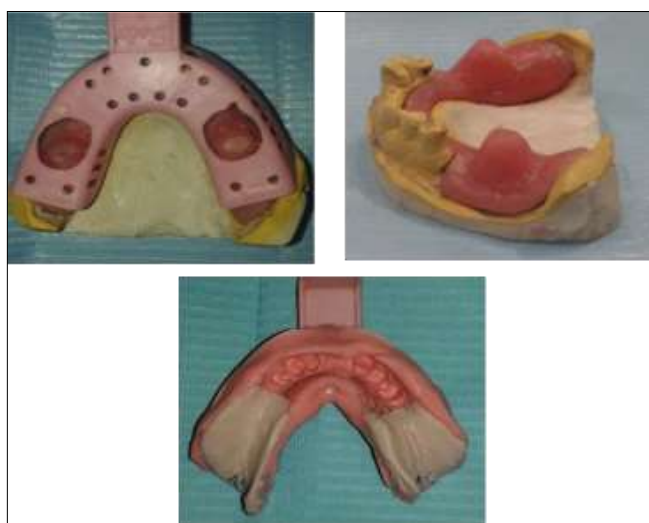


Fig 3: McLean Physiologic Impression with hindle's modification.

▪ Selective Pressure Single Impression method⁵

This method is based on the principle of selective pressure and is carried out in two stages, where the first stage is carried out individually by impression composition, then the second stage is done using a soft rubber material inside the

impression composition but with a single impression. Steps of the technique:

- Place two layers of baseplate wax relief over the teeth and residual ridges of the diagnostic cast.
- Burnish aluminum foil over the wax with either an egg burnisher or the back of a wax spatula.
- Place occlusal stops on the teeth by making definite boxes through the aluminum foil and wax to ensure proper reseating of the tray during border molding procedures.
- Fabricate custom tray with autopolymerizing acrylic resin with borders 2 mm short of the functional vestibule.
- Check intraorally for overextension and reduce as necessary.
- Remove wax relief and wet surface of cast.
- Place softened thermoplastic modeling compound on the tissue surface of the custom tray overlying residual ridges.
- Reseat custom tray on the diagnostic cast, this procedure shapes the modeling compound appropriately before intraoral placement.
- Reheat compound and place intraorally, placing finger pressure on the area of the residual ridges.
- Apply modeling compound to lingual borders of custom tray and any modification spaces and complete border molding procedure.
- Reduce modeling compound contacting the tissue surface by 1 mm except at the pear-shaped pad and buccal shelf areas. (This selectively places pressure over the primary stress-bearing areas during the impression procedure.
- Make the impression with low viscosity polysulfide rubber impression material.
- Apply finger pressure over residual ridge areas during subsequent border molding steps and while impression material is setting.
- Inspect impression for accuracy) and pour in type IV dental stone (Fig 4).



Fig 4: Selective Pressure Single Impression method.

- h) Making and fitting the framework in the patient's mouth.
- i) Registration of occlusal relationship with the appropriate vertical dimension and centric relation and then setting of artificial Teeth, then the try-in were made in patient's mouth in the next appointment.
- j) Processing of acrylic bases of removable partial dentures with flexible acrylic resin, before the delivery appointment the occlusal surface of artificial tooth were prepared with black class I and filled by the dental amalgam to be a reference point for measurement on the digital panoramic radiography (Fig 5).
- k) Dentures delivery to the patients was done after assessment and adjustment procedures for the denture base, borders and the occlusal errors.



Fig 5: the removable partial denture with flexible acrylic resin base and restored artificial tooth by the dental amalgam.

- l) A digital panoramic radiography was made after delivery appointment in the same day, and a silicone bite on the biting block of the radiographic device for each patients, to ensure that the patient bites the same situation after the end of the observation period (Fig 6).



Fig 6: delivery of the dentures and making the digital panoramic radiography.

- m) After 6 months all patients had been contacted and new digital panoramic radiography were made, after several cases had been excluded for various reasons, (one patients was dead, two travel cases, one case for not wearing the denture and one case for poor oral hygiene).

The research sample became consist of 15 patients were divided into two groups:

1. Group (1): 8 removable partial dentures were made with the use of McLean Physiologic Impression.
2. Group (2): 7 removable partial dentures were made

with the use of Selective Pressure Single Impression method.

The measurements was done by the Adobe Photoshop program with the ruler tool in the program from the distal pulpal angle of the amalgam filling beneath the closest and farthest artificial tooth from the last dental abutment and to the alveolar bone crest (Fig 7).

After conducting the measurements and collecting the results, we calculated the amount of alveolar bone absorption according to the following equation in millimeter:

Alveolar bone resorption = Elevation between the dental amalgam and alveolar bone before (6) - Elevation between the dental amalgam and alveolar bone after (6) months.



Fig 7: Measurements with the Adobe Photoshop. cs program

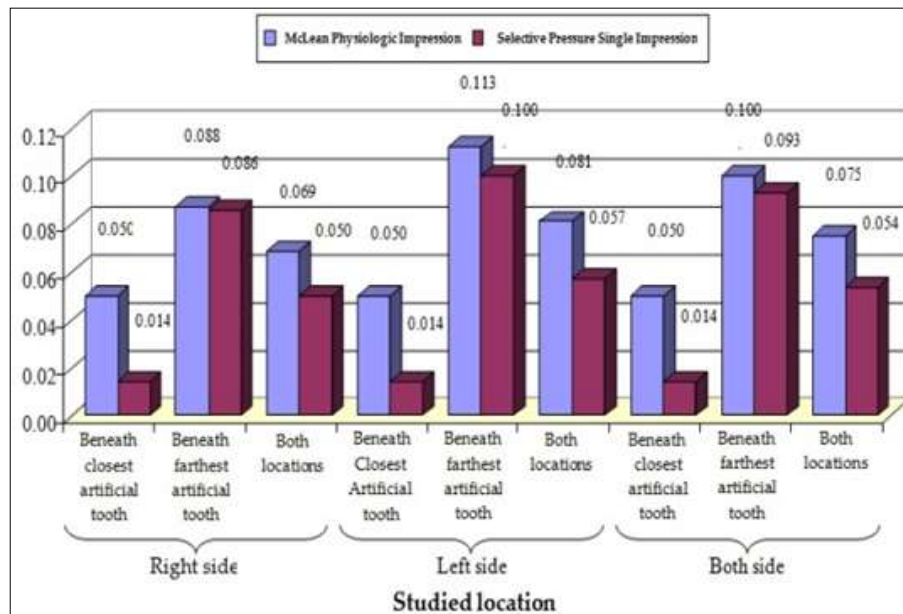
3. Statistical methods

Statistical analyses were carried out using SPSS software (ver. 13.0; SPSS Inc., Chicago, IL). Arithmetic mean and Standard deviation were carried out according to impression type and the studied location. Kolmogorov-Smirnov test were carried out for Standard normal distribution of alveolar bone resorption and p values < 0.05 were considered statistically significant.

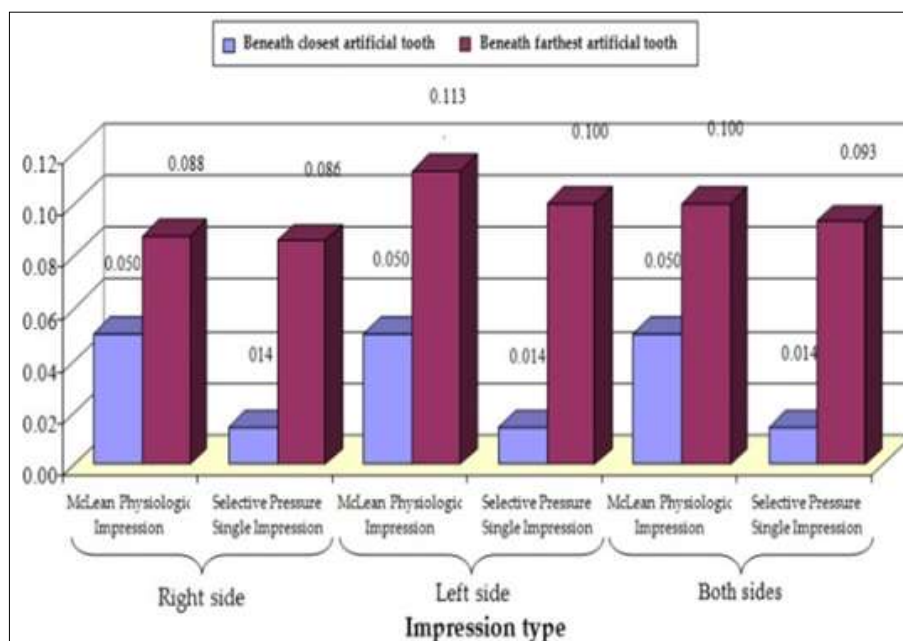
4. Results

After 6 months of observation showed an alveolar bone absorption in all patients at an average varying rate although the arithmetic mean for alveolar absorption was greater in the group1 but and the mean difference was 0.021 mm for both groups and (P > 0.005). Therefore, there were no significant differences between groups according to the impression type (Graph 1) (Tab 1).

The mean differences in alveolar bone between group1 and 2 according to studied location were -0.05 mm and (P > 0.05) for Group1 as for -0.079 and (P < 0.05) for group2. Therefore, the alveolar bone resorption beneath the farthest artificial tooth was larger than closest one in the group2 compared to group1 although it was greater beneath the farthest artificial tooth than closest one in both groups (Graph 2) (Tab 2).



Graph 1: Arithmetic mean of alveolar bone resorption according to impression type



Graph 2: Arithmetic mean of alveolar bone resorption according to studied location

Table 1: Descriptive statistics and the results of the T-Student test of the independent samples to study the significance of differences in the average values of the alveolar absorption amount in (mm) according to the impression type.

Result	p-value	Calculated t value	Means differences	Upper bound	Lower bound	Standard deviation	arithmetic mean	Count of measurements	Impression type	Studied location
Non-significance	0.109	1.657	0.036	0.20	0	0.073	0.050	16	McLean Physiologic Impression	Closest artificial tooth
				0.10	0	0.036	0.014	14	Selective Pressure Single Impression	
Non-significance	0.838	0.207	0.007	0.30	0	0.110	0.100	16	McLean Physiologic Impression	Farthest artificial tooth
				0.20	0	0.073	0.093	14	Selective Pressure Single Impression	
Non-significance	0.329	0.985	0.021	0.30	0	0.095	0.075	32	McLean Physiologic Impression	Both sides
				0.20	0	0.069	0.054	28	Selective Pressure Single Impression	

Table 2: Descriptive statistics and the results of the T-Student test of the independent samples to study the significance of differences in the average values of the alveolar absorption amount in (mm) according to the studied location.

Result	p-value	Calculated t value	Means differences	Upper bound	Lower bound	Standard deviation	arithmetic mean	Count of measurements	Studied location	Impression type
Non-significance	0.139	-1.519	-0.050	0.2	0	0.07	0.05	16	Closest artificial tooth	McLean Physiologic Impression

				0.3	0	0.11	0.10	16	Farthest artificial tooth	
significance	0.001	-3.606	-0.079	0.1	0	0.04	0.01	14	Closet artificial tooth	Selective Pressure Single Impression
				0.2	0	0.07	0.09	14	Farthest artificial tooth	

5. Discussion

Previous studies have indicated that alveolar bone resorption begins immediately following the loss of a tooth and continues in an accelerated manner for about 10 weeks, followed by slower, but progressive, resorption thereafter [12]. The best approach to prevent this resorption is to preserve the residual alveolar ridge using different kinds of prosthetic rehabilitation.

Carlsson [13] stated in a review that the best way to manage bone resorption was to avoid tooth extraction.

In this research a study was conducted on the effect of functional impression on alveolar bone resorption beneath the flexible acrylic resin bases for the Partial Removable Dentures Patients of Class I of Kennedy because it is the most common class among the classes of partial edentulous classes. According to a previous study [14], taking into account to alleviate a difference in occlusal load between patients, the opposite jaw were selected full edentulous in purpose and the complete dentures were made later during the research stages. The cast metal of removable partial dentures were made by cobalt-chrome alloy because it's the most commonly used alloy among the dentists, the acrylic base was made by flexible acrylic resin which is considered one of injectable acrylic resin types to take advantage of the aesthetic aspects or the presence of a certain contraindication of conventional acrylic as allergic to residual monomer [15, 16], despite the controversy about being a possible cause for alveolar bone resorption [17]. Therefore, some researchers advised to use the functional impressions with it [18], As done by this study.

To minimize the factors those related to the removable partial denture design a standardized design was used for all patients, where ligual palate was used as major connector and nonrigid wire clasp as direct retainer. To avoid the presence of contraindications to RPI such as shallow buccal vestibule [3] and flexible acrylic clasps were avoided too, due to insufficient studies about the right design or depth for suitable retentive areas.

After completing the necessary treatments for the patients and the stages of the making of the denture, the occlusal surface of artificial tooth were prepared with black calss I and filled by the dental amalgam to be a reference point for measurement on the digital panoramic radiography. Radiographic imaging was performed using a digital spherical imaging device, which is a fast and effective way to estimate vertical changes in the alveolar bone as Previous study has indicated [19].

A short-term monitoring period of 6 months was adopted and Measurements were then recorded using Adobe Photoshop. CS because the ruler included with the software had better specifications than the ruler included with the panoramic imaging software similar to previous studies [9, 20].

The results showed that there is some degree of absorption of the alveolar bone in some patients in both groups. Thus, the functional impression type does not affect the amount of alveolar bone absorption and its occurrence over time and this agree with previous studies [9, 13, 21].

This study showed no significant differences between groups according to the impression type, This differs from previous studies for Jnaid [9] and Madihalli *et al* [22], which showed that preference of selective pressure impression by reducing the resorption compared to other impressions. The explanation may be because of their use of Selective Tissue Placement Impression Method (Altered cast) while this study used the Selective Pressure Single Impression method and short observation period as well.

The results also showed more frequent alveolar bone resorption beneath the farthest artificial tooth than closest one in both groups, this is explained by the fact that the tooth next to edentulous area will receive part of occlusal load and the rigidity of denture base because the presence of metal mesh which will help to distract the stresses more than area that do not contain any metal structures as Previous references have indicated [3, 8].

more over the alveolar bone resorption beneath the farthest artificial tooth was greater than closest one in the group2 compared to group1 and it is explained by the flexibility of the Acrylic wings of the acrylic base because the low elastic modulus of thermoplastic resin compared to heat Polymerized acrylic resin [15]. Therefore, the flexible acrylic wing did not provide the expected support on the buccal shelf area, more over a previous study found that the cast metal removable partial denture with flexible resin base will produce further stress on the ridge compared to conventional one [17], and this disagree with what was recommended by Ito *et al*. [18].

6. Conclusions

There is no effect of the method of the functional impression in alveolar bone resorption under cast metal removable partial dentures with flexible acrylic resin base, with preferable to use the Mclean physiologic impression for this type of dentures.

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