

Original Article

The Impact of the Flexible Partial Denture Base on the Alveolar Mucosa in comparison to metallic denture: RCT and Histological Study

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Abstract

Statement of the problem: Flexible denture is usually chosen by patients whom esthetics is their top priority, who refuse preparation of the abutment teeth or who have allergy to the metal. Patients are looking for restoring their lost teeth. However, the purpose of denture construction should involve the maintenance of the surrounding tissue health.

Aim of study: to correlate the type of denture base with the distribution of masticatory forces through examining the histological changes in the alveolar mucosa.

Methods: 12 partially edentulous patients with the same missing teeth were selected from Prosthodontics outpatient clinic, Faculty of Dentistry, Cairo University. 6 Patients received metallic partial denture while the rest received flexible partial denture. 2 smear biopsies were taken on the day of delivery and 6 month after denture insertion, stained with PAP and examined histologically to assess the number of keratinized cells.

Results: by Using paired-t-test it show that both types of denture bases altered alveolar mucosal keratinization but there was a significant difference in number of keratinized cells among pretreatment, after-metallic, and after-flexible denture insertion. Flexible partial denture showed thinner and less keratinized epithelium.

Conclusion: Any prosthetic restoration placed in the oral cavity will induce some mucosal changes. The biocompatibility of the prosthesis with oral tissue should be considered in addition to patient's and dentist's preference

Keywords: flexible thermoplastic resin, Metallic denture, keratinization, masticatory forces

Introduction:

Aesthetics is very demanding to the partial edentulous patient, patients required nonmetallic clasp display. The available treatment options are fixed partial dentures or dental implants or removable denture. The factors affecting the choice of prosthesis are the aesthetic requirements, periodontal tooth condition, cost, anatomical constraints and patient's acceptability. 1

Removable partial denture can be cast metal, acrylic resin with wrought metal clasps or flexible thermoplastic resin. Many patients prefer the nonmetallic partial denture because of the changes in public awareness which led to rising in the patient demand toward esthetic in the prostheses fitting. 2

According to a position paper published in 2014, among the flexible denture indications are Patients for whom esthetics is top priority, Patients who

refuse the preparation of abutment teeth, patients with allergy with metal and in cases of tilted teeth with undercut which makes prosthesis insertion easy. Good oral hygiene and sufficient interarch distance are very important in case selection for flexible removable denture prosthesis. 3

Metallic removable partial denture includes rest component. Rest function is to direct the occlusal load toward the longitudinal axis of the abutment teeth to provide prosthesis support, secure the clasp in its position, prevent prosthesis tissue work movement. 4

Flexible partial denture has no rest seats. Zhao et al 5 claimed that there is no need of an occlusal rest or vertical stop in the flexible partial denture, they reported that the rigid occlusal rest functions to compensate for the damaging stresses resulting from the fulcrum effect of a rigid major connector and this fulcrum is nullified by the flexibility in the major connector which act as stress breaker.

Other authors stated that flexible denture without rest component lacks support, the denture rotates and sink with the masticatory forces, this particularly happens in patient with few remaining teeth or without vertical stops like if molar occlusal support has been entirely lost, prosthesis movement may leads to bone resorption or gingival abnormalities due to force concentration . 3

Under normal conditions and in the presence of teeth, alveolar ridge mucosa is covered by thin non keratinized stratified squamous epithelium. After molars extraction, some patients tend to eat on their edentulous ridges. So, masticatory forces impinging directly on alveolar mucosa induce some changes in its nature and increasing the rate of epithelium turnover which may be followed by further loss of alveolar bone. 6

Patients usually come to our clinics to restore the lost teeth. However, the purpose of denture construction should not be restricted to teeth replacement, but should maintain the surrounding tissue health.

In this study, we aim to correlate the type of denture base with the distribution of masticatory forces through examining the changes in the histological picture of on the alveolar mucosa before and after insertion of two widely used dentures.

Subjects and Methods:

Patient selection:

According to sample size calculation, 12 partial maxillary edentulous patients were selected for the clinical trial, 6 patients for each group. The control group received maxillary metallic partial denture for kennedy class I or II partial edentulous arch and the intervention group received flexible partial denture, all patient were recruited from outpatient clinic of the prosthodontics department, Faculty of Dentistry, Cairo University. After patients had been selected to the trial according to eligibility criteria. They were numbered, placed in two identical envelopes and randomly assigned to one of the two groups

Patient age range from 40 to 55 year of both sex, the selected patient criteria were as the following; Patient with opposing natural teeth. , no intraoral soft or hard tissue pathosis , no recent extraction ,Patients having last extraction at least 6 months before denture construction, and non-smokers. Patient selected after medical history, a clinical examination and radiographic assessment.

Informed consent:

For Ethical clearance, all the selected patients were informed with the nature of the research work and the need to participate in scheduled follow up for 6 months after partial denture insertion. Informed consent was obtained for each of them.

Partial denture construction:

Mouth preparation and abutment preparation was performed followed by impression making for construction of metallic removable partial denture. For intervention group, upper and lower Primary impressions were made in irreversible alginate, final impression in perforated acrylic special tray constructed was obtained followed by jaw relation record then acrylic teeth selection is finally obtained. Undesirable undercut were blocked out, Duplication of the master cast was done using technosil duplicating silicone.

Diatrics holes were made in teeth of the selected shade for mechanical retention of acrylic teeth to the flexible denture base. The wax was completely removed from the holes in the teeth allowing proper flow of flexible material into

cartridge and subsequent retention of teeth with denture base

After waxing up the denture, the denture was processed to flexible partial denture by injection thermoplastic resin Breflex 2, as seen in Figure 1. Partial dentures were assessed on the day of delivery and 6 month after delivery⁷. All patients were instructed to strictly follow proper oral and denture hygiene Programs.

Smear biopsy:

A cytological smear was collected from the maxillary edentulous area on the day of delivery and 6 month after denture delivery. Patients were asked to rinse their mouths and then the side of cement spatula was used to scrape the residual ridge epithelial squamous cells with light pressure at premolar-molar area. The material was smeared on a clean glass slide and immediately fixed in 95 percent ethyl alcohol. Then, they were stained by the Papanicolaou stain (PAP) at the Pathology department, faculty of medicine, Cairo University.

Assessment of the changes in alveolar mucosa:

Microscopic examination, by blinded pathologist, PAP stained slides was examined under the ordinary light microscope for morphological analysis and to select the most nuclei rich fields to be counted.

According to Ramulu et al, 8 keratinized cells were stained yellow to orange, parabasal cells were stained faint green to blue and the granular cells were stained pink to red.

Counting of keratinized cells by computer image analyzer:

The computer image analyzer with the software Leica Quin 500 was used to automatically count number of nuclei seen in keratin (representing keratinized cells that showed yellow to orange stain)⁹.

An average of 5 nuclei rich fields was done under magnification power x400 in 3070392 μm^2 field.

The collected data was tabulated and statistically assessed using Paired t test for the comparison between biopsies before and after treatment in each group. Three way analysis of variance (ANOVA) test for three group comparison between pre-treatment biopsies, after construction of metallic

denture and after construction of flexible denture. The confidence level was set as $P < 0.05$ was considered statistically significant.

Results:

Microscopic examinations:

In pretreatment group, the specimens were formed of keratin (orange) and few intermediate cells (pink). It was formed mainly of parakeratinized type (contains nuclei) with scattered small areas of orthokeratin (no nuclei with the keratin), as seen in Figure 2 A

In metallic denture group, the specimens were formed completely of parakeratin (orange). Nuclei appeared with different staining intensities. Some of these nuclei were pyknotic as seen in Figure 2 B. In flexible denture group, the specimen was formed of keratin of both types with predominating orthokeratin. Some granular cells that appeared pink with granular cytoplasm and few parabasal cells that stained blue were also detected as seen in Figure 2 C, D

Computer image analysis:

Assessment of number of nuclei in the three studied groups:

The highest number of nuclei was detected in the group used metallic denture followed by both groups before treatment while the lowest value was seen in the group wearing flexible denture. The difference between groups was highly significant ($p < 0.0001$) table 1.

Assessment of the change in the number of nuclei within each group:

Using paired-t-test, pre and after treatment specimens were compared for every patient in each group and the results showed that there was a statistically significant difference between the mean of numbers of nuclei before and after the use of the denture in both groups ($p < 0.05$) table 2.

Discussion:

After tooth extraction, many changes in the contour of alveolar ridge occur rapidly in the first month and continue but with slower rate up to 4-5 months. The success of prosthesis rehabilitation is closely related to the reduction of residual ridge resorption, preventing drifting of the remaining teeth in addition to restoring missing teeth function.

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Table (1) Mean number of nuclei before denture insertion, after metallic and after flexible denture.

Groups	Mean	Std. Deviation	Std. Error	95% Confidence Interval	p-value
Pretreatment gp	79.5	16.8	4.65	79.5 ± 9.119 (±11.47%)	< 00001
After metallic denture	130.17	4.3	1.62	130.1667 ± 3.181 (±2.44%)	
After flexible denture	16.17	5.7	2.14	16.1667 ± 4.194 (±25.94%)	

Table (2) the change in mean number of nuclei before and after the use of the denture within each group

group	Paired Differences						t	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
before - after Metallic denture Pair 1	-42.66667	3.38625	1.38243	-46.2	-39.1	-30.8	0.000	
before - after Flexible denture Pair 2	55.33333	16.56100	6.76100	37.93	72.7	8.1	0.000	

**Fig (1)** maxillary flexible partial denture

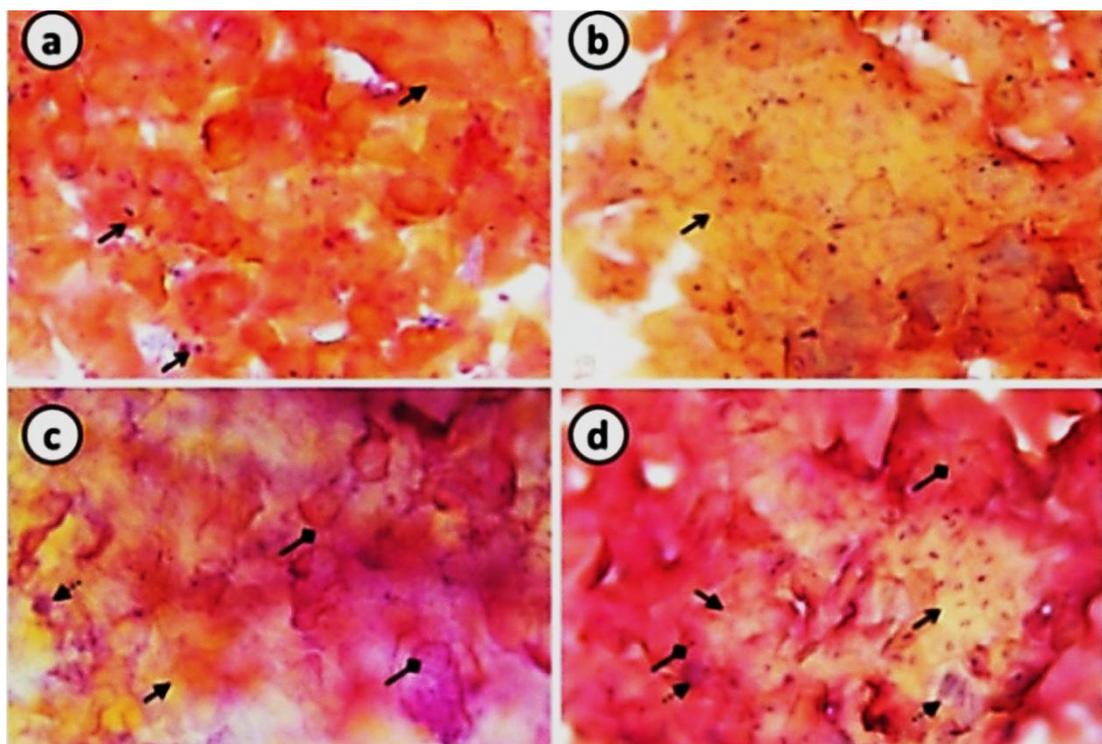


Fig (2) Microphotographs of PAP stained smear specimens. (A) Pretreatment group showing both types of keratin. (B) Metallic denture group showing parakeratin with dark and faint nuclei. (C, D) Flexible denture group demonstrating different layers of epithelium, parabasal(blue), granular (pink), and keratin with predominating orthokeratin (nuclei free)

(Parakeratin  Orthokeratin  Granular cell  Parabasal cells) 

Removable partial denture (RPD) is one of treatment modalities of replacing the lost teeth. Despite advanced techniques and availability of various types of implant, RPD still represent the best option for the cases of insufficient supporting bone, inappropriate anatomy and for finical considerations. However, RPD may be damaging to the oral tissue if it is not carefully designed and improperly distributes the occlusal forces. 10 11

Many studies were done to compare between the effect of different denture bases, impression techniques and impression tray designs on the distortion of residual ridge during impression and after denture insertion. 9 10

The present study aimed to evaluate the ability of metallic and flexible dentures to distribute the occlusal forces applied on the alveolar ridge through microscopic examination of smear biopsies performed before and after denture insertion. Such

minimally invasive biopsy doesn't reduce denture stability or causes patient's discomfort. The histological changes were reported and the number of keratinized cells was determined as an indicator of the rate of epithelial turnover accompanying increased stresses applied on the oral tissues. 9

Before denture construction, alveolar ridge was covered by parakeratinized stratified squamous epithelium loss of granular cell layers and retention of nuclei within the stratum corneum.

Parakeratosis signifies the increased rate of epithelial turnover giving no time for epithelial cells to pass through normal maturation process. Parakeratin acts as a protective barrier against unfavorable stimulus and is usually formed secondary to inflammatory or neoplastic processes. 12

After metallic denture construction, hyperparakeratinization of surface epithelium occurred and this was proved by the absence of

intermediate cells (pink) seen in other two groups despite taking biopsies with the same depth. It was also proved by the appearance of nuclei with different optical densities indicating their presence in different layers.

Furthermore, it was also noticed that parakeratinized epithelium became richer in nuclei reflecting the increased forces applied on the mucosa even after construction of denture

After flexible denture construction, a great change in the surface epithelium occurred as it becomes thinner and covered mainly by orthokeratinized type. Such observations were proved when detecting parabasal cell (stained blue) that can't be removed with such superficial smear biopsy s epithelial thickness reduces. The outer layer of epithelium was formed of nuclei free keratin (orthokeratin) in most areas and granular cells that appeared pink with granular cytoplasm.

This thinning in epithelial thickness means that there was a reduction or better distribution in the masticatory forces which allow better maturation of epithelium and emergence of orthokeratinization. In consistence, Abdel Fdeel et al have suggested that the flexibility of the major connector of flexible denture behaves as a stress-breaker, acts as a tissue conditioner and therefore reduces the leverage rotational force and damaging effect on the underlying mucosa. 13

According to our results, the flexibility of the breflex denture has cushioning effect over the tissue in addition to its good esthetics appearance, the choice may be still resisted by some patients and prosthodontists as reported in the survey study done by Polyzois et al. 14

Conclusion:

Any prosthetic restoration placed in the oral cavity will induce some mucosal changes. Therefore, the selection of the prosthesis should not depend completely on patient's or dentist's preference but also on the amount of the obtained benefits in comparison to the damage it may cause.

Recommendation:

A long term assessment of the underlying bone may also offer an evidence on the most biocompatible denture base. Modification of fitting

surface of metallic restoration to reduce its rigidity may also be a suggestion.

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Conflict of Interest:

The authors declare no conflict of interest.

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