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Effect of nylon and acetal denture base material on Candida albicans count for partial denture cases

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1. Introduction

Denture base is the part of denture which contacts the oral mucosa and to which artificial teeth are attached, which should meet specific requirements such as maximum tissue adaptation and minimal volumetric changes, thermal conductivity, low specific gravity, high strength to withstand fracture, and cleansability [1].

Allergic reactions accompanied by conventional methyl methacrylate acrylic resin have been caused by methyl methacrylate monomer and additives, cell culture experiments proved that compounds released by acrylic based resin may cause various biological responses on mucosa and changes in oral hygiene [2].

Thermoplastic acrylic resin is a heat sensitive monomer free, multipurpose acrylic that provides more than tiny unique applications to improve removable dental appliances, by enhancing retention, esthetic and patient comfort, this acrylic can create any part of a denture to become adjustable, by using warm water. It can be extended into any undercut to mechanically retain a denture, and can be used to produce repeatable thermo-relines, it can replace metal clasp in partial dentures [3,4].

Denture plaque was proved to be mainly bacterial and composed of mixed flora that includes different potential pathogens. Electron microscopic studies proved that denture plaque is mainly Gram-positive and Gram-negative coccal forms with candida rarely observed, and was proved that in its early developmental stages, denture stomatitis appeared as a bacterial inflammation which is more similar to bacterial gingivitis, due to lack of oral hygienic measures unlike a fungal infection [5,6].

Organisms held in the depth of palatal epithelium was found to be the source of denture plaque. Different studies have concentrated on the differential counts of streptococci and experimental techniques as denture rinsing after meals and before samples collection have mitigated against many fastidious species with low adhesive properties [7].

2. Materials and methods

2.1. Patient selection

In this study twelve partially edentulous patients selected from the outpatient clinic of the prosthetic department, Faculty of Dentistry, Suez Canal University. Fig (1A).

The patients were selected with the following criteria:

1. Male and female patients were included in this study.
2. Eight male patients and four female patients were selected with age ranges between 20 and 30 years old to exclude female hormonal changes after age of 50 that may affect oral flora.
3. Patients having class IV Kennedy classification with minimal teeth loss with no previous partial denture experience.
4. Patients selected were free from systemic diseases and oral pathology as examined by physician.
5. Patient with severe undercut areas, exostosis and tori were excluded.
6. Non-smoker patients were chosen.
7. Selected patients had normal maxillo-mandibular relationship.
8. Patients did not take any antibiotics or immunosuppressive two weeks before taking swab samples.
9. Informed patients’ consents were obtained.

2.2. Grouping of patients

Twelve selected patients were divided according to partial denture base material into two groups (A for acetal resin and B for nylon resin material) each group consists of six patients (N = 6).

2.3. Prosthetic treatment

1. The preliminary impressions were made using irreversible hydrocolloid alginate impression material.
2. Acrylic resin special trays were constructed on study casts on a wax spacer for selective pressure impression.
4. Carefully examined in patient's mouth for border and sufficient frenal relief.
5. Final impressions were made using rubber base impression material.
6. Dental stone was used for pouring the impressions and the master casts were obtained.
7. Undesirable undercuts on the master casts were blocked out.
8. Wax wafer bite method was recorded.
9. Upper and lower master casts were mounted on articulator.
10. Setting of artificial teeth with the proper shape and suitable size was carried out.
11. Waxed up dentures were tried in the patient's mouth for optimal occlusion, phonetics and facial contours.

2.4. Group (A)

Thermoplastic Acetal resin material (Sabilex. Italy) used for constructing denture base for group A. Acetal thermoplastic base material was supplied in the form of cartridges each weighs 24 g. Fig (1B)

Specific flask was used with thermoplastic flexible base material according to manufacturer's instructions injection channels were attached as close as possible to the injection opening of the flask and the model. Fig (1C)

Denture is processed with injection molding technique:

1. Cartidge was inserted into one of the heating chambers in the oven.
2. Start key pressed to start melting cartridge at 245 C for 15 min.
3. Start injection key was pressed to inject material into mold of the flask.
4. All flask screws were removed, casts with sprue were separated from flasks. Fig (1D)
5. Laboratory remounting was carried out, denture was removed from the cast.
6. Finishing and polished were carried out using pumice powder and soft brushes. Fig (1E and F)

Group (B): Thermoplastic Nylon resin (TCS.Inc.Canada) material used for constructing denture base. (TCS) thermoplastic resin was supplied in form of crystals weighing 250 g with empty cartridges used for weighing crystals each cartridge
should weighs 24 g before being injected. Fig (2B).

Dentures were processed with injection molding technique, oven was switched on with the cartridge sleeve in place and set to 232°C at least 15 min prior to processing. Fig (1C)

The warm flask halves with brackets and the injection insert were assembled.

1. The injection piston was engaged for one minute, after injection the flask assembly was removed from the system.
2. Flask assembly was bench cooled for five minutes before deflasking.
3. Complete investing, spruing and wax elimination was carried out.

(TCS) thermoplastic resin has been finished and polished using normal procedures for acrylics, a sharp carbide bur can be used for bulk reduction followed by coarse pumice for finishing. Fig (2 D, E and F).

- All patients for both groups were asked to wear their dentures twenty-four hours a day and they were not allowed to take them off except for cleaning.
- Patients were instructed to eat soft food for the first two weeks.

2.5. Sample collection

*Candida albicans* colonization was assessed in both groups with the concentrated oral rinse technique. Such assessment made prior to the denture insertion and every 3 months from denture delivery up to six months.

3. Sample preparation

1. Screwcap tubes were sterilized in B class autoclave unwrapped 132°C (270°F) 3 min.
2. One ml of saline was added in each screw cap tube for sample dilution and enhancing cells isolation.
3. Oral swabs were collected using sterile swab sticks and swabbing ten times from the labial and the buccal vestibule underneath the denture base with the help of a dry sterile cotton stick.
4. Samples in screw cap tubes were centrifuged at 3500 rpm for 15 min.
3.1. Candida albicans microscopic examination

(Bausch and Lomb Optitme Balplan 31.32.13 Binocular Microscope) has been used for candidal identification. After incubation for 24–48 h at 22 °C, the streaks were examined microscopically, through the cover slip, using a low power objective. Along such streaks, Candida albicans appeared with characteristic pseudohyphae. Fig (3).

4. Results

4.1. Comparison between groups

Preoperative: Median candida was 56 (32, 80) for group A and 13 (8, 96) for group B and this was not statistically significant (P = 0.567).

4.2. Post three months

Median candida was 88 (56, 184) for group A and 40 (24, 48) for group B and this was not statistically significant (P = 0.142).

4.3. Post six months

Median candida was 140 (128, 216) for group A and 56 (40, 64) for group B and this was statistically significant (P = 0.011) (Table 1).

Data for Candida albicans are presented in table (1) and figure (4).

5. Discussion

To eliminate the effect of age changes on the oral microbial flora balance, the age of all subjects selected ranged between 40 and 60 years having class IV Kennedy classification with no partial denture experience to avoid incidence of Candida presence. Patients with systemic

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Median and quartile range for comparing Candida level for the tested groups (Group A and Group B).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Candida</td>
<td>Group (A)</td>
</tr>
<tr>
<td>CFU/ml</td>
<td>Median</td>
</tr>
<tr>
<td>Pre-operative</td>
<td>56</td>
</tr>
<tr>
<td>Post 3 months</td>
<td>88</td>
</tr>
<tr>
<td>Post 6 months</td>
<td>140</td>
</tr>
</tbody>
</table>

P ≤ 0.05 is significant, comparing 2 groups at different time points, Mann Whitney test was used.

Culture media: Sabouraud Dextrose Agar (SDA) is a selective medium primarily used for the isolation of fungi and yeasts. Fig (1G) and (2G).

Fig. 3. Showing light microscopic picture showing Candida albicans (pseudohyphae, blastospores, chlamydomspores x400 magnification).

Fig. 4. Boxplot representing candida level in the two groups. (Group A and Group B).
diseases such as, diabetes mellitus, anaemia and immunodeficiency have been excluded as they were reported to cause imbalance of the oral microbial flora and to adversely affect tissue tolerance, resulting in increased mucosal inflammation with the use of dentures.

Candida albicans was the only strain investigated in this study, because it has been found to be the most prevalence of all Candida species, both in healthy and diseased oral cavities Also, and it has been reported to be the most pathogenic member of Candida species, capable of adhering to epithelial cells and acrylic surfaces causing infection [7].

Oral rinse technique was employed in this study, this technique was selected because it is simple, rapid, sensitive and direct for monitoring the degree of colonization of Candida albicans on dentures that could be correlated with the clinical findings [7,8].

Sabouraud Dextrose Agar (SDA) has been used in this study for Candida albicans isolation as the acidic pH of this medium (pH about 5.0) inhibits the growth of bacteria but permits the growth of yeasts and most filamentous fungi [8].

The results of this study revealed an increase in both the frequency of Candida albicans carriers and the density of Candidal colonization after denture use in all the studied groups, but in different degrees. The increase of Candidal count is due to the fact that denture insertion causes changes in the ecology of the oral cavity and provides a saprophytic environment, which encourages Candida albicans growth [9,10].

The prevalence of Candidal colonies was found to be greater in the salivary samples collected after the insertion of (Sabilex) acetal resin base compared to that after insertion with (TCS iFlex) nylon resin base, this might be attributed to surface roughness of a polymethyl methacrylate acetal in comparison with polyamide denture base material is much higher. This might be due to the high crystallinity of the acetal resins which provide excellent material properties (the higher the crystallinity in a plastic, the harder it will be) thus promoting more adhesion of microorganisms and plaque accumulation as it was proved by other studies [11,12].

The monomers composition producing the network is a major factor in determining the extent of degradation, especially when enzymes are responsible. Various esterases that have been proved to be present in saliva can cause esterification of methacrylates, the effect of enzyme degradation on mechanical properties has been manifested as reduction in the surface hardness [13,14].

6. Conclusions

The results obtained from this study revealed that:
• Both (nylon and acetal based) partial denture bases have the affinity to support Candida albicans growth.
• The nylon partial denture base material has less affinity to Candida albicans colonization than acetal denture base material.

References