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CLINICAL INDICES OF IMPLANT SUPPORTED THERMOPLASTIC MANDIBULAR OVERDENTURE VERSUS CONVENTIONAL ACRYLIC WITH BALL AND SOCKET ATTACHMENT

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ABSTRACT

Aim of this study was to evaluate influence of thermoplastic denture base material on plaque index and depth of gingival sulcus of implants supported mandibular overdenture. Patients and methods: Twenty completely edentulous patients were selected according to inclusion and exclusion criteria that affect implant success. Two implants were implanted in the interforaminal area of mandible following the two stages surgical protocol; patients were grouped into two groups Group I (TPG) patients received a complete mandibular overdenture constructed of thermoplastic poly amide denture base material and Group II (HCG) patients received a complete mandibular overdenture constructed of conventional heat cured acrylic resin, both groups are retained by ball and socket attachment system. Plaque index and depth of gingival sulcus were measured for each group after overdenture construction and every three months interval for 24 months. One-way ANOVA with post hoc turkey test was used for multiple time comparison. Results: the mean value of pocket depth between 2 groups [TPG - HCG] at different period has no statistically significant difference but statistically significant at a period of twenty four month <0.001* *P*-value. plaque index show statistically significant <0.001* *P*-value at all different periods. Conclusion: thermoplastic denture base overdenture has a superior benefit than conventional heat cured type as it give longevity of supported implant by enhancing peri-implant gingival health with reduced pocket depth and plaque index.

KEYWORDS: Plaque index. Pocket depth, thermoplastic overdenture, Implant supported overdenture, ball and socket.

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INTRODUCTION

In completely edentulous ridges, implant-supported overdentures are considered the first treatment option over conventional dentures. When compared to conventional dentures, the use of two implant-supported overdentures improved outcomes for edentulous patients. Reduced residual ridge resorption, improved masticatory muscle function, and improved retention and support of prostheses all resulted in improved quality of life, function, and overall health. The superstructure is the portion of the implant restoration that penetrates the protective border of the peri-implant mucosa and is permanently exposed to oral biofilm colonisation. As significant transmission of microorganisms between teeth and implants has been demonstrated, different surface materials facilitate biofilm formation differently, and multi-species biofilms formed on the superstructure can serve as a reservoir for peri-odonto-pathogens that re-colonize the submucosal implant surface. has been revealed As a result, this clinical study was carried out to assess the effect of thermoplastic denture base material on plaque index and gingival sulcus depth of implants supported mandibular overdenture. The null hypothesis in this study is that after 3, 6, 9, 12, 18, and 24 months of use, the periodontal condition and microbiological status of thermoplastic mandibular overdenture with ball and socket attachment will be similar to conventional acrylic mandibular overdenture. This study's null hypothesis was that there were no differences in clinical indices between implant supported thermoplastic and conventional acrylic mandibular overdentures with ball and socket attachment.

MATERIAL AND METHODS

Twenty completely edentulous patients were selected from the clinic of Removable prosthodontics department, Faculty of Dental Medicine Al Azhar University. All patients were selected according to the following inclusion criteria: Male patient aged between 50-70 years, class I jaw relationship, normal tongue size and behaviour and with adequate inter-arch space.

According to ethical committee of Faculty of Dental Medicine Al Azhar University a written consent explaining all surgical and prosthetic steps, merits and demerits of the treatment was taken from each patient. History taking, extra and intraoral examination, and radiographic evaluation were done for each patient. Preoperative cone beam computerized tomography (CBCT) was done for each patient guided by radiographic stent before implant placement for accurate determination of height and width of bone and size of the proposed implant at specific sites.

Patients grouping:

Patients were grouped into two groups.

Group I (TPG): (n =10) patients were received a thermoplastic complete mandibular overdenture (polyamide).

Group II (HCG): (n =10) patients were received a conventional heat cured acrylic resin complete mandibular overdenture.

Treatment plan:

Surgical procedures of implant placement were done following two-stage surgical protocol guided by surgical guide stent; two implants (Dentist, South Korea. 10 mm x Ø 3.7 mm) were inserted in the interforaminal region of the mandible; Three months after first stage surgery the second stage surgery was done to expose implant fixture then ball attachment (male part) was fixed to implants.

Thermoplastic complete denture was constructed for Group I and conventional heat cured acrylic resin complete denture was constructed for Group II with metallic socket (female part) attached to the fitting surface of the tried lower denture before injection of thermoplastic material for Group I and before

packing of acrylic resin for Group II to get sure that it is accurately attached to the fitting surface of the dentures.

The finished mandibular implants supported over dentures were inserted into patient's mouth and get sure that they are seated normally in its place without interference, checked for retention and occlusion, final adjustments were done and patients were instructed how to wear and remove the overdenture, clean it, maintain plaque control protocol and then patients follow up was carried out.

Measurements

Pocket depth (Depth of gingival sulcus): The depth of the gingival sulcus was measured around each implant using a graduated periodontal probe. This probe was inserted between the oral sulcular epithelium and the implant with minimal pressure. The distance from the tip of the probe and the free gingival margin was measured and recorded to the nearest millimeter. Four reading were recorded at the middle of the four surfaces, buccal, lingual, mesial, and distal. The mean of the four readings was considered as the pocket depth for this group at the chosen time

Plaque index:

Amount of plaque accumulation was graded from (0 to 3) where:

Grade 0: No plaque detected by passing the side of probe along the implant.

Grade 1: Film of plaque detected by probing.

Grade 2: Moderate accumulation of soft debris, which can be seen by the naked eye.

Grade 3: Too much soft matter within the sulcus, gingival margin and adjacent implant surface.

For each group, four readings were recorded at the middle of the four surfaces, buccal, lingual, mesial, and distal. The mean of the four readings was considered as the plaque index for this group at the chosen times.

Statistical Analysis

Numerical data were explored for normality by checking the distribution of data and using Kolmogorov–Smirnov test of normality. Data showed normal (parametric) distribution. Data were presented as mean and standard deviation (SD) values. Independent *t*-test was used to compare between two groups. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM SPSS© Statistics Version 20 for Windows.

RESULTS

The data for pocket depth in millimeter of group I and group II was collected and statistically analyzed and expressed by using Mean value ± SD, then compared with Independent *t*-test and the significance level was set at $P \leq 0.05$.

Table 1 showing the scores of the Mean value of pocket depth of Group I (TPG) at the baseline after 3, 6, 9, 12, 18 and 24 months ranged 1.78, 2.2, 2.1, 2.1, 2.1 and 1.75 respectively with mean (±standard deviation SD 0.32 , 0.11, 0.45, 0.25, 0.12, and 0.45 respectively. [*Figure 1*]

Controversy, the scores of the Mean value of pocket depth of Group II (HCG) at the baseline after 3, 6, 9, 12, 18 and 24 months ranged 2.12, 2.2, 2.1, 2.1, 2.1 and 2.1 respectively with mean (±standard deviation SD 0.45 , 0.56, 0.91, 0.69, 0.25, and 0.12 respectively. [*Figure 1*]

When comparing the mean value of pocket depth between 2 groups [TPG - HCG] at different period after 3, 6, 9, 12 and 18 months with independent t-test, the results showing 1.95, 0.0, 0.0, 0.0 and 0.0 respectively with no statistically significant difference but statistically significant at a period of twenty four month $<0.001^{*}$ *P*-value. [*Table 1*]

For plaque index, the data of group I and group II was collected and statistically analyzed and expressed by using Mean value ± SD, then compared with Independent *t*-test and the significance level was set at $P \leq 0.05$.

Table 2 showing the scores of the Mean value of plaque index of Group I (TPG) at the baseline after 3, 6, 9, 12, 18 and 24 months ranged 1.56, 1.61, 1.41, 1.38, 1.18 and 1.18 respectively with mean (±standard deviation SD 0.58, 0.25, 0.78, 0.87, 0.25, and 0.34 respectively. [*Figure 2*]

Controversy, the scores of the Mean value of plaque index of Group II (HCG) at the baseline after 3, 6, 9, 12, 18 and 24 months ranged 2.31, 2.51, 2.31, 2.26, 2.12 and 2.13 respectively with mean (±standard deviation SD 0.58, 0.64, 0.56, 0.12, 0.36, and 0.42 respectively. [*Figure 2*]

When comparing the mean value of plaque index between 2 groups [TPG – HCG] at different period after 3, 6, 9, 12, 18 and 24 months with independent t-test, the results showing 2.891, 4.142, 2.964, 3.169, 6.782, and 5.559 respectively with Statistically significant <0.001* *P*-value at all different periods. [*Table 2*]

TABLE (1): The mean values of pocket depth in millimeter between test groups p ≤ 0.05

Pocket depth	Mean of pocket depth		t	p
Time	(Group I (TPG (n=10)	Group II (HCG) (n=10)		
Three months	±0.32 1.78	±0.45 2.12	1.947	0.067
Six months	2.2±0.11	2.2±0.56	0.0	1.000
Nine months	2.1±0.45	2.1± 0.91	0.0	1.000
Twelve months	2.1±0.25	±0.69 2.1	0.0	1.000
Eighteen months	±0.12 2.1	2.1±0.25	0.0	1.00
Twenty four months	1.75±0.45	2.1±0.12	2.377*	*0.029

Data was expressed by using Mean ± SD. ***t: Student t-test***
p: p value for comparing between the two studied groups ****: Statistically significant at p ≤ 0.5***

TABLE (2): The mean values of plaque index between test groups

Plaque index	Mean of plaque index		t	p value
Time	(Group I (TPG (n=10)	Group II (HCG) (n=10)		
Three months	1.56 ± 0.58	2.31 ±0.58	2.891*	*0.009
Six months	±0.25 1.61	±0.64 2.51	4.142*	*0.001
Nine months	1.41 ± 0.78	2.31 ±0.56	2.964*	*0.008
Twelve months	1.38 ± 0.87	±0.12 2.26	3.169*	*0.005
Eighteen months	1.18 ±0.25	2.12 ± 0.36	6.782*	*0.001>
Twenty four months	±0.34 1.18	2.13±0.42	5.559*	*0.001>

Data was expressed by using Mean ± SD. ***t: Student t-test***
p: p value for comparing between the two studied groups ****: Statistically significant at p ≤ 0.5***

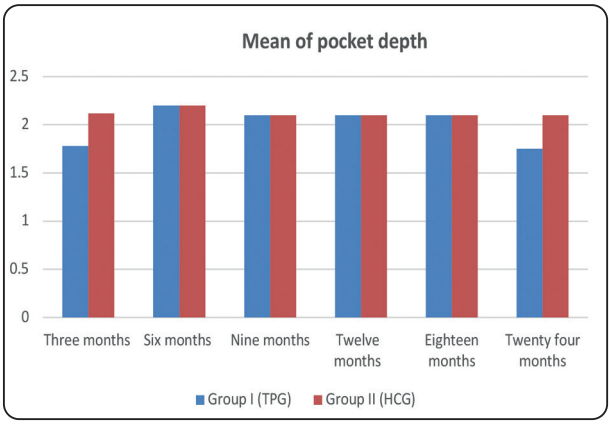

Fig. (1) The mean values of pocket depth in millimetre between test groups $p \leq 0.05$

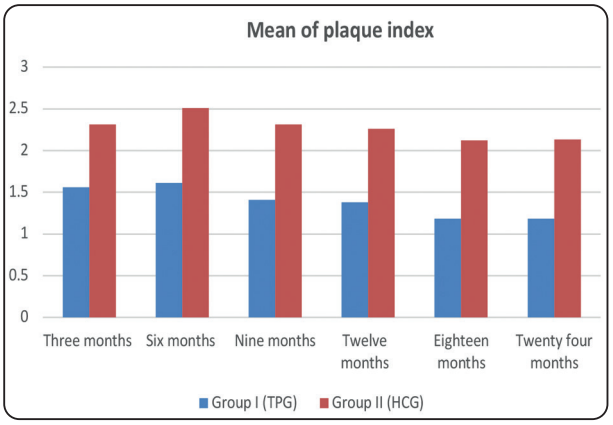

Fig. (2) The mean values of plaque index between test groups

DISCUSSION

In the case of an overdenture, it's crucial to keep in mind that implants only mimic natural teeth and that the implant-mucosa-bone lacks cementum and periodontal ligament, as well as less blood vessels and fibroblasts, a parallel orientation of the supracrestal connective tissue, and a location for attachment that makes the implant structures more vulnerable to the development of inflammation and bone loss when exposed to plaque accumulation or microbial invasion. [14]

The pathophysiology of peri-implantitis and implant loss is thought to be heavily influenced by microbial adherence and the buildup of pathogenic biofilms. [15] Due to the anatomical differences in the tissues, a more pronounced inflammatory response is seen in the peri-implant mucosal tissues than in the dentogingival unit (vascularity and fibroblast-to-collagen ratios). [16]

Danser et al. discovered a connection between the bacteria detected in colonised clinically healthy implant fixes in totally edentulous subjects and the microbiota associated with healthy periodontal sites in periodontally healthy individuals. [17] As a result, the gum tissue around dental implant attachments is crucial to the implant's long-term effectiveness; knowing this may help the dentist select the ideal design for implant attachment beneath the overdenture prosthesis. [18]

Single attachments like the ball, O-ring, or locater attachment may be the best choice for people who struggle with dental hygiene because of their greater accessibility. Furthermore, Takanashi et al. calculated that the construction of a mandibular overdenture held by implants with ball attachments did not need much more time than the standard method. Increased gingival and peri-implant tissue inflammation, including gingivitis and peri-implant mucositis, are linked to higher plaque ratings. Peri-implant mucositis was found in 48% of implant cases in a 9–14 year follow-up study of implant patients, and 13.3% of implants had a 3–4 thread drop in bone level. [22]

The cross-sectional investigation by Grischke et al. demonstrated that the kind of superstructure affects the prevalence of peri-implantitis. [23, 24] The usual base material for dentures is ordinary acrylic resin that has been heat-cured. Due to its advantageous characteristics, such as better elasticity and higher moulding precision than heat cured base resins, thermoplastic polymers have gained attention as a denture base material recently. These properties reduce the stresses on the ridge bone, abutment teeth, or implant as well as facilitate denture

retention by way of utilising the available undercuts in accordance with the denture base design. By closely adapting to the supporting tissues and engaging undercuts, a flexible acrylic resin can act as a cushion during functional motions to distribute forces and improve denture retention. [25-29]

Additionally, different superstructures might offer various physicochemical conditions. For instance, removable dentures (RDs) expose the implant to vigorous colonisation when not worn, but when worn, they create a thin, tightly closed chamber that is probably conducive to the quick development of anaerobiosis. Additionally, decreased saliva flow can affect how biofilms grow. [30, 31]

This study's data collection and analysis revealed a statistically significant difference between the effects of thermoplastic and hard heat-cure acrylic resin overdentures on periodontal health. These data were evaluated, and the study's findings were indicated that, In comparison to soft acrylic cure resins and cast denture foundation, the hard heat cure polymethyl methacrylate denture base resins demonstrated more adherence of microbial cells. Therefore, using soft denture bases for patients who are entirely edentulous would be much more comfortable, satisfied, and kept in addition to having a lower incidence of dentures stomatitis. [32]

The heat-cure polymethyl methacrylate exhibits significant porosity, high water absorption, volumetric changes, and residual monomer, according to Negrutiu et al. [33] Previous results of group II (HCG) may be due to tissue surface of the denture being considered as an irregular surface as it typically shows micro pits and micro porosities that harbour microorganisms that are difficult to remove by mechanical methods. This may be due to the difference in the degree of roughness and surface texture of the materials.

While polished with a traditional laboratory approach, polyamide denture base material reportedly grew smoother than PMMA when employing the same polishing procedure, according to Abuzar et al. However, after ordinary polishing by lathe, the polyamide surface roughness was clinically acceptable and far within the approved range. This idea explains the study's findings because group I's (TPG) denture surface was smoother, which prevented plaque buildup and thus resulted in a lower plaque index on the implant. [34]

It has numerous advantages over traditional hard denture bases. Elastic dentures are available, and their bases are fully installed in the undercut region. The degree of intended modification at the time of denture delivery will be significantly lowered, and that reduction will continue after wearing prosthetics, according to reports that the impact was promoted. Flexible materials can be solid, malleable, and soft, and they can also be synthetically thin in thickness and lighter in component weight than traditional dentures. Using flexible denture base materials allows for the creation of overlay dentures with a substitutional nature that have the optimum flange thickness and height. [35, 36]

The temperature rise and washing action of saliva below the dentures are additional factors that favour bacterial growth. The degree of denture retention and the rise in temperature beneath the dentures are directly related. The higher the temperature and the less the saliva's cleaning impact, the better the retention. However, from the patient's perspective, retention was better when using soft heat cured acrylic resin dentures. However, it appears that the dentures' fitting surface is more sanitary, which is why it outweighs the effect of the elevated temperature under the dentures on the development of bacteria. [32]

Respecting the time and follow up, the statistical data of this study calculated that, the pocket depth and plaque index are significantly different toward the acrylic resin base material. These noted the roughening of the acrylic denture surface.

CONCLUSION AND RECOMMENDATION

The hard heat cure polymethyl methacrylate denture base resins showed more adherence of microbial cells compared to thermoplastic denture base resins. So the use of thermoplastic denture bases for completely overdenture patients with ball and socket attachment would be much comfort, satisfied and retained in addition to less dentures stomatitis and periodontal disease. The thermoplastic denture base overdenture has a superior benefit than conventional heat cured type as it give longevity of supported implant by enhancing the peri-implant gingival health with reduced pocket depth and plaque indices.

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