IMPACT OF MARGINAL CONTACT OF REMOVABLE ACRYLIC PARTIAL DENTURES ON PERIODONTAL PARAMETERS

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ABSTRACT
AIM  
To assess the periodontal parameters, plaque score, bleeding on probing, probing pocket depth, gingival recession and loss of attachment of teeth in contact with removable partial dentures and to compare them with teeth in the contra lateral side of the same arch not in contact with the acrylic resin base.

METHODS
Sample consisted of 46 partially edentulous patients. Maxillary acrylic partial dentures which were designed as the gingival margin of two teeth on one side of the arch was in contact with the acrylic resin base (control side). The same teeth on contra lateral side of the arch were kept relieved from the denture base. Initial periodontal assessment with plaque score (PLS), bleeding on probing (BOP), probing pocket depth (PPD), gingival recession (GR) and loss of attachment (LOA) was carried out. All patients were periodontally assessed after denture insertions.

RESULTS
Measurements for periodontal parameters were increased significantly at 3 and 6 months of denture wearing in the control side. The changes of all parameters in the test side were not significant.

CONCLUSIONS
Acrylic partial dentures tend to adversely affect periodontal parameters when teeth are in contact with resin base. This effect is increased with longer duration of RPD wear.

KEY WORDS: bleeding on probing, periodontal parameters, plaque score, probing pocket depth, removable partial dentures

INTRODUCTION

Removable partial dentures (RPDs) are considered a widely accepted means of replacing missing natural teeth thereby restoring function and aesthetics in partially edentulous patients.1 Although other options are available, such as fixed prosthesis and implant-retained-overdentures, RPDs still play a major role in prosthetic rehabilitation owing to financial issues, patient compliance and residual height of edentulous ridges.2,3 In South East Asian countries such as Sri Lanka, RPDs are still considered the main treatment modality for replacement of missing teeth.

Since RPDs are at least partially supported/retained by remaining natural teeth, various studies have been carried out in order to assess their effects on periodontal health, especially plaque accumulation, gingival inflammation, mobility, pocket depth and bone loss.4,5 Carlsson et al in their 4-year longitudinal study investigated abutment teeth associated with partial dentures, found an
increased incidence of gingival inflammation, deepened gingival pockets, mobile abutment teeth, alveolar bone loss and dental caries compared to the base line. 6 Yeung et al in their study of cobalt-chromium RPDs, reported a significant increase in the prevalence of plaque bacteria, gingivitis and gingival recession in and around the RPD abutment teeth, especially in areas within 3mm of the RPDs. 7 However, in other studies, patients with RPDs have reported only marginal inflammation. 8,9

It has been established that a critical feature of removable prostheses is the relationship of acrylic resin denture bases to the gingival margins of RPD abutment teeth. 10 One study concluded that gingival areas covered by RPDs, without relief, show the most adverse periodontal reactions clinically and histologically, uncovered the least affected. 11 Another study included assessment of periodontal parameters, plaque index, gingival index, probing pocket depth, gingival recession and mobility in relation to teeth in direct contact with the acrylic base of prosthesis. 12

Although there are many studies available in the literature regarding the detrimental effects of RPDs on periodontal health and parameters, 6,7,12-14 one included the teeth in the same arch as the test and controls. 10. Therefore, the purpose of this study was to assess the periodontal parameters, plaque score, bleeding on probing, probing pocket depth, gingival recession and loss of attachment of teeth in contact with denture base of RPDs and to compare them with teeth in the opposite side of the same arch not in contact with the denture base. The null hypothesis for this study is that there will be no significant differences between teeth in the same arch with contact or no contact with RPD base, subjected equally to factors contributing to retention of plaque, bleeding on probing and loss of attachment. Side of the maxillary arch in contact with the denture base was considered as the experimental variable.

METHODS

The initial group of the study consisted of 46 patients at the Department of Prosthetic Dentistry, University of Peradeniya, Sri Lanka during the year of 2009. The sample size, determined with a power of 80%, was doubled initially to allow for patients lost to follow-up at the end of 6 months. The group at the end of 6 months consisted of 10 males and 12 females between the ages of 21 and 43 years. The mean age of the study sample was 28.3 years. Patients were educated and informed about the difference between both sides of the denture base and requested to report any experience of discomfort. Written consent was obtained prior to clinical procedures.

Parameters were defined for the actual sample in order to minimize confounding factors that could otherwise significantly affect the data and results. Patients were selected for inclusion in the study if they met the following criteria:
1. Absence of significant medical history, i.e. neither diagnosed with any medical condition nor taking any medication on a regular basis;
2. Non-smokers;
3. Fewer than four maxillary teeth missing;
4. Complete mandibular dentitions

Prior to prosthetic treatment, all necessary dental treatment and restorations were completed. These included oral hygiene instructions, full mouth scaling and polishing and root surface debridement of teeth with probing pocket depth of 4-7 mm under local anaesthesia, and surgical root surface debridement of teeth with probing pocket depths greater than 7 mm with open flap procedures under local anaesthesia. Restorative treatment including correction of overhanging restorative margins, endodontic treatment and restorations were also carried out.

The prosthetic treatments associated with acrylic resin partial dentures were carried out by the principal investigator to avoid inter-examiner variability. Maxillary partial dentures were designed in such a way that the gingival margins of two teeth on one side of the arch were in contact with the acrylic resin denture bases (control side). The contra lateral teeth had no contact with the acrylic resin denture bases (test side) (6 x 10mm in bucco-lingual and mesial/distal dimensions. Therefore the peripheral margins of one side (right/left) of the denture bases did not contact the gingival margins of the teeth (e.g.: right side of the denture base in the premolar region in fig.1). The denture base on the contra lateral side was designed to contact the gingival margins of the teeth (e.g.: left side of the denture base in fig.1 contact with premolars). Assignment of arch to test/control group was randomized prior to patient examination.

All patients were educated and advised on denture maintenance procedures with demonstrations. They were advised to brush
the dentures and to keep them out of mouth (in water of room temperature) every night after cleaning. Dentures were routinely evaluated in every visit for plaque, stains and deposits and were cleaned accordingly. The importance of denture hygiene was reinforced on each visit.

Initial periodontal assessments were accomplished prior to fabrication of the partial dentures. All patients were recalled at 2 week, 3 month and 6 month intervals after denture insertions. Similar readings were obtained at each visit. Periodontal assessments at each visit were accomplished by the principal investigator to avoid inter-examiner variability. Intra-examiner variability was ascertained by re-examining 10% of the measurements on a particular session. During the follow up period, all patients were given standard maintenance care with advice on plaque control according to the criteria for maintenance care adhered to by the Division of Periodontology, Faculty of Dental Sciences.

Plaque (PLS) and bleeding scores (BOP) were calculated by measuring distopalatal, midpalatal and mesiopalatal aspects of test and control teeth. The average value was considered as a percentage of total number of teeth surfaces. The readings for pocket depths (PPD) and gingival recession (GR) were recorded on the palatal aspects of test and control teeth. Three readings were made for each tooth i.e., mesio-palatal, mid-palatal and disto-palatal, the mean pocket depths were considered to be the score. Probing pocket depths were measured to the nearest millimetre from the gingival margin to the base of the pocket using a periodontal probe (University of Michigan “O” with William marking diameter tip 0.5mm) placed parallel to the long axis of the tooth. PPD of each site was categorized into less than or equal to 3mm (≤3mm) and more than 3mm (>3mm). A similar procedure was carried out for gingival recession (GR), except that the measurements were recorded from the gingival margins to the cemento-enamel junctions. The mean values obtained for PPD and GR of a corresponding tooth were totalled to obtain the mean value for attachment loss (LOA) of a given tooth. GR was considered as less than or equal to 1mm and more than 1mm (≤1mm and >1mm). LOA was noted to be less than or equal to 3mm (≤3mm) and more than 3mm (>3mm).

All study related procedures were approved by the Ethics Review Committee at the Faculty of Dental Sciences, University of Peradeniya. (Approval number: FDS-RERC/2009/02/MJAYAS 1)

Statistics

Paired t test was used to compare data related to plaque scores in pre op test and control. Two-way repeated Measures Analysis of Variance Test was used for comparison data related to plaque scores and bleeding scores in pre op, 2 weeks, 3 months and 6 months in test/control groups.

Multiple comparisons for plaque scores and bleeding scores were carried out.

All Pair wise Multiple Comparison Procedures were used to compare data between baseline, 2 weeks, 3 months and 6 months within the same group (e.g.: to compare data between baseline, 2weeks, 3 months and 6 months in plaque score test group).

Chi-square was used to compare data related to probing pocket depths, loss of attachment and gingival recession in test and control sides of pre treatment. McNemar test was used to compare PPD, LOA and GR between baseline, 2weeks, 3 months and 6 months on test and control sides. The level of significance was p<0.05. The differences between initial values of the test and control sides (PT-t vs. PT-c) were compared.

RESULTS

Although 46 patients received the prosthetic treatment, only 22 patients returned for follow up 6 months post RPD placement. Thus, 48% of the patients who received RPD returned for follow-up. Baseline measures (PT) for the initial group and follow up group were compared; no significant difference was noted.

The difference between PT values of test and control sides for all parameters was not statistically significant.

Table 1 shows the distribution of plaque scores for the test and control sides at each visit (pre-prosthetic treatment, 2 weeks, 3 months and 6 months post RPD insertion respectively). A general trend regarding an increase in PLS for the control sides was noted as the duration of RPD wear increased.

The changes associated with PLS for 2 weeks post RPD placement were not significant. A statistically significant difference was found on control side between baseline values and at 3
months and 6 months post RPD insertion. [53.5% (p>0.05) and 66.64% (p<0.001) at 3 months and 56% (p>0.05) 78.77% (p<0.001) at 6 months respectively].

The frequency of distribution of BOP, test versus controls, at each visit is shown in Table 2. The difference at 2 weeks' recall was not significant. However, data for 3 months and 6 months recall were 29.77% and 32.65% for the test sides and 40.18% and 44.15% for the control sides, demonstrated a statistically significant difference in the latter side.

Table 3 shows the frequency distribution of PPD in relation to the test and control sides. The percentages of sites with PPD ≤ 3mm and ≥ 3mm were clearly defined. It was 0%, 0%, 2% and 4% for the PPD >3mm for the test sides for pre prosthetic treatment, 2weeks, 3 months and 6 months recall visits, whereas 3%, 3%, 21% and 46% for the control sides respectively during similar visits. Although 2 weeks recall data does not show a significant difference in PPD more than 3mm between test and control sides, data for 3 months and 6 months show a highly significant difference in the control side with p<0.001.

Table 4 contains data in relation to LOA considering percentage of sites with less than or equal to 3mm and more than 3mm. They were 0%, 0%, 2% and 6% of LOA more than 3mm for the test side and 1%, 6%, 24% and 79% for the control side during pre prosthetic treatment, and at the 2 week, 3 month and 6 month recall visits respectively. The 3 and 6 months recall data show a significant difference in LOA more than 3 mm in the control side (p<0.001) whereas no such significant difference was observed in the test side.

The values for GR are shown in Table 5. The values in the test side were 25%, 23%, 27% and 32% for GR => 1mm for the test side and the relevant values for the control side were 46%, 55%, 66% and 82% respectively. Data for the 3 month and 6 month recall shows a significant increase in the percentage of sites with GR =>1 mm in control side.

DISCUSSION

Although there are numerous studies in the literature regarding the relationship between RPDs and periodontal health, no papers have been published specifically regarding the Sri Lankan population. Sri Lanka differs from its neighbouring South Asian countries due to its medium-level socioeconomic status, availability of government based free health care and educational facilities. Therefore, such a study would also facilitate one aspect of the cost effectiveness of education and oral health care provided mostly free of charge by the government.

Out of the sample of 46 patients, only 48% remained for follow up at the end of 6 months. Other studies have also experienced similar difficulties regarding long term follow up of prosthetic patients. The selection criteria used in this study attempted to reduce confounding factors associated with systemic and environmental considerations such as smoking and the use of other protheses. Use of the same patient as test and control minimized the individual differences.

Categorization of teeth in contact and not in contact with RPDs is considered to be an established method to study possible effects of denture wearing on oral health. Various studies have investigated the factors that might be related to occurrence of plaque, calculus accumulation and gingival inflammation, changes in PPD, tooth mobility and GR on abutment and non abutment teeth in patients wearing RPDs.

Studies by Bergman, Bates & Addy, McHenry& Johannsen et al, and Brill & Tryde et al have shown that partial dentures in the mouth increase plaque formation particularly, as shown by Ghamrawy, on tooth surfaces in contact with the partial dentures. The results of this study also confirmed this by demonstrating significant increases in plaque score on teeth in contact with denture bases 3 months and 6 months post denture wearing. Bissada et al (1974) concluded that gingival areas covered by parts of RPDs without relief demonstrated the most adverse periodontal reactions both clinically and histologically, whereas the uncovered areas were the least affected. The most severe gingival changes were seen in areas where an acrylic resin denture base covered the gingival margins. Based on the data in the present study, the authors propose that a distance of 5 to 6 mm be maintained from the gingival margins for all RPD components. Findings from the present study support those from a 1994 study by Yusof and Isa, who reported a significant increase in plaque index, gingival index and
LOA of teeth in contact with acrylic resin denture base of RPDs when compared with other teeth in the opposing arch not related to any prosthesis.  

Bissada, Ibrahim et al, Brill, Tryde et al and Stipho, Murphy et al have shown that coverage of marginal gingival tissues with RPDs enhances gingival inflammation around abutment teeth.  

This finding is confirmed by the present study as it demonstrated an increase in BOP on the side of RPD in contact with teeth at 3 and 6 months of denture wearing.  

In a 10 year retrospective study Kern & Wagner reported an increase in probing depth and tooth mobility in RPD wearers. Yeung et al in a clinical study with coball-chromium RPDs found that there were significant (p<0.001) increases in probing depths around teeth in contact with RPDs. Tawse-Smith, Rivillas et al compared the short term clinical effects of an experimental acrylic removable appliance. Their study revealed that the side of the arch in contact with acrylic resin base showed significantly higher gingival index scores and probing depth measurements during the 21 days of the study when contrasted with the side of the arch relieved from the acrylic resin bases. After the test prosthesis was discontinued, the PPD measurements returned to baseline levels or better on both sides. The authors concluded that there were potential irritant effects of various denture base designs on gingival tissues.  

The results of this study are compatible with the above studies that reported increased findings regarding PPD, GR and LOA in teeth in contact with RPDs. Multiple authors have suggested simpler designs, less tissue coverage and frequent recalls for all patients. A number of clinical studies have concluded that proper plaque control in RPD wearers depend on strict recall and optimal personal oral hygiene. It is suggested that a denture base kept well relieved from the gingival margin with regular denture and periodontal maintenance will improve periodontal health in RPD wearers.  

CONCLUSION  

Removable acrylic resin partial dentures tend to adversely affect periodontal parameters when teeth are in contact with resin base. This effect is increased with longer duration of RPD wear. Therefore, it is recommended to keep the dentures well relieved (at least 6x10mm) from the gingival margin wherever possible.  

REFERENCES  


Table 1 - The frequency distribution of PLS in test and control sides of denture - percentage of sites with comparison between each recall appointment – significance is tested to baseline or within baseline.

<table>
<thead>
<tr>
<th></th>
<th>PT (Baseline)</th>
<th>2 Weeks</th>
<th>3 Months</th>
<th>6 Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test (t) side</td>
<td>53.77%</td>
<td>48.50%</td>
<td>53.05%</td>
<td>56%</td>
</tr>
<tr>
<td>*Group p value (test side)</td>
<td>P &gt; 0.05</td>
<td>P &gt; 0.05</td>
<td>P &gt; 0.05</td>
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<tr>
<td>Control (c) side</td>
<td>51.50%</td>
<td>54.50%</td>
<td>66.64%</td>
<td>78.77%</td>
</tr>
<tr>
<td>*Group p value (control side)</td>
<td>P &gt; 0.05</td>
<td>P &lt; 0.001</td>
<td>P &lt; 0.001</td>
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</tr>
<tr>
<td>#Initial p value</td>
<td>P &gt; 0.05</td>
<td></td>
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</tbody>
</table>

PT = Pre treatment
*comparing the differences in percentages between baseline and relevant follow up appointment
#comparing the difference between test and control sides at baseline
Table 2 - The frequency distribution of BOP in test and control sides of denture - percentage of sites with comparison between each recall appointment

<table>
<thead>
<tr>
<th></th>
<th>PT (Base line)</th>
<th>2 Weeks</th>
<th>3 Months</th>
<th>6 Months</th>
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<tbody>
<tr>
<td><strong>Test (t) side</strong></td>
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<td></td>
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<tr>
<td>PT</td>
<td>24.27%</td>
<td>26.50%</td>
<td>29.77%</td>
<td>32.65%</td>
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<tr>
<td><em>Group p value(test side)</em></td>
<td>P&gt;0.05</td>
<td>P&gt;0.05</td>
<td>P&gt;0.05</td>
<td>P&gt;0.05</td>
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<tr>
<td>Control(c)side</td>
<td>23.27%</td>
<td>30.91%</td>
<td>40.18%</td>
<td>44.15%</td>
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<tr>
<td><em>Group p value(control side)</em></td>
<td>P&gt;0.05</td>
<td>P&lt;0.001</td>
<td>P&lt;0.001</td>
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<tr>
<td>#Initial p value</td>
<td>P&gt;0.05</td>
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</table>

PT=Pre treatment
*comparing the differences in percentages between baseline and relevant follow up appointment
#comparing the difference between test and control sides at baseline

Table 3 - The frequency distribution of PPD in test and control sides –percentage of sites with comparison between each recall appointment

<table>
<thead>
<tr>
<th></th>
<th>PT (Base line)</th>
<th>2 Weeks</th>
<th>3 Months</th>
<th>6 Months</th>
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<tbody>
<tr>
<td><strong>Test (t) side</strong></td>
<td>&lt;=3mm</td>
<td>&gt;3mm</td>
<td>&lt;=3mm</td>
<td>&gt;3mm</td>
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<td></td>
<td>100%</td>
<td>0</td>
<td>100%</td>
<td>0</td>
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<td></td>
<td>100%</td>
<td>0</td>
<td>98%</td>
<td>2%</td>
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<tr>
<td></td>
<td>98%</td>
<td>2%</td>
<td>96%</td>
<td>4%</td>
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<tr>
<td><em>Group p value(test side)</em></td>
<td>P&gt;0.05</td>
<td>P&gt;0.05</td>
<td>P&gt;0.05</td>
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<tr>
<td>Control (c) side</td>
<td>&lt;=3mm</td>
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<tr>
<td></td>
<td>97%</td>
<td>3%</td>
<td>97%</td>
<td>3%</td>
</tr>
</tbody>
</table>

*Group p value(control side)

- P>0.05
- P<0.05
- P<0.001

#Initial p value

- P>0.05

PT=Pre treatment

*comparing the differences in PPD between baseline and relevant follow up appointment

#comparing the difference between test and control sides at baseline

Table 4 - The frequency of distribution of LOA in test and control sides – percentage of sites with comparison between each recall appointment

<table>
<thead>
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<th>6 Months</th>
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<tr>
<td>&lt;=3mm</td>
<td>100%</td>
<td>100%</td>
<td>98%</td>
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<tr>
<td>&gt;3mm</td>
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<td>2%</td>
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<td>&lt;=3mm</td>
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<td>94%</td>
<td>94%</td>
</tr>
<tr>
<td>&gt;3mm</td>
<td>6%</td>
<td>6%</td>
<td>6%</td>
</tr>
</tbody>
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*Group p value(test side)

- p>0.05
- p>0.05
- p>0.05

Control side

<table>
<thead>
<tr>
<th>&lt;=3mm</th>
<th>&gt;3mm</th>
<th>&lt;=3mm</th>
<th>&gt;3mm</th>
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<th>&gt;3mm</th>
<th>&lt;=3mm</th>
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<tr>
<td>99%</td>
<td>1%</td>
<td>94%</td>
<td>6%</td>
<td>76%</td>
<td>24%</td>
<td>21%</td>
<td>79%</td>
</tr>
</tbody>
</table>

*Group p value(control side)

- p>0.05
- P<0.001
- P<0.001

#Initial p value

- P>0.05
<table>
<thead>
<tr>
<th></th>
<th>PT (Base line)</th>
<th>2 Weeks</th>
<th>3 Months</th>
<th>6 Months</th>
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</thead>
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<td><strong>Test (t) side</strong></td>
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<td>0 mm</td>
<td>75%</td>
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<tr>
<td>=&gt;1mm</td>
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<td>=&gt;1mm</td>
<td>27%</td>
<td>=&gt;1mm</td>
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<td>=&gt;1mm</td>
<td>46%</td>
<td>=&gt;1mm</td>
<td>66%</td>
<td>=&gt;1mm</td>
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</table>

*Group p value(test side)*
- Test side: p > 0.05
- Control side: p > 0.05, p < 0.05, p < 0.001

#Initial p value
- P > 0.05

PT = Pre treatment
*comparing the differences in LOA between baseline and relevant follow up appointment
#comparing the difference between test and control sides at baseline