A split mouth comparative clinical evaluation of antimicrobial photodynamic therapy and open flap debridement surgery in the management of Aggressive periodontitis.- clinical study.

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ABSTRACT:

Aim: The randomized controlled clinical trial evaluated the effectiveness of non-surgical antimicrobial photodynamic therapy compared with the open flap debridement therapy in the treatment of patients with Aggressive periodontitis with a follow up of 6 months.

Materials and methods: In a split mouth design, 5 patients (2 males & 3 females) with aggressive periodontitis were treated with SRP+ aPDT (test group) and SRP + open flap debridement (control group). Antimicrobial PDT was applied on test side after the SRP using diode laser of 810nm and photosensitizer (methylene blue) and the control side was treated with
SRP + open flap debridement. All the clinical parameters were evaluated at baseline and after 6 months of the treatment.

**Result:** In deep periodontal pockets (PPD ≥5mm) the test group presented significant decrease in PPD similar to that of the open flap debridement group with the p<0.05 on the inter-group comparison no statistically significant differences were observed showing p>0.05.

**Conclusion:** In the treatment of Aggressive periodontitis patients, non-surgical aPDT presented significant results in reducing the periodontal pocket depth. Antimicrobial PDT could be used as treatment option over the invasive, traumatic and painful open flap debridement treatment as the differences in intergroup comparison does not show any significance.

**Key words:** Antimicrobial photodynamic therapy, aggressive periodontitis, photosensitiser.

**Introduction:**

Generalized chronic periodontitis is a rapidly progressing disease affecting the healthy individuals and it is characterized by a pronounced episodic and rapid destruction of periodontal tissue that may lead to early tooth loss.1,2

A. actinomycetemcomitans, P. gingivilis, Capnocytophaga, Eikenella corredens, P. intermedia, and Campylobacter rectus are being associated with aggressive periodontitis according to several studies.3 The conventional therapy in the management of aggressive periodontitis aims to eliminate the bacterial load of periodontal pockets, same as in the treatment of chronic periodontitis. Scaling and root planning being the most common periodontal treatment has proven the clinical effectiveness in terms of reducing the probing pocket depth, inflammation and improving the clinical attachment level(Haffajee et al 1997 )4.

Because of difficulty in assessing the deeper pockets, root concavities and furcation areas (Chava & Reddy 2015, Rabbani, Ash & Caffesse,1981)5 and difficulty in removing the microbial pathogens, that have penetrated dentinal tubules and those residing in the lacunae and concavities (Mombelli, Cionca & Almaghlouth 2011)6. It has led to practice of open flap
debridement therapy. In which the soft tissues can be detached for better access. (Heitz-Mayfield and Lang 2013)\(^7\).

The open flap debridement results in reduced pocket depth due to apical repositioning of the gingival margin, causing gingival recession, exposing root surface to the oral cavity\(^8\). The patient experiences pain and discomfort associated with the periodontal surgery\(^9\). To overcome the drawbacks or shortcomings of periodontal surgery it has led to the need for research into laser assisted periodontal therapy. In a systematic review conducted by Keestra et al., systemic antibiotics when given along with SRP showed significant effect in the treatment of aggressive periodontitis as compared to SRP alone\(^10\). However the efficacy of the systemic antibiotics is limited due to the bacterial resistance developed to the antibiotics\(^11\).

PDT (photodynamic therapy), being a novel non-invasive photochemical therapy for infection control, has emerged as an adjunctive to scaling and root planning\(^12\). The mechanism of PDT is based on two components. 1) The light source and 2) Photosensitizer. This photosensitizer gets activated in the presence of oxygen by light of specific wavelength, which further leads to the release of free radicals and singlet oxygen. The singlet oxygen produced in the process causes the destruction of the bacteria\(^13,14\). The bacterial resistance to this bactericidal action of PDT caused due to singlet oxygen is unlikely to develop. As the singlet oxygen produced causes destruction of bacteria by targeting the cellular contents\(^15,16\).

Each and every factor of PDT is harmless by itself, but when these combined they produce lethal cytotoxic agents that can selectively destroy cells. So, the PDT could be a promising alternative for reducing the bacterial load and destroying periodontal pathogen. Significant reduction in the viability of aerobic and anaerobic bacteria causing periodontitis has been revealed by various experimental studies using Helium/neon (He/Ne) laser or gallium aluminium arsenide laser, in combination with alternative photosensitizers\(^17,18\).
Various photosensitizers used are\(^1\)9:
- Acridine orange.
- Proflavin.
- Methylene blue.
- Ptholocyanines. Etc.

Invitro studies have reported the efficacy of methylene blue in bactericidal action against the potent periodontal pathogens such as A.actinomycetemcomitans, P.gingivalis, when combined and used with 810nm diode laser. Hence, the aim of this study was to compare and clinically evaluate the effectiveness of antimicrobial photodynamic therapy as compared to open flap debridement procedure.

**Material and methods:**

The study was designed as the randomized controlled trial of 6 months duration. The study included total of five subjects (2males and 3females) who were referred for treatment at the outpatient department of Periodontology, Saraswati Dhanwantari dental college and hospital Parbhani. Patients read and signed the informed consent and were included in the study. 36 intraoral sides with the pocket depth of ≥5mm were selected for the study and were randomly divided into two groups using the coin toss method. The groups were 1) Group A = PDT & 2) Group B = OFD.

Inclusion criteria:
- patients diagnosed with aggressive periodontitis.
- patients not on medication for 12 months prior to the treatment.
- probing pocket depth ≥5mm
- patients not allergic to the photosensitizer.

Exclusion criteria:
- patients undergone periodontal therapy for last 6 months.
- patients with any systemic diseases.
- history of present pregnancy.
Experimental design:
Before undergoing the study design all the subjects received full mouth supra and subgingival scaling, and proper home care technique instructions were given to all subjects. Randomization was done after the completion of instrumentation.

The clinical parameters assessed at baseline and 6 months post treatment were:
- plaque index (PI)
- Bleeding score using sulcular bleeding index by Muhlemann (1971) (BI)
- Probing depth (PD)
- Relative clinical attachment level (RAL)

Treatment procedure:
On one side the teeth were treated with antimicrobial photodynamic therapy (Figure 1) and on the other side or the other quadrant with open flap debridement surgery (Figure 2).

In group A (Test group) the methylene blue dye the photosensitizer liquid was applied with a blunt canula to the instrumented sites, starting from the apical end of the pockets and moving coronally. This avoids entrapment of any air bubble. After one minute of application of dye into the pockets, the pockets were thoroughly rinsed with sterile saline to remove excess photosensitizer. Soon after rinsing the pockets, the diode laser of 810nm wavelength and 0.8W of power output, equipped with a probe tip, was then placed at the base of the pocket and moved circumferentially around the tooth for 30 seconds. According to the instructions provided by the manufacturer. (Figure 1)

In group B (control group) on the other side the other side for open flap debridement procedure the treatment was carried out under local anaesthesia (2% lignocaine hydrochloride solution with adrenaline [1:80000]). After placing the intraclavicular incisions the flap was raised and granulation tissue was removed from the defects and roots were thoroughly scaled and planed. The control sites were then sutured with simple interrupted sutures. (Figure 2)
Post-operative instructions were given to the patient. No antibiotics were given, and patients were instructed to discontinue tooth brushing for the day of treatment, to avoid trauma to the treated site. 0.2% chlorhexidine gluconate mouthwash rinse was prescribed twice daily for one week.

Figure 1: Application of antimicrobial photodynamic therapy.

- a) 5mm pocket probing depth
- b) Application of methylene blue dye
- c) Irrigation with normal saline after one minute of application of methylene blue
- d) Irradiating the periodontal pocket with diode laser
- e) Methylene blue dye (photosensitizer) used.
Data collection:

The data was recorded at the baseline and at 6 months of the post treatment. The clinical measurement were taken at 6 points around every tooth.

1. mesiolingual
2. mesiofacial
3. facial
4. distofacial
5. distofacial
6. lingual.

Statistical analysis:

A software package [SPSS (statistical package for social sciences) version 17] was used for the statistical analysis. Wilcoxon signed Rank test was used to test the efficacy in group A and group B. The level of significance was taken at 5% $P < 0.05$. Man Whitney U test was used to compare between group A and group B.

Results:

The comparison of mean values was done at baseline and after 6 months of each parameter for the antimicrobial photodynamic therapy and open flap debridement.
groups. The results showed no statistically significant differences between two treatment groups with (P > 0.05).

Table 1. Plaque Index (PI):

<table>
<thead>
<tr>
<th>PI</th>
<th>Median</th>
<th>Wilcoxon Signed Rank W</th>
<th>P-Value</th>
<th>% Effect</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before Treatment</td>
<td>After Treatment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A</td>
<td>2</td>
<td>1</td>
<td>-2.236\textsuperscript{a}</td>
<td>0.025</td>
<td>45.5</td>
</tr>
<tr>
<td>Group B</td>
<td>2</td>
<td>1</td>
<td>-2.121\textsuperscript{a}</td>
<td>0.034</td>
<td>66.7</td>
</tr>
</tbody>
</table>

Since observations are on ordinal scale (gradations), we have used Wilcoxon Signed Rank test to test efficacy in Group A and Group B. From above table we can observe that P-Values for Group A and Group B are less than 0.05. Hence we conclude that effect observed in both Groups are significant.

Graph 1: Plaque Index graph showing results of before and after treatment for group A and group B.
Table 2. Bleeding Index (BI):

<table>
<thead>
<tr>
<th>BI</th>
<th>Median</th>
<th>Wilcoxon Signed Rank W</th>
<th>P-Value</th>
<th>% Effect</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before Treatment</td>
<td>After Treatment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A</td>
<td>2</td>
<td>1</td>
<td>-2.236&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.025</td>
<td>55.6</td>
</tr>
<tr>
<td>Group B</td>
<td>2</td>
<td>1</td>
<td>-1.841&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.046</td>
<td>70.0</td>
</tr>
</tbody>
</table>

Since observations are on ordinal scale (gradations), we have used Wilcoxon Signed Rank test to test efficacy in Group A and Group B. From above table we can observe that P-Values for Group A and Group B are less than 0.05. Hence we conclude that effect observed in both Groups are significant.

Graph 2. Bleeding Index graph showing results of before and after treatment for group A and group B.

BT: Before treatment.
AT: After treatment.
Table 3. Relative clinical attachment level.(RAL):

<table>
<thead>
<tr>
<th>RAL</th>
<th>Median</th>
<th>Wilcoxon Signed Rank W</th>
<th>P-Value</th>
<th>% Effect</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BT</td>
<td>AT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A</td>
<td>8</td>
<td>6</td>
<td>-2.032(^a)</td>
<td>0.042</td>
<td>31.6</td>
</tr>
<tr>
<td>Group B</td>
<td>7</td>
<td>5</td>
<td>-2.041(^a)</td>
<td>0.041</td>
<td>31.4</td>
</tr>
</tbody>
</table>

Since observations are on ordinal scale (gradations), we have used Wilcoxon Signed Rank test to test efficacy in Group A and Group B. From above table we can observe that P-Values for Group A and Group B are less than 0.05. Hence we conclude that effect observed in both Groups are significant.

Graph 3. Relative attachment level graph showing results of before and after treatment for group A and group B.

BT : Before treatment.
AT: After treatment.
Table 4. Probing depth (PD):

<table>
<thead>
<tr>
<th>PD</th>
<th>Median</th>
<th>Wilcoxon Signed Rank W</th>
<th>P-Value</th>
<th>% Effect</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>BT</td>
<td>AT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Group A</td>
<td>6</td>
<td>2</td>
<td>-2.060a</td>
<td>0.039</td>
<td>62.5</td>
</tr>
<tr>
<td>Group B</td>
<td>6</td>
<td>2</td>
<td>-2.041a</td>
<td>0.041</td>
<td>64.5</td>
</tr>
</tbody>
</table>

Since observations are on ordinal scale (gradations), we have used Wilcoxon Signed Rank test to test efficacy in Group A and Group B. From above table we can observe that P-Values for Group A and Group B are less than 0.05. Hence we conclude that effect observed in both Groups are significant.

Graph 4. Probing depth (PD) graph showing results of before and after treatment for group A and group B.

BT : Before treatment.
AT: After treatment.
For comparison between Group A and Group B, we have used Mann Whitney U test. From above table we can observe that P-Values for all parameters are greater than 0.05. Hence we conclude that there is no significant difference observed in effect of Group A and Group B.
Discussion:

The discovery of lasers and the studies done on their use in dental treatments has emerged as a newer treatment modality in the field of periodontics. The non-surgical antimicrobial photodynamic therapy (aPDT) approach has following over surgical open flap debridement therapy. These are minimal bleeding, instant sterilization of the surgical site, reduced bacteremia, least mechanical trauma, reduced post-operative swelling and scarring, reduced post-operative pain.

Data from the present study showed that there is no significant difference between the two groups for all the parameters evaluated. Though the intragroup comparison showed significant results for both the groups for all the parameters evaluated i.e. plaque index, bleeding index, relative clinical attachment level and probing pocket depth. The results of present study show effects of the non-surgical antimicrobial photodynamic therapy similar to those with the surgical treatment i.e. open flap debridement treatment in the management of aggressive periodontitis.

The improvement in the scores of PPD for aPDT got in this study are in accordance with the similar results obtained by (Chondros et al 2009, Christodoulides et al 2008). Superior results in all evaluated parameters were in favor of aPDT in the study done by (Braun et al 2008).

The benefits of non-surgical aPDT are more evident in the cases of advanced periodontitis. The inaccessible areas are not a problem with aPDT as , it can easily irradiate those inaccessible areas. Another advantage of aPDT over conventional therapy is that the bacterial resistance for reactive oxygen species which kills the bacteria, is highly unlikely to develop (Crispiano et al 2015, Wilson 2004). In conventional therapy there is increase in the bacterial resistance to the antibiotics. Also as the singlet oxygen produced in aPDT kills the tissue invading bacteria there is no or very little chances of relapse of the treatment, which is seen in the open flap debridement treatment.

The results from the present study shows the effectiveness of non-surgical aPDT and showed similar results to the open flap debridement therapy, which is an invasive and painful treatment option for the patients.
Conclusion:

The application of aPDT as adjunct to SRP was able to reduce PPD after the treatment with the follow up of 6 months. Results were similar to that of OFD except to the areas where sub gingival calculus was still persistent. So, aPDT could be the treatment option over the traumatic, invasive and painful open flap debridement therapy and in the cases where OFD is not possible (eg: OSMF patients with restricted mouth opening) for the patients with aggressive periodontitis.

Conflict of interest:

There is no conflict of interest in this study.

References:


