Treatment of experimental furcation perforations with mineral trioxide aggregate, platelet rich plasma or platelet rich fibrin in dogs' teeth

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A B S T R A C T

This work evaluates the effect of mineral trioxide aggregate (MTA), platelet rich plasma (PRP) or platelet rich fibrin (PRF) on healing of non-contaminated and contaminated furcation perforations. A total of 192 teeth of 12 dogs was divided into three equal groups according to evaluation period. Each group was further subdivided into MTA, PRP, PRF, negative and positive control subgroups. Each experimental subgroup was further subdivided according to perforation status into non-contaminated and contaminated subdivisions. Root canal therapy was carried out and furcation perforation was made in all teeth except in negative control subgroup. The furcation perforation was repaired immediately in subdivision (1) and after 4 weeks in subdivision (2). The change in vertical bone loss was measured by radiography. Inflammatory cell count, cemental deposition, new bone formation, bone resorption and epithelial proliferation were assessed. Both PRP and PRF demonstrated statistically significant reduction in vertical bone loss and inflammatory cell count than MTA. No significant difference was found between MTA, PRP and PRF in cemental deposition, new bone formation, bone resorption and epithelial proliferation. The non-contaminated teeth demonstrated better treatment outcomes than the contaminated teeth. In conclusion, PRP and PRF are successful treatment options for repairing of furcation perforation in both non-contaminated and contaminated teeth in dogs with superior outcomes in non-contaminated teeth.

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1. Introduction

Root perforation is a mechanical or pathological communication between the supporting periodontal apparatus and the root canal system. This communication compromises the health of the periradicular tissues and threatens the viability of the tooth (Duggins et al., 1994). Once an infection has established itself at the perforation site, prognosis for treatment is precarious and the complication may prompt extraction of the affected tooth (Corni and Gagliani, 2004).

Furcation perforation usually occurs during a search for a canal orifice. Therefore, it is usually accessible. Numerous materials have been used for furcation and root perforation repair but none was an ideal biomaterial (Samiee et al., 2010).

In several studies, mineral trioxide aggregate (MTA) has proved to be superior than most of the endodontic materials for repairing of furcation perforations due to its predictable periodontal ligament regeneration and cemental deposition (Holland et al., 2001; Hashem and Hassanien, 2008). However, extended setting time, poor handling and relatively high price are main disadvantages (Lysaght and Reyes, 2001; Ferris and Baumgartner, 2004; Tawfik et al., 2013; Nagy et al., 2014).

Platelet-rich plasma (PRP) is a composite of multiple endogenous growth factors which are able to enhance cell proliferation and differentiation (Anitua et al., 2007). It stimulates osteoblastic cells and the proliferation of periodontal ligament and inhibits epithelial cell proliferation (Okuda et al., 2003).

Platelet-rich fibrin (PRF) is described as a second generation platelet concentrate which has fibrin enriched with platelets and growth factors (Choukroun et al., 2006). Slow fibrin polymerization during PRF processing leads to the intrinsic incorporation of platelet cytokines and glycocalic chains in the fibrin meshes (Dohan et al., 2009).

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The aim of the present study was to evaluate the effect of MTA, PRP or PRF on healing of non-contaminated and contaminated furcation perforations in dogs' teeth by using radiographic and histologic examinations.

2. Materials and methods

This study was approved by the Ethical Committee at Faculty of Dentistry, Ain Shams University and Animal Use and Care Committee at Faculty of Veterinary Medicine, Cairo University, Egypt. All efforts were made to minimize animal suffering and to reduce the number of used animals. Three premolars and first molar teeth in each quadrant of 12 healthy mature mongrel dogs were used. These teeth were divided into 3 equal groups (64 teeth each) according to post-treatment evaluation time including; group I (one week), group II (one month) and group III (3 months).

Each group was subdivided into 3 experimental and two control subgroups according to the treatment protocol. These subgroups included; a (MTA), b (PRP), c (PRF), d (negative control) and e (positive control). Each experimental subgroup was further subdivided according to the perforation status into subdivision 1 (contaminated) and subdivision 2 (non-contaminated).

2.1. Anesthesia of the dogs

All dogs were premedicated with subcutaneous injection of atropine sulphate 0.05 mg kg⁻¹ body weight (Atropine Sulphate; Misr Co., Cairo, Egypt) and intramuscular Xylazine HCl 1.1 mg kg⁻¹ body weight (Xylaject; ADWIA Co., Cairo, Egypt). The anaesthesia was induced by intravenous Ketamine HCl 5 mg kg⁻¹ body weight (Ketamine hydrochloride; Rotexmedica Co., Tittau, Germany). The anaesthesia was maintained by 25 mg kg⁻¹ intravenous incremental doses of 2.5% solution of thiopental sodium (Thiopental sodium; Sandoz, Kundl, Austria).

2.2. Tooth instrumentation

Preoperative radiographs were taken and endodontic access opening was done in all experimental and positive control teeth. Extraction of the pulp tissue, instrumentation and irrigation of root canals with 2.5% sodium hypochlorite were performed. The canals were obturated with gutta-percha and Endofill sealer (Dentsply Hero, Petrópolis, Rio de Janeiro, Brazil).

2.3. Perforation creation

In subdivision 1 (non-contaminated), the access cavity was sealed with a temporary filling (Coltosol F: Coltosol Whaledent, Altstatten, Switzerland) without creation of furcation perforation. In subdivision 2 (contaminated), furcation perforation was carried out in experimental and positive control teeth using a # 4 round bur. The perforation length was limited to 1 by rubber stopper. The access cavity was left open for 4 weeks to induce infection. Then, postoperative radiographs were taken. For pain and infection control, the dogs were given intramuscular cefotaxime sodium at a dose of 10 mg kg⁻¹ and diclofenac sodium at a dose of 1.1 mg kg⁻¹ once/day for 5 days after surgery (Abu-Seida, 2012).

2.4. Treatment modalities

In subdivision 2 (radio) radiographs were taken to confirm bone resorption. Both access cavity and perforation were cleaned, curetted, irrigated with 2.5% sodium hypochlorite and then normal saline.

In subdivision 1 (C), removal of the temporary filling and creation of furcation perforation were done. In subgroup (a), ProRoot MTA powder (Dentsply Tulsa Dental, OK, and USA) was mixed, dispensed into the perforation canal with an amalgam carrier and condensed with small plugger.

In subgroups (b) and (c), pieces of PRP and PRF, respectively were used to repair furcation perforation. Mineral trioxide aggregate was used as a base over the pulp chamber floor and the access cavity was sealed with glass ionomer (Medifill: Promedica, Germany).

The teeth were left untouched in subgroup (d) and the access cavity was left open without repair in subgroup (e).

2.5. Radiographic evaluation

The radiographs were digitized using transparency scanner. Digital image file was converted into 32-bitt TIFF files using Image J software (Image J 1.47, NIH, USA). TurboReg plug-in was used to transform non-standardized radiograph into standardized images (Thevenaz et al., 1998). From the base line and follow up radiographs, the change in vertical bone loss was calculated and expressed in percentage according to the following equation:

\[
\text{percentage of bone loss change} = \frac{\text{follow up bone loss} - \text{base line bone loss}}{\text{base line bone loss}} \times 100
\]

2.6. Histological evaluation

According to the groups, the dogs were sacrificed by over dose of thiopental sodium. Each tooth with its surrounding bone was separated. Samples were fixed in 10% buffered formalin solution and decalcified for 8 weeks using formic acid-sodium citrate. Specimens were processed by conventional methods, sectioned at 4–6 μm, stained with hematoxyline and eosin and examined for the followings:

2.6.1. Inflammatory cell count

The average of inflammatory cell count of three representative microscopic fields were measured using image analysis software (Image J 1.47)(Holland et al., 2007).

2.6.2. Cemetal deposition

It was measured according to (Alhadainy et al., 1998) as follow: Score 0, 1, 2 and 3: absence, deposition of newly formed cementum on lateral walls of perforation or close to it, partial and complete newly formed cementum barrier respectively.

2.6.3. New bone formation

It was measured as followings (Alhadainy et al., 1998): Score 0: no osteoblasts or osteoid. Score 1: slight osteoblastic rimming with no osteoid. Score 2: moderate osteoblastic rimming with some osteoid. Score 3: heavy osteoblastic rimming with abundant osteoid.

2.6.4. Bone resorption

It was measured as followings (Alhadainy et al., 1998): Score 0 and 1: absence and presence of epithelial proliferation, respectively.

2.6.5. Epithelial proliferation

It was evaluated as followings (Alhadainy et al., 1998): Score 0 and 1: absence and presence of epithelial proliferation, respectively.
2.7. Statistical analysis

Data were analyzed using SPSS (Statistical Packages for the Social Sciences 19.0, IBM, Armonk, NY, USA). Numeric data were analyzed by the Kruskal–Wallis nonparametric analysis of variance, Mann-Whitney test to identify differences between subgroups.

Friedman’s test was used to test the effect of evaluation period. Wilcoxon signed-rank test was used for pair-wise comparisons between time periods when Friedman’s test was significant. P value <0.05 was considered significant. Nonnumeric data were analyzed with Chi-square test, with the level of significance set at P ≤ 0.05.

3. Results

3.1. Radiographic findings

Data were collected and calculated in Table 1 and Fig. 1. No change in vertical bone loss was observed in all subdivisions of group I.

Subgroup (a) “MTA” demonstrated statistically significant lower mean percent of change in vertical bone loss than subgroups (b) and (c).

3.2. Histopathological findings

3.2.1. Inflammatory cell count

Data were collected and analysed in Table 2.

In all subdivisions of all groups, subgroups (b) “PRP” and (c) “PRF” showed statistical lower mean inflammatory cell count than subgroup (a) “MTA”.

3.2.2. Cemental deposition

Data were calculated and tabulated in Table 3 and Fig. 2a.

In group I, there was no new cemental deposition in all subgroups.

In all subdivisions of groups II and III, there was no significant difference between the experimental subgroups.

3.2.3. New bone formation

Data were collected and analysed in Table 4 and Fig. 2b.

No significant difference was found in mean score of bone formation among experimental subgroups in all groups.

3.2.4. Bone resorption

Data were collected and analysed in Table 5 and Fig. 2c. There was no significant difference in mean score of bone resorption between experimental subgroups of all groups.

3.2.5. Epithelial proliferation

Data were collected and analyzed in Table 6 and Fig. 2d. There was no significant difference between the experimental subgroups in all groups.

4. Discussion

Furcation perforation is an important complication of endodontic treatment and different treatment modalities have been used for the repair of perforations (Fuss and Trope, 1996; Hassanien et al., 2015).

The present study was designed to compare “MTA” as a well-established repair material with “PRP” as a natural scaffold holding growth factors (in gel form) and “PRF” as a natural scaffold holding growth factors (in fibrin clot form). Both radiographic and histologic evaluations were used to overcome the limitations of each method.

The PRF preparation requires collection of blood without anticoagulant, one centrifugation and combining of fibrinogen with thrombin to form a fibrin clot in which growth factors, platelet cytokines and cells are trapped. The PRP preparation requires collection of blood with anticoagulant, two centrifugations, induced polymerization of the platelet concentrate using thromboplastin and coagulation of the plasma using calcium chloride. Although both PRP and PRF are platelets concentrates, the simplified processing technique makes PRF superior to PRP.

The dogs were used in this study because the root furcations provide good accessibility and visibility and their teeth have well developed roots (El Ashry et al., 2013, 2016). In addition, the dogs’ teeth allow suitable room for perforation. In dogs, the furcation is often as close as 1–2 mm from the cementoenamel junction however, it lies more deeply within the alveolus in humans. Therefore, any technique demonstrated a good results in dogs may have a more favorable response in humans (Yildirim et al., 2005).

Additionally, this study was designed to assess the immediate and delayed perforation repair. In non-contaminated subdivision the perforation repair was done at the time of perforation creation to reduce the factors effecting on treatment outcomes. In contaminated subdivision, the access cavity was left open for 4 weeks to induce periodontal pathosis.

In PRP and PRF subgroups, MTA was used as a base material on pulp chamber floor above the repair material because MTA is the most known biocompatible and sealing material therefore it is less likely to interact with the biologic constituents of PRP and PRF (Hashem and Hassanien, 2008).

There was no change in the mean percent of vertical bone loss after one week due to the short time to develop bony changes (Jorge et al., 2008). In contaminated experimental teeth, vertical bone loss was evident at time of treatment due to infection and delayed repair (ElDeeb et al., 1982). In contaminated experimental teeth, there were significant differences in mean percent of change

<table>
<thead>
<tr>
<th>Subgroups</th>
<th>MTA</th>
<th>PRP</th>
<th>PRF</th>
<th>Positive control</th>
<th>Negative control</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Contaminated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 week</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>1.000</td>
</tr>
<tr>
<td>1 month</td>
<td>1.5 ± 0.9b</td>
<td>1.3 ± 0.7b</td>
<td>1.6 ± 0.5b</td>
<td>15.6 ± 1.4a</td>
<td>0 ± 0a</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>3 months</td>
<td>1.8 ± 0.7b</td>
<td>1.6 ± 0.5b</td>
<td>2.0 ± 0.8b</td>
<td>19.8 ± 2.1a</td>
<td>0 ± 0a</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Contaminated</td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>1 week</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>1.000</td>
</tr>
<tr>
<td>1 month</td>
<td>−17.9 ± 1.5b</td>
<td>−35.1 ± 5.1a</td>
<td>−32.8 ± 2.5a</td>
<td>15.6 ± 1.4a</td>
<td>0 ± 0d</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>3 months</td>
<td>−34.5 ± 2.6b</td>
<td>−57.5 ± 3.7a</td>
<td>−53.6 ± 2.9d</td>
<td>19.8 ± 2.1c</td>
<td>0 ± 0d</td>
<td>&lt;0.001*</td>
</tr>
</tbody>
</table>

Different letters in the same raw are statistically significant different according to Mann-Whitney test.

Numbers with negative sign indicate that there is a reduction in vertical bone loss.

* Significant at P>0.05.
in vertical bone loss between groups I and II and groups II and III. This indicates that, there was a continuous improvement in hard tissue healing induced by MTA, PRP and PRF.

In contaminated experimental teeth, PRP and PRF subgroups of groups I and II showed a significant higher reduction in vertical bone loss than MTA subgroup. This may be attributed to the non biodegradable nature of MTA. On the other hand, PRP and PRF act as biodegradable scaffolds that guide new tissue regeneration into the defect (Albanese et al., 2013).

Regarding inflammation in group I, it ranged from moderate to severe in non-contaminated samples and severe in contaminated samples. These findings may be attributed to the inflammatory reaction of the periodontal tissues to the repair materials.

**Table 2**
The mean inflammatory cell count among different subgroups. Results are given as mean ± SD.

<table>
<thead>
<tr>
<th>Subgroups Groups</th>
<th>MTA</th>
<th>PRP</th>
<th>PRF</th>
<th>Positive control</th>
<th>Negative control</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Contaminated</td>
<td>1 week</td>
<td>529 ± 69b</td>
<td>441 ± 53b</td>
<td>413 ± 51c</td>
<td>11.4 ± 2.7d</td>
<td>795 ± 116c</td>
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<td></td>
<td>1 month</td>
<td>336 ± 53b</td>
<td>234 ± 29b</td>
<td>250 ± 50c</td>
<td>10.6 ± 2.3d</td>
<td>644 ± 65c</td>
</tr>
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<td></td>
<td>3 months</td>
<td>134 ± 52b</td>
<td>60 ± 13d</td>
<td>91 ± 18c</td>
<td>8.5 ± 2.1d</td>
<td>626 ± 117c</td>
</tr>
<tr>
<td>Contaminated</td>
<td>1 week</td>
<td>741 ± 58b</td>
<td>641 ± 48b</td>
<td>580 ± 54c</td>
<td>11.4 ± 2.7d</td>
<td>795 ± 116c</td>
</tr>
<tr>
<td></td>
<td>1 month</td>
<td>462 ± 43b</td>
<td>344 ± 57b</td>
<td>371 ± 47c</td>
<td>10.6 ± 2.3d</td>
<td>644 ± 65c</td>
</tr>
<tr>
<td></td>
<td>3 months</td>
<td>205 ± 68b</td>
<td>119 ± 26b</td>
<td>140 ± 38c</td>
<td>8.5 ± 2.4d</td>
<td>626 ± 117c</td>
</tr>
</tbody>
</table>

Different letters in the same raw are statistically significant difference according to Mann-Whitney test.

* Significant at P>0.05.
Table 3
Score of cemental deposition among different subgroups. Results are given as mean ± SD.

<table>
<thead>
<tr>
<th>Subgroups Groups</th>
<th>MTA</th>
<th>PRP</th>
<th>PRF</th>
<th>Positive control</th>
<th>Negative control</th>
<th>P-value</th>
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<tbody>
<tr>
<td>Non-Contaminated</td>
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<tr>
<td>1 week</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>1.000</td>
</tr>
<tr>
<td>1 month</td>
<td>1.25 ± 0.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.88 ± 0.6&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.62 ± 0.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>&lt;0.001&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>3 months</td>
<td>2.12 ± 0.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.50 ± 0.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.38 ± 0.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.007</td>
</tr>
<tr>
<td>Contaminated</td>
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<td></td>
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<tr>
<td>1 week</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>1.000</td>
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<tr>
<td>1 month</td>
<td>0.38 ± 0.2&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.62 ± 0.3&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.88 ± 0.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.025&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>3 months</td>
<td>0.88 ± 0.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.38 ± 0.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.25 ± 0.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.005</td>
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</table>

Different letters in the same raw are statistically significant difference according to Mann-Whitney test.
* Significant at P > 0.05.

Fig. 2. (a) HE stained histological section of furcation perforation of non-contaminated subgroup IIb showing complete cemental bridge Magnification: 40×.

Table 4
Score of new bone formation among different subgroups. Results are given as mean ± SD.

<table>
<thead>
<tr>
<th>Subgroups Groups</th>
<th>MTA</th>
<th>PRP</th>
<th>PRF</th>
<th>Positive control</th>
<th>Negative control</th>
<th>P-value</th>
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<tbody>
<tr>
<td>Non-Contaminated</td>
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<tr>
<td>1 week</td>
<td>0.50 ± 0.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.75 ± 0.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.88 ± 0.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.016</td>
</tr>
<tr>
<td>1 month</td>
<td>1.62 ± 0.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.00 ± 0.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.75 ± 0.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>&lt;0.001&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>3 months</td>
<td>2.25 ± 0.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.75 ± 0.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.62 ± 0.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>&lt;0.001&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Contaminated</td>
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<tr>
<td>1 week</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>0 ± 0</td>
<td>1.000</td>
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<tr>
<td>1 month</td>
<td>0.75 ± 0.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1.12 ± 0.3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.75 ± 0.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.012&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>3 months</td>
<td>1.5 ± 0.5&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.12 ± 0.6</td>
<td>1.75 ± 0.7&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0 ± 0&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.003&lt;sup&gt;3&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Different letters in the same raw are statistically significant difference according to Mann-Whitney test.
* Significant at P > 0.05.
In all groups, MTA demonstrated significant higher inflammatory cell count than PRP and PRF. These findings may be attributed to the autologous nature and anti-inflammatory potential of PRP and PRF (Choukroun et al., 2006). Also, an existing evidence suggests that platelets may play roles in antimicrobial host defense (Drago et al., 2013).

In MTA, PRP and PRF subgroups, there was a significant reduction in inflammatory cell count in group II compared to group I and group III compared to group II. Similar findings were reported before (Yildirim et al., 2005).

As regards mean score of cemental deposition, there was no significant difference between MTA, PRP and PRF subgroups. This is in contrast with the other studies, in which MTA was compared with resin-modified glass ionomer (RMGI), amalgam, Super-EBA, Dycal, and tricalcium phosphate (TCP). This could be explained by the inability of these materials to induce cemental bridge (Yildirim et al., 2005). The ability of PRP and PRF to form cemental bridge is due to the presence of growth factors.

No significant difference was found between MTA, PRP and PRF subgroups in formation of new bone, however, PRP and PRF subgroups showed higher scores of bone formation than that of MTA subgroup. This could be attributed to the healing potential of PRP and PRF (Albanese et al., 2013).

Regarding bone resorption, higher scores were demonstrated in contaminated subgroups than non-contaminated subgroups of all groups due to the pronounced inflammatory response resulted from the induced infection.

Although no statistical significant difference was found between MTA, PRP and PRF subgroups in bone resorption, PRP and PRF subgroups showed lower scores than MTA subgroup. Because PRP and PRF can reduce the inflammatory response and improve healing by releasing growth factors (Dohan et al., 2009).

Contaminated subdivision demonstrated higher prevalence of epithelial proliferation than non-contaminated subdivision. This is in consistence with Torres et al. (1994) who stated that the lesions open to oral environment can lead to epithelial proliferation.

5. Conclusion

In conclusion, both PRP and PRF are successful treatment options for repairing of furcation perforation in both non-contaminated and contaminated teeth with superior outcomes in non contaminated teeth.

Conflict of interest

None.

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References


Dohan ED, de Peppo GM, Doglioli PG, Sammartino G. Slow release of growth factors and thrombospondin-1 in Choukroun’s platelet-rich fibrin (PRF): a gold


