Abstract

Introduction: Propolis is a resinous substance produced by honeybees. Despite antimicrobial properties, tooth discoloration has been reported during its application as intracanal medicament. The aim of this study was to assess the effect of intracanal propolis removal on crown discoloration. Methods: In this experimental study, after access cavity and canal preparation was performed in 40 intact anterior teeth, they were divided into three groups. In group 1 propolis was placed in the canal and pulp chamber while in group 2, it was applied into the canal only. The canals of third group were filled with distilled water as control. After six months, labial surfaces of all teeth were digitally photographed by a digital camera. Propolis was then completely removed and photography was repeated. Tooth color was evaluated in the labial surface using CIE Lab system and Photoshop software. Results: Overall color change (ΔE), change in lightness (ΔL), greenness-redness (Δa) and blueness-yellowness (Δb) were analyzed. ΔL and Δa values were significantly different in all three groups (P<0.001). The difference between groups 1 and 2 was not significant for ΔL or Δa, but groups 1 and 3 were significantly different in ΔL and Δa (P<0.001). Groups 2 and 3 were significantly different in ΔL and Δa (P<0.001). Conclusion: Coronal discoloration after six-month application of propolis as intracanal medicament was not reversed by its removal. Location of application of propolis (in the canal or both canal and pulp chamber) had no significant effect on degree of coronal discoloration.

Keywords: Intracanal medicaments, Propolis, Root canal, Tooth discoloration

Received 6 February 2021 and Accepted 10 March 2021

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inflammation and cell necrosis in its clinical application(12). Thus, researchers have been searching for more efficient medicaments for endodontic treatment with minimum toxicity and maximum antibacterial activity.

Propolis is a resinous substance produced by honeybees. Its appearance and properties may vary depending on the origin(13). This substance is used by the honeybees to seal small gaps in the beehives or mummify the insects invading beehives. Also, due to having optimal disinfecting and antimicrobial properties, propolis can protect the honeybee colony from diseases(14). Several studies have evaluated the antibacterial and antifungal effects of propolis on resistant microorganisms and reported satisfactory results (15, 16). It has been reported that flavonoids present in propolis may induce the formation of reparative dentin. Moreover, propolis has less disruptive effect on fibroblast’s activity (17, 18). On the other hand, flavonoids cause staining(19). The only study found on discoloration during application of propolis as intracanal medicament reported clinical discoloration of tooth crown at different time of applications(20). However, it was not evident whether this change of color was temporary or permanent. Thus, this study aimed to assess whether removal of propolis from the root canal system would reverse initial coronal discoloration or not.

Materials and Methods

This is an in-vitro experimental study that was approved in the ethics committee of Shahid Beheshti University of Medical Sciences. Forty sound extracted human anterior teeth with no caries, restorations, developmental defects, enamel cracks or external developmental defects, enamel cracks or external discoloration with straight roots were randomly divided into two experimental (n=15) and one control (n=10) groups. Soft tissue residues, calculus and debris were removed by a curette. For the purpose of disinfection, all groups. Soft tissue residues, calculus and debris were removed by a curette. For the purpose of disinfection, all

Images were imported to a computer for computer software. In CIE L*a*b* system the L parameter indicates lightness, the a parameter indicates green-red and the b parameter indicates blue-yellow. Lightness, a and b parameters were assessed for each specimen in labial surface of tooth in images. The spectrum of Lab changes ranges from 0 to 255 in Adobe Photoshop CS5 software. In CIE L*a*b* system this spectrum range from 0 to 100 for lightness and from -120 to +120 for a
and b. The Lab values were converted to the CIE Lab system by following formula:
\[ b^* = b - 128, \quad a^* = a - 128, \quad L^* = L \times 100 / 255 \]

\[ \Delta E^* \] was the total color change in the range of 0-100 and was calculated using the formula below (23):
\[ \Delta E^* = [(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2]^{1/2} \]

The Lab parameters for each tooth color along with color change (\(\Delta E^*\)) were entered.

**Statistical analysis**

The Lab parameters for tooth color along with the color change (\(\Delta E^*\)) were entered in version 16 of SPSS software. According to the Shapiro-Wilk test, distribution of \(\Delta E^*\) data was normal in the three groups (P value; group A=0.350, group B=0.149, group C=0.758). One-way ANOVA was applied to compare the mean \(\Delta E^*\) among the three groups.

Due to the abnormal distribution of the variances of \(\Delta L, \Delta a\) and \(\Delta b\) in three groups using Levene test (P<0.05), Kruskal-Wallis non-parametric test was used to compare the groups in terms of these components. Mann-Whitney non-parametric test was also used to compare pairwise groups. The confidence level was considered 95% and P value<0.05 was considered statistically significant.

**Results**

Table I show mean \(\Delta E\) in the three groups. The results showed that the three groups were not significantly different in terms of \(\Delta E\) (P=0.149).

<table>
<thead>
<tr>
<th>Group*</th>
<th>Number</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean± SD</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group A</td>
<td>15</td>
<td>1.17</td>
<td>13.66</td>
<td>6.23±0.93</td>
<td>0.149</td>
</tr>
<tr>
<td>Group B</td>
<td>15</td>
<td>0.81</td>
<td>11.86</td>
<td>5.19±0.89</td>
<td></td>
</tr>
<tr>
<td>Group C</td>
<td>10</td>
<td>0.88</td>
<td>7.17</td>
<td>3.64±0.61</td>
<td></td>
</tr>
</tbody>
</table>

* Group A: Propolis in the canals and pulp chamber, Group B: Propolis in canals, Group C: Control

Table II shows mean \(\Delta L\), \(\Delta a\) and \(\Delta b\) values in the three groups. Surveys revealed no significant difference among three groups in terms of \(\Delta b\) (P=0.057). However, the difference among groups was significant for \(\Delta L\) and \(\Delta a\) (P<0.001). No significant difference was observed between groups 1 and 2 for \(\Delta L\) (P=0.461) or \(\Delta a\) (P=0.683). However, groups 1 and 3 were significantly different in terms of \(\Delta L\) and \(\Delta a\) and groups 2 and 3 were significantly different in terms of \(\Delta L\) and \(\Delta a\) (P<0.001 for all four).

**Discussion**

Discoloration of teeth, particularly in the anterior teeth, following application of intracanal medicaments during endodontic treatment is a common concern for patients and dentists (24, 25). Propolis as an intracanal medicament, similar to calcium hydroxide, with advantage of easy retrieval from tooth canal by rinsing the canal with sodium hypochlorite and using a endodontic file (25). But since propolis is produced by honeybees, its composition and physical, chemical and

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biological properties may vary depending on the origin of plants and may have different colors (26). Therefore, considering the variability in color of propolis due to its origin, different results may be obtained in terms of coronal discoloration by using different types of propolis. However, considering similar overall chemical composition of propolis, the results of this study applies to various types of propolis. This study assessed coronal tooth discoloration six months after application of 30% propolis as an intracanal medicament and evaluated the effect of its removal on discoloration.

Visual assessment and electronic instruments are the two main methods for assessment of tooth discoloration. Several studies have compared these two methods. Visual assessment has the highest measurement error, and electronic instruments have been reported to be more accurate than human eye (27). In the current study, digital photography and assessment of the CIELab color parameters were performed to determine color change; this method has been used in previous studies (28, 29).

Krastl et al (30), in their review study showed that all endodontic materials cause tooth discoloration. Therefore, in order to decrease the risk of discoloration, they should be used with caution in the esthetic region. In the current study, all teeth showed discoloration compared to the control group.

In the current study, similar to that of Kim et al (31), coronal access cavity was prepared for placement of propolis as intracanal medicament, to simulate the clinical setting. In contrast, previous studies prepared canals through an apical access cavity, which is different from clinical setting (32, 33).

Kim et al. (31) evaluated the effect of Ledermix as intracanal medicament on tooth color and showed that less discoloration occurred when Ledermix was placed in the root canal to the level of the cementoenamel junction compared to when Ledermix was placed in the entire root canal and the pulp chamber. However, in the current study, location of placement of propolis (in the canal or in the canal and pulp chamber) caused no significant difference in lightness (L), greenness-redness (a) or blueness-yellowness (b) color parameters. This controversy in the results of the two studies may be due to the physical and chemical differences of propolis and Ledermix and greater penetration depth of propolis into the dentinal tubules. Also, using ethanol for cleaning of pulp chamber can enhance penetration of propolis into the tubules. The constituents of propolis such as flavonoids and minerals such as iron can be responsible for the discoloration, and use of ethanol can enhance their penetration depth (20).

Kontogiannis et al. (34) evaluated the effect of calcium hydroxide and calcium hydroxide mixed with chlorhexidine on tooth discoloration and revealed that lightness (L) value in both groups significantly increased compared to the control group, which was in agreement with our findings. According to Kontogiannis et al. the time of remaining of intracanal medicament in the root canal is more important than the kind of medicament in causing discoloration(34). Nevertheless in the past study about propolis, the discoloration ability was shown(20).

One of the strengths of the current study was evaluation of discoloration immediately after removal of propolis from the canal. Previous study showed crown discoloration during application of propolis, but it was not clear if it was due to the shadow of that dark material in site which can be disappeared after its removal. Our results indicated that no change in color parameters occurred after removal of propolis from the canal. Stability of discoloration may be attributed to the penetration of propolis into the dentinal tubules and the inability to completely eliminate it from the tooth structure due to its resinous and sticky nature (35).

**Conclusion**

Despite significant antimicrobial properties of propolis, application of propolis as an intracanal medicament can cause clinical discoloration in tooth crowns that does not diminish with medicament removal. Covering the inner walls of pulp chamber with resin or flowable composite in addition to complete removal of propolis from the pulp chamber can be beneficial. Further assessments are required to determine the pattern of discoloration and ways to prevent it.

**Conflicts of interest:**

None declared

**Acknowledgment:**

None

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