SUMMARY:

The purpose of the study is to compare microleakage after root end resection of the two materials (MTA and Biodentine) for two different apical cavity preparation using the method of penetration of dye - 0.2 % Rodamine B. Materials and Methods: Forty-eight extracted single-rooted human teeth were used in this study. The resection was made at 3 mm from the root tip with a high speed diamond bur at an angle of 90 degree to the long axis of the tooth. For the retrofilling, ProRoot MTA and Biodentine were used. The teeth were divided into 5 groups: 1st group (10 teeth) – the apical cavity was prepared with stainless steel fissure bur #10 at 3 mm depth in the root canal parallel to the long axis of the tooth and is filled retrograde with MTA, 3rd group (10 teeth) - retrofilling with Biodentine, 2nd group (10 teeth) - with a round bur apical cavity was prepared with a concave shape and cavity along the root canal with a depth of 3 mm and retrograde obturation with MTA, 4th group (10 teeth) - retrofilling with Biodentine, 5th group (8 teeth) - control group - with preparation of the cavity after resection without retrofilling. The outer surface of the root is covered with two layers of varnish, with the exception of the apical 3 mm then immersed in 0.2% Rodamine B for 72 h. The degree of penetration of the dye is measured in millimeters. Results: Relative highest median value of penetration of the dye in mm is in the control group. MTA group has a higher value in mm versus the Biodentine. The apical preparation with a concave shape and cavity along the root canal with a depth of 3 mm after apicoectomy is important to reduce apical microleakage. Conclusion: Different apical cavity preparations in both types of material have led to the microleakage dye, but to varying degrees.

Key words: apical microleakage, bevel angle, Biodentine, endodontic surgery, root-end filling materials, MTA

INTRODUCTION

In cases, when healing process in peri-radicular tissues does not occur after conventional endodontic treatment or it is impossible to carry out re-treatment, apicoectomy is needed to implement in order to eliminate the root apex and apical lesions which are the source of infection [1-4]. Endodontic surgery involves four critical steps in elimination of persistent endodontic pathogens: 1. Surgical removal of the pathological tissues of the periapical area. 2. Resection of the root tip 3. Apical root canal preparation. 4. Retrograde filling of the root canal [5].

Kim and Kratchman [8] reported that resection of 3 mm root tip reduced the apical ramification to 98% and lateral canals to 93%. In conventional techniques the resection is at an angle of 45 or 30 degrees. In modern techniques 0 - 10 degrees resection is recommended, which reduces the number of exposed dentinal tubules [2, 6, 7, 8].

Root-end cavity preparation is an important procedure in periapical surgery. In conventional techniques, the apical preparation was performed with a round bur [1, 6, 7]. In our country no comparative studies for microleakage in different from traditional apical preparation after root tip resection have been carried out so far.

The primary goal in apical resection is to perform a hermetic sealing between the apical portion of the root canal and periapical tissue by retrograde root end filling. Many materials have been used for root-end fillings in endodontic surgery - amalgam, glass ionomer cements (Vitremer), zinc oxide-eugenol based materials (SuperEBA, IRM, Rickert), mineral trioxide aggregate - MTA, zinc - phosphate cements, calcium hydroxide cements (Sealapex, Sealer 26) sealer based on epoxy resins (AH 26, AH Plus) [6, 9, 10, 11, 12].

MTA is well known and studied material [4, 13, 14]. It has good biological compatibility as well as good sealing properties. Its drawbacks associated with its long setting time (170 min) and difficulties in its application are also familiar. Some new calcium-silicate materials that appear in recent years are trying to compensate for MTA disadvantages. One of these materials is Biodentine (Septodont, France). It has a reduced curing time (12-15 min) and better handling properties. The main difference between Biodentine and MTA is the absence of calcium aluminate and calcium sulphate in Biodentine formation. It is known that these compounds tend to reduce the mechanical strength and determine longer curing time, typically for MTA [13, 15, 16].

Biodentine is a relatively new material (since January 2011) and there have not been many studies and observations of its use in endodontic surgery up to now, which is why it was included in recent study.

The aim of the study is to compare microleakage after root end resection of the two materials (MTA and Biodentine) for two different apical cavity preparation using the method of penetration of dye - 0, 2 % Rodamine B.
MATERIALS AND METHODS

Forty-eight extracted single-rooted human teeth were used in this study. The resection was made at 3 mm from the root tip with a high speed diamond bur at an angle of 90 degree to the long axis of the tooth. For the retrofilling, ProRoot MTA and Biodentine were used. The teeth were divided into 5 groups:

First group (10 teeth) – the apical cavity was prepared with stainless steel fissure bur #10 at 3 mm depth in the root canal parallel to the long axis of the tooth (fig. 1a, fig. 2a) and is filled retrograde with MTA. (fig. 1b, fig. 2b).

Fig. 1 a. The apical cavity was prepared with straight fissure bur #10 at 3 mm depth in the root canal. b. Retrograde filling with ProRoot MTA. c. Retrograde filling with Biodentine

Second group (10 teeth) - with a round bur apical cavity was prepared with a concave shape and cavity along the root canal with a depth of 3 mm (fig. 3a, fig. 4a) and retrograde obturation with MTA fig. 3b, fig. 4b).

Fig. 3 a. The apical cavity was prepared with a round bur at 3 mm depth with a concave shape, b. Retrograde filling with ProRoot MTA, c. Retrograde filling with Biodentine
Fig. 4 View after apical resection a. After preparation of the root canal with round bur b. After retrograde filling with MTA.

Third group (10 teeth) - The apical cavity was prepared with straight fissure bur #10 at 3 mm depth in the root canal parallel to the long axis of the tooth. Retrofilling with Biodentine (fig 1c).

Fourth group (10 teeth) - The apical cavity was prepared with a round bur at 3 mm depth with a concave shape. Retrofilling with Biodentine (fig. 3c).

Fifth group (8 teeth) - control group - with preparation of the cavity after resection without retrofilling.

The outer surface of the root is covered with two layers of varnish, with the exception of the apical 3 mm, then immersed in 0.2% Rodamine B for 72 h. The teeth were washed under tap water for 24 h. The degree of penetration of the dye is measured in millimeters.

After this procedure, slices (fig. 5) were prepared by means of a microtom Leica SP 1600.

Fig. 5. The degree of dye penetration (a & b)

a. Presence of dye microleakage

b. Absence of dye microleakage

The data was input and processed using the statistical software package SPSS 19.0.1. The level of significance for rejecting the null hypothesis was fixed at p<0.05.

The following methods were applied: Graphical analysis – for visualizing the results obtained. Shapiro-Wilk test – to check the normality distribution. Mann-Whitney nonparametric test – for checking hypotheses of difference between two independent samples.

RESULTS

The results were present in tables 1 - 2 and figures 6 - 7.

The data analysis in tabl. 1 and fig. 6 show that:

• The average micro-leakage after apical resection was higher in treatment with straight fissure bur and steel in both materials (0.18 mm for MTA and 0.10 mm for Biodentine). While preparing the apical cavity with round bur and concave shape the average means are respectively - 0.08 mm for MTA and 0.07 mm for Biodentine.

• The average microleakage after apical resection was higher in MTA regardless of the methods of preparation (straight fissure bur - 0.18 mm, round bur - 0.08 mm).

• The difference was not statistically significant (tabl.1 and fig. 6) as in this case p>0.05 despite the higher difference estimated in mathematical value for MTA.
Tab. 1: Comparative analysis of microleakage after apical resection by two different apical preparation of two materials (MTA and Biodentine)

<table>
<thead>
<tr>
<th>Retrograde cavity</th>
<th>MTA</th>
<th>Biodentine</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>X</td>
<td>SD</td>
</tr>
<tr>
<td>Straight fissure bur</td>
<td>10</td>
<td>0,18</td>
<td>0,16</td>
</tr>
<tr>
<td>Round bur</td>
<td>10</td>
<td>0,08</td>
<td>0,09</td>
</tr>
</tbody>
</table>

Fig. 6: Comparative analysis of the impact of the type used in filling both methods of preparation on microleakage after apical resection

The average micro leakage after apical resection in the control group was greater (3.06 mm) than that of all other groups constituted according to the way of the processing and filling. The differences have significant character (table 2. and fig. 7.)

Table 2. Comparative analysis of microleakage after apical resection by two different apical preparations of two materials (MTA and Biodentine) and control group

<table>
<thead>
<tr>
<th>Groups</th>
<th>n</th>
<th>X</th>
<th>SD</th>
<th>n</th>
<th>X</th>
<th>SD</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>10</td>
<td>0,18</td>
<td>0,16</td>
<td>8</td>
<td>3,06</td>
<td>0,61</td>
<td>&lt;0,001</td>
</tr>
<tr>
<td>II</td>
<td>10</td>
<td>0,08</td>
<td>0,09</td>
<td>8</td>
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<td>8</td>
<td>3,06</td>
<td>0,61</td>
<td>&lt;0,001</td>
</tr>
</tbody>
</table>

Fig. 7. Comparative analysis of microleakage after apical resection of two different apical preparations of two materials (ProRoot MTA and Biodentine) and control group

DISCUSSION:
Hermetic sealing of the apical part of the root canal and the minimum micro leakage of tissue fluids in this area are of great importance for the healing process after the endodontic surgery [17, 18, 19, 20].

The quality of apical seal obtained by root end filling materials has been assessed by the degree of penetration. There are several methods – chemical compounds (silver nitrate), bacterial penetration, fluid filtration techniques and radioisotope penetration. But the most common ones use dyes (methylene blue, fuchsin, rhodamine B, fluorescent dyes). Using dyes is a simple and safe method for studying micro leakage, which is why we use it in current in-vitro study. This method has also been used by many researchers in their studies [2, 3, 11, 19, 20, 21, 22].

Post et al. compare the degree of dye penetration in MTA and amalgam. It was concluded that the penetration in MTA is lesser, and no connection was established between the apical preparation and the degree of dye penetration [21].

Kuzmanova and Nikiforova have done a comparative
measurement of microleakage in four different materials for retrograde filling - gray MTA, Adhesor, Astralloy, and Adseal at an angle of 45 degrees and 3 mm apical resection using a traditional technique. They established that the lowest microleakage was observed for MTA Angelus - from 0.34 to 0.67 mm, while in amalgam the microleakage was most expressed - from 2.8 to 0.44 mm [17].

In current study we have established that microleakage for MTA is 0.18 mm after apical preparation from 0 to 10 degrees by using stainless steel straight fissure bur and 0.08 mm for concave shape of apical cavity preparation. This confirms the relationship between apical preparation and the materials used for retrograde filling as key to success.

Shashi S. et al. have received similar results. They compared the microleakage of methylene blue in MTA-white and gray and Portland cement – white and gray. They established minimal penetration in white MTA - from 0.18 mm to ±0.31 mm, which isn’t statistically important.

During the study, it has been established from the X-ray after retrograde filling that radio opacity for Biodentine is lower in comparison with MTA. The content of the radio pacifier - Zirconium oxide in Biodentine differs from the Bismuth oxide as a radio pacifier in MTA [8, 9].

In current study MTA sealing abilities have been confirmed and those of Biodentine have been proved in different cavity preparations after apical resection.

**CONCLUSION:**

Different apical cavity preparations in both types of material have led to the microleakage dye, but to varying degrees. According to our results Biodentine can be more effective material for retrograde filling comparing to MTA. Within the limit of this study we can conclude that the apical preparation with concave shape and cavity along the root canal in depth of 3 mm after apical resection is important for apical microleakage reduction.

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**REFERENCES:**


18. Marinova M. Methods and materials for detection of microleakage


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