EFFECTIVENESS OF DIFFERENT OBTURATION TECHNIQUES OF INTERNAL RESORPTIVE CAVITIES USING RADIOGRAPH AND STEREOMICROSCOPE- AN IN-VITRO STUDY

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ABSTRACT:

Aim of this study was to compare the quality of different obturation techniques in extracted human teeth with artificial internal resorptive cavities.

Materials and method: 30 extracted human single rooted teeth were selected and access opening was done in each tooth. Cleaning and shaping procedure was done using ProTaper Universal (Dentsply) till F3. The teeth were sectioned horizontally 7mm from the apex and artificial resorption cavities were prepared on the canal using #5 round bur. The sectioned teeth were recemented using glue (resin-bond) guided with the help of a guide mark and specimens were mounted in acrylic block using separating medium. The teeth were then randomly divided into 3 groups of 10 teeth each based on the obturation technique used: Group I - Cold lateral compaction technique, Group II - Thermoplastisized gutta-percha technique (Calamus) and group III - Cold flowable gutta-percha technique (Gutta Flow 2). Teeth were removed from the acrylic block and radiographed in buccolingual and mesiodistal direction to evaluate obturation quality at internal resorption cavities which was observed by 2 experienced endodontists. The teeth were re-sectioned at the previous level (7mm from the apex) and quality of obturation viewed under the stereomicroscope. The percentage of sealer, guttapercha & voids in internal resorptive cavities was calculated and analyzed statistically using Fisher Exact probability test.

Results: Radiographic data indicated that the differences were significant between Group 1 & Group 2, i.e P=0.02 (P<0.05) and highly significant between Group 1 and group 3, i.e P=0.002 (P<0.05). Stereomicroscopic evaluation indicated that the difference was highly significant between Group1 and Group 2, i.e P=0.001 (P<0.05) and between Group 1 and Group 3, i.e P=0.001 (P<0.05). The radiographic data as well as stereomicroscopic data indicated that there was no significant difference between Group 2 and Group 3, i.e P> 0.05.

Conclusion: Thermoplasticized gutta-percha technique (Calamus) and Cold flowable gutta-percha technique (Guttaflow 2) showed better quality of obturation as compared to Cold lateral compaction technique.

INTRODUCTION:

The primary goal of root canal treatment is complete filling of the root canal with dimensionally stable and biocompatible inert materials (1). Pathological processes such as internal resorption can make root canal anatomy very complex. These irregularities are inaccessible for endodontic instruments which leads to improper cleaning and shaping of root canals (2). Internal resorption is provoked by enduring chronic pulpitis which leads to dentinoclastic activities of odontoblast. In most cases trauma is the initiating factor for internal resorption (2,3). Pulp extirpation and root canal treatment followed by sodium hypochlorite irrigation and calcium hydroxide intracanal medicament is the only treatment modality. Many in-vitro studies describe multitudinous techniques of obturation for internal resorptive cavities. Gutmann et al. (1993) recommend the use of the thermal obturation technique. Collins et al. (2006) advocated the use of warm lateral and warm vertical condensation gutta-percha techniques. Agarwal et al. (2002) suggested that the use of ultrasonics to condense the gutta-percha and the Obtura II system were better when compared to Thermafil and Lateral compaction (LC) techniques. (2) Clinically and radiographically the full extent of resorptive defect is not always visible as radiograph presents a 2-dimentional image of a 3-dimentional obturation.
MATERIALS AND METHOD:

30 freshly extracted human single rooted teeth with single canal were selected and access cavities were prepared in each tooth using high-speed #5 round diamond points. The patency of each canal was maintained throughout the procedure by passing #10 K-file approximately 0.5 mm short from the apex. The canals were prepared in Crown-down fashion using Rotary ProTaper Universal (Dentsply) and copious irrigation was done with 3% Sodium hypochlorite solution (Prime dental products) between the instrumentation. All canals were prepared up to F3 ProTaper.

**Internal resorptive cavities**

Roots were sectioned transversely with a fine diamond disk (Mani) 7 mm from the apex by using guide mark on the buccal surface of the root. After the sectioning, semi-circular resorptive cavities were prepared at the opening of the root canal on both the sections using a low-speed handpiece and #5 round diamond point(Mani) till half depth of the bur. A small drop of glue (resin-bond) was used to cement the corresponding sections by guide mark and specimens were mounted in an acrylic block using separating medium. While cementing canal patency was maintained using a 25k file. (figure-1) The samples were then randomly allocated to 3 different groups of 10 teeth each (n=10) as follows:

**GROUP 1 - COLD LATERAL COMPACTION TECHNIQUE** - A standardized master cone was selected and placed into the canal 0.5mm from the apex. AH Plus (Dentsply, Germany) sealer was freshly mixed on the paper pad. It was applied on canal wall by using a standardized gutta-percha point coated with the sealer in a counter clockwise direction. The gutta-percha point was again coated with the sealer and placed into the canal. Standardized finger spreaders (K endo) were used and the space was filled with accessory gutta-percha points. The excess gutta-percha was seared off using a heated ball burnisher. (figure-2)

**GROUP 2 - THERMOPLASTICIZED GUTTA-PERCHA TECHNIQUE – CALAMUS** - A selected master cone was coated with AH PLUS (Dentsply) sealer and introduced into the root canal to full working length and confirmed radiographically. The Calamus Pack handpiece was activated to sear off the non-useful portion of the master cone to maintain an apical plug of 4mm (figure-3). After searing, the backfill phase was started by dispensing warm gutta-percha into middle region of the canal with the help of the flow handpiece. (figure-4)
GROUP 3 - COLD FLOWABLE GUTTA-PERCHA TECHNIQUE - GUTTAFLOW 2

The GuttaFlow 2 (Coltene) was loaded on the dispenser pad to coat the master gutta-percha cone. First the mixed material was loaded directly in the apical third of root canal with auto mixed syringe tip. Coated standardized F3 gutta-percha master cone was inserted slowly to reach up to full working length. The excess gutta-percha was seared off using hot ball burnisher. (figure-5)

The acrylic block was removed 7 days after the obturation and examined radiographically using digital x-ray in mesio-distal as well as bucco-lingual direction. (figure-5)

RADIOGRAPHIC EVALUATION

Taking into consideration the quality of the obturation of the IRC, the specimens were grouped as follows (figure-6)

1. TOTAL OBTURATION - The mass of the filling material or between the gutta percha and dentinal walls is >1/3.
2. PARTIAL OBTURATION - The mass of the filling material or between the gutta percha and dentinal walls is <1/3.

The radiographs of each tooth were analysed by two experienced endodontists.

(Fig-6) Radiograph showing complete obturation in buccolingual view and partial obturation in mesiodistal of same tooth.

STEREOMICROSCOPIC EVALUATION

Each tooth was sectioned with a rotary saw 7 mm from the apex at the level of the previous cut, and under cold water to minimize gutta-percha smearing.

Each root section was examined under a stereomicroscope. (figure-7)

The nature of the filling material predominant at the IRC was recorded and specimens were grouped as follows:

a. The predominant filling material was sealer
b. The predominant filling material was gutta-percha
c. Similar amounts of sealer and gutta-percha
RESULTS

The best results were obtained by both Thermoplasticized gutta-percha technique (Calamus) and Cold flowable gutta-percha technique (Guttaflow 2).

Statistical analysis of the radiographic and stereomicroscopic data was done by using Fisher exact test.

Radiographic data indicated that the differences were significant between Group 1 & group 2- $P=0.02$ ($P<0.05$) and highly significant between Group 1 and group 3- ($P<0.05$) $P=0.002$.(table-1)

While stereomicroscopic evaluation indicated that the difference was highly significant between group1 and group 2- $P=0.001$ ($P<0.05$) and group 3- $P=0.001$ ($P<0.05$).(table-2)

The radiographic data, as well as stereomicroscopic data, indicated that there was no significant difference between group 2 and group 3- $P>0.05$.

Table 1. Radiographic evaluation of quality of obturation of simulated internal resorptive cavities

<table>
<thead>
<tr>
<th>Groups</th>
<th>Obturation Partial</th>
<th>Complete</th>
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<th>P value</th>
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<tr>
<td>1</td>
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<td>8</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
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<td>3</td>
<td>3</td>
<td>7</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
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Table 2. Stereomicroscopic evaluation of quality of obturation of simulated internal resorptive cavities

<table>
<thead>
<tr>
<th>Groups</th>
<th>obturating material</th>
<th>Gutta-percha</th>
<th>Sealer</th>
<th>Gutta-percha and sealer</th>
<th>Total</th>
<th>P value</th>
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<tbody>
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<tr>
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<td>6</td>
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DISCUSSION:

Internal resorption is a pathological process which begins within the pulp (5), where the outermost odontoblastic layer and predentin of the root canal is damaged leading to exposure of dentinal wall to odontoclast (6).

In this study, internal resorptive cavities were prepared in the middle third of the root canal because internal resorption is most frequently seen in this area.
The two factors which complicated the treatment of internal resorptions are:

1. Improper cleaning and shaping of the resorptive defects because of the inaccessibility of the instrument in the defects.
2. The full extent of resorptive defects could not be estimated by radiograph (Agrawal et al.).

The aim of obturating the root canal is to arrest the growth of bacteria and inhibit the growth of new bacterial species into the canal by providing such an environment (2). Hence the search is for the best obturation technique and material that totally fills the resorptive defects. (7)

The main objective while obturating the root canal is the presence of a maximum amount of gutta-percha in the root canal. Wesselink suggested that during obturation there should be a maximum amount of solid nucleus gutta-percha and minimum amount of sealer for better sealing. (8).

In this study we have selected three techniques for filling internal resorptive cavities, which were Cold lateral compaction, Thermoplasticized gutta-percha (Calamus) and Cold flowable gutta percha (GuttaFlow2) technique.

Cold lateral compaction gave poorest results which is similar to the results of earlier studies. When total obturation of the resorptive cavities was achieved in this group, it mainly consisted of sealer, which sealed the intracanal defects and lateral canals to a lesser extent. It was seen as a less homogenous mass (8). While the thermoplasticized technique (calamus) was found to be significantly superior to cold lateral condensation and showed a better adaptation to the three-dimensional root canal system.

Most of the studies have suggested that appropriate filling of internal resorptive cavities is achieved due to the superiority of thermoplastisized technique. Torabinejad et al (1978) observed that when the root canal was obturated with injectable thermoplasticized gutta-percha, it showed better adaptability to the canal walls. (4)

The superiority of Cold flowable gutta-percha (GuttaFlow 2) was non-significant. The better sealing may be due to the flowable property at room temperature and because of the material which expands on setting. (7) GuttaFlow 2, a new root canal obturation material has thixotropic property. An important property of Gutta-Flow is its short and long-term sealing ability to the canal walls (9), biocompatibility and low cytotoxicity (10). Another study compared GuttaFlow 2 and Cold lateral compaction technique to check the apical leakage after obturation. GuttaFlow 2 was used with and without master cone with lateral compaction. It was concluded that GuttaFlow2 was a good alternative to lateral compaction (7).

In the present study, the best results were obtained using both GuttaFlow 2 and Thermoplasticized technique - Calamus. Amongst the 10 specimens obturated with Calamus, the IRC in seven specimens were completely obturated, and showed gutta-percha as the main filling material. Amongst the 10 specimens obturated with GuttaFlow 2, the IRC of all specimens were totally obturated, and showed gutta-percha as the main filling material.

CONCLUSION –

Within the limitations of the study, it can be concluded that Cold flowable gutta-percha (GuttaFlow 2) and Thermoplasticized gutta-percha technique (Calamus) are recommended to be used to obturate the defects of internal resorption in clinical practice.

The Cold lateral condensation technique was considered inferior when compared to Cold flowable gutta-percha (GuttaFlow 2) and Thermoplasticized gutta-percha technique (Calamus) for obturation of internal resorption defects.
REFERENCES