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An In-Vitro Comparative Evaluation of Different Obturation Techniques for Simulated Internal Resorptive Cavities

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Abstract

Background: To compare and evaluate the quality of obturation in simulated internal resorptive cavities using different guttaperchaobturation techniques namely, hybrid (combination of lateral and vertical compaction), ultrasonic compaction and thermo plasticized guttapercha technique and also to compare radiographic and stereomicroscopic methods to evaluate the quality of obturation.

Materials and Methods: Thirty extracted maxillary central incisors were instrumented at the working length to a #50 file. The roots were sectioned transversely with a diamond disc at 7 mm from the anatomical apex. At the opening of the root canal of each section, hemi-circular cavities were drilled with a specially designed bur. The corresponding root sections were cemented with glue, thus obtaining root canals with similar cavities that simulated internal resorption. The specimens were randomly separated into three groups of 10 each. The following obturation techniques were evaluated. Group A: Hybrid technique (combination of lateral and vertical compaction); Group B: Ultrasonic compaction (Satellac); Group C: Injectable thermo plasticized gutta-percha technique (Ultrafil). After obturation, the teeth were radiographed in buccolingual and mesiodistal directions to evaluate the quality of obturation at the Internal Resorptive Cavities (IRC). The incisors were then cut with a scalpel at the same levels as the previous section to examine the type of material that filled the Internal Resorptive Cavities, under a stereomicroscope.

Results: Ultrafil (thermo plasticized gutta-percha) gave the best result and in most of the specimens obturated with this technique, the IRC were filled mainly with gutta-percha. Statistical analysis of the data indicated that the difference between group C (Ultrafil) and the other groups A (Hybrid) and B (Ultrasonic) were significant ($p<0.05$)

Conclusion: Thermo plasticized guttapercha (Ultrafil) is the best obturating technique for internal resorptive cavities, as compared to hybrid and ultrasonic compaction technique. Ultrasonic compaction is better than hybrid technique for obturating internal resorptive defects. Stereomicroscopic evaluation is much better and precise method to evaluate the quality and nature of filling material in to the resorptive defect than the radiographic evaluation.

Key words: Internal resorptive cavities, hybrid technique, thermo plasticized guttapercha technique, ultrasonic

Introduction

Traumas that affect the hard tissues and cause pulpal and periodontal lesions are of great relevance to present day dentistry because of their frequency, the functional and aesthetic disturbances that accompany them and the rapidity with which these problems must be treated. Periodic evaluation of such teeth is mandatory because when the crown or root is fractured, the pulp may recover and survive the injury, it may succumb immediately or it may undergo progressive degeneration and ultimately get necrosed. Tooth resorption is a common sequelae following injuries to or irritation of the periodontal ligament and/or tooth pulp. One of the major goals of a successful root canal therapy is to achieve total obliteration of the root canal space using a dimensionally stable and biologically compatible filling material[1-2]. The complex irregularities of the root canal system, as well as those resulting from pathological processes such as internal resorption, pose technical difficulties for the thorough cleaning and obturation of the root canal. The persistence of organic debris and bacteria in these irregularities may interfere with the long term success of the endodontic treatment. Moreover, it is impossible to determine the complete anatomical extent of the internal resorption, either clinically or radiographically.

The importance of achieving total obturation of the root canal space, especially in internal resorption with perforative defects has been stressed by Frank and Weine[3]. Several clinical studies have shown acceptable obturation of internally resorbed areas using thermo plasticized gutta-percha filling techniques[4-7]. However, it is important to stress that radiographic images only show the buccolingual view of the tooth, which is insufficient to establish the quality of the three dimensional fill achieved. In this regard, the use of an experimental model to study the behaviorof different techniques in the obturation of internal resorptive defects would be beneficial. The purpose of this study was to compare and evaluate the quality of obturation in simulated IRC using different gutta-percha obturation techniques, namely hybrid (combination of lateral & vertical compaction), ultrasonic compaction and thermo plasticized guttapercha techniques and also to compare the efficacy of radiographic and stereomicroscopic methods used to evaluate the quality of obturation.

Materials and Methods

Thirty extracted maxillary central incisors were used for this study. Part of the crown was removed to obtain a standard crown/root length of 19 mm.

The access cavities were prepared; the coronal and middle portions were shaped using #1, 2 and 3 Gates Glidden drills. The working length was visually established by placing a # 15 file in each root canal until it was seen emerging through the apical foramen. All teeth were instrumented at the working length to a #50 file. After every change of file size and the completion of instrumentation, the canals were irrigated with 2 ml of 2.5 % sodium hypochlorite solution. The canals were dried with paper points. A guide mark was placed on the buccal face of each root using carborundum disc. Following instrumentation, the experimental internal Resorptive cavities were created using the following procedure. A. Transverse sectioning of the root 7 mm from the apex; B. Hemicircular cavity created at the opening of the root canal in the apical half using a round bur with a stopper; C. Hemicircular cavity created in the coronal half drilled as in B; D. Both halves glued together showing the simulated internal resorptive cavity.

All roots were sectioned transversely with a fine diamond disk 7 mm from the apex. At the openings of the root canals of each section, hemi circular cavities were created using a low speed hand piece and a #5 round carbide bur with a stopper, in order to ensure the precise depth of the cavities.

A small drop of glue was carried with the tip of a dental explorer and spread carefully on the dentine surface. The specimens were randomly separated into three groups of 10 each. In all groups, zinc oxide eugenol was used as the root canal sealer. The sealer was mixed according to the manufacturer's instructions and then applied by coating canal walls using a #50 file.

The root canals were obturated according to the following techniques.

Group A: Hybrid technique (combination of lateral and vertical compaction).

Group B: Ultrasonic compaction (Satellac-P-Max).

Group C: Injectable thermo plasticized gutta-percha obturation technique (Ultrafil).

All the teeth were kept for 7 days to ensure the setting of sealer and were then radiographed in buccolingual and mesiodistal directions to evaluate the quality of the obturation obtained at the level of internal Resorptive cavities. Radiographic Evaluation: Taking into consideration the quality of obturation of internal resorption cavities, the specimens were grouped as follows:

a) Total obturation: The IRC was obturated completely in the buccolingual as well as in the mesiodistal radiographs. Empty spaces were not evident in the filling mass or between the gutta-percha and then surface.

Partial Obturation: The obturated IRC showed empty spaces in the mass of the filling material or between the gutta-percha and the dentin walls in buccolingual and/or mesiodistal radiographs. Data were analyzed statistically using Fisher's exact probability test.

Stereomicroscopic Evaluation: Following radiographic assessment, the teeth were sectioned with a sharp scalpel blade at the level of the previous cut 7 mm from the apex. Paired root sections were examined under a stereomicroscope (X20). In both sections, the nature of the filling material predominant at the lRC was recorded and specimens were grouped as follows: Type I: Predominant filling material was sealer. Type II: Predominant filling material was gutta-percha. Type III: Similar amount of sealer and gutta-percha was observed. Data were analyzed statistically using KruskalWalli's ANOVA test.

Results

The radiographic and stereomicroscopic results obtained are summarized in Tables 1 & 2, respectively. The best results were obtained by Injectable thermo plasticized gutta-percha technique i.e. Group C. Statistical analysis of the radiographic data indicated that the differences were significant between group C and the other groups, i.e. Group A and B ($p < 0.05$), while no statistically significant differences were observed among group A and B ($p > 0.05$). Statistical analysis of the stereomicroscopic data showed significant differences between all the three groups Group A, B and C.

Groups	No. of samples	Total obturation	Partial obturation
Hybrid(A)	10	3(30%)	7(70%)
Satellac(B)	10	4(40%)	6(60%)
Ultrafil(C)	10	9(90%)	1(10%)

Table 1: Radiographic Evaluation

Groups	No. of samples	Type-1	Type -2	Type – 3
Hybrid(A)	10	9(90%)	0	1(10%)
Satellac(B)	10	1(10%)	2(20%)	7(70%)
Ultrafil(C)	10	0	7(70%)	2(20%)

Table 2: Stereomicroscope Evaluation

Discussion

Tooth resorption is a perplexing problem for all clinicians as resorption is a multi factorial process that results in loss of tooth structure. Since the full extent of the resorptive defect is not always radiographically visible, the search for a permanent filling material and technique to obturate completely the resorbed area is clinically important and challenging[6].

In the present study, maxillary central incisors with simulated internal resorptive cavities located in the middle thirds of the roots were used, since these are the teeth and areas in which internal resorption is most frequently seen[6-7].

Radiographically, it appears as a circumscribed oval radiolucency continuous with root canal wall usually in the coronal or radicular portion of the tooth. Lesion may be symmetrical or eccentric, margins are sharp, smooth and clearly defined, and defect appears uniform in density. Histologically, we see granulation tissue with multinucleated giant cells (osteoclasts in howship's lacunae).

Conventional radiography does not provide a true and full representation of the lesion. Conventional radiography is often unable to identify the true extent, location or the portal of entry of a resorptive lesion. Cone beam computed tomography (CBCT) has been shown to help determine treatment complexity as well as aid the clinician in offering an accurate prognosis on the basis of the resorptive lesion[9].As a result, both treatment and treatment outcomes are likely to become more predictable.

Heated guttapercha changes its crystalline form from a beta-phase, which is relatively solid, to an alpha-phase, where it becomes a more plasticized material that is stickier and adheres to the canal walls. In its alpha phase, gutta-percha can be compacted vertically and laterally by using mechanical or rotary instruments. Resilon, a polyester- and methacrylate-based resin obturator, has good flow and bonds to etched canal walls after it is heated, which may provide a tighter seal of the canal system while strengthening the root system[10].

The best results were observed in Group C where Ultrafil was used to fill the resorptive defects. A potential advantage of Ultrafil is that thermoplastic filling material flows both vertically and laterally during the injeciton[11].

These results were in accordance with those obtained by Michanowiczet al[12] and Gencoglu N et al[13] who observed a good adaptation of gutta-percha to the walls of the canal with injection molded thermo plasticized gutta-percha.

Group B i.e. ultrasonic compaction showed better results compared to Group A i.e. hybrid technique (Combination of Vertical and Lateral Compaction). In accordance to Zmener O &Banegas G[14], it was suggested that the energy developed by the ultrasonic could be transformed into heat up to 6°C with a range of 4.2° C to 7.1 °C, and consequently, thermo

mechanical effects produced by the ultrasonic energized spreader and plugger could transform the cones into a more homogenous gutta perch mass.

In the present study, hybrid technique showed the worst obturation as this technique did not replicate well the internal surface of the canal walls, leaving voids or spreader tracts and producing an irregular distribution of the sealer[14].

Stereomicroscope is better than the conventional radiographs as it gives a precise data about the quality and nature of filling material within the resorptive cavities, and assesses obturation in all the three dimensions.

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