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Clinical and Radiographic Evaluation of Root-canal Obturation with Obtura II

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This study evaluated clinical and radiographic healing of 236 root-canal treatments in 131 cases obturated with the Obtura II system. One operator performed all canal preparation and obturation with sealer. A standardized apical-coronal preparation technique instrumented all canals. Clinical symptoms, periodontal condition, and radiographic findings were evaluated at 3, 6, and 12 months. Radiographs taken immediately postobturation were compared to recall radiographs. The level of the final root filling was classified as short (more than 2 mm short of the apex), flush (within 2 mm), or over (beyond) in 12.7%, 81.4%, and 5.9% of cases, respectively. More than 96% of cases were treated successfully by the Obtura II system. Where roots were filled flush, over, or short, lesions healed in 97%, 93%, and 93% of cases, respectively, with no significant differences ($p < 0.05$). Root filling excess had no impact on the healing process.

Thermoplasticized, injectable, obturation techniques have been developed and available for several years. Heated gutta-percha techniques (low-temperature, high-temperature) have been shown to produce a significantly better quality root-canal obturation than that produced by the lateral-condensation technique (1–3). Especially the high-temperature technique, Obtura II system (Texceed Co., Fenton, MO) has been found to be significantly superior to lateral-condensation methods and has demonstrated the best adaptation to the three-dimensional root-canal system (1).

In vitro studies by Weller and Koch (4) (1994) have shown that the Obtura II technique demonstrated the best adaptation to prepared root canals, and the Obtura II system also is commonly used for back-filling. Johnson and Bond (5) suggested that it might be clinically acceptable to backfill canals up to 10 mm in a single increment using sealer and the Obtura II system. The high temperature generated in the root canal can be dissipated through the root surface and periodontal ligament. Molyvdas et al. (6) showed histologically the inflammation reaction in periapical tissue after injection of warm gutta-percha in beagle dogs. However, it is generally accepted that a temperature rise of approximately 10°C above normal body temperature is most critical (7). Weller and Koch (8) (1995) measured the radicular temperatures produced when gutta-percha was heated to 160°C, 185°C, and 200°C and injected into the root canal by Obtura II. The results indicated that the rise in temperature on the root surface was below the level of 10°C and did not cause damage to the periodontal ligament. These in vivo and in vitro studies have shown that Obtura II has a good adaptation to the canal wall and causes no periodontal tissue injury. However, there have been no studies reporting a clinical patient case study of the Obtura II system. The purpose of this study was to evaluate the clinical and radiographic healing of 131 teeth (236 canals) of 87 patients to estimate the relationship of the root-filling level in relation to the root apex, and assess outcomes of treatment for roots with apical periodontitis.

MATERIALS AND METHODS

The Obtura II heat-injected system treated 236 root canals: 82 in molars, 97 in premolars, and 57 in anteriors. The working length of the root canal was established by electric-root canal measurement (Root ZX, J. Morita Corp., Osaka, Japan). All root canals were instrumented by standardized apical-coronal preparation techniques and were prepared with hand K-files (#15 ~80) at the established working lengths. Sizes 3, 4, or 5 Reamer T (Pierce Co., Tokyo, Japan) were used to flare the canal orifice of the roots. All apical preparations were enlarged three sizes greater than the initial size of the file that bound at the full working length. Root-canal irrigation with a combination of 2.5% sodium hypochlorite and 3.0% hydrogen peroxide was performed during root-canal preparation by a root-canal syringe. After preparation the patency of the apical foramen was confirmed by inserting a #15 K-file 1 mm through the working length. The root canal was irrigated and then dried with paper points.

The Obtura II system was prepared according to the manufacturer's instructions (Obtura II Operator's Manual 1993). Silver injection needles of 20- and 23-gauge were used for all obturations and a silicone stop was placed 2 to 5 mm from the working length. Root-canal sealer (Canals N, Showa Dental Co., Tokyo, Japan) was placed into the canal using a paper point. At the time of obturation, injection of the thermoplasticized gutta-percha was performed twice, separately. First, the needle was inserted in the apical direction until it bound to the canal wall, and the thermoplasticized gutta-percha heated to 170–175°C in the delivery system was injected. The needle was removed after injecting a few

millimeters of gutta-percha near the tip of the preparation. The softened gutta-percha in the apical portion was then vertically condensed to the apex with a hand plugger dipped in alcohol to avoid adherence to the gutta-percha. The remaining root-canal space was then back-filled in increments until gutta-percha was observed in the cervical aspect of the root. The needle was withdrawn and the entire mass vertically condensed with a hand plugger. The void created by compaction was then refilled with thermoplasticized gutta-percha with no additional plugging. One operator performed all canal preparation and obturation. The level of the final root filling was classified as short filling (more than 2 mm short of the radiographic apex), flush filling (within 2 mm of the radiographic apex), and over filling (beyond the radiographic apex).

Clinical and Radiographic Examination

Clinical examination was made and radiographs were evaluated at 3, 6, and 12 months after obturation. Clinically, all patients were free of symptoms and periodontal disease. The dental radiographs used in this study were made by a X-ray radiation machine (MAX-F, Morita Co. Ltd., Kyoto, Japan) and Kodak dental films (INSIGHT, Kodak, Rochester, NY). All films were processed in a X-ray automatic processor machine (Hi-RHEIN, NIX Co. LTD., Tokyo, Japan) using NIX dental developer and fixer. The viewing conditions were standardized, using a view box with fixed light intensity. Radiographic healing assessment criteria was as developed by Rud et al. (9). Lesion-healing cases were those in which regeneration of a periodontal ligament space was shown to the degree of a periodontal ligament space or to the degree that the lamina dura could be followed completely around the apex. Lesion-decreased cases were those in which periapical radiolucency smaller in size than the original was still present. Lesion-unchanged cases were those in which a periapical radiolucency the same size as the original was still present. Lesion-increased cases were those in which apical radiolucency, although larger in size than the original, was still present. Cases of normal periapical condition were similarly classified as remaining normal or as lesion development. Remaining normal = apical periodontal ligament space not more than double the width compared to other parts of the root. Lesion development = periapical radiolucency observed. Two experienced endodontists, who had not been involved in the treatment or follow-up appointments, were asked to analyze the radiographs. Twenty-five radiographs (not included in the study) were used for calibration of the evaluations.

Statistical Analysis

A Chi-square test with Yate's correction was performed for successful results (healing and lesion-decreased) of the canals, and the failure cases (lesion-unchanged and increased) of canals in each level of the final root filling (under, flush, or over) after 12 months. For all tests, $p < 0.05$ was considered statistically significant.

RESULTS

Outcomes of the Obtura II System

Endodontic treatment with the Obtura II system was performed on 236 canals of 131 cases (anterior teeth: 40; premolar: 44; molar:

TABLE 1. Distribution of cases in filling levels from radiographic apex

Levels of Filling	No. of Infected Canals	No. of Pulpectomy Canals
Short	27	3
Flush	156	36
Over	14	0
Total root canals	197	39

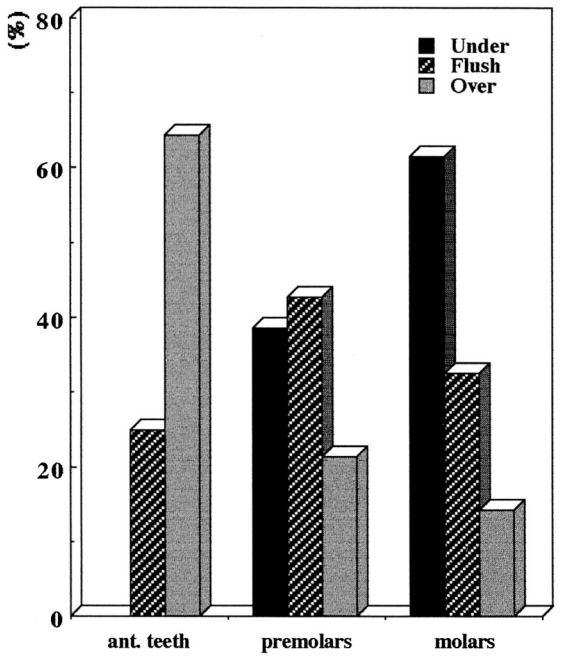

FIG 1. The relationship between the distribution of teeth and the level of root filling from apex by Obtura II.

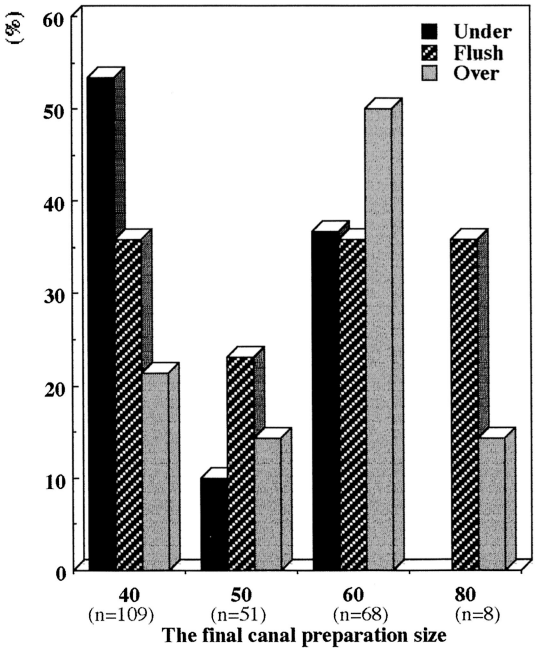

FIG 2. The relationship between the final canal preparation and the level of root filling from apex.

47) in 87 patients. The periapical status of the endodontically treated teeth was normal in 39 canals of 37 cases (irreversible pulpitis: 30; necrosis: 7), whereas apical periodontitis was present in 197 canals of 94 cases (acute apical periodontitis: 13; chronic apical periodontitis: 81). The level of the final root filling was classified as short, flush, and over filling in 12.7%, 81.4%, and 5.9% of cases, respectively (Table 1).

Figure 1 shows the relation between distribution of the teeth and the level of the root filling from the radiographic apex. Of over-filled teeth, more than 60% were located in anterior teeth. Of under-filled teeth, more than 60% were located in molar, although no under-filled teeth were short-anterior teeth. The distribution of flush-filled teeth was not significantly different among anterior, premolar, or molar. Figure 2 shows the relationship between final canal-preparation sizes and levels of root filling from the radiographic apex. Of over-filled teeth, 65% were located in #60 and #80 preparation sizes. On the other hand, 65% of short-filled teeth were located in #40 and #50 preparation sizes. No short-filled teeth were located in the #80 preparation size.

Follow-up Study

In all teeth endodontically treated with the Obtura II system, clinical symptoms (spontaneous pain, palpation pain, percussion pain, and abscess formation), periodontal disease, and radiographic findings were evaluated at 3, 6, and 12 months. All 236 canals of 131 cases had no clinical symptoms and periodontal disease at 3, 6, and 12 months.

TEETH WITH APICAL PERIODONTITIS

Table 2 shows the status changes after 3, 6, and 12 months for endodontically treated teeth with an apical periodontitis in root filling, distributed according to endodontic status in root-canal filling. Periapical lesions were registered in 197 canals of 94 cases at the primary examination. Of 197 canals that had not been retreated, 189 canals showed complete or incomplete healing, whereas in only 8 canals did the lesions remained unchanged in size after 12 months. The ratios of lesion-healing canals were not significantly different among the level (flush, short, or over) of filling from the apex. Although the excess sealer was absorbed by 3 months (data not shown), the excess thermoplasticized gutta-percha still remained at 12 months

TEETH WITH NORMAL PERIAPICAL CONDITIONS

Table 3 shows the change of status after 3, 6, and 12 months for endodontically treated teeth with normal periapical conditions in root filling, distributed according to endodontic status in the root-canal filling. All 39 endodontically treated canals (both flush and short filling) remained in normal periapical condition and with no clinical symptoms up to 12 months.

DISCUSSION

The use of the Obtura II technique is especially beneficial for irregular canals. The adaptation of the softened gutta-percha to the canal walls has been shown to be significantly better than lateral compaction by cold gutta-percha point (1, 10). When 94 apical periodontitis, 7 pulpal necrosis, and 30 pulpitis requiring endodontic therapy were obturated with Obtura II system in this study, the level of the final-root filling was classified as short, flush, and over fillings (12.7%, 81.4%, and 5.9%, respectively). The warmed gutta-percha was fully filled to the end of the preparation canal in 94% of all cases (short- and flush-filling cases). Some dead-space canals were found in the anterior teeth after Obtura II technique in first trial, all those cases then had repreparation and refilling using the same technique. The level of the root filling from the radiographic apex was related to the distribution of teeth (Fig. 1) and the final canal preparation size (Fig. 2).

The results showed that it was better to use the lower setting (170°C) in cases of large preparation sizes (#60 and #80) to avoid

TABLE 2. Change in periapical status after 3, 6, and 12 months for endodontically treated teeth with an apical periodontitis in root filling, distributed according to endodontic status in root-canal filling

		3 Months			6 Months			12 Months		
Levels of Filling	*n*	Lesion Healed or Decreased	Lesion Unchanged	Lesion Increased	Lesion Healed or Decreased	Lesion Unchanged	Lesion Increased	Lesion Healed or Decreased	Lesion Unchanged	Lesion Increased
Short	27	11 (40.7)	16 (59.3)	0 (0)	24 (88.9)	3 (11.1)	0 (0)	25 (92.6)	2 (7.4)	0 (0)
Flush	156	72 (46.1)	84 (53.8)	0 (0)	141 (90.3)	15 (9.7)	0 (0)	151 (96.8)	5 (3.2)	0 (0)
Over	14	6 (42.9)	8 (57.1)	0 (0)	13 (92.9)	1 (7.1)	0 (0)	13 (92.9)	1 (7.1)	0 (0)
Total root canals	197	89 (45.2)	108 (54.8)	0 (0)	178 (90.3)	19 (9.7)	0 (0)	189 (95.9)	8 (4.1)	0 (0)

TABLE 3. Change in periapical status after 3, 6, and 12 months for endodontically treated teeth with normal periapical conditions in root filling, distributed according to endodontic status in root-canal filling

		3 Months		6 Months		12 Months	
Levels of Filling	*n*	Remained Normal	Lesion Developed	Remained Normal	Lesion Developed	Remained Normal	Lesion Developed
Short	3	3 (100.0)	0 (0)	3 (100.0)	0 (0)	3 (100.0)	0 (0)
Flush	36	36 (100.0)	0 (0)	36 (100.0)	0 (0)	36 (100.0)	0 (0)
Over	0	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total root canals	39	39 (100.0)	0 (0)	39 (100.0)	0 (0)	39 (100.0)	0 (0)

excess filling, because the flow of heated gutta-percha was increased by the high temperature setting (more than 175°C). Because of the potential for the extrusion of gutta-percha and sealer beyond the apical foramen in the over-filled cases, the possibility of heat damage to the periodontium has been identified as a possible drawback to this technique (11, 12). Temperature rises on the external lateral surface of the roots appear to be negligible and with minimal-to-no tissue damage, whereas the apical tissue may experience an inflammatory reaction even to gutta-percha retained within the root-canal system. Clinically, excess-filling material beyond the apical foramen is an unnecessary invasion of the attachment apparatus. Fortunately, tissue tolerance to commonly used filling materials is high, excess sealer is usually absorbed by 3 months (data not shown), and prognosis is generally good (13).

In cases where the roots were filled to excess or the filling was more than 2-mm short of the root apex by the cold gutta-percha technique, lesions healed in only 76% and 68% of the cases, respectively (14). Moreover, the negative impact of root-filling excess on the healing of periapical lesions may indicate a cytotoxic effect from the gutta-percha. In this study, all teeth without preoperative periapical lesions were treated successfully, with approximately 93% of over-filled and short-filled cases having necrotic pulps and periapical lesions healed. Although the lesions remained unchanged in 8 of 197 canals (4.1%), 189 of 197 canals (95.9%) had healed or decreased by 12 months. Even though the treatment outcome for roots with pulp necrosis and apical periodontitis depended on the level of root filling in relation to the radiographic root apex, favorable results were obtained with each level of root filling. Namely, in cases where the roots were filled to excess or flush filled, or the filling was more than 2-mm short of the root apex by the Obtura II technique, lesions healed in 92.9%, 96.8%, and 92.9% of cases, respectively.

The essential role of bacteria in the development of apical periodontitis has been established by Kakehashi et al. (15). Sundqvist (16) demonstrated that bacteria could only be isolated from intact traumatized teeth with associated periapical lesions and not from necrotic teeth without lesions. The nature of the root-canal microbiota associated with periapical-lesion development has been reviewed extensively in humans (17–20) and in nonhuman primates (21, 22). These studies indicated that there is a strong correlation between infection of the root canal and development of apical periodontitis. It is suggested that the adaptation of the softened gutta-percha to the canal walls and the sealing of apical foremen have been shown to be better than lateral compaction in under- and over-filled cases in the present study.

CONCLUSION

The root-filling excess when using the Obtura II system had no impact on the healing process of periapical lesions. Preoperative sizes of periapical lesions were smaller in the over-filled cases after 12 months. The treatment outcome for roots with apical periodontitis was not dependent on the level of root filling in relation to the root apex.

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