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USE OF RADIOLOGICAL ANALYSIS FOR CHOOSING OF OPTIMIZED ROOT CANAL OBTURATION TECHNIQUE

The objectives of this in vitro study were to evaluate three different root canal obturation techniques in respect of the radiographic quality of root canal obturation.

In the radiographic evaluation of the obturation quality in the present study, Lateral Condensation technique resulted in the poorest obturation quality, coronally and apically. Many voids were observed in the obturations and thies are directly related to the difficulty of handling with Lateral Condensation technique in the prepared canals.

Key words: obturation, canals, lateral condensation.

Since the earliest mention of endodontics in the 17th century, there have been numerous advances and developments as a result of continuous research. The apparent relationship between oral sepsis and bacterial endocarditis was pointed out by Frank Billings in 1904 and a few years later one of his students, E.C. Rosenow developed the theory of "focal infection", where he found streptococci to be present in many diseased organs and the fact that they could cause infection at some distant site by hematogenous spread [7]. Pierre Fauchard, who was considered the founder of modern dentistry, accurately described the dental pulp in his textbook.

In 1725 the oil of cloves for its sedative properties was introduced by Lazare Riviere while in 1746 Pierre Fauchard described the removal of pulp tissue [1]. Barnum isolated a tooth with a thin rubber leaf in 1864 and in 1873 introduced the rubber dam clamp forceps. Gutta-percha cones as the sole material for root canal obturation was used by Bowman in 1867, and during the same year Magitot suggested the use of an electrical current to test pulp vitality [2, 3].

The first dental radiograph was taken in late 1895 by Otto Walkhoff, a German dentist soon after the discovery of x-rays by Rontgen earlier that year. In 1900 periapical radiolucencies was described by Price as "blind abscesses" and he advised that radiographs were used to diagnose pulpless teeth [8].

But it is extremely interesting to the dental practitioners all over the world the question of improvement of quality of endodontic treatment by the choosing of correct technique and reliable sealer [4, 5, 6, 9].

The aim was improvement of endodontic treatment quality using different root canal obturation techniques and evidence-based approach.

Materials and methods. To assess the radiographic quality of root canal obturation. To visualize obturated root canal system and give the quality estimation. Object of investigation – extracted intact teeth of different anatomical groups. Investigation methods – macroscopic investigation of obturated root canal system using clearing technique for quality estimation; histologically for verifying and morphological ground of obturation rate; radiological for clinical ground of the offered obturation technique. 59 non-carious, recently extracted human teeth were collected from various dental clinics. Only teeth which had been extracted for periodontal or orthodontic reasons were used. Ethical and safety guidelines for the handling of human teeth and laboratory research were strictly followed. All selected teeth were examined and only roots with narrow canals, with no sharp curves were included in this study. Any roots that showed evidence of resorption, fractures or open apices (larger than 3 mm) were excluded from this study.

Preparation of root canals. Access cavities were prepared using a NSK high-speed handpiece (NSK, Nakanishi Inc., Japan), with size 023 round diamond burs (Dentsply Maillefer Instruments SA, Switzerland). The finishing of the access cavities was done with size 023 round steel burs (Dentsply Maillefer Instruments SA, Switzerland) and a NSK 1:1 contra-angle handpiece (NSK, Nakanishi Inc., Japan).

All the root canals were prepared by one operator under 3,5X magnification (Dental loupes, Carl Zeiss).

Working length was determined by passing a 08 K-file (Dentsply Maillefer Instruments SA, Baillagues, Switzerland) carefully along the canal, until the tip of the file was visible at the apical foramen. This length was recorded and 1 mm subtracted to provide the operator with a working length for each root canal. Apical patency was established by using C+ Files (Dentsply Maillefer Instruments SA, Baillagues, Switzerland) size 08, 10 and 15. A glide path was established with rotary NiTi files Pathfiles size 13, 16, 19 (Dentsply Maillefer Instruments SA, Baillagues, Switzerland) to working length.

Root canal preparation was done using ProTaper nickel titanium rotary files (Dentsply Maillefer Instruments SA, Baillagues Switzerland) mounted in a 16:1 gear reduction handpiece driven by an electric motor X-Smart (Dentsply Maillefer Instruments SA, Baillagues, Switzerland), using EndoGel #2 (VladMiVa, Belgorod, Russia), which is a mixture of 10% peroxide and 17% EDTA. The EndoGel #2 was alternated with 5,25% Sodium Hypochlorite (NaOCl) solution (VladMiVa, Belgorod, Russia). The files were used according to manufacturer's instructions by opening canal orifices to size 40 (10 percent taper) and the apical region of each canal was prepared to a size 30 (6 percent taper).

Finally, the dentinal smear layer was removed from all prepared root canals by leaving EndoZhi Solution (VladMiVa, Belgorod, Russia) in the prepared root canals for 2 minutes before rinsing for 5 minutes with 5,25% Sodium Hypochlorite (NaOCl) solution (VladMiVa, Belgorod, Russia). The irrigation solutions were delivered in a disposable syringe with a NaviTip needle (Ultradent Products Inc, South Jordan, Utah, USA).

The prepared teeth were randomly and equally divided into three groups (n = 30 canals). Each group contained prepared root canals of the following teeth: two maxillary first molars (four canals each), four maxillary premolars (two canals each), one maxillary canine (one canal each), two maxillary central incisors (one canal each), two mandibular molars (three canals each), four mandibular premolars (one canal each), one mandibular canine (one canal each), two mandibular central incisors (one canal each). All canals were dried by using several 6 percent tapered Paper Points (Dentsply Maillefer Instruments SA, Baillagues, Switzerland).

Results and discussion. Group A. Lateral Condensation Technique with Gutta-percha and AH plus cement **(**Dentsply Maillefer Instruments SA, Baillagues, Switzerland**).** A single gutta-percha point with a taper of 2 percent (Dentsply Maillefer Instruments SA, Baillagues, Switzerland) was used as a master cone, in conjunction with AH plus root canal cement (Dentsply Maillefer Instruments SA, Baillagues, Switzerland). The cement was applied to the entire length of the canals using the master cone. Accessory gutta-percha cones placed, using 2% tapered Spreader (Dentsply Maillefer Instruments SA, Baillagues, Switzerland) using lateral cold condensation. Group B. Continuous Wave of Obturation with Gutta-percha and AH plus (Calamus technique). A single gutta-percha point with a taper of 6 percent (Dentsply Maillefer Instruments SA, Baillagues, Switzerland) was used as a master cone, AH plus (Dentsply Maillefer Instruments SA, Baillagues, Switzerland) as root canal cement and Calamus (Dentsply Maillefer Instruments SA, Baillagues, Switzerland) to perform the continuous wave of condensation. Canals were back-filled with gutta-percha heated to 180°C in the Calamus unit (Dentsply Maillefer Instruments SA, Baillagues, Switzerland).

The master cone was cut back to 0.5 mm short of working length to ensure that the cone binds to the canal wall in its terminal 1 mm. The continuous wave electric heat plugger was selected with a taper matching the master cone taper. The plugger was inserted into the canal and confirmed that the binding point was within 4 mm of the working length. The stop was then adjusted to that reference point.

The master cone was buttered with AH plus sealer and slowly placed in the prepared root canal. The Calamus device (Dentsply Maillefer Instruments SA, Baillagues, Switzerland) set on 180°C, was used to sear off the master cone at the orifice with the tip of the continuous wave plugger and the softened gutta-percha was compacted with a Machtou plugger (Dentsply Maillefer Instruments SA, Baillagues, Switzerland). The cold continuous wave plugger was placed against the gutta-percha, the Calamus handpiece switch activated and gently pushed downwards until it was 3-4 mm shy of its binding point. With the switch released, apical pressure was maintained firmly on the plugger and after pressure was sustained for 10 seconds, the handpiece switch was activated for 1 second, the continuous wave plugger rotated and retracted to remove the coronal access of gutta-percha. The apical gutta-percha seal was compacted with a small Machtou plugger (Dentsply Maillefer Instruments SA, Baillagues, Switzerland) to create a flat surface that would avoid the formation of a void when backfilling. With the downpack completed, the Calamus Gun and needle (Dentsply Maillefer Instruments SA, Baillagues, Switzerland) were allowed to heat to 180°C. A 23 gauge needle was inserted into the canal until it touched the apical seal. A waiting period of 5 seconds was observed before pulling the trigger of the Calamus Gun (Dentsply Maillefer Instruments SA, Baillagues, Switzerland) to inject the heated gutta-percha into the backfill space. The gutta-percha was compacted at the canal orifices with a Machtou plugger (Dentsply Maillefer Instruments SA, Baillagues, Switzerland).

Group C. Thermafil Obturators with AH plus (Thermafil technique). The canals were verified with size 30 nickel titanium Verifier (Dentsply Maillefer Instruments SA, Baillagues, Switzerland). AH plus sealer (Dentsply Maillefer Instruments SA, Baillagues, Switzerland) was placed in the canals, adapting it to the walls and eliminating the excess with a paper point. Size 30 Thermafil Obturators (Dentsply Maillefer Instruments SA, Baillagues, Switzerland) were heated in the ThermaPrep Plus Oven (Dentsply Maillefer Instruments SA, Baillagues, Switzerland). The heated obturators were introduced into the canals, using small clockwise/counter-clockwise movements until they reached their final positions. After 8-10 seconds the obturators were sectioned with a Thermacut bur (Dentsply Maillefer Instruments SA, Baillagues, Switzerland) using light pressure.

After root canal obturation all the access openings were cleaned with 90% alcohol and sealed with Miracle Mix (GC Corporation, 76-1 Hasunuma-Cho, Itabashi-Ku, Tokyo, Japan). Specimens were stored at 37°C at 100 percent humidity for 48 hours to ensure complete setting of the root canal cements.

Radiographic Evaluation and Criteria Used For Obturation Quality Assessment**.**

Digital radiographs were taken of each obturated tooth from buccolingual and mesiodistal directions to assess the quality of the root canal obturation using a Satelec RVG sensor (Satelec Radiologie, France).

The quality of obturation was determined separately for the coronal and apical halves of each canal and was rated and scored according to the following radiographic appearances [7].

- well condensed root filling material that obturated the entire prepared canal, well adapted to the root canal wall and only show few minor areas of relative radiolucency (less than 0.25mm in diameter) – Scored 1,
- imperfectly condensed root filling material that show irregularities of less than 1 mm in adaptation – Scored 2,
- root canal filling material was inadequately condensed with irregularities of less than 2mm – Scored 3,
- root canal filling material was poorly condensed with irregularities of more than 2 mm – Scored 4.

Group A: Lateral Condensation Technique.

In the coronal aspects of the root canals in this group, most of the specimens demonstrated well condensed root fillings with no areas of radiolucency (Score 1) Figure 1 illustrates the radiographic appearance of one of these specimens (lower canine). Two of the ten obturated root canals (coronal aspect) in this group showed imperfectly

condensed root fillings, with irregularities of less than l mm in adaptation (Score 2). Two canals presented with inadequately condensed root canal fillings, with irregularities of less than 2 mm (Score 3).

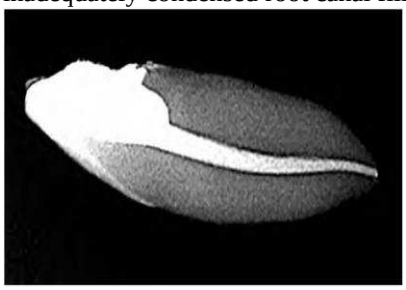

Figure 1 Radiographic appearance of lower canine with well condensed root fillings with no areas of radiolucency (Score 1).

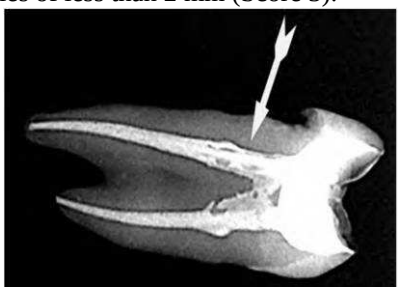

Figure 2. Lateral condensation technique specimen (upper premolar) that illustrated irregularities of less than 1mm (Score 2) in the coronal aspect of the buccal canal (arrow right).

The same specimens also demonstrated inadequately condensed root canal fillings in the coronal parts of these root canals. The specimens that were obturated with Lateral Condensation technique demonstrated a statistically significant higher number of radiographic obturation defects in the coronal aspect of the root canals compared with System B/Calamus and Thermafil techniques. In the apical aspect, there was also a statistically significantly higher number of radiographic obturation defects between the root canal fillings of Lateral Condensation technique compared with all the other techniques.

Group B: System B/Calamus Technique. Most of the canals in this group demonstrated well condensed root fillings with no areas of radiolucency (Score 1) in the coronal and apical aspects of the root canals. The quality of obturation of one of these System B/Calamus technique specimens is depicted in Figure 3. All three root canals in this lower first molar were well condensed with no areas of radiolucency (Score l).

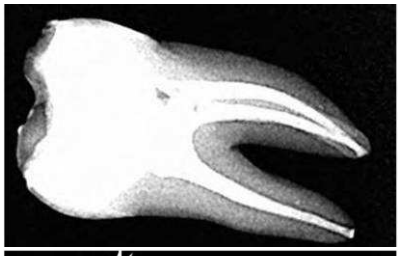

Figure 3. Lower first molar obturated with System B/Calamus technique, well condensed with no areas of radiolucency (Score 1).

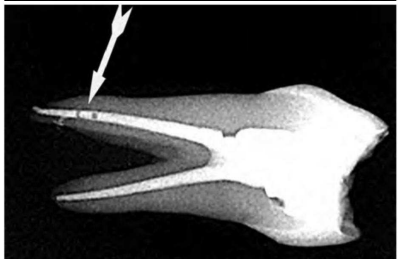

Figure 5. Upper premolar with imperfect root filling (Score 2) in the apical aspect of a buccal (arrow).

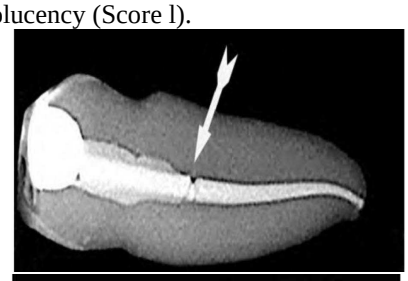

Figure 4. Lower canine with imperfect root filling (Score 2) in the coronal aspect (arrow).

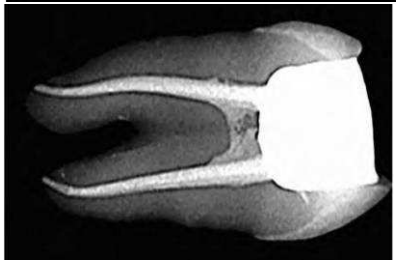

Figure 6. Upper first premolar obturated with Thermafil technique specimen, well condensed with no areas of radiolucency in the buccal and palatal root canals (Score 1).

There was evidence of only one imperfect root filling (Score 2) (Fig 4) in the coronal aspect of a lower canine (arrow) as well as in the apical aspect of a buccal canal of an upper premolar (arrow) (Fig. 5) of all the other root canals. The specimens that were obturated using System B/Calamus technique demonstrated the lowest number of radiographic obturation defects in the coronal aspects of the root canals compared with all the other techniques. However, there was only a statistically significant difference between System B/Calamus and Lateral Condensation techniques.

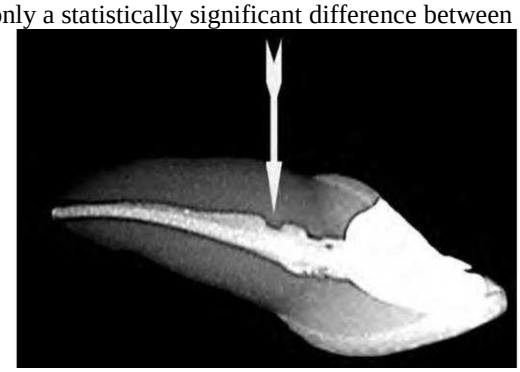

Fig. 7. Upper central incisor obturated with Thermafil technique that illustrated irregularities of less than 1 mm (Score 2) (arrow) in the coronal aspect of the root canal.

Group C: Thermafil Technique. Nearly all the canals in this group demonstrated well condensed root fillings with no areas of radiolucency (Score 1) in the coronal and apical aspects of the root canals. An example of a Thermafil technique specimen (upper first premolar) that was well condensed with no areas of radiolucency in the buccal and palatal root canals (Score 1) is depicted in Figure 6. Two of all the obturated root canals in this group illustrated imperfect root fillings (Score 2) in the coronal aspects of the root canals. All the root canals in this group showed well condensed root fillings in the apical aspects of the obturated root canals. Figure 7 shows one of the Thermafil technique specimens (upper central) that illustrated irregularities of less than 1 mm (Score 2) (arrow) in the coronal aspect of the root canal.

The specimens that were obturated with Thermatil and Calamus techniques demonstrated the lowest number of radiographic obturation defects in the apical aspects of the root canals compared with all the other groups. However, there was only a statistically significant difference between these two techniques and Lateral Condensation technique.

Conclusions

The Lateral Condensation technique demonstrated a statistically significant higher number of radiographic defects in the coronal and apical aspects of the root canals when compared to the Calamus and Thermafil techniques. There was no statistically significant difference between the radiographic defects in the coronal and apical aspects of the root canals between the Calamus and Thermafil techniques.

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Summary

ОПТИМІЗАЦІЯ ВИБОРУ СПОСОБУ ОБТУРАЦІЇ СИСТЕМИ КОРЕНЕВИХ КАНАЛІВ ЗА ДОПОМОГОЮ РЕНТГЕНОГРАФІЧНОГО АНАЛІЗУ

Геранін С.І., Гасюк Н.В., Черняк В.В.

При рентгенологічній оцінці якості обтурації в даному дослідженні, техніка латеральної конденсації показала найгіршу якість обтурації, як у корональному відділі, так і апікальному. Була виявлена велика кількість мікропорожнин і ці недоліки в обтурації напряму пов'язані із складністю виконання техніки латеральної конденсації у відпрепарованих зубах.

Ключові слова: обтурація, канали, латеральна конденсація.

Стаття надійшла 12.12.2011 р.

ОПТИМИЗАЦИЯ ВЫБОРА СПОСОБА ОБТУРАЦИИ СИСТЕМЫ КОРНЕВЫХ КАНАЛОВ ПРИ ПОМОЩИ РЕНТГЕНОЛОГИЧЕСКОГО АНАЛИЗА

Геранин С.И., Гасюк Н.В., Черняк В.В.

При рентгенологической оценке качества обтурации в данном исследовании, техника латеральной конденсации показала худшее качество обтурации, как в корональном отделе, так и в апикальном. Было выявлено большое количество микрополостей и эти недостатки в обтурации напрямую связаны со сложностью выполнения техники латеральной конденсации в отпрепарированных зубах.

Ключевые слова: обтурация, каналы, латеральная конденсация.

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НОРМАТИВНО-ПРАВОВІ АСПЕКТИ ОРГАНІЗАЦІЙНО-УПРАВЛІНСЬКИХ ЗАХОДІВ ЩОДО ПРОФІЛАКТИКИ ГРИПУ ТА ГРВІ

Проведений системний аналіз нормативно-правоовових актів у сфері профілактики грипу та гострих респіраторних вірусних інфекцій. Виконання державних нормативно-правоовових актів на місцевому рівні забезпечується за допомогою функціонально-структурної моделі організаційно-управлінських заходів, де організатором профілактичних заходів виступають органи місцевої влади і державного самоврядування. Виконавцями 1-го рівня є медичні учбові заклади, засоби масової інформації, санітарно-епідеміологічні служби, 2-го рівня – медико-санітарні частини, які безпосередньо проводять профілактику.

Ключові слова: нормативно-правові аспекти, організаційно-управлінські заходи, профілактика, грип, ГРВІ.

Наукові дослідження є фрагментом науково-дослідної роботи «Запальні та незапальні хвороби органів і систем людини, що формуються під впливом екологічних стресових метаболічних та інфекційних факторів. Стан гемо-, гомеостазу, гемодинаміки при застосуванні традиційних та нетрадиційних засобів лікування» № держреєстрації Укр. ІНТЕЛ 0198U000134.

За даними ВООЗ, щорічна смертність від гострих респіраторних вірусних інфекцій та їх ускладнень складає майже 4,5 млн. осіб в рік. Для порівняння: смертність від туберкульозу – 3,1 млн., малярії – 2,2 млн., гепатиту В – 1,1 млн [1]. В Україні активно формується правове поле державної політики у сфері профілактики інфекційних хвороб, в тому числі грипу та ГРВІ. Зокрема, прийнято Закони України «Про захист населення від інфекційних хвороб» [8], «Про затвердження Загальнодержавної програми імунопрофілактики та захисту населення від інфекційних хвороб на 2009 – 2015 роки» [6], Накази МОЗ України «Про заходи щодо