Temperature Changes on External Root Surfaces with the Use of Several Thermoplastic Filling Techniques

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Abstract

Introduction: The purpose of this study was to measure the temperature rise on the external root surface of filled root canals using Touch'n Heat (Analytic Endodontics, Orange, CA), the TC System (TC; Tanaka de Castro & Minatel Ltda, Cascavel, PR, Brazil), and the Tagger technique. **Methods:** Forty-five single-canal mandibular premolar human teeth were used in the 3 experimental groups. The root canals were enlarged to accommodate up to an R40 Reciproc file (VDW, Munich, Germany). Next, the specimens were filled according to the technique evaluated. The measurement of the temperature was performed by K chromium-aluminum thermocouples attached to the coronal, middle, and apical root levels. **Results:** There was a significant difference among the 3 techniques ($P < .001$) in relation to the temperature variation between the highest temperature and the initial temperature. The highest temperature change was found with the Tagger technique at the middle third root level (11.8°C), and the lowest variation was in TC at the cervical third (2.05°C). **Conclusions:** There was a rise of temperature on the external root surface for all of the techniques evaluated. TC showed the lowest temperature rise. *(J Endod 2016;42:1131–1134)*

Key Words

Tagger technique, TC system, temperature rise, Touch'n heat

Significance

Thermoplasticized gutta-percha techniques have been used in most endodontic treatments performed all over the world. This work highlights the increase in temperature on the external root surface of filled root canals using 3 techniques: TC System, Touch'n Heat, and Tagger technique. There was a rise in temperature on the external root surface for all of the techniques evaluated. TC System showed the lowest temperature rise.

The main therapeutic strategy to eliminate microorganisms in root canal systems is chemomechanical debridement. However, because of the known anatomic complexity of the root canal, microorganisms are left inside its space after biomechanical preparation. Thus, the obturation must seal the periradicular tissues from the residual microorganisms (1).

The materials commonly used in the obturation phase are gutta-percha and a sealer. Cold lateral condensation (CLC) is a very popular obturation technique; however, it has been stated that CLC does not effectively fill the root canal system and frequently leaves empty spaces and an irregular distribution of the sealer (2, 3). Thermoplasticized gutta-percha techniques have been used in most of the endodontic treatments performed all over the world because they present advantages, such as a shorter time required to perform the obturation and a better filling, compared with CLC (4–6).

Much research has shown that an excellent filling results from thermoplasticized gutta-percha (2, 6–9). Nevertheless, studies have also shown that the heat used to plasticize the gutta-percha promotes a rise of temperature at the external root surface (10–12). An increase of up to 10°C, continuing for 1 minute, is not harmful, which is compatible with normal bone repair, but higher temperatures or longer application times can cause damage to the periodontal ligament and can cause bone necrosis (13, 14).

There are various systems that are used to plasticize the gutta-percha. The main advantage of Touch'n Heat (TH; Analytic Endodontics, Orange, CA) is the simplicity of the technique, in which the downpack of gutta-percha can be achieved in 1 continuous motion with 1 heated plugger (15). The Tagger technique (TT) uses thermoplasty with gutta condensers on the gutta-percha cones inside the root canal (16). There is a hypothesis that the friction produced between the gutta condenser, the gutta-percha, and the wall of the root canal can cause a temperature rise, which can be transferred to the external surface. The TC System (TC; Tanaka de Castro & Minatel Ltda, Cascavel,

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0099-2399/$ - see front matter

http://dx.doi.org/10.1016/j.joen.2016.04.011

PR, Brazil) consists of filling the root canal with gutta-percha that has previously been plasticized in a specific device (17).

Considering the importance of the use of thermoplasty and whether its use can cause injury to periodontal tissues, the aim of this study was to measure the temperature rise on the external root surface of filled root canals by TH, TC, and TT.

Materials and Methods

Approval for this study was granted by the Ethics Committee of the Federal University of Mato Grosso do Sul, Campo Grande, MS, Brazil (CAAE 36405614.4.0000.0021). Forty-five mandibular premolars with complete root formation, which were extracted for orthodontic or periodontal reasons, were selected for this study. Soft tissues and the calculus were removed from the teeth. Next, all of the crowns were removed, and the root lengths were standardized at 12 mm. The working length was determined to be 1 mm shorter from the apical foramen.

The biomechanical preparation was performed using the Reciproc System (VDW, Munich, Germany) powered by an electric motor (VDW) in reciprocal movement. The root canals were enlarged up to the R40 file size. The irrigant used was 5% sodium hypochlorite of approximately 20 mL per root canal. Before the obturation, passive ultrasonic irrigation was applied with an Irrisonic tip (Helse Dental Technology, São Paulo, SP, Brazil), which was activated by an ultrasonic EMS device (Hu-Friedy, Chicago, IL). Then, the root canals were dried with absorbent paper points, and AH Plus sealer (Dentsply, York, PA) was manipulated according to the manufacturer's instructions. In sequence, the samples were divided into 3 groups (n = 15) in accordance with the obturation techniques: TC, TH, and TT.

Description of the Obturation Techniques

All of the devices analyzed were handled according to the manufacturer's instructions.

TC. First, the wall of the canal was coated with a thin layer of endodontic sealer as far as the working length with a paper point. Next, the gutta-percha alfa skirts were placed inside the electrical heater in which they had been plasticized by heat induction. The next step was to fill a small #25 or #40 gutta condenser (Dentsply Maillefer, Ballaigues, Switzerland) with the plasticized gutta-percha, and the set was introduced up to 1 mm before the working length. A micromotor was activated in the sequence at its fastest speed and was withdrawn to the exterior of the root canal with slow pistonlike movements. After the conclusion of the filling, a smooth vertical condensation was performed with a cold hand plugger to take up any shrinkage that might have occurred upon cooling.

TH. Before obturation, the plugger (0.08) was fitted, and the apical binding point was determined to be 5 mm shorter than the working length. A master cone #40 of medium size (Odous, de Deus, Brazil) was fitted to the working length, coated with AH Plus sealer, and placed in the canal. Each gutta-percha cone was seared at the orifice. TH was set to 10 potency, and the tip of the plugger was placed into the canal orifice beside the master cone and was heat activated. The plugger was advanced through the gutta-percha until it reached the apical binding point. Then, the heat of the plugger was inactivated, and apical pressure was maintained on the plugger in this position for 5 seconds to avoid any shrinkage because of the cooling gutta-percha. After 5 seconds, heat was activated for 1 second, and the plugger was quickly removed from the canal.

TT. A master cone #40 of fine-medium size (Odous) was fitted to the working length, coated with a minimal amount of root canal sealer (AH Plus), and placed in the canal. Subsequently, a size 25 fine finger spreader was selected and introduced within 2 mm of the working length. Fine accessory XF cones (Dentsply Maillefer) coated with the sealer were laterally condensed. Next, a set of gutta-percha and sealer was plasticized by a #50 stainless steel gutta condenser with a 2% taper (Dentsply Maillefer), which was activated with a micromotor at 10,000 rpm. The depth of the gutta condenser was 3 mm before the working length, and the duration of thermoplasty was between 5 and 10 seconds. Thereafter, a cold hand plugger (Dentsply Maillefer) was used to vertically condense the plasticized gutta-percha mass.

Analysis of Heat Changes on the External Root Surface

The study was performed at room temperature. The temperature at the mesial aspect of the external root surface was recorded every 5 seconds during the heating and cooling phases using a K chromium-aluminum thermocouple (Omega Engineering Inc, Stamford, CT) attached to the coronal, middle, and apical root levels with wax (New Wax; Technew, Rio de Janeiro, RJ, Brazil), and then this set was fitted to a clamp to perform the obturation technique.

With the recorded temperatures, the evaluation of the effect of the technique, the temperature level, and both the technique and the temperature in relation to the change of the initial and highest temperatures reached were analyzed by 2-way analysis of variance, and Tukey post-tests were used to perform multiple comparison tests. The statistical software used was SigmaPlot, version 12.5 (Systat Software Inc, San Jose, CA), at a significance level of 5%.

Results

The values of the initial and highest temperature recorded in each third of the evaluated root surface are shown in Table 1. The results of the temperature difference between the highest temperature and the initial temperature in each third of the root surface for the techniques used are shown in Table 2 and Figure 1. In relation to the temperature difference between the highest temperature and the initial temperature, there was a significant difference between the performed techniques ($P < .001$) of the evaluated thirds or the root surface ($P < .001$) as well as an interaction between these 2 factors ($P < .001$). In the multiple comparisons (Tukey post-test) at the cervical third, the temperature rise of the TC technique was observed to have statistically significant differences related to the other 2 evaluated techniques ($P < .05$). At the middle third, the temperature rise was different among all of the assessed techniques. TC was the lowest followed by TH and TT ($P < .05$). On the other hand, for the apical third, there was no difference among the 3 evaluated techniques ($P > .05$).

In the comparison of the root surface thirds, the temperature rise of the TH technique at the cervical and middle thirds was significantly higher than that recorded for the apical third (Tukey post-test, $P < .05$). TT showed a temperature rise that was higher than that of

TABLE 1. Mean (standard deviation) of the Initial and Highest Temperature Recorded for Each Technique on the Cervical, Middle, and Apical Thirds

Techniques	Third		
	Cervical	Middle	Apical
Touch'n Heat			
Initial temperature	27.91 ± 0.38	28.06 ± 0.42	27.98 ± 0.42
Highest temperature	37.15 ± 0.45	35.76 ± 0.60	30.69 ± 0.38
Tagger			
Initial temperature	26.12 ± 0.14	26.16 ± 0.17	26.22 ± 0.17
Highest temperature	33.82 ± 0.68	37.96 ± 1.29	29.82 ± 0.39
TC			
Initial temperature	27.53 ± 0.53	27.74 ± 0.58	27.74 ± 0.60
Highest temperature	29.58 ± 0.69	29.93 ± 0.70	29.93 ± 0.69