

IN VITRO INVESTIGATION OF INFLUENCE OF TEMPERATURE RISING ON PERIODONTAL TISSUE DURING ENDODONTIC TREATMENT

Sl. Dimitrov, Tz. Gueorgieva, V. Dogandzhiyska, I. Angelov*

*Department of Operative dentistry and Endodontics,
Faculty of Dental Medicin-Sofia,*

**Institute of Organic Chemistry, Bulgarian Academy of Sciences, Sofia, Bulgaria*

SUMMARY

Various manipulations during endodontic treatment and restoration of endodontic treated teeth can be associated with increase of the temperature in dental structure and periodontal tissue. These manipulations include: mechanical root canal preparation, obturation with warm condensation techniques, root – canal preparation for radicular post. The critical level of temperature, that doesn't cause irreversible consequences is 43°C. The aim of this study is to investigate the temperature changes on external root surface during endodontic treatment depending of dentin thickness. Thirty six single - rooted, human teeth extracted for prosthetic or periodontal reasons were selected for this study. Teeth were divided into four groups-nine teeth in each one. The temperature changes during mechanical root canal preparation, vertical warm condensation, continuous wave of condensation and root canal preparation for radicular post are explored and the results are presented.

Key words: temperature changes, external root surface, mechanical root canal preparation, warm condensation techniques for obturation, root canal preparation for radicular post.

INTRODUCTION

Various manipulations during endodontic treatment and restoration of endodontic treated teeth can be associated with increase of the temperature in dental structure and periodontal tissue. During thermoplastic methods of condensation the plastification of gutta-percha leads to rise of temperature on external and internal root surface (1,3,6,7). This may injure the cementum, periodontal ligament and alveolar bone. It has been found that the alkaline phosphatase in bone can be inactivated at 56°C, which is a critical temperature for bone damage (1) . The same authors report that if the bone structures are exposed to temperature at 50°C for 1 minute or 47°C for 5 minutes, the bone will resorb and will be replaced by adipose tissue

(1). The other authors announce for periapical inflammation when thermoplastified gutta-percha is injected - 160°C (3) . It has been accepted that 10°C is permitted level of temperature augmentation on external root surface (47°C) (3, 2) . The temperature changes on external root surface was investigated during root canal preparation for posts . The results show that during preparation the temperature on external root surface may increase at level that could cause injury of periapical tissue (2, 4, 5). These manipulations include: mechanical root canal preparation, obturation with warm condensation techniques, root – canal preparation for radicular post. The critical level of temperature, that doesn't cause irreversible consequences is 43°. The analysis of literary data shows discrepancies of the received results of heating the external root surface. In the use of miscellaneous techniques for processing and fulfilling of root canals the warming depends on the sort and the qualities of the instruments used for preparation, their cutting ability, number of revolutions per minute. Have given the importance of discussed issues for the endodontic treatment, the purpose in our study is to investigate the temperature changes on external root surface during endodontic treatment depending of dentin thickness. Thirty six single - rooted, human teeth extracted for prosthetic or periodontal reasons were selected for this study. Teeth were divided into four groups-nine teeth in each one. The temperature changes during mechanical root canal preparation, vertical warm condensation, continuous wave of condensation and root canal preparation for radicular post are explored and the results are presented.

Fig. 1. Experimental setting for thermal study

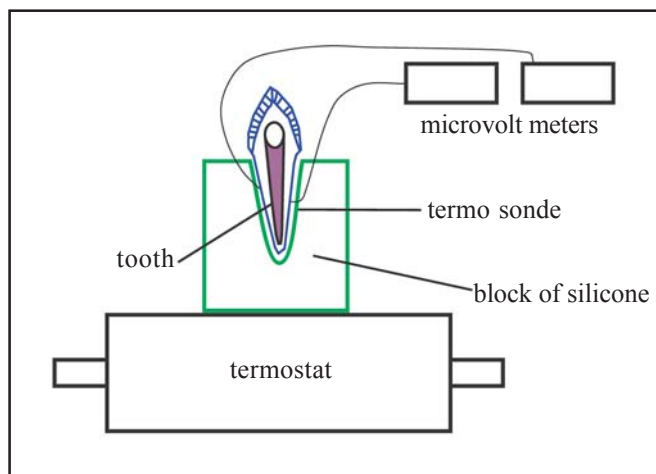
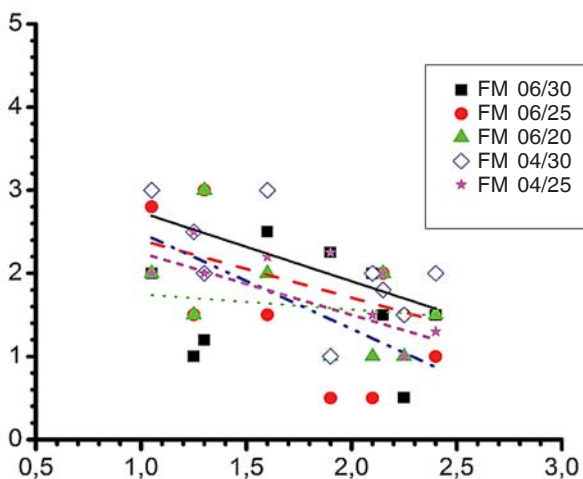


Fig. 2. Raising of temperature on external root surface depending on root dentin thickness during mechanical root-canal preparation with Flex Master



MATERIALS AND METHODS:

Forty single-rooted, human teeth extracted for prosthetic or periodontal reasons were selected for this study. Teeth were divided into four groups-nine teeth in each one. Endodontic cavities were prepared and working length was determined. The root canals were prepared at working length with hand K-file №25. Teeth were fixed in silicone canules at the enamel-cement junction/ECJ/ at $36^{\circ}\text{C}\pm 1^{\circ}\text{C}$. Temperature rise on the root surface was measured using one thermocouple for each tooth, that was fixed 10-

11mm apical from ECJ . The silicon blocks with included teeth with thermocouples are put on thermostatic camera made for the purpose. The measurement of temperature on external tooth surface at any particular manipulation begins after tempering the entire system up to $36^{\circ}\text{C} + 1^{\circ}\text{C}$. The used equipment gave a possibility for detection of temperature changes of dental surface with accuracy next to $0,2^{\circ}\text{C}$.

CONDUCTED EXPERIMENTS :

Group № 1: The root canals of teeth from group №1 are prepared with endodontic motor Endo IT and Flex master endodontic system at 260rpm; 125g/smI. The samples №1, 2, 3, 4, 5 and 6 are prepared with instruments:06/30,06/25,06/20 and 04/30; samples №7, 8 and 9 with instruments:06/25,06/20,04/30 and 04 /25.

Group № 2: The teeth are prepared the same way as the teeth from group № 1. The teeth were filled with the continuous wave of condensation technique using a System B Heat Source. The plugger and the gutta-percha cone are adjusted. The heat source was adjusted to 200°C . The plugger was driven through the gutta-percha cone in the canal to within 3-4mm of the binding point, the touch spring was released and then apical pressure was maintained on the plugger in this position for 10 seconds. The heat was activated for 1 seconds and the plugger was removed.

Group № 3: The teeth were prepared the same way as the teeth from group № 1. The root canals were obturated with gutta-percha using injectable technique and Obtura II system. The needle was positioned at a distance of ~3mm from the apex in order to inject the gutta-percha and vertically compacted with condenser.

Group № 4: The teeth were prepared the same way as the teeth from group № 1 and obturated using Obtura II. The root canals were prepared for radicular post with Dental Reamers "NORDIN", H. Nordin SA; CH-1816 Chailly at 600rpm; 217 g/cm^2 .

RESULTS, ANALYSIS AND DISCUSSION

The received values of temperature rise during various manipulations are presented on figure № № 2, 3 and 4.

The measuring of the temperature changes during mechanical root-canal preparation with Flex Master files (fig. 2.), root-canal obturation with warm condensation techniques (using System B and Obtura II) (fig. 3.) and root-canal preparation for radicular post with dental reamers "Nordin", showed that these manipulations are accompanied with raising of temperature on external root surface.

Fig. 3. Raising of temperature on external root surface depending on root dentin thickness during root-canal obturation with warm condensation techniques (using System B and Obtura II).

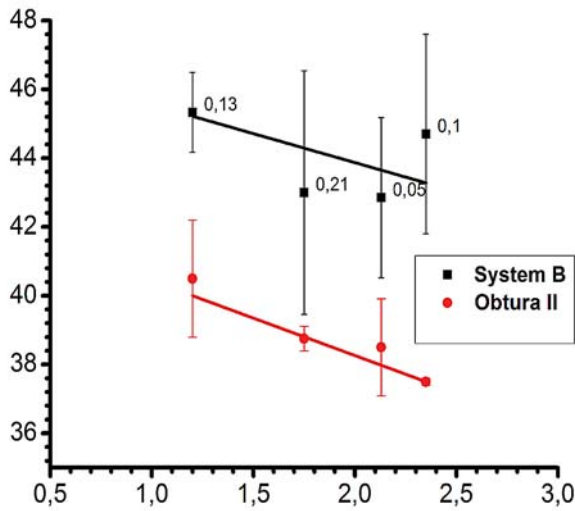
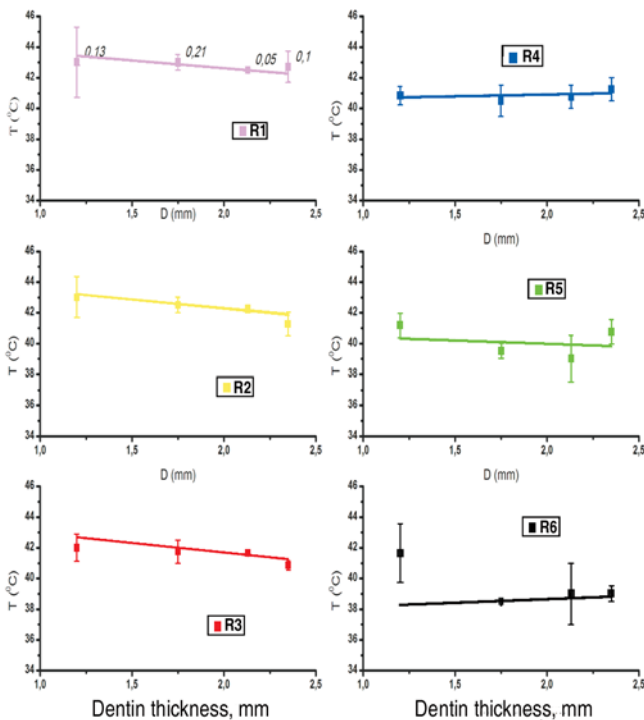


Fig. 4. (a, b, c, d, e, f): Raising of temperature on external root surface depending on root dentin thickness during root-canal preparation for radicular post with different No. No. dental reamers



The values of overheating diminish with increase of root dentin thickness and are different for each of the three techniques.

During mechanical root-canal preparation with different №№ files, the values of overheating are low and they couldn't cause damages of periradicular tissues (the values don't exceed 3-4°C in our study).

During root-canal obturation with warm condensation techniques with gutta-percha, when the heating continue more than 5-6 seconds is possible that the temperature values to reach 47-48°C (increasing with 10-11°C). This temperature could injure the periradicular tissues and alveolar bone (fig. №3). The risk is bigger for teeth with fine roots (lower incisors and premolars) – the thickness of root dentin of these teeth is under 1,5-2 mm.

During root-canal preparation for radicular posts are determined higher values of overheating when the smaller reamers are used №№ 1, 2- up to 8-9°C (to 45°C) and when the prepared teeth are with fine roots. This probably is associated with the fact that with the smaller reamers is taken off more dentin for unit time; the risk of overheating is bigger in initial stage of preparation.

CONCLUSION

The results of our study showed, that during warm condensation with System B and during initial stage of root-canal preparation for radicular post could be achieve overheating of external root surface over the critical level- from 6-7 to 10-11°C. It's necessary that we work with great attention, with precise dosage of the time of manipulation and cooling the dentin. It's recommended the use of devices for warm condensation with fixed time of heating up to 5 seconds. The break between the heating should be 10-15 seconds.

During root-canal obturation with Obtura II the temperature raising is lower and there is no risk of injury.

The root canal preparation for intraradicular posts should be done with new instruments at slow-motion of endodontic handpieces.

When we prepare teeth with fine roots, the risk of overheating is bigger.

For exact control of overheating during thermal manipulation during endodontic treatment we need in vivo studies with modern technique, such as infrared thermal imaging camera.

REFERENCES:

1. Behnia A, McDonald NJ. In vitro infrared thermographic assessment of root surface temperatures generated by the Thermafil plus system. *J Endod* 2001 March;27(3): 203-205
2. Hussey DL, Biagioni PA, McCullagh JJ, Lamey PJ. Thermographic assessment of heat generated on the root surface during post space preparation. *Int Endod J*. 1997 May; 30(3):187-90
3. Lipski M. Root surface temperature rises during root canal obturation, in vitro, by the continuous wave of condensation technique using system B heat source. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2005;99:505-510
4. Saunders EM, Saunders WP. The heat generated on the external root surface during post space preparation. *Int Endod J*. 1989 Jul;22(4):169-73.
5. Tjan AH, Abbate MF. Temperature rise at root surface during post-space preparation. *J Prosthet Dent*. 1993 Jan;69(1):41-5
6. Venturi M, G Pasquantonio, M Falconi, L Breschi. Temperature change within gutta-percha induced by System-B heat source. *Int Dent J*, 2002;35:740-746
7. Weller RN, KA Koch. In vitro radicular temperatures produced by injectable thermoplasticized gutta-percha. *Int Endod J*. 1995;28(2):86-90

Address for correspondence:

Tzvetelina Gueorgieva
Department of Operative dentistry and Endodontics,
Faculty of Dental Medicine,
1, Georgi Sofiiski str., 1431 Sofia, Bulgaria
E-mail: d_rtzvetelinageorgieva@abv.bg