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AN *IN VITRO* EVALUATION OF THE EFFECTS OF THREE THERMAL PULP TESTING METHODS ON INTRAPULPAL TEMPERATURE

AVALIAÇÃO IN VITRO *DOS EFEITOS DE TRÊS TESTES PULPARES TÉRMICOS SOBRE A TEMPERATURA INTRAPULPAR*

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ABSTRACT

Ice, CO_2 snow and dichlorodifluoromethane (–20°C) were compared for their ability to decrease intrapulpal temperature. CO_2 snow promoted the major temperature decrease while –20°C spent the minor time to produce the maximum decrease.

UNITERM: Dental pulp test

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INTRODUCTION

Thermal tests are widely used in assessing pulpal vitality with reference to the cold tests.

BEVERIDGE and BROWN[2] (1965) showed that an eight seconds application of cold ethyl spray to an anesthetized mandibular premolar caused a fall in intrapulpal pressure of 30 mmHg.

INGLE *et al.*[4] (1976) advocate that the fall in "interstitial pressure" results on an increase in "arterial transmural pressure", and the sudden filling of the pulp capillaries causes the pain of cold sensitive.

Among cold tests the most commonly used are ice, CO_2 snow and dichlorodifluoromethane.

PESCE *et al.*[7] (1985) evaluated the reliability of ice to produced pulpal response on intact teeth and found it to be 85.4% accurate.

OBWEGESER and STEINHAUSER[6] (1963) found CO_2 snow to be 97.5% accurate.

MAYER-WESSELING[5] (1970) found dichlorodifluoromethane to be 94.9% accurate.

The great accuracy of CO_2 snow and dichlorodifluoromethane may be due to the fact that they provide a higher decrease on intrapulpal temperature than ice does.

The objective of this study was to compare these pulping tests regarding their ability to decrease intrapulpal temperature *in vitro*.

MATERIALS AND METHODS

Two intact extracted central mandibular human incisors were used in this experiment. In each one a perforation was made from the enamel to the pulp chamber with a 1 mm diameter diamond round bur, on a point near the cingulus.

By means of a Mizzy needle and a carpule syringe, physiologic solution was injected into the pulp chamber until the solution escaped from the apical foramen ensuring that the pulp cavity was fulfilled with the solution.

Each tooth was placed in a circular hole of a specimen fixing device intending to isolate the crowns from the roots.

After that, the roots were submerged in a thermostatic bath denoting a constant moving of distilled water at a temperature of 37°C.

A copper-nickel (T type) thermocouple (24 AWG gauge, with captow protection, 1 mm diameter) was introduced in the pulp chamber of each tooth and connected to a temperature register (Yokogawa - LR 4100).

The thermocouple of one tooth (control) registered the temperature of the bath and, the other, the temperature changes in the pulp chamber during the application of the cold agents on the buccal surface of the tooth.

The temperature of the bath was still measured with a standard liquid in a glass thermometer 0.1°C graduation with uncertainty of about 0.05°C.

The thermal agents applied were ice, CO_2 snow and dichlorodifluoromethane (–20°C).

The ice sticks were made with freezing water in discarded anesthetic carpules.

The CO_2 snow sticks were produced with a G type cylinder, 165 mm external diameter, 10.5 Kg weight, 7 liters water

capacity and 4 Kg CO_2, coupled to a slow outlet escape valve and ejection tube with a CGA type connector for insulin syringe.

The ice and CO_2 snow sticks were applied directly on enamel, and –20°C was applied by means of cotton pellets, and were only removed when the decrease of temperature reached its maximum value.

The temperatures of the agents were registered with the same thermocouple previously described, and following the application of each agent, the intrapulpal temperature was registered with a digital display and with a printer.

RESULTS

The temperature of ice was 2°C; CO_2 snow and –20°C provided a temperature of –40°C and –55°C respectively (Table 1).

Table 2 shows the intrapulpal temperature decreases produced by CO_2 snow (13°C), ice (4.5°C) and –20°C (8.5°C).

The time consumed by ice to promote the lowest temperature was 69 seconds, higher than that consumed by –20°C (36 seconds) and by CO_2 snow (51 seconds) (Table 3).

DISCUSSION AND CONCLUSIONS

The aim of this study was to evaluate the lowest intrapulpal temperature produced by application of three cold agents used in the clinical determination of pulp vitality, and also the time spent for this.

One single tooth was used for tests because the aim of this study was to establish a comparison of the cooling efficiency of the thermal agents and not their cooling ability in different dental groups.

WHITE *et al.*[8] (1977) evaluated these cooling effects with the tooth calibrated at room temperature while AUGSBURGER and PETERS[1] (1981) calibrated the teeth at body temperature using a temperature control unit, and FUSS *et al.*[3] (1986), a water bath at 34°C.

Table 1 - *Temperature of the agents (°C).*

Ice	2
CO_2 snow	–40
–20°C	–55

Table 2 - *Maximum decrease of intrapulpal temperature (°C).*

Ice	4.5
CO_2 snow	13
–20°C	8.5

Table 3 - *Time spent to reach the maximum decrease of intrapulpal temperature (sec).*

Ice	69
CO_2 snow	51
–20°C	36

We used a water bath at 37°C, and submersion of the root was carried out in a manner that the water at this temperature, once entering the apical foramen, fulfilled the root canal and pulp chamber so as to reproduce, *in vitro*, the *in vivo* intrapulpal temperature.

The time spent on applications did not correspond, in this study, to that recommended in clinical situations because we were interested in determining the cooling capacity of the thermal agents and in comparing the lowest intrapulpal temperatures they promote when applied on dental enamel.

Our results regarding the comparison of intrapulpal temperature decrease agree with those of other authors who found that CO_2 snow produces intrapulpal temperature

decrease higher than dichlorodifluoromethane and ice are the less effective.

The ice consumed more time to reach the lowest intrapulpal temperature and provided the minor decrease when compared with the other two tested agents, which may be explained by the great difference between its temperature (2°C) and that of the CO_2 snow (–40°C) or –20°C (–55°C).

The lesser time spent by –20°C to reach the lowest temperature may be explained by the fact that when the cotton pellet was applied to the tooth, the cold was dissipated by the melting of the crystals, resulting on no cooling beyond 36 seconds. Otherwise, CO_2 snow and ice were not exhausted during all the time that they were applied, and the greater temperature decrease produced by CO_2 snow, when compared with –20°C, may have resulted from the fact that this agent acted for more time.

These findings are in agreement with those of FUSS *et al.*[3] (1986) who found that a 15 seconds application of dichlorodifluoromethane produced a lower decrease of intrapulpal temperature than did CO_2 snow.

We believe that the major ability of CO_2 snow and –20°C in decreasing intrapulpal temperature lies on the fact that they cause a more prompt and pronounced fall in intrapulpal pressure and a consequent faster filling of the pulp capillaries, so justifying the greater reliability of these agents in comparison with ice.

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RESUMO

O gelo, a neve carbônica e o diclorodifluorometano (–20°C) foram comparados quanto à sua capacidade em diminuir a temperatura intrapulpar. A neve carbônica promoveu a maior diminuição de temperatura enquanto o –20°C despendeu o menor tempo para produzir a diminuição máxima de temperatura.

UNITERMO: Teste da polpa dentária

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