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Cold Test: Highly Valued, but Inappropriately Used?

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Abstract

Background: Pulp test is one of the crucial facet in determining health of dental pulp. Cold test with endofrost and ice sticks have been performed but the exact location for the best response has not been cited.

Aim: To check the appropriate site to perform a cold test on anterior tooth and to compare endofrost with icesticks based on the response time.

Setting and design: An invivo study was performed following the approval of ethical committee after obtaining the consent from the subjects. A total of 20 subjects in the age groups of 20-50 years were considered in the study.

Methods: The test was subcategorised and cold test was performed with icesticks and endofrost. The labial surface of the anterior tooth of the patient was divided into three parts cervical, middle, incisal third. The patients were instructed to raise one hand when they experienced a sensation and time was noted using a stopwatch. Also the test was performed with #2 cotton tip applicators and #4 cotton tip applicators and checked for the response time and the results were calculated.

Results: The time taken to respond to cold test with icesticks was lowest in the cervical third. The patients took the least time to respond in the middle third to cold test with endofrost when used with both small and large cotton tip applicators. The time taken by majority of the patients was least when the cold test was performed with endofrost than when the cold test was performed with icesticks in the middle and incisal third

Conclusion: Within the limitations of this study we can conclude that endofrost is a faster method to do a cold test when compared to ice sticks. Cervical third is the appropriate site toperform cold test with icesticks. With endofrost middle third is the faster to perform cold test. Larger the size of cotton tip applicator faster is the response when performing the cold test.

Keywords: Vitality test, Cold test, Endofrost, Icesticks, Cotton tip applicators.

Introduction

Pulp sensibility test is one of the crucial facet in determining the health status of dental pulp. It provides a valuable treatment planning information and thus complements the endodontic diagnosis. Thermal tests using cold as stimulus are most commonly used in clinical practice. Cold tests have been previously performed with ice sticks and endofrost but the exact location for appropriate response has not been exactly cited. So this study was employed to check the appropriate site to perform a cold test on anterior tooth and to compare endofrost with icesticks based on the response time.

Subjects and Methods

An in vivo study was performed following the approval of ethical committee after obtaining the consent from the subjects. A total of 20 subjects in the age groups of 20-50 years were considered in the study. The tooth tested was incisors and canines.

They met the following inclusion criteria

• Subjects without diagnosed systemic diseases.

• Without medication 24 hours before starting the study.

The exclusion criteria included

• Subjects undergoing orthodontic treatment

• Trauma within last six months

The subjects were blindfolded. The tests were performed by a single clinician to avoid any bias. The tests were conducted as follows:

Cold Test with Icesticks

2ml of anaesthetic carpule was filled with water and placed in refrigerator to form an icestick. The icesticks obtained were of 3.5mm diameter and 7mm length. The teeth were isolated with rubberdam for cold test with icesticks. The labial surface of the anterior tooth of the patient was divided into three parts cervical, middle, incisal third. While performing the tests ice sticks were placed in gauze to prevent the warmth from operator's fingers prematurely. Then the icesticks were placed on the labial surface of the tooth in the cervical third of the tooth following which the timer was set. The patients were instructed to raise one hand when they experienced a sensation and time was noted using a stopwatch. For the pulp to recover there was a 5 minute gap while performing the test and then similarly the procedure was conducted on middle third and incisal third of the tooth.

Cold Test With Endofrost

ENDOFROST (-50 degrees Celsius, Coltene / Whaledent that contains propane, butane, isobutane) was used in the study. The teeth were isolated using cotton rolls and gauze pieces. The labial surface of the tooth to be tested was divided into three parts incisal, middle, cervical third. Cotton pellets of size #2 were held with a pair of stainless steel cotton pliers and ENDOFROST was sprayed on cotton pellets directly with distance of 5.0 mm for a period of 5s. This allowed the cotton pellet to become saturated to the point where the frost was dripping from the pellet. The pellet was then placed on the cervical third of the tooth (for 5 seconds or till the patient felt any cold sensation) and timer was set. The patient was instructed to raise a hand when a cold sensation was felt and time was recorded using a stop watch. A gap of 5 minutes that allowed the recovery of pulp was given and then the above procedure was carried out in middle third and incisal third respectively.

The labial surface of the teeth were divided into incisal, middle and cervical thirds and cold test was carried out with endofrost spray and cotton pellets of size #4 as mentioned above in all the thirds of the tooth with a gap of 5 minutes and the response time was noted.

The appropriate location to perform a cold test was based on response time.

Result

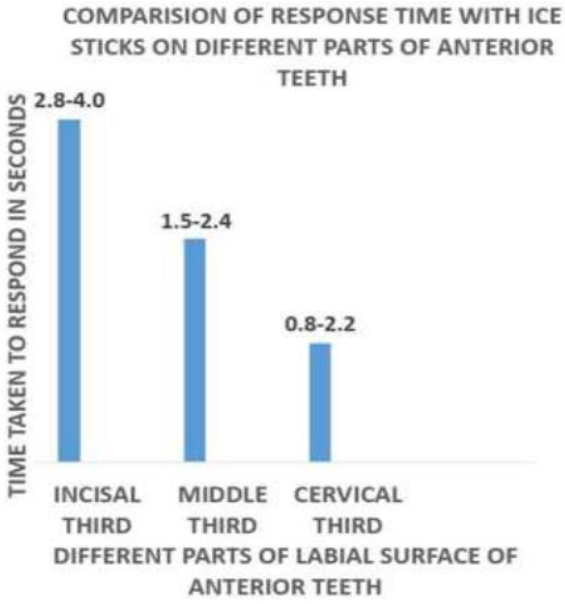

Figure 1

The average time taken by the patients in the incisal third with icesticks was 2.8-4 seconds (Figure 1). Similarly the patients responded in range of 1.5-2.4 seconds and 0.8-2.2 seconds in the middle third and cervical third respectively with the icesticks. As depicted (in Figure 1) the time taken to respond to cold test with icesticks was lowest in the cervical third.

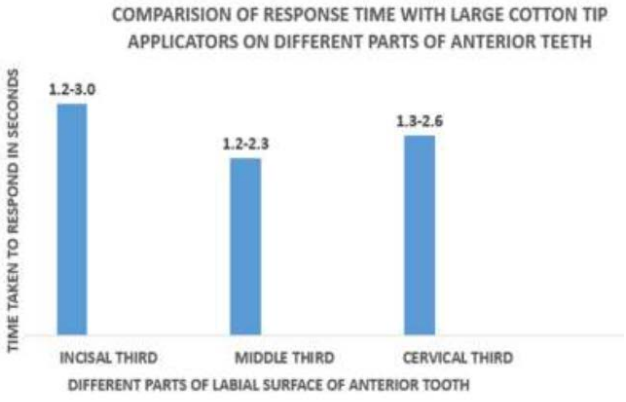

Figure 2

The average time taken by the patients to respond with size #2 cotton tip applicator was 1.5-3 seconds in the incisal third, 1.2-2.3 seconds in the middle third, 1.3-2.6 in the cervical third.

(Figure 2)The average time taken by the patients to respond with size #4 cotton tip applicator was 2.5-4 seconds in the incisal third,1.4-2.5 seconds in the middle third and 1.6-3.1 seconds in the cervical third.(Figure 2) As depicted above (Figure 2) the patients took the least time to respond in the middle third to cold test with endofrost when used with both small and large cotton tip applicators.

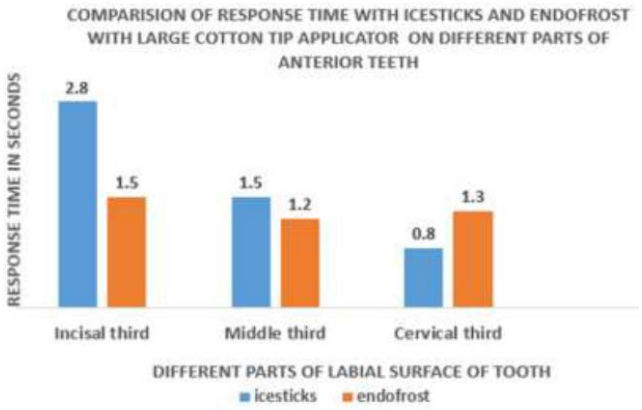

Figure 3

The time taken by majority of the patients was least when the cold test was performed with endofrost than when the cold test was performed with icesticks in the middle and incisal third (Figure 3) which is depicted in the above graph.

Discussion

Stimulation of pulp with thermal tests is one of the oldest methods to evaluate health of pulp and its ability to respond to external stimulation. Records including Edwin Smith Surgical Papyrus have referred to use of cold stimulus as a form of pulp testing since 2500BC1. Severalmethods such as ice sticks, refrigerant sprays, carbondioxide snow, ethylchloride are available with major difference between them being temperature produced by each test2.In general the response to cold

test is measured as positive or negative reaction but the quality of response is also important3.

Icesticks have been used as media for cold test. It has been indicated that application of ice stick for a period of 5 seconds is reliable and valid method4. In this study the fastest response was seen in cervical third with ice sticks where the mean time taken to respond by patients was 0.8-2.2 seconds (Figure1) compared to the time taken by the patients to respond in the incisal and middle third thus suggesting that this could be the best site for performing cold test. This can be attributed to the layer of enamel thickness which is less on cervical third of teeth thus generating a quicker response from dentin.

Studies by Chen E and Peters indicate that thermal tests are more accurate when placed on the cervical third of the buccal surface because this location represents the thinnest aspect of the enamel and the closest distance to the pulp chamber5.Cold response appears to relate directly to the thickness and type of tooth structure (enamel or dentin) between the source of the cold and the pulp. When any part of the tooth had thin enamel or where there was exposed dentin or metal restorations, these surfaces were used as the test surface if deemed likely to give better thermal conduction[6].

However studies conducted suggest that icestick is simply not cold enough and other methods like dry ice and refrigerant sprays can be used3. Also studies suggest that the melting ice might stimulate nerves within surrounding gingiva of tooth being tested or adjacent teeth or nearby teeth, which can result in false response that may lead to incorrect diagnosis[1].

In this study endofrost was sprayed on cotton pellets the patients took an average time of 1.2- 2.3 seconds to respond when used with large cotton tip applicator and in the range of 1.4-2.5 seconds to respond with small cotton tip applicators (Figure 2) thus suggesting middle third gave the quickest response and thus middle third is the appropriate site to perform cold test using endofrost. This can be explained by the hydrodynamic theory concerning the sensory response of tooth to thermal stimulation. Application of heat and cold results in the rapid movement of dentinal fluid that mechanically stimulate the sensory terminals located in the region of PDJ. This response is due to rapid temperature change that causes sudden fluid flow in dentinal fluids and deforms the cell membranes of free nerve endings. Based on hydrodynamic theory outward movement of dentinal fluid caused by (contraction of fluid) application of cold produced stronger response in a delta fibres than the inward movement of fluid caused by application of heat(9, 10) .The cervical third may give false positive response.

The thermal tests are effective if a sufficient amount of osmotic changes take place within tubules and tubules get narrower as we move incisally with lesser fluid thus it takes greater time to respond to the test. Thus this explains that middle third is appropriate site to perform a cold test with endofrost. Our study found similar results to study conducted by Cohen who also suggests that middle third is the appropriate site to perform a cold test with refrigerant sprays[8].

The greatest time to respond to cold test was taken in the incisal third of the tooth surface. Researchers have reported high and low values of sensitivity, specificity, accuracy, positive predictive value and negative predictive value with cold and electric tests in the incisal third of the tooth surface7.Demercii and Roh D et al have reported high frequencies of caries followed by restoration, enamel loss (abrasion) and exposed dentin on the incisal third of the tooth and suggest all these clinical pathologies are associated with false

results when using pulp sensibility tests and suggest incisal third might not be an appropriate site for performing the cold test(11, 12)

In this study it was seen that larger the cotton tip applicator, faster is the response at all the three sites cervical third, middle third and incisal third (Figure 2). This could be explained by the theory that the smaller cotton tip applicator had smaller surface area hence it did not wet enough the tooth with refrigerant spray to generate the delayed response. However the same large cotton pellet cannot be applied twice. Studies performed by Garza et al and Jones also showed that when the refrigerant spray was used, larger cotton carrier generally produced the largest decrease in pulpal temperature at each repeated application compared to other types of carriers(13, 14)

Various authors have suggested different sites for performing the cold test. Thus more studies need to be done in future to confirm the appropriate sites for performing the cold test.

Conclusion

Within the limitations of this study we can conclude that endofrost is a faster method to do a cold test when compared to ice sticks. Cervical third is the appropriate site to perform cold test with icesticks. With endofrost middle third is the faster to perform cold test. Larger the size of cotton tip applicator faster is the response when performing the cold test.

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