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Original Research

Effect of intracanal cryotherapy on fracture resistance of teeth that have undergone endodontic treatment-An *in vitro* study

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ABSTRACT:

Introduction: Intracanal cryotherapy is a promising pain control strategy without any side effects so it is important to know about its effect on mechanical properties of teeth. Hence the present study aims to evaluate the effect of applying intracanal cryotherapy on the fracture resistance of teeth that are endodontically treated. **Method:** Thirty mandibular incisors with single root canal were selected and randomly divided into groups A & B (n=15). The specimens were kept in distilled water at 37°C that simulated mouth temperature during the procedures. The biomechanical preparation of the samples was done till the apical size of 50 and assigned to either the control group or the cryotherapy group. The surfaces of the specimen were covered with silicone upto 2 mm below Cementoenamel junction to simulate periodontal ligament and immersed in self-curing resin. The specimens in the cryotherapy group (group B) were irrigated with 20mL sterile cold (2.5°C) saline solution for 5 min, whereas specimens in the control group (Group A) received a sterile saline solution at room temperature. The fracture resistance of the specimens was tested with a universal testing machine. The statistical analysis was done **Result**: The results showed that the cryotherapy specimens group had lower fracture resistance as compared to that of control group specimens. **Conclusion**: Within the limitations of the present study, it can be concluded that if we use intracanal cryotherapy as a final irrigant, it reduces the vertical fracture resistance of roots.

Keywords: Intracanal Cryotherapy, Fracture Resistance, Universal testing machine, Endodontically treated teeth.

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INTRODUCTION:

Postoperative pain is a discomforting experience for both the patient and the doctor and is contributed to by various factors which includes the condition of the pulp and the perirapical tissues, pretreatment pain, and the presence of periradicular radiolucency [1–3]. The causes of postoperative pain are mechanical, chemical, and/or microbiological injuries to the periradicular tissues [2,4–6]. Several strategies have been developed to minimize or eliminate postoperative pain, which include the prescription of prophylactic drugs, administration of long-lasting anesthesia, crown-down preparation, occlusal reduction, and recently intracanal cryotherapy [4,5,7–10,11]. It is reported that inflammatory enzymes get released at higher temperatures which contribute to the postoperative pain [13]. Cryotherapy has been seen to substract heat from the applied tissues and decreases tissue temperature, which results in vasoconstriction and the prevention of edema [12]. Vasoconstriction also inhibits the metabolism in cell therefore reduces the oxygen demand of cells thus preventing the production of tissue free radicals [12,13]. Moreover, cryotherapy also limits the conductive capacity of nerves, decreasing the incidence of postoperative pain [14]. A previous in vitro study has shown that intracanal cryotherapy reduces the external root surface temperature by 10 ℃ for 4 min[15]. Various clinical studies and a recent randomized control trial has proved that intracanal cryotherapy

reduces the post operative pain [7,16–18]. It is reported that temperature changes influence the mechanical properties of dentin [19,20]. However, very few literatures exist regarding the application of intracanal cryotherapy and its effect on the fracture resistance of endodontically treated teeth. Since intracanal cryotherapy is a promising pain control strategy with minimal side effects, it is very important to know whether it has any effect on the mechanical behaviour of teeth.

Therefore, the purpose of this study was to apply intracanal cryotherapy as a final irrigant in endodontically treated teeth and check their fracture resistance. The null hypothesis is that there would be no difference among the fracture resistances of the specimens regardless of the cryotherapy applications.

MATERIAL AND METHOD:

This present study was conducted by PG student and staff of Department of conservative Dentistry and Endodontics Ahmedabad Dental College And Hospital, Bhadaj Ahmedabad, Gujarat 382115. In this study 30 single rooted human mandibular incisors extracted due to periodontal reasons were included. Teeth with incomplete apices, decayed teeth, fractured teeth, teeth with abnormal anatomy, teeth with previous endodontic treatment were excluded. Soft and hard tissue debris was cleaned from all teeth and were standardized to 15 mm length by decoronation. The specimens were immersed in distilled water to prevent dehydration until needed for the experiment. To establish the WL, #10 K-file was inserted into the root canal until it was visible through the foramen, and 0.5 mm was subtracted from that distance. Biomechanical preparation was done with hand filing with K files using crown down method. Master apical file was #50 K file. Copius irrigation was done in between use of each file with 3% sodium hypochlorite and normal saline. A final rinse with 17% EDTA was used to irrigate all root canals for 1 minute and then dried with sterile paper points. The surfaces of the specimens were covered with silicone up to 2 mm below the CEJ to simulate periodontal ligament. The specimens were then kept in self-curing acrylic resin up to 2 mm below the CEJ and allowed to polymerize for one hour. The specimens were divided into 2 groups, CONTROL GROUP (A) (n=15) and EXPERIMENTAL GROUP (B) (n=15). The specimens were subjected to 2 different irrigation interventions. The specimens in the cryotherapy group(group B) were irrigated with 20 mL sterile cold (2.5°C) saline solution for 5 min (Saline solution was kept in a calibrated refrigerator at 2.5ºC until used) whereas specimens in the control group(Group A) received a sterile saline solution at room temperature. The base of the specimens i.e. acrylic portion were kept in distilled water at 37°C temperature. During the procedure and the irrigation was done from the exposed 2mm tooth structure through opening. The fracture resistance of the specimens were tested with a universal testing machine. The statistical analysis of the results was done.

STATISTICAL ANALYSIS:

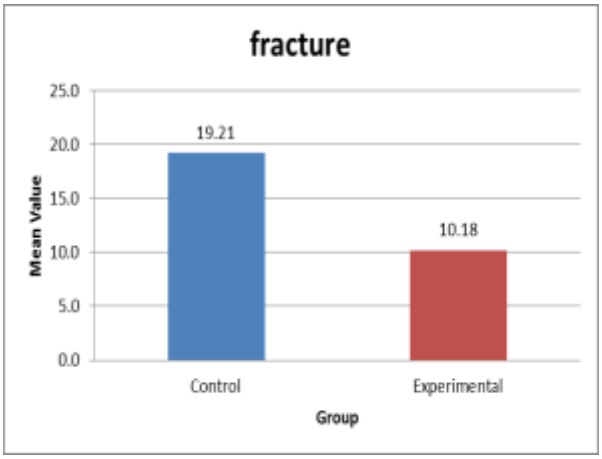
Independent Sample T-Test showed that the p value is <0.05, hence there is significant difference between groups and we can reject the null hypothesis.

RESULTS:

The results showed that the specimens in the cryotherapy group had lower fracture resistance as compared to that of specimens in control group.

GROUPS	N	Mean	Std. Deviation	Std. Error Mean	Mean Difference	P Value
Control Group (A)	15	19.21	0.99	0.19	9.04	.000
Experimental Group (B)	15	10.18	0.39	0.07		

FRACTURE RESISTANCE



DISCUSSION

The purpose of this study was to evaluate the effect of applying intracanal cryotherapy on the fracture resistance of teeth that are endodontically treated The results of this study showed that the specimens in the intracanal cryotherapy group exhibited significantly lower fracture strength values as compared to the control group. One of the source of mechanical stress in the tooth structure is thermal change [(26)]. The magnitude of stress is dependent on the temperature difference between the tooth and the medium, the tooth geometry, the heat transfer coefficient, and the physical properties of the tooth, such as aging or previous mechanical stress [(26)]. A study had showed that the application of ice water on the outer surface of the tooth resulted in excessive thermal stresses in the tooth structure, specifically tensile stress in enamel and compressive stress in dentin, which lead to structural deformation as rapidly as within 1 second after exposure [(26)] . However, in clinical procedures, when cold solutions are applied to the teeth they would acclimate to body temperature in a short period of time so in the present study, body temperature was simulated during intracanal cryotherapy irrigation, and the results of this study indicated significantly lower fracture strength in specimens exposed to cryotherapy irrigation. The application of cold water inside of the pulp space might result in excessive thermal stress in the dentin substance because of the lack of enamel structure and the different tubular microstructure of the dentin near the pulp space [(22,23,24)] . Hence we can say that just as there are two sides of a coin the intracanal cryotherapy although being a good strategy for controlling post operative pain, has a big disadvantage of adversely affecting the mechanical property of teeth by reducing their fracture resistance. Clinical studies are required to confirm the clinical survival rate of root canal treated teeth that have undergone different cryotherapy procedures. In the present study, all included specimens were mandibular incisors, which were selected and assigned to groups according to their similar dimensions. The length of the specimens was standardized to 15 mm and the root canals were mechanically enlarged to the same dimensions using the same types of instruments and techniques. However, uncontrollable physiological variations, such as the unknown age of the patient or previous mechanical stresses on teeth, might still influence the results.

CONCLUSION:

Within the limitations of the present study, it can be concluded that if we use intracanal cryotherapy as a final irrigant, it reduces the vertical fracture resistance of roots

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