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FUZZY MEASURE-CHOQUET MODEL IN HEAT TRANSFER PHENOMENON IN HUMAN TEETH

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ABSTRACT

Warmness generated inside tooth all through medical dentistry can motive thermally triggered damage to tough and soft additives of the enamel (tooth, dentin and pulp). Geometrical characteristics of immature teeth are one-of-a-kind from those of mature tooth. The purpose of this experimental and theoretical look at was to research thermal adjustments in immature everlasting enamel during the usage of mild-curing units. This research investigates fuzzy Measure-Choquet Model investigation about heat transfer phenomenon in human teeth. Common polymerization light sources are used as the main heat source; Overall, thermal stimulation for 30 seconds with a low-intensity increased the temperature from 28°C to 38°C in IIT (intact immature tooth) and PIT (cavity-prepared immature tooth). When an excessive-intensity LED LCU became used, tooth temperature extended from 28°C to 48°C. The outcomes of the experimental tests and mathematical modeling illustrated that using LED LCU on immature teeth did not have any unfavorable impact on the pulp temperature. Sensitivity evaluation showed that versions of heat conductivity may have an effect on warmness switch in immature teeth; therefore, similarly researches are required to decide thermal conductivity of immature tooth.

KEYWORDS: Fuzzy Measure-Choquet, Heat Transfer, Dental Pulp, Human Tooth, Light Polymerization

INTRODUCTION

A number of products and procedures used in dental diagnosis and treatment, such as cavity such as the geometry of tooth components, thickness of enamel and dentin, type of restorative materials, blood perfusion and pulp circulation. In recent years of dentistry, as in whole medicine, heat effects and heat transfer phenomena are of great importance. Warmness transfer happens in each day lifestyles and curing process. The thermal surroundings of teeth at some stage in daily life vary over a wide range of temperatures of temperature. The purpose of this in vitro study was to investigate thermal changes in different layers of immature permanent teeth during the use of Fuzzy Measure-Choquet with different intensities in order to detect possible harmful effects [1, 4, 8 and 13].

This wide temperature variety is so perilous and may create irrecoverable injuries in enamel tissue. This wide temperature variety is so perilous and may create irrecoverable injuries in teeth tissue. With the rapid growth of dental instruments, high-energy laser lights and polymerizing units are increasingly employed in dental surgeries for applications such as bleaching, polymerization of dental restorative materials and hypersensitivity treatments. This lists currently available treatments and corresponding intrapolar temperature rise (IPTR). Considerable changes in temperature as a result of utilizing these instruments occur during treatment procedure and may cause injury to tooth hard (enamel and dentine) and soft components (dental pulp),Figure I shows the details of tooth layers. The thermo-physical properties of tooth vary from one layer to another; they even differ from an immature person to a mature person in the same layer. The mismatch in the thermal expansion coefficients between tooth hard components may induce thermal pressure, followed by split inception and propagation through the dentine enamel. Furthermore, when the temperature in the pulp chamber exceeds the critical value the pulpal damage occurs in found that usage a high power for a short time or a standard halogen for a longer time did not result in a considerable difference in the temperature increase or the number of living cells within a pulp chamber[2,3,7,22].

However, found experimentally that the healthy pulps of monkey tooth were unsuccessful in recovering in 60% of the cases if the intrapolar temperature increases to 46.5°C and 15% failed to recover when heated to 42.5°C, with pulp necrosis observed the temperature acquires 52°C [21].

Despite the wide applications of these high-tech dental treatments, the base of their mechanisms are far from clear. Besides, the degree of tooth damage depends on a wide range of reasons, most significant of which are individual specifications e.g. age, sex and race. The swift usage of polymerization lights has brought measuring temperature in tooth layers to a higher level. In addition, there is an essential need to investigate the heat transfer phenomenon in human teeth [17].

Meanwhile these investigations and measurements provide helpful tools for prediction of possible damage for applications of light sources during polymerization procedures. The aim of this research is to investigate the temperature rise in human tooth (in vivo) because of utilizing light sources common for polymerization tasks [12].

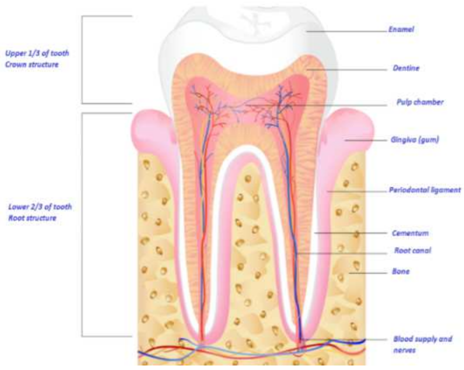


Figure.1: Human Tooth Layers

METHODS

Fuzzy Expert Systems

A fuzzy expert gadget is an expert expertise-based device that incorporates the bushy algorithm in a simple rule base. In this device, the information, encoded in the rule base, is originated from human experience and instinct and the rules constitute the relationships between the inputs and outputs of a system. A fuzzy expert machine is constituted of 4 components: fuzzifier, information base, inference engine and deffuzifier (Fig. three): The Fuzzifier plays fuzzification, which is ‘to transform actual numbers of enter into fuzzy sets. ’The understanding base includes a database and a rule base. Database includes ‘membership functions of the fuzzy sets’, whereas the guideline base includes ‘a set of linguistic statements in the form of IF-THEN regulations with antecedents and consequents, respectively, linked by using AND operator (different operators inclusive of OR, and not may be used).’The inference engine that paperwork the center of a fuzzy expert system utilizes IF-THEN rules included in the guideline base to deduce the output through fuzzy or approximate reasoning. The approximate reasoning system is to broaden end from a hard and fast of IF-THEN guidelines alongside with some distinctive situations. The defuzzifier the fuzzy output elicited through the inference engine via converting it to an actual number domain. The center of place (COA) is the most famous defuzzification method all of parameters which discuss on this version are defined in table 1 to 4 [15, 16 & 18].

Table1: Input Values and those Choquet Integrated Values

No.	Laser Assisted	Bleaching	Polymerization	HSHP	Choquet Integrated Values
1	0.1	0.4	0.2	0.3	0.217243
2	0.2	0.3	0.2	0.3	0.240162
3	0.3	0.2	0.1	0.4	0.266321
4	0.1	0.2	0.2	0.5	0.257658

Fuzzy Measure$\xi=0.5,\lambda=0$

Table 2: Pairwise Comparison Matrix

	Laser Assisted	Bleaching	Polymerization	HSHP
Laser assisted	1	4	3	0.5
Bleaching	0.25	1	1	0.2
Polymerization	0.333333	1	1	3
HSHP	2	5	0.333333	1

C.I.=0.377517C.I. Value is very high. (C.I.=0.377517 > 0.15) Recommend: Retry to Pairwise Comparison (Use [BACK] Button)

Table 3: Weights

Evaluation Items	Weights
Laser assisted	0.328953
Bleaching	0.0997713
Polymerization	0.269431
HSHP	0.301845

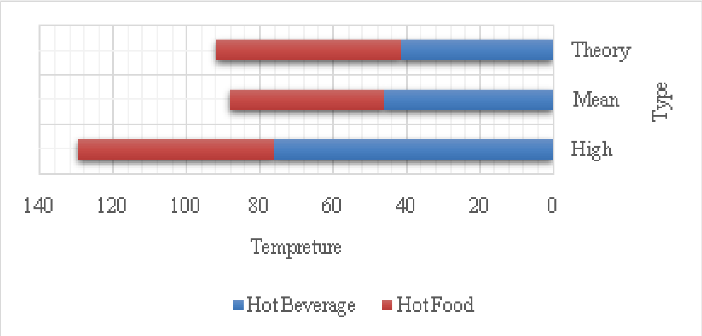
Table 4: Identified Fuzzy Measure

Sets	Fuzzy Measure
{}	0
{Laser assisted}	0.328953
{Bleaching}	0.0997713
{Laser assisted, Bleaching}	0.428724
{Polymerization}	0.269431
{Laser assisted, Polymerization}	0.598384
{Bleaching, Polymerization}	0.369202
{Laser assisted, Bleaching, Polymerization}	0.698155
{HSHP}	0.301845
{Laser assisted, HSHP}	0.630798
{Bleaching, HSHP}	0.401616
{Laser assisted, Bleaching, HSHP}	0.730569
{Polymerization, HSHP}	0.571276
{Laser assisted, Polymerization, HSHP}	0.900229
{Bleaching, Polymerization, HSHP}	0.671047
{Laser assisted, Bleaching, Polymerization, HSHP}	1

Data Binding of Temperature

Also based on this research the details of our experimental setup for temperature measurement in tooth could be organized in four main modules as follows. In this module, we provide an (one after the other) communication between PC and the seeing (in your mind) system, which sends the gotten over time/purchased data from the circuit to PC via a microprocessor. This module consists of three sections: the data acquisition, processing and analysis system. Based on this research, we've got an embedded enamel inside the chamber of isothermal liquid flowing that implements the warmth transfer from the pulp and vascular tissue in gum. For adjusting the temperature of the chamber and keeping the condition of test near the actual case, we use a thermo-cycle field, which has a stabilizer gadget. Two main heat sources are used; first is direct heat from the polymerization light on the surface of the tooth and the second is the heat transfer through the tooth pulp placed inside the water chamber [18, 22, 10 and 7].

Table 5: Range Temperature of Teeth during Daily Life



Based totally on, statistics acquisition module includes 3 most important sections. First is the amplifier subsystem, which amplifies the output voltage sign of the thermocouples, rejects all noise indicators, and presents a clear suitable signal for the second part. The subsequent section is a microprocessor that converts analog sign to virtual, calculates average of 1 thousand samples and eventually the virtual statistics are dispatched thru a serial verbal exchange port to computer. In fact, the sign being measured are handled by means of a portable computer (computer) ready with a serial connection. That is an interface, which is supplied by means of a microcontroller (ATmegaI6) for multichannel temperature and coffee voltage sign measurement from micro-thermocouples. A quadratic equation extracts the actual temperatures from the obtained virtual temperatures (used as gold trendy) which can be then recorded inside the gadget reminiscence. A pc program is applied for illustration of consequences on computer display screen and imparting a real time graph. This approach makes an online manipulate of the situations of the test. The absolutely transportable system of facts acquisition became designed in the sort of manner that it could be used for measurements in dentist surgical procedure rooms.

DISCUSSIONS

Also, there are several factors about heat transfer in human teeth. However, there are at least two mechanism of heat transfer away from the tooth. The first is the direct heat exchange between the light polymerization source and the tooth surface placed in the chamber, another one is the heat transfer through the pulp of the tooth, which is located in the water bath. There are a number of reports on investigating the whole tooth in the air and investigations with the tooth placed in a gel of stabilized temperature. Both experiments, the conditions of the experiments are not sufficient and the reliability of the temperature measurements could be disputable. Meanwhile, there is lack of literature reports on experiments with modeling of the heat transport through the tooth pulp. The polymerization light is glinted on the tooth surface. Base on the cure procedure, the frequent time for glinting on the tooth is between 20 to 30 seconds, minimum and maximum respectively. According to the extended research, the thermal conductivity of the tooth pulp is quite similar to the cupper element; therefore, it is decided to model the heat transference through the pulp by a cupper shaft.

Based on fuzzy measure of this test measurements were performed for a tooth equipped with six micro-thermocouples. The tooth was mounted on a plastic plate and then placed between footstool legs in water bath. Based on this investigation, temperature of water which use in this model will be stable at 37±1 °C, which corresponds to the anticipated mean sub-gingival temperature. This model will be gather required data in two steps, one in 20 second and other in 30 second of exposition time. As test start, these three model of each step for low, high and soft measured by polymerization lamp which used in this test.

Based on popular polymerization lamp which name asb1ue-phase was modified and which make a high temperature which rise in three modes that discussed. So this process, illustrate that every mode, by acquisition data system recorded temperature signals regarding to exposition time of tooth which effected by lamp. Although, this cited that assumption of applied micro-thermocouples is name as six, however here we demonstrate the results of four of them. Typical recordings of transient temperature of two main modes in Low and High.

CONCLUSIONS

A fuzzy investigation about the heat transfer phenomenon in human teeth is presented in this paper. With this particular method, the tooth temperature changes trend in the curing procedure can be recorded. In addition, this system is easy to handle in the laboratory environment and the obtained results are reliable. So based on this research this mathematical method will lead to this investigation that the heat exchange will be between the lamp and tooth is undeniable, especially in the high mode. As a result, we did not apply L1 into tooth and in procedure experiment, it was in water chamber. Based on illustrated figure, this will show that second micro-thermocouple temperature which name as L^2 remained steady approximately and did not change because it reports the temperature of air.

This stabilized temperature trend also occurred for the micro-thermocouple number five L3 especially in two of graphs while in the first graph, the temperature changes corresponds to the TS is perceptible., the temperature of pulp fluctuates between 28 to 30°C while in the last graph, the temperature of pulp is roughly 30°C. To show the temperature changes process in the tooth as a function of lamp parameters table_3 is formed which illustrates the average values of temperature measured in all measuring points. t can be seen that heat from the lamp in the low mode and soft mode does not cause a significant rise in temperature of the pulp and surface of tooth. [n the high mode, the temperature of the fifth point L4 increased substantially from 24 to 33 while other point had not changed considerably. What more in the soft mode, the temperature of this point has changed gradually from 24 to 28 °C. As we expect, the copper wire leads to a steady state in the recorded temperature. These results are considered as preliminary.

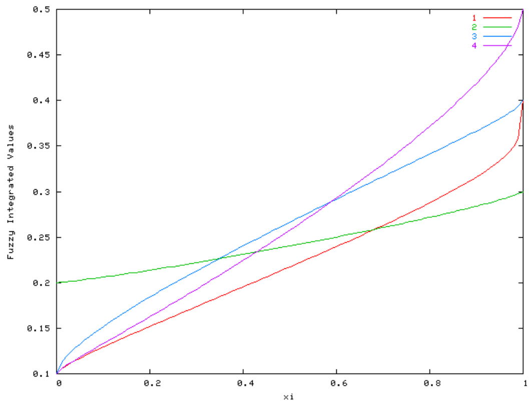


Figure: 2

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