ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 9, Issue, 6(B), pp. 27290-27293, June, 2018

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Review Article

METHODS TO CONTROL OF HEAT PRODUCTION DURING TOOTH PREPARATION-A SYSTEMATIC REVIEW

Kabilan P., Prabhu K., MohammadImthiyas and Ganagamani A.T

Adhiparasakthi Dental College and Hospital, Melmaruvathur. Tamilnadu, India, 603319

DOI: http://dx.doi.org/10.24327/ijrsr.2018.0906.2229

ARTICLE INFO

Article History:

Received 05th March, 2018
Received in revised form 08th April, 2018
Accepted 10th May, 2018
Published online 28st June, 2018

Key Words:

Tooth Preparation, Temperature Control, Heat Production, intra-pulpal temperature, Coolant

ABSTRACT

It is well known that there will be increase in the temperature of the tooth's surface during certain dental procedures and has greater interest is their potential damaging effect on the pulp of the tooth. Many studies have investigated the responses of the dental pulp to thermal irritation and the temperature at which thermal damage is initiated. There are also many *in-vitro*studies that have measured the temperature increase of the pulp and tooth-supporting tissues during restorative procedures. This review article provides an overview of studies measuring temperature increases in tooth structures during tooth preparation, and proposes clinical guidelines for reducing potential thermal hazards to the pulp and supporting tissues by various methods and armamentariums used to control heat production.

INTRODUCTION

When two surfaces move over each other, generation of heat is inevitable. More so when a tooth is prepared[1].This heat is not pleasant to the patient and may also result in injury to the pulp[2]. Multiple ways are employed to reduce this heat, from making the abrasive finer, to use of coolant to more exotic methods like designing the abrasive diamond in various ways to dissipate the heat[3,4].Even methods using either coolant spray on the outside or from the inside of the diamond points are also considered. Some design where coolants are channeled around the diamond are also available[5].

Literature is abundant with articles on pulp hyperemia[6] due to heat generated and on patient's response[7]. But structured research on this subject is sparse. More recently use of Lasers[8] and Piezoelectric devices have made large strides in dissipation of heat generated. This study was initiated to find the best of the various methodologies used for heat reduction found in literature. The aim of this study is to help in searching new avenues to future research with regards to heat generation and dissipation.

MATERIALS AND METHODS

The following analysis was performed according to the guidelines of the PRISMA statement for a systematic review.

Focused question on comparison and outcome.

The review is focused on: "What are the methods used to reduce the heat production during tooth preparation?"

Search strategy

The MEDLINE -PubMed database was searched from1990 to May2018.

Study inclusion criteria

The studies were analysed according to the following inclusive criteria

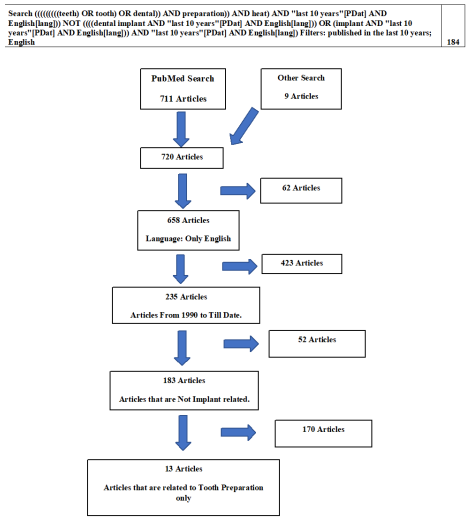
1. All studies related to heat generation during dental restorative procedures
2. Articles related to tooth preparation were considered for inclusion
3. Articles related to comparison of diamonds, hand pieces & coolants were included
4. Only human studies were included
5. Only studies in the English language were included

Study exclusion criteria

The studies with following criteria were not included in the review:

Corresponding author:* **Kabilan P
Adhiparasakthi Dental College and Hospital, Melmaruvathur. Tamilnadu, India, 603319

1. Studies not related to temperature control
2. Studies other than the dental restorative procedures
3. Studies not related to the dental field
4. Studies with in sufficient information
5. Animal studies were excluded



Data extraction

All the studies which met the followed inclusion and exclusion criteria for review were obtained and screened. The quality of various studies regarding temperature control and the instruments used during the procedures were considered for the assessment of the control of heat production[9].

DISCUSSION

In the review of the past studies, evidence is available about temperature control during the dental tooth preparation procedures. This review tried to systematically evaluate the current evidence and to compare the different methods to control heat production during tooth preparation.

In total,13 articles could be included, from which the data were obtained. To assess the different methods and techniques for maintaining temperature during the procedure., all the 13 articles were reviewed for the following characteristics: design of the study, samples used, diamonds and burs, hand pieces, lasers, ultra-sonics and coolants used.

Table 1 evaluation of control of heat production in various articles

	Reference	*Study design*	*Sample Size*	*materials used*									
				Diamonds and Burs				Handpiece		Laser	ultrasonic tips	Coolants used	
				Standard Diamond bur	Premium Diamond Bur	TDA system	Internally cooled Diamond burs	Low Speed	High speed			with coolant (water and air)	without coolant (water and air)
1	Pnina seagul DDm, danny sap	Comparative study	48	4.438	2.975								
2	Glockner K, Rumpler J, Ebeleseder K, Stadtler P Journal of Clinical Laser Medicine & Surgery Volume 16, Number 3, 1998	Comparative study	20							Er-yag laser -- (-7-10)			
3	Watson T F, Flanagan D, Stone D G British Dental Journal, VOLUME 188, NO. 12, JUNE 24 2000	Comparative study	10									(-11)	(-5)
4	Geraldo-Martins V R, Tanji E Y, Wetter N U, Nogueira R D, Eduardo C P Photomedicine and Laser Surgery Volume 23, Number 2, 2005	invitro study	72									0	0.93
5	Galindo DF, Ercoli C, FunkenbuschPD,Greene TD, Moss ME, Lee HJ, *et al*	Comparative study	60	(-0.2)	(-0.8)	(-0.3)							
6	Ercoli C, Rotella M, Funkenbusch P, RusselS, Feng C	Comparative study	75	(-8)	(-8)	(-8)							
7	L. Firoozmand, R. Faria, M. A. Araujo, R. di Nicoló and M. F. Huthala	Comparative study	30					0.8	0.8	0.39			
8	Uri Ben-Hanan, Michael Regev and Herbert Judes Journal of Materials Science and Engineering B 2 (10) (2012) 551-559	Comparative study	75	(-10)			(-13)						
9	Bruno Neves Cavalcanti, DDS,a Choyu Otani, PhD (J Prosthet Dent 2002;87:158-61.)	Comparative study	30									-16	(-0.04)
10	Aleska Dias Vanderlei, DDS, MS,a Alexandre Luiz Souto Borges DDS (J Prosthet Dent 2008;100:107-109)	Comparative study	20						-4.2		-3.8		
11	Bora O¨ ztu¨ rk, DDS, PhD,a Aslihan U¨ sxu¨mez, DDS, PhD, (J Prosthet Dent 2004;91:436-40.)	Comparative study	12									-3.1	19.7
12	Carlo Ercoli, DDS,a Mario Rotella, DDS(J Prosthet Dent 2009;101:248-261)	Comparative study	30	(-8)	(-10)	(-10)							
13	Silvana Juki´c Krmek, D.D.S., Ph.D.,1 Ivana Miletic, D.D.S Photomedicine and Laser Surgery Volume 27, Number 2, 2009		10							0.7			

Diamonds and burs

Out of 13 articles,5 articles used standard diamonds 4 articles used premium diamonds 3 articles used TDA system and one articles used internally cooled diamond burs, In this the premium diamonds are specially made diamond grits, in size 100-150µm.the homogenized diamond surface is evenly distributed on the bur with no "bald" area.

The channeled diamonds are specially designed to allow the water to flow inside through a hollow in it by which the internal cooling is possible, and also it provides the improved visibility of the field of operation.

The mean reduction in temperature was observed for premium diamonds[10], standard diamonds, TDA system and internally cooled diamond bur are -10°C,-8°C,-8°Cand -13°C respectively.

According to this it showed that premium diamond bur and internally cooled diamond bur showed less rise in temperature than standard diamond burs during tooth preparation.

Hand pieces

Out of 13 articles , 2 articles[11] used high speed hand piece and 1 article compared high and low torque handpieces[12], In this the high speed handpiece[13] showed a reduction temperature about 8°C and for high torque handpiece[14] its about -4.2°C

According to this it was showed that the high torque handpiece[15] was having capacity to reduce temperature during tooth preparation when it is used with proper coolant.

Lasers

Out of 13 articles, In 3 articles they used Er-YAG laser[16] in that it was stated that the usage of Er-YAG laser showed less rise in temperature during tooth preparation of about -7°C average.

The Er-YAG laser[17,18] has the ability to remove the particles in microexplosions and to vaporize them, this process is called as ablation. During this process heat can be generated and this could be controlled by using coolants.

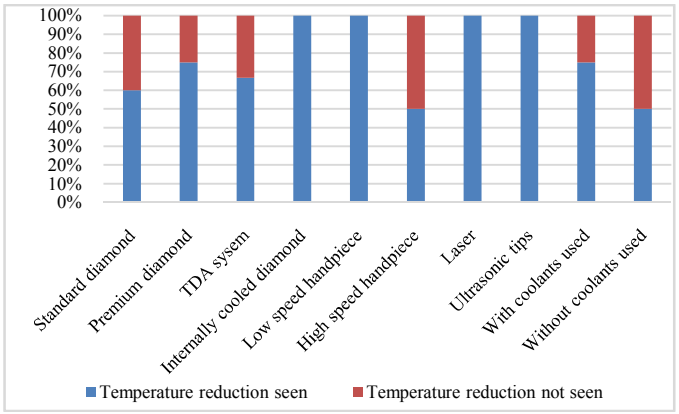
Ultrasonics

Out of 13 articles, In one article they used ultrasonic tips[19] in that article, It was concluded that the ultrasonic tips induced the same temperature increases as the high-speed hand piece during tooth preparation. And it showed a reduction temperature of about -3.8°C for ultrasonic preparation.

Coolants

Out of 13 articles,8 articles had given importance to the coolants[20] used, In that 4 articles done the study without coolant used, In that 2 articles was observed for reduction in temperature[21],but it showed comparable temperature increase, In 4 articles they done the study with coolants used, In that 3 articles shown more reduction in temperature. In an article it was also concluded that internal irrigation showed much more reduction in rise in temperature while doing tooth preparation.

RESULT



The results in the study are depicted in the chart

The blue bar signifies the temperature reduction seen, and the orange bar signifies the temperature reduction not seen.

From the chart we can observe that

1. For premium diamond bur the rise in temperature was good enough when compared with standard diamonds.
2. For Internally cooled diamond bur, Er-YAG laser, Ultrasonic tips and High speed hand pieces it showed the maximum temperature control.

CONCLUSION

Out of 13 articles, all the studies showed the different methods to control heat production, in an article it was concluded that premium burs showed much more reduction in rise in temperature while doing tooth preparation and Er-YAG LASER, ultrasonic tipsand internally cooled diamonds showed more superior effects in temperature control.

Reference

1. Hudson, D.C., and Sweeney, W.T.: Temperature Developed in Rotating Dental Cutting Instruments, Jada 48:127-133, 1954
2. S. N. Bhaskar and Gilbert E. Lilly Intrapulpal Temperature during Cavity Preparation *J. dent. Res.* July-August 1965
3. Ercoli C, Rotella M, Funkenbusch P, RusselS, Feng C. In vitro comparison of the cutting efficiency and temperature production of ten different burs. Part I: turbine. *JProsthet Dent* 2009;101:248-61
4. Carlo Ercoli, DDS,a Mario Rotella, DDS In vitro comparison of the cutting efficiency and temperature production of 10 different rotary cutting instruments. Part II:Electrichandpiece and comparison with turbine: *(J Prosthet Dent* 2009;101:248-261)
5. Galindo DF, Ercoli C, Funkenbusch PD, Greene TD, Moss ME, Lee HJ, *et al*. Tooth preparation: a study on the effect of different variables and a comparison between conventional and channeled diamond burs
6. KaareLangeland, D.D.S., Ph.D.,t and Leena K. Langeland, D.D.S. Pulp reactions to cavity and crown preparation, *Australian Dental Journal*, August, I970

7. Dachi, S.F., and Stigers, R.W.: Pulpal Effects of Water and Air Coolants Used in High Speed Cavity Preparations, *JADA* 76:95-98, 1968.
8. Glockner K, Rumpler J, Ebeleseder K, Stadtler P. Intrapulpal temperature during preparation with the Er:YAG laser compared to the conventional burr: an in vitro study. *J Clin Laser Med Surg* 1998; 16: 153-157.
9. Donald. C. Hudson* D.D.S., and W. T. Sweeney, f A. B., Washington, D. C. Temperatures developed in rotating dental cutting instruments The Journal of The American Dental Association Volume48, February 1954
10. A comparison of temperature increased by premium and standard diamond burs: an in vitro study, Quintessence Int. 2016 Feb;47(2):161-6. doi: 10.3290/j.qi.a34978
11. Firoozmand,R. Faria,M. A. Araujo,R. di Nicolóand M. F. HuthalaTemperature rise in cavities prepared by high and low torque handpieces and Er:YAG laser British Dental Journal
12. Watson T F, Flanagan D, Stone D G. High and low torque handpieces: cutting dynamics, enamel cracking and tooth temperature. *Br Dent J* 2000; 188: 680-686
13. Lauer HC, Kraft E, Rothlauf W, Zwingers T. Effects of the temperature of cooling water during high-speed and ultrahigh-speed tooth preparation. *J Prosthet Dent* 1990;63:407-14
14. Bora O¨ ztu¨ rk, DDS, PhD, aAslihan U¨ sxu¨mez, DDS In vitro assessment of temperature change in the pulp chamber during cavity preparation(*J Prosthet Dent* 2004;91:436-40.)
15. Effect of Cooling Techniques on Temperature Control and Cutting Rate for High-Speed Dental Drills *J Dent Res* 57(5-6):675-684, May-June 1978
16. Attrill D C, Davies R M, King T A, Dickinson M R, Blinkhorn A S. Thermal effects of the Er:YAG laser on a simulated dental pulp: a quantitative evaluation of the effects of a water spray. *J Dent* 2004; 32: 35-40.
17. Cavalcanti BN, Lage-Marques JL, Rode SM. Pulpal temperature increases with Er:YAG laser and high-speed handpieces. *J Prosthet Dent* 2003;90:447-51
18. SilvanaJuki´cKrmek, D.D.S., Ph.D. The Temperature Changes in the Pulp Chamber During Cavity Preparation with the Er:YAG Laser Using a Very Short Pulse
19. Aleska Dias Vanderlei, DDS, MS Ultrasonic versus high-speed cavity preparation: Analysis of increases in pulpal temperature and time to complete preparation (*J Prosthet Dent* 2008;100:107-109)
20. Bruno NevesCavalcanti, DDS High-speed cavity preparation techniques with different water flows (*J Prosthet Dent* 2002;87:158-61)
21. Stephen F. Dachi, DMD, MSD R. Winston Stigers, DMD, Lexington, Ky. Pulpal effects of water and air coolants used in high-speed cavity preparations *JADA*, Vol. 76, Jan. 1968

How to cite this article:

Kabilan P *et al.*2018, Methods to Control of Heat Production During Tooth Preparation-A Systematic Review. *Int J Recent Sci Res.* 9(6), pp. 27290-27293. DOI: http://dx.doi.org/10.24327/ijrsr.2018.0906.2229

****