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A SHORT STUDY

The Temperature Changes Within the Pulp Chamber With Different Stripping Procedures- A Short in Vitro Study

Kajol Kumari[1]
Zainab Hassan[2]
Richashree[3]
Amesh Kr. Golwara[4]
K. H. Sudheer[5]
Rashi Chauhan[6]

MDS Student[1]
Dept. of Orthodontics & Dentofacial Orthopedics, Buddha Institute of Dental Sciences & Hospital, Patna,
MDS Student[2]
Dept. of Orthodontics & Dentofacial Orthopedics, Buddha Institute of Dental Sciences & Hospital, Patna,
Reader[3]
Dept. of Orthodontics & Dentofacial Orthopedics, Buddha Institute of Dental Sciences & Hospital, Patna,
Professor & Head[4]
Dept. of Orthodontics & Dentofacial Orthopedics, Buddha Institute of Dental Sciences & Hospital, Patna,
Professor[5]
Dept. of Orthodontics & Dentofacial Orthopedics, Buddha Institute of Dental Sciences & Hospital, Patna,
Reader[6]
Dept. of Orthodontics & Dentofacial Orthopedics, Buddha Institute of Dental Sciences & Hospital, Patna

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Corresponding Author:
Kajol Kumari
MDS Student
Department of Orthodontics & Dentofacial Orthopedics
Buddha Institute of Dental Sciences & Hospital, Patna
Email : drkajolkumari1985@gmail.com,
Contact No : 9546309706

Abstract

Objective: To measure the temperature changes in the pulp chamber when different stripping procedures were used without any type of coolant.

Materials & Method: Extracted human teeth were used in this study. The teeth were separated into five groups. Mesial and distal sides of the teeth were used separately. The stripping procedures were performed on premolars with a metal handheld stripper, stripping disk, or tungsten carbide bur diamond bur. A J-type thermocouple wire was positioned in the centre of the pulp chamber and was connected to a data logger during application of stripping procedures.

Result: According to one-way ANOVA, temperature rise in the pulp chamber varied significantly depending on the stripping procedure ($P < 0.001$). The null hypothesis proposed in our study was rejected as stripping procedure elevated the temperature in the pulp chamber significantly ($P<0.001$).

Conclusion: Frictional heat is a common side effect of stripping procedures.

Keywords- Interproximal stripping, thermal changes, pulp chamber, burs, disk

Introduction

Stripping is defined as the act of clinically removing part of enamel from an interproximal contact area. By this procedure, space is created to align teeth and teeth can be reshaped to more ideal form. This also may improve aesthetics, improve the gingival relationship, and eliminate the need of lower retention and is used for correction of curve of Spee and camouflage Class II and III malocclusions. Because this procedure has become more routine in orthodontics practice, several studies evaluated the detrimental effects of stripping. According to Twesme et al[1] increasing susceptibility of proximal enamel surface to demineralization and also to caries, Radlanski et al[2] also showed that furrows resulting from the stripping caused increased plaque accumulation and Joseph et al[3] states that these furrows would remain permanently on enamel surface with no change of natural healing mechanisms aiding in the repair. On the other hand, Crain and Sheridan[4] and Sheridan and Ledoux[5] suggested that stripped posterior surfaces are no more susceptible to caries or periodontal disease than unaltered surfaces but recommended sealant application for caries protection. Another possible side effect of stripping is the heat generation during this procedure. Therefore, Zachrisson and Shedridan[6] emphasize cooling during stripping to prevent the possible damaging effect of frictional heat during air rotor stripping and indicator wire to prevent bleeding, thus getting better visibility. In general, temperature increases more than 5.5^{0}C in the pulp lead to inflammation. Investigation have shown that it is, A fibres rather than C fibres that are activated by hydrodynamic stimuli(e.g., heat, cold, air blasts) applied to exposed dentine[7]. Slow heating of tooth produced no response until the temperature reached 111^{o}F(43.8^{0}C), at which time C fibres were activate.

Materials & Method

Ten intact, freshly extracted human teeth were used in this study. To evaluate temperature changes in teeth with different stripping procedures. The root portion was sectioned with a carborundum disk approximately 4mm below the CEJ. The pulpal chamber was enlarged as needed to insert the thermocouple wire with Gates glidden files[8]. The pulp chamber was cleaned of remnants of soft tissue with a spoon excavator and sodium hypochlorite application for 1 min. Pulp chamber was filled with silicone transfer compound[9]. Teeth were placed on acrylic blocks of teeth each labelled according to tooth group and stripping procedure. Group 1: A tungsten small tapered fissure carbide bur (Raintree Essix Inc) was used on mandibular premolars at high speed (above 20,000 rpm)

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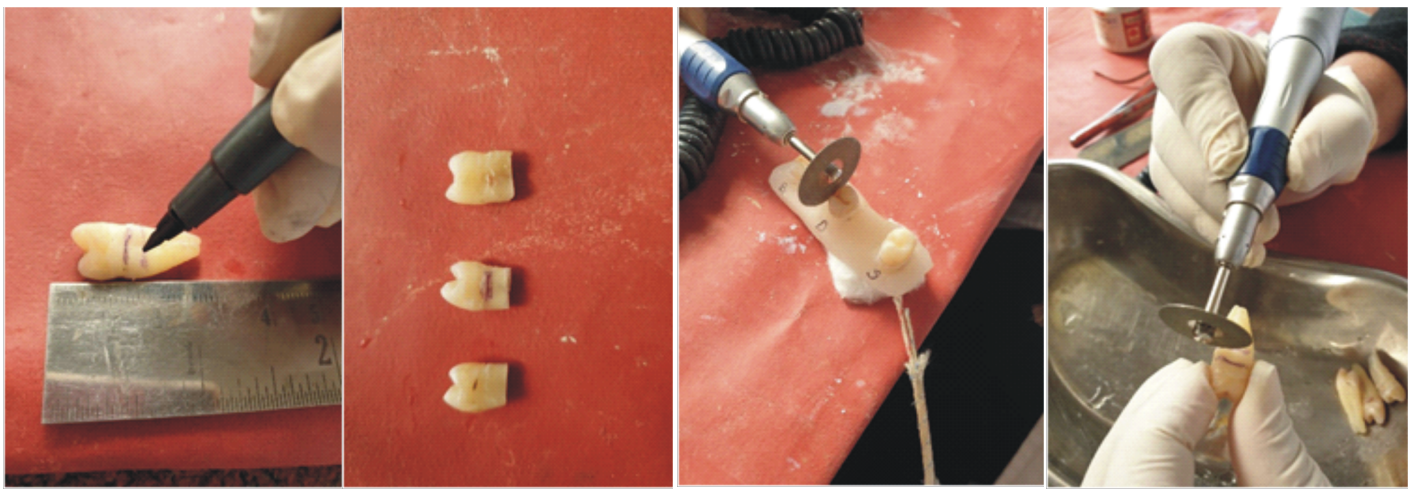
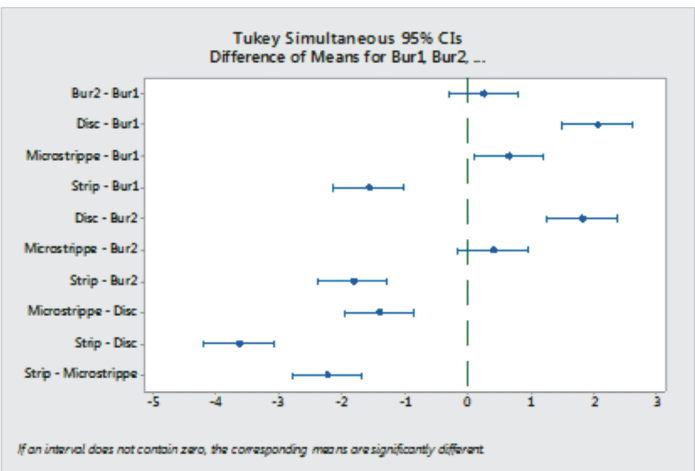
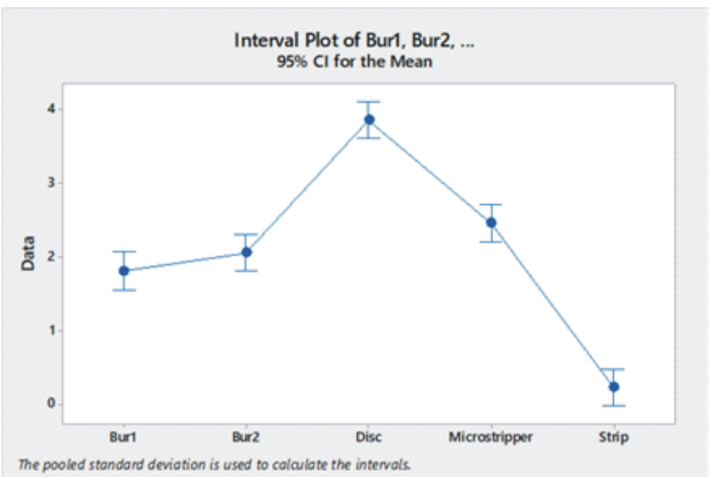
with a contra-angle hand piece. Group 2: A diamond small tapered fissure was used on premolars at high speed (above 20,000 rpm) with a contra-angle hand piece for 10 seconds. Group3: A tungsten small tapered fissure carbide bur was used on premolars at high speed (above 20 ,000 rpm) with a contra-angle hand piece for 10 seconds. Group 4: A perforated stripping disk at low speed (below 15,000 rpm) with a contra- angle hand piece for 10 seconds.Group 5: A metal handheld stripper (LSDSM6M, double side 6 mm, was used (20 strokes for each tooth) on premolars



Result

According to one-way ANOVA, temperature rise in the pulp chamber varied significantly depending on the stripping procedure($P<0.001$). The null hypothesis proposed in our study was rejected as stripping procedure elevated the temperature in the pulp chamber significantly ($P<0.001$).





Analysis of Variance (ANOVA) between the 5 groups

Source	DF	Adj SS	Adj MS	F- Value	P- Value
Factor	4	13.58	3.395	176.36	0
Error	5	0.0963	0.01925		
Total	9	13.6763			

Grouping Information Using the post hoc Tukeys test						
Factor	N	Mean	Grouping			
Disc	2	3.85	A			
Microstripper	2	2.45		B		
Bur2	2	2.05		B	C	
Bur1	2	1.8			C	
Strip	2	0.225				D
Means that do not share a letter are significantly different.						

Discussion

In this in vitro study the heat generated by different stripping procedures were measured. If one also takes into account that even a few seconds of external thermal stress with a temperature of 27.5°C has the potential to produce irreversible pulp damage, it becomes obvious that the pulp tissue is very susceptible to thermal stress even within a short time[10]. For the present comparative study, extracted adult premolars were selected to assess the thermal changes in different stripping procedures. This procedure was followed by elimination of any possible structural variables of teeth that may manifest as differences in the thermal conductivity and specific heat[11]. On the other hand, the teeth used in this study were collected from an adult sample[15], so the thermal conduction to the pulp chamber during stripping procedures might have been limited compared with the actual scenario in orthodontic patients who are usually 13–16 years of age[12]. Therefore, one would expect to record higher temperature increases when younger teeth are used for a similar study[13,14,]. Thermocouples were selected to evaluate temperature alterations during the removal of the remnant adhesive because of high precision and reliable readings associated with this technique in orthodontics and operative and prosthetic dentistry.[16,17,19,23,24] Trauma to the pulp and dentin during the use of rotary instruments results from several factors.[25,26] The pressure,[19] revolutions per minute,[19] bur design, and type of coolant[27] influence the temperature rise and the degree of vibration. The various clinical reactions of the pulp and dentin are attributed to the interrelated factors. Schuchard[28] and Sato[29] reported that excessive heat adduction can result in structural changes to the hard dental tissues and damage the dental pulp. Zach and Cohen[16] reported that a 5.5°C rise led to necrosis of the pulp in 15% of teeth, an 11.1°C rise resulted in necrosis of the pulp in 60% of teeth, and a 16.6°C rise led to necrosis of the pulp in 100% of teeth. A soldering iron was applied to the tooth surfaces to produce the temperature rise. Because the temperature rise does not appear to have been monitored after removal of the soldering iron, the results must be treated with caution. To standardize procedures for the study, 20 strokes were performed for metal strips, and 10 seconds of application was preferred for perforated discs and carbide burs. Sheridan[8] stated that initial tooth structure reduction lasts for 30 seconds and must be performed with cooling. Robinson and Lefkowitz,[30] Taira et al,[31] and Moulding and Loney[32] reported that cooling techniques, such as the use of an air-water spray, were effective in limiting the temperature rise in the pulp chamber. According to individual needs, stripping duration or number of strokes may differ, so the temperature change may exceed the critical level of 5.5C. The condition and quality of the pulpal vascularity may determine the degree of damage caused by thermal trauma.[33] Zachrisson[15] suggested an air stream to reduce pain during gross recontouring. It has been concluded that painful stimulation can induce significant increases in blood flow in the region adjacent to the stimulus.[34] In clinical conditions, pain during stripping may increase temperature in the pulp chamber. The experimental design of the present study did not consider heat conduction within the tooth during the in vivo stripping process because of the effect of blood circulation in the pulp chamber and fluid motion in the dentin tubules.[35] In addition, the surrounding periodontal tissues can promote heat convection in vivo, limiting the intrapulpal temperature rise.[36] Although a potential hazard to dental pulp may exist with stripping procedures, only a well-designed histological study can accurately assess the actual damage to the pulp or odontoblasts. The data on temperature elevation recorded while preparing extracted teeth have limited applications in determining pulpal reactions. However, it is advisable to use intermittent spray cooling with stripping procedures

Conclusion

A.Mean temperature changes did not exceed the critical level of 5.5°C in all the stripping procedures. B. metal strip used on teeth seems to be the safest procedure for thermal changes in the pulp chamber. C. Stripping procedure done with a disk showed greater temperature rise among all the procedures. D. Clinicians must be aware of the detrimental effects of heat during stripping, and air cooling should be preferred because of greater visibility than with airwater spray.

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