Journal of Advanced Medical and Dental Sciences Research
@Society of Scientific Research and Studies

Journal home page: www.jamdsr.com doi: 10.21276/jamdsr UGC approved journal no. 63854

(e) ISSN Online: 2321-9599; (p) ISSN Print: 2348-6805

Original Article

Comparison of temperature change in different adhesive resin cements during polymerization

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***ABSTRACT*:**
Background: Resin‐based materials generally require light activation for the polymerization. The present study was conducted to compare the temperature changes of self‐etch and self‐adhesive resin cement during the polymerization process. **Materials & Methods:** The present study was conducted in the department of Prosthodontics. It comprised of thirty recently extracted non carious human mandibular third molars. Dentin surface was prepared with extracted human mandibular third molars. Adhesive resin cements (Panavia F and Rely X) were applied to the dentin surface and polymerized under IPS e.max Press restoration. Differences between the baseline temperature and temperatures of various time points at 2 minutes, 6 minutes, 10 minutes, and 14 minutes were calculated. **Results:** Panavia F showed temperature change of 2.16° at 2 minutes, 2.03° at 6 minutes, 1.42° at 10 minutes and 0.86° at 14 minutes. Rely X showed temperature change of 1.72° at 2 minutes, 1.10° at 6 minutes, 0.58° at 10 minute and 0.24° at 14 minutes. The difference was significant (P< 0.05). **Conclusion:** Authors found that Panavia F showed maximum temperature change than Rely X recorded at 2 minutes, 6 minutes, 10 minutes and 14 minutes. There was significant difference between two adhesive resins.
Key words: Adhesive resin cements, Polymerization, Temperature.

Received: 4 February, 2019 Revised: 24 February, 2019 Accepted: 27 February, 2019

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This article may be cited as: Dogra S, Sharma N, Gupta B, Rajan S, Dua B. Comparison of temperature change in different adhesive resin cements during polymerization. J Adv Med Dent Scie Res 2019;7(3):62-64.

INTRODUCTION

The clinical success of an indirect restorative procedure depends in part on the cementation technique used to create a link between the restoration and the tooth. The different luting cements that are available to clinicians have been categorized into five main classes: zinc phosphate cements, polycarboxylate cements, glass-ionomer cements, resin-modified glass-ionomer cements, and resin composite cements. Although each of the five classes has been widely investigated, the correct clinical choice between them is not always clear.[1]

In dentistry, resin‐based materials generally require light activation for the polymerization. However, light curing causes a temperature increase because of light energy absorption and exothermic polymerization reaction within resin. The increase of temperature may be a detrimental potential effect on the pulpal tissue. The potentially harmful effect of temperature level within the pulp tissue

has been a concern for many years. During the restorative treatment, in case of intrapulpal temperature exceeding 42.5°C, irreversible pulpal damage may develop in the pulp tissue.[2]

Dental practice needs have led to the recent development of self-adhesive resin cement that eliminates the multistep bonding procedure. Like conventional cement, self-adhesive resin cement is applied in a single step. In spite of the widespread use of adhesive resin cement, little information is available about their exothermicreaction.[3]The present study was conducted to compare the temperature changes of self-etch and self-adhesive resin cement during the polymerization process.

MATERIALS & METHODS

The present study was conducted in the department of Prosthodontics. It comprised of thirty recently extracted non carious human mandibular third molars. The study protocol was approved by the institutional ethical committee.

All teeth were cleaned and stored in 0.5% chloramine-T at 4°C for 1 week. The roots of the molars were removed 2 mm below the cementoenamel junction and perpendicular to the long axis of the teeth for temperature measurements. The pulpal soft tissues were removed using curettes, the occlusal enamels of teeth were removed.

The dentin specimens were standardized at approximately2 mm thickness from the highest pulp horn, as measured with a caliper. The root of teeth was placed in an acrylic plastic base with an autopolymerizing acrylic resin. A hole providing entrance for thermocouple wire into the pulp was created at the center of acrylic plastic base. The thermocouple wire was placed below the pulpal chamber of the highest pulp horn, in contact with the dentin.

One self-etch adhesive resin cement (Pan F) and one self-adhesive resin cement and (Rely X) were used. 100micrometer thick, black Teflon sheets (20 mm × 20 mm) with a hole at the center were used as spacers for resin cement on dentin surface. The adhesive resin cement was adhered to the dentin surface under IPS e.max Press restoration. The resin cement was polymerized with a light source distanced between adhesive resin cement 10 mm. All adhesive resin cement was tested at 23°C ± 2°C and50% ± 5% relative humidity. The temperature changes were measured with a K type thermocouple wire connected to a digital thermometer. Results thus obtained were subjected to statistical analysis. P value less than 0.05 was considered significant.

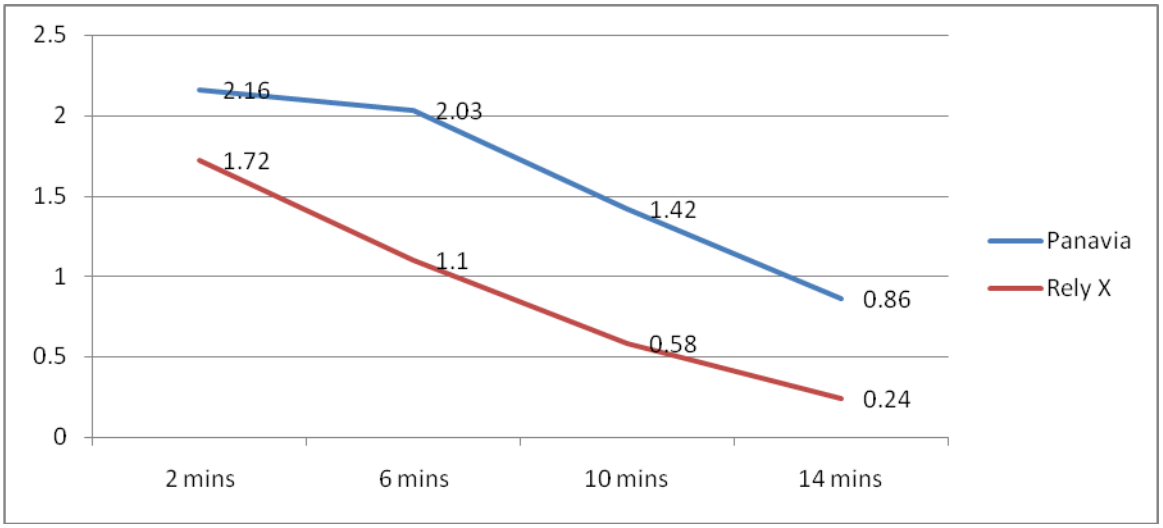
RESULTS

Table I: Mean temperature difference values of the adhesive resin cements

Adhesive resin cements	Time (minutes)				P value
	2	6	10	14	
Panavia F	2.16	2.03	1.42	0.86	0.05
Rely X	1.72	1.10	0.58	0.24	

Table I, graph I shows that Panavia F showed temperature change of 2.16° at 2 minutes, 2.03° at 6 minutes, 1.42° at 10 minutes and 0.86° at 14 minutes. Rely X showed temperature change of 1.72° at 2 minutes, 1.10° at 6 minutes, 0.58° at 10 minute and 0.24° at 14 minutes. The difference was significant (P< 0.05).

Graph I: Mean temperature difference values of the adhesive resin cements



DISCUSSION

Self-adhesive cements are comparatively new and detailed information on their composition and adhesive properties is limited. Although the basic adhesion mechanism appears to be the same for all self-adhesive cements, features of Rely X Unicem are by far the most extensively explained by the manufacturer. Its multifunctional monomers with phosphoric acid groups simultaneously demineralized and infiltrate enamel and dentin.[4]

Heat has been identified as a primary cause of pulpal damage. Dentin has a low thermal conductivity; however, during excess preparation for ceramic restorations, the potential for pulp injury is greater due to the increase in the tubular surface area. It was observed that normal human teeth withstand temperatures between –7°C and75°C without any damage to the pulpal tissue, but during the dental treatment, temperatures should not exceed 42°C.[5]

The dominant setting reaction is the radical polymerization that can be initiated by light exposure or through the self-curing mechanism. This results in extensive cross linking of cement monomers and the creation of high molecular-weight polymers. Additionally, in order to assure neutralization of this initially acidic system, a glass-ionomer concept was applied, resulting in a pH increase from 1 to 6through reactions between phosphoric acid groups and alkaline filler. Phosphoric acid groups also react with the toothapatite. Water that is formed in these neutralization processes is claimed to contribute to the cement's initial hydrophilicity, which provides improved adaptation to the tooth structure and moisture tolerance. Subsequently, water is expected to be reused by reaction with acidic functional groups and during the cement reaction with ion-releasing basic fillerparticles.[6]The present study was conducted to compare the temperature changes of self‑etch and self‑ adhesive resin cement during the polymerization process.

In present study, thirty recently extracted non carious human mandibular third molars. We observed that Panavia F showed temperature change of 2.16° at 2 minutes, 2.03° at 6 minutes, 1.42° at 10 minutes and 0.86° at 14 minutes. Rely X showed temperature change of 1.72° at 2 minutes, 1.10° at 6 minutes, 0.58° at 10 minute and 0.24° at 14 minutes. Alkurt et al[7] in their study the temperature data were recorded and stored on a computer every 0.1 second for sixteen minutes. Differences between the baseline temperature and temperatures of various time points (2, 4, 6, 8, 10, 12, 14, and 16 minute) were determined and mean temperature changes were calculated. They found significant differences among the time points and resin cements ($P < 0.05$). Temperature values of the Pan SA group were significantly higher than Pan F and RelyX ($P < 0.05$).

Pohto and Scheinin[8] reported that the pulp is affected at temperatures ranging from 39°C to 42°C. Temperatures within this range lead to an increase in the blood flow of living rats. They also noted that when the duration of the thermal irritation is 30 seconds and the temperature ranges from 46°C to 50°C, stasis and thrombosis develop in the exposed pulp leading to arrest of the circulation.

CONCLUSION

Authors found that Panavia F showed maximum temperature change than Rely X recorded at 2 minutes, 6 minutes, 10 minutes and 14 minutes. There was significant difference between two adhesive resins.

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