The Role of Halogen Ion in Initiating System Comprising Barbituric Acid Derivative and Metal Ion

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INTRODUCTION

Dental materials usually consist of a monomer mixture, an initiator system, fillers, additives, and optionally plasticizers. An initiator system that consists of tertiary aromatic amine and organic peroxide is the most frequently used in self-curing dental materials. A main disadvantage of this initiator system is poor color stability, short shelf-life period, the toxic and allergenic action of components of initiator system, and high temperature of polymerization.

There are also alternative initiator systems that are used for chemical curing of dental materials. One of them is the system that consists of acid compounds in combination with metal ion and halogen ion. Materials that are cured by this initiator system typically exhibit good color stability and mechanical properties. In addition, the curing of these formulations may produce less heat in comparison to other redox initiating systems. These initiator systems are usually based on barbituric acid or its derivatives, transition metal cations from iron or copper group, and chloride ion (BMH system). Chloride ion in this system initiates, controls and accelerates the polymerization process.

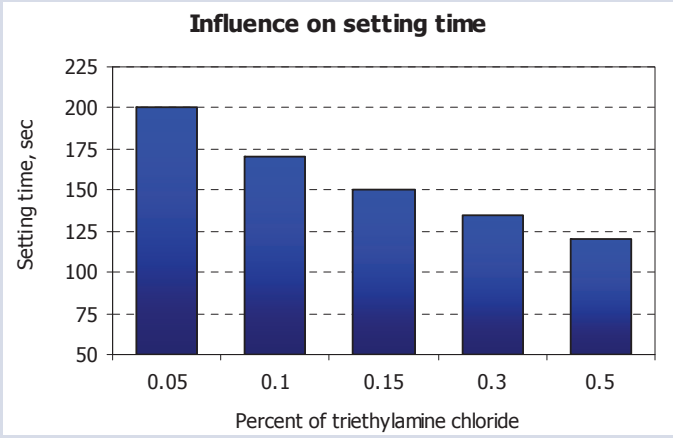
The aim of this study was to evaluate the influence of chloride ion on chemical and mechanical properties of material.

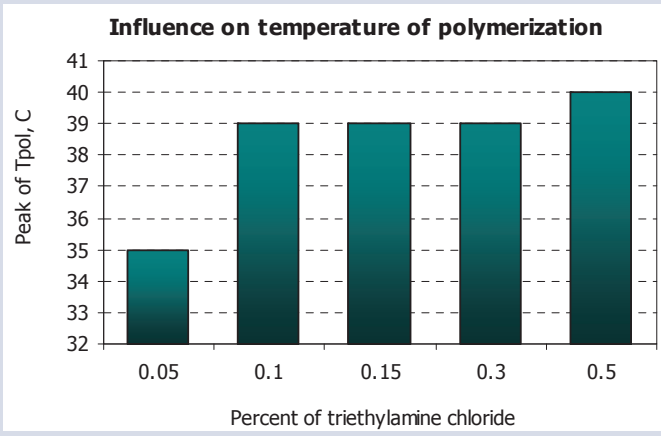
METHODS

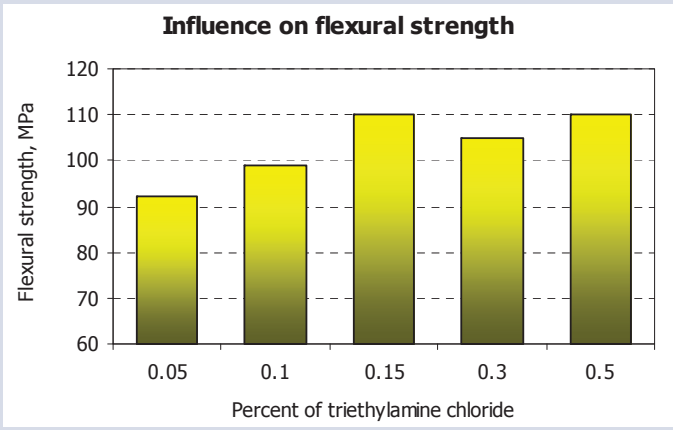
The resin blend of Bis-GMA and TEGDMA with ratio 40/60 was prepared for this study. The 1-benzyl-5-phenil barbituric acid, triethylamine chloride and cooper acetate were used as an initiators for self-curing polymerization. Samples (n=20) with different quantity of triethylamine chloride and constant quantity of 1-benzyl-5-phenil barbituric acid cooper acetate were tested. Peak of temperature of polymerization (Tpolm), setting time, flexural strength, and degree of conversion (DC) of all samples were measured. Degree of conversion of samples was calculated after 2, 5, 10, and 15 minute after mixing. The experimental results were analyzed statistically (N=10) by ANOVA ($p<0.05$).

RESULTS

Triethylamine chloride, %	Peak of Tpolm, °C	Setting time, min'sec''	Degree of conversion, %				Flexural strength, MPa
			2 min	5 min	10 min	15 min	
0.00	Material was not completely polymerized						
0.05	35°C	3'20''	26	35	40	42	92
0.10	39°C	2'50''	23	37	49	52	99
0.15	39°C	2'30''	35	53	60	61	110
0.30	39°C	2'15''	36	53	61	64	105
0.50	40°C	2'00''	39	53	60	63	110







DISCUSSION

- Smaller flexural strength was measured for samples with 0.05% of triethylamine chloride. Starting from 0.15% of triethylamine chloride no significant change in flexural strength was observed.
- Smaller peak of temperature of polymerization was measured for samples with 0.05% of triethylamine chloride. Starting from 0.1% of triethylamine chloride wasn't observed significant difference in maximum temperature of polymerization.
- Curing time of materials significantly depends on amount of triethylamine chloride. Starting from samples with 0.05% of triethylamine chloride setting time was reduced with increase of quantity of triethylamine chloride.
- The smallest quantity of DC was observed for samples with 0.05% of triethylamine chloride. Samples that contain 0.15%, 0.3% and 0.5% had the same rate of DC.

CONCLUSIONS

The choice of right amount of halogen ion in BMH initiator system is very important. Addition of small quantity of halogen compound in redox initiating system BMH can improve mechanical properties, significantly increase degree of conversion, and reduce curing time. However, it also can increase temperature of polymerization that may irritate the surrounding tissues, including pulp and oral mucosa.