International Journal of Applied Dental Sciences 2018; 4(3): 352-354


**ISSN Print:** 2394-7489
**ISSN Online:** 2394-7497
IJADS 2018; 4(3): 352-354
© 2018 IJADS
www.oraljournal.com
Received: 04-05-2018
Accepted: 06-06-2018

**Elif Ok**
Faculty of Dentistry, Department of Pedodontics, Fırat University Elazıg, Center, Turkey

**Hakan Kamalak**
Faculty of Dentistry, Department of Restorative Dentistry, Kahramanmaras Sutcu Imam University Elazıg, Center, Turkey

**Canan Aksu Canbay**
Faculty of Science, Department of Physics, Fırat University Elazıg, Center, Turkey

**Serdar Altin**
Faculty of Technology, Department of Physics, Fırat University, Inonu University Malatya, Center, Turkey

**Correspondence**
**Hakan Kamalak**
Faculty of Dentistry, Department of Restorative Dentistry, Kahramanmaras Sutcu Imam University Elazıg, Center, Turkey

# The evaluation of thermal conductivity of different restorative glass ionomer cements

**Elif Ok, Hakan Kamalak, Canan Aksu Canbay and Serdar Altin**

**Abstract**
The purpose of this study is to compare the thermal conductivity properties of glass ionomer cements in different contents. Method: The study group included five different glass ionomer cements; EQUIA Forte Fil (GC, Tokyo, Japan, EQF), Fuji II LC Light-Cured Glass-Ionomer Cement for Restorative Filling (GC Corp, Tokyo, Japan, F2S), Fuji IX Conventional glass ionomer Cement for Restorative Filling (GC Corp, Tokyo, Japan, F9S),Glass carbomer (Glass Carbomer, GCP), Ionoseal (Glass ionomer cement, VOCO, Cuxhaven, IOS). They were filled in teflon molds (height: 4 mm, width: 6 mm) and irradiated for 20 s chemically or by LED device. The heat conductivity of the samples was analyzed by the home made thermal conductivity measurement system. Five materials showed clinically acceptable values in terms of thermal conductivity. The results we observed in this study are in agreement with literature.

**Keywords:** Thermal conductivity, Glass ionomer cement

## 1. Introduction
The oral environment is constantly subjected to thermal changes due to the hot and cold foods being taken. the increase and decrease of the temperature in the mouth may cause cracks and fractures in tooth structure and edge leakages in restoration [1]. It was observed that a 5.5 degree heat increase caused significant damage to the pulp and a 15% decrease in pulp viability. It was also observed that an elevation of 11 degrees caused irreversible necrosis in the pulp [2]. Thermal conductivity of materials is important for the health of the pulp. For this purpose, the thermal conductivity of five different glass ionomer cements, which are frequently used in restorative treatments, was determined.

## 2. Materials and methods
Glass ionomer cements were used in five different brands in the study. These materials; EQUIA Forte Fil (GC, Tokyo, Japan, EQF), Fuji II LC Light-Cured Glass-Ionomer Cement for Restorative Filling (GC Corp, Tokyo, Japan, F2S), Fuji IX Conventional glass ionomer Cement for Restorative Filling (GC Corp, Tokyo, Japan, F9S),Glass carbomer (Glass Carbomer, GCP), Ionoseal (Glass ionomer cement, VOCO, Cuxhaven, IOS).
The study was conducted *in vitro*. After placing the restorative materials in the molds (4mm height, 4 mm width), strip bands were placed on the upper and lower surfaces of the molds and pressed to form a flat surface with glass slides and then with LED light device (Elipar Freelight II, 3M-ESPE, St. Paul, MN, USA) and manufacturer's instructions 20/40 sec polymerized. Some materials were expected to be chemically polymerized. These cured materials were removed from the molds. As a result, a sample of 4 mm in diameter and 4 mm in height was obtained. Samples were stored in distilled deionized water at 37 ° C for 2 weeks.
The heat conductivity of the samples was analyzed by the home made thermal conductivity measurement system (Figure 1). We used two brass blocks which the first base has a heater inside it and the second is the heat sink and both of them have k-type thermocouple inserted the surface of the blocks. We calibrated the system using Al (Alfa Aesar Cas No: 7429-90-5 which have thermal conductivity value 205 W/Km) [3]. It was used 120 W power to obtain temperature gradient in both side with PID temperature controller to reach 55°C temperature which is the highest temperature that can be applied without decomposition of the biomaterials.

## 3. Results & Discussion (Times New Roman, 12, Bold)

Temperature changes in the mouth dental tissues and dental restorations influence of many researchers for many years it has become a subject. While tooth tissues and restorative materials are expanding by taking hot food into the mouth, the end result of cold food ingestion. It is shrinking. Thermal conductivity and thermal properties of dental restorative materials the expansion is significantly clinically important [4, 5]. Heat transfer science, theory and experimentation for many years based on observations. Heat transfer analyzes mainly related to the laws of physics. Heat conduction The mechanism is a very complex heat exchange or energy conversion system [6, 7].

The heat in the system is carried over the material being tested, towards the compartment cooled from the heated section. If the material has high thermal conductivity, it is transported over the material being tested towards the compartment cooled from the heated section. If the material has a high thermal conductivity, the heat generated in the heated zone is transmitted to the easily cooled compartment. Whereas if the material's heat conductivity is not good, less heat will be transmitted to the cold side and the temperature on the heated side will increase. When steady-state conditions occur in the system, the temperature becomes constant and measurement is made. The method presented is reliable and easy.

It is desirable that the thermal conductivity of the materials used in dentistry is weak. According to findings obtained in this study; the thermal conductivity was the lowest of IOS and the highest of EQF at 0 ° C. EQF and IOS showed similar results at 40 ° C. At 40 ° C, F2S has the highest thermal conductivity. At 60 ° C, the highest thermal conductivity was F2S, while the least thermal EQF was seen. At 80 ° C, similar results were obtained for EQF, F9S and IOS. At 100 ° C, thermal conductivity was also seen at least in IOS. As a result of this study, the thermal conductivity is at least IOS and F9S, while the EQF, F2S and GCP have higher thermal conductivity than the other groups (Figure 2).

### 3.1 Tables and Figures

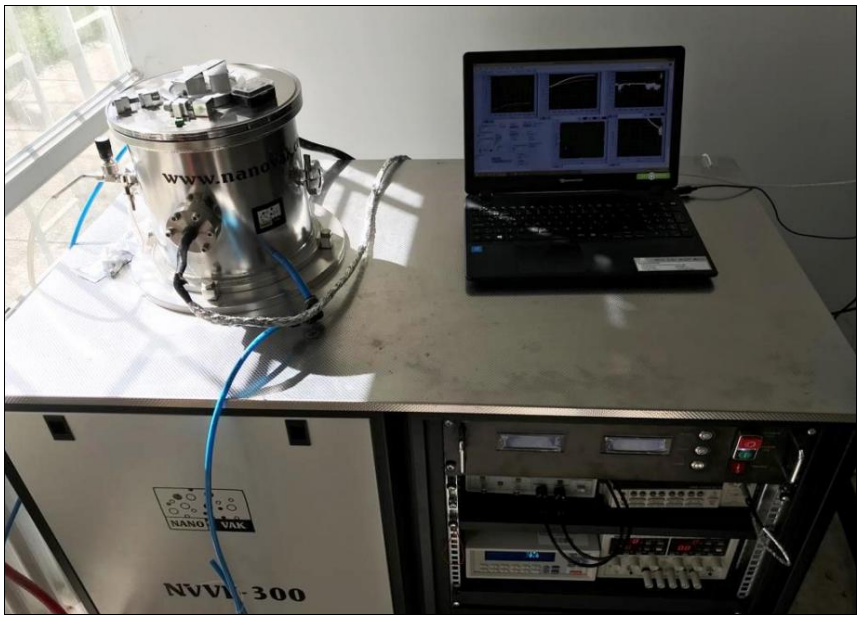
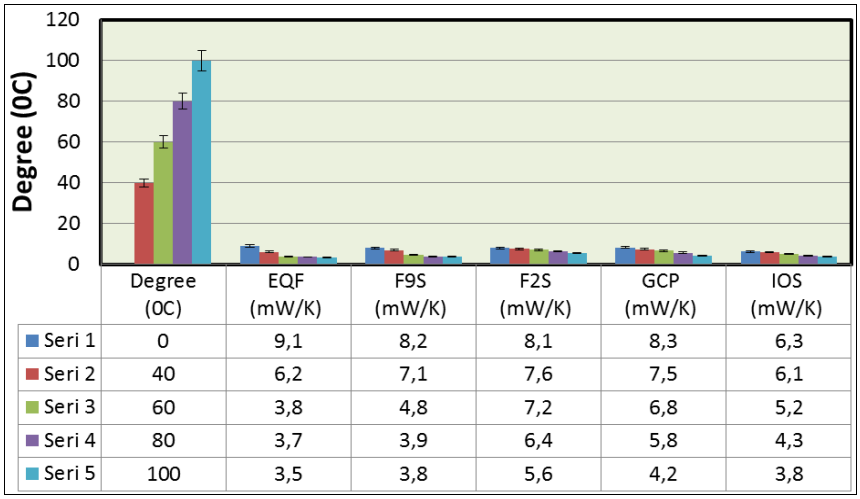



**Fig 1:** The homemade thermal conductivity measurement system




| | Degree (0C) | EQF (mW/K) | F9S (mW/K) | F2S (mW/K) | GCP (mW/K) | IOS (mW/K) |
|---|---|---|---|---|---|---|
| Seri 1 | 0 | 9,1 | 8,2 | 8,1 | 8,3 | 6,3 |
| Seri 2 | 40 | 6,2 | 7,1 | 7,6 | 7,5 | 6,1 |
| Seri 3 | 60 | 3,8 | 4,8 | 7,2 | 6,8 | 5,2 |
| Seri 4 | 80 | 3,7 | 3,9 | 6,4 | 5,8 | 4,3 |
| Seri 5 | 100 | 3,5 | 3,8 | 5,6 | 4,2 | 3,8 |

**Fig 2:** the thermal conductivity results of the groups

## 4. Conclusions

The reason for the variation in the range of the thermal conductivity is not only due to the effect of experimental factors such as the measuring method, preparation of materials, but also because many factors such as type of hand pieces used, light curing unit, diameters of cylindrical blocks will affect these parameters.

## 5. References


1. O'Brien WJ. Dental Materials and Their Selection. Michigan: Quintessence Publishing Co, 2002, 132-56.
2. Zach L, Cohen G. Pulp Response to Externally Applied Heat. Oral Surg Oral Med Oral Pathol. 1965; 19:515-30.
3. Kamalak H, Oz E, Demirel S, Altin S. The mechanical and heat conducting properties of dental composites. Bio interface Res Appl Chem, 2016, 6.
4. Toparli M, Sasaki S. Finite element analysis of the temperature and thermal stress in a post restored tooth. J Oral Rehabil. 2003; 30:921-926.
5. Yang SH, Lang LA, Guckes AD, Felton DA. The effect of thermal change on various dowel-and-core restorative materials. J Prosthet Dent. 2001; 86:74-80.
6. Çengel YA, Boles MA. Thermodynamics. An Engineering Approach. 2nd ed. USA: McGraw-Hill Inc., 1994.
7. Incropera Frank P, Dewitt David P. Fundamentals of Heat and Mass Transfer. 3rd ed. USA: John Wiley & Sons Publishing, 1990.