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The Impact of Storage Temperature on the Microhardness of Composite Restorative Materials

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ABSTRACT: This current study aimed to evaluate the impact of storage temperature on the microhardness of pure Ormocer-, methacrylate modified Ormocer-, and methacrylate-based composites. Sixty cylindrical composite discs were assigned into three main groups of 20 discs each. Groups were divided according to composite restorative material used as follows; An Ormocer based composite (Admira Fusion), a Methacrylate modified Ormocer based composite, (Ceram.X SphereTEC One), and a Methacrylate based composite (Tetric N-Ceram). Each group was divided into 2 subgroups according to the storage temperature; stored at room temperature or stored in refrigerator at 4°- 5° C. Microhardness was evaluated using micro-Vickers hardness tester under a load of 50-g with a dwell time of 10 seconds. The results were analysed by Independent t tests. Statistically significant differences between all room-stored groups and their counterparts stored at refrigerator were observed (P=≤0.005). It was concluded that Refrigerator storage has negatively affected composite microhardness as compared to room temperature storage.

KEYWORDS:storage temperature, microhardness, ormocer.

I. INTRODUCTION

Composite restorative materials have gained high acceptance owing to their characteristics, such as aesthetic, non-toxic and antibacterial properties.[1,2] As well, some advantages could be provided by resin composite restorations such as, adhesion to tooth structure using adhesive agents, possibility of repair, and avoidance of undesirable sacrifice of sound tooth structure.[3,4]

However, Polymerization shrinkage was considered one of the serious drawbacks of resin composites [5]. Recently, most developments have focused on the organic matrix to provide systems with less polymerization shrinkage such as Ormocer (organically modified ceramic), [6,7] which was introduced to the dental field by Fraunhofer Institute [8]

The pre-cure temperature is an important factor that affects the polymerization process of composite materials.[9] To extend the shelf-life of composite restorative materials, some clinicians store them in the refrigerator at 2°C - 5°C.[10] Clinicians might use resin composite materials after waiting for a while. But occasionally, composite materials are used immediately after being removed from the refrigerator temperature.[11] The purpose of this study to evaluate the impact of storage temperature on the microhardness of composite restorative materials.

II. MATERIALS AND METHODS

Three composite restorative materials were investigated as follows; An Ormocer based composite, Admira Fusion; a Methacrylate modified Ormocer based composite, Ceram.X SphereTEC One; and a Methacrylate based composite, Tetric N-Ceram. Sixty disc-shaped composite specimens were performed and randomly divided into 3 groups (20 discs each) according to each restorative material used. Each group was divided into 2 subgroups (n=10) according to the storage temperature; stored at room temperature or stored in the refrigerator at 4°C-5 °C.

Specimens were prepared using a cylindrical plastic mold (10 mm diameter x 2 mm thickness). A glass slide was held under the mold

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and covered with Mylar strip matrix. The composite material was inserted into the mold. Another strip matrix was placed on the surface and pressured with another glass slide. Light curing was performed using a light-emitting diode (LED) Elipar S10 (3M ESPE, St. Paul, MN, USA). Light curing was applied for 20s through Mylar strip and the glass slide. Regarding refrigerated composite materials, they were used immediately after removal from refrigerator.

The Vickers microhardness was evaluated using micro -Vickers hardness tester (JINAN PRECISION TESTING EQUIPMENT CO., Model) under a load of 50-g and a dwell time of 10 seconds using a diamond micro-indenter. Vickers hardness number (VHN) was calculated by the following equation: VHN=1854.4P/d2 where P is the applied load (g) and d is the average length of the indentations' diagonals (µm). The data were analyzed using the Statistical Package of Social Science (SPSS) program.

III. RESULTS

The Independent t test showed that there were statistically significant lower microhardness results for all refrigerator-stored composites as compared to their counterparts of room-stored composites. (P=≤0.05)

IV. DISCUSSION

Based on the results of this study, the null hypothesis which stated that storage temperature has no significant impact on microhardness of three different composites materials has been rejected. Vickers microhardness test was chosen for this study because it is relatively simple and reliable method for microhardness evaluation.[7] To avoid false interpretations, all tested samples were submitted to the same fabrication method, light-curing intensity, light-exposure duration, and curing distance between the samples' surface and the tip of the light curing device. Moreover, 2-mm-thick composite samples were used to ensure uniform photo-polymerization.[12,13].There were statistically significant lower microhardness results for all refrigerator-stored composites as compared to their counterparts of room-stored composites. This may be attributed to the effect of refrigeration which increased the material's viscosity which decreased the movement of monomer and retarded the velocity of the polymerization reaction. [14] This could have negatively affected the polymerization quality leading to lower microhardness results.

Our results agreed with **Osternack et al (2009)**who reported that immediate hardness values were affected by the temperature as refrigerated materials have shown lower hardness values. [15] Contrawise, **Torres et al (2011)** reported that cooling of resin composite cooling did not affect the microhardness results suggeesting that refrigerator-stored composites when directly used after removal form refrigerator would not affect the microhardness results. [16]

IV. CONCLUSION

It was concluded that refrigerator-storage has negatively affected microhardness which suggest the use of refrigerated composites after reaching room temperature at least

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