

Immersion Time and Watersorption Ability of Tooth Restorative Polymers

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INTRODUCTION:

A polymer's capacity to absorb water is generally evaluated according the ISO 4049 standards [1] whose recommendations remain identical whatever the material aspects. This study evaluated the immersion time required to obtain the maximum watersorption of a resin-modified glass-ionomer [Fuji II LC (FLC)], two resin-based composites [Filtek P60 (P60) and Filtek Flow (FLO)] and an ormocer [Admira (ADM)], comparing the results with those obtained according to ISO 4049 specifications:07.2000.

METHODS:

According to a protocol previously described [2] 5 disks (15 x 1 mm) of each material were made and photopolymerized with an XL 3000 Curing Light (3M Espe). The specimens were desiccated at 37°C until a constant mass m_1 was obtained, and the volume V of each disk was calculated in cubic mm. In this initial cycle, free water was removed.

Each sample was then immersed in distilled water, and weighed to record the mass (m_2 in μg) after 168h (ISO 4049 recommendations) and 180h, then after every 24h until a maximum constant mass was obtained, i.e. until the mass loss or gain was less than ± 0.1 mg in any 24h period. This second cycle gives a combination of watersorption and solubility for the material.

Finally, the disks were reconditioned at a constant mass (m_3) in a desiccator to measure the mass loss. The watersorption W_{sp} was calculated using the following equation:

$$W_{sp} = (m_2 - m_3) / V$$

Results were analyzed with Kruskal-Wallis tests and Bonferroni correction multiple-comparison procedures.

RESULTS:

Watersorption results are presented in Table 1 for materials tested with ISO 4049 standard experiment, and in Table 2 for materials whose immersion duration was greater than ISO 4049 specifications.

FLC sorbed significantly larger amounts of water than the other three materials, the watersorption of which was not statistically different whatever the experiment protocol.

Table 1. Absorption mean (standard deviation) in $\mu\text{g}\cdot\text{mm}^{-3}$ (ISO 4049 specifications).

| Material | absorption (standard deviation) (immersion time) |
|----------|--|
| ADM | 22.8 (0.3) ^a (168h) |
| P60 | 17 (0.8) ^a (168h) |
| FLC | 161.8 (7.9) ^b (168h) |
| FLO | 22.3 (0.4) ^a (168h) |

Results with the same superscript letter are not different.

Table 2. Maximum absorption mean (standard deviation) in $\mu\text{g}\cdot\text{mm}^{-3}$

| material | absorption (standard deviation) (immersion time) |
|----------|--|
| ADM | 23.5 (0.3) ^a (348h) |
| P60 | 20.9 (0.4) ^a (516h) |
| FLC | 163.8 (7.5) ^b (372h) |
| FLO | 22.3 (0.4) ^a (168h) |

Results with the same superscript letter are not different.

DISCUSSION – CONCLUSION:

Water is capable of diffusing through polymers, which absorb water to different degrees depending on their molecular and microstructural characteristics.

FLC contains numerous hydrophilic functional groups and, because of a highly entangled HEMA matrix, behaves as a synthetic gel which can absorb large amounts of water. Therefore, materials with higher HEMA content can soak up more water.

The specimens of P60, FLO and ADM clearly absorbed less water than FLC. The differences in watersorption found among these materials may come from the type of resin and filler. For an equal volume, the less filled the resin composite, the greater the matrix volume and the more watersorption. As a matter of fact, FLO and P60 have an identical matrix, but FLO has a larger amount of matrix than P60 and absorbed more water, more quickly. Besides, the hydrophobic nature of the constituents plays a major role. ADM contains Bis-GMA, which has two hydroxyl groups per molecule that can absorb water, while P60 and FLO contain Bis-EMA, a molecule where many hydroxyl groups are substituted.

Water intake causes dimensional changes and may deteriorate the quality of the interfacial bond. Immersion time, specified by the ISO 4049 standard, did not predict the complete water sorption capability of the materials used in this study.

REFERENCES :

- [1] ISO – Dentistry. *Polymer-based filling, restorative and luting materials*. Geneva: ISO 4049 (15.07.2000): 18-21.
- [2].Mortier E.,Gerdolle D, Jacquot B et al (2004) *Importance of water sorption and solubility studies for couple bonding agent resin-based filling material*. Oper Dent **29**: 669-676.