

# RESEARCH AND ACADEMIC EXPLORATION ABOUT OPTIMAL ATTITUDES OF DENTAL FILLING MATERIALS

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## 1. Introduction

Nowadays, dental filling materials with fizionomic properties are mostly used in dental care. Due to this, more and more products, which we know quite little about, appear on the market. During the curing process they all have certain polymerization shrinkage. Most of the dental practitioners believe that polymerization shrinkage is the causing mechanism of poor marginal adaptation between the two surfaces (tooth-filling material), ultimately leading to micro leakage and appearance of secondary caries lesions. Although this misconception is in clear contradiction with the facts experienced in dental practice it is widely spread. Our purpose is to demonstrate that poor marginal adaptation is caused mainly by the different elastic modules of the tooth and filling materials, and its consequences. We also wanted to categorize some of the most widely spread dental filling materials of our region from this point of view. This is important for us, because the least elastic material will exercise the smallest amounts of horizontal forces on the walls of the cavity during its deformation, in response of the vertical masticator forces. Summarising these, the dental filling material with the highest Young's modulus will not fracture the tooth's walls, and will not provoke micro-cracks in the tooth's tissues.

## 2. Experimental Setup and strategy

In order to establish the displacement fields the authors used an ESPI/Shearography System (ISI-Sys GmbH, Germany). The system allows a high-accuracy (with some *nanometres* resolution) evaluation of the displacements. In this sense the so-called *reference plate method* was applied. It is well-known that the image of this small, unloaded plate, superposed by shearing over the tested (loaded) specimen's image offers a good and high-sensitivity strain analysis. Were subjected to

uni-axial compression not only small cylindrical specimens (12 mm high and 10 mm dia.) manufactured from different kind of dental filling materials, but also some real filled teeth pares with these materials.

In this sense, the authors conceived and manufactured some original loading devices.

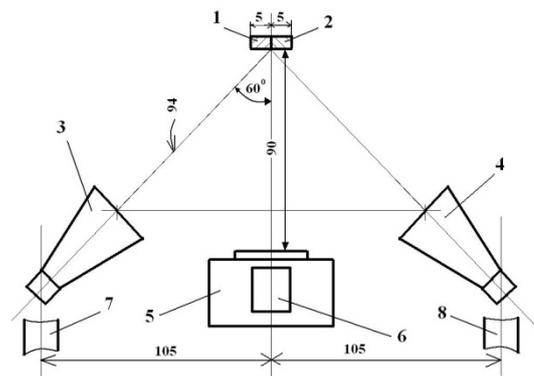


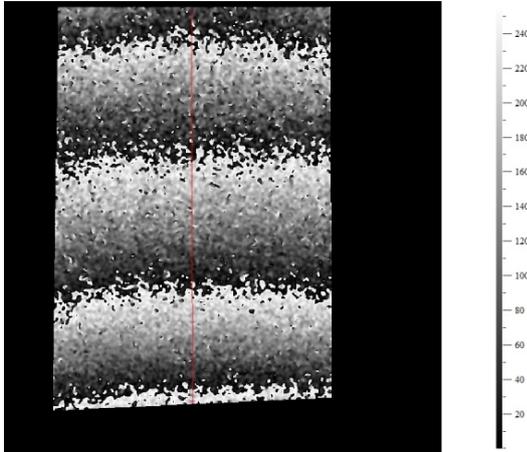
Fig. 1: Experimental setup

In figure 1 is shown the experimental setup. The small reference plate 1 (having width 5 mm) is superposed by shearing over the tested specimen's nearest site (2). The laser diodes 3 and 4 assure a good and equal illumination of the observed surface. They are fixed on the high-stiffened polycarbonate rods (7, 8). The Michelson Interferometer 5 and the 4 Mpx CCD cameras 6 are disposed in normal direction to the object. The distances are given in mm.

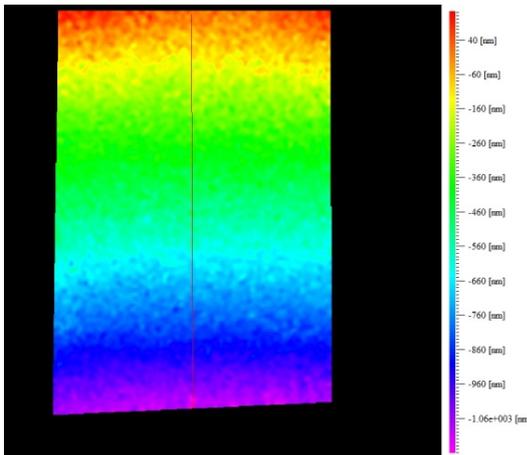
## 3. Experimental Results

In these experiences were tested 2 types of filling materials: composites (TE-Econom, Carisma, Ex-tra Fil), respectively glass-ionomers (Fuji Gp IX, Ketach Molar, Ionofil +). From all of them were manufactured both small cylinder specimens and filled teeth assemblies. In the following figures are illustrated both the cylinder-

shape specimens' analysis and the filled teeth ones, too.



**Fig. 2:** Cylindrical specimen #1, Filtered data



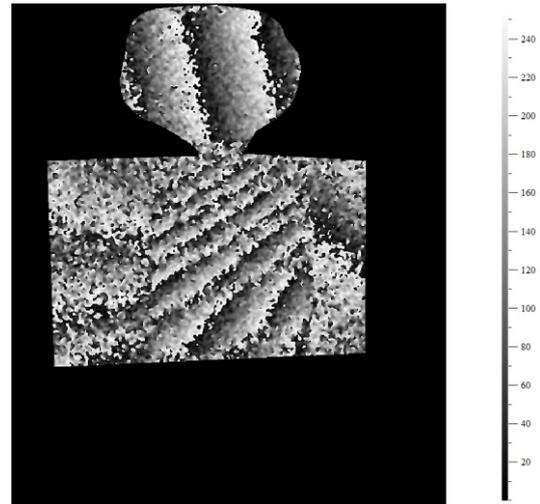
**Fig. 3:** Cylindrical specimen #1, Evaluated data

#### 4. Final Remarks

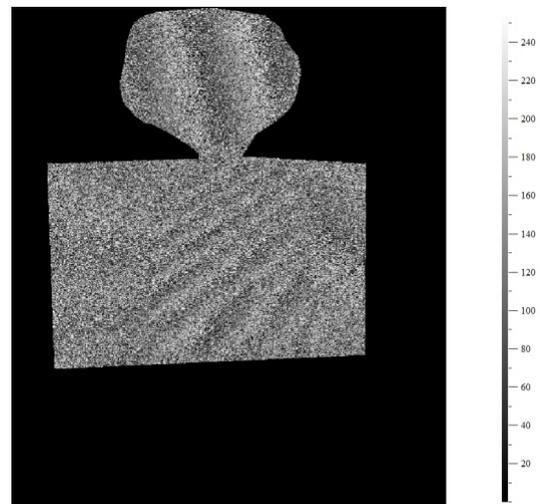
In these investigations the authors examined mainly the transversal elongation and its effect on the tooth.

The greater the lateral swelling of the filling material it is (in function of the compressive force exercised on it), the more it resorts the tooth's tissues (in fact the surrounding walls of the cavity in which the filling material is placed), mainly on bending. The aim of the research was to categorise and to evaluate from this point of view some of these often used dental filling materials.

Based on the result of the experiments, in the next period, the authors intend to perform some FEM analysis in order to establish the stress-field of the filled teeth.



**Fig. 4:** Teeth assembly #1, Filtered data



**Fig. 5:** Teeth assembly #1, Measured data

**Acknowledgements:** The authors express their gratitude to Mr. Manager Eng. Gelu Ungureanu, from Brasov, Who allowed in His Company to be performed the above-described experiments.

#### References

- [1] Sutton, A. M., Orteu, J. J., Schreier, W. H., Image Correlation for Shape, Motion and Deformation Measurements, Springer Verlag, 2010
- [2] \*\*\* User Manual and Service Instructions SE3 Shearography/ESPI-System, ISI-Sys GmbH, Kassel, Germany, 2009