MECHANICAL BEHAVIOUR OF DENTAL COMPOSITE FILLING MATERIALS USING DIGITAL HOLOGRAPHY

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Abstract

One of the most common clinical problems in dentistry is tooth decay. Among the dental filling materials used to repair tooth structure that has been destroyed by decay are dental amalgam and composite materials based on acrylics.

Dental amalgam has been used by dentists for the past 150 years as a dental restorative material due to its low cost, ease of application, strength, durability, and bacteriostatic effects. However its safety as a filling material has been questioned due to the presence of mercury.

Amalgam possesses greater longevity when compared to other direct restorative materials, such as, composite [1]. However, this difference has decreased with continual development of composite resins [2].

Photo-activated composites are widely used during dental restorative procedures. In that respect they have almost replaced amalgam fillings. Composites are glued into teeth restoring most of the original strength structure of the tooth.

Studies show that recurrent marginal decay is the main reason for failure in both amalgam and composite restorations [3]. Polymerization shrinkage that occurs during the composite curing process has been implicated as the primary reason for postoperative marginal leakage [4]. Polymerization of composite filling is considered to be an important factor in achieving longevity of the restorative treatment. Contraction induces certain amount of stress, which is transferred to surrounding dental structures.

The objective of this work was to study the dimensional changes in tooth, produced by light-induced polymerization of dental composite filling using Digital Holography (DH). DH presents some characteristics that make this technique well adapted to this study. It has a high resolution, can work with small objects and has a simple setup. Digital holography enables the determination of total strain on any point of the tooth surface, as shown in Fig 1(a).

In this study, a human tooth's a molar (28) and a premolar (14) were chosen. Both were mounted in a holder made of acrylic resin for good immobilization. A preparation was made in both tooth's, a cavity in occlusion in the molar, as shown in Fig 1(b), and mesio-occlusion in the premolar was drilled and filed with composite, according to Black requisites. The cavities were drilled with a depth of 2,5 mm using a calibrated drill with stop. The prepared tooth was placed in a digital holographic set up allowing the recording of holograms almost in real-time. A blue led lamp is used to induce composite polymerization and the deformation induced by dental composite contraction recorded by the digital holographic setup. The holograms are post processed for data analysis.

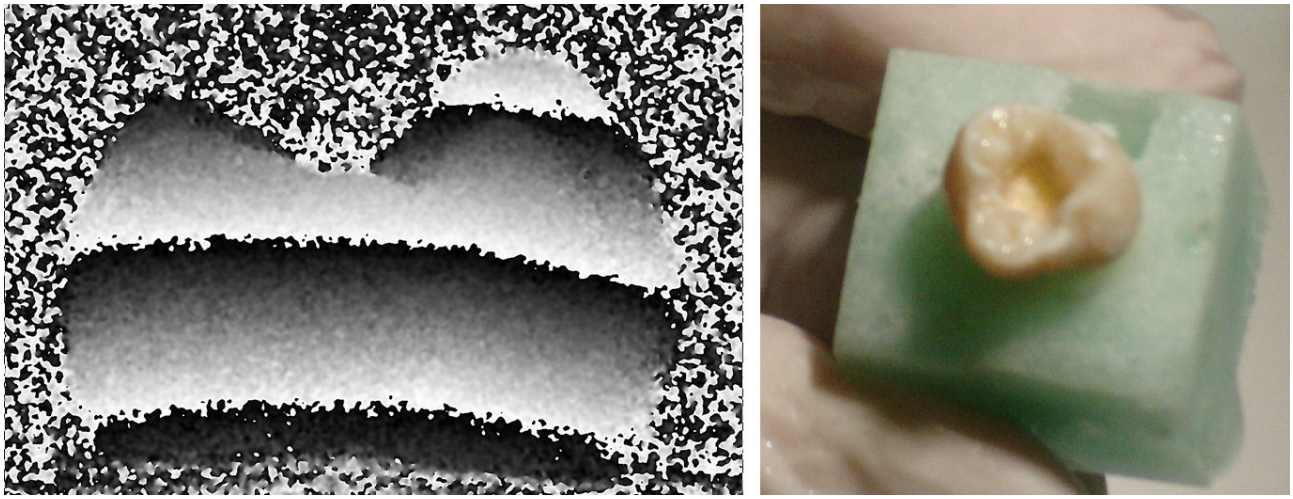

Fig. 1. (a) digital hologram of a Intact tooth subjected to a thermal load, (b) tooth with drilled cavity.

References

1. Christensen, GJ. Longevity of posterior tooth dental restorations. "JADA 2005;136:201-203,
2. Leinfelder KF and the skill of dentists. Do restorations made of amalgam outlast those made of resin-based composites? JADA 2000;131:1186-1187.

3 Bernardo M, Martin MD, Lerouz BG. Survival and reasons for failure of amalgam versus resin-based composites posterior restorations placed in a randomized clinical trial. JADA 2007;138:775-783.

4 Burgess JO, Walker R, Davidson JM. Posterior resin-based composite: review of the literature. Pediatr Dent 2002;24(5):465-479.