Oscillation energy has been proposed in a new method to condense resin composites. The principle of this technique assumes that vibration lowers the viscosity of the resin, allowing the material to flow and easily adapt to the cavity walls, in a similar way as a flowable composite. The aim of the study was to assess the efficiency and quality of composite compaction, using one of these new devices.

MATERIALS AND METHOD: The study included 20 class I cavities prepared in extracted human molars. The teeth were randomly divided into two groups of 10 cavities. Both groups were filled with composite material Filtek Z250 and the adhesive system Single Bond Plus Adhesive Adper TM Adhesive (3M ESPE). In the control group, condensation of the composite was done with standard instruments. In the experimental group, condensation was done using a vibration instrument: Compothixo (Kerr). The prepared sections were observed on a scanning electron microscope (SEM), VEGA II model LSH (TESCAN). RESULTS: When using Compothixo, the average working time was 8.53 min / restoration while, when using standard instruments, the average working time was 10.32 min, which seems to indicate that the vibration technique was more effective than traditional condensation. Microscopic images have shown that neither vibrating condensation nor manual condensation precluded the formation of a hiatus in some areas of the interface between the restoration and the cavity walls, especially in areas of small irregularities. CONCLUSIONS: Condensation of composite resins can be faster when using vibrating instruments. Adaptation of the material to the cavity walls is comparable to that obtained by traditional techniques.

Key words: vibration, composite resin, restoration

INTRODUCTION

Composites restoration involves a rigorous and time-consuming technique. The risks related to shrinkage stress and low penetrability of the photoactivation beam during the setting of the material are the main reasons that support layered techniques for composite restoration. In order to minimize polymerization shrinkage and maximize conversion of the monomer, the thickness of each layer should not exceed 2 mm. Therefore, in most cavities, two or more layers of material have to be used, each being applied, condensed, shaped and polymerized. This repetitive protocol renders the technique extremely laborious. Even so, adaptation of the composite to the margins and walls of the cavity is not perfect.

These problems have activated producers to find solutions to make either the material or the technique easier to apply and faster to use. In order to achieve these goals, several solutions have been proposed: light curing units with increased intensity (more than 800 mW/cm²), composite resins that can be light-activated up to 4 mm or more, low shrinkage materials (less than 2%), flowable composites and restorative techniques using pre-heated composites. The results of all these alternatives are questionable in terms of economic efficiency and therapeutic results.

A new method of restoration relies on more sophisticated instruments that condense the material by vibration. The principle of this technique assumes that vibration lowers the viscosity of the resin, allowing the material to flow and easily adapt to the cavity walls without air pores, in a similar way as a flowable composite. Thus, a condensable material with increased viscosity can be used similarly to a flowable composite, without the disadvantage of high polymerization shrinkage and poor mechanical properties. Such devices have been created by several producers (Kerr, Kavo) and operate according to the same principle: sonic vibration.

The aim of this study was to assess the efficiency and quality of composite compaction using one of these new devices.
MATERIALS AND METHOD

The study included 20 sound molars, extracted for orthodontic reasons. Class I occlusal cavities were prepared using a 330 diamond bur, under water spray. The cavities had rectangular contour with rounded angles, depth of approximately 3-3.5 mm, long axes between the medial and distal grooves and width of approximately 2.5 mm. On the cavity bottom, a medial-distal groove was prepared with a ½ burr, to simulate the irregularity of the real, minimally-invasive cavities.

The teeth were randomly divided into two groups of 10 cavities. Both groups were filled with the composite material Filtek Z250 and the adhesive system Single Bond Plus Adhesive Adper TM Adhesive (3M ESPE). Two layers of material, about 1.5-2 mm thick, were inserted, condensed and light-activated for 40 s with a LED unit (800 mW/cm²). In the control group, condensation of the composite was done with a spatula and pluggers made of stainless steel. In the experimental group, condensation was performed with Compothixo (Kerr), using corresponding applicators.

Compothixo is a tool designed to vibrate during modeling composite. Vibration frequency is 140Hz +/-20Hz and the amplitude of peak extremity is +/-150ìm. The instrument is designed for 10 min discontinuous application. Components include a handle and four tips: pointed tip; spatula tip; plugger tip; semi-sphere tip. The instrument is activated using the button on the handle in a similar way as a standard instrument for composites, slightly touching the material.

The duration of each restorative procedure was registered.

Each restored tooth was cut into three slices. The resulting sections were polished using coarse to fine grain discs. The prepared specimens were observed on a scanning electron microscope (SEM), VEGA II model LSH (TESCAN).

RESULTS

When using Compothixo, the average working time was 8.53 min / restoration while, when using conventional instruments, the average working time was 10.32 min, which seems to indicate that the vibration technique was more effective than traditional condensation.

Condensation and modeling within the control group have led to inconsistent results, the areas of adequate adaptation alternating – in some sections – with areas of poor adaptation (Figs. 1, 2).

![Fig. 1. Area of poor adaptation of the composite material to the cavity wall, following conventional condensation and modeling (magnification 2200 x)](image1)

![Fig. 2. Interface between the composite material and wall cavity, following conventional condensation and modeling. A slight lack of adaptation and a small pore within the material may be observed (magnification x 200 ).](image2)
Within the experimental group, the microscopic images have showed that the vibrating method is effective in achieving appropriate adaptations to the cavity walls, even when using in cavities with very small irregularities and retention (Fig. 3).

Fig. 3. Adaptation of the composite material to the cavity wall in Compothixo group (magnification x600)

However, the vibrating technique does not seem to exclude problems of poor adaptation and trapping of air or impurities (Figs. 4, 5).

Fig. 4. Area of defective adaptation of the composite material to the cavity walls in the Compothixo group (magnification x800)

Fig. 5. Area of defective adaptation of the composite material to the cavity walls in the Compothixo group. A big pore is filled with the detritus resulted from sample preparation (magnification x 200).

None of the techniques preclude the formation of a hiatus in some areas of the interface, between the restoration and the cavity walls, especially in the groove area.

DISCUSSION

The instruments that use vibration to condense materials have been introduced in dental practice to facilitate the material flow and adaptation to the walls of the cavity. These objectives were difficult to attain, especially for materials with increased viscosity, which are advantageous for dentistry, due to their low polymerization shrinkage and good mechanical properties. The technique was initially recommended for amalgams; however, the results were not as good as expected. More recently, such instruments have been introduced for the application of dental sealants (1). Nowadays, several vibration instruments designed for restorations with composite resins are in use.

Restoration with composite resins involves a rigorous and time-consuming technique. Kavo company produced a vibration instrument (Kavo SonicFill) which allows introduction and
condensation of a special composite, that can be cured up to a depth of 5 mm. The producers claim a 30% reduction of the working time in comparison with the traditional technique. In our case, applying two layers of conventional universal material with the Compothixo instrument has reduced the average working time with approximately 17.34%. The lower efficiency of Compothixo, compared to Sonic Fill, is explained mainly by doubling the working time required by the layering technique applied.

Although the vibration technique seems faster than traditional condensation, it is difficult to assess to what extent, the difference of working time, of approximately 1.79 min, being clinically relevant. Placing the material in the cavity and initial condensation seem simpler to perform using a conventional instrument or the inactive Compothixo, because vibration seems to make the material more adherent to the instrument and more difficult to apply. Once the material is slightly condensed on the bottom of the cavity, it does no longer stick to the instrument tip and vibration can be started. Also, changing the tip of the instrument is quite difficult and time-consuming. Using several handles with different insert tips for each patient would resolve this problem, but it would be inefficient in terms of costs involved.

Producers claim that, although material consistency does not equal that of a flowable composite, vibration secures an adaptation to the cavity walls similar to that obtained with a composite flow.

The material produced for Sonic Fill allows photo activation of significantly thicker layers, which considerably reduces the working time. Independent tests have shown hardening up to 5 mm depth, with a Rockwell hardness of 80% of surface hardness (2). These characteristics would allow dental practitioners to place bulk restorations even in large cavities, although the bulk technique is considered to determine poor adaptations to cavities’ wall. However, several recent studies suggest that the advantages of layering are overestimated, compared to bulk restorations with new materials, characterized by low polymerization shrinkage (3-8). In addition, vibration would contribute to a better adaptation of the material restoration, even when large volumes of material have been used. Up to now, no independent studies assess the vibration technique, only some data offered by the producers of such devices being available.

The present study does not use the bulk technique, but two layers of material, because the composite used had been designed to harden up to a maximum thickness of 2.5 mm. However, the volumes of material applied were large, because of the dimensions of the cavities. The composite used is a material with quite high consistency. Using vibration seemed to facilitate condensation and modeling, yet without eliminating the adaptation defects observed on the images obtained on the scanning electron microscope.

When making options between an acceptable bulk restoration and a sophisticated layered one, it seems likely that the practitioner would choose the first alternative, especially for posterior restorations. Most patients would probably make the same choice. Therefore, if vibration improves the qualities of bulk restorations, there is a serious reason to use it.

So far, the results of this study demonstrate that the results of vibration condensation are comparable or slightly better than those of the traditional technique, and can be achieved in shorter time. However, in dentistry, faster and easier are not always equivalent to high quality. Therefore, more studies are needed to assess the effectiveness of the vibratory condensation technique for bulk restorations.

CONCLUSIONS

Condensation of composite resins can be faster achieved by using vibrating instruments. Vibration decreases the viscosity of the material and facilitates its flow within the preparation irregularities.

Adaptation of the material to the cavity walls is comparable to that obtained by traditional techniques.

The working time required by the use of this instrument is lower, compared with the conventional techniques.
The applicability of these devices for improving the results of bulk restorations requires future extensive studies.

References