Since composite resin restorative materials were first introduced, many improvements have been made in filler technology and handling properties. Still, today the typical composite restorative material has a stiff viscosity which, while desirable when molding and sculpting, makes it difficult to fully contact all of the cavity walls in cases where there is an acute line angle. This has been addressed to some degree by the creation of flowable composites, which exhibit excellent flow and wetting properties, but at a sacrifice of some of the performance characteristics of traditional filled resins.

In addition to flow/cavity adaptation challenges, all modern composite resins exhibit some degree of stickiness, resulting in a frustrating phenomenon commonly referred to as “pull-back.” In an attempt to overcome this, many practitioners utilize instruments designed to be “non-sticky” or, to the potential detriment of the restoration, dip their composite instrument in unfilled resin in order to make it “slippery.”

Over the years, several vibrational devices have been tried in an effort to increase the flow of composite material and to reduce stickiness/pull-back, all with little to no success. An oscillation device (ET 3000, Brasseler USA, patent pending) has recently been developed and has been found to significantly increase the flow of composite materials while eliminating composite stickiness/pull-back. The development of the device is based on laboratory research aimed at quantification of the effects of oscillation on the properties of composites before and after polymerization.

The success of the oscillating composite placement device is due to the basic difference between vibration and oscillation. Vibration is a trembling, shaking or quivering motion which is usually uncontrolled and might be in several directions. Oscillation is a steady or regular back-and-forth movement in a predictable and regular pattern. Our research has found that the most desirable limit for the back-and-forth action (amplitude) is in the general vicinity of 1.5mm with a speed (frequency) of 65Hz. The high-speed, definite back-and-forth action to the composite material that immediately reduces its viscosity, allowing it to flow much more freely. Also, because the oscillating placement blade strikes the material and withdraws so quickly, the material does not have time to adhere to the placement blade and therefore does not stick – thus pull-back is eliminated.

In these experiments, we used a model oscillating instrument with amplitude of 1.5mm and a frequency of 65Hz. A schematic of an instrument is shown in figure 1. Attached to the oscillation instrument was a “beaver tail” placement tip. The same tip was used with a non-oscillating manual procedure. Several widely used composite materials were tested. After oscillation, polymerized specimens of the composites were compared to the polymerized specimens of the non-oscillated (traditionally placed) composites. The results of the measurements are:

- **Flow Properties:** Among the oscillated composites, there was an increase in the amount of flow up to 30 percent more than the non-oscillated composites.
- **Microhardness:** Oscillating force caused no difference in the hardness.
- **Tensile Strength:** The strengths of the composite materials were not affected by oscillation.
• Density: No difference in density was detected between oscillated and non-oscillated specimens.
• Microstructure: There were no differences in the spatial distributions of reinforcing particles in the oscillated and the non-oscillated specimens and no differences between the thickness of polymer rich regions at the surface of the oscillated and non-oscillated specimens. In addition, differences were not observed in the amount or size of porosity.
• Bond Strength to Dentin: With the oscillated and non-oscillated samples, there was no significant difference in the bond strength to dentin.
• Adherence of the Composite to the Oscillating Placement Instrument: Contrary to the “stickiness” common to the non-oscillating composite (regular) placement tip, there was no measurable sticking/pull-back with the oscillating composite placement tip; i.e., composites do not stick to an oscillating composite placement instrument.

Imposition of oscillation to appropriately designed placement tips can allow practitioners to use the device in a variety of clinical procedures. For example:

• Operative Dentistry – Classes I-V
  ◦ Placing of composite resins in all cases can be made more efficient. In multi-layer posterior restorations, voids and lamination gaps between layers can be more easily avoided.
  ◦ The need to place a flowable composite in some situations is potentially reduced.
  ◦ A greater degree of restoration shaping and contouring can be accomplished pre-cure, reducing time consuming post-cure shaping and finishing.
• Direct Veneers
  ◦ Due to the increase in flow and no pull-back, this technique can greatly decrease the time spent in shaping the body and interproximal of the veneer.
• Placement of Sealants
  ◦ More highly filled resins can potentially be used as oscillation enhances flow into pits and fissures, and could decrease the presence of bubbles and voids within the placed sealant.

Conclusions

It was found that an oscillating (not vibrating) composite placement tip can increase the flow of composite more than 30 percent. The research also showed that composite materials do not stick to an oscillating placement instrument and the use of oscillation does not affect the properties of polymerized composites. The improvements in handling properties have the potential to significantly facilitate clinical procedures using composite materials.

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References

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