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What's in Your Composite? Get Filled in on Fillers.

Microfill, hybrid or nanocomposite? Find out how your composite composition – and filler particle size – could be impacting the success of your restoration.

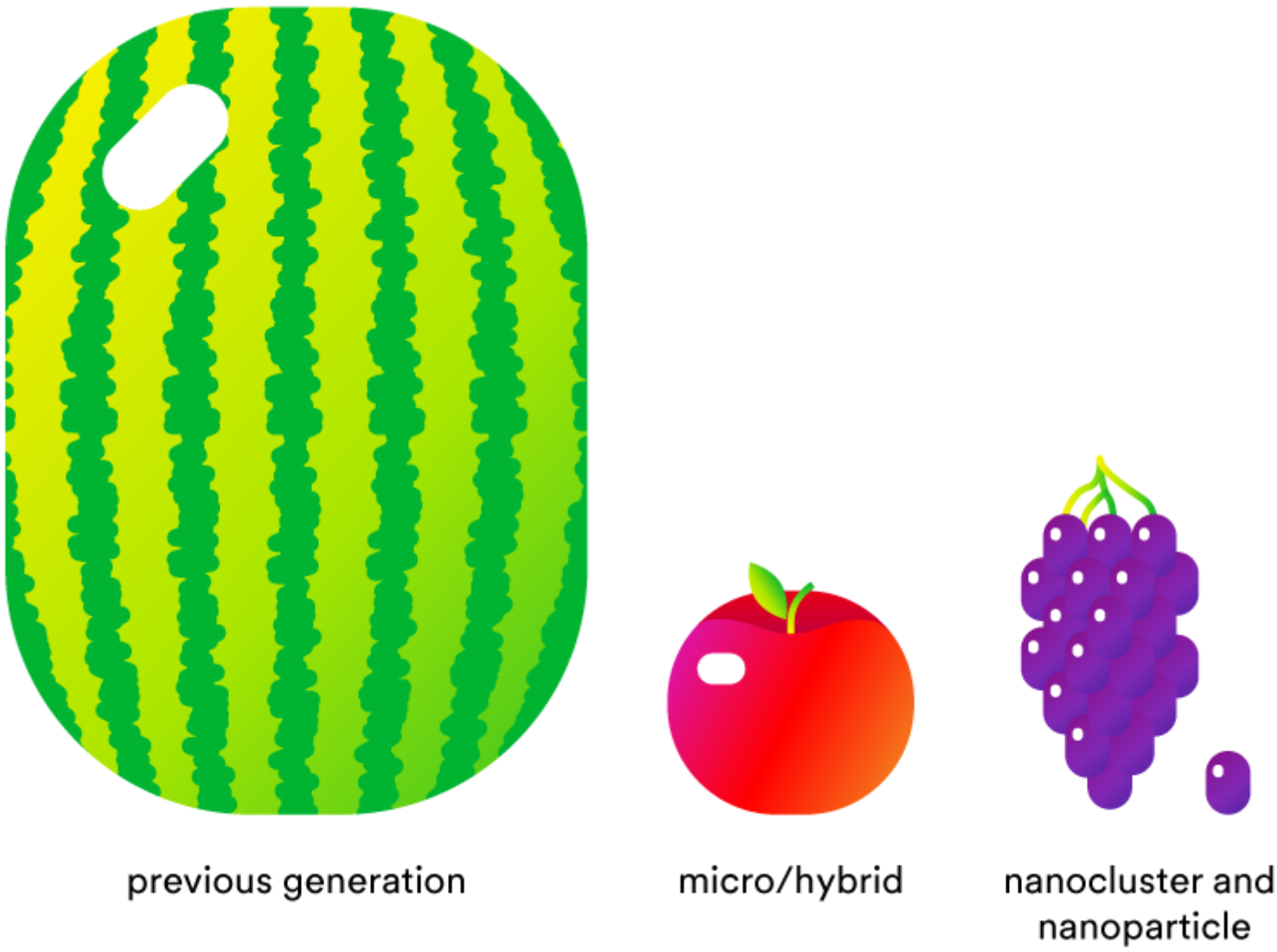
Choosing a dental composite can be complex and flat out confusing. Every commercially available composite has a different set of features, benefits and shortcomings, which can be hard to keep straight – particularly when each manufacturer names their technologies differently. The reality is that dental composites are more than the sum of their parts, but each part is selected for a reason. Knowing exactly what's in your composite and what each ingredient brings to the table can help you make the right choice for every case.

One of the most critical parts of a composite has a deceptively unimpressive name of "filler." But it's worth sweating the small stuff, because these fillers do far more than simply take up space.

A Recipe for Robust Restorations

Dental composites are made of multiple critical components: a resin matrix, fillers, coupling agents, polymerization initiators, stabilizers and pigments mixed in different combinations to achieve a specific, desired outcome.[1] Fillers are generally made of fine glass, quartz or silica and are added to enhance the elastic modulus, increase tensile strength, hardness and wear resistance, as well as decrease polymerization shrinkage of the restoration.[1-3] But composite material properties also depend on the size, shape, concentration and composition of the filler particles, and even their bond with the matrix – so your choice can make a difference.[2]

While there are many ways to classify composites, they tend to be categorized by the size and distribution of the filler particles. Generally, the smaller the particle, the smoother the surface of the composite over time. The higher the filler content, the stronger the final restoration – but that's much easier said than done.



Hybrids or Microhybrids

While the term originally referred to the mix of organic and inorganic content in the first composites (the resin matrix and filler, respectively), it's now more commonly used to refer to composites that contain a blend of large and small particles. This mix of fillers is intended to provide the "best of both worlds," with smaller particles improving polish and handling, while larger particles improve strength. In practice, however, it ends up being more of a compromise.

While the differently sized particles provide strength, the composite wears inconsistently over time. As the resin wears down, the larger particles can pop out and fall away, leaving craters that lead to a rough, unpolished surface – which ultimately limits the material's esthetic potential.[4,6]

Microfills

Microfilled composites were first introduced in the early 1980s to combat the esthetic deficiencies of earlier hybrid composite compositions. In response, filler particles were drastically downsized. Microfills

These small particles provide excellent natural-looking esthetics with a high and easily maintained polish. However, the tradeoff comes in the mechanical properties. In order to achieve these results, microfills contain less filler, which results in less strength, less wear resistance and greater polymerization shrinkage.[4,5]

Some clinicians still utilize microfills for anterior restorations due to their reputation for esthetics, but as dentistry moves toward simplified, universal composites, their long-term usability is limited. In other words, picking a composite for appearance alone isn't a recipe for success.

Nanohybrids

Probably the most prevalent composite composition used today, nanohybrids are made up of a mix of nanoparticles and larger, conventionally sized particles. As with microhybrids, the goal is to achieve a combination of optimal esthetics and strength with nanoparticles providing the next level of polish and life-like translucency. However, many nanohybrids on the market are primarily made of large particles, with nanoparticles taking up only a small percentage of the formulation. This can result in similar polish retention issues to standard microhybrids and keeps the nanoparticles from reaching full esthetic potential.[9]

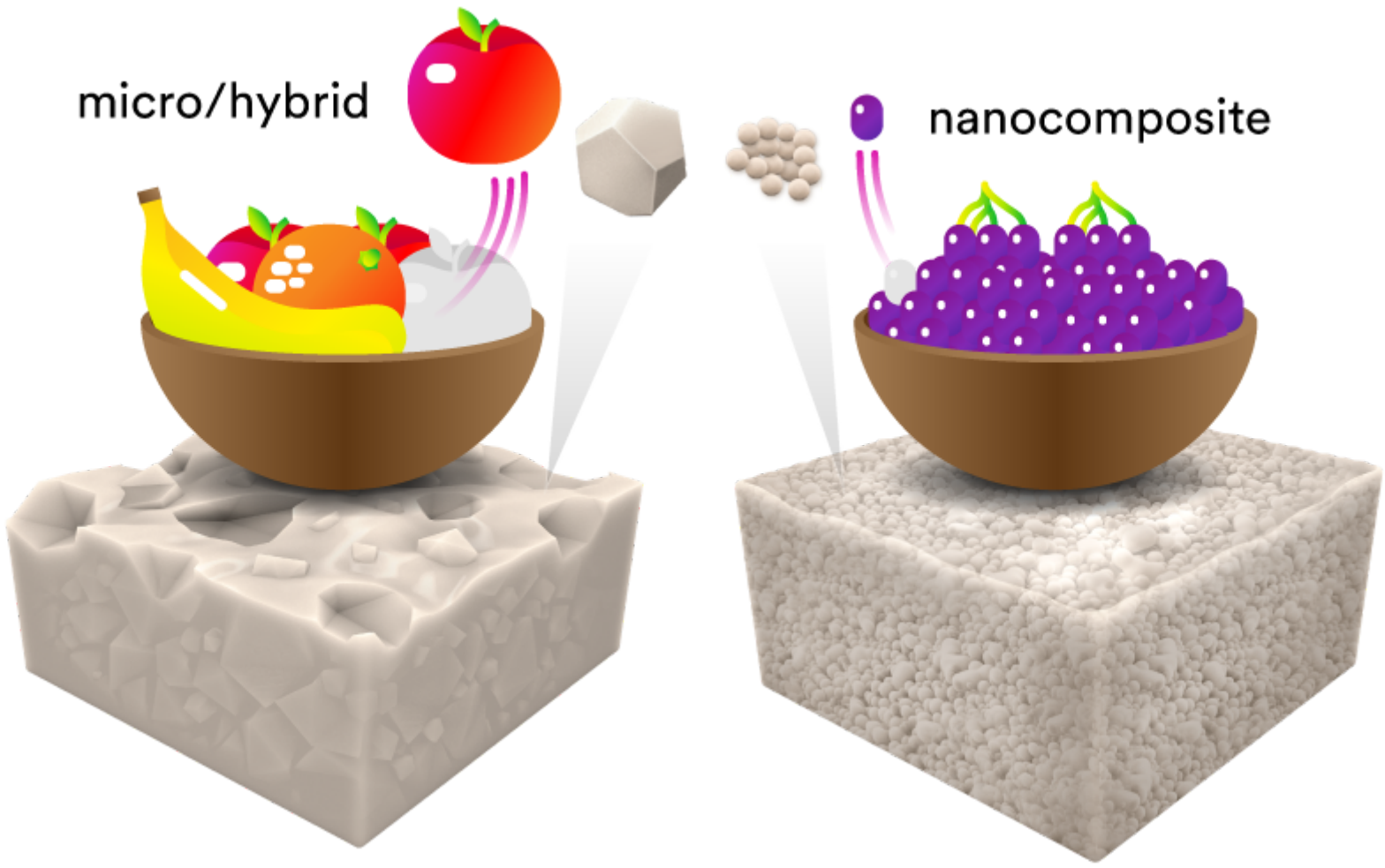
Nanocomposites

Nanocomposite is the most recent development in dental composites, which utilizes nanoparticles *exclusively*. But what makes them special? The ultimate goal of dental composite restorations in general is to match the tooth as closely as possible. Teeth themselves are nanostructured – they're made up of nanocrystals called hydroxyapatite – so it's only logical to use particles of the same size to produce the most natural-looking result.

Microfills may have small particles, but it's difficult to get enough filler into the composite to make it strong mechanically and wear like natural enamel, particularly without unwanted interactions with the resin. In many hybrids, on the other hand, the small filler particles are physically downsized from larger particles in a top-down process – which results in a wide range of particle shapes and sizes with the exact same physical properties. While the diversity of particle size enables higher filler loading and strength, the particles are all much harder than the surrounding resin. This means that the resin will wear away more quickly and allow the large particles to reach the surface and pop away. Think of it as filling a bowl with a variety of fruit: pulling any one piece could greatly impact the rest of the bowl.

Nanoparticles, on the other hand, are manufactured from the bottom-up. This enables them to be an equal size and shape, so they wear evenly and consistently with surrounding tooth structure. Plus, nanocomposites can be manipulated at the nanoscale: the particles can be fused into nanoclusters that act like larger particles to improve filler loading, which in turn improves strength and wear resistance – without detracting from overall esthetics.[2,8] You can think of it as filling a bowl with clusters of grapes: you can easily pluck individual grapes from the bunch without leaving a huge space behind.

In addition, working at such a small scale gives manufacturers more control over the optical properties of



Why it Matters

When it comes to choosing composites, it can be easy to overlook tiny details like filler particle size – particularly when you can't actually see them without a high-powered microscope. But each composite is much more than meets the eye.

As dental composite technology evolves, it's important to not only keep an eye on ingredient developments, but also to be open to the benefits that new composite technology could bring to your practice. When choosing your next composite, take technology names with a grain of salt, and take a closer look at particle sizes instead. Because the smallest details can ultimately have a big impact on the quality of your restorations.

Sources

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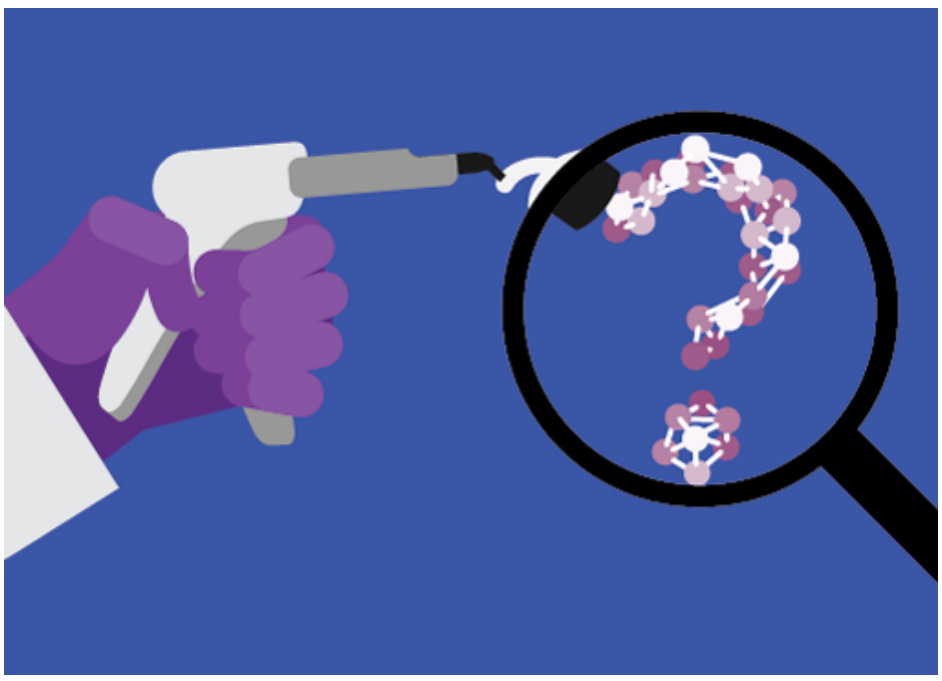

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