Understanding the Properties and Behavior of Zirconia

All zirconia materials are not identical. They will differ by composition, processing, and other factors which ultimately affects mechanical and physical properties along their level of translucency. Stabilizers are used to influence their mechanical properties such as flexural strength, fracture toughness, and opacity/translucency. The more translucent the zirconia material, the weaker it becomes. Yttria is used by all manufacturers to alter the properties of zirconia. The more yttria that is added to zirconia the more translucent it will become with the corresponding loss of fracture resistance. Yttria additions are commonly expressed by percentage of either 3, 4, or 5 % mol content.

Flexural strength is the most common factor that dentists will examine when choosing a ceramic material for intraoral use. Unfortunately, it cannot predict performance and longevity. Resistance to fracturing is an indicator of toughness, flexural strength on the other and defines when a material will give way to bending. Understandably, it does not correlate well to what happens in the mouth. Fracture toughness on the other hand defines the ability of the material containing a crack to resist fracture and consequently is one of the most important properties you should consider when evaluating all dental ceramics, since it much closely correlates to clinical performance.

ISO standards have been established to categorize dental materials by classes reflecting their actual applications and appropriateness for their use. Zirconia is commonly considered the toughest ceramic material that can be used in the mouth. But keep in mind not all zirconia materials are identical especially as it relates to the more translucent versions. This is exemplified by the fact that the more translucent zirconia materials have fracture toughness values equal or lower to that of lithium disilicate.

Translucency is certainly important, but with zirconia too much can create a graying or low value affect. It can be one reason to choose alternative materials which have translucency and color built in like lithium disilicate. Although dentists are rapidly moving toward zirconia and away from traditional glass ceramics, in many cases they will be sacrificing overall esthetic effect in the name of perceived strength. The performance of ceramics is multifactorial and mechanical properties alone will not solely predict their behavior and long-term outcome. Glass ceramics have a long history of success, and although zirconia is admired for strength, it still lacks the overall esthetic effect and known predictability particularly with lithium disilicate.