

Evaluation of Fracture Toughness of Injectable Composites

Abstract

Led by Nathaniel Lawson, DMD, PhD, Director of Biomaterials at the University of Alabama at Birmingham, this study evaluates the fracture toughness of two commercially available injectable composite materials: Evanesce® Injectable (Clinician's Choice®) and G-aenial™ Universal Injectable (GC America).

The results demonstrate that Evanesce Injectable exhibited a significantly higher fracture toughness than G-aenial Universal Injectable, validating its mechanical performance.

Introduction

Fracture toughness is a crucial mechanical property for dental materials, as it measures their ability to resist crack propagation under stress. Injectable composites are widely used due to their versatility and ease of application, but their mechanical properties vary significantly. This study compares the fracture toughness of two injectable composites to provide clinicians with insights into their durability and performance.

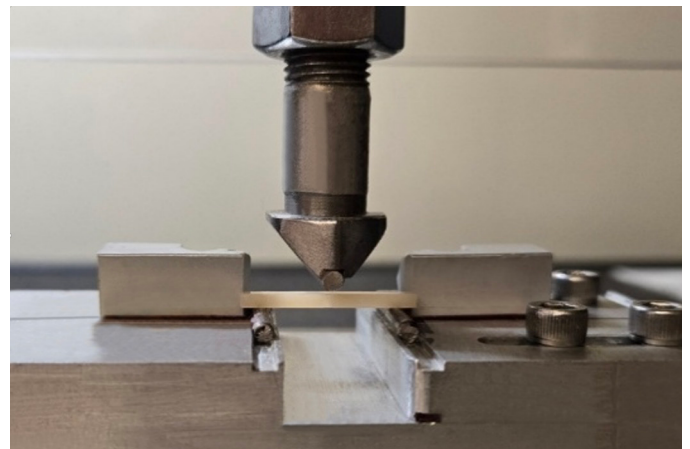
Injectable Composite Materials Evaluated:

- **Evanesce Injectable** (Clinician's Choice)
- **G-aenial Universal Injectable** (GC America)

Study Design

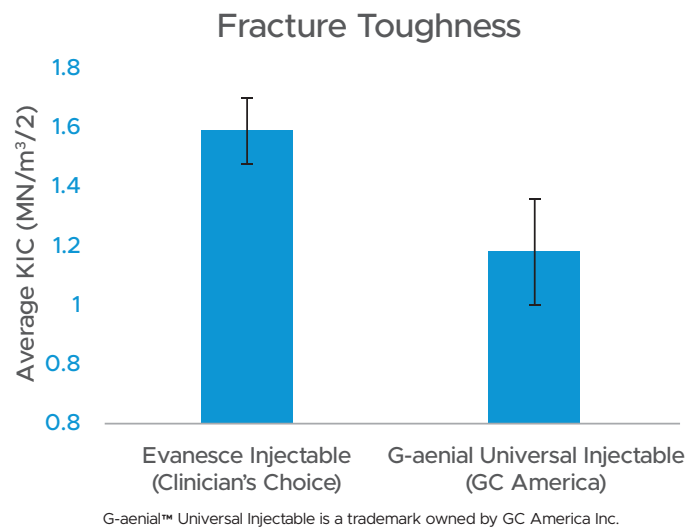
The fracture toughness specimens were prepared using Teflon molds (2 x 2 x 25 mm) with a 1 mm central metal fin, lightly lubricated with silicone spray. The molds were covered with a mylar strip and glass slide, and the materials were cured using a 3M™ ESPE™ Elipar™ S10 curing light with an irradiance of at least 1000 mW/cm², verified by a radiometer. Curing was performed in overlapping 10-second steps, starting at the center and moving outward, repeated five times on each side of the specimen. After curing, excess material was removed using a blade or polished with 600-grit SiC paper, and the specimens were stored in water at 37°C for 24 hours.

For testing, the height and width of the specimens were measured with digital calipers, and the notch was oriented in the same plane as the applied load. The testing apparatus consisted of 3 mm diameter rod supports spaced 20 mm apart, with a 2 mm diameter loading indenter applying force at a rate of 1 mm/min. The maximum load was recorded to calculate the fracture toughness (KIC).



Results

Statistical analysis using a t-test confirmed a significant difference between the fracture toughness of the two materials ($p < 0.001$). Evanesce Injectable consistently demonstrated higher fracture toughness, indicating an average of 35% greater resistance to crack propagation than G-aenial Universal Injectable making it a more reliable choice for restorative applications where mechanical durability is critical.



Material	Average KIC (MN/M³/2)	Standard Deviation
Evanesce Injectable	1.590	0.111
G-aenial Universal Injectable	1.181	0.180