# "Physio-Mechanical Properties of a New Zinc-Reinforced Glass Ionomer Restorative Material"

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## Abstract

**Objective**: Zinc-reinforced glass ionomer restorative material (ZRGIC) has been proposed as an improved restorative material. The study compared the mechanical properties of a ZRGIC restorative material (ChemFil Rock, (Dentsply)), with three commercially available glass ionomers (GICs); Fuji IX GP Extra (GC America), Ketac Molar (3M ESPE) and EQUIA Fil (GC America). A resin composite, Premise (Kerr), was included as a control group.

**Methods:** Fracture toughness ($K_{IC}$) testing was done according to ISO 13586, using single edge notched-beam specimens (n=10), loaded until failure in a three-point bending test device. Specimens (n=9) for the hardness, roughness and abrasive wear testing were made by mixing and inserting the restorative materials into individual stainless steel molds followed by flattening and polishing. Knoop microhardness (KHN) was performed (25g, 30s),on pre-determined areas of the polished surfaces. For toothbrushing wear resistance and roughness, specimens were brushed in an automated brushing machine (200g) with a suspension of dentifrice and water (1:1w/v) for 20,000 strokes. Specimen surfaces were scanned in an optical profilometer before and after brushing to obtain surface roughness (Ra) and mean height (surface) loss using image subtraction and dedicated software. Data were analyzed using Wilcoxon Rank Sum tests ($\alpha$=0.05).

**Results:** The means ± standard deviation for all tests are given in the Table.

| Material | Knoop Hardness (KHN,kg/mm$^2$) | Surface Loss (µm) | Roughness Change (Ra,µm) | Fracture Toughness ($K_{IC,}$ MPa-m$^{1/2}$) |
|---|---|---|---|---|
| ChemFil Rock | 52.39±2.67$^c$ | 4.69±1.23$^a$ | 0.79±0.14$^a$ | 0.99±0.07$^b$ |
| Fuji IX | 66.86±5.36$^a$ | 5.21±1.48$^a$ | 0.10±0.98$^b$ | 0.80±0.04$^c$ |
| Ketac Molar | 62.53±2.91$^a$ | 3.79±2.82$^{ab}$ | 0.62±0.60$^b$ | 0.85±0.09$^c$ |
| EQUIA Fil | 58.64±2.01$^b$ | 5.72±1.04$^a$ | 0.14±0.46$^b$ | 1.21±0.23$^a$ |
| Premise | 45.44±2.87$^d$ | 3.07±0.93$^b$ | 0.68±0.97$^{ab}$ | _ |

Superscript letters indicate statistically similar groups.

**Conclusion:** Based on the results of the present study, it can be concluded that ZRGIC has good fracture toughness and comparable abrasive wear to other tested GICs. However, ZRGIC showed inferior roughness and hardness characteristics compared to other tested GICs.



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