

Fracture Toughness Evaluation for Eclipse UDMA Resins

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INTRODUCTION: Composite resins have been used in complete dentures technology for their esthetics and biocompatibility. Because these materials are very brittle and vulnerable to tensile stress (which opens pre-existing defects) one needs to evaluate the strength of these materials, based on Fracture Mechanics concepts [1,2]. The aim of study was to compare fracture toughness of three Eclipse resins: Base Plate, Setup & Contour Resin used in complete denture technology.

METHODS: One realised samples (25/4/2mm) of Base Plate, Set Up and Contour Resin (Eclipse DENTSPLY International Inc.-DeguDent GmbH, Hanau, Germany), which were light cured in Processing Unit II, according to technical book

Considering small sizes of specimens type SENB, the fracture toughness of the considered materials was determined according to ASTM D 5045 standard. The specimens were loaded in three-point-bending and the fracture toughness is given by the critical stress intensity factor, K_{Ic} :

$$K_{Ic} = \frac{P_Q}{B \cdot W^{3/2}} \cdot f(x) \quad f(x) = 6x^{3/2} \cdot \frac{1.99 - x(1-x) \cdot (2.15 - 3.93 \cdot x + 2.7 \cdot x^2)}{(1+2x) \cdot (1-x)^{3/2}}$$

$x = a/W$ a – crack length; W – specimen width

The tests were performed on tensile testing machine; model Zwick/Roell (fig.2)

RESULTS: All samples have structural surface and depth defects. The results of Fracture Mechanics tests were: $K_{Ic} = 3,183 \text{ MPa} \cdot \sqrt{\text{m}}$ for Eclipse Base Plate; $K_{Ic} = 1.927 \text{ MPa} \cdot \sqrt{\text{m}}$ – for Eclipse Set Up and $K_{Ic} = 2,31 \text{ MPa} \cdot \sqrt{\text{m}}$ for Eclipse Contour Resin, being known the fact that, K_{Ic} -stress intensity factor is used to characterize crack's severity, depending on crack's geometry and internal stress. The fracture toughness values of Eclipse resins are different, Base Plate having the biggest value of K_{Ic} .

DISCUSSION & CONCLUSIONS: Complete denture is stressed by flexure/bend during mastication, because of its inadequate support, which leads to its possible cracking/fracture, especially in zones with preexisting defects and are responsible for failure of dentures before the expected lifetime. Experimental studies of mechanical properties of dental materials for prosthesis are used for knowledge of fracture risk

zone and durability prediction for dentures. Fracture toughness evaluation of Eclipse is a feature, which depends on loading type and its high values indicate a more resistant material (Base Plate).

REFERENCES: ¹Mecholsky JJ (1995) *Fracture mechanics principles*. Dent Mater;11:111–2; ²Alexander Staroselsky (1999) *The express method of determining the fracture toughness of brittle materials* International Journal of Fracture 98: L47–L52;

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