

# **Distribusi Tegangan Restorasi Teknik *Wallpapering* Menggunakan Pita Fiber *Polyethylene* dan *E-Glass* pada Gigi Pasca Perawatan Saluran Akar Kavitas Mesio-Oklusal Menggunakan Metode Elemen Hingga**

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## **ABSTRAK**

Restorasi pasca perawatan saluran akar merupakan salah satu faktor untuk mencapai keberhasilan perawatan endodontik. Restorasi direk komposit yang diperkuat pita fiber dengan teknik *wallpapering* merupakan inovasi untuk restorasi pasca perawatan saluran akar dengan pendekatan minimal invasif. Restorasi dengan teknik *wallpapering* berbahan *polyethylene* dan *E-glass* secara *in vitro* terbukti dapat meningkatkan ketahanan gigi dari fraktur. Tujuan penelitian ini untuk menganalisis gambaran distribusi tegangan restorasi pasca perawatan saluran akar menggunakan teknik *wallpapering* berbahan *polyethylene* dan *E-glass* pada kavitas mesio-oklusal menggunakan metode elemen hingga.

Pemodelan dibuat berdasarkan hasil pemindaian *Micro-CT* gigi molar pertama rahang bawah kemudian dibuat model tiga dimensi dengan kavitas mesio-oklusal di restorasi dengan teknik *wallpapering* menggunakan perangkat lunak *SolidWorks*. Simulasi pembebanan dengan arah vertikal sebesar 720 N dan lateral sebesar 200 N secara terpisah pada masing-masing model restorasi berbahan *polyethylene* dan *E-glass*. Simulasi tegangan *interface* menggunakan sistem adhesif generasi 6. Kedua simulasi ini menggunakan perangkat lunak ABAQUS 2021.

Hasil penelitian diperoleh dari data kualitatif dan kuantitatif pada model dengan restorasi *polyethylene* dan *E-glass* dengan masing-masing pembebanan. Nilai *tensile stress* tertinggi pada kedua jenis restorasi melebihi nilai *tensile strength* pada struktur enamel dan komposit. Nilai *compressive stress* tertinggi pada semua struktur gigi dan restorasi tidak ada yang melebihi nilai *compressive strength* masing-masing struktur. Kegagalan *interface* (*debonding*) terjadi di bidang enamel-komposit pada kedua model.

Simpulan dari penelitian distribusi tegangan restorasi teknik *wallpapering* menggunakan pita fiber *polyethylene* dan *E-glass* pada gigi pasca perawatan saluran akar kavitas mesio-oklusal dengan MEH adalah terjadi kegagalan statik akibat gaya tarik serta kegagalan bidang *interface* yang terjadi pada struktur enamel dan komposit pada kedua jenis restorasi. Lokasi yang menjadi kegagalan statik gaya tarik dan *interface* berada pada margin restorasi dan enamel dekat dengan daerah pembebanan. Kegagalan statik akibat gaya tekan tidak terjadi pada semua model.

**Kata Kunci:** Distribusi tegangan, restorasi pasca perawatan saluran akar, teknik *wallpapering*, *polyethylene*, *E-glass*, metode elemen hingga.

***Stress Distribution on Endodontically Treated Tooth with Mesio-Occlusal Cavity Restored with Wallpapering Technique Using Polyethylene and E-Glass Fibers Using Finite Element Method***

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***ABSTRACT***

*The restoration of endodontically treated teeth is one of the main factors of successful endodontic treatment. The restoration with a minimally invasive approach has the goal to preserve healthy tooth structure as much as possible to prevent fracture. Direct composite restoration with fiber reinforcement with wallpapering technique is an innovative procedure to restore endodontically treated teeth with a minimally invasive approach. The wallpapering technique restoration with polyethylene and E-glass fibers was proven in many in vitro studies to prevent the fracture of endodontically treated teeth. This study aims to analyze stress distribution on endodontically treated teeth with mesio-occlusal cavities restored with wallpapering technique between polyethylene and E-glass fibers using the finite element method (FEM).*

*Modeling was made based on the result of Micro-CT scanning of the lower first molar and the three-dimensional model with mesio-occlusal cavities restored with wallpapering technique was then made using SolidWorks software. Loading simulations with a vertical direction of 720 N and a lateral direction of 200 N were performed separately at each model restored with polyethylene and E-glass fiber. Adhesive system simulations were performed with the 6<sup>th</sup> generation bonding agent. Both loading and adhesive system simulations were performed using ABAQUS 2021 software.*

*The results were obtained from qualitative and quantitative data on the model restored with polyethylene and E-glass models with each loading. Both models' maximum tensile stress value exceeds the ultimate tensile strength value of enamel and composite structure. The maximum compressive stress value on both models was under the ultimate compressive strength value of all tooth and restoration structures. Interface failure (debonding) occurs at both models' enamel-composite interface.*

*The conclusion of this study is that there is a static tensile failure and interface failure in the enamel and composite structure on endodontically treated tooth restored with wallpapering technique both using polyethylene and E-glass fiber. Both failures are located at the restoration margin near the loading site. Static compressive failure does not occur in all the models.*

***Keywords:*** *Stress distribution, endodontically treated teeth, wallpapering technique, polyethylene, E-glass, finite element method.*