Introduction

It has been postulated that endodontic treatment results in reduction of fracture strength of teeth. Brittleness of the dentin in the endodontically treated teeth has been attributed to dehydration and loss of collagen cross-linking. However, more recent studies concluded that neither dehydration nor endodontic treatment caused degradation of the physical or mechanical properties of the dentin. One of the aims of root canal filling is to reinforce the dentin and increase the fracture resistance.

Studies suggested that filling the coronal and radicular loss tooth structure with bonded restorative materials, such as glass ionomer cement or composite resin, could reinforce the compromised teeth.

Mineral trioxide aggregate (MTA) is a fine biocompatible hydrophilic material that hardens in the presence of moisture or blood. The aim of this study was to measure the fracture resistance of over-flared root canals filled with different materials (gutta-percha-nano HA, resilon-epiphany, composite and MTA) using the Instron machine test and 3D focus-variation scanning microscopy images were used to illustrate the type of fracture patterns of the specimens.

Materials and Methods

One hundred and twenty extracted human mandibular single-rooted premolars were selected. A total of 105 out of the selected teeth were prepared to the working length and over-flared, leaving the apical 5 mm undisturbed. Fifteen samples had no treatment and were used as a positive control group (Group +ve). The 105 test teeth were further divided into 7 groups of 15 samples each. One of the 7 groups was designated as negative control (Group -ve) where teeth were over prepared and left without obturation. Remaining groups were filled with gutta-percha-nano HA (Group 1), gutta-percha-nano HA + composite (Group 2), gutta-percha-nano HA + MTA (Group 3), resilon-epiphany (Group 4), resilon-epiphany + composite (Group 5), and resilon-epiphany + MTA (Group 6). Fracture resistance of all samples was measured using the Instron testing machine. Two samples from each group had their surface topography and fracture pattern of the specimens were evaluated with an Alicona Imaging, Graz, Austria.

Results and Discussion

Statistical analysis for root fracture resistance showed highly significant difference between all groups with p value < 0.001. Micro CT Scan and 3D focus-variation scanning microscopy analysis indicated the ability of MTA to withstand vertical force. The fracture pattern for roots filled with MTA is only one vertical line, which is initially wide and becomes progressively narrower. Whereas roots filled with composite and resilon show several cracks all over the root in addition to the vertical root fracture.

Acknowledgement: This study was supported by Universiti Sains Malaysia research grant.
Fig. 1: Image of root fracture filled with gutta-percha/ Nano HA+MTA showing a fracture line across the MTA, becoming narrow and thin. The 3D image shows the surface topographic information in combination with its true color information on tooth 34 (5x Objective lens).

Fig. 2: Similar images of root fracture on tooth 34. The mixture of pseudo and real colors has constructed the rough surfaces of the sample to be more contrast in combination with color gradients. This sample is captured by 5x Objective lens.

Fig. 3: Image of root fracture filled with gutta-percha/Nano HA+resin composite showing a complete vertical line of fracture line. The 3D image shows the surface topographic information in pseudo+real colors in combination on tooth 25 (5x Objective lens).