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Bioactive Composite Reinforced with Glass Fiber as a New Experimental Bioactive Dental Post

(Comparative *In Vitro* Studies)

A Thesis Submitted to the Council of the College of Dentistry, University of Baghdad, in Partial Fulfillment of the Requirements for the degree of Doctor of Philosophy in Conservative Dentistry

By

Akram Mohammed Abdulkareem
B.D.S., M.Sc.

Supervised by:

Asst. Prof. Dr. Manhal A. Majeed
B.D.S., M.Sc., Ph.D.

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Abstract

Post and core build-up following endodontic treatment could be of great assistance for retaining and supporting the future restoration. Recent longitudinal clinical studies on fiber post restorations report a relatively high failure rate qualified to a gathering of reasons such as adhesive failure, secondary caries, root and post-fracture, and recurrence of endodontic lesions. To solve these problems, it would be highly desirable to design a new post with a bioactive resin matrix, shock-absorbing component, and ions release that may improve the post adhesion and reduce secondary caries by the reinforcement of the ACTIVA BioACTIVE cement with 40% E-glass fibers and to investigate their effect on the cytocompatibility, flexural strength, flexural fatigue, push-out bond strength, water sorption and solubility, radiopacity, bioactivity and ions release.

In this study, surface treated unidirectional E-glass fiber were impregnated and implanted with a triple cure, self-adhesive ACTIVA BioACTIVE resin cement to fabricate an experimental bioactive glass fiber post using hand lay-up moulding technique and clear cylindrical split mould with a 2mm diameter. Each specimen ensures 3min for self-cure setting, then light-cured for 40s. Cylindrical shape posts specimens were prepared at room temperature before subjected to many experimental studies that used experimental post samples. The results were compared with the commercially available EXACTO post.

Different cylindrical and rectangular form specimens were prepared using custom-made teflon mould and hand lay-up moulding techniques. The specimens were individually immersed in a Simulated Body Fluid solution, deionized water, and sodium chloride solution to assess the bioactivity, fluoride ion release, and calcium-phosphate ions release sequentially. In addition to cytocompatibility study. ACTIVA BioACTIVE cement was used as a reference group for these studies. SPSS Software used to analyze findings statistically.

The flexural strength study showed highly significant increased in flexural strength and flexural modulus of experimental material compared to the virgin ACTIVA BioACTIVE. In addition, The flexural fatigue study showed that the experimental post exhibited higher fatigue resistance than the commercially available EXACTO post with a statistically highly significant difference.

Concerning direct and indirect cytocompatibility tests, the experimental material showed comparable cytocompatibility to the ACTIVA BioACTIVE material, with no significant differences.

The push-out study showed that the experimental post provides a higher bond strength than the commercially available EXACTO post with two different self-adhesive resin cement.

The water sorption study showed no significant differences between the experimental and the control groups. While regarding water solubility, the experimental groups have significantly higher values than the control groups.

Regarding the radiopacity, the experimental post showed a higher mean gray value than dentin with close radiopacity to the enamel and commercially available glass fiber posts.

The ions released study showed that experimental material recognized a significant reduction in fluoride, calcium, and phosphate ions release after reinforcement compared to control ACTIVA BioACTIVE.

The bioactivity study showed a precise formation of the calcium-phosphates layer on the surface of the experimental material along the immersion time as evidenced by Fourier Transform Infrared Spectroscopy, scanning electron microscopy with energy dispersive X-ray, and X-ray diffraction.

In conclusion, it seems that experimental material is a promising material to be used as a dental post material since it provided a higher push-out bond strength and higher fatigue resistance than the traditional fiber post added to the advantage of bioactivity, which along with enhanced bond strength may overcome the inherent shortcoming of debonding of the fiber post.

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جامعة بغداد
كلية طب الأسنان
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من قبل

أكرم محمد عبد الكريم

بكالوريوس طب وجراحة الفم والأسنان
ماجستير معالجة الاسنان

بأشراف

الاستاذ المساعد الدكتور

منهل عبد الرحمن مجيد

بكالوريوس طب وجراحة الفم والأسنان
ماجستير معالجة الأسنان، دكتوراة معالجة الاسنان

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