UNIVERSITI TEKNOLOGI MARA

EFFECT OF ARTIFICIAL AGING ON COLOUR STABILITY AND SURFACE ANALYSIS OF FILTEK Z350XT AND OMNICHROMA

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Dissertation submitted in partial fulfilment
of the requirements for the degree of
Dr in Restorative Dentistry

Faculty Dentistry

September 2025

ACKNOWLEDGEMENT

First and foremost, I would like to praise Allah the Almighty, the Most Gracious, and the Most Merciful for His blessing given to me during my study and in completing this dissertation. May Allah's blessing goes to His final Prophet Muhammad (peace be upon him), his family and his companions.

I am deeply grateful to my main supervisor, Col (R) Associate Professor Ikmal Hisham bin Ismail, for his steadfast support and belief in me. My sincere thanks also go to my co-supervisors, Capt (R) Dr. Hayati Ishak, Dr. Norazlina Mohammad, and Dr. Amalina Amir, whose guidance and encouragement were invaluable throughout this journey.

Special thanks to Puan Najibah and Puan Izyan for their help in generating results and assisting with statistical analysis. I also appreciate the support from the staff at the Faculty of Dentistry and the UiTM Research and Preclinical Laboratory Unit for guiding me in handling samples and lab equipment.

A heartfelt thank you to Encik Rahimi from the College of Engineering, UiTM Shah Alam, for his expertise with SEM/EDS and Vickers Hardness machines.

I would also like to extend my heartfelt gratitude to the current and former Programme Directors, Postgraduate Coordinators, and the Head of the Postgraduate Department for their unwavering support and invaluable guidance throughout this journey.

I am especially grateful to my batchmates, particularly my coursemates, Dr. Faiz bin Nasruddin and Dr. Nazrin Rosli, for their support and for standing by my side as we navigated the hurdles of being the first batch in this course. Through moments of doubt, confusion, and even breakdowns, their presence made all the difference. I truly appreciate the camaraderie and resilience we shared—it kept me going.

Finally, my deepest gratitude goes to my family—my in-laws, siblings, and especially my beloved husband, Dr. Ahmad Syahmi bin Zulkifli. His unwavering support, patience, and love have been my strength throughout this journey. I am truly blessed to have a partner who not only shared my burdens but also lightened them with kindness and care, especially in looking after our home and our growing children during my most difficult moments.

To my children, Jasmin Insyirah and Haris Ibrahim—you are my sunshine and my greatest inspiration. Your understanding, love, and laughter have given me strength when I needed it most. Mummy is endlessly grateful for you.

ABSTRACT

Background: Millions of people consume coffee daily, subjecting dental restorations to staining and physico-chemical degradation. Dental composite resins are especially susceptible to acidic or staining nature of coffee which compromises long-term aesthetics and durability. Objectives: To elucidate the comparative effect of coffee between thermocycling and static immersion, as artificial aging methods on dental composite resins. Then, to compare color changes (ΔE00) between Filtek Z350XT and Omnichroma following thermocycling within coffee solution. Next, to evaluate and compare the subsurface properties and surface microhardness of Filtek Z350XT and Omnichroma after immersion in coffee staining solution using SEM-EDS analysis and Vicker's hardness test, respectively. Methods: Phase 1: 40 discs (1mm thick x 10mm diameter) of Filtek Z350XT were prepared and divided into 2 groups: thermocycling and static immersion, with 2 immersion solutions (n=10) – coffee (TC: Thermocycled Coffee, SC: Static Coffee) and distilled water (TDW: Thermocycled Distilled Water, SDW: Static Distilled Water). Color measurements were obtained using a spectrophotometer at 20 time points and analyzed. Phase 2: 20 new discs were prepared from Filtek Z350XT (n=10) and Omnichroma (n=10). The specimens were subjected to 10,000 cycles in coffee and color changes were studied. Phase 3: Filtek Z350XT and Omnichroma were evaluated for post-staining surface morphology and mechanical properties. Results: Pearson Correlation Analysis showed no significant association between ΔE00 and standardized Surface Roughness. Phase 1: Repeated Measure Anova revealed significant differences across all groups ($p<0.001$). Post hoc Tukey's test indicated significantly higher color changes between (TC) and (SC), (TC) and (TDW), as well as (TC) and (SDW). However, no significant differences were observed between SDW and TDW ($p>0.001$). Phase 2: An independent t-test demonstrated a significant difference in ΔE00 values between Filtek Z350XT and Omnichroma ($p<0.001$), with Omnichroma exhibiting significantly higher ΔE00. Phase 3: SEM and EDS analyses revealed significant changes in the surface morphology and elemental composition of the composites after thermocycled in coffee solution. Regardless of materials investigated, Wilcoxon Signed Rank Test showed no significant differences in median Vicker's Hardness Number (VHN) before and after immersion. Conversely, the Mann-Whitney Test indicated a significant difference ($p=0.05$) between the groups, with Filtek Z350XT exhibiting a higher median VHN (195) compared to Omnichroma (114.4). Conclusions: Coffee significantly influenced the staining of dental composite resins. Thermocycling causes pronounced color changes when compared to static immersion, with Omnichroma elucidating a higher ΔE00. Filtek Z350XT exhibited superior colour and surface stability despite changes observed after thermocycling.

Keywords: Colour Stability, Omnichroma, Static Immersion, Thermocycling, Microhardness, SEM-EDS

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CHAPTER 1
INTRODUCTION

1.1 Research Background

In recent years, the demand for aesthetic, biomimetic, and long-lasting restorative materials has increased significantly in clinical dentistry. Patients today are more conscious of the appearance of their teeth, and clinicians are increasingly expected not only to restore function but also to achieve a highly aesthetic and natural outcome.

Resin-based composite materials have become the preferred choice for direct restorations, especially in the anterior region, due to their excellent optical properties, conservative preparation requirements, and ease of intraoral repair (Ferracane, 2011). However, long-term clinical success depends not only on initial aesthetics and mechanical performance but also on the material's ability to maintain color stability and surface integrity under daily oral challenges.

Given these technological advancements, the aesthetic longevity of composite resins—especially their resistance to discoloration—remains a core concern in restorative dentistry. Color stability is essential not only for maintaining patient satisfaction but also as an indicator of the material's resistance to degradation in the oral environment.

Discoloration may arise from both intrinsic and extrinsic factors. Intrinsically, material composition plays a critical role, particularly the type of monomers used. Hydrophilic components like TEGDMA tend to absorb more water, which can increase pigment uptake and matrix swelling over time (Ferracane, 2006). Additionally, the quality of the filler-resin interface and the degree of polymerization affect how the material ages in the oral cavity. Extrinsically, factors such as oral hygiene habits, dietary intake, surface roughness, and exposure to chromogenic substances contribute significantly to staining.

Common beverages like coffee, tea, and red wine are well-documented for their staining potential due to their tannin and polyphenol content (Ertaş et al., 2006; Bagheri et al., 2005). Moreover, surface degradation from mechanical wear or chemical exposure can exacerbate these effects by increasing surface roughness, thereby allowing more pigment retention (Mundim et al., 2010).