

UNIVERSITI TEKNOLOGI MARA

**THE EFFECT OF TOOTHBRUSHING
ON THE PHYSICAL, MECHANICAL
AND CHEMICAL SURFACE
PROPERTIES OF RESIN
COMPOSITE CAD/CAM BLOCKS**

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Dissertation submitted in partial fulfillment of the
requirements for the degree of
Dr In Prosthodontics

Faculty of Dentistry

July 2025

ACKNOWLEDGEMENT

In the name of God, the Most Gracious, the Most Merciful, I begin with profound gratitude to the Almighty for blessing me with the opportunity to pursue this doctorate. His guidance and grace have been my source of strength throughout this arduous yet rewarding journey.

I extend my heartfelt appreciation to my supervisor, AP Dr Siti Mariam Abd Ghani, whose wisdom, and patience were instrumental in shaping this dissertation. I am equally grateful to my co-supervisor, Dr Zethy Hanum Mohamed Kassim for her invaluable insights and steadfast encouragement. Your dedication has left an indelible mark on my academic journey.

My sincerest gratitude also goes to the Oral Health Division of the Ministry of Health for their generous financial support, which made this academic pursuit possible. To the faculty and staff at UiTM's Faculty of Dentistry, Research Lab, Faculty of Mechanical Engineering, UiTM Shah Alam, Polymer Characterization Research Lab, Institute of Science (IoS), UiTM Puncak Alam, Selangor and Analytical Teaching Laboratory, Faculty of Science, University Malaya, your unwavering assistance and encouragement have been deeply appreciated. A special note of thanks to my batch mates, for your camaraderie and moral support- it has been a joy to share this journey with you.

To my beloved family and friends, especially my parents, my husband and my daughters, your love, prayers, and unwavering support have been my anchor throughout this journey. I am endlessly grateful for everything you have done for me.

Alhamdulillah.

ABSTRACT

Statement of Problem: The properties of CAD/CAM resin composite blocks (RCBs) have improved over the years through modification in their composition including the addition of fluoride. However, there is currently limited data on their surface properties, biocompatibility and fluoride release following wear testing. **Purpose:** This study aimed to evaluate the surface hardness, roughness, gloss, monomer elution and fluoride release of two newly developed CAD/CAM Resin Composite Blocks with different filler contents and characteristics subjected to thermocycling and a 3-body wear test using a locally manufactured toothbrushing simulator. **Materials and methods:** Thirty samples each of edelweiss (EDL), KZR-CAD HR 3(KZR) RCBs, and CEREC felspathic block (CB) were sectioned into blocks measuring (14 x 12 x 18 mm). These were divided into 3 groups: No Treatment (NT), Toothbrushing (TB), and Thermocycling and Toothbrushing (TC+TB) for testing hardness, surface roughness, gloss, and monomer elution. To evaluate the fluoride release, 20 samples of Compoglass (COM) blocks measuring (14 x 12 x 5 mm) along with EDL and KZR RCBs were also divided into NT and TB groups, to evaluate fluoride release. All the parameters were separately analysed using repeated measures analysis of variance (ANOVA) with significance set at less than 0.05. **Result:** CEREC Blocs (CB) consistently showed higher VHN values than both Edelweiss (EDL) and KZR CAD HR3 (KZR) across all three intervention types (NT, TB, TC+TB). However, there were no significant differences between EDL and KZR suggesting that these materials exhibit similar VHN values regardless of the type of intervention applied. For surface roughness, KZR material appears to exhibit resilience to surface roughness particularly under thermocycling and toothbrushing conditions. The effect of toothbrushing (TB) and combination of thermocycling and toothbrushing (TC +TB) was found to significantly reduce the gloss values for all materials when compared to no treatment group (NT). Monomers were not detectable in any of the experimental groups suggesting that the levels of the monomers, if present, were below the detection limits of the HPLC method used in this study. Both EDL and KZR has the ability to release fluoride and KZR showed high fluoride release when subjected to toothbrushing. Toothbrushing and thermocycling significantly influenced the wear patterns of both fluoride containing RCB resulting in significant changes in the surface integrity of RCB. **Conclusion:** Both EDL and KZR showed similar results in hardness, gloss, and monomer elution. The hardness value comparable to dentine, optimal gloss, and biocompatibility in monomer release. However, KZR was more resistant to surface roughness and had higher fluoride release, especially after thermocycling and toothbrushing. Both materials showed evident wear and surface changes with toothbrushing and thermocycling.

Keywords: Gloss, surface roughness, hardness, monomer elution, fluoride release toothbrushing, CAD/CAM, resin composite block

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CHAPTER 1

INTRODUCTION

1.1 Research Background

Surfaces of dental materials are in constant contact with teeth, soft tissue, other dental materials, food, toothbrush, and interdental cleaning aids that may result in wear. Toothbrush wear is a 3-body wear whereby the abrasives from the toothpaste act as a medium in a sliding contact between the toothbrush and the restorative surfaces resulting in the roughness of the dental material. All surfaces of the restoration are affected by this type of wear, but less so on the proximal surfaces depending on the type of interdental cleaning aid used. The labial and buccal surfaces of restored teeth are important from the perspective of aesthetics, as they are visible to the observer, especially in patients with wide and high smile lines (Mehta et al., 2012). Therefore, the ability of the material to resist toothbrush wear may affect their selection for aesthetically demanding restorations such as veneers for anterior teeth. Manufacturers of dental composites usually provide data on the percentage of mass loss from toothbrush wear, and few studies measure the roughness of direct composite following wear (Yin et al., 2019). However, it is not known to what extent of duration and depth of the toothbrush wear, will affect the aesthetic parameter of the restoration such as the gloss properties.

Apart from this, the data reported on direct composite cannot be extrapolated to Computer-Aided Design and Computer-Aided Manufacturing (CAD/CAM) resin-composite blocks (RCBs) due to the differences in the manufacturing process and composition of these materials (Nguyen et al., 2012). RCBs in the oral cavity are exposed to corrosive wear upon contact to saliva and other chemicals in the oral cavity which is worsened by the cyclical temperature change. The process may soften the superficial layer of the RCBs, thus predisposing the material to further wear and may also release filler particles and elude monomers that may be biologically hazardous to the patient.