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ABSTRACT OF DISSERTATION

Title	2-methacryloyloxyethyl phosphorylcholine polymer treatment prevents *Candida albicans* biofilm formation on acrylic resin [2-methacryloyloxyethyl phosphorylcholine ポリマー処理によるアクリルレジン上のカンジダアルビカンスバイオフィルム形成の抑制]
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Background: Polymethyl methacrylate (PMMA) is widely used as a denture base material due to its favorable properties. In contrary, it is also reported to be prone to plaque adhesion and biofilm formation. Consequently, it poses a significant risk, as *Candida albicans*, an opportunistic pathogen, is frequently implicated in denture stomatitis, a common infection affecting denture wearers. To address this issue, 2-methacryloyloxyethyl phosphorylcholine (MPC) polymer has been suggested for its potential to inhibit protein adsorption and microbial adhesion. Following insertion into the oral cavity, the denture surface immediately interacts with surrounding environments like saliva, forming a pellicle. Moreover, denture is also subjected to thermal changes occurred during function, such as when consuming hot or cold drinks and foods. However, the thermal durability of new photoreactive MPC coatings and their interactions with salivary mucin when applied to PMMA remains unexplored.

Purpose: This study aimed to evaluate the effectiveness of a spray and cure system for PMBPAz (photopolymerized MPC-co-BMA-co-MPAz) coating on PMMA. We focused on assessing its efficacy on preventing *C. albicans* biofilm formation on coated PMMA and assess its mechanism and need for re-application by evaluating its interaction with salivary mucin and durability against temperature changes.

Materials and Methods: Heat-cured PMMA discs were prepared and polished as specimens. The specimens were coated with PMBPAz via spraying a pre-mixed liquid to the PMMA surface, followed by rinsing and UV light activation. The coating

durability was tested by subjecting the specimens to thermal cycling (5°C and 55°C) for 1000, 2500, and 5000 cycles. Consequently, the specimens then assigned to five different groups: control (without MPC treatment), four MPC treatment (MT) groups differentiated with the number of thermal cycles applied from 0 to 5000. Afterwards, surface evaluations were performed starting from immersing the specimens into a bovine submaxillary mucin. The mucin adsorption was evaluated through optical density and surface hydrophilicity was assessed using captive bubble contact angle analysis. X-ray photoelectron spectroscopy (XPS) analysis was performed to confirm the presence of coating components on the specimen surface by targeting phosphorus (phosphate group–P–O) and nitrogen (ammonium group–$N^+(CH_3)_3$) signals. *C. albicans* biofilm formation was evaluated quantitatively by counting the colony-forming units (CFU) and qualitatively with scanning electron microscopy (SEM) images. Statistical analysis was performed using one-way ANOVA with Tukey's Post-hoc and two-way ANOVA to observe differences and interactions between variables.

Results and Discussion: The MPC coating significantly inhibited *C. albicans* biofilm formation on PMMA. SEM images revealed less dense biofilm structures on coated specimens compared to uncoated controls. The XPS analysis confirmed the presence of MPC components on the surface. Thermal cycling up to 2500 cycles did not significantly reduce the coating's efficacy; however, a marked decrease was observed at 5000 cycles, indicating a need for coating re-application approximately every three months. All coated groups demonstrated significantly higher hydrophilicity than uncoated PMMA without difference between different thermal cycles applied. Mucin adsorption was significantly higher on coated groups, and likely contributed to the observed anti-biofilm activity.

Conclusion: The photoreactive MPC polymer (PMBPAz) coating effectively prevented *C. albicans* biofilm formation on PMMA surfaces, with estimated efficacy sustained for about three months under intraoral thermal changes. The coating's performance is attributed to increased surface hydrophilicity and mucin adsorption.