

Evaluating Antimicrobial Coatings for Peri-Implantitis and Novel Dental Implant Applications

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Introduction

Peri-Implantitis

- Pathology characterized by local inflammation around dental implants which leads to progressive loss of osseointegration and supporting bone
- Patients with chronic periodontitis, poor plaque control and no regular maintenance post operative are at increased risk of development [1]
- Studies suggest that certain plaque bacteria and infection may affect peri-implant tissue health [3]

Bactericidal/Antifouling surface coatings

- SD90+ (ADC) is unique because unlike a disinfectant, ADC can be applied to clean surfaces
- ADC is made of dimethyloctadecyl (3-trimethoxysilylpropyl) ammonium chloride
- ADC kills and mitigates growth of microbes while preventing surface damage.

Surfaces of Interest

- Millipore Sigma Smooth Machined Titanium disks (MSMD)
- Straumann Smooth Machined disks (SMD)
- Straumann SLA Roughened disks (SLA)

Clinical Uses

- Prevent bacterial overgrowth and increased inflammation around peri-implant tissue while osseointegration is occurring
- A solution for preventing biofilm formation on external surfaces of implant devices
- Allows the potential to creating implant devices with internal structures

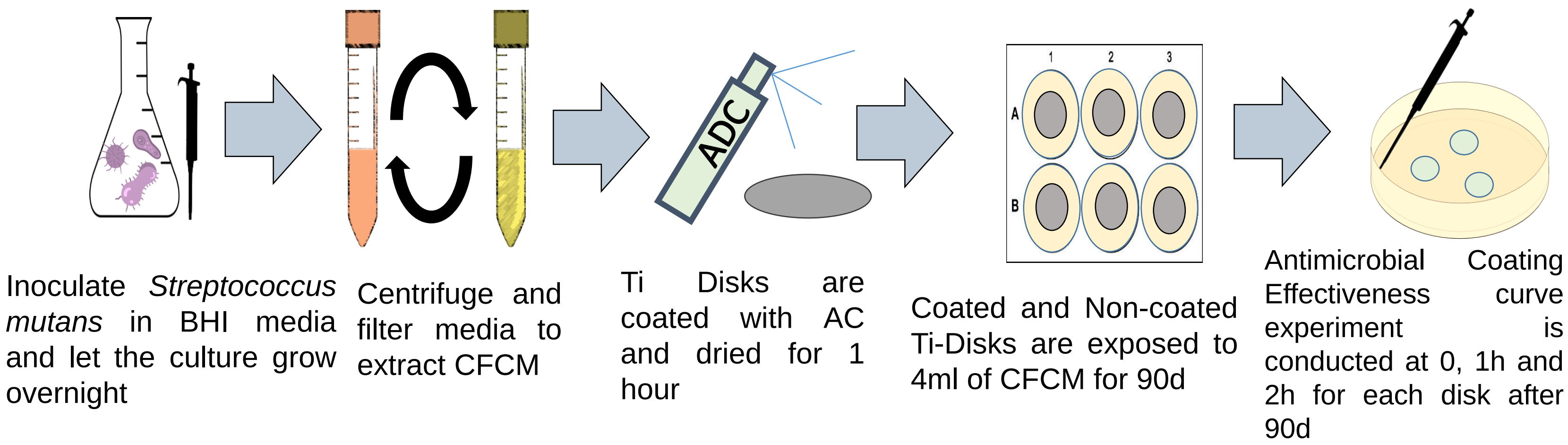
Objective

Test antimicrobial and antifouling surface coatings that can be applied to implant surfaces of varying surface textures and implant shapes

We will evaluate antimicrobial effects by:

- Effectiveness: how quickly does AC kill microbes and what quantity of the population
- Longevity: after 90 days of exposure to cell free culture media (CFCM) how effective is the coating

Methods



Results

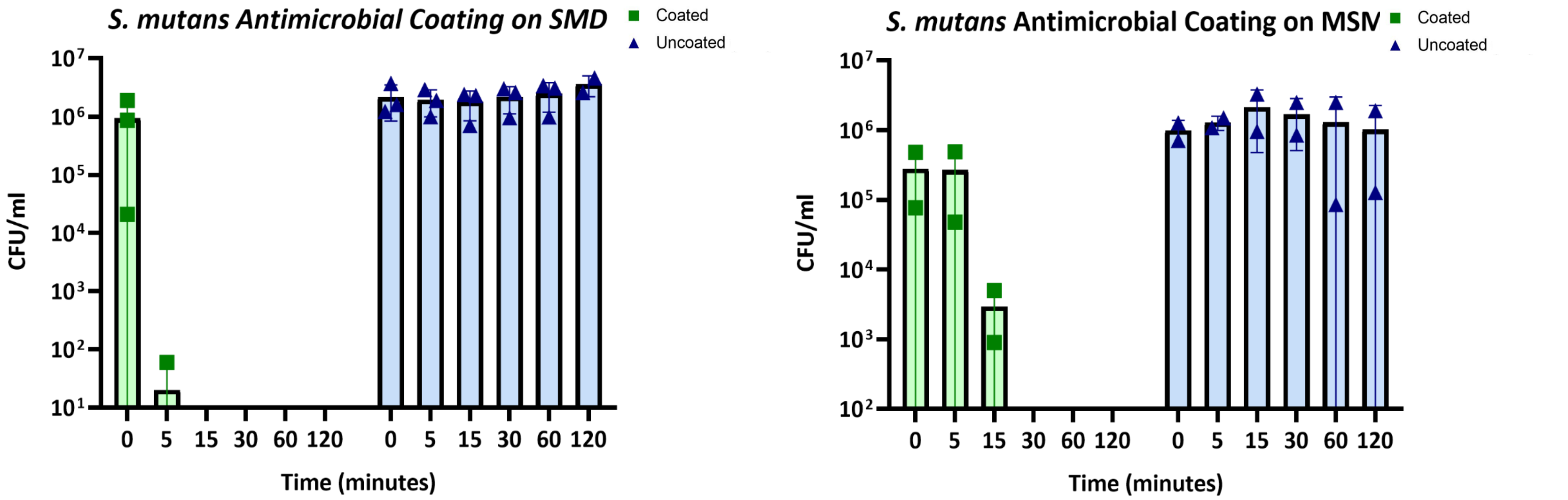


Figure 1. ADC, a commercially available antimicrobial coating efficiently kills units per milliliter (CFU/ml), a measure of the number of via *Streptococcus mutans* on different titanium surfaces: SMD (n=2) on left and MSMD (n=3) on the right. Data is shown as survival fraction where CFU/ml at a given time are compared to the CFU/ml plated at t=0. The assay limit of detection is 12.5 CFU/ml. Error bars represent the standard error of the mean (n≥2 biological replicates).

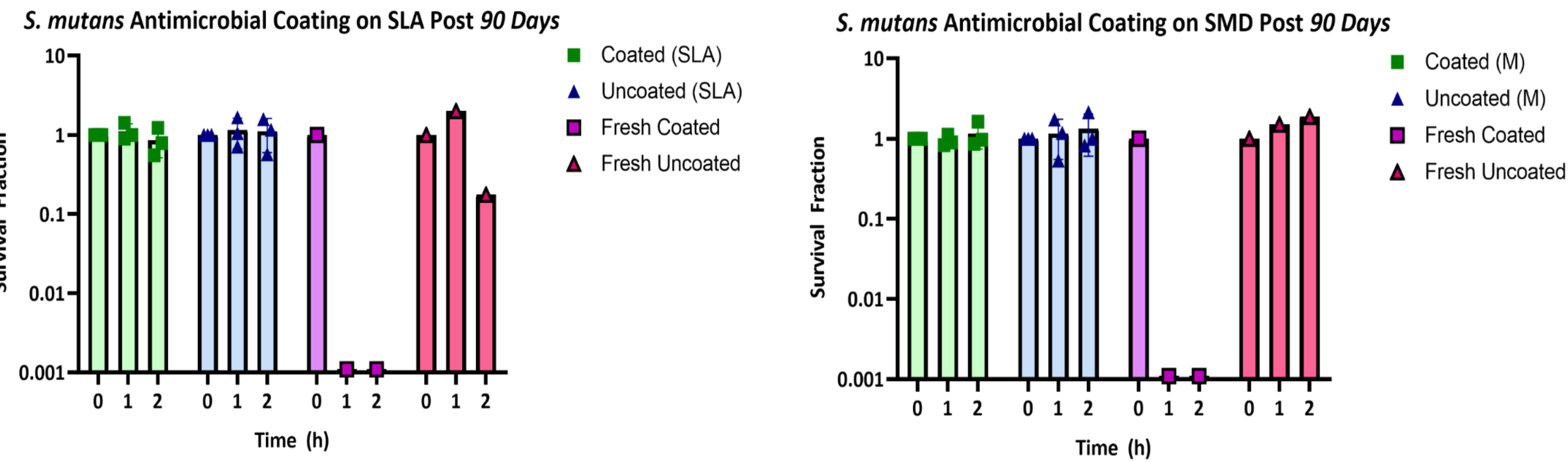


Figure 2. ADC coated disks were exposed to *S. mutans* CFCM for 90 days and coating effectiveness was evaluated. SLA disk (n=3) (left) and MSMD (n=3) (right). Data is represented as survival fractions where CFU/ml at a given time are compared to CFU/ml plated at t=0. Freshly coated disks and uncoated disks were tested as controls. Error bars represent the standard error of mean (n ≥3 biological replicates).

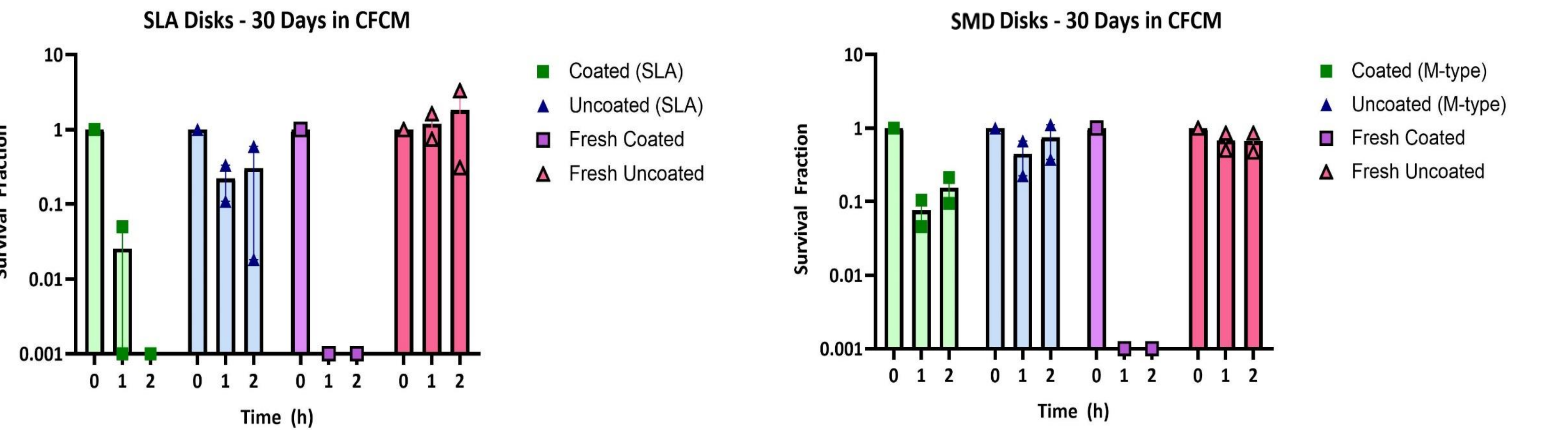


Figure 3. ADC coated disks were exposed to *S. mutans* CFCM for 30 days and coating effectiveness was evaluated. E) SLA disk (n=3) (left) and MSMD(n=3) (right). Data is represented as survival fractions where surviving colonies are compared to a known plated value. Freshly coated disks and uncoated disks were tested as controls. Error bars represent the standard error of mean (n ≥2 biological replicates).

Conclusion

Effectiveness

- Preliminary data from this study suggests ADC is an effective bactericidal coating on all dental implant surfaces tested. On SMD and MSMD, bacteria counts were below the limit of detection after 15 and 30 minutes, respectively.
- SMD was more effective at retaining ADC than the MSMD surface

Longevity

- After 90 days of exposure to *S. mutans* CFCM the antimicrobial coating had lost its bactericidal properties
- After 30 days bactericidal effects were still observed. Coating adherence was greater on SLA disks

Next Steps

- Determine at what point from 30 to 90 days the coating becomes ineffective which can inform future reapplication cycles
- Explore how coating failed and if current protocol is attributing to this failure

Future Directions

- Measure the antimicrobial effects of other antifouling and bactericidal surface coatings (Titanium dioxide, Silica nano-particles, Colloidal silver titania)
- Explore effect of coating on prevalent **anaerobic periodontal bacteria** which cause disease
- Explore implant surfaces and how coating affects them in regard to osseointegration

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