



401 N. Lindbergh Blvd.
St. Louis, MO 63141
Tel.: 314.993.1700, #546
Toll Free: 800.424.2841, #546
Fax: 800.708.1364

Send via email to: jbode@aaortho.org and cyoung@aaortho.org

AAO Foundation Final Report Form (a/o 5/30/2020)

In an attempt to make things a little easier for the reviewer who will read this report, please consider these two questions before this is sent for review:

- Is this an example of your very best work, in that it provides sufficient explanation and justification, and is something otherwise worthy of publication? (We do publish the Final Report on our website, so this does need to be complete and polished.)*
- Does this Final Report provide the level of detail, etc. that you would expect, if you were the reviewer?*

Please prepare a report that addresses the following:

Type of Award: Research Aid Award

Name(s) of Principal Investigator(s): Laurie Susarchick

Institution: University of Illinois Chicago

Title of Project: Staining Ability on Retainer Materials and Effects of Cleaning Methods on Stained Retainer Materials

Period of AAOF Support: 07-01-2020-06-30-2021

Amount of Funding: \$5,000

Summary/Abstract: attached

Detailed results and inferences:

1. If the work has been published please attach a pdf of manuscript OR
2. Describe in detail the results of your study. The intent is to share the knowledge you have generated with the AAOF and orthodontic community specifically and other who may benefit from your study. Table, Figures, Statistical Analysis, and interpretation of results should be included.

Respond to the following questions:

1. Were the original, specific aims of the proposal realized? *Yes*

2. Were the results published?

a. If so, cite reference/s for publication/s including titles, dates, author or co-authors, journal, issue and page numbers . *Not yet*

b. Was AAOF support acknowledged? *Not yet. However, once the manuscripts are ready for publication, AAOF support will be acknowledged.*

c. If not, are there plans to do so? If not, why not? *Yes. The manuscripts are in the process of drafting.*

3. Have the results of this proposal been presented?

a. If so, list titles, author or co-authors of these presentation/s, year and locations

1. **Susarchick L., Virji I., Viana G., Allareddy V., Lukic H., Megremis S., Atsawasuwan P.** *Staining and Cleaning Effects of Copolyester and Copolymer Retainer Materials. 121th Annual session-American Association of Orthodontists, e-poster, virtual meeting, July 2021.*
2. **Virji, I., Susarchick L., Viana G., Allareddy V., Lukic H., Megremis S., Atsawasuwan P.** *Evaluation of translucency change of two retainers materials after staining and destaining. 121th Annual session-American Association of Orthodontists, e-poster, virtual meeting, July 2021.*
3. **Susarchick L., Virji I., Viana G., Allareddy V., Lukic H., Megremis S., Atsawasuwan P.** *Staining and Cleaning Effects of Copolyester and Copolymer Retainer Materials. 2021 Clinic & Research virtual event, University of Illinois Chicago, May 2021.*
4. **Virji, I., Susarchick L., Viana G., Allareddy V., Lukic H., Megremis S., Atsawasuwan P.** *Evaluation of translucency change of two retainers materials after staining and destaining. 2021 Clinic & Research virtual event, University of Illinois Chicago, May 2021.*

b. Was AAOF support acknowledged? *Yes.*

c. If not, are there plans to publish? If not, why not?

4. To what extent have you used, or how do you intend to use, AAOF funding to further your career? *AAOF funding is very helpful to accommodate the expense for the research materials and supplies. I have gained experiences on research conduct and presentation. The support from AAOF on my research project will enhance my ability to learn and think in a critical way and will be able to present my work and clinical cases in a systematic way.*

Accounting for Project; (i.e.), any leftover funds, etc. *No*

Abstract

The increasing demand for aesthetics by all patients makes clear aligner therapy (CAT) and clear retainers in orthodontic treatment popular. The removable nature of clear retainers is often a benefit, allowing patients to remove the retainers to maintain good oral hygiene. However, long-term compliance is required of all post-orthodontic treatment patients and when patients become non-compliant, relapse can occur. Relapse is complicated and unpredictable. To prevent relapse, all patients should be treated as if they are at high-risk for relapse. Often, patients become non-compliant as the clear retainers become less clear, and therefore, less aesthetic. Thus, the need for research on how to maintain clear aligner translucency and color, while also maintaining the retainer properties and integrity, is needed. The objective of this study is to investigate the staining ability of different staining solutions on retainer materials and the effect of destaining agents on the light transmittance and color changes of two retainer materials, *in vitro*. This research focuses on the study of three retainer materials, polyurethane (Zendura®), copolyester (Essix ACE®) and copolymer (Essix C+®), stained with red wine, coffee, black tea, and distilled water followed by destaining with five cleaning materials, namely, hydrogen peroxide (H₂O₂), Invisalign® Cleaning Crystals, Retainer Brite®, Polident® denture cleaner, and Listerine® mouthwash. The retainer materials were thermoformed over a custom stainless-steel block with disposable polymer molds rendering two surfaces, smooth and textured. The smooth surface mimics retainers made from plaster models and the textured surface mimics retainers made from 3D-printed models. The translucency and color changes of retainer material specimens were analyzed using specific spectrophotometers, and composition changes were evaluated by Raman Spectrometry before and after the 28-day staining and one-session destaining processes. During the destaining, one group of stained specimens were subjected to either ultrasonic or non-ultrasonic cleaning methods. The Δ values (difference from baseline values) were used to evaluate the change of color and translucency in each material from baseline to the end of the destaining process. Due to the non-normal distribution of the data analyzed by the Shapiro-Wilk test, the data were analyzed with non-parametric statistics, namely, Kruskal Wallis statistical and Bonferroni correction and Mann-Whitney tests. Due to the differences in the innate characteristics of the individual materials, the outcome data were not compared among the test retainer materials. The results showed staining in all materials increased with exposure time. The most staining occurred at the end of staining (28 days) and the specimens were more susceptible to coffee and black tea staining. At the end of the staining period, the coffee and black tea staining solutions resulted in the most color change ($P < 0.05$). The textured surface stained easier than smooth surface ($P < 0.05$). After immersion in the destaining solutions, no statistically significant differences for light transmittance or color change were found between ultrasonic and non-ultrasonic cleaning groups ($P > 0.05$). No major changes were noted among all staining solutions or destaining means. All cleaning solutions showed improved light transmittance. All materials had statistically significant changes in translucency and color change on the textured surface. Qualitatively, no composition changes were observed in any groups at the end of destaining. The results from this study will contribute to an evidence-based approach for clinical guidance for long-term maintenance of clear retainer.

Materials and Methods

Copolyester: Essix ACE® Dentsply® International Inc.
Copolymer: Essix C+® Dentsply® International Inc.

Specimen
Preparation



T0: baseline (unstained specimens)

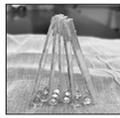
T1: day 7 of staining

T2: day 14 of staining

T3: day 28 of staining (last day of staining/before destaining)

T4: after specimens have been destained

Destaining
method



COFFEE



**BLACK
TEA**



**RED
WINE**

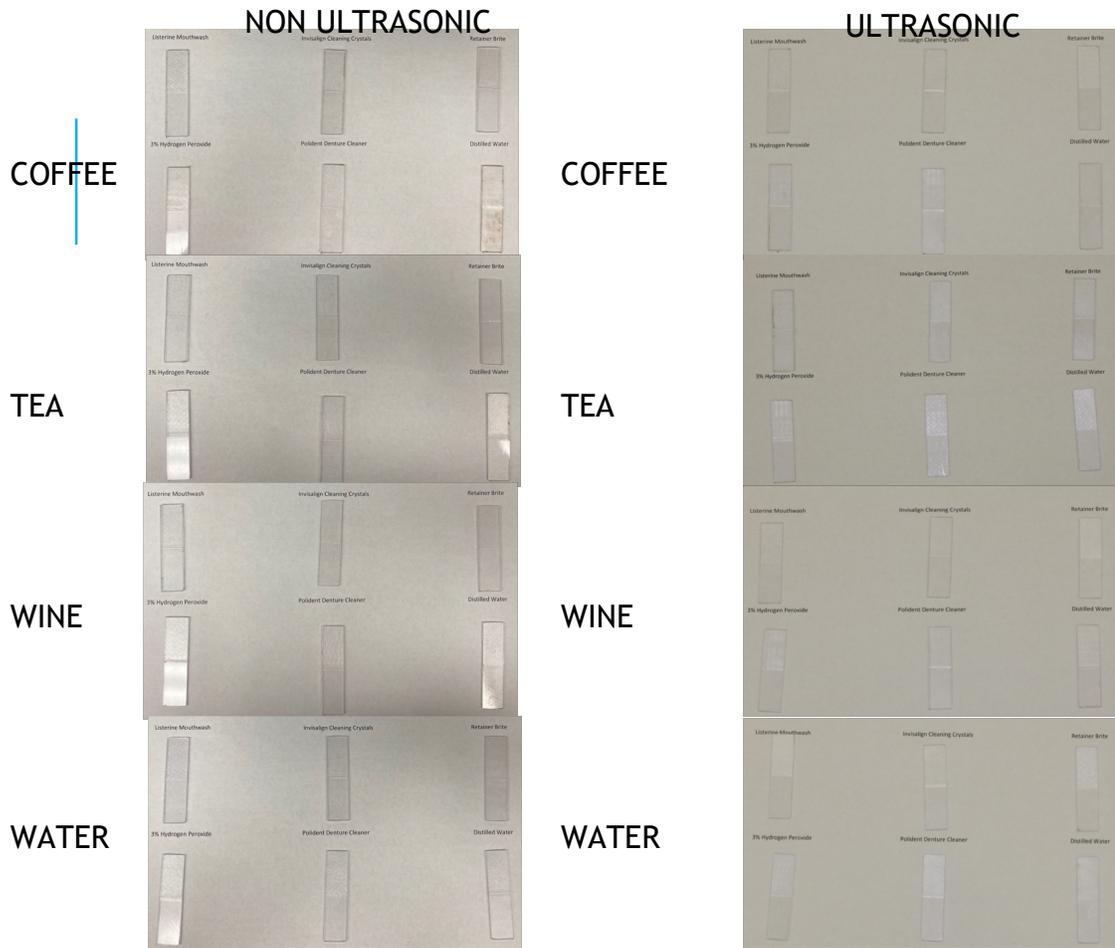
T0

T1

T2

T3

Examples of retainer materials with stained solution at each timepoint



Examples of retainer materials after destained with cleaning solutions with or with ultrasonic mean.