



Effect of Denture Cleansers on Retentiveness of Various Overdenture Attachment Inserts



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INTRODUCTION

Implant overdentures utilizing stud-type abutments rely upon retention provided by attachment inserts. The material composition of retentive inserts has evolved to impart increased retentive force at the abutment-attachment interface.

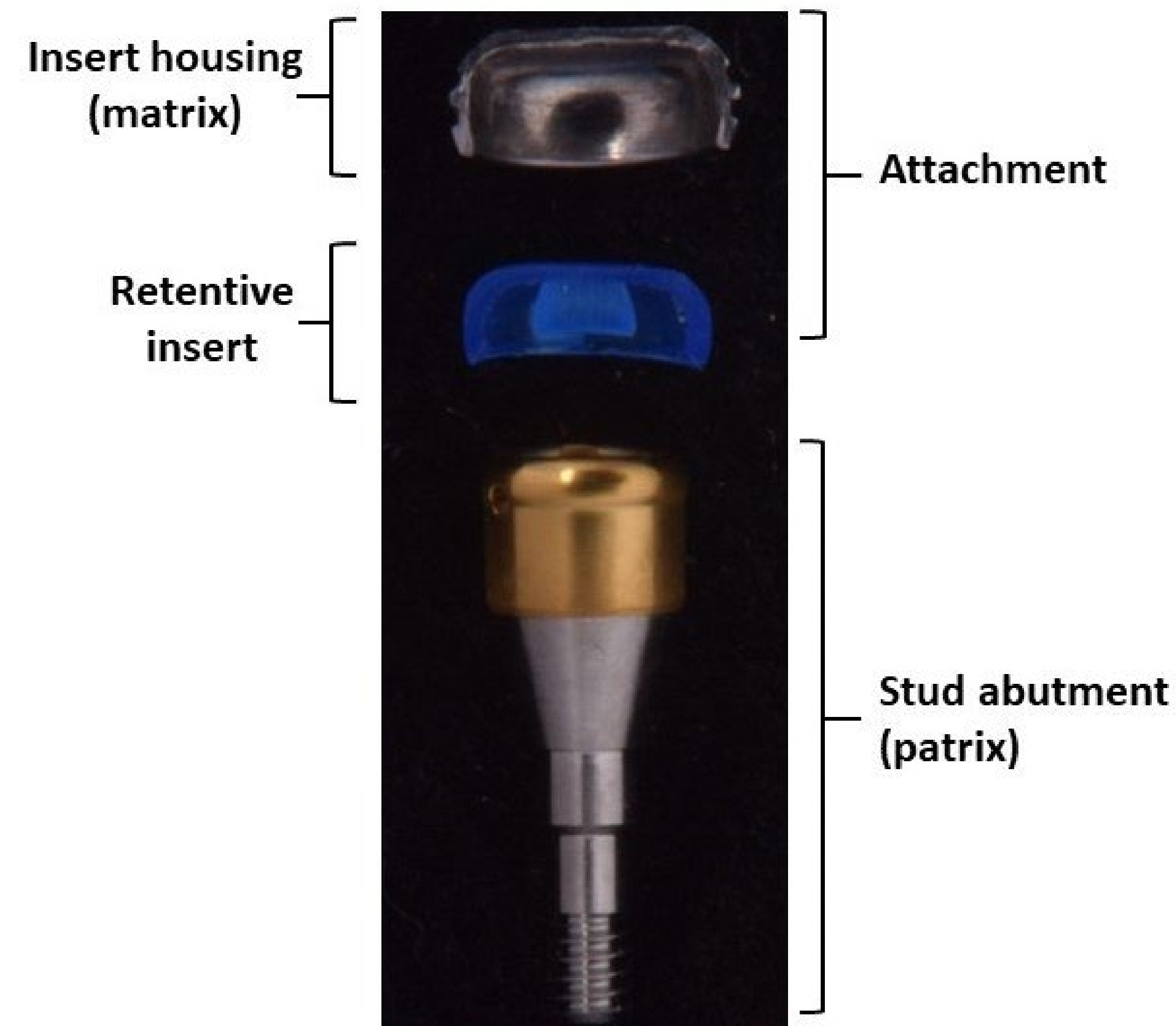


Figure 1. Schematic of conventional basic stud cylindrical-type attachment system.

PURPOSE and NULL HYPOTHESIS

PURPOSE: To evaluate the retentive characteristics of two common nylon-based overdenture attachments and one novel attachment (utilizing PEEK) after simulating a year of exposure to two common denture cleansers and sodium hypochlorite (NaOCl) dilution. **NULL HYPOTHESIS:** There would be no effect on retentive characteristics of all three attachment systems when comparing control (water) and treatment groups.



Figure 2. Occlusal view of maxillary arch containing novel stud abutments that engage polyetheretherketone (PEEK) matrix inserts.

CLINICAL SIGNIFICANCE

With advances in polymer technology, new dental materials are available in the form of overdenture attachments. Understanding the range of prosthesis retention after being subjected to daily hygiene measures will allow for improved treatment planning and rehabilitation of patients. The findings of this study can help clinicians to decide on abutment selection more appropriately, as well as provide qualified advice to patients on how to best care for their prosthesis, and ultimately, how to prolong their oral health and masticatory function.

EXPERIMENTAL DESIGN

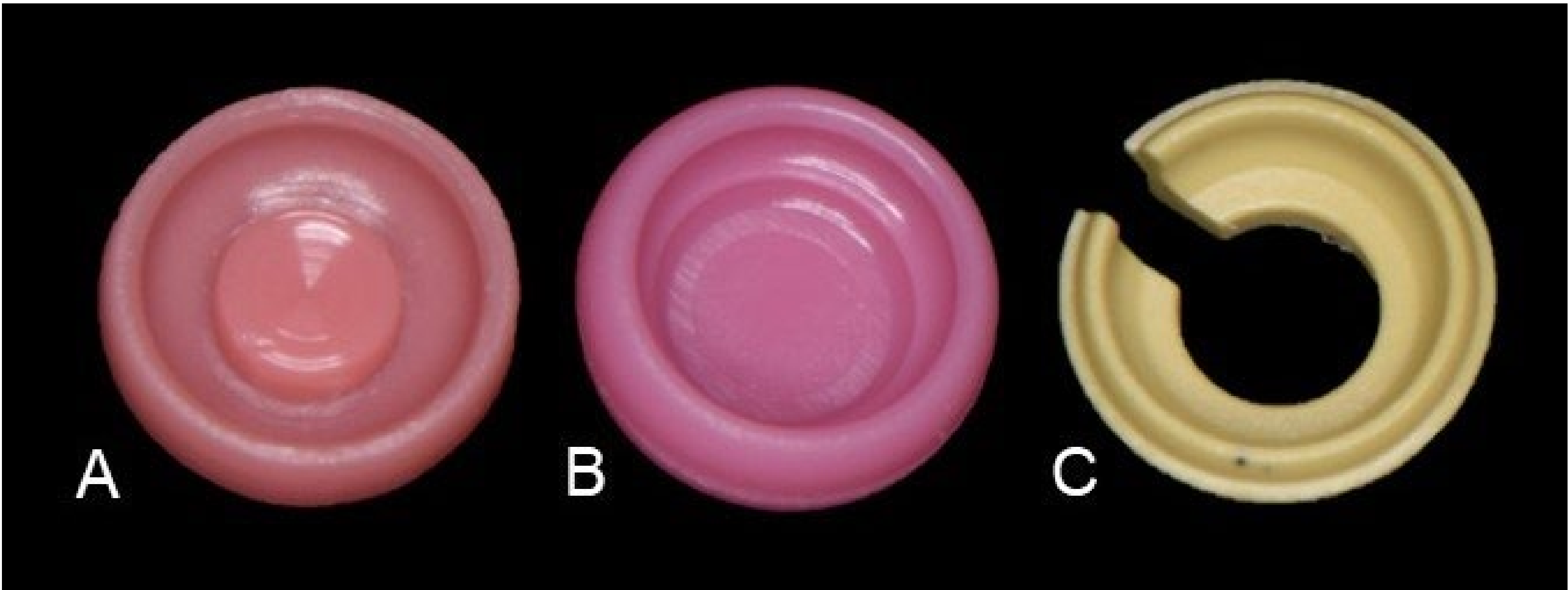


Figure 3. Medium force matrix inserts for stud abutments:
A, *Nylon* with dual internal and external engagement features.
B, *Modified design nylon* with external retention grooves.
C, *PEEK* C-shaped with external engagement design.



Figure 4. Groups of inserts (n=10) were randomly divided and placed into perforated plastic zip-lock bags with a separately-bagged marble.

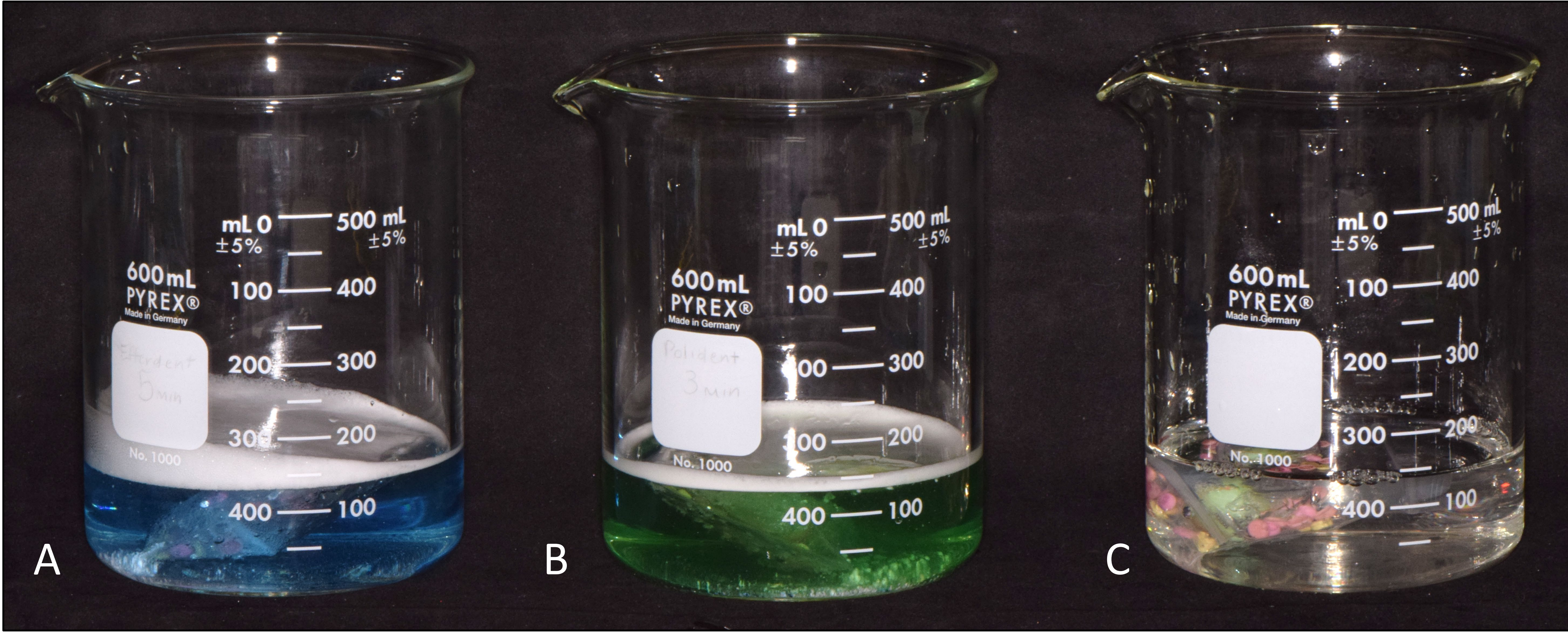


Figure 5. Immersion of retentive inserts in water (not shown) and three denture cleansers: **A**, effervescent antibacterial denture cleanser #1. **B**, effervescent antibacterial denture cleanser #2. **C**, 1:10 NaOCl dilution.

Table 1. Denture cleansing protocols tested.

Solution Tested	Manufacturer solution change interval	Total immersion time (1 year equivalent)
Tap water (control)	8 hours	336 hours
Effervescent cleanser #1	5 minutes	30.4 hours
Effervescent cleanser #2	3 minutes	18.25 hours
1:10 NaOCl dilution	10 minutes	60.8 hours

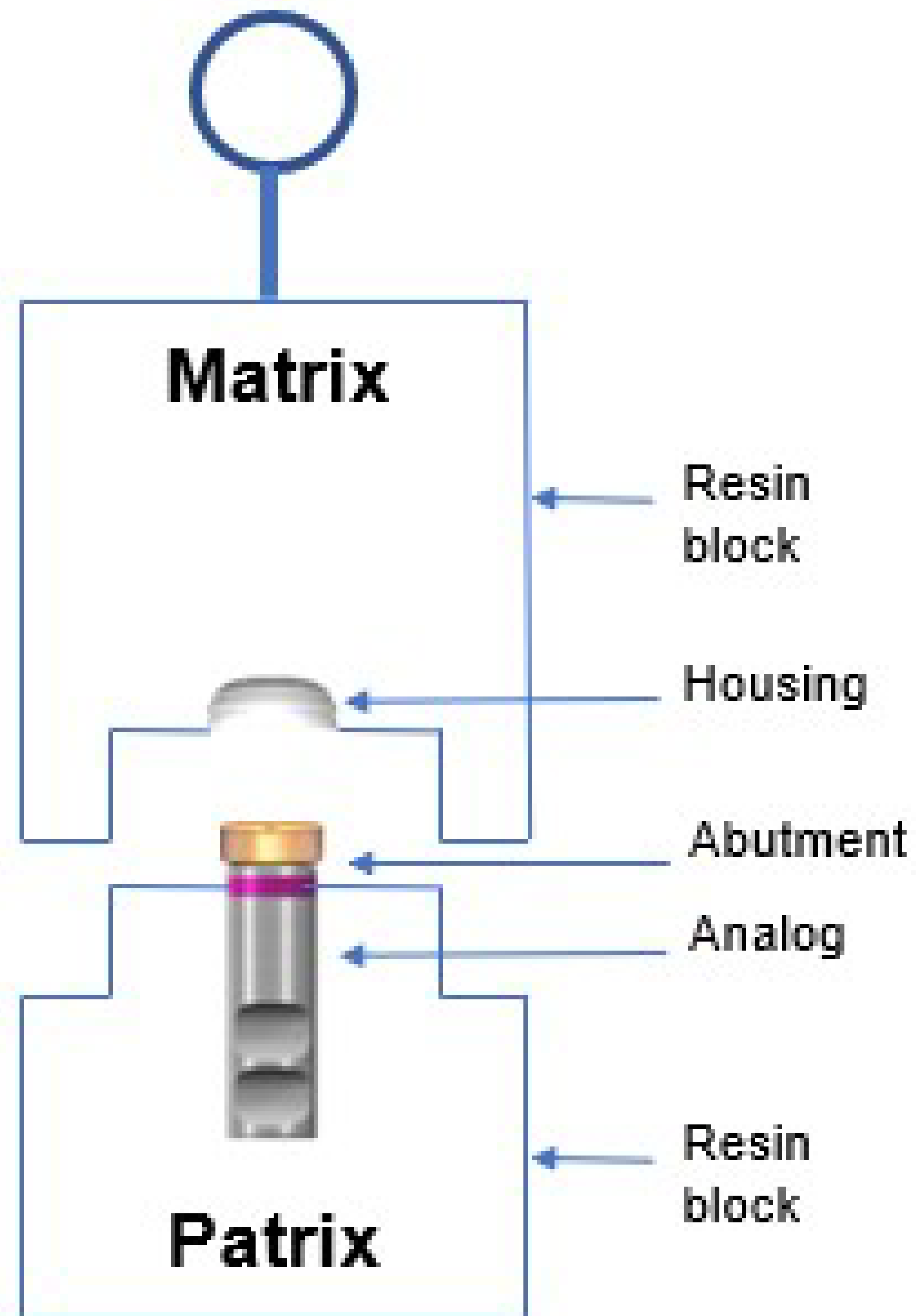


Figure 6. Schematic of upper and lower members of testing jig for assembling the stud abutment with corresponding denture housing and retentive insert.



Figure 7. Attachment housings and overdenture abutment components were manually connected via the treated inserts. The pattern resin assembly was secured in a universal testing machine.

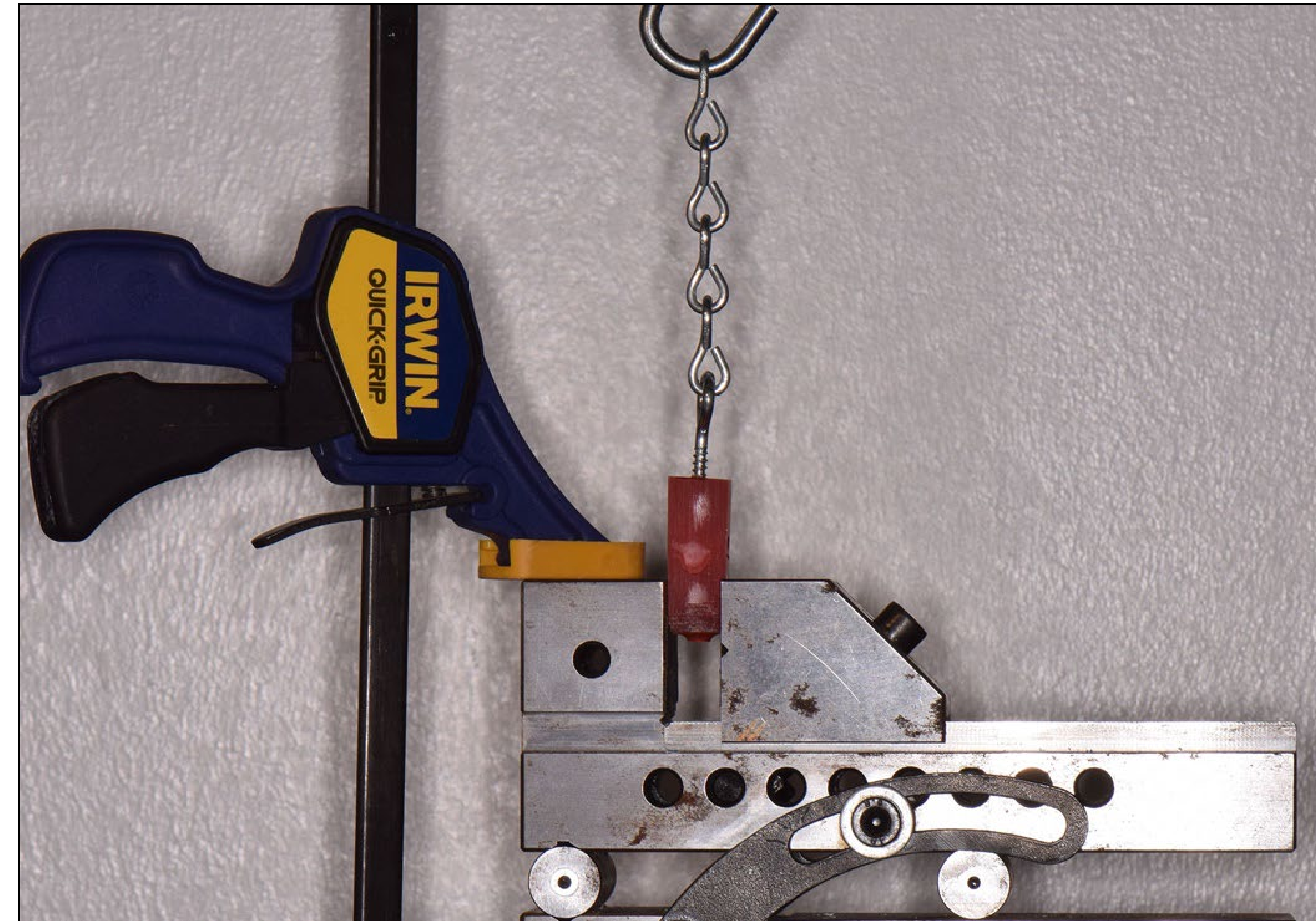


Figure 8. The testing jig was fixed using a large clamp. The upper portion was connected to the universal testing machine load cell using a hook and metal chain without tension.

RESULTS

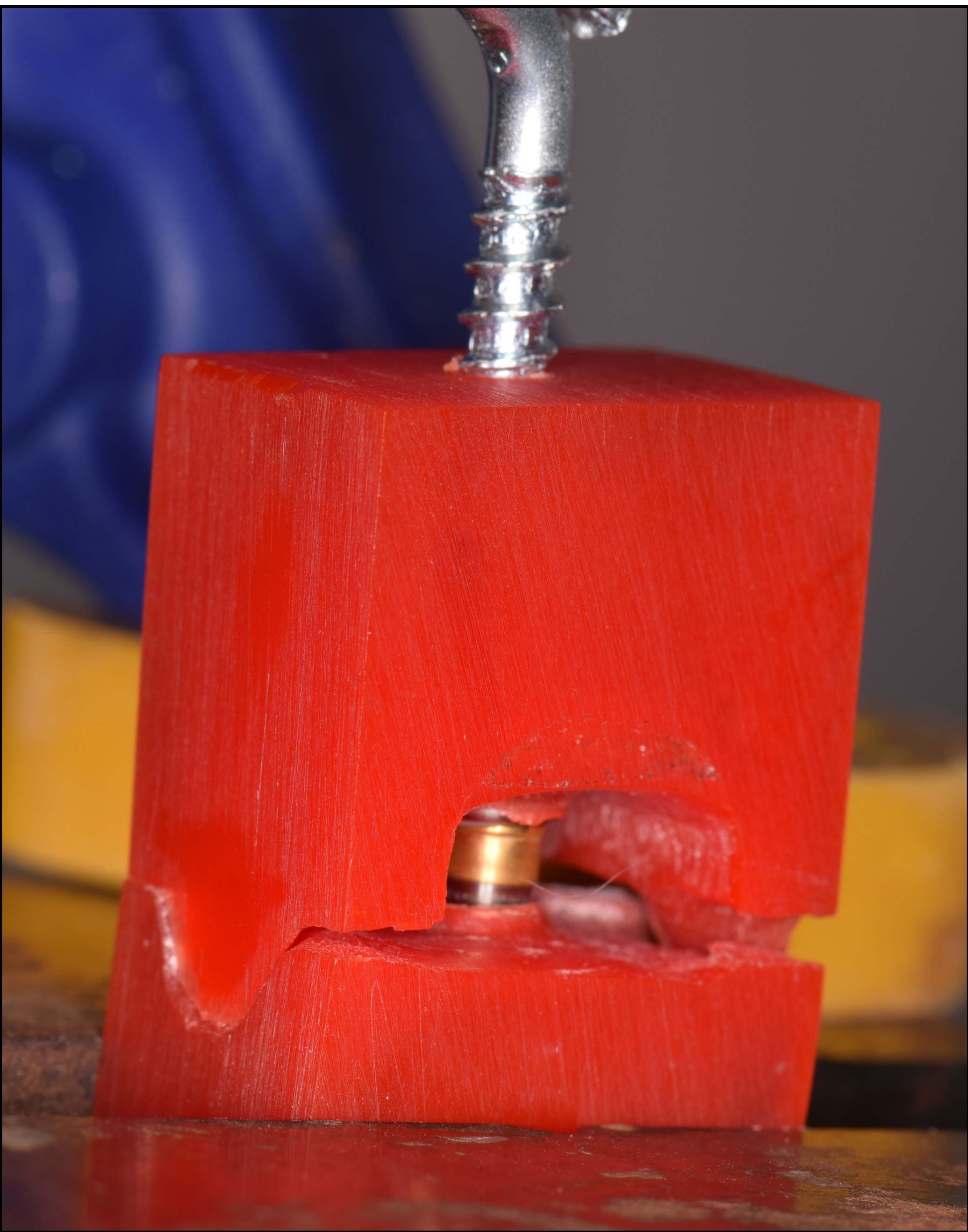


Figure 9. One pull-off without lateral force was completed for each retentive insert in the four groups at a speed of 1 mm/min until the retentive insert was completely detached from the abutment. The maximum force before retention was lost was recorded in Newtons as the detachment force.

Table 2. Detachment force (mean ± standard deviation; N) for three attachment types and 4 denture cleansers.

Attachment Insert	Tap Water	Effervescent cleanser #1	Effervescent cleanser #2	1:10 NaOCl dilution
Nylon	18.3 ± 2.3 a	21.0 ± 6.9 a	19.7 ± 5.8 a	22.4 ± 6.3 a
Modified design nylon	9.2 ± 2.7 a	12.3 ± 0.9 b	12.1 ± 1.1 b	13.0 ± 2.7 b
PEEK	13.6 ± 0.6 a	16.4 ± 0.8 c	14.6 ± 1.4 b	15.6 ± 0.8 c

Same letters indicate no significant difference within an attachment group (horizontal).

Statistical Analysis: After confirming normal distribution (Kolmogorov-Smirnov Test of Normality), the data were statistically analyzed using two-way ANOVA. The effect of the cleansers on each attachment type was analyzed using one-way ANOVA followed by Student-Newman-Keuls post hoc test. Significance value was set to $\alpha=0.05$.

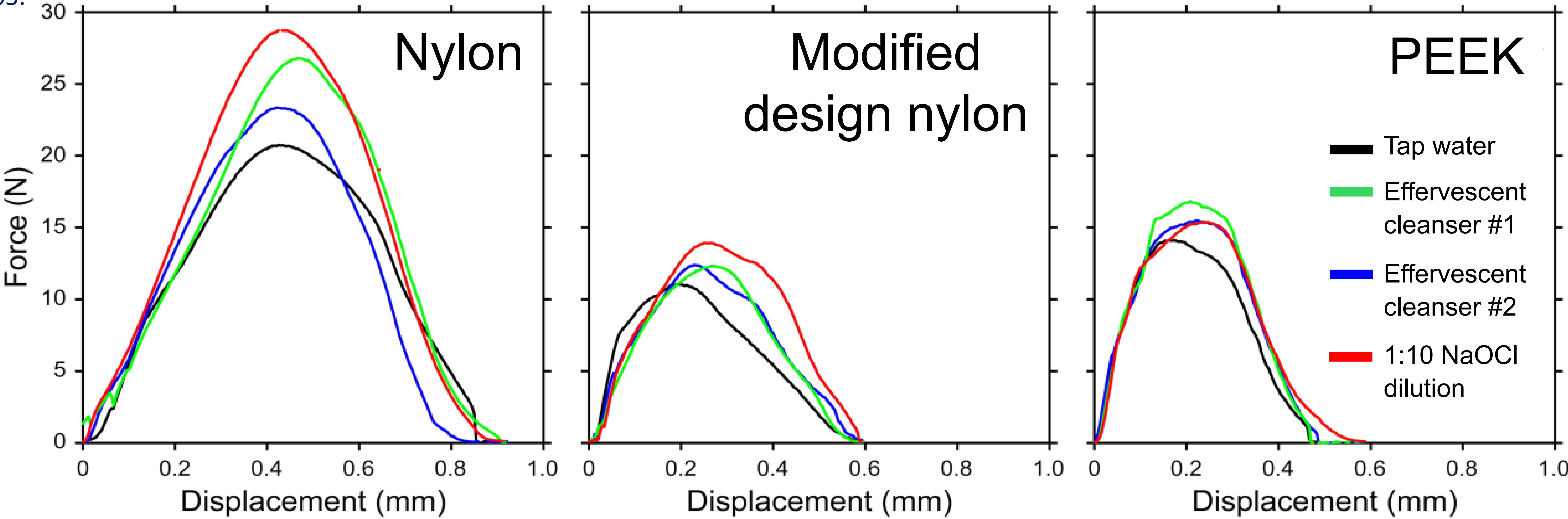


Figure 10. Representative displacement-force curves recorded during the 1 mm/min pull-off tests for the three insert types. The highest value of each curve was defined as the maximum retention force.

SUMMARY OF FINDINGS

- Compared to control samples, treatment groups demonstrated higher mean detachment force for all three insert types.
- Attachment type and cleanser were *each* significant factors in detachment force (p=0.0001 and p=0.0018, respectively).
- The null hypothesis was partially rejected: Exposure to all three non-control cleansers significantly increased the retentive values of the modified design nylon and PEEK insert groups (p=0.0007 and p=0.0001, respectively).
- There was no significant interaction *between* attachment and cleanser (p=0.9037).
- One-way ANOVA found no significant effect of denture cleansing solutions on retention of nylon inserts (p=0.4177).
- Among the cleansers, the 5-minute effervescent cleanser and sodium hypochlorite dilution increased PEEK insert detachment forces compared to the 3-minute effervescent solution.

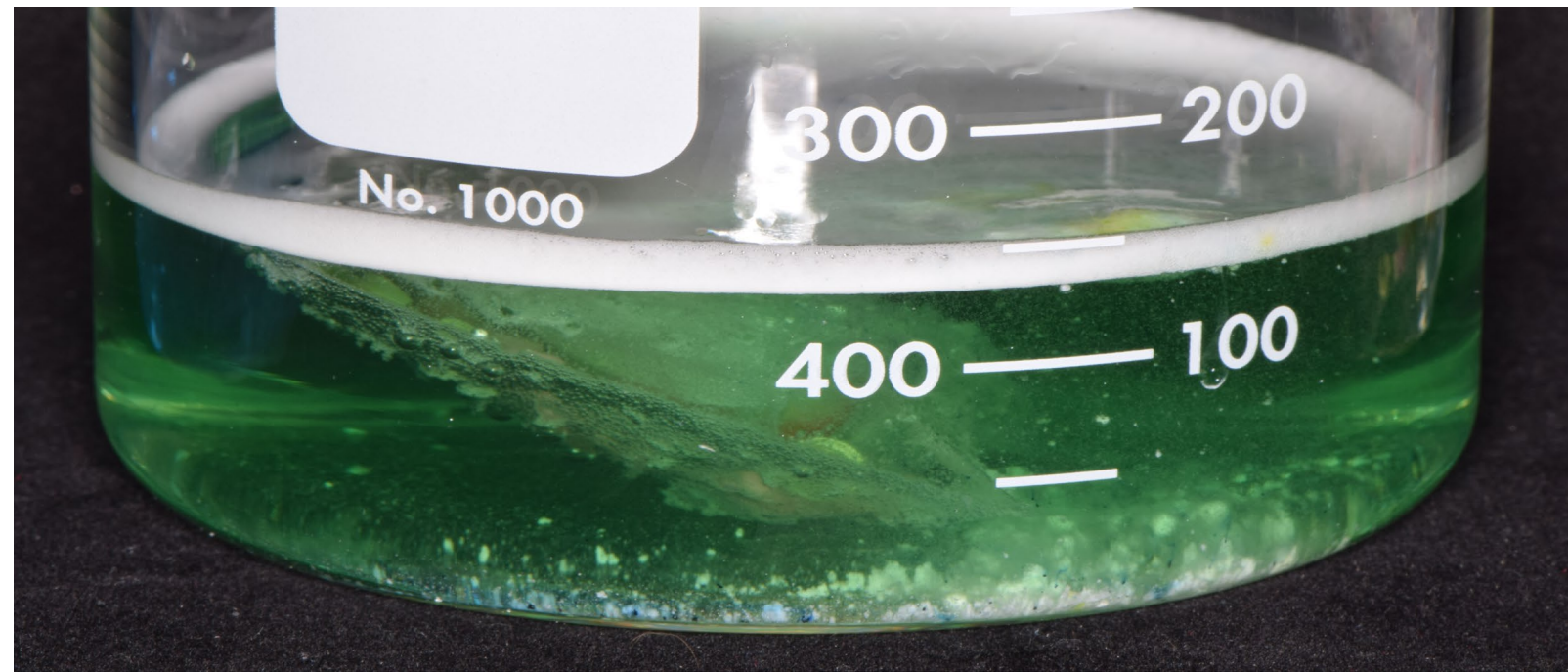
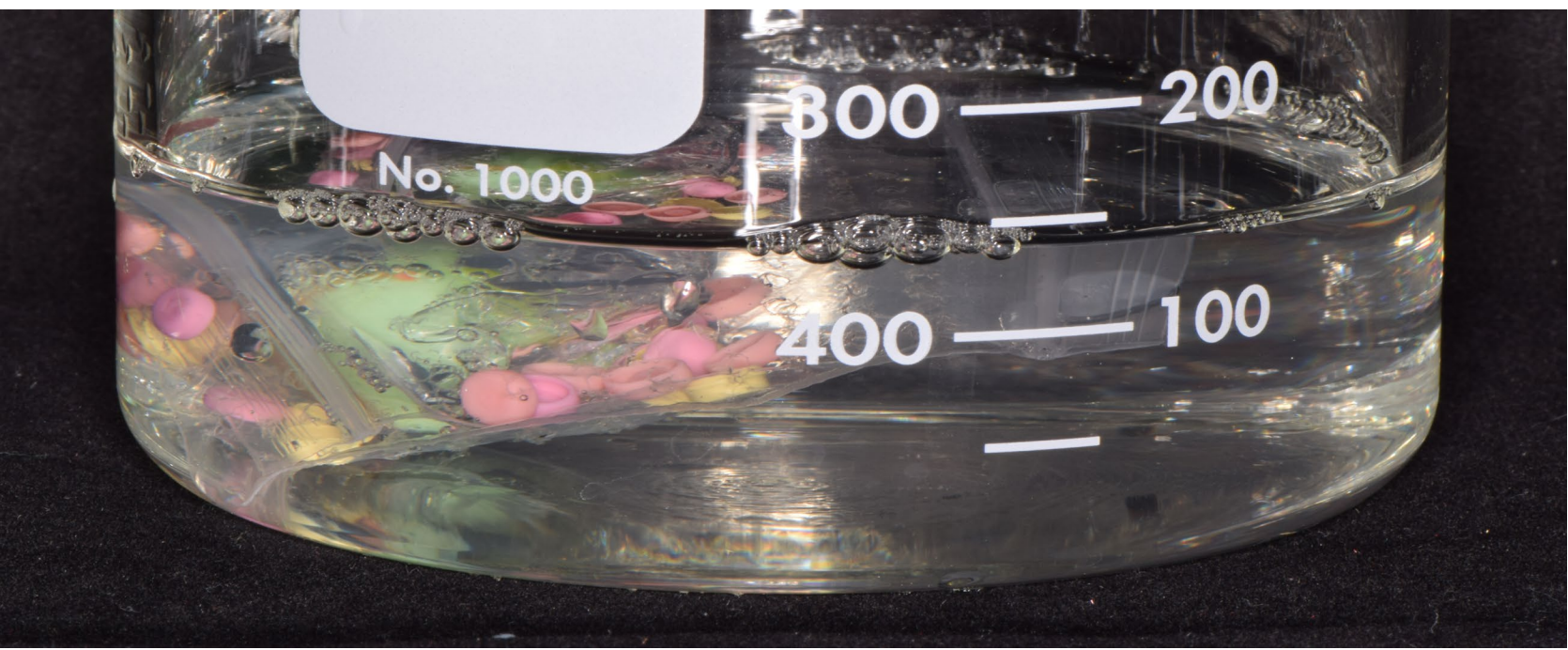
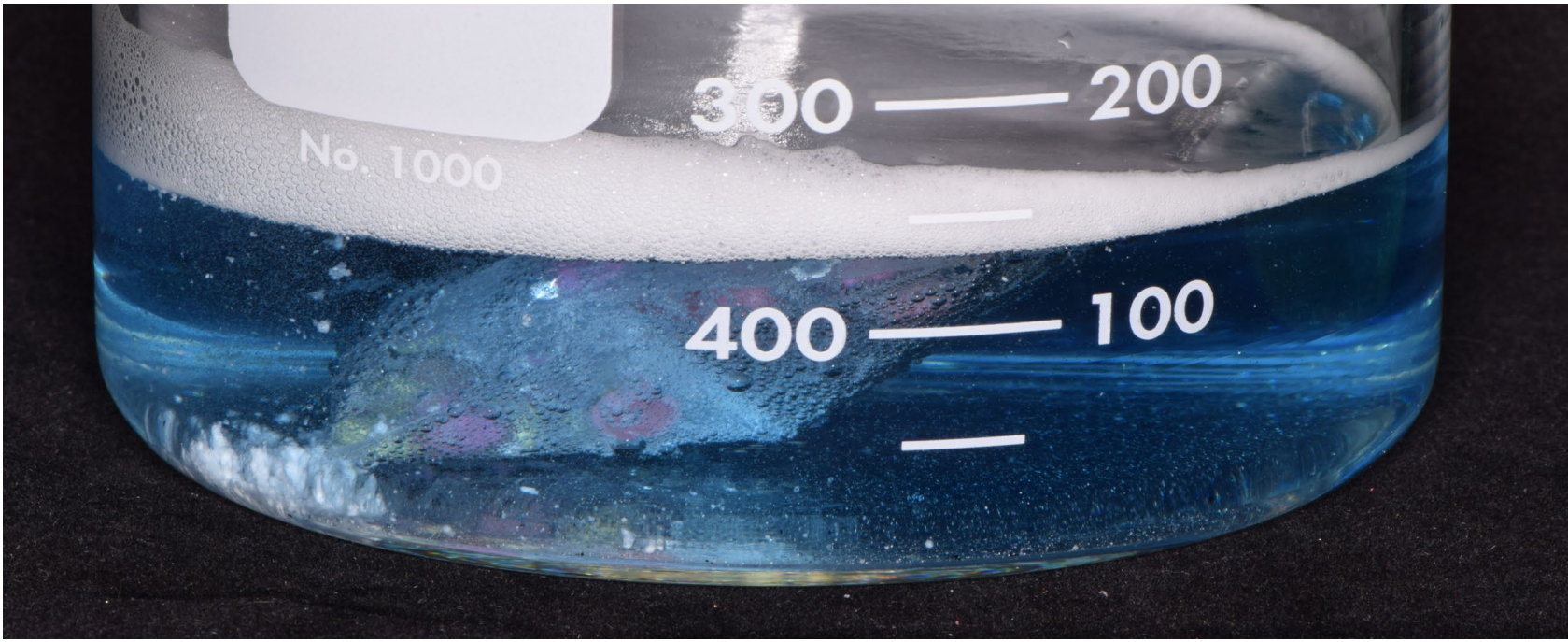
LIMITATIONS

1. Attachments were not subjected to masticatory forces or thermocycling, which may better simulate the oral environment.
2. Patients typically remove their implant overdentures on average 2-3 times a day; this study only utilized a single pull following a simulated year of exposure to cleansing solution.
3. Attachments were continuously soaked in denture cleansers, whereas patients typically soak their dentures at night and wear them during the day.

CONCLUSIONS

Within the limitations of this *in vitro* study, the following can be concluded:

1. The retention of the nylon attachment was not affected by the three cleansing agents.
2. The modified design nylon and PEEK attachments exhibited a significant increase in retentive values after immersion in all three cleansing agents.
3. Neither of the commercial effervescent denture cleansers demonstrated detrimental effects on retentive values of the three attachment systems when manufacturer protocols were followed.
4. Sodium hypochlorite, when used in a 1:10 dilution, did not impart a diminishing effect on retention for the three types of attachment inserts.
5. Changes observed in retention of the three types of attachment inserts may not be clinically significant.
6. While the present study is limited to an *in vitro* investigation, the above findings support the use of all the cleansers tested.



ACKNOWLEDGMENTS

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