

The Influence of Denture Cleansers on the Retention of Different Locator Attachments of Implant Supported Overdenture

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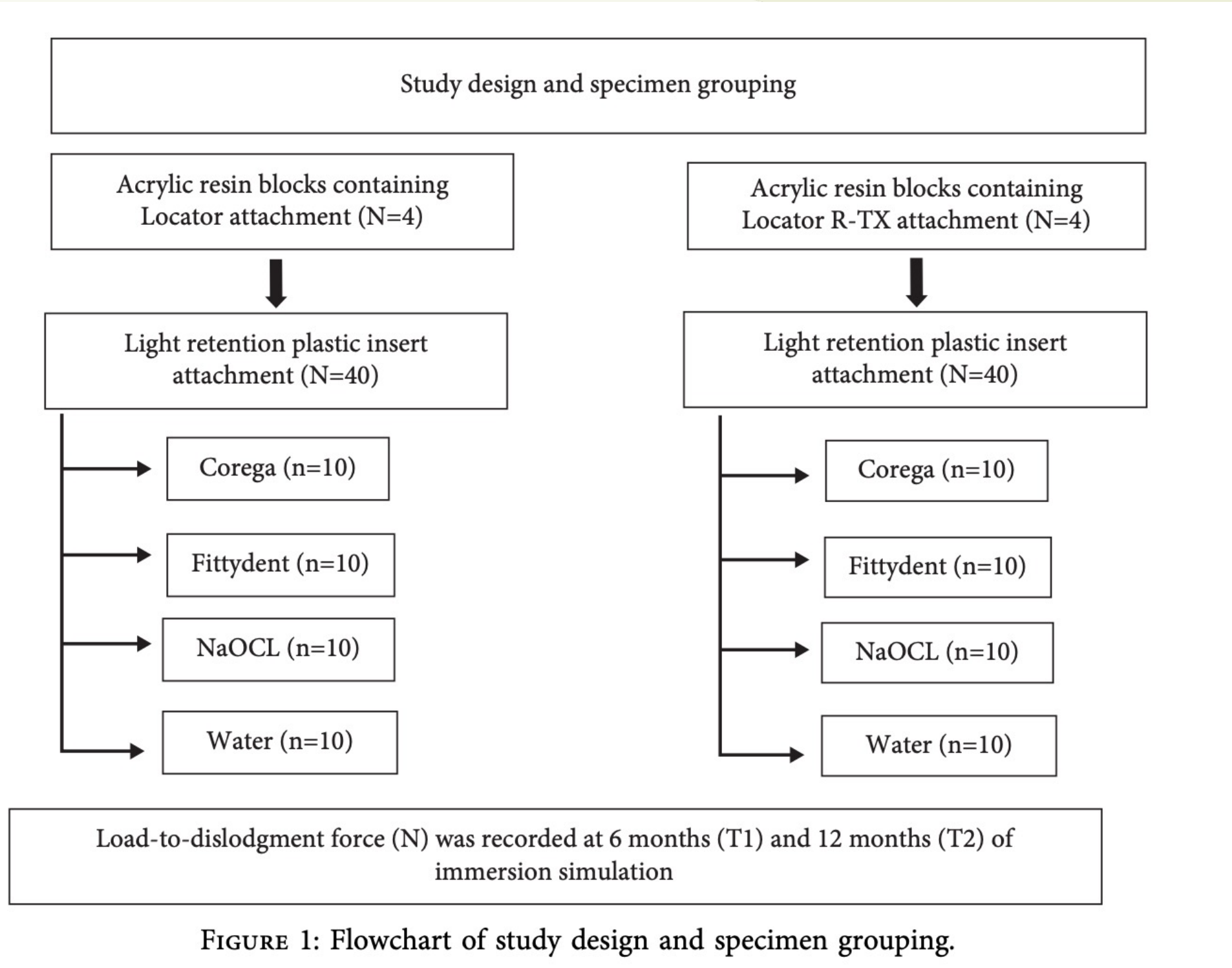
INTRODUCTION

Implant supported overdentures (ISOs) are an effective treatment option for edentulous patients [1]. ISO was developed to improve retention, stability, support, and chewing ability, as well as to preserve the surrounding bone and enhance patient satisfaction by utilizing various retentive attachment systems [2, 3]. Locator attachment selection is guided by the amount of retention needed, jaw anatomy, complexity of the case, implant alignment, vertical and horizontal prosthetic space, and patient compliance for recall appointments in to perform adequate maintenance [3]. The most common attachment system in dental practice is the Locator® attachment system (Zest Anchors, Inc., Escondido, CA), which is a stud-type attachment and was designed to make restorative treatment with implant overdentures easier [4, 5]. The Locator® R-TX abutment system incorporates various enhancements over the original Locator abutment, in addition to a design that aids patient care. This innovative design allows for mobility in all axes, minimizing the amount of load placed on the implant and supporting bone [6]. According to the manufacturer, the Locator R-TX has an improved angle correction and pivot function, and is, therefore, recommended for implant angular discrepancies of up to 60° (maximum 30° per implant). ISO demands rigorous hygienic care; therefore, commercial denture cleansing solutions (DCSs) are often recommended for effective denture care. Only a few investigators have studied the effects of DCS on the retention of the Locator attachments in the past. Moreover, the effect of DCS on the newly introduced Locator R-TX has not yet been investigated. The aim of this study was to evaluate the effects of different DCS on the retention of two commercially available attachment systems. The null hypothesis of our study was that DCS does not affect the retention of Locator and Locator R-TX attachment systems.

MATERIALS AND METHODS

Specimen Preparation: The sample size was calculated with G*Power software (version 3.0.10) using one-way ANOVA, a medium effect size of $f = 0.4$, 80% power, and a 0.05 significance level, resulting in a required sample size of 10 specimens per group to evaluate the effects of DCS on the retention of the Locator R-TX attachment compared to the Locator attachment system. Two acrylic blocks, each with compartments for the metal housing and implant analog (3.7 mm diameter), were prepared. The blocks were immersed in three DCS (Corega, Fittydent, and NaOCl) and tap water (control) for varying time intervals to simulate 6 and 12 months of clinical usage. The acrylic blocks were made using a plastic mold, with a wax guide pin positioning the implant analog. After polymerization, the upper and lower compartments were designed to fit together accurately. The surface was coated with Vaseline, and the Locator and Locator R-TX abutments were fitted into their respective analogs before being secured with autopolymerized acrylic resin.

TABLE 1: Denture cleaning solution preparation and immersion protocol.					
Solution/manufacturer	Composition	Preparation/temperature	Time/day	Total immersion time (12 months)	
Water	—	—	8 hours	2880 hours	
Corega	Potassium monopersulfate; sodium bicarbonate; sodium lauryl sulfoacetate; sodium perborate monohydrate; sodium polyphosphate	One tablet dissolved in 200 mL of warm tap water (40°C)	3 minutes	6 months: 1440 h (18 hours) 12 months: 2880 h (36 hours)	
Fittydent	Sodium perborate, sodium bicarbonate, potassium monopersulfate, trisodium phosphate, PEG-240, sulfamic acid, PVP, TAED, silica, sodium methyl oleyl taurate, cellulose-lactose, color C.I. 42090, aroma	One tablet dissolved in 200 mL of warm tap water (40°C)	5 minutes	6 months: 15 h (30 hours) 12 months: 30 h (60 hours)	
NaOCl	5.25% NaOCl (1:1 ratio of sodium and chloride ions) diluted 1:10 in tap water	Solution of 5.25% sodium hypochlorite (NaOCl, 1:5 dilution) was diluted to obtain 1% NaOCl solution by adding 50 mL NaOCl to 200 mL water	10 minutes	6 months: 30 h (60 hours) 12 months: 60 h (120 hours)	



Denture Cleanser Preparation and Immersion Protocol: The denture cleansers used were assigned to four groups: Corega, Fittydent, NaOCl, and water as a control group. Ten inserts for each cleanser were placed in bags and immersed in 125 ml of the respective solutions, simulating 6 months (T1) and 12 months (T2) of immersion.

Testing Procedures, Data Collection, and Statistical Analysis: Load-to-dislodgment force was recorded after 6 months (T1) and 12 months (T2) of immersion. A Locator Core Tool was used for processing inserts, ensuring proper attachment engagement monitored by a load cell. The force was measured using an Instron universal testing machine with a specific testing cycle, all conducted by a single expert technician. Data were subsequently collected and analyzed.

Descriptive analyses used means and standard deviations, testing for normality with Kolmogorov–Smirnov and Shapiro–Wilk tests, confirming a normal distribution. Paired t-tests assessed differences between the immersion solutions at T1 and T2, while Student’s t-test evaluated differences between Locator and Locator R-TX groups. ANOVA

and Tukey’s test analyzed differences among the immersion solutions at 6 and 12 months, with statistical significance set at $P < 0.05$, using SAS software (version 9.4).

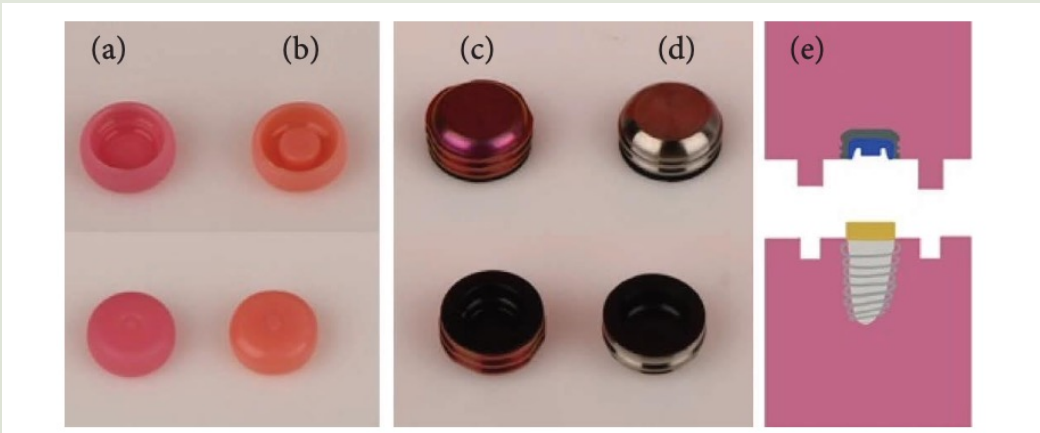


FIGURE 2: Rubber inserts (a and b) and metal housing (c and d); two acrylic blocks with metal housing containing rubber insert (e).

TABLE 2: Means, SDs, and statistical significances of retention of both Locator attachment systems in different cleaning solutions at the two time points.						
Attachment system	Solutions	T1 mean (SD)	T2 mean (SD)	T2–T1 mean difference (SD)	Retention loss in %	P value
Locator attachment	Water	61.34 (4.44)	51.45 (3.27)	−9.89 (4.93)	16.12%	0.0001
	Corega	57.08 (1.09)	25.38 (0.65)	−31.70 (1.30)	45.84%	<0.0001
	Fittydent	52.89 (2.36)	30.08 (1.31)	−22.82 (2.42)	43.14%	<0.0001
	NaOCl	47.78 (1.44)	18.22 (1.72)	−29.56 (1.98)	61.75%	<0.0001
Locator R-TX attachment	Water	63.39 (3.49)	65.54 (7.31)	2.15 (9.08)	−03.93%	0.474
	Corega	64.22 (4.56)	42.20 (0.90)	−21.50 (5.35)	33.47%	<0.0001
	Fittydent	67.74 (1.80)	41.42 (2.25)	−26.32 (3.21)	38.85%	<0.0001
	NaOCl	59.48 (0.88)	41.34 (1.86)	−18.15 (1.82)	30.51%	<0.0001

SD: standard deviation. P value <0.05 is significant.

RESULTS

The means, standard deviations, and statistical significances of retention for the two types of Locator attachments across different DCS were measured. ANOVA results indicated a significant decrease in retention after soaking both Locator types in various cleansing solutions ($P < 0.001$), except for Locator R-TX in water ($P = 0.474$). Tukey post hoc test results showed significant retention differences among all cleansing solutions at T1 and T2 ($P < 0.001$). Water groups exhibited the highest retention values at T1 (61.34 ± 4.44 N) and T2 (51.45 ± 3.27 N), while NaOCl groups had the lowest at T1 (47.78 ± 1.44 N) and T2 (18.22 ± 1.72 N). In retention loss percentage, NaOCl had the highest loss (61.87%), followed by Corega (55.54%) and Fittydent (43.13%), with water showing the best retention (16.13%) in both groups. According to Tukey’s post hoc test, Locator R-TX experienced a significant retention decrease in NaOCl compared to water, Corega, and Fittydent at T1. No significant differences were found between water and Corega or Corega and Fittydent at T2. Overall, retention significantly decreased in all DCS compared to water ($P < 0.001$), with no significant differences in retention between Corega and Fittydent or Corega and NaOCl. Fittydent had the lowest retention values (38.86%), followed by Corega (34.28%) and NaOCl (30.5%), while water had the best retention (−3.39%). In intergroup comparisons, water immersion at T1 showed no significant differences between the attachment groups ($P = 0.266$), but Locator R-TX had significantly greater retention compared to the other Locator system across all solutions at both recall times ($P < 0.001$).

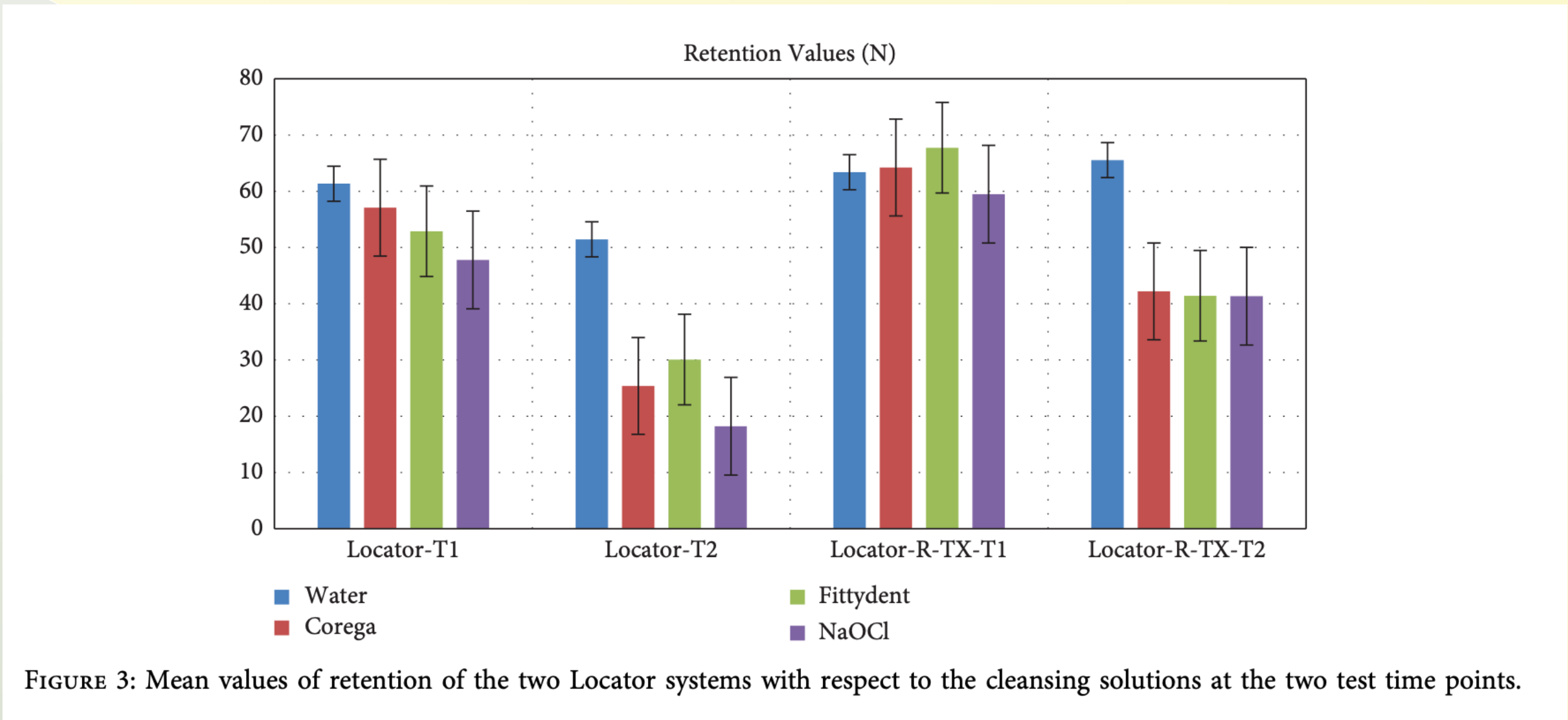


FIGURE 3: Mean values of retention of the two Locator systems with respect to the cleansing solutions at the two test time points.

TABLE 3: Pairwise comparisons of the cleansing solutions in the Locator group.							
Recall times	F-value	P value	Multiple comparison Tukey’s test				
			Water vs. corega	Water vs. fittydent	Water vs. NaOCl	Corega vs. fittydent	Corega vs. NaOCl
6 month	47.16	<0.0001	0.0055	0.0010	0.0010	0.0066	0.0010
12 months	519.32	<0.0001	0.0010	0.0010	0.0010	0.0010	0.0010

P value <0.05 is significant.

TABLE 4: Pairwise comparisons of the cleansing solutions in the Locator R-TX group.							
Recall times	F-value	P value	Multiple comparison Tukey’s test				
			Water vs. corega	Water vs. fittydent	Water vs. NaOCl	Corega vs. fittydent	Corega vs. NaOCl
6 month	12.44	<0.0001	0.8999	0.0147	0.0324	0.0633	0.0069
12 months	84.84	<0.0001	0.0010	0.0010	0.0010	0.8999	0.8999

P value <0.05 is significant.

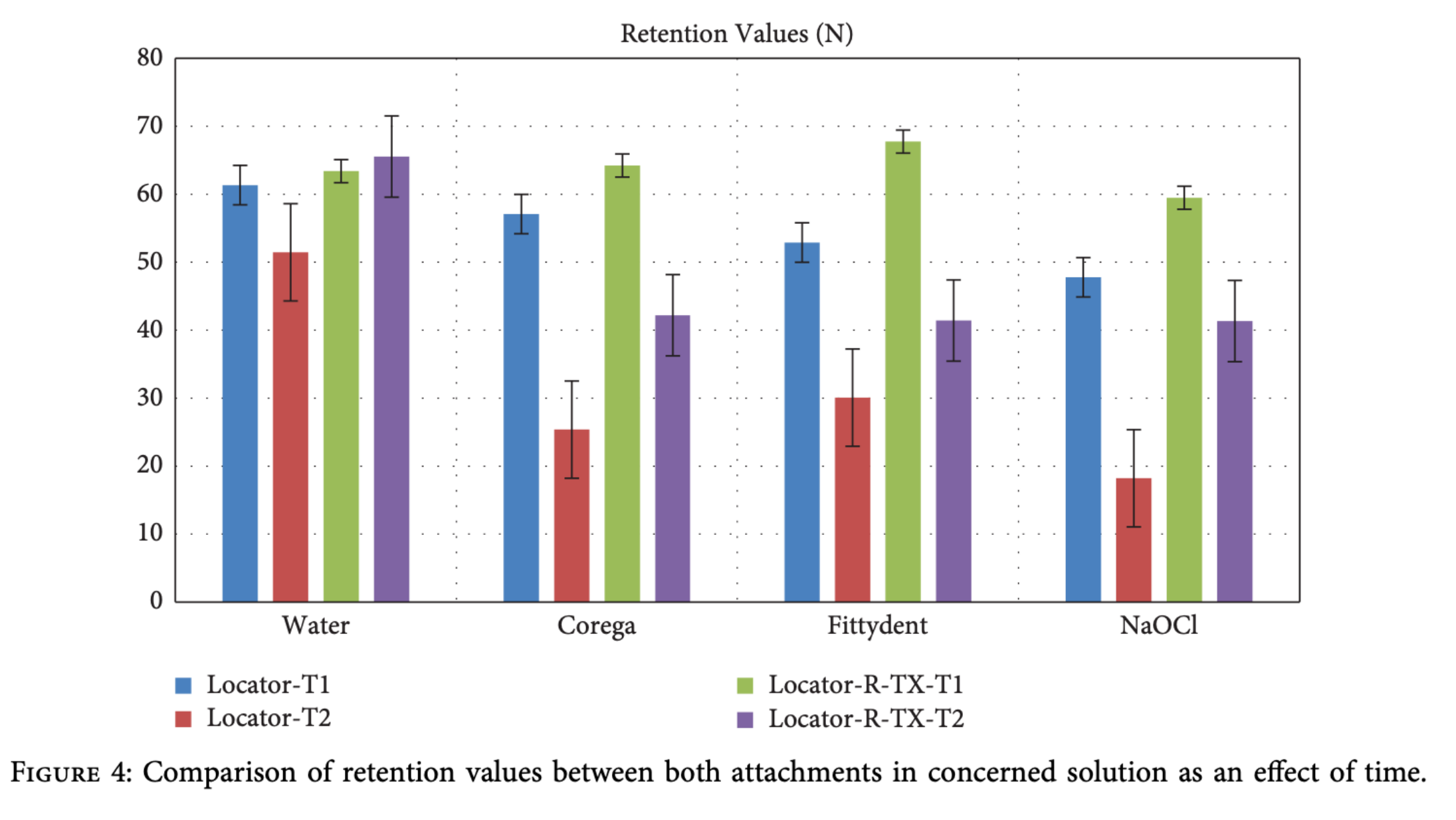


FIGURE 4: Comparison of retention values between both attachments in concerned solution as an effect of time.

DISCUSSION

The effect of DCS on the Locator R-TX attachments of the ISO has not been investigated to date. Our results showed that when selecting a cleaning solution, it is important to consider which cleaning solution will result in the best long-term retention when used with a specific attachment system.

The null hypothesis that DCS will not affect the retention of the attachment systems was rejected. After a simulated period of 12 months, a significant decrease was observed in the peak load-to-dislodgement force of both attachment systems. It was observed that the loss of retention values in Locator attachments immersed in NaOCl solution was much higher than that in the other cleansers at all time intervals, which is consistent with the findings of multiple previous studies [22, 23, 28]. The data obtained from this study demonstrate that water affects the retention of Locator attachments, whereas water has no impact of the retention of Locator R-TX attachments. This may be attributed to the differences in design between the two attachments. Further studies are needed to confirm the direct relationship between the denture attachment design and retention.

CONCLUSION

Within the limitations of present study, the following conclusion could be drawn:

- (1) The retention of the Locator as well as Locator R-TX attachment systems decreased with immersion in all types of DCS after 6 months and 12 months of immersion.
- (2) R-TX attachments showed higher retention values compared to the Locator attachments with all types of DCS after 6 months and 12 months of immersion.
- (3) The lowest retention values for both attachments were recorded after immersion in NaOCl. Therefore, it is not recommended to use NaOCl as a routine hygiene regimen.
- (4) Periodic replacement of that the locator attachment every 6 months is recommended to improve long-term denture retention.
- (5) Further in vivo studies are recommended to evaluate the clinical retention loss for the locator attachment after using different denture cleansers.

REFERENCES

