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Research Article

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Comparative Evaluation of Gingival Displacement by Using Retraction Paste and Retraction Cord- In-Vivo Pilot Study

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Abstract: Marginal integrity is one of the important principles of Tooth preparation. To achieve this, a satisfactory gingival displacement procedure is necessary. Aim of this study was to determine an appropriate gingival displacement and to access the gingival displacement on an unprepared tooth using retraction paste and impregnated retraction cord. Fourteen patients were chosen for this in vivo study. Oral prophylaxis was completed 15 days prior to the retraction procedure. Mandibular preliminary impressions were made using rubber base impression material. Gingival retraction procedure was carried out on the right and left 1st mandibular molars alternatively using retraction paste and retraction cord after 2 days of preliminary impression. Retraction paste was placed directly over the sulcus as per manufacturer's instructions and kept for 2-3 minutes and rinsed and the required length of retraction cord was dispensed and placed into the gingival sulcus using a cord packer and cord was removed after 5 minutes. Post retraction measurements completed made an impression with rubber base impression material by using sectional tray alternatively. Statistical analysis was performed with ANOVA test, paired student t test with SPSS version 21. Patients were more comfortable with retraction paste as against gingival retraction cord with significance observed by observers 1, 3 and 4. ($P<0.05$). Retraction paste had significantly better retraction ability compared to retraction cord as observed by observer 1, 3 and 4 ($p<0.05$) whereas no significant difference was observed by observer 2($p>0.05$). Retraction paste was significantly less time consuming compared to retraction cord as reported by observer 1 and 4 ($P<0.05$) and no significant differences between the two systems was reported by observer 3and 4($P>0.05$.Within the limitations of the study, both retraction techniques showed adequate gingival retraction for the prosthesis and clinically insignificant differences were seen in both gingival retraction system regarding the retraction achieve. Retraction paste found to be easy for the control of hemorrhage and easy for placement and recommended to use where there is uncontrolled bleeding and sub-gingival finish lines of the tooth preparations. However, the amount of vertical gingival retraction observed with the paste retraction system was significantly less than the medicated retraction cord.

Key words: Gingival retraction, Retraction cord, Fixed Prosthesis and gingival margin.

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1. INTRODUCTION

Fixed prosthodontics plays an important role for the patient who lost one or more teeth. In present era of high esthetic demands from the patient are aware of development with technology as well as biomaterials. It is necessary to provide prosthesis with adequate masticatory, phonetic, and esthetic function.[1]For the successful treatment of fixed dental prosthesis, all the procedures should be completed with utmost watchful and accurate methods. Making accurate impression is always challenging. Tissue displacement is required to obtain adequate access to the prepared tooth by procedure called gingival retraction. Gingiva and periodontium plays an important role for the esthetics and durability of the prosthesis.[2]All the procedures should be performed by keeping an eye on health of gingiva and periodontium[3]. Preparation margins can be supragingival, at the crest or sub-gingival. Supragingival and crestal margins are always easier to prepare and to complete the whole procedure. But in some cases clinician is forced to place the finish line subgingivally due to situations like previous restorations, existing decay, esthetics and short crown. Sub-gingival margins are always problematic and should be avoided whenever possible. Periodontally, a sub-gingival margin always results in a gingival inflammatory response.[4, 5, 6] Gingival tissues are required to be adequately displaced for recording all details of sub-gingival finish lines.[7] For improving quality of impression for sub-gingival finish line, it is essential to expose the gingival sulcus without damaging the periodontium and control of bleeding.[8, 9, 10] For the success of fixed prosthesis, periodontium should be healthy. For achieving this goal an accurately made impression for indirect restorations is very important[11]. To achieve this, it is always preferable to place supragingival finish line for any kind of indirect restoration, although, for esthetics and some other reasons, it becomes mandatory for the dentist to place the finish line sub-gingivally.[12]Main factor for the failure of fixed prosthesis is poor marginal adaptation, which usually results from defective marginal details. According to studies 35.5% failures in case of fixed partial denture is due to the periodontal disease followed by caries.[13]This could be consequences of the inadequate gingival retraction. Gingival displacement is defined as the deflection of marginal gingiva away from the tooth. The goal of gingival retraction is to atraumatically displace gingival tissues and allow access for impression material to record the finish line and provide sufficient thickness of gingival sulcus so that the impression does not tear off during removal.[14]Gingival retraction is additionally useful for assessing marginal fit and during cementation procedure for the complete elimination of the excess cement without injury to gingival tissue.[15]The critical sulcular width required is approximately 0.2 mm at the level of the finish line to get sufficient thickness of impression material at the margins of impressions so that they can withstand distortion on removal of the impression.[16]Whenever hydrophobic material is used, control of moisture in the sulcus is very important. Moisture can cause defective impression.Gingival tissue displacement can be predominantly classified into nonsurgical and surgical methods. The non-surgical methods include mechanical (retraction cords) & chemo mechanical (Pre-impregnated retraction cords, Expasyl, Magic Foam etc.) while the surgical methods include Lasers, Electro surgery and rotary curettage. Retraction cords can generate decent retraction, but clinicians usually observe the problem of more time consumption in the placement of the cord and moreover gingival laceration which usually takes more than one week to heal.[17] Hence, the retraction material which is used for gingival retraction should displace the gingival tissue laterally and vertically and should also control hemorrhage. Soaking a retraction cord with a hemostatic can control the sulcular to achieve quality gingival retraction.[18, 19, 20]The chemicals used along with retraction cords (gingival displacement medicaments) can be broadly classified[21]into vasoconstrictors (Epinephrine, Sympathomimetic amine) and astringents (Aluminum sulfate compounds (aluminum potassium sulfate [Alum] and aluminum sulphate, Aluminum chloride, Ferric sulphate). Due to shortcomings of the conventional cord, the development of cordless retraction materials has slowly made impregnated retraction cords less competitive. A cordless retraction material in the form of a paste-like material supplied with a specialized dispenser is commercially available. The displacement of gingiva takes place when it is injected into the sulcus because of its high viscosity .[22]This commercial product contains about 15% aluminum chloride ($AlCl_3$).[23] The high cost of this product prevents it from becoming an economic material. Choice of appropriate gingival retraction system is still a dilemma in the mind of the dentist.[24, 25]There are few studies comparing the efficacy of gingival retraction depending upon the materials and techniques used. This in-vivo study was proposed to determine an appropriate gingival displacement material and to access the gingival displacement on an unprepared tooth using retraction paste and impregnated retraction cord.

2. MATERIALS & METHODS:

This study was conducted in Dental clinic OPD of Ibn Sina National College for Medical studies, Jeddah, Saudi Arabia. Ethical committee approval was taken from the Institute and Ethical committee with reference number is H-17-11072019. A total of forty participants were screened and out of which fourteen participants were chosen who best suit the criteria for this in vivo study with their consent and cooperation. The participants were randomly selected based on inclusion and exclusion criteria.

2.1 Inclusion criteria

1. Age group of 20-30 of both genders
2. They should be nonsmokers, free from caries and periodontal diseases in the mandibular first molar.

2.2 Exclusion criteria

1. Participants suffering from any systemic problems, long term medications and immunosuppressed ,
2. Participants having Malocclusion.
3. Participants with poor oral hygiene, gingival recession/gingival hypertrophy, high plaque index and bleeding on probing.

Armamentarium used for the procedures were as follows; Mouth mirror, tweezers, and Cotton rolls, Cord packers, Digital caliper (Precision measuring Digital caliper) [Figure1], Lower impression tray (full arch & sectional try). Materials used for this study were as follows;

2.3 Retraction systems used in the study

1. Atriapak retraction cord (Atria pack 000) is made of 100% cotton, knitted into thousands of tiny loops to form long, interlocking chains. This unique knitted design exerts a

gentle, continuous outward force following placement, as the knitted loops seek to open. Optimal tissue displacement occurs in 3–8 minutes. [Figure 3] with hemostat (25% buffered Aluminum chloride hemostatic liquid) [Figure 4],

2. 3M astringent retraction paste (3M ESPE) is a 15% Aluminum chloride is a retraction paste for the displacement of marginal gingiva and hemostasis within the sulcus. It is dispensed in a capsule applicator and directly applied into the sulcus. It is meant as an alternative to cords or may be used as an adjunct to a single cord. The active ingredient in 3M ESPE is an aluminum chloride which constricts or occludes blood vessel, causing denatruation and providing a physical meshwork. This retraction paste is indicated for any patient a healthy periodontium and predictably provides a dry and well retracted field. [Figure 2], Putty material DENTSPLY Sirona soft putty (base + catalyst), (polysiloxane) [Figure 5] and Light body 3M ESPE vinyl polysiloxane [Figure 6]. All the procedures were clearly explained to the participants and written consent was taken. Scaling and oral hygiene procedures were completed fifteen days prior to the procedure and they were asked to maintain oral hygiene. Each participant was recalled after two weeks and started with measuring of the distance from the Mesio-buccal cusp of mandibular right and left first molar to the gingival margin using a digital caliper and repeated for two more times to avoid any error. The Vernier caliper delivered an accuracy of 1µ [Figure 7]. To eliminate subjective errors, each sample was measured twice and the consistent value was considered. Only one operator was performing the procedures to avoid any inaccuracy. However, for each patient, observation regarding each step was noted by four observers and an average of their readings was considered. This is something unique in our study. Preoperative impression was made with rubber base impression material [Figure 8] for mandibular arch and impression was poured. For all the participants' gingival retraction paste was used for mandibular right first molar and retraction cord with size (000) hemostat was used for mandibular left first molar. Retraction procedure was completed as per manufacturers' instructions. The area to be recorded was isolated. Retraction paste which was placed directly into the gingival sulcus of mandibular right molar according to the manufacturer's instructions [Figure 9]. This paste was left in place for 2-3 minutes and washed it with air water spray thoroughly and dried the area with cotton roll. The required length of retraction cord was dispensed and placed into the buccal gingival sulcus using a cord packer from mesial to distal direction and Precautions were taken not to injure the gingiva [Figure 10]. The retraction cord was left in the gingival sulcus of the mandibular left first molar for approximately 5 minutes. After gingival retraction, measurement was taken with a digital caliper. Post retraction measurement was repeated and distance from Mesio-buccal cusp of mandibular right first molar to the gingival margin using digital caliper. Impression was made with putty wash technique using sectional tray for both right and left side separately. The impressions poured and the casts were trimmed [Figure11]. They were grouped for evaluation. For every group, pre- and post-retraction width in samples was measured with digital caliper. The difference between the pre- and post-retraction width of the individual groups was the amount of retraction achieved by the retraction procedure. This was calculated for all the samples. The values were tabulated and subjected to statistical analysis using SPSS statistical package which version 21. A paired t' test was performed to determine whether there was a significant difference in amount of vertical gingival retraction between paste retraction technique and medicated retraction cord technique. Inter group comparison was done using Mann-Whitney test and Wilcoxon signed rank test was used to assess the significance. In all above tests P value less than 0.05 was taken to be statistically significant.

3. RESULTS

The present study was conducted with the purpose of analyzing the clinical efficacy of two commercially available gingival retraction systems, i.e., Ultrapak retraction cord and 3M astringent Retraction Paste. The collected data were analyzed using Mann-Whitney test ($p<0.05$) indicates significant difference between the variables. Data were analyzed for pre-operative and post-operative gingival retraction. With regard to clinician's perception on both techniques used, patients were more comfortable with Gingifoam against gingival retraction cord with significance observed by observers 1, 3 and 4 ($P<0.05$). However, observer 2 did not find any significant differences ($P>0.05$) in the comfort factors of both techniques Additionally, with regard to bleeding, Gingifoam technique was significantly better than gingival retraction cord as observed by observer 2 and 3($p<0.05$) whereas observer 1 and 4 did not find any significant differences between both techniques ($p>0.05$). Gingifoam had significantly better retraction ability compared to retraction cord as observed by observer 1, 3 and 4 ($p<0.05$) whereas no significant difference was observed by observer 2($p>0.05$). Gingifoam was significantly less time consuming compared to retraction cord as reported by observer 1 and 4 ($P<0.05$) and no significant differences between the 2 was reported by observer 3and 4($P>0.05$).Overall, observer 1, 3 and 4 significantly preferred Gingifoam over retraction cord ($p<0.001$) whereas observer 2 reported no significant differences between the 2. ($p>0.05$). With regard to patient perceptions, there were no significant differences between the 2 techniques with respect to patient comfort, pain during the procedures, irritation during or after the procedure and bad taste ($P>0.05$). However, with regard to time taken, patients felt that Gingifoam was significantly less time consuming than retraction cord. ($p<0.05$) There were no significant differences in the pre-operative clinical measurement of the gingiva and the measurement on the cast in both the techniques. ($P>0.05$) (Table 1&2). Additionally, there were also no significant differences in the gingiva after retraction clinically and on the cast with both techniques ($p>0.05$) (Table 3 &4).There were no significant differences in the gingiva preoperatively and postoperatively when the Gingifoam technique was used ($p>0.05$). However, there were significant changes observed on the cast with the technique ($p<0.05$) (Table 5&6). Similarly, significant differences were observed in the gingiva clinically and on the cast, preoperatively and postoperatively when the retraction cord was used, ($p<0.05$) (Table 7&8).

Table 1: Comparison of the preoperative measurement of gingiva between the groups using Mann-Whitney test

	N	Minimum	Maximum	Mean	Std. Deviation	Median	Mean diff	P value
Gingifoam	14	6.10	7.70	6.83	.449	6.85	0.142	0.729
Retraction cord	14	4.90	7.80	6.69	.779	6.80		

Table 2: Comparison of the preoperative impression and measurement over the cast between the groups using Mann-Whitney test

	N	Minimum	Maximum	Mean	Std. Deviation	Median	Mean diff	P value
Gingifoam	14	5.9	7.8	6.771	.5121	6.8	0.028	0.85
Retraction cord	14	5.0	7.8	6.743	.7703	6.85		

Table 3: Comparison of the gingiva after retraction between the groups using Mann-Whitney test

	N	Minimum	Maximum	Mean	Std. Deviation	Median	Mean diff	P value
Gingifoam	14	6.3	7.9	6.907	.4649	6.9	0.042	0.94
Retraction cord	14	5.2	7.8	6.864	.7023	6.85		

Table 4: Comparison of the gingiva after retraction in cast between the groups using Mann-Whitney test

	N	Minimum	Maximum	Mean	Std. Deviation	Median	Mean diff	P value
Gingifoam	14	6.1	7.7	6.986	.4833	7.05	0.014	0.83
Retraction cord	14	5.3	7.9	6.971	.7447	7.05		

Table 5: Comparison of the measurement of gingiva within the Gingifoam group using Wilcoxon sign test

	N	Minimum	Maximum	Mean	Std. Deviation	Median	Mean diff	P value
PRE	14	6.10	7.70	6.83	.449	6.85	-0.07	0.11
AFTER	14	6.3	7.9	6.90	.4649	6.9		

Table 6: Comparison of the measurement of gingiva within the Gingifoam group in cast using Wilcoxon sign test

	N	Minimum	Maximum	Mean	Std. Deviation	Median	Mean diff	P value
PRE	14	5.9	7.8	6.771	.5121	6.8	-0.21	0.033*
AFTER	14	6.1	7.7	6.986	.4833	7.05		

significant

Table 7: Comparison of the measurement of gingiva within the retraction cord group using Wilcoxon sign test

	N	Minimum	Maximum	Mean	Std. Deviation	Median	Mean diff	P value
PRE	14	4.90	7.80	6.69	.779	6.80	-0.17	0.05
AFTER	14	5.2	7.8	6.86	.7023	6.85		

Table 8: Comparison of the measurement of gingiva within the retraction cord group in cast using Wilcoxon sign test

	N	Minimum	Maximum	Mean	Std. Deviation	Median	Mean diff	P value
PRE	14	5.0	7.8	6.743	.7703	6.85	-0.22	0.018*
AFTER	14	5.3	7.9	6.971	.7447	7.05		

significant

Photograph 1 Digital caliper

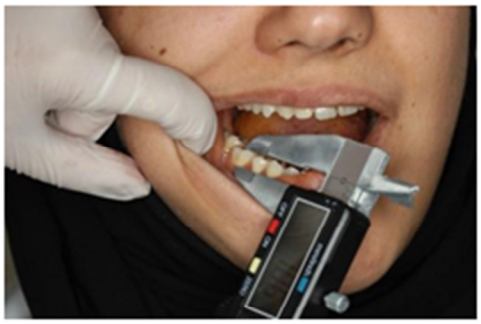
Photograph 2: Retraction paste

Photograph 3: Retraction cord

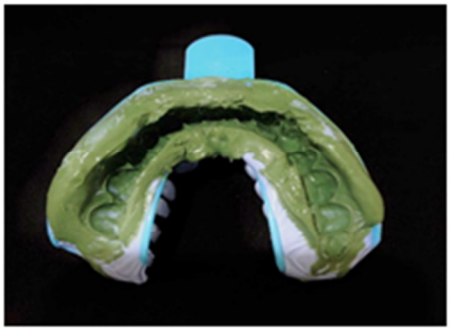
Photograph 4: Hemostat

Photograph 5: Putty Rubber base

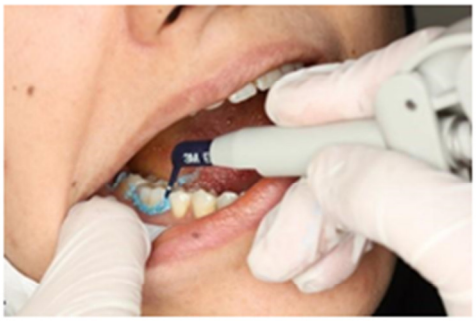
Photograph 6: Light body Impression material



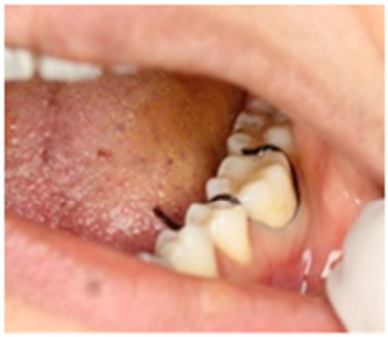
Photograph 7: Preoperative measurement



Photograph 8: Primary



Photograph 9: Gingival retraction



Photograph 10: Gingival retraction

Fig1 1: Post retraction impressions and casts.

4. DISCUSSION

A young age range group (20-30 years) was studied and the teeth included were mandibular first molars, which eliminated age/gender influence and ensured little variation in gingival thickness.[1]This allowed using the same size cord in all subjects (size one) to minimize differences among the groups. The use of retraction cords as a mechanical or chemo-mechanical technique is well established in practice due to their relative predictability, effectiveness, and safety. However, the use of retraction cord can be laborious, time-consuming, can cause gingival bleeding, uncomfortable for patients in the absence of anesthesia, and when inappropriately manipulated, can lead to direct injury and gingival recession.[15] Impregnated retraction cords are gently forced into the gingival sulcus, using a cord packing instrument, to displace the gingiva laterally from the tooth. The study used single cord technique. The cord is left there for at least 5 minutes as they have been reported to cause necrosis of the crevicular epithelium when placed longer than 10min.[26]The retraction cord achieves the desired retraction, but placing a retraction cord is not an easy method.[14]It needs physical manipulation of the tissue, leading to gingival bleeding. Placement of retraction cords can cause injury to the sulcular epithelium and underlying connective tissues.[27]Several researchers tried to investigate the reason for fixed prosthesis failure, and their length of service and analyzed the life span of restorations as well as causes of failure of unserviceable fixed prosthesis. They defined unserviceable FP as "any crown or fixed partial denture that required either repair or replacement". They found that the caries accounted for the largest number of failures. Walton TR concluded that caries was the common cause of failure.[28] Furthermore, study by Amina Khiari supports the same conclusion.[29] Expasyl uses 15 percent aluminum chloride in a kaolin matrix. It opens the sulcus, providing significant retraction. Homeostasis was controlled by the Aluminum chloride present in the Expasyl. Furthermore, its effectiveness in reducing the flow of sulcular exudate is similar to that of epinephrine-soaked cords. It also is safe, with the results of one study showing no reports of adverse effects.[30] Patient did not have any problems performing gingival retraction with Expasyl and all the patients were comfortable. According to Phatale ET al[31] the retraction procedure with the newly advanced material in the form of retraction pastes like Expasyl or Magic Foam Cord appears very safe and easy to use. Homeostasis was controlled by the little pressure applied on the gingiva in the Magic Foam group. Histologically, they were found to be better than the cord, with respect to the periodontium. The patient tolerance was observed to be very good. No anesthesia was required and the material exhibited total biocompatibility. Kazemi et al[15]also supported the evidence that gingival inflammation is less with the retraction paste. Yang et al. reported no significant difference in achieving gingival deflection, but reported that the use of cord appeared to be more painful and produced more gingival recession than the cordless techniques. This is in accordance with the results of our study. According to Beier et al., the pastes are a less traumatic alternative method of gingival retraction. Cranham et al also advocate displacement paste over cord. These pastes are also advocated around cement-retained implant prostheses. They are also preferred when taking a digital impression for CAD/CAM prostheses since the artefacts caused by retraction cord fibers can be avoided. The high cost of retraction pastes, commercially available with or without hemostatic agents, has also prevented them from becoming a mainstream commodity.[32]Each type of retraction appears to possess desirable characteristics. It is imperative to match positive characteristics to a particular challenge presented by each unique patient, clinical condition, and specific abutment. All the measurements in the study were made by a single operator to avoid inter-operator variability.[33] Baharav *et al.* conducted a study to evaluate the ideal time required to achieve gingival retraction. The cord was left in the sulcus for 2, 4, 6, and 8 min. The authors observed that there was no difference in the gingival retraction done for 4, 6, and 8 min. They concluded that cord should remain in the gingival crevice for an optimum time of 4 min prior to impression making.[34]Laufer *et al.* checked the time required for closure of the gingival crevice following gingival retraction. Chemo mechanical retraction method was advocated for the displacement of the gingival crevice. The closure rate at the transitional line angle area was significantly faster than that of the mid-buccal area during the first 90 s. Hence, the impression was to be made immediately after retraction procedure[35] In this present in vivo study, new parameters were used i.e. patient opinion and observer's opinion. The opinions of four observers about gingival retraction for each patient, regarding each step was noted. Displacement cord technique is the most commonly used method. Non impregnated and impregnated cords are available.[22]In this present study, it was observed that patients were more comfortable with retraction paste than retraction cord. Weir and Williams demonstrated that non impregnated cords were less suitable for a hemostatic

purpose than those impregnated with aluminum sulfate and epinephrine. Runyan et al.[36]reported that soaking the cord in an aluminum chloride solution before placing it in the gingival sulcus provides hemostasis but does not lessen the cord's ability to absorb crevicular fluid. Hence, in this study, 10% aluminum chloride hemostatic agent was used. De Camargo et al.[37]in 1993 observed that hemostatic solutions absorbed by retraction cords did not alter the polymerization and accuracy of impression materials. O'Mahony[38] recommended careful removal of all traces of medicaments from the gingival sulcus before making the impression with vinyl polysiloxane.

5. CONCLUSION

Within the limitations of the study, both the retraction techniques showed adequate gingival retraction for the prosthesis and clinically insignificant differences were seen in both system and regarding the retraction achieved, retraction paste found to be easy for the control of hemorrhage and easy for placement and recommended to use where there is uncontrolled bleeding and sub-gingival finish lines of the tooth preparations. However, the amount of vertical gingival retraction observed with paste retraction system was significantly less than the medicated retraction cord system. Patients were more comfortable with retraction paste than retraction cord. Judicious clinical judgment & skill of the operator are the deciding factors for the selection of any one of the various methods of soft-tissue management.

6. LIMITATIONS IN THIS STUDY

1. Since, this is a pilot study, sample size was small and further studies with large sample size is recommended.
2. The influence thickness of gingiva plays vital role with gingival retraction study, especially for using retraction cord.
3. For this study digital caliper was used to measure the distanced and computerized measuring technique might give better result.

7. AUTHORS CONTRIBUTION STATEMENT

Dr. Karunakar Shetty conceptualized the study, formulated the study design with regard to this work and was also the principal investigator and primary author of the manuscript. He also analyzed the collected data and coordinated with the statistician for the analysis of the data. Alghaydaa, Maha Khalil, Sarah Muteb, Razan Yosif gathered the data, helped in analysis of these data and necessary inputs are given towards the designing of manuscript. All authors discussed the methodology and results and contributed to the final manuscript.

8. CONFLICT OF INTEREST

Conflict of interest declared none.

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