Research Article

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In Vivo Evaluation of Three Gingival Displacement Materials on Gingival Sulcus Width

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ABSTRACT

Aim: The aim of the study is to evaluate the clinical efficacy, ease of use, retraction time of three gingival retraction materials namely Magic foam gingival retraction material, ultrapak cord and stayput cord.

Methods and Material: The study has involved 20 partially edentulous patients who require full veneer crown restorations for premolar. Amount of horizontal gingival retraction obtained is to be measured at three line angles, indirectly from impression of the gingival sulcus after retraction by using stereomicroscope and image analysis software. Statistical analysis used: One – way ANOVA test, Post hoc test like Bonferroni test.

Results: The obtained values were subjected to one way ANOVA test and Post hoc test. With regard to gingival displacement all the three materials achieved similar results and were statistically insignificant but time of placement and comfort are better for magic foam cord compared to other materials.

Conclusions: The three test agents employed in this study achieved adequate horizontal gingival displacement. Magic foam cord ranks better among the test agents when minimal haemorrhage and time required for gingival retraction is considered.

Keywords: Magic Foam Retraction Cord, Ultrapak Retraction Cord, Stayput Retraction Cord, Elastomeric impression material, Putty Index.

INTRODUCTION

The success of fixed prosthodontic restorations is largely dependent upon long term health and stability of surrounding periodontal structures. The gingival tissues must be displaced to allow enough impression materials to be injected into expanded gingival crevice. Elastomeric impression materials by themselves do not initiate displacement of the gingival tissues and the impression shall not reproduce the subgingival area unless a visible space exists between the gingiva and the tooth.[1] Several clinical methods are available for adequate retraction, including mechanical retraction, mechanico-chemical retraction, electro surgery, and rotary gingival curettage. Physically displacing the gingiva was one of the first methods used for insuring adequate reproduction of the preparation finish line. Non medicated cords placed in the gingival sulcus are safe but have limited effect in controlling hemorrhage.[2, 3] Various studies have been done on gingival retraction methods like retraction cord, electrosurgery, and rotary gingival curettage. Evaluating the clinical efficiency of

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different retraction materials directly is difficult because of lack of appropriate measuring tools. Choice of appropriate gingival retraction system is still a dilemma in the mind of the operator.[4] In the view of above considerations this study was aimed to evaluate efficiency of Magic foam retraction cord (Coltene Whaledent), Stay-put a copper wire reinforced retraction system (Roeke, Coltene Whaledent), a conventional ultrapak retraction cord (Ultradent products, INC.) based on amount of horizontal gingival retraction obtained, that is measured indirectly from the impressions. Time taken for placement and relative ease of placement of retraction cords were also assessed.

MATERIALS AND METHODS

Patients required for this study were selected with the following criteria

PATIENT SELECTION CRITERIA:

1. Twenty patients with age groups among 18 years to 40 years were selected requiring fixed prosthesis.
2. Clinically and radiographically healthy gingiva and periodontium around the abutments
3. Patients maintaining good oral hygiene standards.

EXCLUSION CRITERIA:

Following patients are excluded from study

1. Patients with systemic pathologies
2. Patients with signs of periodontal disease
3. Patients with any other malignancies.

As the study involves clinical procedures on patients ethical committee permission was taken and patients were informed about the entire procedure to be done and consent was taken. Three retraction agents used in the study are Injectable displacement material – Magic foam cord (Coltene/Whaledent), Copperwire reinforcement braided stayput retraction cord (Roeko, Coltene/Whaledent), Knitted Ultrapak retraction cord (Ultradent products, Inc.). Premolars were taken as index teeth for standardisation and patients were classified into 2 groups. The study was designed to cross over a minimum of 60 assessments, with 20 assessments for each test agent.

Impressions for carrier tray

Initially, preliminary impressions of the patient's maxillary and mandibular dentition were made using alginate. On the diagnostic casts the carrier for matrix was fabricated with 2 mm thick spacer between its wall and the teeth. The carrier was fabricated using conventional self cure PMMA (figure 1). The carrier provides 3-4mm of space between its wall and the prepared teeth and 2-3mm between its walls and adjacent unprepared teeth.[5, 6]

Gingival displacement & impression making

The three gingival retraction materials were used on the prepared tooth by following manufacturer instructions. Out of 20 assessments 10 were carried by first placing the ultrapak gingival retraction cord, Magic foam retraction cord followed by stay put retraction cord with a gap of 8 days for complete recovery of gingival tissues, for the rest of 10 it was vice versa. Alteration in the sequence of application among gingival displacement agents were done to obtain an equi-distribution without bias.[6]

Ultrapak retraction cord

The operating area is dried first and isolated with cotton rolls. The cord is drawn from dispenser bottle with sterile cotton pliers, and required amount is cut off. Retraction cord was looped around the tooth and gently pushed into the sulcus with the gingival cord packer instrument (figure 2). Retraction cord was removed after keeping for 10 min in the gingival sulcus. Then impressions were made with carrier tray.

MAGIC FOAM RETRACTION SYSTEM:

Magic foam cord (Coltene/Whaledent) is the first expanding polyvinyl siloxane material. Magic foam is syringed around the preparation margin with auto mixing gun. Pre-fitted Comprecap was placed over tooth and patient is asked to bite on it (figure 3). Due to counter pressure of the Comprecap, the expansion of the magic foam occurs in the gingival sulcus. The Comprecap is comfortably held in place by the patient's antagonist for a minimum of 5 minutes. After proper setting, the Comprecap and magic foam cords are removed in one piece and then impression was made.[7]

STAYPUT RETRACTION CORD

Fig 1: Carrier with spacer for impression.

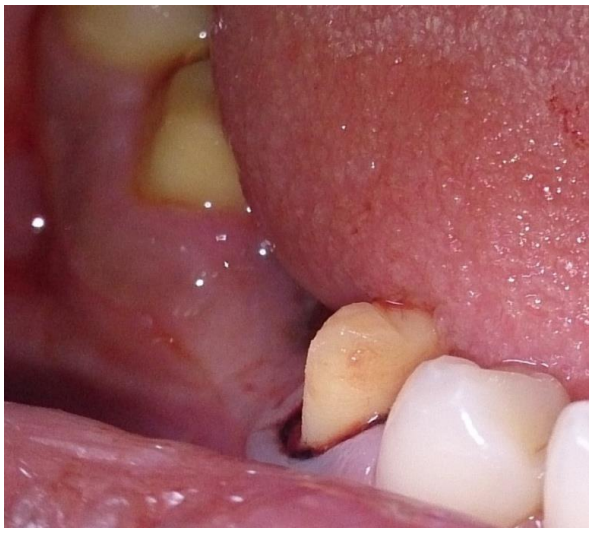

Fig 2: Ultrapak retraction cord in gingival sulcus.

Fig 3: Patient biting on Comprecap with magic foam retraction cord.

Fig 4: Stay put cord in gingival sulcus.

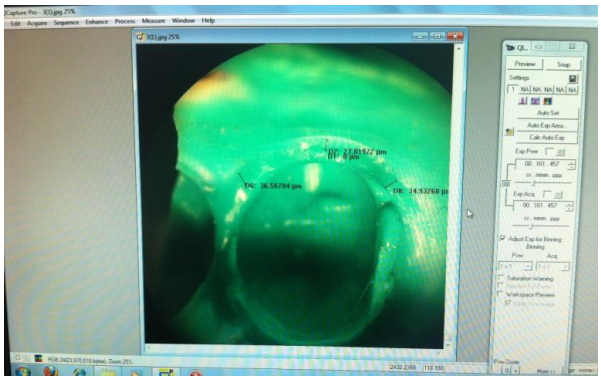

Fig 5: Analysing specimen in image analysis software.

Stay put is a unique combination of softly braided retraction cord and an ultra fine copper filament bounded with nylon. Stayput is cut for required length corresponding to circumference of the prepared tooth. Cord was placed at the center of the tooth and then work out towards the ends of the cords, packing into sulcus (figure 4). The cord is left for at least 5 minutes in the sulcus. Then cord is removed directly before impression making

After retraction impressions were made with Vinyl polysiloxane elastomer (DENTSPLY) after removing the spacer from carrier tray. Once, the impressions were made they were disinfected with glutaraldehyde solution.

Table 1: Mean horizontal displacement obtained with three gingival retraction materials (in mm).

SNo	ULTRA PAK			MAGIC FOAM			STAY PUT		
	MB	Z	DB	MB	Z	DB	MB	Z	DB
1	0.0909	0.0808	0.0684	0.0958	0.0601	0.0607	0.0946	0.0660	0.0608
2	0.0894	0.0960	0.0810	0.0812	0.0933	0.0707	0.0784	0.1021	0.0709
3	0.1726	0.1714	0.0888	0.1804	0.1756	0.0965	0.1703	0.1694	0.0926
4	0.2116	0.2361	0.1670	0.2094	0.2572	0.1245	0.2001	0.2404	0.1828
5	0.2056	0.2872	0.0912	0.1998	0.2652	0.0898	0.2094	0.2920	0.0946
6	0.1023	0.0998	0.0832	0.0972	0.0988	0.0812	0.1107	0.1020	0.0947
7	0.2010	0.2462	0.1198	0.1196	0.2102	0.1040	0.2019	0.2512	0.1214
8	0.1148	0.1798	0.1498	0.1240	0.1841	0.1698	0.1218	0.1894	0.1547
9	0.2098	0.2014	0.2056	0.2019	0.2042	0.2071	0.2089	0.2056	0.2068
10	0.0742	0.0914	0.0798	0.0842	0.0898	0.0741	0.0862	0.0927	0.0843
11	0.0841	0.0898	0.0814	0.0851	0.0841	0.0867	0.0891	0.0898	0.0891
12	0.1198	0.1498	0.1047	0.1080	0.1321	0.1121	0.1241	0.1561	0.1234
13	0.2412	0.2341	0.2467	0.2342	0.2247	0.2124	0.2467	0.2412	0.2042
14	0.2594	0.3124	0.2648	0.2414	0.2997	0.2541	0.2457	0.3010	0.2668
15	0.1148	0.1341	0.1007	0.1247	0.1398	0.1114	0.1167	0.1401	0.1209
16	0.1467	0.1561	0.1412	0.1407	0.1498	0.1418	0.1472	0.1567	0.1468
17	0.0978	0.0871	0.0641	0.0812	0.0798	0.0468	0.0898	0.0901	0.0571
18	0.0746	0.0860	0.0808	0.0894	0.0860	0.0810	0.0812	0.0733	0.0707
19	0.0784	0.1020	0.1093	0.0698	0.0978	0.0998	0.0892	0.1123	0.1012
20	0.1728	0.1734	0.1308	0.1584	0.1560	0.1224	0.1658	0.1749	0.1148
MEAN	0.143	0.161	0.123	0.136	0.154	0.117	0.136	0.162	0.123
	0.142			0.136			0.140		
S.D	0.060			0.056			0.059		

MB – Mesio buccal, Z – Zenith(mid buccal), DB – Disto buccal

Table 2: Mean and standard deviation values for difference in horizontal displacement.

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
ULTRA PAK	60	0.142	0.065	0.008	0.126	0.159	0.064	0.312
MAGIC FOAM	60	0.136	0.062	0.008	0.120	0.152	0.047	0.300
STAY PUT	60	0.143	0.064	0.008	0.127	0.159	0.057	0.301
Total	180	0.140	0.063	0.005	0.131	0.150	0.047	0.312

Table 3: Summary of ANOVA tests among three gingival retraction materials.

	Sum of Squares	df	Mean Square	F	Significance
Between Groups	0.002	2	0.001	0.221	0.802
Within Groups	0.711	177	0.004		
Total	0.712	179			

Table 4: Multiple comparison of retraction materials using Bonferroni test.

(I) VARIABLES	(J) VARIABLES	Mean Difference (I-J)	Standard Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
ULTRA PAK	MAGIC FOAM	0.00624	0.011688	1	-0.02201	0.03449
	STAY PUT	0.00177	0.011688	1	-0.02648	0.03002
MAGIC FOAM	ULTRA PAK	-0.00624	0.011688	1	-0.03449	0.02201
	STAY PUT	-0.00446	0.011688	1	-0.03271	0.02379
STAY PUT	ULTRA PAK	-0.00177	0.011688	1	-0.03002	0.02648
	MAGIC FOAM	0.00446	0.011688	1	-0.02379	0.03271

Table 5: Multiple comparison of gingival displacement at different line angles using Bonferroni test.

(I) GROUPS	(J) GROUPS	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
MB	Z	-0.02061	0.011342	0.213	-0.04803	0.0068
	DB	0.01747	0.011342	0.376	-0.00994	0.04488
Z	MB	0.02061	0.011342	0.213	-0.0068	0.04803
	DB	.03808(*)	0.011342	0.003	0.01067	0.06549
DB	MB	-0.01747	0.011342	0.376	-0.04488	0.00994
	Z	-.03808(*)	0.011342	0.003	-0.06549	-0.01067

Table 6: Mean time taken for placement of retraction materials (seconds).

	MAGIC FOAM	STAY PUT	ULTRA PAK
MEAN	64.497	324.771	418.871
S.D	3.094	14.322	14.508

MEASUREMENTS:

The horizontal sulcular width was measured indirectly using elastomeric impression of the prepared abutment, made after retraction. The width of sulcular extension was determined by using stereomicroscope with 10X resolution and measurements were done using image analysis software (Image-Pro Express; Media Cybernetics, Silver Spring) with accuracy of 1/10th of a micron. Sulcular widths were measured at the mesio-buccal, mid-buccal, disto-buccal line angle regions. The image analysis measurements were in micrometer scale that was later converted into millimetre grading (figure 5). This was repeated for all the samples.[8]

TIME TAKEN FOR CORD PLACEMENT:

Following tooth preparation of the abutments the application time of each retraction system was noted using a stop watch.

RESULTS

The measurements were done after the horizontal displacement of the gingival sulcus. The width of the gingival sulcus was measured from the impression of the respective tooth at the mesio buccal, mid buccal, disto buccal line angles using stereomicroscope. The results of the clinical study were tabulated (table 1).

For all the analysis, a p value of < 0.05 was considered to be statistically significant. Data was subjected to following tests-

- One – way ANOVA test

- Post hoc test like Bonferroni test.

All the descriptive data are presented as mean and standard deviation. The mean value of the displaced sulcus width by three agents employed in the study is within the range of adequate requirement (Table 2, 3). One way ANOVA technique was used for multiple group comparison followed by post hoc tests (Table 4). The statistical analysis ($P<0.001$) for the mean time taken to place gingival retraction cord resulted in statistically significant differences among three gingival retraction materials (Table 6)

DISCUSSION

Effective gingival retraction before making impression without damaging periodontal tissues is very important in the long term success of cast restorations. Poor marginal fit is the major cause of failure in cast restorations usually results from incomplete marginal detail in the impression.[9]

Gingival retraction is especially critical when using hydrophobic impression materials that do not displace gingival tissues. A 0.2 – 0.4 mm horizontal displacement of the marginal gingiva provides enough space for adequate bulk of impression material at the apical aspect under the finish line. Various methods and techniques have been described in the literature to adequately achieve exposure of the finish line and create an acceptable environment for impression materials. These have been classified as mechanical, chemical, surgical, and a combination of three. Plain or chemically impregnated cord has been widely used to achieve displacement of the gingival tissues and to control haemorrhage or gingival fluid seepage. Use of these materials has the disadvantage of taking considerable time to soak the cord in the haemostatic solution, to insert and necessarily have to wait for the haemostasis and tissue displacement. Retraction cords are supplied in three basic designs, including twisted cords, knitted cords, and braided cords. There is little scientific evidence to differentiate one type of cord from another; thus, the selection of which design of cord to use is determined by operator preference. Asbjorn jokstad (1999) conducted a study and found that Knitted cords were ranked well than twined cords. Cords containing epinephrine performed no better clinically than aluminum sulfate cords.[9-12] Ultrapak cord retraction 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 whereas Stay-put retraction cord combines the advantages of a braided retraction cord with the adaptability of a fine metal filament. The pliable core is so effective that the cord is not only easy to place in the sulcus but it stays there. Magic foam cord (Coltene Whaledent AG, Switzerland) is an expanding polyvinyl siloxane material designed for easy and fast retraction of sulcus without the problems of trauma and time consumption during packing of retraction cord.

So in the present study Ultrapak cord, Stay-put retraction cord and Magic foam cord were used as test agents. The orifice to gingival crevice in the transitional line angle area closed faster than that in the mid buccal area, because of greater density of collagen fibers in the transitional line angle area. This may be the cause of the high frequency of defects commonly observed in the interproximal areas of impressions. So in the present study three regions that are mesio – buccal, mid buccal, disto – buccal line angle areas are considered for evaluating gingival retraction.

According to Baharav H et al., (1997) when gingival retraction with cord is limited to 10 minutes duration there is no gingival injury; however, if cord is left in place for 30 minutes, the sulcular epithelium is damaged. This damage is repaired within 10 days. A clinical and histopathologic evaluation of gingival retraction in humans showed that gingival retraction with cord caused destruction of the junctional epithelium, which required about 8 days to heal. Therefore in the present study, ultrapak retraction cord was left in the sulcus for a period of 10 minutes, for stayput it was 5 minutes and Magic foam cord, it was 5 minutes as per manufacturer's instructions.[13] Additional polyvinyl siloxanes are considered the most dimensionally stable impression materials. They have the best elastic properties, the recovery of strain being said to be almost instantaneous and they have adequate tear resistance. Hence light bodied polyvinyl siloxane was used in the present study. [14, 15] Based on the results the following inferences can be drawn, the amount of horizontal gingival retraction obtained with the use of magic

foam cord, ultrapak retraction and stayput retraction cords were almost similar. Time taken for placement of magic foam cord is significantly less compared to time taken for placement of ultrapak and stayput retraction cords. The haemorrhage control with the magic foam cord is better compared to ultrapak and stayput retraction systems. There were some limitations of the study, Influence of distendability of gingiva, gingival thickness, and varied sulcular depth on gingival sulcus was not considered, Amount of haemorrhage was not considered in the study, Single retraction cord technique was followed while using stayput and ultrapak in all the cases, other retraction cord techniques such as double cord technique were not considered.

There is need for further studies to investigate the influence of distendability, gingival thickness, and varied sulcular depth on gingival sulcus. From the results it was found that magic foam cord is effective as it attained similar retraction compared with other test agents with minimal time required for placement and minimal bleeding on removal. However, selecting a retraction agent still depends on clinical scenario and operator's preference.

CONCLUSION

Within the limitations of the study following conclusions can be drawn:

1. All the three test agents employed in this study achieved adequate horizontal gingival displacement.
2. Statistical analysis showed statistically insignificant difference (P>0.001) for mean horizontal gingival displacement for three test agents. Thus horizontal gingival displacements obtained by test agents are almost nearly equal.
3. Time taken for placement of magic foam cord is significantly less compared to ultrapak cord and stayput cord.
4. Haemorrhage control with magic foam cord is better than ultrapak cord and stayput cord.
5. Magic foam cord can be considered more effective among the three retraction systems used in this study, as it has taken less time and was easier in placement, attained good amount of retraction and induced minimal bleeding on removal compared to ultrapak and stay-put retraction cords.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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