Quality of Impressions After Use of the Magic FoamCord Gingival Retraction System—A Clinical Study of 269 Abutment Teeth

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Purpose: The aim of this study was to evaluate a new gingival retraction system relative to clinical success for fixed dental restorations under various clinical conditions. ***Materials and Methods:*** Two hundred sixty-nine abutment teeth were evaluated. The ability to displace gingiva was indirectly measured by the quality of the final impression. Preparation finish line with respect to the crest of the marginal gingiva (Level I through III) and type of preparation finish line (ie, shoulder or beveled) were recorded. The reproduction of the preparation finish line and an absence of bubbles or voids (Criteria I through III) were assesed. The results were compared with an established retraction system using one retraction cord. ***Results:*** Of the 269 impressions evaluated, 93.7% were clinically acceptable and showed complete reproduction of the preparation finish line; 17.5% showed small defects but the impressions were still rated clinically acceptable and categorized as Criteria II. Only 6.3% of the impressions were unacceptable and categorized as Criteria III. A significant influence on the quality of the impressions was found when the preparation finish line was more than 2 mm subgingivally for shoulder ($P < .004$) as well as beveled preparations ($P < .004$). Nearly twice as many impressions were rated Criteria III when using the Magic FoamCord (MFC) system compared to impressions done with the single cord retraction technique. ***Conclusions:*** In cases of epigingival and subgingival (< 2 mm) preparation margins, MFC was a less traumatic alternative method of gingival retraction. However, when there were deep subgingival margins and a beveled preparation, the material was less effective than the single cord retraction technique. *Int J Prosthodont 2009;22:143–147*

Gingiva management is an essential element throughout the entire impression procedure for fixed prosthodontics. While the quality of impression materials and proper impression techniques have reached a high level,[1] tissue displacement is still one of the most difficult procedures for the clinician to perform.[2] Gingiva management comprises the creation of hemostasis and the deflexion of the gingiva. Control of possible hemorrhage is provided by the use of medications either prior to or in conjunction with a retraction method[3] to enable accurate recordings of preparation margins. The classic method for gingival displacement is the mechanochemical method,[4] using retraction cords in addition to hemostatic agents.[5]

The single-cord or double-cord techniques are the most widely accepted methods of gingiva management while taking an impression.[6] With the single-cord technique, the thinnest cord that adequately retracts tissue is placed in the sulcus and removed just before impression taking. The double-cord technique uses two cords of differing thicknesses. They are packed successively, with the first thin cord remaining in place while the impression is taken. Both techniques can traumatize the delicate epithelial lining[3] and may lead to an average postoperative gingival recession of 0.2 ± 0.1 mm.[7] Nevertheless, retraction cords offer a familiar and inexpensive retraction method. Plain cotton cords show poor gingiva displacement when compared to chemically impregnated cords.[3]

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Table 1 Number of Prepared Teeth According to Tooth Position

No. of prepared teeth	0	12	17	18	16	9	9	10	9	13	10	10	10	12	8	0	163
Maxilla	18	17	16	15	14	13	12	11	21	22	23	24	25	26	27	28	Total
Mandible	48	47	46	45	44	43	42	41	31	32	33	34	35	36	37	38	Total
No. of prepared teeth	1	12	13	13	6	4	3	2	3	3	3	9	12	11	9	2	106

In addition to the classic method, polymers and pastes have been introduced as means of noncord retraction techniques. The polymer retraction material Merocel (Merocel) is a synthetic material (hydroxylate polyvinyl acetate) that creates a netlike strip and is very effective for the absorption of intraoral fluids such as blood, saliva, and crevicular fluid.[8] This technique shows good results but is very time consuming.[9] The use of a gingival retraction paste (Expasyl, Kerr Dental) also combines gingiva displacement (Kaolin) and hemostasis (15% aluminum chloride).[10] Its application is limited once the finish line is subgingival, but it is painless, quick, and harmless to the gingiva.[11,12]

A new silicone polymer retraction material, Magic FoamCord (MFC) (Coltène/Whaledent), was recently proposed for dentistry to gain access to the preparation finish line without the potentially traumatic and time-consuming packing of a retraction cord. It is an expanding two-component polyvinyl siloxane rubber addition without a hemostatic agent. During setting, reaction of the MFC polyvinyl siloxane, an enforced side reaction, generates hydrogen gas. The released hydrogen gas creates bubbles and forms the setting material into a sponge-like texture.[13] The material has to be syringed around the preparation margins of the abutment teeth and maintained under pressure before impression taking.

The purpose of the present study was to evaluate the MFC system relative to clinical success and to compare the results with a previous study that used one retraction cord technique under various clinical conditions.

Materials and Methods

A total of 50 patients were included in this prospective clinical study. All patients were recruited through the Department of Prosthetic and Restorative Dentistry, Innsbruck Medical University, Austria. The patients required various types of indirect fixed restorations in anterior and posterior teeth. As part of preliminary treatment, all patients took part in the dental hygiene program available at the clinic. Prior to preparation, all teeth had to be free of active periodontal inflammation and have probing depths less than 3 mm and no bleeding on probing. If patients met these selection criteria, they were randomly divided into groups for dental treatment by five experienced dental clinicians from the department to achieve the best clinical results.[14] During this investigation period, gingival retraction was performed using the MFC retraction system in all cases.

A total of 269 preparations for fixed restorations (106 mandibular, 163 maxillary; 78 anterior, 191 posterior) were performed according to the accepted universal guidelines for tooth preparation (Table 1).[15] The mean number of preparations per patient was 5.38 (range: 1 to 31, median: 2.5) and was evaluated in this investigation. The study included veneer, inlay, onlay, and crown preparations for gold, porcelain-fused-to-metal, and all-ceramic restorations. Clinicians used their clinical skills to decide which type of preparation was needed in each individual case. The type of preparation and position of the teeth were recorded. A distinction was made between shoulder and beveled preparations. A beveled preparation was used for gold and porcelain-fused-to-metal restorations. Adhesive restorations were done using the shoulder preparation method.

The position of the preparation finish line was measured with a periodontal probe with respect to the crest of the marginal gingiva and recorded using the following classification:

- Level I: Epigingival preparation finish line
- Level II: ≤ 2 mm subgingival preparation finish line
- Level III: Deep preparation finish line (> 2 mm subgingival)

Abutment teeth with supragingival preparation margins and implants were excluded from this study because no opening of the gingival sulcus was necessary for impression taking.

MFC is a nonhemostatic system. If hemostasis was necessary, it was performed using solutions containing aluminum chlorate (Orbat, lege artis) or a ferric-sulphide–based hemostatic solution (ViscoStat, Ultradent Products). The retraction process of the gingiva began once hemostasis was achieved (Fig 1). There were two different techniques for using the MFC depending on the number of abutment teeth. The comprecap technique was used for single abutment

Fig 1 Original situation prior to retraction.

Fig 2 A comprecap used to maintain pressure on the applied Magic FoamCord.

teeth and the putty-impression technique was used when there were several abutment teeth. The material was syringed around the preparation margins and a comprecap or impression tray filled with putty was placed over the material to obtain and maintain pressure for 5 minutes (Fig 2). After the material was removed, the open sulcus was dried (Fig 3).

The impression making followed a standardized protocol.[16] A one-step double-phase impression technique was utilized.[17] A heavy and light body material (Affinis, Coltène/Whaledent) were mixed simultaneously using automixing systems. After the light body material was applied on the abutment teeth, the individual tray filled with the heavy body material was placed in the mouth. Light finger pressure was used to stabilize the impression tray. The manufacturer's recommendations on working and polymerization times were strictly followed.

The quality evaluation of the impression, by means of visual inspection, was made by one experienced dental clinician who was not included in the preparation of the teeth and the laboratory technician responsible for the prosthodontic restoration. The impression was investigated using a laboratory microscope (OPMI pico, Zeiss) and lenses with 2 to 6 times magnification. The presence or absence of bubbles or voids and the complete reproduction of the preparation finish line were examined. Bubbles were defined as globular or half-globular spaces caused by air entrapments in the impression material. Irregular defects with a glossy surface appearing in the impression material were classified as voids.

Three possible categories were established. Perfect impressions with the absence of any voids or bubbles and a perfect reproduction of the preparation finish line were categorized as Criteria I. Minimal defects up to 2 mm in diameter in the impression, not involving the preparation finish line, that could be corrected by the technician were rated acceptable and were categorized as Criteria II. If the preparation finish line was not reproduced or impressions showed larger voids, bubbles (more than 2 mm in diameter), and defects involving the preparation finish line, they were rated unacceptable and categorized as Criteria III.[16]

Fig 3 Opened sulcus with access to the prepared margin.

After all impressions were categorized, the results were compared with the quality of impressions done after the use of the single retraction cord technique, evaluated in a former clinical study.[16] The design of that impression study (clinicians, investigators, conditions, categories, and materials) was the same as in this study except for the gingival retraction method. In that study, gingival retraction was completed with the single retraction cord technique in all cases. To make a comparison of both studies possible, the supragingival preparation margins (n = 297) were excluded from the 1,466 preparations in the former study because no retraction was necessary in those cases.

Table 2 Comparison of Classification of Impressions According to Level of Preparation Finish Line

	Level of preparation finish line*							
	I		II		III		Total	
	Single cord (%)	MFC (%)	Single cord (%)	MFC (%)	Single cord (%)	MFC (%)	Single cord (%)	MFC (%)
Criteria I	421 (92.73)	61 (81.3)	493 (86.50)	100 (78.1)	108 (74.48)	44 (66.7)	1,022 (87.43)	205 (76.2)
Criteria II	27 (5.95)	13 (17.3)	52 (9.12)	22 (17.2)	22 (15.17)	12 (18.2)	101 (9.24)	47 (17.5)
Criteria III	6 (1.32)	1 (1.3)	25 (4.39)	6 (4.7)	15 (10.34)	10 (15.2)	46 (3.93)	17 (6.3)
Total	454 (100)	75 (100)	570 (100)	128 (100)	145 (100)	66 (100)	1,169 (100)	269 (100)

*I = epigingival; II = ≤ 2 mm subgingival, III = > 2 mm subgingival.

Table 3 Comparison of Classification of Impressions According to Preparation Margin

	Preparation margin					
	Shoulder preparation		Beveled preparation		Total	
	Single cord (%)	MFC (%)	Single cord (%)	MFC (%)	Single cord (%)	MFC (%)
Criteria I	592 (95.18)	113 (78.5)	430 (84.81)	92 (73.6)	1,022 (87.43)	205 (76.2)
Criteria II	52 (8.36)	24 (16.7)	49 (9.66)	23 (18.4)	101 (9.24)	47 (17.5)
Criteria III	18 (2.83)	7 (4.9)	28 (5.52)	10 (8.0)	46 (3.93)	17 (6.3)
Total	622 (100)	144 (100)	507 (100)	125 (100)	1,169 (100)	269(100)

Statistical Analyses

Data were tabulated using the SPSS program (version 13.0, SPSS) and nonparametric statistical tests, such as the Kruskal-Wallis test, were performed. The level of significance was established at 5%.

Results

Impressions of a total of 269 prepared teeth were examined and evaluated. Of those, 76.2% were rated perfect and categorized as Criteria I; 17.5% showed minimal voids or bubbles, but the impressions were still acceptable and categorized as Criteria II. Only 6.3% of the impressions were unacceptable (Criteria III). Frequency over all of the acceptable and unacceptable final impressions according to the level of preparation finish line are presented in Table 2.

Results according to preparation margin are presented in Table 3. Both categories were compared with the results of the established impression-taking procedure in a former study.[16] The evaluation results of both studies are listed in Tables 2 and 3. The single retraction technique is more successful than the MFC retraction system in all categories for acceptable impressions, but not significantly (Tables 2 and 3). The MFC showed over twice as many unacceptable impressions categorized Criteria III. Seventeen (6.3%) of 269 teeth were categorized Criteria III after use of the MFC compared to 46 (3.93%) of 1,169 using a retraction cord.

The deeper the preparation finish line, the bigger the difference between both retraction systems. The Kruskal-Wallis test revealed significant associations between level of preparation finish line and quality of the final impression ($P < .004$). Also, the beveled preparation showed significantly worse results than the shoulder preparation ($P < .004$). Comparing both retraction systems, the single cord retraction technique performed significantly better if the preparation finish line was > 2 mm subgingival and preparations were beveled.

Discussion

This study was designed to evaluate the clinical success of the expanding polyvinyl siloxane MFC retraction material. The ability to displace gingiva was indirectly measured by the quality of the final impression. Quality and clinical success were investigated by the complete reproduction of the preparation finish line and the presence or absence of bubbles or voids. To improve the clinical procedure, the reason for failure was compared with the level of preparation finish line and type of preparation.

In this clinical investigation, the MFC retraction method proved suitable for retraction of gingival tissue and provided acceptable impressions in 93.7% of the prepared teeth. Only 6.3% of the impressions taken were unacceptable and categorized as Criteria III. In these particular cases, the injured gingiva and blood worsened the quality of the final impression. Bleeding

must be stopped before using the MFC technique in all cases because there is no hemostatic agent included, unlike Merocel[8] and Expasyl.[11] At the outset of the study, decent impression-taking conditions were established since all teeth had be free of active gingival and periodontal inflammation and have probing depths less than 3 mm with no bleeding on probing prior to preparation. A more difficult environment, such as the presence of gingivitis and periodontal inflammation, may have produced different results.[18,19]

The MFC method emphasized the advantage of gentle tissue management because there is no traumatic packing of a retraction cord, but the application is limited to epigingival or subgingival (≤ 2 mm) margins. A significant influence on the quality of impressions was found when the preparation finish line was more than 2 mm subgingival ($P < .004$), as well as for beveled preparations ($P < .004$). The deep subgingival preparation finish line is a critical area and increases the risk of bleeding when the gingival tissue is injured during preparation, especially when doing beveled preparations. In these cases, perfect hemostasis must be established beforehand.

Comparing the two studies, single cord retraction was more sufficient in all categories, especially in cases with a > 2 mm subgingival preparation margin and beveled preparation. In cases with deep subgingival margins and beveled preparations, the combination of cord retraction and hemostases seemed to reduce the risk of impression failure.

The handling of the material with the comprecap and putty techniques was quite easy. There were no complications with the removal and in all cases it came off in one piece. The preimpression with the MFC took 5 minutes and was completed before impression taking. The MFC system was faster than the single cord technique, especially when two or more teeth were involved. No traumatic injury to the gingival tissue was recorded with the MFC procedure.

Conclusions

The use of the MFC method was time saving, but the material was less effective in teeth with deep subgingival margins (> 2 mm) and beveled preparations, compared to the retraction cord technique. If hemostasis was needed, it had to be established prior to impression taking. MFC offers an easy and nontraumatic alternative method of temporary gingival retraction for epigingival and subgingival (< 2 mm) preparation margins.

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References

1. Donovan TE, Chee WW. Current concepts in gingival displacement. Dent Clin North Am 2004;48:433–444.
2. Nemetz H, Donovan T, Landesman H. Exposing the gingival margin: A systematic approach for the control of hemorrhage. J Prosthet Dent 1984;51:647–651.
3. Benson BW, Bomberg TJ, Hatch RA, Hoffman W Jr. Tissue displacement methods in fixed prosthodontics. J Prosthet Dent 1986;55:175–181.
4. Baharav H, Laufer BZ, Langer Y, Cardash HS. The effect of displacement time on gingival crevice width. Int J Prosthodont 1997;10:248–253.
5. Donovan TE, Gandara BK, Nemetz H. Review and survey of medicaments used with gingival retraction cords. J Prosthet Dent 1985;53:525–531.
6. Hansen PA, Tira DE, Barlow J. Current methods of finish-line exposure by practicing prosthodontists. J Prosthodont 1999;8:163–170.
7. Ruel J, Schuessler PJ, Malament K, Mori D. Effect of retraction procedures on the periodontium in humans. J Prosthet Dent 1980;44:508–515.
8. Ferrari M, Cagidiaco MC, Ercoli C. Tissue management with a new gingival retraction material: A preliminary clinical report. J Prosthet Dent 1996;75:242–247.
9. Ferrari M, Nathanson D. Tissue management and retraction technique combined with all-ceramic crowns: Case reports. Pract Periodontics Aesthet Dent 1995;7:87–94.
10. Poss S. An innovative tissue-retraction material. Compend Contin Educ Dent 2002;23:13–17.
11. Shannon A. Expanded clinical uses of a novel tissue-retraction material. Compend Contin Educ Dent 2002;23:3–6.
12. Blanchard J. Neues Verfahren der Sulkusöffnung zur Abformung für festsitzenden Zahnersatz. Die Quintessenz 2001:52.
13. Lampl S, Kollefrath R, Lübbers D. Dentalset sowie Verfahren für die Sulkus-Retraktion. In: Office EP (ed). Patentblatt 2004/39. Switzerland, 2004.
14. Stackhouse JA Jr, Harris WT, Mansour RM, Von Hagen S. A study of bubbles in a rubber elastomer manipulated under clinical conditions. J Prosthet Dent 1987;57:591–596.
15. Shillingburg HT, Hobo S, Whitsett LD. Fundamentals of fixed prosthodontics. In: Shillingburg HT, Hobo S, Whitsett LD (eds). Fundamentals of Fixed Prosthodontics. Chicago: Quintessence, 1997:260–276.
16. Beier US, Grunert I, Kulmer S, Dumfahrt H. Quality of impressions using hydrophilic polyvinyl siloxane in a clinical study of 249 patients. Int J Prosthodont 2007;20:270–274.
17. Chee WW, Donovan TE. Polyvinyl siloxane impression materials: A review of properties and techniques. J Prosthet Dent 1992;68:728–732.
18. Ericsson I, Lindhe J. Recession in sites with inadequate width of the keratinized gingiva. An experimental study in the dog. J Clin Periodontol 1984;11:95–103.
19. Wennström J, Lindhe J. Plaque-induced gingival inflammation in the absence of attached gingiva in dogs. J Clin Periodontol 1983;10:266–276.