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A Comparative Evaluation of Efficacy of Gingival Retraction Using Polyvinyl Siloxane Foam Retraction System, Vinyl Polysiloxane Paste Retraction System, and Copper Wire Reinforced Retraction Cord in Endodontically Treated Teeth: An *in vivo* Study

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Abstract

Purpose of the Study:

The purpose of the study is to evaluate the efficacy of three gingival retraction systems such as polyvinyl siloxane foam retraction system (magic foam cord; Coltene/WhaledentInc), polysiloxane paste retraction system (GingiTrac; Centrix), and aluminum chloride impregnated twisted retraction cord (Stay-Put; Roeko) in endodontically treated teeth.

Materials and Methods:

Patients who were endodontically treated for molars and requiring crown for the same, were selected for the present study with sample size of 45. The 45 participants were divided into three groups. Group 1 was treated with Stay-Put, Group 2 with Magic Foam, and Group 3 with GingiTrac. About 90 elastomeric impressions of the participants were taken—45 impressions before retraction and 45 impressions after retraction. The sulcus width was measured on the die obtained from the elastomeric impressions by placing the dies under OVI-200 optical microscope in combination with X soft imaging system software attached to a computer.

Results:

The study indicated 0.465627 mm ± 0.063066 mm of gingival retraction for aluminum chloride impregnated retraction cord, 0.210993 mm ± 0.067358 mm of gingival retraction for GingiTrac paste, and 0.294147 mm ± 0.056697 mm of gingival retraction for magic foam cord.

Conclusion:

The study data indicated that the new retraction systems are not as effective as the standard retraction cord; however, of the two new systems the Magic Foam system did prove to be effective enough for clinical use. The GingiTrac system failed to achieve the minimum gingival retraction required and hence may not be suitable for clinical use.

Keywords: *GingiTrac*, *gingival displacement*, *magic foam cord*, *optical microscope*, *Stay-Put retraction cord*

Introduction

Indirect restorations, including cast gold inlays, onlays, partial veneer restorations and complete crowns, metal-ceramic and all-ceramic crowns, and bonded ceramic inlays and onlays, are routinely used to restore defective teeth. These restorations frequently have cervical margins that are intentionally placed in the gingival sulcus for aesthetic or functional reasons.[1] In the impression made as part of the restoration process, it is imperative that the finish line is accurately reproduced. If the impression fails to accurately reproduce the finish line, the marginal integrity can be compromised, which can cause recurrent caries and/or gingival inflammation and periodontal breakdown.[2]

To capture the finish line accurately, the gingival tissue needs to be displaced properly. Acceptable criteria for gingival deflection procedures have been described as follows: (1) sufficient (0.22 mm) lateral and vertical space between the gingival finish line and the gingival tissue to allow the margin of the prepared tooth to be recorded in an impression medium without tearing on removal, (2) a small amount of impression material flowing beyond the prepared margin to permit accurate trimming of the recovered die,[3] (3) absolute control of gingival fluid seepage and hemorrhage, especially when elastomeric impression materials are used, (4) prevention of significant irreversible soft- or hard-tissue damage, and (5) prevention of any potentially dangerous systemic effects.[2]

The standard method involves placement of a cord into the gingival sulcus to displace the tissues physically.[4] The labor-intensive and potentially harmful nature of the cord technique have led researchers to develop new chemicomechanical gingival retraction systems such as GingiTrac (Centrix) retraction paste and magic foam cord (Coltene/WhaledentInc).

Magic foam had been developed in a free partnership with Prof. Dr. Dumfahrt and is the first expanding polyvinyl siloxane (PVS) material designed for easy and fast retraction of the sulcus without the potentially traumatic and time-consuming packing of retraction cord.[5] The foam works through the expansion of silicone foam. After the foam's application, a comprecap is used to apply pressure, which causes the expansion of the magic foam cord in the sulcus.[6] Similarly, GingiTrac is a mild natural astringent in gel form of a creamy, easy flowing vinyl polysiloxane-based material. It utilizes patient's bite pressure to push material into sulcus and retract gingiva which makes procedure nontraumatic, quick and more efficient requiring less than 5 minutes of time.[7]

Previous studies have compared various gingival retraction methods such as retraction cord, electrosurgery, and rotary gingival curettage.[3]

However, until now, no studies have been done exclusively to compare the clinical efficacy of Stay-Put cord, magic foam cord, and GingiTrac paste. Furthermore, comparative evaluations of gingival retraction systems are done very rarely because of a lack of a consensus on the evaluation criteria. These circumstances have provided a compelling reason to design and execute the present study.

Materials and Methods

For the objective of this study, 45 patients who had reported to the outpatient department of the Department of Prosthodontics, Manubhai Patel Dental College, Vadodara and after fulfilling the inclusion and exclusion criteria and if they were ready to sign the consent, then they were selected for the study. The inclusion criteria for the study were as follows: age group between 25 and 35, clinically and radiographically healthy gingiva and periodontium around the teeth, properly root canal therapy treated teeth, and maxillary/mandibular 1st molar. Patients were excluded from the study if they had tipped, titled or rotated abutment teeth.

The primary materials for the study were as follows: retraction cord (Stay-Put; Roeko), magic foam cord (Coltene/WhaledentInc), GingiTrac retraction system (GingiTrac; Centrix), impression materials and RAM-Optic Instrument, OVI-200 optical microscope in combination with X soft imaging system software (RAM Instrumentation, Rochester, NY).

The 45 patients were placed into the three groups of the study, each made up of 15 patients. In each of the groups, a preretraction impression was taken so that the preretraction and postretraction measurements could be compared reliably. The tooth preparation for the restored teeth was done following the principles of tooth preparation given by Shillingburg *et al*.[8] A perforated metal tray, addition silicone putty light body (Acquasil, Dentsply) were used to make the impression before retraction and then poured with Type IV dental stone (Ultra rock, Kalabhai Karson Pvt. Ltd.; Mumbai, India) to obtain the final preretraction cast of all the patients in each of the three groups. For the patients in Group 1, a retraction cord impregnated with viscous 20% ferric sulfate was used; for the patients [Figure 1] in Group 2, the magic foam cord was used, and for the patients in Group 3 [Figure 2], the GingiTrac paste was used [Figure 3]. All three of the retraction systems were used as per the manufacturer's instructions provided. After the retractions, impressions were taken using addition silicone (Aquasil, Dentsply) and then poured with Type IV dental stone (Ultra rock, Kalabhai Karson Pvt. Ltd.; Mumbai, India) to obtain the final postretraction cast of all the patients in each of the groups. The cast which were obtained by the die stones were sectioned perpendicular to the coronal plane at the center with the help of mechanical saw.

The sectioned casts were then taken to Sahajanand Medical Technologies Pvt, Ltd., Surat, and then measured by placing the halved sections under the RAM-Optic Instrument, OVI-200 optical microscope in combination with X soft imaging system software for retraction cord [Figure 4], for magic foam [Figure 5], and GingiTrac [Figure 6], respectively.

The results of amount of retraction within each group were compared with the results of other study groups and statistically analyzed. The observations were then subjected to statistical analysis. Mean and standard deviation were calculated and one-way ANOVA test and *post hoc* test for multiple comparisons were applied to statistically analyze the data.

Results

- The mean ± standard deviation of the width of gingival sulcus is 0.465627 mm ± 0.063066 mm for aluminum chloride-impregnated retraction cord, 0.210993 mm ± 0.067358 mm for gingitac paste, and 0.294147 mm ± 0.056697 mm for magic foam cord
- The retraction cord had the highest retraction value of 0.465627 mm and GingiTrac had the lowest value of 0.210993 mm. The difference was statistically significant with a test value of 64.685 and $P < 0.001$. The mean difference between the retraction cord and GingiTrac groups was 0.2546333*. it is significant. The mean difference between the retraction cord and magic foam groups was 0.1714800*. It was statistically significant with a $P < 0.001$. The mean difference between the GingiTrac and magic foam groups was 0.0831533*. It was statistically significant with a $P = 0.002$ [Table 1].

Discussion

During the impression fabrication as part of the restoration process, it is imperative that the finish line be accurately reproduced. If the impression fails to accurately reproduce the finish line, the marginal integrity can be compromised, which can cause recurrent caries and/or gingival inflammation and periodontal breakdown.[2] To achieve a defect-free impression, a proper gingival retraction must be achieved. While the retraction cord has become the standard operating technique for gingival retraction, the more recently introduced pastes and gels claim to overcome the shortcomings of the retraction cords.[9]

This study was taken up to evaluate the effectivity of some of these new retraction materials available in the market, namely magic foam retraction paste and the GingiTrac retraction paste, in comparison to the standard retraction cord and Stay-Put retraction cord.

Stay-Put cord is a "mechanical method" of the gingival displacement. The mechanical method involves physical displacement of the gingival tissue by placement of retraction cord within the sulcus to obtain maximal gingival retraction.[10]

The magic foam cord is a "mechanical" gingival retraction system consisting of expanding type PVS material. Hence, it might be the reason for getting easy and better retraction from magic foam cord. However, the retraction was lesser than that from Stay-Put retraction cord where the cord was pushed mechanically into the gingival sulcus.[6]

The GingiTrac retraction system is one of the most recently introduced retraction system in the market. The system and its working procedure is similar in nature to the Magic Foam system with one key distinguishing factor which is that it contains a mild natural astringent making it capable of hemostasis.[11]

Based on the data collected, Stay-Put showed maximum retraction value as compared to magic foam cord and GingiTrac paste. There are numerous studies which support these results. The retraction cord produced a 0.466 mm ± 0.06 mm higher gingival retraction compared to the magic foam. The result of the present study was in agreement with Anupam *et al*[12], in which stay put retraction system had a mean retraction value of 0.528 mm ± 0.12 mm.

According to Kamath *et al*.,[5] the magic foam system has a key advantage: it provides an outstanding retraction for perfect impressions while being a nontraumatic, conservative method of gingival retraction. The key disadvantage of the magic foam system is that it is not capable of hemostasis, a factor which both the retraction cord and the GingiTrac systems are capable of the GingiTrac system provides a mean retraction value of 0.211 mm ± 0.067 mm and the magic foam cord provides a mean value of 0.294 mm ± 0.057 mm.

Of the three materials studied, both the retraction cord and the magic foam system achieved retraction values significantly above and beyond the critical width needed. Furthermore, the magic foam system also proved to be quicker and more efficient to use for the clinician while being more comfortable for the patient. The GingiTrac system similarly proved to be quick and efficient as well as comfortable for the patient; however, it failed to achieve the critical retraction width.

To the extent possible, extreme care was taken to standardize all aspects of the study and ensure that the most reliable set of study results is produced. The follow-up study should incorporate a variety of clinical situations (both in anterior and in posterior regions of the jaw and in both maxillary and mandibular arches), a variety of gingival biotypes (thick and thin), and a broader range of participant ages as well as both males and females. The follow-up study should also incorporate the histological analysis of the effects of gingival retraction materials on the soft tissues in an effort to obtain a truly holistic understanding of the procedures and the advantages/disadvantages of one method over another.

Conclusion

The maximum retraction was produced by aluminum chloride-impregnated cord and least amount of retraction was produced by GingiTrac. Although there was a statistically significant difference in the width of retracted gingival sulcus between retraction cord and magic foam, the mean width of gingival sulcus achieved with magic foam cord was more than the minimum width (0.22 mm) cited in the literature and thus the clinical use of magic foam can be effective for retraction in an established way. The GingiTrac system, however, failed to achieve the minimum requirement, calling into question the viability of the system as an effective treatment tool.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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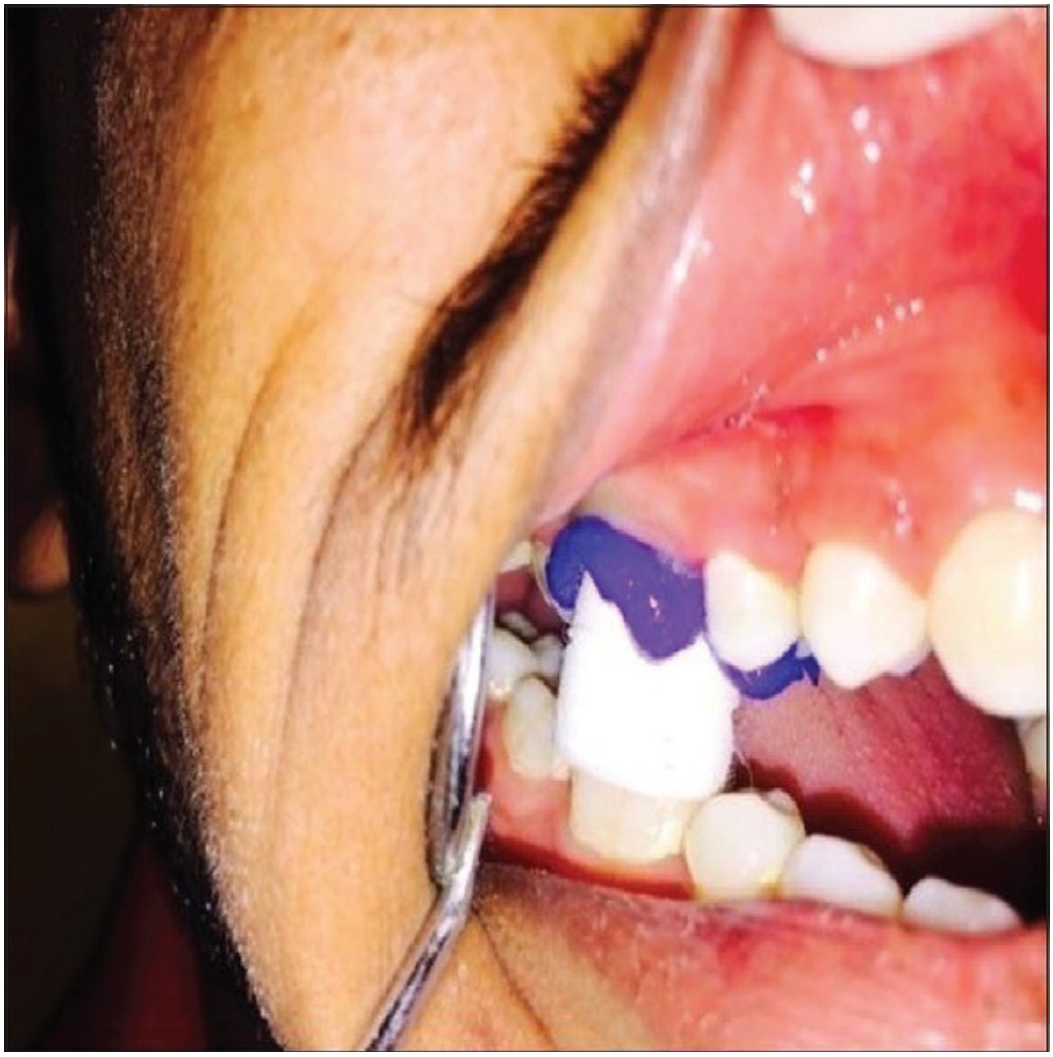
Figures and Tables

Figure 1

Gingival retraction with retraction cord

Figure 2

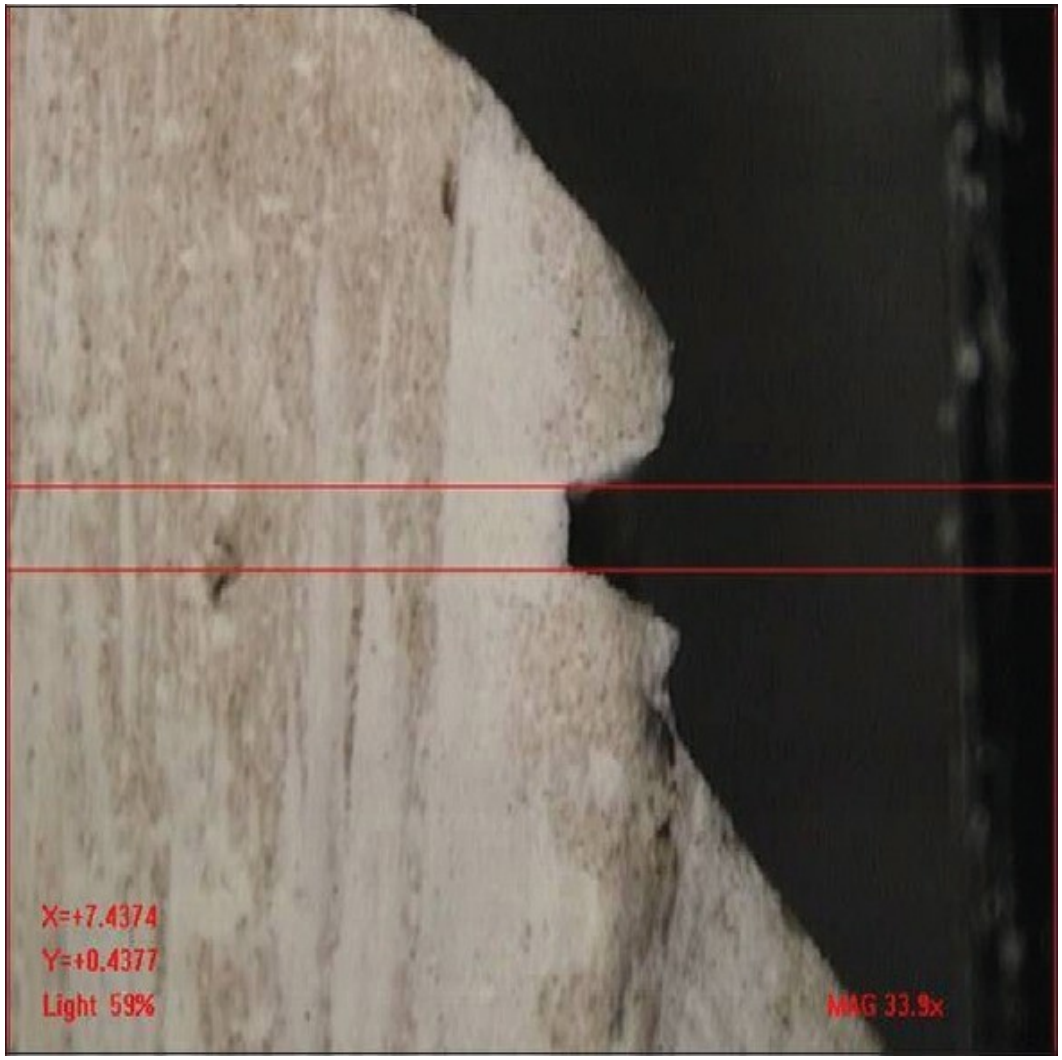


Gingival retraction with magic foam

Figure 3

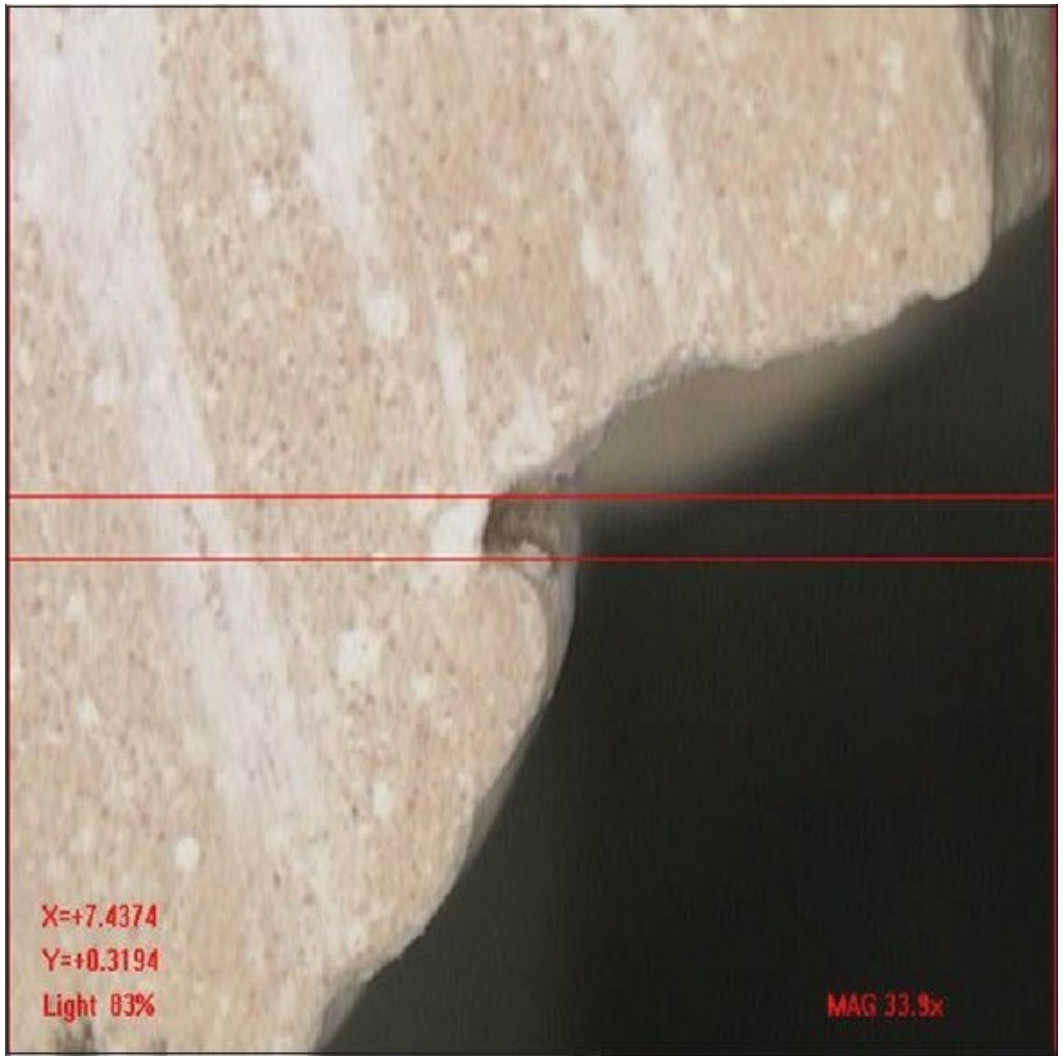
Gingival retraction with GingiTrac

Figure 4



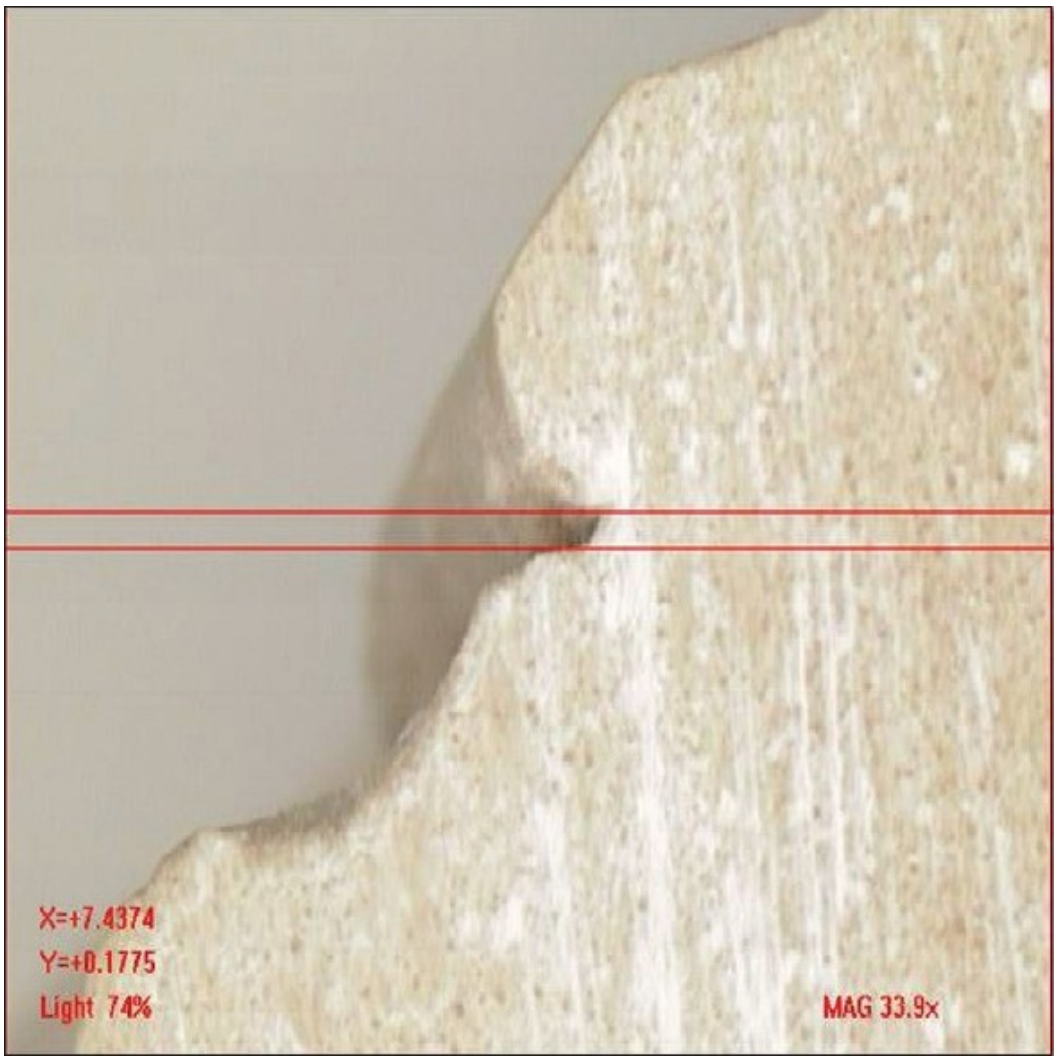
Gingival retraction using retraction cord obtained from optical microscope

Figure 5



Gingival retraction using magic foam obtained from optical microscope

Figure 6



Gingival retraction using GingiTrac obtained from optical microscope

Table 1

Comparison of change in width of the sulcus caused by aluminum chloride retraction cord, magic foam, and GingiTrac

Dependent variable	Group (I)	Group (J)	Mean difference (I−J)	SE	*P*
Displacement	Retraction cord	GingiTrac	0.2546333*	0.022832	<0.001
		Magic foam	0.1714800*	0.022832	<0.001
	GingiTrac	Magic foam	−0.0831533*	0.022832	0.002

Post Hoc: Tukey Test. SE: Standard error. *Statistically significant