Clinical Comparison of the Efficacy of Magic Foam Cord Retraction System and Medicated Retraction Cord impregnated in Ferric Sulphate on the basis of relative ease of working, Hemorrhage Control and amount of Vertical Gingival Retraction: An in Vivo Study

Dr. Vikram J. Nain, [1] Dr. Jyoti Beniwal, [2] Dr. Deepanshu Tiwari, [3] Dr. Deepika Dahiya, [4] Dr. Reshmi R V, [5]

1. **Dr. Vikram J. Nain**
   MDS (Prosthodontist), Shah Satnamji Speciality Hospitals,Sirsa
2. **Dr. Jyoti Beniwal**
   Prosthodontist, Dr. Harvansh Singh Judge Institute of Dental Sciences Hospital, Sector 25, South Campus, Panjab University, Chandigarh
3. **Dr. Deepanshu Tiwari**
   BDS
4. **Dr. Deepika Dahiya**
   MDS Final Year, Department of Prosthodontics, JCD Dental College, Sirsa
5. **Dr. Reshmi R V**
   MDS Final Year, Department of Prosthodontics, JCD Dental College, Sirsa

Abstract Medicated retraction cords are effective and gold standard, however various studies in past have shown local and systemic side effects induced by medicaments used for gingival retraction. Various newer gingival retraction systems are available in the market with no systemic and local side effects. Out of them Magic Foam Cord is a newer gingival retraction system. Chemically it is expanding polyvinyl siloxane, which claims to be fast, easy and atraumatic system. Thus there is a need to clinically evaluate the efficacy of Magic Foam Cord gingival retraction system with the Ferric sulphate impregnated gingival retraction cord on the basis of amount of vertical gingival retraction, time taken for placement, hemorrhage control and relative ease of working.

Keywords: Gingival retraction, Magic foam cord, Ferric sulphate impregnated gingival retraction cord, hemorrhage control.

INTRODUCTION

Full coverage preparation often requires subgingival margins because of caries, existing restorations, esthetic demands, or the need for additional retention. In these situations, the gingival tissue must be displaced to allow sufficient impression material to be injected to the expanded gingival crevice, to capture the prepared finish lines and permit fabrication of accurate dies on which the restorations can be fabricated.[3]

Gingival retraction can be defined as the temporary deflection of the marginal gingiva away from the tooth. This is performed to create sufficient lateral and vertical space between the prepared finish line and the gingival tissue to allow for the injection of adequate bulk of impression material into the expanded gingival crevice.[4]

Gingival retraction methods have been broadly classified as conservative or radical, depending on whether or not a loss of tissue results from the use of the method. The conservative methods obtain

adequate gingival retraction by means of mechanical and chemical displacement of the gingival tissues. The radical methods obtain adequate gingival retraction through actual removal of gingival tissues, either in whole or in part using electrosurgical procedures.[6]

The mechanical (retraction cord) and chemico-mechanical method of using a retraction cord impregnated or soaked in various chemicals is the most frequently used method. The retraction cord mechanically displaces the gingival tissue and absorbs moisture contamination in the gingival sulcus, while chemical agents control hemorrhage and shrink the gingival tissue.[7]

New materials for gingival retraction include: Expasyl retraction system, Magic Foam Cord retraction system and Merocel retraction system.[9]

Of the various gingival retraction systems available in the market, a cordless paste system (Magic Foam Cord) is a fairly a new entrant in this field. This is an expanding polyvinyl siloxane retraction system, claims to be fast, easy and non traumatic method of temporary gingival retraction

Therefore the present study is designed with the purpose of clinically evaluating the efficacy of Magic Foam Cord retraction system with Ferric Sulphate impregnated retraction cord on the basis of amount of vertical gingival retraction, time taken for placement, haemorrhage control and relative ease of working.

Material and Methodology:

The present study was carried out in the Department of Prosthodontics at JCD Dental College, Sirsa. The study included subjects who were having more than one abutment tooth to be prepared for full coverage restoration. Subjects with following criteria were included in the study:

1. Preparation for full coverage restorations involving more than one-abutment teeth.
2. Clinically and radio-graphically healthy gingiva and periodontium around the abutments.
3. Abutment teeth of normal size and contour (no developmental anomaly or regressive age changes).

Subjects with less than 18 years of age were not included in the study. Pt with gingival and periodontal disease, uncontrolled diabetes, hypertension, hyperthyroidism, any cardiovascular disorder and with tipped, tilted or rotated abutment teeth were not included for the study.

Written informed consent was obtained from those patients who agreed to participate voluntarily and the ethical clearance was obtained from the ethical committee of JCD Dental College, Sirsa.

A minimum of 15 patients were selected having more than one abutment tooth to be prepared for full coverage restoration based on inclusion and exclusion criteria.

A total sample size of 30 abutment teeth which were divided into 2 groups of 15 abutment teeth each.

A flexible scale was fabricated by printing scale markings on transparent flexible plastic sheets to the accuracy of 0.5 mm for measuring the sulcus depth in the patients

Abutments were prepared for full coverage restoration with subgingival margins taking care to avoid any damage to the surrounding gingival tissue.

Prior to the application of any retraction system, flexible measuring scale was used to measure the sulcus depth at mesio- buccal, mid-buccal and disto-buccal region on all the prepared abutment teeth. This provided the initial sulcus depth before retraction.

Retraction cord of adequate size was selected based on the clinical situation (thickness of gingiva and sulcus depth). Cord of adequate length i.e. slightly more than required to encircle the tooth was cut and looped around the tooth. Medicated retraction cord was obtained by soaking plain knitted retraction cord (Ultrapak) in Ferrous sulfate solution for 20 minutes in a clean dappen dish.

Cord packing was started from the mesial inter-proximal area by gently pushing the cord into the sulcus. Cord packer was angled toward the tooth so that the cord was pushed directly into the sulcus. Out of the two prepared abutments, any one was selected randomly on which medicated retraction cord was placed. The following parameters were recorded:

1. The ease of placement of the retraction cord was assessed subjectively by the operator.
2. The time taken for placement of cord i.e. (from start of packing till completion) was recorded using a stop watch. The cord was left in the sulcus for 4 minutes, after which it was slowly removed.
3. The amount of hemorrhage was then recorded in terms of score 0 to 2.
   a. Score 0: No bleeding on removal.
   b. Score 1: Bleeding controlled with air and water spray within 1 minute.
   c. Score 2: Bleeding not controlled within 1 minute.
4. Immediately following the assessment of hemorrhage, amount of vertical gingival retraction was recorded at the same three locations (mesio-buccal, mid-buccal, disto-buccal) using flexible scales.
5. The amount of gingival retraction was calculated by taking the difference between the values obtained before retraction and after retraction.

Magic foam cord retraction material was applied to the remaining abutment tooth. This retraction system consists of cartridges of expanding type of polyvinyl siloxane retraction material, auto- mixing gun, mixing tips, intrasulcular tips and anatomic comprecap. The comprecaps are available in three different sizes for incisors, premolars and molars.

Magic foam cord retraction material was applied around the prepared abutment tooth with the help of intrasulcular tips. After injecting the retraction material the corresponding comprecap was placed on to the abutment tooth & the patients were asked to close on to it this applies uniform closing pressure to push the retraction material deep into the sulcus. After 4 minutes, the comprecap with the set retraction material attached to it, was removed from the patient mouth. The gingival sulcus was ready for the recordings.

Haemostasis, time taken and ease of placement, vertical gingival retraction was measured and recorded.

Results: The present clinical study was carried out to evaluate the efficacy of Magic Foam Cord retraction system and retraction cord impregnated in Ferric sulphate solution on gingival retraction.

15 subjects who required full coverage restoration with maximum of two abutment teeth formed the sample of this study

Group 1: Retraction cord impregnated with Ferric sulphate solution

Group 2: Magic Foam Cord Retraction system

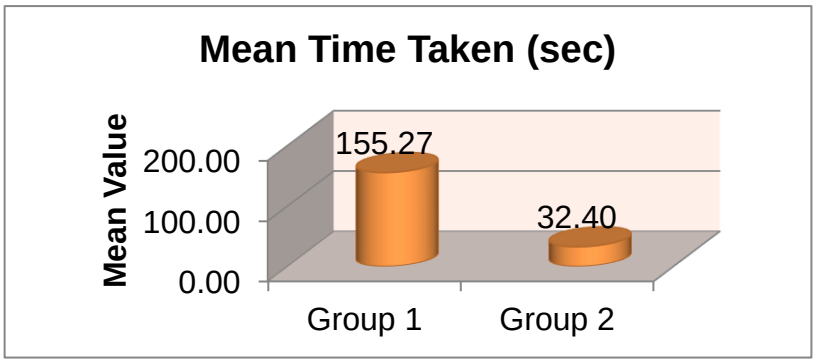
The mean time taken for the placement of Retraction Cord impregnated in Ferric sulphate solution was 155.27 seconds. The time range for the medicated retraction cord was 87- 200 seconds. The mean time taken for the placement of magic foam cord retraction system was 32.40 seconds. The time range for the Magic Foam Cord was 15- 58 seconds. The results are tabulated in **Table 1 & Graph 1**.

Table 1: Mean time taken (sec)

Group	Mean	Standard Deviation	Range	't' value	P value
Group 1	155.27	30.58	87 – 200	17.100	<0.001**
Group 2	32.40	12.60	15 – 58		

Paired 't' test; **p<0.001; Highly significant

Graph 1

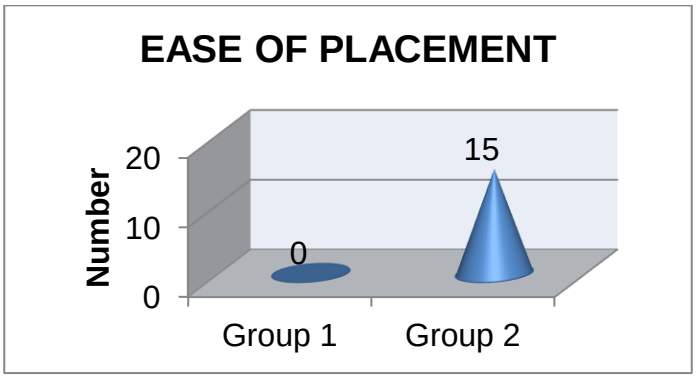


The ease of placement with Magic Foam Cord was 100% (15 subjects) whereas for Retraction cord impregnated in Ferric sulphate solution it was 0% (no subjects). These results are tabulated in **Table 2 & Graph 2.**

Table 2: Ease of placement

EASE OF PLACEMENT	Group	
	Group 1	Group 2
	0 (0%)	15 (100%)

Graph 2:



Mean hemorrhage scores with retraction cord impregnated with Ferric sulphate solution was 1.40 and with Magic Foam Cord retraction system was 0.33. The results are tabulated in **Table 3 and Graph 3.** The division of hemorrhage scores in medicated retraction cord were: ***Score 0- 0%*** (no subjects), ***Score 1- 60%*** (9 subjects), ***Score 2- 40%*** (6 subjects). The division of hemorrhage scores in Magic Foam Cord retraction system were: ***Score 0- 66.70%*** (10 subjects), ***Score 1- 33.30%*** (5 subjects), ***Score 2- 0%*** (0 subjects). The results are shown in **Table 4 and Graph 4** .

Table 3: Mean hemorrhage scores

Group	Mean	Standard Deviation	Z value	P value
Group 1	1.40	0.51	3.176	0.001*
Group 2	0.33	0.49		

Wilcoxon signed rank test; *p<0.05; Significant

Graph 3:

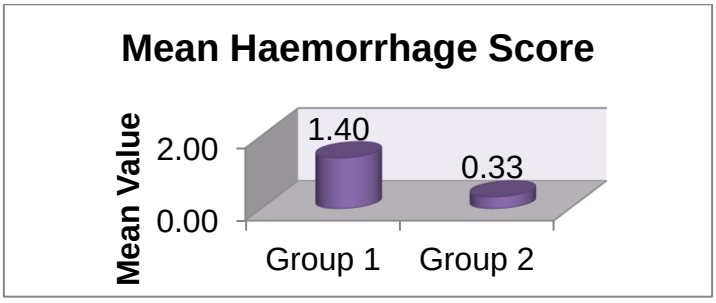
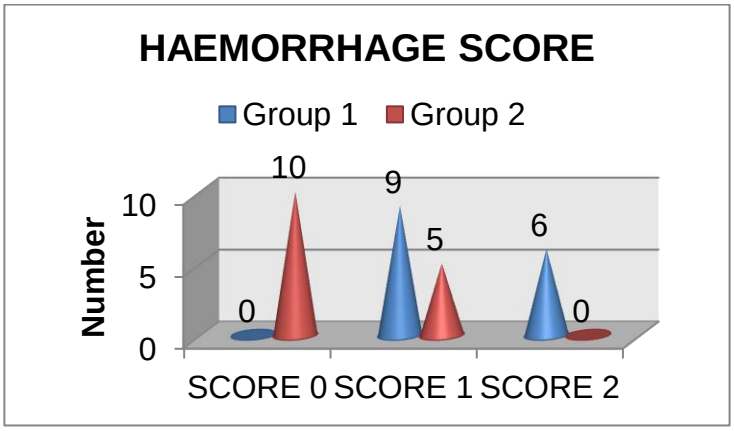


Table 4: Division of hemorrhage scores in two groups

HEMORRHAGE SCORES	Group 1		Group 2	
	FREQUENCY	PERCENTAGE	FREQUENCY	PERCENTAGE
SCORE 0	0	0.00	10	66.70
SCORE 1	9	60.00	5	33.30
SCORE 2	6	40.00	0	0.00
Total	15	100.00	15	100.00

Graph 4:

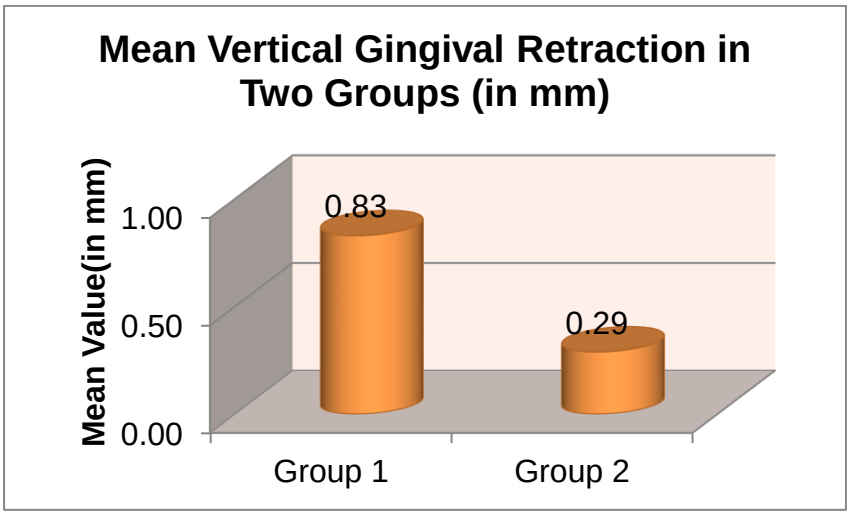


Mean vertical gingival retraction with Retraction Cord impregnated with Ferric sulphate solution was 0.83 ± 0.17 and with Magic Foam Retraction Cord was 0.29 ± 0.13, with a p - value of 0.001. So the hypothesis of equality of means is rejected even at 5% level of significance (P< 0.05), which signifies the results are statistically significant. The results are tabulated in **Table 5 and Graph 5.**

Table 5: Comparison of mean vertical retraction in Two Groups

GROUP	Mean ± SD	Z value	p - value	Inference
Group 1	0.83 ± 0.17	3.419	0.001	Significant
Group 2	0.29 ± 0.13			

Graph 5:



Mean vertical gingival retraction with Retraction cord impregnated with Ferric sulphate solution at mesio buccal location was 0.83mm, at mid buccal location 0.82mm and at disto- buccal location was 0.85mm and with Magic Foam Cord retraction system was 0.28mm at mesio buccal location, 0.33mm at mid buccal location and 0.27mm at disto-buccal location. The results are tabulated in **Table 6, Table 7, Table 8 and Graph 6.**

Table 6: Comparison of mean vertical retraction in Mesio buccal

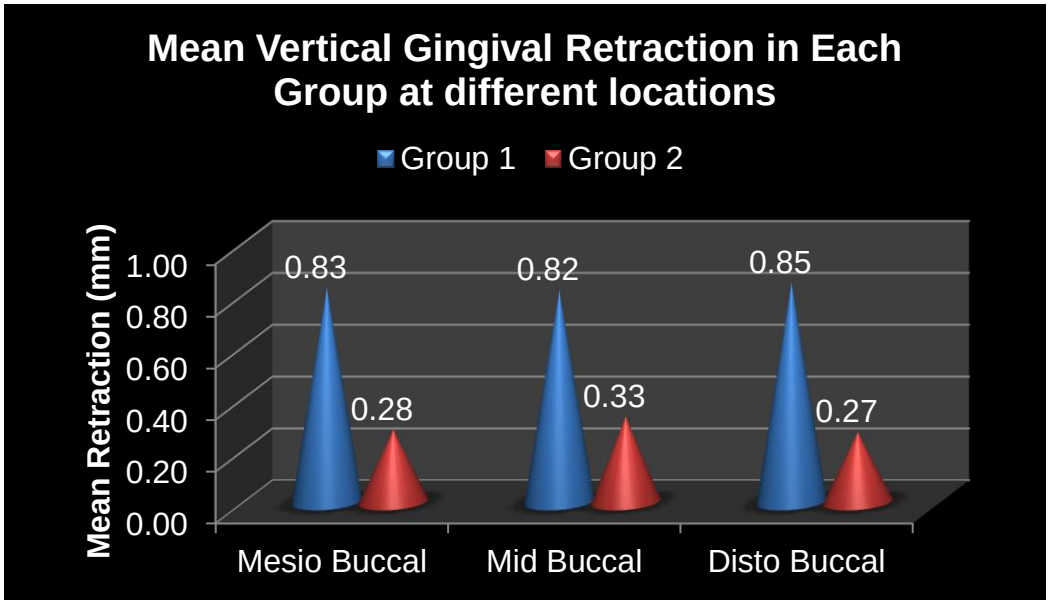
GROUP	Mean ± SD	Z value	p - value	Inference
Group 1	0.83 ± 0.32	3.441	0.001	Significant
Group 2	0.28 ± 0.18			

Table 7: Comparison of mean vertical retraction in Mid buccal .

GROUP	Mean ± SD	Z value	p - value	Inference
Group 1	0.82 ± 0.24	3.330	0.001	Significant
Group 2	0.33 ± 0.18			

Table 8: Comparison of mean vertical retraction in Disto buccal .

GROUP	Mean ± SD	Z value	p - value	Inference
Group 1	0.85 ± 0.26	3.334	0.001	Significant
Group 2	0.27 ± 0.20			



DISCUSSION: The long-term success of fixed prostheses is greatly dependent upon the health and stability of the surrounding periodontal structures[2]. An adequate understanding of the relationship between periodontal tissues and restorative dentistry is paramount to ensure adequate form, function, esthetics, and comfort of the dentition[1].

Full coverage restorations often require subgingival margins because of caries, esthetic demands, or need for additional retention[3]. Impression techniques used in the process of making fixed prostheses require the gingival tissue to be displaced to expose the finish lines on the prepared teeth. The gingival retraction can also be used to enhance access and visibility during margin preparation to avoid damage to the surrounding gingival architecture. Therefore, effectively managing the gingiva prior to making an impression is a critical preliminary step in the process of fabricating restorations[35].

One of the most used methods to obtain gingival retraction is by means of cord packed into the sulcus[45]. Nonmedicated cords placed in the gingival sulcus are safe but have limited effect in controlling hemorrhage .

Therefore, to overcome this problem various medicaments were developed which were used in conjunction with retraction cords, such as; 0.1% and 8% racemic epinephrine, 100% alum solution, 5% and 25% aluminum chloride solution, ferric subsulfate (Monsel's solution). A study by Hansen et al in 1999, revealed that, the most common medicaments used with retraction cord by prosthodontists for finish-line exposure are buffered aluminum chloride (55%), followed by ferric sulfate(23%)[8].

Ultrapak retraction cord has chain like construction of interlocking loops which let the cord bend passively in any direction. Ultrapak cord's interlocking loops also carry approximately 2.5 times more hemostatic solution than conventional cords[51].

Various studies have been done in past on local and systemic side effects induced by medicaments used for gingival retraction[10,52,53,54]. Cords saturated with zinc chloride have been shown to cause tissue damage. Cords saturated with epinephrine are widely used but can precipitate the "epinephrine syndrome" in patients[3]. The major problems associated with these tissue displacement methods include; difficulty in placement, discomfort to the patient, gingival tissue damage, inadequate control of hemorrhage, alteration of periodontal attachment, and increased chair-side time[46]. To overcome these disadvantages, various new retraction material/systems have been developed. These include; expasyl retraction system, magic foam cord, merocel etc.

The magic foam cord is a non-hemostatic "mechanical" gingival retraction system consisting of expanding type vinyl polysiloxane material. According to manufacturers, it is potentially less traumatic to gingival tissue, as the magic foam cord material is syringed around the crown preparation margins and a comprecap is placed to maintain pressure which causes physical displacement of the gingival tissues.

The parameters used in this study to compare the three retraction systems were; amount of vertical gingival retraction, hemorrhage control, time taken and ease of placement.

There are various instruments and apparatus available to measure the depth and width of gingival sulcus such as; ultrasonographic periodontal probe[55], endoscope specifically designed for dental endoscopic images, manual periodontal probe[56], flexible scales or flexible measuring strips (FMS)[57], dental space and periodontal cavity measuring instrument, centrally rotating periodontal probe, Remote-recording periodontal depth probe, measurements on the cast of prepared abutment using low power microscope[24], and measurements directly on the impression using stereomicroscope. The manual periodontal probe can be used instead of flexible scales but manual probing is invasive, which may cause patient discomfort[55]. Whereas, flexible scales were smooth rounded measuring strips with 0.5mm grading which can be introduced into the gingival sulcus with a greater ease. The measurements recorded in between two consecutive calibrations were considered as 0.25mm. This may influenced the accuracy of measurements to a certain extent.

Prior to the application of retraction system, with the help of flexible scale the sulcular depth at mesio-buccal, mid-buccal and disto-buccal regions[29] were measured on both the abutment teeth. These locations on the buccal/labial aspects were chosen for the sake of convenience in recording the measurements. This recording gave the sulcus depth before gingival retraction. Similarly, the measurements were recorded after gingival retraction and compared to obtain net amount of vertical gingival retraction.

Mean vertical gingival retraction was compared between the groups by using Wilcoxon signed rank test & was found 0.29mm mean vertical retraction for Magic foam Cord and 0.83mm for Medicated retraction cord impregnated with Ferric Sulphate solution with a 'P' value of 0.001.

Mean vertical gingival retraction at mesio- buccal, mid- buccal and disto-buccal region for Magic Foam cord was 0.28mm, 0.33mm, 0.27mm resp. & for Medicated Retraction Cord impregnated with Ferric Sulphate solution at mesio-buccal, mid-buccal, disto-buccal region were 0.83mm, 0.82mm, 0.85mm resp.

These values indicates that at all the locations medicated retraction cord showed significantly increased amount of vertical gingival retraction in comparison to Magic Foam Cord.

The above mentioned results can be attributed to be following factors i.e. medicated retraction cord is a chemico - mechanical method of gingival displacement, which involves physical displacement of the gingival tissue by placement of materials within the sulcus to obtain maximal gingival retraction[58]. The Magic Foam Cord is a mechanical gingival retraction system consisting of expanding type vinyl polysiloxane material. The material is syringed around the crown preparation margins and a comprecap is placed to maintain pressure which causes physical displacement of the gingival tissues. Also the size of the comprecaps often does not properly fits around the prepared teeth as they are available in fixed sizes.

The influence of distendability of gingiva, gingival thickness and varied sulcus depth on the gingival retraction was not considered in the study. Further, flexible scales were used to measure sulcus depth (soft tissue), which may lead to some variations in the measured values. However, utmost care was taken to minimize these errors.

The mean time taken for placement of medicated retraction cord in the gingival sulcus was 155.27 sec and for Magic Foam Cord was 32.40 sec. Among the two retraction systems compared in the present study Magic Foam Cord was relatively clinician friendly and easy to place, as it was applied with an automixing gun directly into the gingival sulcus and a comprecap was placed over it. However, the medicated retraction cord placement requires more skill, experience. This analysis was more of subjective in nature where the skill and experience of the operator was not considered.

Weir and Williams[3] considered amount of bleeding on removal of the retraction cords as criterion for success. They categorized hemorrhage into following scores -

No bleeding - score 0,

Bleeding controlled with air and water spray within 1 minute - score 1,

Bleeding not controlled in 1 minute - score 2

Based on the data collected, it was found that the mean hemorrhage scores for medicated retraction cord was 1.40 and for the Magic Foam Cord it was 0.33.

In Magic Foam Cord retraction system the material was syringed around the crown preparation margins and a comprecap was placed to maintain the pressure, it was found potentially less traumatic to the tissues as compared to medicated retraction cord.

A study conducted by Weir DJ and Williams BH[3], to compare the clinical effectiveness of mechanical-chemical tissue displacement methods showed that the maximum bleeding on removal was caused by dry retraction cords. Also the placement of retraction cord into the gingival sulcus may cause injury to sulcular epithelium and may induce bleeding on removal[2].

In 1978, Van der Velden and De Vries studied the forces applied to the sulcus during various dental procedures. They observed a tearing of the epithelial attachment as soon as the pressure of 1 N/mm^2 was applied to the marginal gingiva. The attachment was destroyed when the pressure exceeded 2.5 N/mm^2 . The pressure applied by the retraction cord in this region is between 5 and 10 N/mm^2. To avoid any damage to the epithelial attachment, gingival retraction should be accomplished under a pressure between 0.1 and 1 N/mm^2 .

Within the limitations of the study, Magic Foam Cord retraction system appears to be a promising system for the control of hemorrhage, reduced clinical time for application and ease of placement. However, the amount of vertical gingival retraction observed with Magic Foam Cord retraction system was significantly less than the medicated retraction cord system. These findings indicate that Magic Foam Cord retraction system may be considered when hemorrhage control is of prime importance and amount of gingival retraction required is minimal. Medicated retraction cord should be considered when gingival retraction is of utmost importance. For

achieving both effective hemorrhage control and optimum gingival retraction combination of medicated retraction cord and Magic Foam Cord retraction system may be considered, however this aspect require further studies.

CONCLUSION: Some of the inferences that were drawn from this study:

1. Time taken for application of Magic Foam Cord retraction system is significantly less as compared to time taken for medicated retraction cord.
2. Use of Magic Foam Cord retraction system is easier in comparison to placement of medicated retraction cord.
3. The hemorrhage score with the Magic Foam Cord retraction system is better in comparison to hemorrhage score with medicated retraction cord as the application of Magic Foam Cord is atraumatic to the peridontium than medicated retraction cord.
4. Increased amount of vertical gingival retraction is obtained with the use of medicated retraction cord in comparison to vertical gingival retraction obtained with Magic Foam Cord retraction system.

Within the limitations of the study, Magic Foam Cord retraction system appears to be a promising system for the control of hemorrhage and ease of placement. However, the amount of vertical gingival retraction observed with Magic Foam Cord retraction system was significantly less than the medicated retraction cord system. Further more studies may be carried out to confirm this.

FUTURE PROSPECTIVE

1. There is a need for further studies with a larger sample size to investigate the amount of horizontal retraction obtained with different retraction systems.
2. Prospective studies with a larger sample size are essential to consider the amount of pressure exerted during retraction procedure and their effect on integrity of periodontium.
3. Combination of medicated retraction cord and Magic Foam Cord retraction system may be considered for achieving both effective hemorrhage control and optimum gingival retraction, however this aspect require further studies.

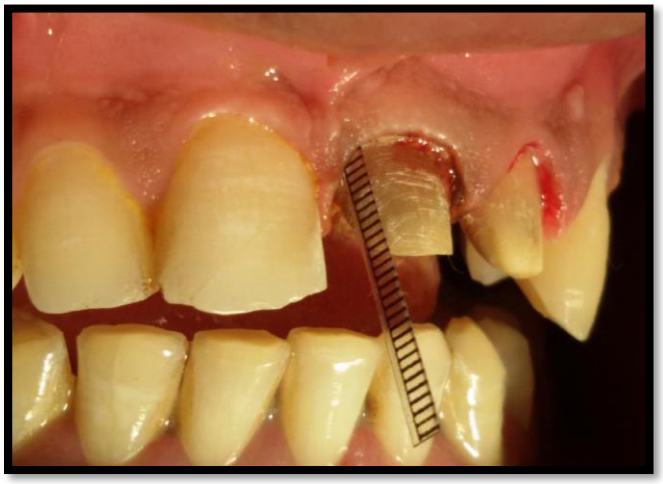


Fig 1: Sulcus depth measured at mesio- buccal region before retraction

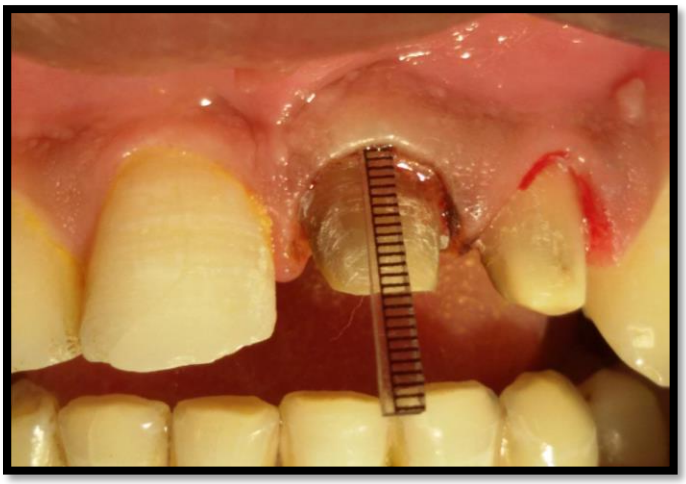


Fig 2. Sulcus depth measured at mid- buccal region before retraction

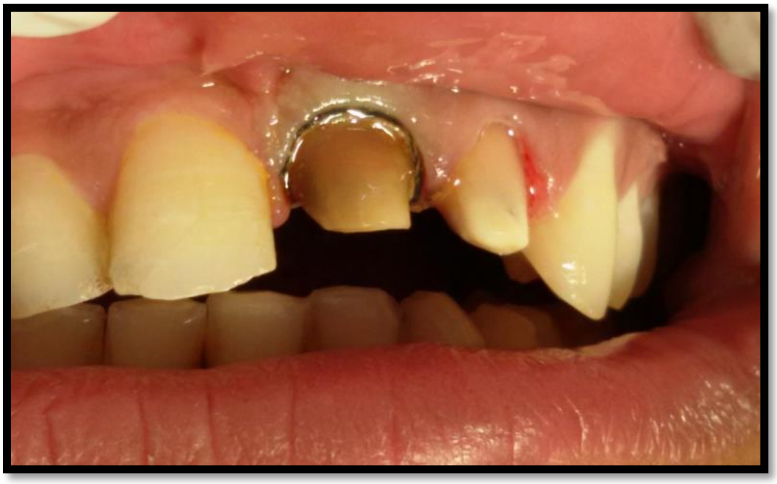


Fig 3. Medicated retraction cord impregnated with Ferric sulphate solution placed in gingival sulcus

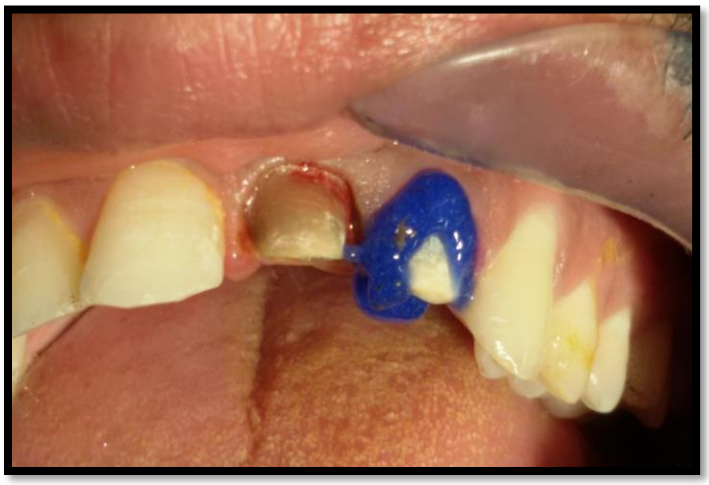


Fig 4. Magic Foam Cord Retraction system placed in the gingival sulcus

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