To Evaluate the Clinical Efficiency of Resin Modified Glass Ionomer Varnish in Preventing Enamel Demineralisation During Orthodontic Treatment

Sheneva Shailesh, Nayak U.S.K.**, Sebastian Joseph***, Saidath K*****

Background and objectives: Fixed orthodontic treatment makes oral Hygiene procedures difficult and may result in enamel demineralization. Resin Modified Glass Ionomer Varnish (Clinpro XT Varnish) reduces the incidence of enamel demineralization. The objective of this study has been clinically evaluate the effects of RMGIV (Clinpro XT Varnish) application, incidence and progress of enamel demineralization in patients undergoing orthodontic treatment. 30 subjects seeking orthodontic treatment were selected from patients visiting Department of Orthodontics and Dentofacial Orthopedics A. B. Shetty Memorial Institute of Dental Sciences, Mangalore. The subjects were divided into Test and Control group.

The study was divided into two parts:

- **Visual evaluation – incidence of white spot lesion and their progress for six months.**
- **SEM (Scanning Electron Microscopic) evaluation to compare level of surface roughness on samples of both the groups.**

No White Spot Lesions was clinically appreciable in either Group A or Group B. Oral Hygiene Index of all patients was scored and compared between Group A and Group B. The scores were statistically evaluated which proved to be statistically significant with 'p' value below 0.001 with better oral hygiene in Group A.

After extracting the teeth, SEM images of surface of the teeth was graded and statistically evaluated with Pearson's Chi square test. The results were significant with 'p' value below 0.001 which indicated increased surface roughness in Group B compared to the Group A patients. Use of Resin Modified Glass Ionomer Varnish (Clinpro XT Varnish) as an adjunctive to thorough oral hygiene measures and has proven to be effective in reducing enamel demineralization significantly although not completely. The oral hygiene also improves but, is it the effect of active ingredient of the varnish is not confirmable under this study design.

Key words: Enamel Demineralization; White Spot Lesions; Clinpro XT Varnish

Fixed orthodontic treatment makes oral Hygiene procedures difficult and may result in enamel demineralization. Demineralized surface enamel is considered to be the precursor, or early lesion of enamel caries and is primarily due to the action of acids which during orthodontic treatment, may come from two sources, namely, the cement used for retaining the orthodontic bands and the breakdown

**Senior Professor & Head of Department, Department of Orthodontics and Dentofacial Orthopaedics, Terna Dental College, Navi Mumbai.*

***Dean*

****Post Graduate Student*

*****Reader, Department of Orthodontics and Dentofacial Orthopaedics, A. B. Shetty Memorial Institute of Dental Sciences, Derlakatte, Mangalore*

products of food debris Fluorides and RMGIV have been proven to inhibit enamel demineralization by formation of more resistant Fluorapatite crystals. However the fluoride released from these products lasts for first 48 hours, after which there is minimal or no fluoride released.[10,11,12,13] However a new product Resin Modified Glass Ionomer Varnish containing flouride (Clinpro XT Varnish), claims to reduce the incidence of enamel demineralization. The objective of this study is to clinically evaluate the effects of RMGIV (Clinpro XT Varnish) application, incidence and progress of enamel demineralization in patients undergoing orthodontic treatment.

Studies by Mizrahi E and Gorelick L,Geiger AM, Gwinnett have shown that there was a significant increase in both the prevalence and severity of enamel opacities following completion of orthodontic treatment.[1,6]

Male patients experienced a significantly higher increase in the severity of enamel opacities following orthodontic treatment.

The obvious degree of iatrogenic damage during orthodontic treatment, thus suggests the need for preventive programs using fluoride. For the teeth studied, there was no difference in white spot formation in those that were banded or bonded.[6]

The labiogingival area of the maxillary lateral incisors had the highest incidence of white spots. When studied by segments, the highest incidence occurred among the maxillary incisors; the lowest was in the maxillary posterior segment. No white spots were found on the lingual surfaces of mandibular canines and incisors after prolonged use of a canine-to-canine bonded retainer. These findings suggest a relationship between resistance to white spot formation and the rate of salivary flow.[6]

Rapid demineralization occurred in the absence of fluoride, whereas a remarkable protection of enamel surface with little fluoride. No mineral loss was detected when demineralising solution containing 1ppm of fluoride.

All presently available fluoride agents are developed from the concept of fluoridating the enamel in the form of fluorhydroxyapatite. Recent research has indicated, however, that calcium fluoride formation may be a major aspect of the mechanism of the cariostatic effect of topical fluoride.[12]

Studies also have shown there was a tendency for increased WSL development during the adolescent years compared with the preadolescent and post-adolescent age groups.

It was concluded that the regular use of fluoride toothpastes was insufficient to inhibit lesion development around orthodontic brackets. A fluoride-releasing adhesive reduced lesion development significantly adjacent to brackets.[11]

Aims and Objectives:

- To evaluate the clinical efficiency of Resin Modified Glass Ionomer Varnish (Clinpro XT Varnish) in preventing Enamel demineralization during Orthodontic Treatment.
- To compare the findings with a control group, using regular oral hygiene measures without Resin Modified Glass Ionomer Varnish (Clinpro XT Varnish) as a supplement.
- To compare the level of demineralization on -
  a. Teeth with orthodontic attachments and RMGIV
  b. Teeth with orthodontic attachments and no RMGIV

Materials and Methods:

30 subjects in whom extractions were indicated for the purpose of treatment with Fixed Orthodontic Appliances were selected from the patients visiting the Department of Orthodontics and Dentofacial Orthopedics at A. B. Shetty Memorial Institute of Dental Sciences, Mangalore.

The teeth used for the purpose of the study were divided into 2 groups

Group A (Test Side): The teeth indicated for extraction on the right side of all the 30 subjects were

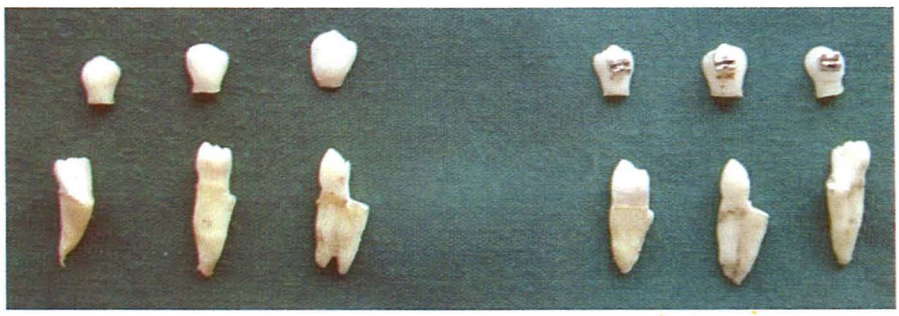


Fig. 1 Sectioned facial surfaces of teeth for SEM evaluation.

bonded and recieved professional application of RMGIV

Group B (Control Side) : The teeth indicated for extraction on the left side in all the 30 subjects were bonded but did not receive the professional application of RMGIV

Inclusion Criteria:

- Patients volunteering to take part in the study.
- Patients treated with fixed orthodontic appliances.
- Patients with good compliance.
- Patients in whom extractions are indicated for orthodontic treatment.

Exclusion Criteria:

- Non co-operative patient.
- Patients with enamel developmental defects e.g. hypoplasia, hypocalcification, fluorosis.
- Teeth with restored facial surfaces.

Methodology:

- A structured case history, pretreatment records and DMFS (Decayed Missing Filled Surfaces) scores for each patient were recorded.
- Thorough oral prophylaxis was done for all the patients included in the study before starting the orthodontic treatment.
- Any white spot lesions already found in the patients are detected, recorded and graded before the start of orthodontic treatment.
- Patients undergoing orthodontic treatment were educated about oral hygiene measures and the problems that may arise due to poor oral health during orthodontic treatment.
- Oral Hygiene Index was recorded for each patient at beginning of the treatment and during each appointment.
- During the orthodontic appliance strap up, the teeth indicated for extraction on the Right side were bonded and professional application of RMGIV was done (Group A-Test), the teeth indicated for extraction on Left side were bonded but did not receive the application of RMGIV (Group B- Control).
- In Group A acid etching was done for 15 seconds around the bracket on the tooth which was indicated for extraction. It was rinsed and air dried. Professional application of RMGIV (Clinpro XT Varnish) was carried out and light cured for 20 seconds (Fig. 2).
- All the subjects were educated on regular oral hygiene measures.
- All the subjects were recalled on a monthly basis and visually examined for the Incidence of white spot lesions and was recorded
- The oral hygiene instructions were reinforced during each appointment.
- At the end of six months the teeth indicated for orthodontic extraction were extracted.

About 10 samples randomly selected from each Group A and Group B were evaluated under Scanning Electron Microscope.

- SEM (Scanning Electron Microscopic) evaluation was to compare the level of demineralization in two conditions:

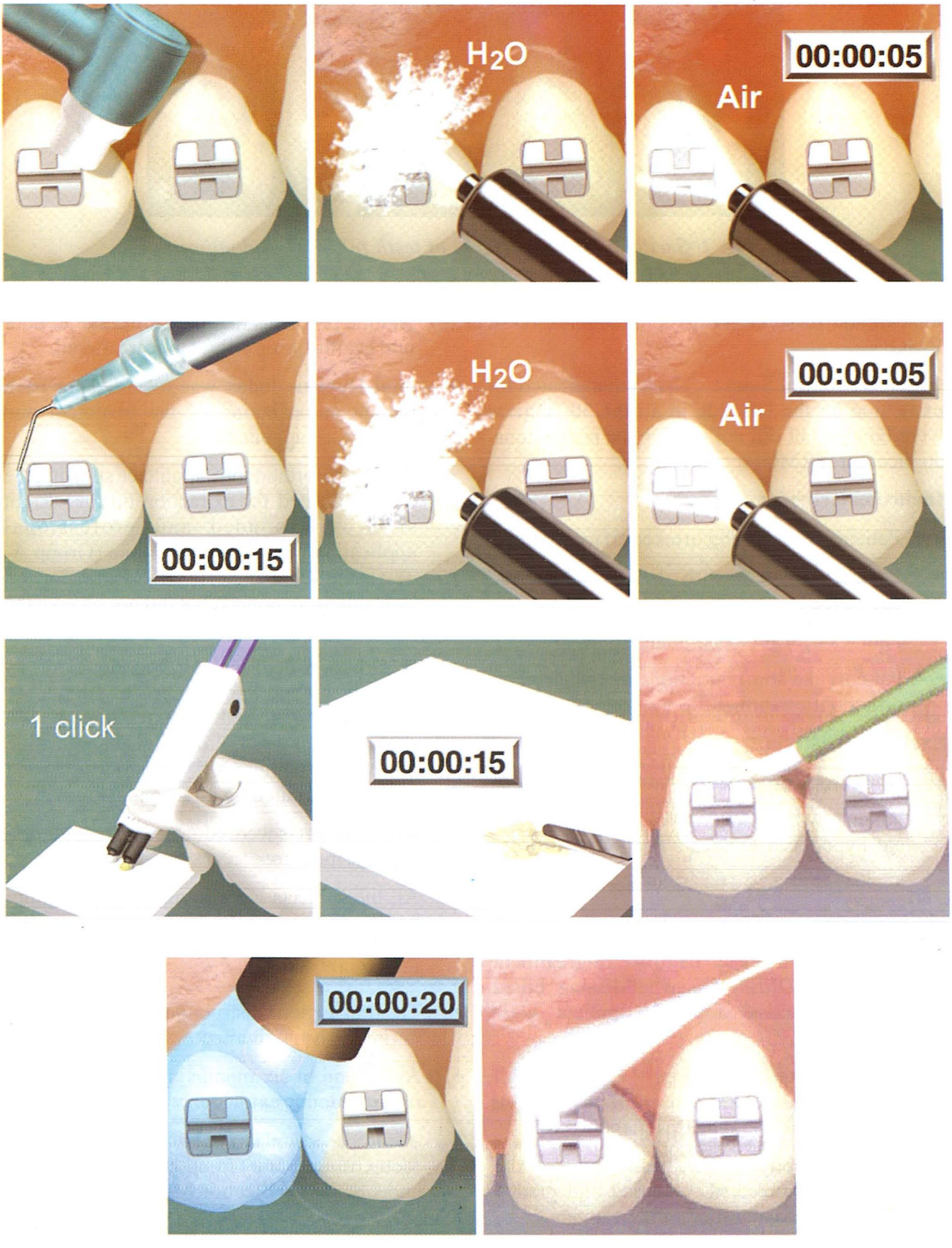


Fig.2 Professional application of Resin Modified Glass Ionomer Varnish

- Teeth with orthodontic attachments and RMGIV (Group A)
- Teeth with orthodontic attachments and no RMGIV (Group B)
- All the extracted teeth were cleaned with formalin and distilled water thoroughly. The buccal cusps of all the teeth were cut off using a cutting disc (Fig.1). These samples were sent for scanning electron microscopic evaluation at Indian institute Of Science at Bangalore.
- Surface images for 10 samples from each group were scanned at 1000X and 500X magnification. All the images were scored by single examiner for three times at interval of 2 weeks between each scoring. Blinding of the examiner was done to avoid bias. The scoring was done as follows: All the SEM pictures were scored from 0 to 5 based on comparative surface roughness by a single examiner.

Then the scores were graded as follows:

- 0 and 1- Mild roughness
- 2 and 3- Moderate roughness
- 4 and 5-Severe roughness

Student's *t* test was used to analyze visually collected data i.e. oral hygiene scores.

Pearson's chi square test was used for statistical analysis of SEM data.

Results:

1. No clinically appreciable white spot lesion or enamel demineralization was evident in any patient at the start of the treatment. No white spot lesion was clinically appreciable in either the Group A or the Group B subjects during the orthodontic treatment.

2. Oral Hygiene Index (OHI) of all the patients was scored on each appointment and was compared between Group A or the Group B subjects . Group A had a mean OHI of 0.3443 with std. deviation of 0.1173, whereas Group B had a mean score of 1.118 with std. deviation of 0.3051 (Table.1). The scores were statistically evaluated using Students *t* test of independent variance which proved to be statistically significant with 'p' value below 0.001, with better oral hygiene in Group A (Table 2). The mean of scores of all patients was plotted on a graph (Fig.6).

3. When the OHI scores were analyzed with time duration of six months there was an increase in OHI scores with time in both groups, which was plotted on a graph (Fig.7).

4. Teeth indicated for Orthodontic extraction were extracted after six months of intraoral exposure to Orthodontic treatment.

5. Care was taken not to debond the brackets while extracting the teeth. Enamel surface gingival to

Comparison of all the 6 months variation (repeated measures anova)

	group	Mean	Std. Deviation	N
1 month	GROUP A (RMGIV)	.3020	.09586	15
	GROUP B	.7627	.21878	15
2month	GROUP A (RMGIV)	.3213	.19733	15
	GROUP B	.9427	.23551	15
3month	GROUP A (RMGIV)	.3500	.13093	15
	GROUP B	.9460	.28370	15
4month	GROUP A (RMGIV)	.3733	.09752	15
	GROUP B	1.3700	.48943	15
5month	GROUP A (RMGIV)	.3633	.08541	15
	GROUP B	1.4067	.30170	15
6month	GROUP A (RMGIV)	.3560	.09723	15
	GROUP B	1.2820	.30148	15

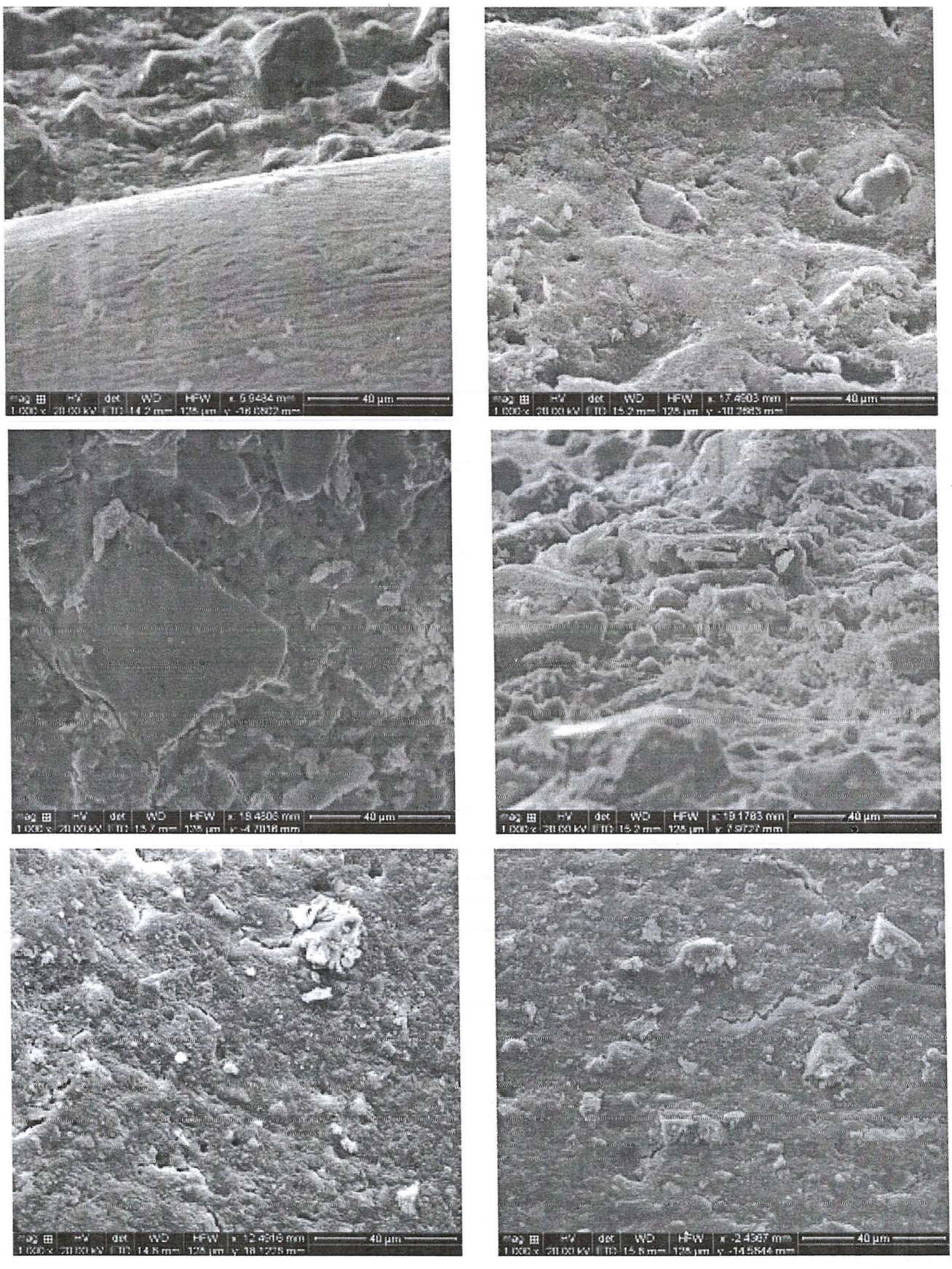


Fig.3. SEM images of the tooth surface of group A at 1000X

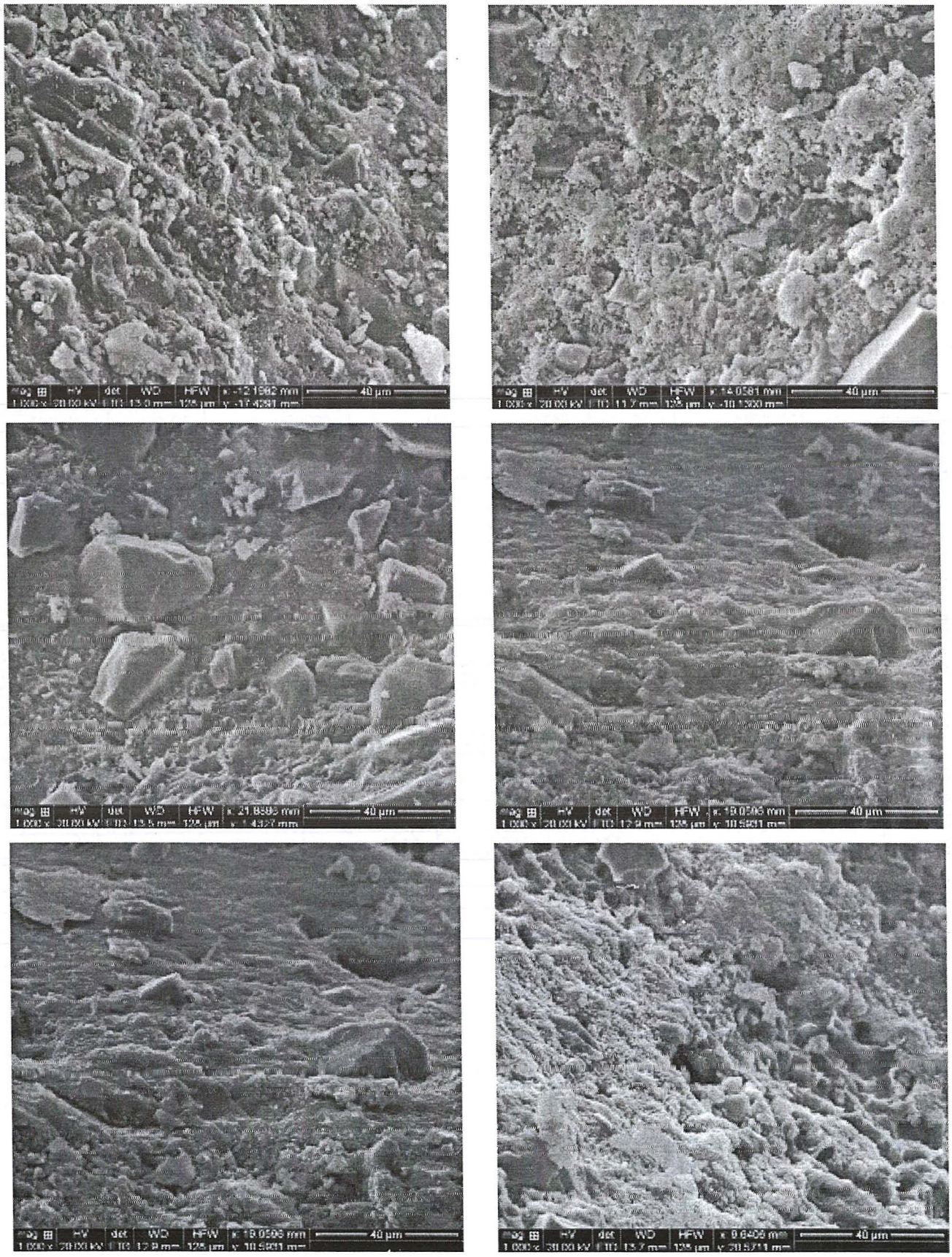


Fig.4. SEM images of the tooth surface of group B at 1000X

Comparison of each month variable with the control (independent t test)

	group	N	Mean	Std. Deviation	Std. Error Mean	t	p value
1 month	GROUPA (RMGIV)	15	.3020	.09586	.02475	-7.470	**≤0.001**
	GROUPB	15	.7627	.21878	.05649		
2month	GROUPA (RMGIV)	15	.3213	.19733	.05095	-7.832	**≤0.001**
	GROUPB	15	.9427	.23551	.06081		
3month	GROUPA (RMGIV)	15	.3500	.13093	.03381	-7.388	**≤0.001**
	GROUPB	15	.9460	.28370	.07325		
4month	GROUPA (RMGIV)	15	.3733	.09752	.02518	-7.735	**≤0.001**
	GROUPB	15	1.3700	.48943	.12637		
5month	GROUPA (RMGIV)	15	.3633	.08541	.02205	-12.887	**≤0.001**
	GROUPB	15	1.4067	.30170	.07790		
6month	GROUPA (RMGIV)	15	.3560	.09723	.02511	-11.322	**≤0.001**
	GROUPB	15	1.2820	.30148	.07784		

COMPARISON OF SEM VALUES BY CHISQUARE

			GROUPS				
			GROUP A (RMGV)	CONTROL B	Total	CHI SQUARE	P VALUE
SEM	MILD ROUGHNESS	Count	3	0	3	7.107	**0.009**
		% within SEM	100.0%	.0%	100.0%		
		% within GROUPS	30.0%	.0%	15.0%		
	MODERATE ROUGHNESS 1	Count	4	2	6		
		% within SEM	66.7%	33.3%	100.0%		
		% within GROUPS	40.0%	20.0%	30.0%		
	MODERATE ROUGHNESS 2	Count	3	4	7		
		% within SEM	42.9%	57.1%	100.0%		
		% within GROUPS	30.0%	40.0%	35.0%		
	SEVERE ROUGHNESS 1	Count	0	2	2		
		% within SEM	.0%	100.0%	100.0%		
		% within GROUPS	.0%	20.0%	10.0%		
	SEVERE ROUGHNESS 2	Count	0	2	2		
		% within SEM	.0%	100.0%	100.0%		
		% within GROUPS	.0%	20.0%	10.0%		
Total	Count	10	10	20			
	% within SEM	50.0%	50.0%	100.0%			
				100.0%			

bracket position of 20 sample teeth (10 from each group) were evaluated under scanning electron microscope for surface roughness at magnification of 1000X and were compared.

6. All the SEM pictures were scored from 0 to 5 based on comparative surface roughness by a single examiner (Figs.3-5). The readings were taken 3 times at an interval of 2 weeks between each scoring. This was done to eliminate intra examiner bias. Blinding of the examiner was done to avoid bias. Then the scores were graded as follows:

0 and 1- Mild roughness
2 and 3- Moderate roughness
4 and 5- Severe roughness

7. The mean scoring of groups A was 2.0 and group B was 3.4 on evaluation with Pearson's Chisquare test. The results were significant with 'p' value below 0.001, which indicated increased surface roughness in Group B compared to the Group A patients (Table 3). The scores were plotted on a graph (Fig.8).

DISCUSSION

Fixed appliances are an inseparable part of contemporary orthodontic treatment. But a major disadvantage of fixed mechanotherapy is significant amount of enamel demineralization that might occur adjacent to orthodontic bracket even within one month of bonding. Decalcification of the enamel surface adjacent to fixed orthodontic appliance is an important and prevalent iatrogenic effect of orthodontic therapy. The banding and bonding of orthodontic appliances to teeth increases the number of plaque retention sites and, as a result, oral hygiene maintenance becomes more difficult. The low pH of plaque adjacent to orthodontic brackets hinders the remineralisation process and demineralization of enamel can occur. As enamel translucency is directly related to the degree of mineralization, initial enamel demineralization usually manifest itself clinically as a white spot lesion. Such a lesion has been clinically induced within a span of four weeks, which is typically within the time period between one orthodontic appointment to the next.[34,35]

In a highly cariogenic environment these lesions can rapidly progress. If left untreated, they may produce carious cavitations that may need an appropriate restoration. Thus, prevention, diagnosis, and treatment of white spot lesions (WSL) are crucial to prevent tooth decay as well as minimize tooth discoloration that could compromise the esthetics of the smile[37&38].

The most important prophylactic measure to prevent occurrence of white spot lesions in orthodontic patients is by educating the patient about the importance of maintaining a high standard of oral hygiene by implementing a proper oral hygiene regimen. The use of topical fluorides in addition to

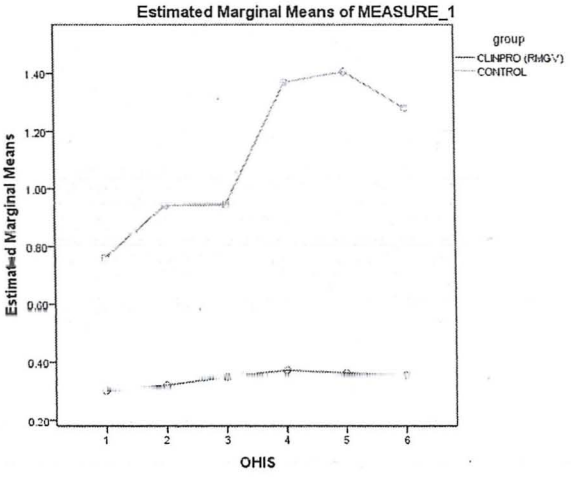


Fig. 6.

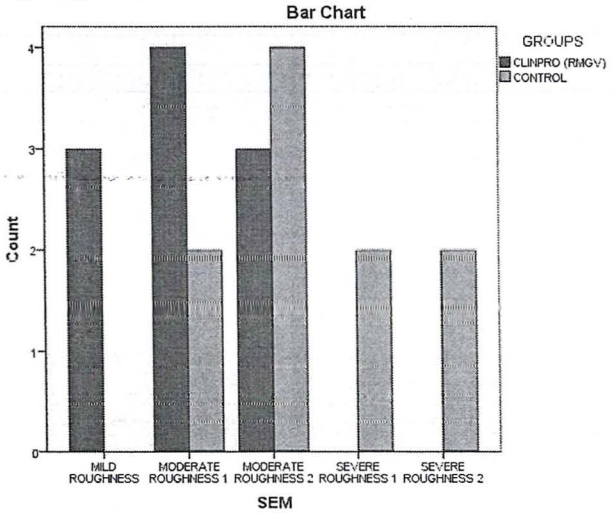


Fig. 7.

fluoride tooth paste appears to reduce the incidence of decalcification in patients undergoing orthodontic treatment with fixed appliance[12]. Various forms of fluoride supplements like mouth rinses, gels, high-potency gels, varnishes, have been shown to reduce the incidence of decalcification in patients undergoing orthodontic treatment, but none appear to be superior. Hence patient compliance is necessary for prevention of white spot lesions.

The term white spot lesion was defined by Fejerskov as "the first sign of a caries lesion on enamel that can be detected with the naked eye." Demineralization of enamel around brackets can be extremely rapid process and appears most frequently on the cervical and middle thirds of the buccal surfaces of maxillary lateral incisors, mandibular canines and first premolars. Decalcification of the labial (buccal) surfaces of teeth during orthodontic therapy is a problem of clinical importance, as shown by the finding that 50 per cent of the patients experienced an increase in white spot lesions. Certain teeth and tooth surfaces exhibit a predisposition to white spot formation. Decreased access to the flow of saliva and the distance from bracket to free gingival margins is the factors for white spot formation, suggested by the data. The male patients did experience an increase in the severity of opacities following orthodontic treatment.[1]

Recently, the measurement of white spot lesions from conventional photographic images using computerized image analysis was suggested for the clinical setting. Thereproducibility of this method has been confirmed by various study protocols and the accuracy has also been proved when carried out on digital images.[39] The area of white spots when quantitatively assessed was increased significantly during orthodontic treatment and decreased markedly during the first and second years post treatment, but did not reach the pretreatment level even 12 years after debonding. White spot lesions classified as related to orthodontic appliance treatment showed similar results and might be a cariologic and cosmetic problem even 12 years after debonding.[32]

Several preparations have been shown to reduce the incidence of decalcification in patients undergoing orthodontic treatment with fixed appliances, but none appears to be superior. High-potency preparations appear to offer benefits. It is not possible to recommend which topical preparations or schedules, provide the greatest decrease in decalcification.[34]

Since patient compliance during orthodontic treatment is unreliable and variable, there is a strong need for compliance-free methods that are not time-consuming for reduction of enamel lesions. Single topical application of fluoride varnish with a high concentration can decrease enamel lesion depth adjacent to bonded brackets for 3 months by about 40%.[27]

Use of glass ionomer cement as an orthodontic adhesive is more effective in preventing decalcification during fixed appliance treatment than a conventional composite resin but the evidence is weak. Because of the limitations of successful bonding with a glass ionomer adhesive it is not recommended.[18]

Together with RMGIV (Clinpro XT Varnish) and use of fluoride-releasing orthodontic materials may reduce the risk of enamel demineralization during orthodontic treatment. Similar decalcification prevention has been reported by many authors for other fluoride-releasing materials. The effects of RMGIV (Clinpro XT Varnish) have so far shown promising dose-related increases in enamel remineralization.

In this study, we have analyzed the effects of topical application of RMGIV (Clinpro XT Varnish) in preventing dimeralization in patients undergoing fixed orthodontic treatment. Incidence of new white spots/ enamel demineralization in patients undergoing orthodontic treatment and effect of RMGIV (Clinpro XT Varnish) on established white spot lesions was evaluated. Level of demineralization was assessed on the basis of surface roughness under scanning electron microscopy (SEM) and all the results were compared with control group.

30 orthodontic patients were divided into Group A (Test Side) and Group B (Control Side). As this is

in vivo study, only the patients indicated for orthodontic extractions were selected. Patients were informed and explained about the study method and possible increase in treatment time if any.

Evaluation of the extracted teeth was done using scanning electron microscope after 6 monthsof intraoral exposure.None of the patients selected in the study had white spot lesion at the start of treatment. During the treatment course of six month no new white spots appeared. Visual detection of the lesion is possible only after a substantial progress of the lesion. Until the demineralization has progressed to a certain level, initial sign of caries or demineralization that is the white spot lesion is not visible clinically. At this incipient stage of demineralization the surface of the enamel which is undergoing spontaneous demineralization and remineralization was evaluated at a higher magnification.[40]

Trimpeneers et al[8] used intraoral photographic slides before and after mean treatment period of 21 months and white spot lesion was analyzed only after debonding the appliance. Leonard Gorelick et al[4] evaluated visually for mean intra oral exposure of 22 months and in few patients, least exposure intraorally was 12 months which is sufficient for white spots to develop. Eliakim Mirahi[1] also evaluated patients with completed orthodontic treatment i.e. after mean exposure of 24-36 month. In our study the intraoral evaluation time was only six months, which may not be sufficient for the development of clinically appreciable white spot lesion.

Monthly monitoring of oral hygiene of patients was done. Oral hygiene scores showed significantly higher scores in Group B, which signifies that RMGIV (Clinpro XT Varnish) has a significant effect on reduction of plaque accumulation in Group A. The effect of fluorides in reducing plaque accumulation is seen in some studies but is questionable.[41] Fluoride is thought to cause an alteration of adhesive properties between enamel and bacteria as well as between bacterias themselves, resulting in less plaque accumulation (Titanoff et al 1976).[42]

Both the groups had good oral hygiene habits and were relatively co operative. Further placebo or double blind studies could be done to confirm if RMGIV (Clinpro XT Varnish) when applied together have an anti plaque effect.

As plaque accumulation is a cumulative process, oral hygiene scores were plotted against time, it showed a gradual increase in the OHI scores in both Group A and Group B. There was no difference in the trend of plaque accumulation in either of the groups but as previously noted, Group B had higher scores compared to Group A.

SEM evaluation was advantageous as visually we did not get any results. When orthodontic attachment is present and teeth are supplemented with RMGIV (Clinpro XT Varnish), the teeth showed mild to moderate surface roughness, and in teeth which were not supplemented RMGIV (Clinpro XT Varnish) application showed severe roughness in about 50% of the samples.

This indicated that before formation of white spot lesion the enamel demineralization is sub clinically present and may aggregate to a clinically higher level leading to white spot lesion and further cavitations. Simultaneous application of RMGIV (Clinpro XT Varnish) with additive fluorides and accompanied with thorough oral hygiene measure can prevent the inception of clinically visible white spot lesions.

CONCLUSION

Enamel demineralization is a known side effect of Orthodontic treatment. Use of Resin Modified Glass Ionomer Varnish (Clinpro XT Varnish) as an adjunctive to thorough oral hygiene measures has proven to be effective in reducing enamel demineralization significantly although not completely, when compared to patients not using any such adjunctive. The oral hygiene also improves but whether this is due to the active ingredient of the varnish or just another motivation factor to the patient for maintaining better oral hygiene is not confirmable under this study design. Further placebo study may be required to confirm it.

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Pierre Fauchard Academy

India Section

request your gracious presence during the

26th ANNUAL CONVOCATION

and

AWARDS CEREMONY

which shall be held on

Saturday, December 15, 2012

12 Noon

at

I.T.S. Centre for Dental Sciences and Research

Meerut Road, Murad Nagar, Ghaziabad – 201 206.