ENAMEL SURFACES WITH SEM AFTER THE APPLICATION OF DIFFERENT IN VIVO STRIPPING METHODS

Delal Dara KILINC[1], Orhan HAMAMCI[2]*

[1]Private Practice Adiyaman / TURKEY
[2]Professor Dicle University Faculty of Dentistry Department of Orthodontics Diyarbakir / TURKEY

Abstract

Aim: Space gaining method is one of the long standing methods used in orthodontics that still preserves its currency. The space method applied as made from the approximal surfaces of teeth is among the alternative methods developed against other methods. In this study, it is aimed to evaluate the results of morphological changes formed by classical metal band stripes and air rotor stripping (ARS) over teeth between 1st and 3d months by checking Scanning Electron Microscope (SEM).

Materials and Methods: 40 premolar teeth of 10 patients were applied stripping process using ARS and metal band stripes as a space method from mesial and distal surfaces. The mesial and distal surfaces of 40 premolar teeth were examined by extracting teeth in the 1st and 3rd months.

Results: In terms of surface roughness statistically significant difference was found in the stripping process made by ARS and metal band stripes. ($p<.05$) However when it was evaluated according to the 1st and 3rd months no statistically significant difference was found. ($p>.05$)

Conclusion: As a result of our research we were convinced that ARS system will be more beneficial in terms of patient comfort and hygiene motivation after the treatment.

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Key words: Air rotor stripping, band strippes, approximal abrasion, enamel thickness.

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Introduction

Air rotor stripping (ARS) is a technique used to remove controlled amount of proximal enamel in posterior segments to gain arch length for retracting and aligning anterior teeth. This treatment philosophy centers on overcoming the difficulties in adult extraction cases and the instability of over expansion in none-extraction cases. In addition, a posterior stripping strategy has been reported to significantly reduce treatment time when compared with premolar extraction treatment.[1]

The ARS can be differentiated from reproximation, slenderizing, or simply stripping in that these terms usually refer to enamel reduction procedures in the mandibulary incisor region. The main indications for the technique include reshaping the approximal contacts,[2] solving Bolton discrepancy problems,[3] treating mild or moderate crowding, and stabilizing the dental arch.[4] Little concern over caries development is raised when the mandible incisor are slenderized as this area seldom develops caries. However, extending stripping posterior into areas that are certainly more caries prone may lead to increased caries susceptibility.

With scanning electron microscopy (SEM), researches[5] reported that metal strips used for gross reduction of proximal surfaces of premolars in vivo caused irreversible furrows in the enamel resulting in a significant increase plaque accumulation. A number of in vitro investigations have also examined caries formation on abraded and unabraded enamel surfaces [6-11] and have found significant increases in the rate of demineralization on abraded versus intact enamel. These findings have led others [12-14] to suggest that stripping should be done with caution, and only in patients with good oral hygiene.

The aim of this study to examine the structure characteristics on the enamel surfaces that were applied stripping in the 1st and 3rd months following the two different stripping methods made by using ARS and band strippes.

***Corresponding author:**
Dr. Dara KILINÇ
Private Pratice Adiyaman/TURKEY

Fax: + 90 412 2488100
Phone: + 90 412 2488101/3410
Email: ddarakilinc@ gmail.com

Materials and Methods

Our research was planned according to total 40 teeth including the lower and upper I. Premolar teeth of 10 patients applied to our clinic for treatment suffering skeletal and dental Class I anterior crowding anomaly. The following criteria were taken into consideration in the selection of patients and teeth. The patient;

1) Should have a good mouth hygiene and skeletal and dental class I anterior crowding requiring 4 premolar extractions for treatment.
2) Should not have any systemic disease.
3) Should not have any endodontic, conservative and prosthetic restoration in all teeth.
4) Should not have any bad habits such as bruxism.
5) Should not have enamel hyperplasia and enamel thicknesses should be compatible with the research of Shillingburg et al[15](table 1, 2).

	OCLUSAL				MID CROWN				ENAMEL DENTINE LINE			
	INCISAL	F	CENTRAL	L	M	D	F	L	M	D	F	L
Central												
Enamel	0.9				0.7	1.0	1.0	0.7				
Dentine	3.4				1.6	1.4	1.6	1.0	2.2	2.5	2.3	3.1
Lateral												
Enamel	0.9				0.8	1.0	0.6	0.7				
Dentine	3.3				1.2	1.1	1.2	0.9	1.8	2.2	1.7	2.4
Cuspid												
Enamel	1.1				0.7	0.8	0.8	0.7				
Dentine	4.4				1.8	2.0	2.2	2.0	2.0	2.7	2.2	2.9
I. Premolares		T	O	T								
Enamel		1.5	1.3	1.8	1	1.2	1.1	1.0				
Dentine		3.0	3.1	3.3					2.1	2.5	2.1	2.8
II. Premolares		T	O	T								
Enamel		1.7	1.3	1.7	1.1	1.3	1.1	1.4				
Dentine		3.3	3.2	3.4					2.2	2.6	2.2	2.5

Table 1. Enamel And Dentine Thickness Of Upper Teeth (**M**: Mesial, **D**: Distal, **F**: Facial, **L**: Lingual, **T**: Tuberculum, **O**: Fissur).

	OCLUSAL				MID CROWN				ENAMEL DENTINE LINE			
	INCİSAL	F	CENTRAL	L	M	D	F	L	M	D	F	L
Incisors												
Enamel	0.9				0.6	0.9	0.7	0.6				
Dentine	3.7				1.0	1.0	1.2	0.9	1.5	2.3	1.5	2.4
Cuspid												
Enamel	1.0				0.6	0.8	0.8	0.6				
Dentine	3.6				2.0	2.0	2.1	1.7	2.1	2.8	2.2	2.9
1. Premolares												
Enamel	1.1	1.3	1.2	1.1	1.0	1.2	1.0	1.1				
Dentine	4.4	3.2	2.0	3.0					2.1	2.5	2.1	2.8
II. Premolares		T	O	T								
Enamel		1.6	1.3	1.6	1.1	1.3	1.1	1.4				
Dentine		3.4	2.7	3.8					2.2	2.6	2.2	2.5

Table 1. Enamel And Dentin Thickness Of Upper Teeth (**M**: Mesial, **D**: Distal, **F**: Facial, **L**: Lingual, **T**: Tuberculum, **O**: Fissur).

It was planned to apply ARS operation to the mesial surfaces of the teeth that will be used in our study and make stripping with thin granned band stripes to the distal surfaces. After stripping the premolar teeth in the left quadrant were decided to be extracted at the end of the first month and the premolar teeth in the right quadrant were at the end off the third month. In our study, the periapical and bitewing radiographies were obtained from the teeth in the area where stripping is intended to be made.[16] Enamel thicknesses and anatomic variations were evaluated in detail in the radiographies obtained. The patients with sufficient enamel thickness and who don't have anatomic variation were selected for stripping that will be made by ARS and band stripes.

The thin granned band stripes were applied through the aproximal surfaces of the teeth. The stripping obtained by band stripes was performed manually providing a parallel motion. The stripping was ended as the band stripe could move through the teeth approximal easily.

Wire indicator was placed to prevent the laserations that might form in tissues and also ARS application to be a guide before the stripping as suggested by Sheridan.[17-19] In ARS operation specially produced safe tipped (Stars Series) (Dentsplay Raintree Essix, Inc. Metairie, LA, USA) burs was applied water cooled to prevent the teeth from air rotor heat. The edges of these burs were designed and produced so as to prevent step formation. Stripping was made as offered by the producer firm.

* Applying stripping by using safe tipped 699 L carbide burs
* Initial contouring and smoothing out by safe tipped medium grid (100 µ particles of size)
* Continuation of smouting out by safe tipped fine grid (30 µ particles of size)
* Making the surface ending by safe tipped extra fine grid (30 µ of size)

Stripping was ended in ideal distance by measuring through "space measuring gauges", which is obtained with ARS kit. It was applied once a month with a period of 2 minutes by the help of a micro brush, providing spittle isolation accompanied by flour solution named Remin + (Raintree Essix, Inc. Metairie, LA ,USA) located inside the ARS kit. The patient was recommended not to eat anything for a hour.

1. Premolar teeth in the left quadrant were extracted at the end of the first month and the 1.premolar teeth in the right quadrant were extracted at the end of the third month. The extracted teeth were left inside 25 % gluther aldehyde solution and fixed until SEM examination.

The mesial and distal surfaces of the samples obtained were examined in SEM device. The SEM images of the tooth, that was not applied any stripping was obtained. Randomly chosen 10 photographs were evaluated as “rough” or “less rough” by taking the SEM image that was not operated in different times as the guided. No statistically significant difference was observed among the results of the researchers. All other photos were evaluated afterwards. The data obtained were evaluated by using Chi-square test and SPSS 13.0 package program.

Results

The ARS applied teeth was examined as 70 % less rough, 30 % rough in the first month (Figure 1,2).

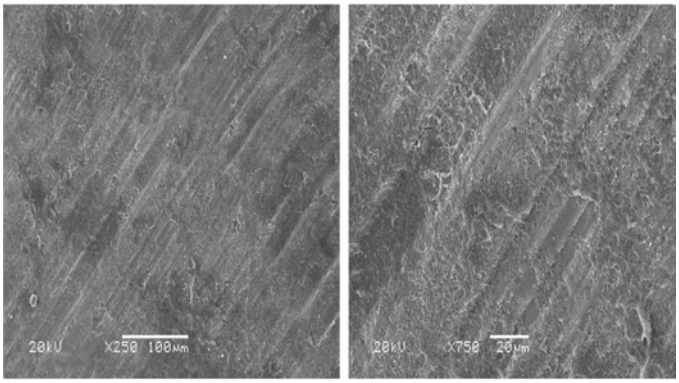

Figure 1. The SEM photographs of less rough enamel surfaces on the first month after ARS application.

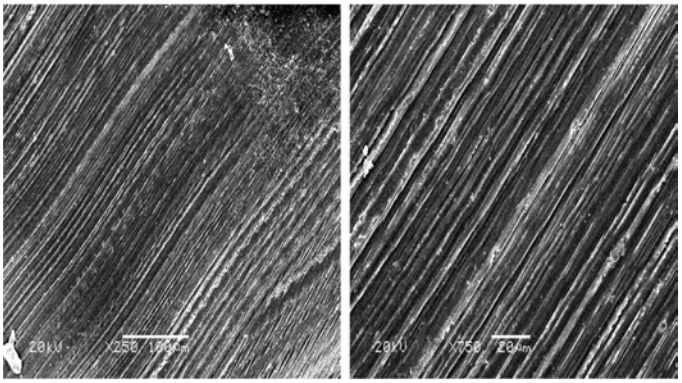

Figure 2. The SEM photographs of rough enamel surfaces on the first month after ARS application.

In the third month 82.5 % less rough and 17.5 % roughness ratio was observed (Figure 3,4).

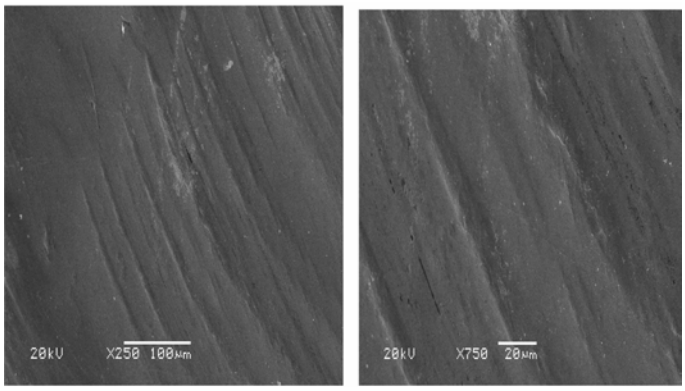

Figure 3. The SEM photographs of less rough enamel surfaces on the third month after ARS application.

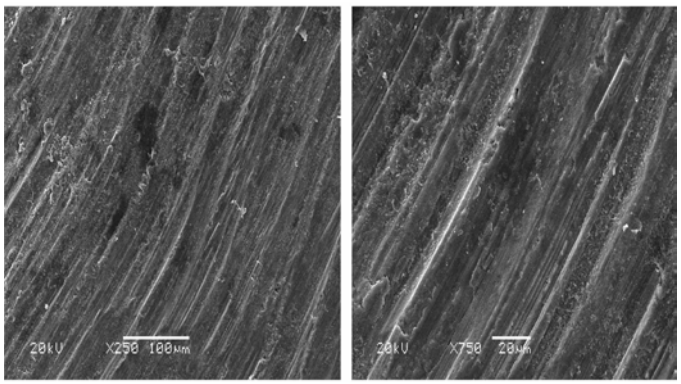

Figure 4. The SEM photographs of rough enamel surfaces on the third month after ARS application.

When the ARS applied teeth operation was evaluated together as 1 and 3 months they were observed as 76.3 % less rough and 23.7 % rough. No statistically significant difference was found in the teeth applied ARS operation between 1 and 3 months (p>.05) (Table 3).

STRIPPING TECHNIQUE		Roughness		Less Roughness		Total		Significant
		n	%	n	%	n	%	Chi Square
ARS	1 month	12	30	28	70	40	100	p>.05 (1.726)
	3 month	7	17.5	33	82.5	40	100	
	total	19	23.7	61	76.3	80	100	
Band Stripes	1 month	28	70	12	30	40	100	p>.05 (1.796)
	3 month	33	82.5	7	17.5	40	100	
	total	61	76.2	19	23.8	80	100	

Table 3. The Evaluation of roughness after ARS Application and Stripping with Band Stripes According to Months.

When the ARS applied teeth is examined as lower and upper arch, 72.5 % less roughness as seen in the lower arch and in the upper arch this ratio determined as 80 %. (p>.05) When upper and lower teeth were examined alltogether; 76.8 % less roughness was observed and ther was not statistically significant difference (p>.05) (Table 4) (Figure 5,6).

STRIPPING TECHNIQUE		Roughness		Less Roughness		Total		Significant
		n	%	n	%	n	%	Chi Square
ARS	Upper arch	8	20	32	80	40	100	p>.05 0.431
	Lower arch	11	27.5	29	72.5	40	100	
	total	19	23.8	61	76.2	80	100	
Band Stripes	Upper arch	32	80	8	20	40	100	p>.05 0.431
	Lower arch	29	72.5	11	27.5	40	100	
	total	61	76.2	19	23.8	80	100	

Table 4. The Evaluation of Roughness after ARS Application and Stripping with Band Stripes in The Upper and Lower Arch.

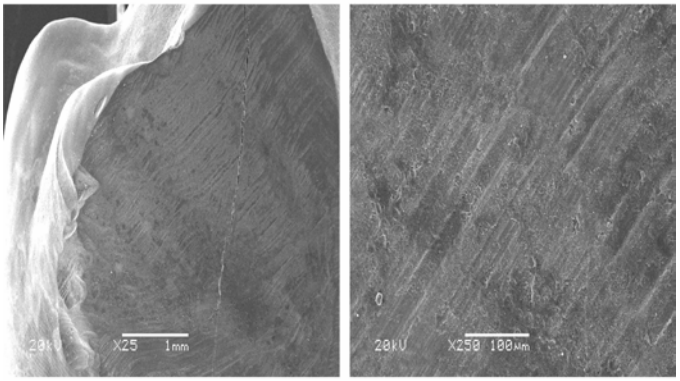

Figure 5. The SEM photographs of ARS applied enamel surfaces in the lower arch.

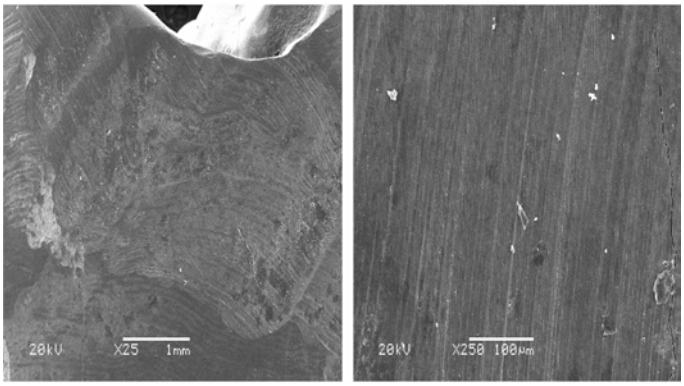

Figure 6. The SEM photographs of ARS applied enamel surfaces in the upper arch.

In the band stripes applied teeth 30 % less roughness, 70% roughness was observed at the first month (Figure 7,8) and in the third month 17.5 % less roughness and 82.5% roughness was observed.(Figure 9,10) When band stripes applied teeth were evaluated together for 1 and 3 months 23.8 % less roughness and 76.2 % roughness was observed. (Table 3)

When the band stripes applied teeth examined by separating as upper and lower arch in the lower arch 27.5 % less roughness was observed and this ratio was 20 % in the upper arch. When all upper and lower teeth are taken together 23.8 % less roughness was observed. No statistically significant difference was found (p>.05) (Table 4). (Figure 11,12).

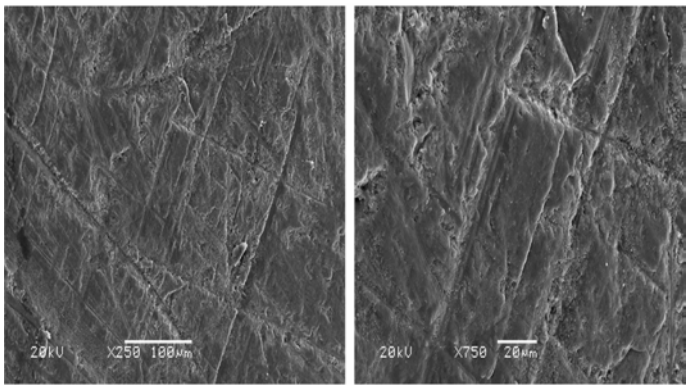

Figure 7. The SEM photographs of less rough enamel surfaces on the first month after band stripes application.

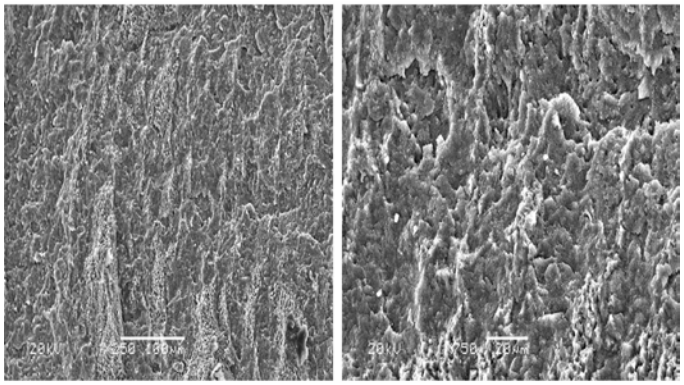

Figure 8. The SEM photographs of rough enamel surfaces on the first month after band stripes application.

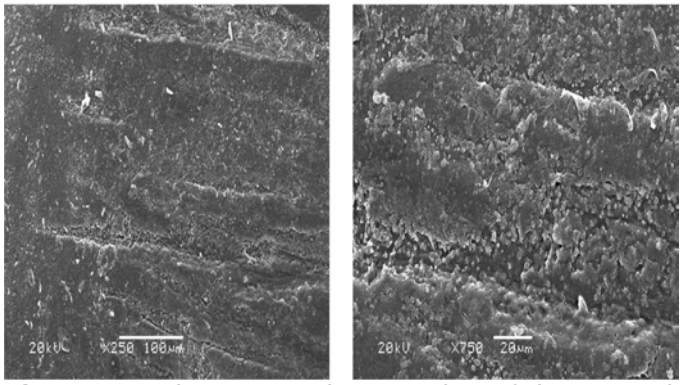

Figure 9. The SEM photographs of less rough enamel surfaces on the third month after band stripes application.

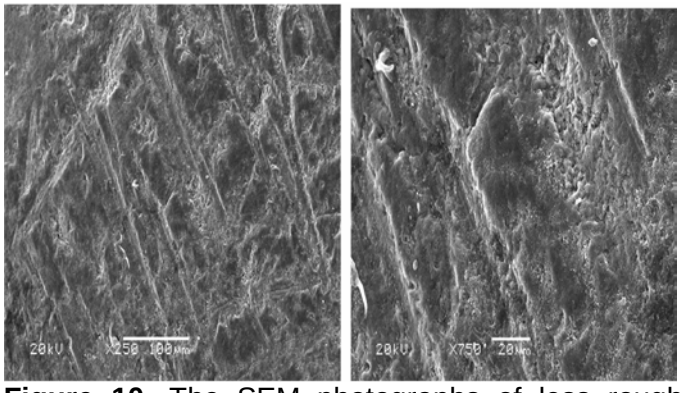

Figure 10. The SEM photographs of less rough

enamel surfaces on the third month after band stripes application.

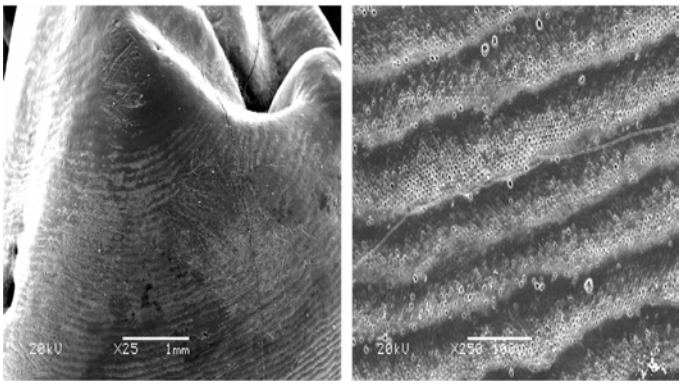

Figure 11. The SEM photographs of band stripes applied enamel surfaces in the upper arch.

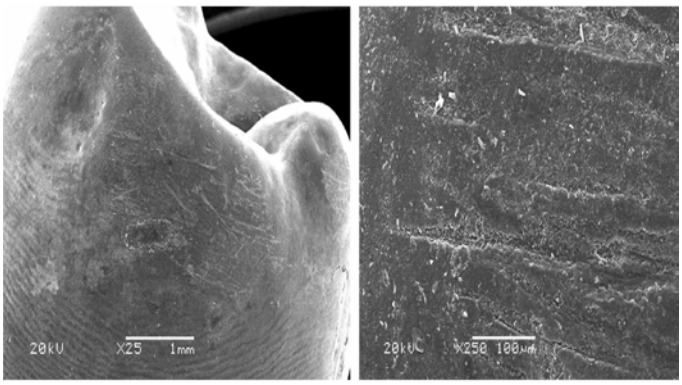

Figure 12. The SEM photographs of band stripes applied enamel surfaces in the lower arch.

When evaluated with stripping methods in the first month 70 % less roughness was observed in ARS the first month and 30 % ratio was observed in band stripes. (p<.05) In the third month 82.5 % less roughness was observed in ARS operation and 17.5 % ratio was observed in band stripes. (p<.05) In the first and third months 76.3 % less roughness was observed in ARS operation and 23.7 % ratio was observed in band stripes (p<.05)(Table 5).

STRIPPING TECHNIQUE		Roughness		Less Roughness		Total		Significant
		n	%	n	%	n	%	Chi Square
1st MONTH	ARS	12	30	28	70	40	100	
	Band strippes	28	70	12	30	40	100	p <.05 (12.80)
3th MONTH	ARS	7	17.5	33	82.5	40	100	
	Band strippes	33	82.5	7	17.5	400	100	p <.05 (33.80)
TOTAL	ARS	19	23.7	61	76.3	80	100	
	Band strippes	61	76.3	19	23.7	80	100	p <.05 (44.10)

Table 5. The evaluation of roughness after ARS application and stripping with band stripes among themselves according to the months.

Discussion

The abrasion in aproximal surfaces were observed by Begg[20] in Australia Stone Age man and it was determined that there were no crowding in the regions where interproximal abrasion was observed. Today it is observed that the arch length, arc depth, with and intercanin length decreases by time[21]. The contraction in arch length turns into crowding and anomalies by time[22]. Today the procedures depending on slenderizing the enamel thickness in orthodontics practice is used more efficiently for the solution of crowding from minor to mild level among clinicians. [23] In the border line cases events that extraction decision can not be taken to gain the needed space for treatment without expansion, stripping 0.25 mm from the aproximal surfaces of the teeth was recommended[24].

In the border line cases that were decided to be treated by ARS 0.50 mm stripping was recommended from the approximal surfaces of the teeth.[17] Straud et.al [25] measured the thickness of enamel and dentine and reported that the enamel thickness in the distal surfaces of the teeth was more and space gainning of 8 mm could be solved by abrasion of the enamel of the teeth at a ratio of 50 % and by abrasion of the molar teeth.

Morphological changes in enamel as a result of stripping procedures are inevitable. As in our study the researchers[3, 4] evaluated the examination of teeth surface as qualitative studies depending on observation in terms of morphology. These morphological changes carry importance in terms of the future life comfort of the patient. Because the increase in the amount of roughness in the enamel increases colonization [26-28] and forms microbial colonization approximately 25 times compared to a smooth surface[27].

It is indicated that this colonization increases periodontal problems and decay incidence.[26-28] But there is also studies that don't contain any problem as a result of the stripping in the follow-up containing 2-5 years.[29] Jarjoura et al[30] called the patients for controlling in once in six months who have ARS applied teeth and had no operation and didn't observe any problems. Research reported that the secondary enamel formed after abrading on enamel surface was more resistant against decay[29].

In the research of the Zacrisson et al.[31] no decay formation in teeth was seen after strippind in a period of 10 years follow-up. We also didn't deserve areas inclined to decay or periodontal problems over teeth as a result of 3 monthly controls. We think that the bacterial colonization will be prevented and integrity will continue by a good awareness raising, flour application and motivation.

As a result of strpping abrasive troughs were seen in teeth. In our study variable ratios of wells and troughs were observed. Radlanski[5] indicated in SEM study that the traces occurring after abrading with a thick granned drill on enamel surface could be decreased by a thinner granned drill but could not be removed completely. Arman et al.[28] in their SEM surface examination reported that cavity and spurs on the surface of the enamel can be observed even in a good polishing operation. Moreover abrading traces can be followed in a ten year follow-up.[32] Radlanski et al.[5] observed irreversible changes in stripping made by band stripes and indicated the inclination to the formation of plaque accumulation and dental caries. We believe that the difference between the stripping surfaces made by ARS and band stripes arises from using polishing techniques in ARS operation as mentioned by the researchers.

One of the complications that may form in stripping operation was reported as sensitivity. In our study, no sensitivity was observed in the information obtained from patients till the teeth extraction period. We believe that as recommended by Rossouw and Tortorella[33] enamel thickness was determined by obtaining bitewing radiographies and so possible complications may be prevented and this situation arises from the lack of tubular and nerve ending inside the enamel tissue in case of the ARS operation is made in disciplined approach.

Conclusion

As a result we believe that while in all teeth applied ARS and band stripes areas causing plaque accumulation and retention are observed; the ARS applied surfaces can give more positive results in terms of self-healing.

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