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Restoration Status in the Treatment of Non-Carious Lesions Associated with Fatty Liver Disease

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Abstract In patients with non-carious hard tissue lesions associated with fatty liver disease, the clinical performance of restorations was assessed at multiple follow-up intervals. A comparative analysis of restoration status—using the USPHS "Alpha" rating—was carried out across these observation periods. Additionally, under a comprehensive treatment protocol, enamel acid resistance (TER-test) and salivary remineralization potential (COSRE-test) were evaluated and compared.

Keywords Dental erosion, Non-carious lesions, Enamel acid resistance, Orthophosphoric acid etching, Composite restoration, TER-test, COSRE-test, Remineralization therapy, Marginal adaptation

1. Introduction

It is well established that Grade II–III erosive defects of dental hard tissues necessitate restorative treatment. Because these lesions predominantly affect the anterior teeth, only light-curing composite materials are used, with acid etching of the enamel as a mandatory step (typically 5–15 seconds) [2,4].

Considering that the extent of enamel erosion depends on factors such as the acid content of foods and beverages, duration of exposure, oral pH, and the mineralization status of the tooth, it is essential to determine the optimal etching time with 37 % orthophosphoric acid when restoring eroded primary teeth [1,3].

To establish the proper etching duration, 22 children were enrolled 12 with healthy enamel and 12 with erosive lesions and a total of 62 tests were performed to assess enamel permeability after acid exposure. Following etching, the tooth surface was stained with a 2% aqueous methylene blue solution.

2. Materials and Methods

In both healthy and eroded groups, a 2 mm-diameter drop of acid was applied to the medial segment of the vestibular surface of the central incisors for 15 seconds, and to the distal segment for 5 seconds. The acid was then rinsed off, and the tooth surface was dried. A cotton pellet soaked in 2% methylene blue was applied to the etched area for one minute. Acid resistance was evaluated by the degree of dye uptake, scored using a ten-point topographic intensity scale of blue coloration.

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In the healthy cohort, 5 seconds of etching prodced a mean staining intensity of 46.7±2.1%, which rose to 60.0±3.7% after 15 seconds ($p<0.05$). In contrast, patients with enamel erosion exhibited 68.3±4.8% staining at both 5 and 15 seconds ($p>0.05$).

These results indicate that in teeth without pathology, staining intensity and thus acid penetration increases with longer etching times, whereas in eroded enamel the degree of penetration remains uniformly high regardless of exposure time.

3. Result and Discussion

Thus, whereas intact teeth require adherence to a 5-second etching time, in cases of enamel erosion this duration should be reduced three-fold. It is noteworthy that immediately after placement, all restorations were rated "Alpha" for marginal adaptation, anatomical form, and color match an indication of excellent initial outcomes. However, by the 6- and 12-month reviews, the clinical performance of the restorations in the study groups had changed (see Table 1).

Thus, in the comparison group, one filling was lost after 6 months (2.6%), and four fillings (10.3%) were lost by the 12-month mark. In the main group, only one restoration was rated as "Bravo" after 6 months, while the remaining were rated "Alpha." After 12 months, only one filling had failed (2.7%).

As seen in Table 1, after 6 months of observation in the comparison group, the marginal adaptation of some restorations had deteriorated. By 12 months, a decline in marginal adaptation, anatomical form, and color match was observed in a majority of the restorations ($p < 0.001$). In contrast, the main group showed no significant deterioration after 6 months, and at the 12-month follow-up, only one filling was rated "Charlie" compared to four in the comparison group.

Table 1. Clinical evaluation of restoration status at different follow-up intervals in patients with non-carious lesions associated with fatty liver disease. (M±m)

Group	Criteria	6 months			12 months		
		A(Alfa)	**B(Bravo)**	**C(Charlie)**	**A(Alfa)**	**B(Bravo)**	**C(Charlie)**
		%	%	%	%	%	%
Comparison (n=15)	Marginal adaptation	89,7	7,7	-	76,9	12,8	-
	Anatomical form	92,3	5,1	2,6	71,8	18,0	10,3
	Color match	92,3	5,1	2,6	76,9	12,8	10,3
2A group (n=36)	Marginal adaptation	97,3	2,7	-	89,2	8	2,7
	Anatomical form	100,0	-	-	89,2	8	2,7
	Color match	100,0	-	-	91,9	5,4	2,7
2B group (n=24)	Marginal adaptation	97,3	2,7	-	91,9	5,4	2,7
	Anatomical form	100,0	-	-	89,2	8	2,7
	Color match	91,9	5,4	2,7	76,9	12,8	10,3

Table 2. Comparative analysis of the clinical condition of restorations rated "Alpha" at different follow-up intervals in patients with non-carious lesions of hard dental tissues. (M±m)

Group	Marginal adaptation to the cavity walls, %		
	10 mins	6 months	12 months
Comparison (n=15)	100,0±0,0	98,4±2,1	95,3±2,3
Main (2A) (n=36)	100,0±0,0	100,0±0,0	97,3±2,7
Main (2B) (n=24)	100,0±0,0	89,7±4,9	76,9±6,8
Anatomical form, %			
Comparison (n=15)	100,0±0,0	92,3±4,3	89,7±4,9
Main (2A) (n=36)	100,0±0,0	100,0±0,0	97,3±2,7
Main (2B) (n=24)	100,0±0,0	89,2±5,1	76,9±6,8
Discoloration at the restoration margins, %			
Comparison (n=15)	100,0±0,0	92,3±4,3	76,9±6,8
Main (2A) (n=36)	100,0±0,0	100,0±0,0	91,9±4,5
Main (2B) (n=24)	100,0±0,0	89,7±4,9	71,4±6,8

Table 3. Comparative analysis of enamel acid resistance (TER-test) and salivary remineralization potential (COSRE-test) in patients with non-carious lesions of dental hard tissues following comprehensive treatment (M±m, %, day,)

Group	**TER-test, %**		**COSRE-test, days**	
	Until treatment	After treatment	Until treatment	After treatment
Control Group (n=20)	46,7±2,1%		2,4±0,2	
Comparison Group (n=15)	56,5±2,5%	52,3±3,9%	4,1±0,2	3,2±0,2*
Main Group (2A) (n=36)	64,3±4,2%	49,1±2,2%	4,5±0,2	3,4±0,1
Main Group (2B) (n=24)	62,1±4,1%	54,5±2,2%	4,4±0,1	4,3±0,2

Note: * – Differences were statistically significant compared to healthy individuals at $p<0.05$.

For comparative analysis of restoration quality specifically marginal adaptation, anatomical form, and color match the "Alpha" rating was used. The outcomes of this comparison are presented in Table 2.

Thus, the treatment of dental hard tissue erosion using the recommended method demonstrated that the number of unsatisfactory restorations in the main group was significantly lower, and the marginal adaptation of the fillings was notably higher from the very first day of placement. It was also found that the proposed treatment approach maintained favorable marginal adaptation over a prolonged period and significantly reduced the percentage of unsatisfactory outcomes across different follow-up intervals.

Certainly, it was logical to expect an improvement in enamel resistance to acid in the TER test when performing enamel saturation treatments and remineralization therapy (main group). In the main group, the decrease in the index (i.e., an increase in enamel resistance to acid) averaged 47.1%, approaching the values observed in the control group children. However, a similar, albeit less pronounced, effect was also observed in the comparison group where comprehensive treatment was not performed. This change is associated with several factors, including improved oral hygiene, reduced acid production by microorganisms, increased salivary flow, and possibly enhanced remineralization potential of the oral fluid.

The COSRE test results showed that the remineralization time in the main group approached that of the control group (3.4±0.1 days and 3.2±0.2 days, respectively). In contrast, the comparison group showed almost no change, with remineralization time at 4.3±0.2 days ($p<0.05$).

Overall, these data indicate a significant increase in enamel mineralization levels in patients of the main group following comprehensive treatment. Moreover, the shortening of the enamel surface layer remineralization time was clearly evident when compared to patients in the comparison group.

4. Conclusions

Thus, following the recommended methods for treating dental erosion, an increase in enamel resistance to acid and a reduction in remineralization time were observed. These positive outcomes suggest improved enamel mineralization processes in children affected by enamel erosion.

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