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Evaluation of the Erosive Effect of Specific Medicinal syrups on the Surface Microhardness of the Enamel of Primary Teeth

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ABSTRACT
Background: This study aims to investigatethe effect of specific medicinal syrups on the enamel of primary anterior teeth using surface microhardness test.
Materials and method: 64 primary anterior teeth were used in the study. Enamel blocks were prepared and divided into two groups (32) samples for each: group (1) samples were treated with Salbutamol syrup, group (2) sampleswere treatedwith Paracetamol syrup.Vickers microhardness tester machine was used to evaluate the enamel surface microhardness of the tested samples at baseline, after 7 days and 14 days of drugs cycles. The obtained results were statistically analyzed.
Results:high statistically significant differences were found among the tested groups after drugs cycles.Independent sample T test was carried out to illustrate thatat baseline, no significant difference in surface microhardness readings was found among the tested groups. While after one week and two weeks of exposure to the syrups, significant difference in surface microhardness readings among the tested groups was found.
Conclusion: There was a reduction in surface microhardness of the enamel in both tested groups due to the demineralizing effect of the syrups.Salbutamol syrup showed higher erosive effect on primary teeth enamel when compared with paracetamol syrup.
Keywords: Dental erosion, Pediatric Medicinal Syrups,Surface Microhardness.

I. INTRODUCTION

Dental erosion is a pathological process that is chronic and characterized by localized loss of hard tooth structure, which is removed chemically by acid and/or chelation without bacterial involvement [1]. It is irreversible and its incidence has increased in the modern societies especially among children and adolescents as a result of changing in the eating habits [2]. People suffering from erosive wear during the period of deciduous dentition are usually at an increased risk of having erosion in the permanent dentition. Diagnosis and prevention of erosion at early age will aid in avoiding the harm to the permanent teeth [3].

The risk as well as the severity of dental erosion may be increased as a result of some medications. In children, prescriptions in the form of liquid are very common prescribed form of medicine in order to evade the problem encountered in taking the other forms. Acidic preparations are often essential in the formulations of these drugs as they can be added to act as buffering agents for maintaining chemical stability, physiological compatibility, controlling tonicity and enhancing the flavor, thus increasing the palatability to children. Different studies have stated that liquid oral medications can influence the hardness of the enamel and result in morphological alterations [4].

The aim of the study is to investigatethe effect of specific medicinal syrup on the enamel of primary anterior teeth using surface microhardness test.

II. MATERIALS AND METHODS

Ethical Aspect:

This study protocol was conducted in vitro, submitted and approved by the Local Ethics Committee (UoM.Dent/ H.L.2/ 21) Research Ethics Committee of Collage of Dentistry, University of Mosul, Nineveh, Iraq.

Sample Collection and Preparation:

Primary anterior teeth of children living in Nineveh Governorate were collected from the pediatric dental clinic in Al-Noor specialized dental center in addition to some private clinics.Among all the collected teeth, total of (64) deciduous teeth with intact enamel surface (no developmental defects, no cracks, caries, fluorosis, stain, restorations or exposure to chemical agents (i.e., bleaches) were used as the sample of this study after being checked for any structural abnormalities that could possibly interfere with the results.

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Teeth were cleaned and polished with rubber cup and non-fluoridated pumice then the roots were cut at the level of cement-enamel junction using straight diamond bur of a high-speed handpiece with continuous water cooling to avoid damaging of the enamel. Then the coronal portions of the specimens were embedded in auto polymerized cold cure acrylic resin blocks using (15 mm height) cylindrical plastic tubes (that were cut and prepared with flat and parallel upper and lower borders) with the outer labial surface facing upward. The enamel surfaces were grinded wet using (400 and 600) grit silicon carbide abrasive paper to produce standardized flat enamel surfaces for surface microhardness test [5].

Study Design

After preparation, teeth Samples were randomly divided into two groups as below:

1. Group 1: Salbutamol group No. = 32, these samples were treated with Salbutamol drug.

2. Group 2: Paracetamol group No. = 32, these samples were treated with Paracetamol drug.

Immersion Cycle:

Teeth were immersed into 100 ml of undiluted syrup and agitated for 1 min three times per day for 14 days. After each immersion, teeth were washed with distilled water and preserved in artificial saliva with daily change of the solution. Artificial was papered with the following components: NaCl 0.40, KCl 0.40, CaCL2.2H2O 0.79, NaH2PO4.2H2O 0.78, NaS9.H2O 0.005, CO (NH2)2 Urea 0.1, in 1000 ml distilled water (concentrations G\L) with pH value 7. The medicine was replaced before each immersion and at the end of the 14days; teeth were transported to microhardness testing laboratory where their enamel surface microhardness was measured [6].

Surface Microhardness Test

The microhardness of the enamel surface of the teeth was tested at Mosul Technical Institute / North Technical University using Vickers microhardness machine (OTTO WOLPERT−WERKE GMBH, V-Tester 2/ Germany). All readings were performed by the same examiner using the same calibrated machine. The microhardness was determined on the middle third of the labial surface of the teeth by the application of 500 gm load for 15 seconds which were constant for all samples and during the entire study. Three indentations were made on the flattest points of the enamel surface to ensure accuracy of the measurements, the length of each indentation was measured microscopically using 70X lens, and then, the mean value of these 3 indentations was calculated for each sample to obtain one reading [7].

Indentation result can be seen in the form of shadow forming rhomboidat projector screen, the diagonal lengths of the indentations was measured in micronby microscope. The Vickers values were converted into microhardness values using the following equation:

$HV = 1.854 (p/d^2)$ where:

HV: is microhardness value in Kgf/mm^2 (Mpa).

P: is the diagonal of the indentation (mm).

d: $d_1+d_2/2$[8].

III. RESULTS

According to the obtained measurements of this study, table (1) illustrates the descriptive statistics including means, standard deviations, minimum and maximum values in addition to the number of the samples in each tested group at baseline, after one week and after two weeks of exposure to salbutamol and paracetamol syrups.

Table (1): Descriptive statistics of microhardness measurements among tested groups at baseline, after one week and after two weeks.

Descriptive Statistics						
		N	Minimum	Maximum	Mean	Std. Deviation
At baseline	**Salbutamol**	32	206.00	245.00	226.18	8.29
	Paracetamol	32	210.00	245.00	226.46	8.08
	Valid N(listwise)	32				
After one week	**Salbutamol**	32	185.00	204.00	194.75	5.71
	Paracetamol	32	190.00	230.00	212.59	9.62
	Valid N(listwise)	32				

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After two weeks	**Salbutamol**	32	166.00	192.00	178.21	6.16
	Paracetamol	32	182.00	220.00	198.90	9.04
	Valid N(listwise)	32				

In table (2), independent sample T test was carried out to illustrate thatat baseline, no significant difference in surface microhardness readings found among the tested groups. While after one week and two weeks of exposure to the syrups, significant difference in surface microhardness readings among the tested groups was found and based on mean values of the tested groups, salbutamol syrup showed higher erosive effect when compared with paracetamol syrup.

Table (2): Independent sample T test among tested groups at baseline, after one week and after two weeks.

Independent Samples Test										
		Levene's Test for equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
At baseline	**Equal variances assumed**	0.23	.880	-.137	62	.891	-.28	2.04	-4.37	3.81
	Equal variances not assumed			-.137	61.95	.891	-.28	2.04	-4.37	3.81
After one week	**Equal variances assumed**	7.964	.006	-9.014	62	.000	-17.84	1.97	-21.80	-13.88
	Equal variances not assumed			-9.014	50.45	.000	-17.84	1.97	-21.81	-13.86
After two weeks	**Equal variances assumed**	2.021	.160	-10.68	62	.000	-20.68	1.93	-24.55	-16.81
	Equal variances not assumed			-10.68	54.70	.000	-20.68	1.93	-24.56	-16.80

IV. DISCUSSION

A new risk factor for dental health not only inadults but also in children and adolescents is tooth erosion which is presented by today's lifestyle. In dental erosion, frequent contact between acidsand tooth surface occurs which results in demineralization of the tooth surface [4].

The independent sample T test, which compared between the microhardness values of the samples exposed to butadin syrup with those of the samples exposed to antipyr syrup after 7 and 14 days of exposure to the drugs, has revealed that the erosive effect of butadin syrup was higher than that of antipyr syrup as butadin syrup caused higher

reduction in the microhardness mean values of the teeth samples when compared to the antipyr syrup.

Pediatric medicinal syrups may have a great erosive potential due to the existence of an acid component in their formulation. Thus, the analysis of their pH is an essential factor when studying dental erosion [9]. The pH value can be defined as the equilibrium measure of the hydrogen ion concentration [10]. The critical pH of enamel and dentin is the pH under which dental hard tissue begins to erode. It was reported that the critical pH for enamel located in the range of 5.2–5.5 [11]. Excessive dependence on Stephan Curve leads to considering foods and drinks as "safe" if they do not cause fall in pH below the so-called "critical pH" [12]. The dissolution of enamel is highly dependent on the pH of the substance surrounding it. A lower pH dissolves the hydroxyapatite of enamel more severely and at a faster rate than would a higher pH irrespective of the exact type of acid in a drink [13]. That is why, in this study, the analysis of pH played a major role in the assessment of the dental erosion process.

In our study, the pH values were measured for both medicinal syrups used and found to be (3.8) for salbutamol syrup (butabin) and (5) for paracetamol syrup (antipyr). Our measurements are close to that found in the study of Yılmazet al., (2019), who stated that the pH value for salbutamol syrup (ventolin) was (3.58) [14], and the study of Mahmoud and Omar, (2018) who stated that the pH value for paracetamol syrup (adol) was (5.33) [9].

Both medicinal syrups used in this study possessed pH below the critical pH of enamel demineralization which explains their erosive effect expressed by reduction in the microhardness mean values of the teeth samples exposed to these two medications and clarifies why salbutamol syrup (butadin) showed higher reduction in the microhardness mean values of the teeth samples when compared with paracetamol syrup (antipyr), as butabin syrup has pH value lower than that of antipyr.

Our findings are in accordance with the study by Yılmazet al., (2019) in which both paracetamol syrup and salbutamol syrup caused reduction in the microhardness mean values of teeth samples [14], but the reduction was higher in case of salbutamol syrup.

V. CONCLUSION

There was a reduction in enamel surface microhardness of the teeth samples of both groups due to the demineralizing effect of the syrups. Salbutamol syrup showed higher erosive effect on primary teeth enamel when compared with paracetamol syrup.

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