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Do Pediatric Medicinal Syrups Have an Effect on the Enamel Surface Roughness of Primary Teeth?

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ABSTRACT
Background: This study aims to investigatethe influence of specific medicinal syrups on the enamel surface roughness of primary anterior teeth.
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 treated with Paracetamol syrup. Roughness profilometer machine was used to evaluate the enamel surface roughness of the tested samples at baseline, after 7 days and 14 days of drugs cycles, then, the obtained data were analyzedstatistically.
Results:high statistically significant differences were found among the tested groups after drugs cycles.Independent sample T test was performed to illustrate thatat baseline, no significant difference in surface roughness readings was found among the tested groups. While after one week and two weeks of exposure to the syrups, significant difference in surface roughness readings among the tested groups was found.
Conclusion: There was anincrease in surface roughness of the enamel in both tested groups due to the demineralizing effect of the syrups. Salbutamol syrup showed higher increase in enamel surface roughnessof primary teeth when compared with paracetamol syrup.
Keywords: Primary Teeth, Pediatric Medicinal Syrups, Surface Roughness.

I. INTRODUCTION

Since deciduous teeth act as eruption guide for the permanent dentition, participate in jaw development and chewing process, they are important for childhood. Premature loss of these teeth can cause alteration in the eruption guide of the permanent tooth that leads to phonetic and aesthetic disturbances [1].

Some morphological differences present between enamel of primary teeth and that of permanent teeth. Enamel of primary teeth seems to be thinner than that of permanent ones, lesser mineralized (mineralization of 89.7% in permanent enamel and 80.6% in deciduous enamel) with prisms at the outer layer that are not completely formed, called aprismatic enamel [2]. It has been found that enamel demineralization of permanent and primary teeth in acidic media exhibits significant differences, with the enamel of permanent teeth showed less susceptibility to demineralization than that of primary teeth. All these variations increase the susceptibility of primary teeth to dental erosion [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. Different studies have stated that liquid oral medications can influence the hardness of the enamel and result in morphological alterations [4].
Trivial illnesses such as cough, fever, and anemia are very popular in childhood and frequently receive medications such as decongestants, antipyretic, and iron syrups for these conditions. A high consumption of these oral medicinal syrups may establish possible causative or aggravating factors for severe dental erosion in childhood [5]. Sugar is added to the bulk of oral liquid medications to make them palatable and therefore tolerable for the child. These sugars, mainly sucrose, act as a substrate for the oral bacteria, which ferment the sugar and produce acids with a subsequent drop in the pH of the mouth [6]. Acidic preparations are often essential in the formulations of 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.These propertiesmay be related to the loss of surface structure of dental enamel[4].

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The aim of the study is to investigate the effect of specific medicinal syrups on the enamel surface roughness of primary anterior teeth.

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.

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 [7].

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 14 days; teeth were transported to surface roughness testing laboratory where their enamel surface roughness was measured [8].

Surface Roughness Test

Surface roughness of the enamel surface of the teeth was tested at Mosul Technical Institute / North Technical University using a profile projector (Mitutoyo \type PJ-250 \ Japan) as shown in figure (3.17) with magnification of 50X. All readings were performed by the same examiner using the same calibrated machine.

Surface roughness of samples was determined by measuring the maximum peak to-valley roughness which was characterized by the vertical distance between the top of the highest peak and the bottom of the deepest valley within the sampling length and is measured in micrometers. The distance between the peaks and valleys of the sampled line was measured in the y direction [9]. The cut-off value (distance transversed by the stylus over which the data were collected) was 0.8 mm, and the traversing distance of the stylus was 5.0 mm. Three readings were recorded for each sample and the mean of these readings was calculated and used for statistical analysis [10].

III. RESULTS

According to the obtained measurements of this study, table (4.19) 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 (4.19): Descriptive statistics of surface roughness 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	.31	.68	.48	.101
	paracetamol	32	.31	.70	.49	.101
	Valid N (listwise)	32				

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After one week	**Salbutamol**	32	.56	.89	.74	.088
	paracetamol	32	.40	.69	.55	.082
	Valid N (listwise)	32				
After two weeks	**Salbutamol**	32	.89	1.16	1.03	.0830
	paracetamol	32	.74	.98	.84	.0673
	Valid N (listwise)	32				

In table (4.20), independent sample T test was carried out to illustrate thatat baseline, no significant difference in surface roughness readings found among the tested groups. While after one week and after two weeks of exposure to the syrups, significant difference in surface roughness 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 (4.20): 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**	.085	.772	-.457	62	.649	-.01	.02	-.06	.03
	Equal variances not assumed			-.457	62.000	.649	-.01	.02	-.06	.03
After one week	**Equal variances assumed**	.126	.724	8.740	62	.000	.18	.02	.14	.23
	Equal variances not assumed			8.740	61.638	.000	.18	.02	.14	.23
After two weeks	**Equal variances assumed**	3.602	.062	9.605	62	.000	.18	.01	.14	.21
	Equal variances not assumed			9.605	59.474	.000	.18	.01	.14	.21

IV. DISCUSSION

In the present work the effect of two pediatric medicinal syrups, Butadin and Antipyr, on the enamel surface roughness of primary teeth taken from children living in Mosul city was investigated.

Primary teeth were chosen in this study because of the morphological and structural variations that have been observed between deciduous and permanent teeth such as enamel thickness, its

mineralization levels, and structural arrangement which make the primary teeth more susceptible to the cariogenic and acidic environment [5]. The samples were obtained from frontal dental elements, as they are regarded to be the most affected elements by dental erosion and they were stored in artificial saliva during the entire period of treatment to mimic the natural environment of the oral cavity [11].

The independent sample T test, which compared between the surface roughness mean 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 increase in surface roughness 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 [6]. The pH value can be defined as the equilibrium measure of the hydrogen ion concentration [12]. 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 [13]. 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" [14]. 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 [15]. 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) [12], and the study of Mahmoud and Omar, (2018) who stated that the pH value for paracetamol syrup (adol) was (5.33)[6].

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

The findings of this study are in agreement with the study made by Alexandria et al., (2016) in which most of the pediatric medicines analyzed had a low pH at room temperature, among them, syrups with pH range between 3.7-5.5 that caused an increase in the surface roughness of the teeth exposed to them [16].

V. CONCLUSION

Within the limitations of the current study,there was an increase in enamel surface roughness of the teeth samples of both groups due to the demineralizing effect of the syrups. Salbutamol syrup showed higher increase in enamel surface roughness of primary teeth when compared with paracetamol syrup.

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