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Effect of Antibiotic Syrups on Enamel Microhardness of Primary Teeth

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Abstract

Purpose: to assess the erosive effect of antibiotic suspensions on the enamel of primary anterior teeth by using surface microhardness and scanning electron microscopy examination.

Materials and method: The study utilized sixty anterior primary teeth. After preparation, the samples were divided into two groups, thirty samples each. The samples in group (1) were subjected to a suspension of amoxicillin. Samples in group (2) were subjected to the Cefixime suspension.

Results: Significant differences were seen in enamel microhardness among the tested groups after the antibiotic syrup cycle. An independent sample T test was conducted to demonstrate that there were no significant differences in surface microhardness readings among the tested groups at the baseline of the study. While after three weeks of exposure to the antibiotic syrup, all groups experienced a decrease in enamel microhardness; the highest value was for Cefixime followed by Amoxicillin.

Conclusion: Due to their acidity, antibiotics, which are frequently prescribed to youngsters, can erode primary enamel**.**

key words: dental erosion, primary teeth, antibiotic syrups.

Introduction

Dental erosion has recently come to be recognized as an important factor in tooth structural loss in both adults and younger generations. Acid erosion occurs when the tooth's hard tissues dissolve chemically due to exposure to acids in the environment, acidic meals and drinks consumed often, or acid reflux from the stomach (Kulkarni et al., 2016).

Important life functions like speech, phonetics, and eating are significantly impacted by the primary teeth. In order to achieve their most basic requirements, children rely on their primary teeth. Most people don't put a premium on taking care of their deciduous teeth first (Ramakrishnan et al., 2019).

Eating disorders, regurgitation, and reflux are all examples of intrinsic etiological factors that arise when tooth tissue comes into contact with stomach acids. Environmental and behavioral variables, as well as acidic medications, are examples of external etiological factors (Ahmed et al., 2021).

Both permanent and deciduous teeth are susceptible to erosion. Teeth surface (enamel) weakening and subsequent substantial tooth material loss are the initial stages. The erosive pattern of deciduous and permanent enamel differs because deciduous enamel is less mineralized and contains more organic material. A child's likelihood of developing erosive lesions in their permanent teeth increases dramatically if they first experience them in their deciduous teeth. Medical practitioners should be well-versed in the eroding effects of various drugs on both permanent and deciduous enamel (Lussi and Carvalho 2015).

A lot of children who have trouble swallowing other types of pills take their medication in liquid form. Drugs in liquid form are accessible in many different kinds of forms, including syrups, solutions, and suspensions. The compatibility and consistency of syrup are both guaranteed by adding acids, which also serve as buffers. Teeth can erode from syrups because their pH is too low, below the critical pH (Kulkarni et al., 2016).

The aim of this study was to compare the erosive effect of two types of antibiotic, amoxicillin and Cefixime suspensions, on the enamel microhardness of primary anterior teeth using Vickers microhardness and scanning electron microscopy.

Materials And Methods

Samples Collection and Preparation

The study approval number is (MUPRV005).This study included 60 primary anterior teeth, teeth that show signs of caries, discoloration, hypoplastic abnormalities, restorations, white spot lesions, or cracks were not included in the study. The teeth were immersed in a solution containing 0.1% thymol to prevent bacterial and fungal diseases and then kept in the fridge. The research samples were taken from children between the ages of 6 and 8, due to factors such as tooth root resorption or movement (Ramos-Oliveira et al., 2017).

A rubber cup and pumice that was not fluoridated were used to clean and polish the teeth with great care. At the cement-enamel junction, the roots were then meticulously cut with a straight diamond bur that was fastened to a handpiece. To

ensure the enamel remained unharmed, continuous water chilling was utilized. Placing the specimens inside acrylic resin blocks constructed from plastic tubes was the next step. In order to create uniformly flat enamel surfaces for the surface microhardness test, they were wet ground with silicon carbide abrasive paper having grit sizes of 400 and 600 (Rirattanapong et al., 2011; Al-Hashimi and Habeeb, 2018).

Artificial saliva preparation

Artificial saliva solution was made by mixing the following substances: 1.5 grams each of potassium chloride, sorbitol, and sodium fluoride; 0.0002 grams of sodium fluoride; 0.05 grams of calcium chloride; 0.05 grams of magnesium chloride; 0.04 grams of potassium phosphate; 0.01 grams of potassium thiocyanate; and 1 gram of sodium chloride. One liter made up the entire solution. Nine hundred milliliters of distilled water were used to dissolve all of the compounds described before. Afterwards, 100 milliliters of boiling water was used to dissolve 10 grams of sodium carboxymethyl cellulose. After it cooled, the mixtures were added to the previous ingredients. The pH of the synthetic saliva was brought to 7 by means of pH readings taken using a calibrated pH meter (Björklund et al., 2011).

Study Design

1. Group 1: Amoxicillin group (number No.) = 30, these samples immersed in Amoxicillin suspension.

2. Group 2: Cefixime group No. = 30, these samples immersed in Cefixime suspension.

Immersion Cycle:

Immersion cycles were performed by immersing the tooth samples in the immersion media over a period of 21 days (for a total of five days, spread out over three two-day immersion procedures) according to the following sessions: Amoxicillin suspension (250mg/5ml, pH4.8) (Jamox, Aljazeera, Iraq) for 2 minutes 3 times daily, while the Cefixime suspension (100mg /5ml, Piocefix, Pioneer, Iraq) for twice. After each sample immersion cycle, the samples were washed away and stored in 5 mL of artificial saliva between cycles until the next immersion time (Ahmed et al., 2021).

Surface Microhardness Test

The enamel surface of the teeth was subjected to microhardness, using a Vickers microhardness machine. The readings were conducted by a single examiner using a standardized machine that was calibrated consistently. A steady load of 500 grams was applied to the labial surface of the teeth for 15 seconds in order to measure their microhardness. Throughout the investigation, this method was consistently applied to all samples. Three indentations were done on the enamel's smoothest areas to guarantee precise measurements. After that, we averaged these three depressions for every sample and got one number. A shadow in the shape of a rhomboid appears on the screen of the projector as a result of the indentation. Through the use of a microscope, the indentations' lengths were measured in microns (Chuenarrom et al., 2009).

Scanning electron microscope

Surface morphology was qualitatively analyzed using a scanning electron microscope. The specimens were then

placed inside a coating machine with a vacuum system, allowed to air dry, and then were coated with gold. Then the samples were ready to be scanned by SEM at ×10000 magnification.

Statistical analysis

We used SPSS (Statistical Package for the Social Sciences, version 22, Chicago, Illinois, USA) to describe, analyze, and present the data. We calculated the minimum, maximum, mean, and standard deviation. Independent sample T test and paired T test are two types of statistical tests. P-values below 0.05 are considered statistically significant.

Results

This study's descriptive statistics, including means, standard deviations, minimum and maximum values, sample numbers for each group at baseline and 21 days following exposure to Amoxicillin and Cefixime syrups, are shown in {figure 1}. Since the data were found to be normally distributed at $p<0.05$, parametric tests were selected after conducting Shapiro-Wilk tests {table 1}. This was the initial stage before applying any test. Surface microhardness was described and statistically tested in {table 2} for both phases and syrups. Results from the surface microhardness tests taken before and after three weeks of syrup exposure showed a statistically significant change, as confirmed by the paired T test. The results of the independent T test show that the groups treated with amoxicillin and cefixime had significantly different surface microhardness measurements.

Observation of primary tooth enamel with scanning electron microscope

Surface morphology analysis (SEM) showed that the experimental groups' dental enamel varied in terms of surface roughness and erosion severity. Figure 2 shows that the primary tooth specimens that were considered to be in good health had an enamel surface that was reasonably level and smooth, free of any morphological abnormalities and signs of erosion. A damaged, cracked surface with many irregularly shaped pores of varying sizes and depths was observed on the enamel surface of the primary teeth specimens that were immersed in amoxicillin suspension (see figure 3). Figure 4 shows that the specimens immersed in the cefixime solution had enamel surfaces that were extremely damaged, uneven, and rough, resembling fish scales and including numerous craters.

Discussion

Tooth erosion, brought on by today's lifestyle, is a new risk factor for oral health in children and adolescents as well as adults. Dental erosion is characterized by recurrent acid-tooth surface contact that demineralizes the tooth surface. The frequent consumption of acidic foods, drinks, and prescription syrups is associated with extrinsic dental erosion. These products contain acids in their formulations to function as buffering agents that control tartness, maintain chemical stability, and maintain physiological compatibility, as well as to improve flavor and increase children's palatability (Vakil et al., 2019). Antibiotics have been developed and are widely used to treat various infections in children. Otitis media is just one of several common childhood illnesses treated with amoxicillin and cephalosporin. To improve medication dispersion and chemical stability, several of these medicinal syrups

contain inert, acidic components (Cavalcanti et al., 2008). According to Shellis et al., microhardness is the most useful approach to assess enamel softening; so, we used it to evaluate the erosive potential of medicinal syrups in our research. The pH values for the two medicinal syrups that were employed in our investigation were (3.2) for Cefixime syrup and (4.8) for Amoxicillin syrup. The erosive effects of the two medicinal syrups (Cefixime and Amoxicillin) on the teeth samples exposed to them were explained by the fact that their pH values were below the critical pH of enamel demineralization. This also explains why Cefixime syrup had a higher degrease in surface microhardness mean value compared to Amoxicillin syrup, since its pH value is lower. Calcium (Ca^{2+}), phosphate ($PO4^{3-}$), hydroxide (OH^{-}), and trace quantities of fluoride (F−) ions make up tooth enamel. The balance between enamel crystals and saliva is maintained through a continual substitution of Ca^{2+}, $PO4^{3-}$, OH^{-}, and F^{-} between the two substances. In order to achieve a new equilibrium, enamel is likely to lose more of these ions to the surrounding medium when teeth are exposed to substances with a low concentration of these ions. In addition, the acidity or alkalinity of the surrounding substance plays a pivotal role in enamel's disintegration (Attin et al., 2003, Barbouret et al., 2003). Thus, as previously noted by West et al., the pH analysis was crucial in our investigation for evaluating the process of tooth erosion(West et al., 2001). Our findings were in accordance with the study of Singana and Suma, 2020 in which oral medical syrups also caused reduction in surface microhardness of the teeth (Singana and Suma, 2020). The results of this study are in line with those of Alexandria et al., (2016), which found that syrups with a pH range of 3.7-5.5 increased the surface roughness of the teeth exposed to them, as did the majority of the pediatric medications examined in that study (Alexandria et al., 2016).

Scanning electron microscopy (SEM) revealed that both antibiotic syrups tested in this study eroded the surface of primary enamel, independent of pH. Samples of enamel that had been exposed to antibiotics showed surface irregularities, pitting, and roughness, as well as many pores of multiple sizes and depths.

Conclusions

There was a decrease in enamel surface microhardness of the teeth samples of both groups due to the erosive effect of the syrups. Cefixime syrup showed a higher decrease in enamel surface microhardness of primary teeth when compared with amoxicillin syrup.

Conflict of interest

The authors reported that they have no conflicts of interest.

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Table 1: Shapiro Wilk test for Amoxicillin and Cefixime groups at baseline, after three week of drug cycles.

Phases	Antibiotic syrup	Shapiro-Wilk		
		Statistic	df	P value
Baseline	Amoxicillin	0.943	30	0.108
	Cefixime	0.986	30	0.956
Demin	Amoxicillin	0.955	30	0.224
	Cefixime	0.934	30	0.063

Df: dgree of freedom

Table 2: Descriptive and statistical tests (Paired T test and Independent Samples Test) of surface microhardness among tested groups at baseline, after three weeks.

Antibiotic syrup		Baseline	Demin.	% change	Paired T test	P value
Amoxicillin	Minimum	252.700	198.500	18.883	49.327	0.000
	Maximum	291.900	243.700			
	Mean	274.443	222.620			
	±SD	12.187	13.091			
Cefixime	Minimum	252.700	184.600	23.836	41.777	0.000
	Maximum	294.200	241.200			
	Mean	271.653	206.903			
	±SD	10.069	13.517			
T test		0.967	4.575			
P value		0.338	0.000			

%: percentage; **Demin.:** demineralization

Figure Legend

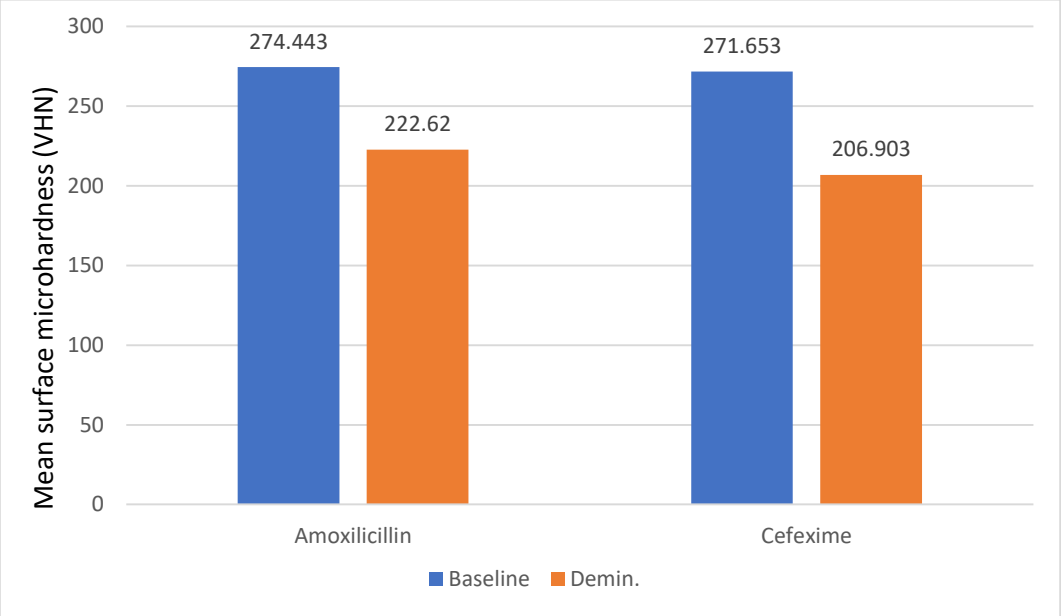

Figure 1 : Mean of enamel microhardness at baseline, after demineralization

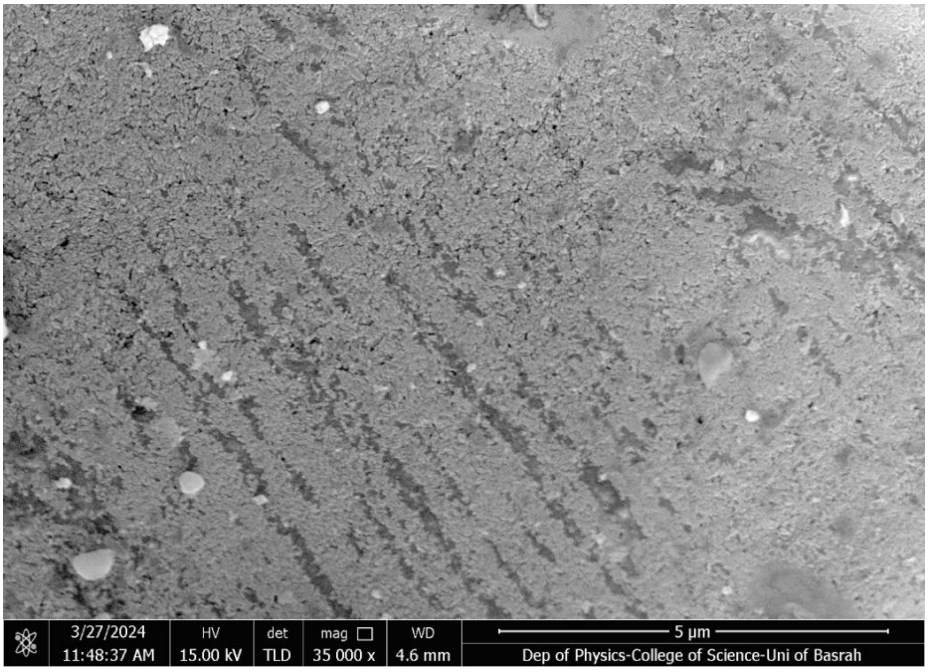

Figure 2: Enamel surface of Sound Primary tooth

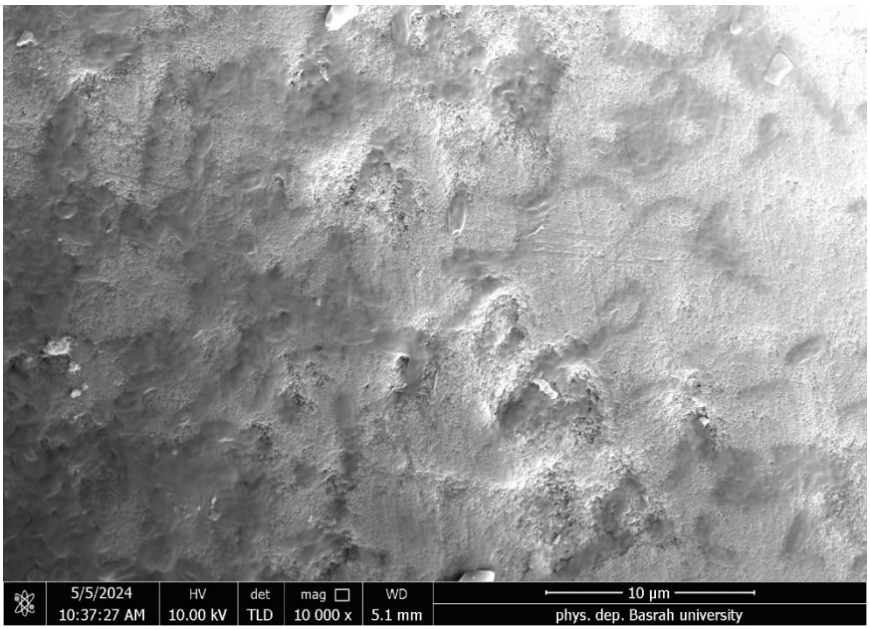

Figure 3 : Enamel of primary tooth exposed to Amoxicillin suspension

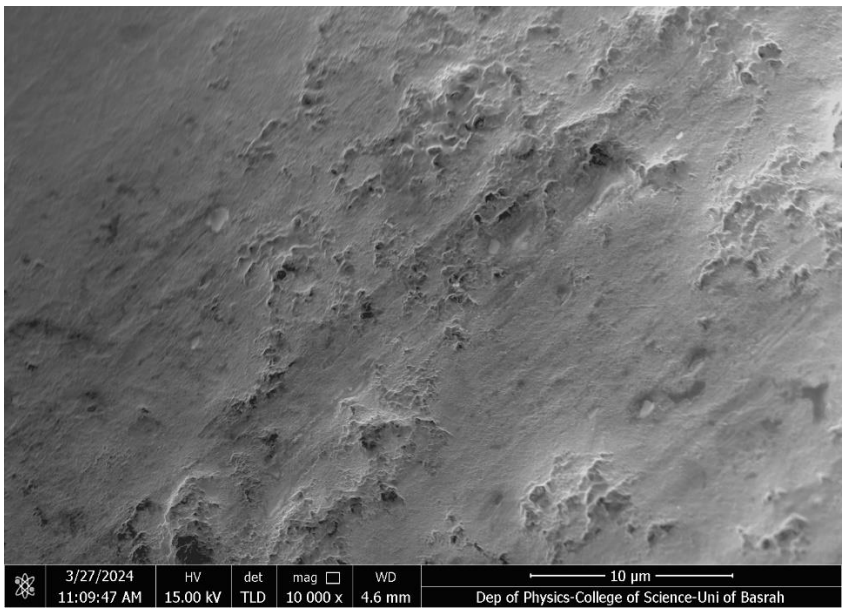

Figure 4 : Enamel of primary tooth exposed to Cefixime suspension