

Erosive effects of pediatric liquid medicinal syrups on primary enamel: An *in vitro* comparative study

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Abstract

Context: The use of liquid medicinal syrups in childhood is high owing to the reasons that children suffer from illness quite often. The acidic component in the formulations may cause erosion to the dental tissues. **Aims:** The aim of this study is to evaluate the erosive potential of pediatric liquid medicinal syrups on the deciduous teeth. **Subjects and Methods:** A total of sixty extracted/exfoliated noncarious deciduous molars were used. Four medical syrups were used (viz., 1 - artificial saliva [control], 2 - Ferium XT, 3 - Crocin syrup, 4 - Ambrolite-D) and the teeth were equally divided into the four groups ($n = 15$) for the immersion cycle, following which the teeth were examined for surface microhardness at 7, 14, 21, and 28 days. **Statistical Analysis Used:** ANOVA and *post hoc* analysis were applied. **Results:** The time and immersion media interaction demonstrated that antitussives produced a significant and gradual loss of surface microhardness on all days (viz., 7, 14, 21, and 28 days), but a statistically significant difference was seen only between 7th and 28th day ($P < 0.05$). **Conclusions:** The knowledge of the erosive potential of commonly used syrups is mandatory as erosion in children teeth may be associated with dental hypersensitivity, loss of the occlusal vertical dimension, eating difficulties, poor esthetics, pulp exposure, and abscesses. Mouth rinsing with water after taking the medication; addition of calcium, fluoride, or phosphate to formulations; and consumption of the medication at meal times have been recommended to avoid tooth damage that is caused by the regular use of medication.

Key words: Dental erosion, pediatric medicinal syrups, primary enamel

INTRODUCTION

In the recent years, dental erosion is increasingly recognized as an important cause of tooth structure loss not only in adults but also in children and adolescents. It is a chemical dissolution of the dental hard tissues caused by intrinsic or extrinsic acids, exposure of teeth to frequent consumption of acidic drinks or foods, environmental exposure to acids, or reflux of gastric acid into the mouth.^[1] The enamel thickness, its mineralization levels, and structural arrangement of deciduous teeth are also different from that of permanent teeth, and so making it more vulnerable to acidic and cariogenic environment.^[2]

The trivial illness such as fever, cough, and anemia are very common in childhood and often receive medications such as antipyretic, decongestants, and

iron syrups for these conditions. A high intake of these oral medicinal syrups may constitute possible etiological or aggravating factors for severe dental erosion in childhood particularly among children under the age of 2 years. Acidic preparations are often necessary for drug dispersion and chemical stability maintenance to ensure physiological compatibility and to improve flavor. In addition to the acidic components, other factors such as prolonged and frequent ingestion (i.e., two or more times daily), bedtime and between meals consumption, high viscosity, and collateral effect of reduced salivary flow may contribute in

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increasing the risk for medication-induced dental erosion.^[2]

SUBJECTS AND METHODS

The study was approved by the Institutional Ethical Committee.

A total of sixty extracted/exfoliated noncarious deciduous molars were used. Before use, the teeth were hand scaled and cleaned. The teeth were checked for any structural abnormality that could possibly interfere with the results, and on this basis, the teeth selection was done.

The roots were removed at the cemento-enamel junction. The crowns were fixed in a wax block parallel to the surface. The specimen before immersion cycle was stored at 37°C in artificial saliva for 24 h.

The syrups that are commonly used in pediatric patients were considered to check their erosive potential. The pediatric medicinal syrups included were Ferium XT, Crocin syrup, Wikoryl, and artificial saliva (control).

Immersion cycles

The following immersion cycling protocol was adopted to simulate a usual number of intakes: The specimens were immersed with the exposed area up for 1 min in 5 mL of the each medication, under agitation, three times daily with 6-h intervals between the immersion cycles. After each immersion cycle, the specimens were washed with distilled water and maintained in 10 mL of artificial saliva at 37°C until next immersion cycle. The medicines were replaced before each immersion. The control specimens were kept in artificial saliva during the experiment (28 days), with the solution refreshed daily. Surface microhardness

was tested using the universal microhardness machine at 7, 14, 21, and 28 days after the continuous and systematic repetition of the daily immersion cycles.

RESULTS

The time and immersion media interaction demonstrated that Ambrolite-D produced a significant and gradual loss of surface microhardness on all days (*viz.*, 7, 14, 21, and 28 days), but a statistically significant difference was seen only between 7th and 28th day ($P < 0.05$). As for the Ferium XT and Crocin groups, there was a significant loss of microhardness in Group 3, *i.e.*, Crocin, which differed from artificial saliva only at 28th day as seen in Table 1.

While comparing the mean difference of microhardness between four groups, it was seen that microhardness of the three groups gradually increased when they were compared with control group, showing a statistically significant difference on all days, *i.e.*, 7, 14, 21, and 28 days ($P < 0.05$). However, when three medicinal groups were compared for the mean difference in microhardness, a statistically significant difference was seen between Ambrolite-D and Ferium XT ($P < 0.05$) and Ambrolite-D and Crocin ($P < 0.05$) as seen in Table 2.

DISCUSSION

The present research provided evidence that the studied medicines could potentially erode deciduous tooth enamel after successive immersion cycles. The enamel surfaces presented a decrease in Knoop microhardness, which resulted from the mineral loss caused by medicine intake. The three evaluated medicines have acids in their composition, which results in a low pH.^[2]

Table 1: Comparisons of microhardness of all groups

Solutions	7 days	14 days	21 days	28 days	P
Artificial saliva	312.66±1.46	311.91±1.42	311.75±1.25	310.41±0.28	0.223
Ferium XT	304.00±1.52	302.58±0.14	300.83±0.38	300.46±0.70	0.610
Crocin	303.41±0.38	302.83±0.57	301.17±0.80	300.08±0.87	0.003
Ambrolite-D	301.16±0.72	301.00±0.25	299.17±0.62	295.76±0.46	0.001

Table 2: Comparison of mean differences of microhardness of all groups

Groups	7 days		14 days		21 days		28 days	
	Mean difference	P	Mean difference	P	Mean difference	P	Mean difference	P
1 versus 2	8.66	0.001	9.33	0.001	10.91	0.001	9.95	0.001
1 versus 3	9.25	0.001	9.08	0.001	10.58	0.001	10.33	0.001
1 versus 4	11.50	0.001	10.91	0.001	12.58	0.001	14.65	0.001
2 versus 3	0.58	0.919	0.25	0.97	0.33	0.95	0.38	0.87
2 versus 4	2.8	0.06	1.58	0.13	1.66	0.14	4.70	0.001
3 versus 4	2.25	0.147	1.83	0.072	2.00	0.07	4.31	0.001

It is reported that as substance pH decreases, the potential of enamel erosion increases. Nevertheless, the erosive potential of a substance is not exclusively dependent on pH value and acid type but also titratable acidity, calcium chelation properties, mineral content, and adhesion to the dental surface.^[2]

In our study, the used protocol was based on the following frequency of syrup ingestion, i.e., 5 ml three times a day under agitation of the solution during immersion period; when a substance is ingested, a certain agitation occurs which favors the substance capacity to cause erosion. The experimental period (28 days) was chosen to simulate what would happen over a long treatment. It is likely that longer treatment-induced damages to tooth structures might be greater than those observed. A similar protocol was used by Lussi *et al.* and Amaechi *et al.*^[3-4]

In our study, the erosive potential of medicinal syrups was assessed by loss of microhardness from the enamel surface; according to Shellis *et al.*, microhardness is the most useful method to assess enamel softening.^[5] Studies also observed the erosive effects of some medicines, such as antiasthmatic syrups, iron supplements, and antiallergic/expectorant medications, and reported enamel surface roughness, microhardness, and morphological alteration findings.^[6-10]

In our study, antitussive syrup (Ambrolite-D) presented the highest erosive potential showing substantial in microhardness compared to iron preparation (Ferium XT) and Crocin.

Most of the studies are performed on a permanent tooth substrate, and no study evaluated the enamel erosive effects of the medications on deciduous teeth using microhardness employed in the present investigation. Valinoti *et al.* have reported a reduction of deciduous tooth enamel microhardness analyzing the erosive effects of other acidic medications which are corroborating with our study.

Studies on deciduous tooth substrates are of scientific relevance because structural and morphological differences between deciduous and permanent substrates have been observed. Furthermore, differences in the chemical composition, rate of formation, and ultrastructural appearance between the pellicle on primary and permanent teeth have been reported.

CONCLUSION

Consumption of medicinal syrups by children is unavoidable and so are their deleterious effects on the oro-dental structures. The present study aimed at assessing the erosive potential of commonly used syrups as erosion of teeth in children may be associated with eating disorders, dental hypersensitivity and other esthetic and functional challenges. Loss of microhardness of enamel was evaluated which showed that antitussive syrup (Ambrolite-D) had highest erosive potential. Since regular use of such syrups are associated with tooth damage, certain recommendations should be made to avoid the same, like mouth rinsing with water after taking the medication; addition of calcium, fluoride, or phosphate to formulations; and consumption of the medication at meal times.

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Conflicts of interest

There are no conflicts of interest.

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