RESEARCH SUMMARY

Enamel erosion by soft drinks with and without abrasion

Erosion of enamel by non-carbonated soft drinks with and without toothbrushing abrasion

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Objective

To investigate how enamel loss due to erosion, and due to cycling of erosion and abrasion, depends on compositional parameters of soft drinks, and particularly whether the thickness of the erosive softened layer is a function of drink composition.

Setting

University dental hospital research laboratory in the UK, 2004.

Materials and methods

Six drinks were chosen based on their popularity and composition: apple juice, orange juice, apple drink, orange drink, cranberry drink and 'ToothKind' blackcurrant drink. Group A samples (n = 36) were exposed to soft drinks at 36°C for six consecutive 10 minute periods. Group B samples (n = 36) were subjected to alternating erosion and toothbrushing, repeated six times. Enamel loss was measured using optical profilometry.

Results

Group A: significant enamel loss was seen for all drinks ($p < 0.001$). Erosion was correlated with pH and calcium concentration but not phosphate concentration or titratable acidity. Group B: significant additional material loss due to toothbrush abrasion occurred with all drinks. Abrasive enamel loss differed between the drinks and was positively correlated with drink erosive potential.

Conclusion

Enamel loss by erosion is exacerbated by subsequent abrasion. The amount of softened enamel removed by toothbrushing is a function of the chemical composition of the erosive medium.

IN BRIEF

- This manuscript discusses an investigation of the relationship between chemical parameters of popular soft drinks and enamel erosion.
- The effects of toothbrushing after exposure to soft drinks are described as a function of the chemical parameters of the drink.
- Clinically relevant times for erosion and brushing are used in this *in vitro* study.
- A correlation is drawn between the amount of tissue loss caused by erosion, and the extent of the softened layer, in that drinks which cause greater erosion also cause a thicker softened layer.

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COMMENT

This study assessed depth of enamel loss after an erosive challenge alone and after a combined erosive/abrasive challenge using a non-fluoridated tooth paste *in vitro*.

This work confirmed the low erosive potential of Ribena ToothKind and reported on the significant erosive potential of cranberry juice after one hour. The latter had the lowest pH of the six drinks and apart from an apple drink, the lowest calcium concentration. The two drinks with the lowest calcium concentrations had the greatest erosive potential whereas phosphate concentration was not associated with enamel loss. The authors concluded that pH was a more important predictor of erosive potential than titratable acidity but highlighted that this occurred under their experimental conditions. This is a valuable point to make. Ranking erosive potential can be misleading, not only because it is dependent on study design, but also because patients' drinking habits will vary significantly. Furthermore, the authors recognised that *in vitro* erosion studies are more aggressive than *in vivo* work because of salivary protection and the nature of the substrate, polished enamel being rapidly eroded.

That enamel softened by erosion is readily susceptible to tooth brush abrasion is not new. The greatest added loss of enamel from tooth brush abrasion over an hour, to a mean depth of 2.16 µm, was for an apple drink. This study also found that the drinks with the greatest enamel surface loss also caused the greatest sub-surface softening. The distribution of tooth wear into dentine in epidemiological studies on school children, however, shows greater prevalence on incisal, occlusal and palatal surfaces,[1-3] rather than cervical, buccal and labial sites which arguably may be more readily abraded by tooth brushing. Furthermore, girls brush more frequently than boys yet have less erosion, whilst the relationship between social class and tooth brushing (more common in higher socio-economic groups) is uncertain.[4,5] Attrition and tongue abrasion, rather than tooth brush abrasion, may have a greater influence on the distribution of exposed dentine *in vivo*.

This study provides further evidence that acidic soft drinks have erosive potential, can soften the subsequent sub-surface and that tooth brushing immediately after an acid challenge will abrade away the softened area leading to additional enamel loss.

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