

CASE REPORT

Unusual Dental Erosion Caused by a Cola Drink

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Dental erosion has been defined as a progressive loss of hard tissue due to a chemical process that does not involve bacterial action.¹ Usually seen in the cervical third of the tooth's labial surface, this mineral loss is characterized by shallow, rounded, smooth, and highly glazed cavities. Erosion is distinguished from attrition, which is the physiologic wear of the teeth resulting from functional contact between them, and from abrasion, which is a pathologic wear due to abnormal mechanical function.²

The prevalence of erosion on the palatal surfaces of primary molars is about 50% in 5-year-old children; in the permanent dentition, it is found in 31% of 14-year-olds.³ Although Darby in 1892 attributed dental ero-

sion to dietetic acids and some diseases,⁴ there have been reports associating dental erosion with excessive intake of citrus fruits and cola drinks since 1907.^{3,5-16} The pH of cola, due to the addition of phosphoric acid,¹⁷ is about 2.6—low enough to cause softening of the enamel (perimolysis) after as little as five minutes of exposure.¹⁸

Perimolysis is a kind of chemical erosion produced by acids in the diet.^{6,7,9,14,19-22} The chemical action results in decalcification of the enamel, while the mechanical action of the tongue, toothbrushing, and occlusion cause the erosion.¹⁴ The risk of perimolysis can increase if gastric symptoms are also present, especially when the patient has a psychological eating disorder such as anorexia nervosa or

bulimia.^{9,20,23-26} An important additional factor is low salivary flow, which results in inadequate rinsing and buffering of acids on the tooth surfaces.^{3,9} Besides acidic drinks, extrinsic causes include airborne acids breathed in chemical and metal industries⁶ and activities such as frequent swimming in chlorinated pool water.²⁷

This article presents a clinical case of perimolysis associated with dental erosion caused by frequent ingestion of cola drinks.

Orthodontic Treatment

A 12-year-old male with an Angle Class I malocclusion presented for orthodontic treatment with fixed appliances (Fig. 1). When the brackets were removed after 34 months of treat-

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Fig. 1 12-year-old male patient before treatment.



Fig. 2 Dental erosion visible on upper incisors after bracket removal.

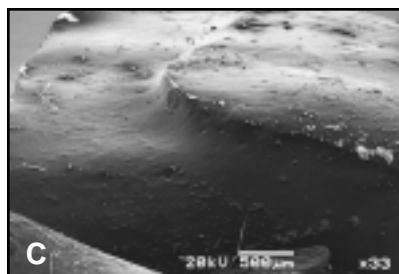
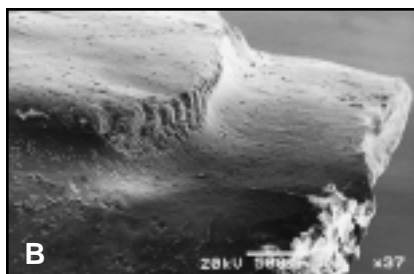
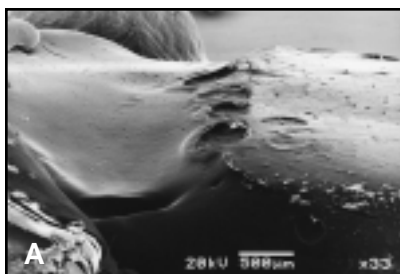


Fig. 3 Scanning electron micrographs of erosion. A. Cervical region of maxillary central incisor (magnification = 33 \times). B. Erosion on incisal edge of maxillary central incisor (magnification = 37 \times). C. Lesion on maxillary left central incisor (magnification = 33 \times).

ment, a severe loss of dental enamel was observed around the bracket areas, although the enamel that had been covered by the brackets was intact (Fig. 2).

The patient related that he had no stomach problems or eating disorders, but that he used to drink 2-4 liters of cola beverages daily.

After appliance removal, an impression of the maxillary anterior region was taken first with a heavy silicone (Elite*) and then with a light silicone (Reproductions of the impression were made with a low-viscosity resin (Durcupan**) for scanning electron microscopy. Micro-

*Zhermack, Inc., 1380 Greg St., Suite 219, Reno, NV 89431.

**Sigma-Aldrich Corp., 3050 Spruce St., St. Louis, MO 63103.

scopic analysis showed a mineral loss of about 500 microns, as well as small fractures on the incisal edges of the maxillary anterior teeth (Fig. 3). The lesions, which were more evident on the labial surfaces of the incisors than on the lingual surfaces, appeared as unusual projections around the areas protected by the brackets.

The patient was given dietary advice and referred for esthetic and functional restoration of his anterior teeth with veneers (Fig. 4).

Discussion

Smith and Knight¹⁵ and Bödecker²⁸ recognized that acid erosion can make tooth surfaces more susceptible to attrition and

abrasion, and could lead to removal of the disintegrated tissue by brushing.^{10,14} Abrasion and erosion are often found together, but erosion cavities tend to occur on both sides of the teeth.^{7,8,20} The patient described in this report showed the shallow, smooth, and rounded lesions typical of dental erosion, possibly combined with abrasion. The small fractures of the maxillary central incisal edges could be attributed to the fragility caused by severe mineral loss (Fig. 3B). Although this patient did not complain of hypersensitivity, House and colleagues reported that most patients with dental erosion exhibit such symptoms when exposed to cold, sweet, or acidic foods and beverages, with consequent pain that inhibits oral



Fig. 4 Patient after restorative treatment with veneers.

hygiene.²⁰

The severity of erosion lesions has been graded by Eccles and Jenkins as 0 when there is no involvement; 1 when there is loss of labial, lingual, or occlusal surface enamel, resulting in a smooth glazed appearance, but no dentinal involvement; 2 when there is involvement of the dentin over less than one-third of the tooth surface area; and 3 when there is involvement of the dentin over more than one-third of the tooth surface area.⁶ According to these criteria, the patient showed grade 1 erosion, with no dentinal involvement despite 500 microns of incisor enamel loss (Fig. 3).

Erosion patterns from as little as 100 microns of mineral loss are readily visible to the naked eye.¹² In patients with erosion due to a high ingestion of acidic food, the lesions usually appear on the labial surfaces and only occasionally on the lingual surfaces.^{6,20} In patients with chronic regurgitation, the lesions are more severe and are more often found on the lingual surfaces. This might explain the greater erosion seen on the labial surfaces of the maxillary incisors in this patient (Fig. 2), who did

not evidence any eating disorders.

Because of the acidity and high sugar content of cola drinks, their corrosive potential is probably related to both the volume and the frequency of intake.¹⁰ The manner in which a person consumes acidic foods or beverages—such as drinking with a straw rather than directly from a bottle or glass—can affect the distribution of lesions.⁶ High reported an unusual case of a boy with widespread enamel loss who had the habit of holding a cola drink in his mouth until all the dissolved gas had dissipated.⁷ The swishing and holding habit was also noted as an aggravating factor for dental erosion by O'Sullivan and colleagues in a study of 309 children.²⁹ On the other hand, Smith and Shaw considered the mode of intake of acidic beverages to be of less importance than the frequency, since the pH of the tooth surface requires at least five minutes to return to resting levels after dropping.³⁰ Eccles and Jenkins reported a case of a young man who drank more than seven bottles of cola per day and showed extensive dental erosion.⁶

Preventive measures in-

clude topical application of fluoride, dietary restrictions, and the use of alkaline mouthwashes following the ingestion of fruit. Eccles and Jenkins advised that food be cut into small pieces and that juice be drunk with a straw.⁶ Nunn and colleagues recommended that each meal be finished with something neutral or alkaline.³¹ A drink's corrosiveness can be reduced by sodium fluoride, even in a concentration as small as 2 parts per million, or by sodium oxalate as an ingredient in the drink.⁸ Lussi and colleagues found that while the fluoride concentration in some beverages appears to be too small to prevent erosion, it can reduce the amount of perimolysis.³ Davis and Winter showed a greater likelihood of breaking the protective superficial enamel layers if toothbrushing followed immediately after exposure to acid.³²

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(continued on next page)

REFERENCES

1. Shafer, W.G.; Hine, M.K.; and Levy, B.M.: *Tratado de Patologia Bucal*, 4th ed., Editora Guanabara, Rio de Janeiro, 1987, pp. 295-297.
2. Lewis, K.J. and Smith, B.G.N.: The relationship of erosion and attrition in extensive tooth tissue loss: Case reports, *Brit. Dent. J.* 135:400-404, 1973.
3. Lussi, A.; Jaeggi, T.; and Jaeggi-Schärer, S.: Prediction of erosive potential of some beverages, *Caries Res.* 29:349-354, 1995.
4. Darby, E.T.: Dental erosion and the gouty diathesis: Are they usually associated? *Dent. Cosmos* 34:629-638, 1892.
5. Al Dilaigan, Y.H.; Shaw, L.; and Smith, J.: Dental erosion in a group of British 14 year-old school children, Part I: Prevalence and influence of differing socioeconomic backgrounds, *Br. Dent. J.* 190:145-149, 2001.
6. Eccles, J.D. and Jenkins, W.G.: Dental erosion and diet, *J. Dent.* 2:153-159, 1974.
7. High, A.S.: An unusual pattern of dental erosion: A case report, *Br. Dent. J.* 143:403-404, 1977.
8. Holloway, P.J.; Mellanby, M.; and Stewart, R.J.C.: Fruit drinks and tooth erosion, *Br. Dent. J.* 104:305-309, 1958.
9. Järvinen, V.K.; Rytömaa, I.I.; and Heinonen, O.P.: Risk factors in dental erosion, *J. Dent. Res.* 70:942-947, 1991.
10. Johansson, A.K.; Johansson, A.; Birkhed, D.; Omar, R.; Baghdadi, S.; Khan, N.; and Carlsson, G.E.: Dental erosion associated with soft drink consumption in young Saudi men, *Acta Odont. Scand.* 55:390-397, 1997.
11. Miller, W.D.: Experiments and observations on the wasting of tooth tissue variously designated as erosion, abrasion, chemical abrasion, denudation, etc., *Dent. Cosmos* 49:225-247, 1907.
12. Mueninghoff, L.A. and Johnson, M.H.: Erosion: A case caused by unusual diet, *J. Am. Dent. Soc.* 104:51-52, 1982.
13. Pindborg, J.J.: *Pathology of Dental Hard Tissues*, W.B. Saunders, Philadelphia, 1970, pp. 312-321.
14. Porto Neto, S.T.; Machado, C.T.; Pozzobon, R.T.; and Porto Carreiro, A.F.: Erosão dental (perimólise) associada a problemas gástricos e hábitos parafuncionais: Uma visão multidisciplinar, Parte I, *J. Bras. Clin. Estet. Odont.* 4:52-56, 2000.
15. Smith, B.G.N. and Knight, J.K.: A comparison of patterns of tooth wear with aetiological factors, *Br. Dent. J.* 157:16-19, 1984.
16. West, N.X.; Hughes, J.A.; and Addy, M.: The effect of pH on the erosion of dentine and enamel by dietary acids in vitro, *J. Oral Rehab.* 28:860-864, 2001.
17. Stafne, E.C. and Lovstedt, S.A.: Dissolution of tooth substance by lemon juice, acid beverage and acids from other sources, *J. Am. Dent. Assoc.* 34:586-592, 1947.
18. Kim, J.W.; Jang, K.T.; Lee, S.H.; Kim, C.C.; Hahn, S.H.; and Garcia-Godoy, F.G.: In vivo rehardening of enamel eroded by a cola drink, *ASDC J. Dent. Child.* 68:122-124, 2001.
19. Gedalia, I.; Ionat-Bendat, D.; Ben-Mosheh, S.; and Shapira, L.: Tooth enamel softening with cola type drink and rehardening with hard cheese or stimulated saliva in situ, *J. Oral Rehab.* 18:501-506, 1991.
20. House, R.C.; Grisius, R.; Blizotes, M.M.; and Licht, J.H.: Perimolysis: Unveiling the surreptitious vomiter, *Oral Surg. Oral Med. Oral Pathol.* 51:152-155, 1981.
21. Steffen, J.M.: The effects of soft drinks on etched and sealed enamel, *Angle Orthod.* 66:449-455, 1996.
22. White, D.K.; Hayes, R.C.; and Benjamin, R.N.: Loss of tooth structure associated with chronic regurgitation and vomiting, *J. Am. Dent. Assoc.* 97:833-835, 1978.
23. Abrams, R. and Ruff, J.C.: Oral signs and symptoms in the diagnosis of bulimia, *J. Am. Dent. Assoc.* 113:761-764, 1986.
24. Andrews, F.F.H.: Dental erosion due to anorexia nervosa with bulimia, *Br. Dent. J.* 152:89-90, 1982.
25. Cowan, R.D.; Sabates, C.R.; Gross, K.B.W.; and Ellegde, D.A.: Integrating dental and medical care for chronic bulimia nervosa patient, *Quintess. Int.* 22:553-557, 1991.
26. Järvinen, V.K.; Meurman, J.H.; Hyvärinen, H.; Rytömaa, I.I.; and Murtomaa, H.: Dental erosion and upper gastrointestinal disorders, *Oral Surg. Oral Med. Oral Pathol.* 65:298-303, 1988.
27. Centerwall, B.S.; Armstrong, C.W.; Funkhouser, L.; and Elzay, R.: Erosion of dental enamel among competitive swimmers at a gas-chlorinated swimming pool, *Am. J. Epidemiol.* 123:641-647, 1986.
28. Bödecker, C.F.: Dental erosion: Its possible causes and treatment, *Dent. Cosmos* 75:1056-1062, 1933.
29. O'Sullivan, E.A. and Curzon, M.E.: A comparison of acidic dietary factors in children with and without dental erosion, *ASDC J. Dent. Child.* 67:186-192, 2000.
30. Smith, A.J. and Shaw, L.: Dental erosion, *Br. Dent. J.* 178:207, 1995.
31. Nunn, J.; Shaw, L.; and Smith, A.: Tooth wear: Dental erosion, *Br. Dent. J.* 180:349-352, 1996.
32. Davis, W.B. and Winter, P.J.: The effect of abrasion on enamel and dentine after exposure to dietary acid, *Br. Dent. J.* 148:253-255, 1980.