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Environmental health aspects of lead

Die gesundheitlichen Aspekte
der Umweltverschmutzung durch Blei

Les problèmes sanitaires posés par le plomb
présent dans l'environnement

LEAD IN DECIDUOUS TEETH: A MARKER OF
EXPOSURE IN HERETOFORE ASYMPTOMATIC
CHILDREN

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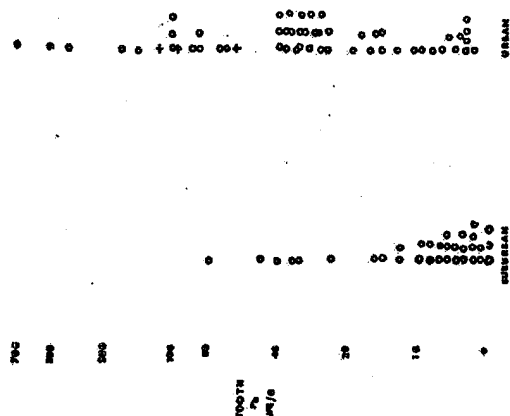
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"Lead Belt" of urban Philadelphia, an area from which the bulk of cases of lead poisoning are reported. Employing methods developed by Irving Shapiro and Orlean Tuncay at the University of Pennsylvania, whole teeth were analyzed.³

FIGURE 1



TOOTH LEAD LEVELS IN URBAN AND SUBURBAN PHILADELPHIA CHILDREN

Whether subclinical lead absorption in children produces significant effects on body function is critical to the understanding, management and prevention of childhood lead poisoning. Yet this question, raised as early as 1943 by Byers and Lord¹ has escaped systematic analysis. This is to some extent due to certain methodologic limitations in identifying children with excessive exposure to lead.

Blood lead concentration as an index of exposure represents a single static measurement of a number of dynamic processes such as intake, output and sequestration in tissue. Once ingestion ceases, blood lead concentrations tend to decline, making this measurement inadequate to determine past exposure.

If a means could be found to identify older children considered asymptomatic with elevated body burden of lead, the measurement of their neuropsychologic performance, controlling for other factors known to produce developmental deficit, would allow the investigator to more accurately estimate the effects of subclinical exposure.

We will present data to indicate that the measurement of lead in shed deciduous teeth is a useful measure of past exposure.

In 1962 Altshuler et al² analyzed 18 deciduous teeth from 6 children who died from lead poisoning, 15 teeth from 9 lead poisoned children who survived, and 82 shed control teeth. The mean tooth levels were 160 ppm for fatal cases, 116 ppm for survivors, and 15 ppm for controls. In this analysis, whole teeth, after caries were removed manually, were dissolved in nitric acid and analyzed spectrographically.

In 1970 we collected 109 teeth from asymptomatic children, forty from children in the suburbs, and sixty-nine from children residing in the

The mean tooth level for ghetto children was 51.1 ± 109.0 ppm, for suburban controls, 11.1 ± 14.8 ppm. Three teeth from children with lead poisoning were obtained. These values were 110, 92, and 62 ppm. Fifteen of sixty-nine, or 23% of the asymptomatic population had values equal or greater than these.

Kenneth Carroll,⁴ examined twelve specimens from the above mentioned study, ten from asymptomatic children, two from lead poisoned children, by means of electron microprobe analysis. Lead was found concentrated in the body of the dentine, and particularly in areas adjacent to the pulp. Shapiro and Tunney, by running out zones of dentine of differing widths from the root canal, and analyzing for lead with Anodal Stripping Voltammetry, confirmed the increased storage of lead in the zone of dentine immediately adjacent to the pulp. This dentine continues to be laid down after eruption, and lead localized there reflects exposure at that time.

TABLE I

The distribution of lead (ug/g) in deciduous teeth. Teeth were obtained from asymptomatic children in Philadelphia. Between 30-100 ug of tissue was collected from each zone.

TOOTH TYPE	ENAMEL	CORONAL DENTINE	CIRCUMPULPAL DENTINE
Molar	35	14	349
Molar	45	36	92
Incis.	44	23	115
Incis.	51	27	70
Molar	33	17	69
Molar	36	48	369
Incis.	23	21	245

*Dentine removed from the roof of the pulp, cavity

Acting upon the above data, we now concentrate our analysis upon the zone of dentine immediately adjacent to the pulp. After cutting 500 μ sagittal sections of teeth, a 300 μ zone adjacent to the pulp is dissected, weighed, and analyzed by Anodal Stripping Voltammetry.

Nine such deciduous teeth from children recovered from lead poisoning were compared to 20 specimens obtained from suburban Boston children, and 17 specimens obtained from Icelandic children.

TABLE II

Concentration of lead in circumpulpal dentine of lead poisoned children, normal children from suburban Boston, and Icelandic children

	CONCENTRATION (ppm)	t TEST
Lead Poisoned (N=9)	601 ± 225	P < .0005
Suburban Boston (N=20)	84.4 ± 56.6	P < .005
Icelandic (N=17)	35.9 ± 29.8	P < .005

The mean dentine lead level from lead poisoned children was 601 ± 225 ppm, from American controls 84.4 ± 56.6 ppm and from Icelandic controls 35 ± 29.8 ppm.

We are now beginning the analysis of one thousand teeth collected from asymptomatic children enrolled in the Philadelphia school system. The children will be rank-ordered according to the tooth lead levels obtained, and controlling for socioeconomic status, race, and family size, their school performance and outcome on a number of psychological measures determined.

The data obtained should be of use in more clearly establishing whether sub-clinical lead exposure is related to neuropsychological deficit.

In summary, deciduous teeth store lead. Children known to have had lead poisoning have significantly higher concentrations of this element in their circumpulpal dentine than normal children. Asymptomatic children from areas where lead poisoning occurs frequently bear levels in their teeth in the range of those associated with toxicity.

This tissue can be used to identify past exposure, and thus be employed to measure hidden deficit due to lead.

REFERENCES

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SUMMARY

Levels of lead in shed deciduous teeth are elevated in cases of known lead poisoning and in children who reside in areas where lead poisoning is endemic. Teeth from children residing in suburban Boston bear significantly higher levels of lead than Icelandic children. This tissue can be used to identify previously unknown cases of exposure to lead.