Content available at: https://www.ipinnovative.com/open-access-journals

International Journal of Oral Health Dentistry

Journal homepage: www.ijohd.org

Review Article

# Lead poisoning and oral manifestations: revisiting the significance of burtonian lines

**Surbhi Priyadarshi**[1*]

[1]Dept. of Public Health Dentistry, Faculty of Dental Sciences, SGT University, Gurugram, Haryana, India

## Abstract

Lead toxicity is a major global health concern, affecting both children and adults through environmental, occupational, and consumer product exposure. Despite regulatory efforts to minimize risk, lead continues to pose significant hazards, particularly in developing regions and among vulnerable populations. One of the classical, though now rare, clinical signs of chronic lead poisoning is the Burtonian line—a bluish-black pigmentation along the gingival margin caused by the reaction between circulating lead and hydrogen sulfide produced by oral bacteria. This review explores the historical background, sources of exposure, pathophysiological mechanisms, and systemic manifestations of lead toxicity. It emphasizes the diagnostic significance of Burtonian lines in identifying chronic lead exposure. The article also discusses current diagnostic approaches including blood lead level testing, hematological findings, and radiographic imaging. Treatment strategies focus on exposure elimination, chelation therapy, and supportive care. While Burtonian lines are infrequently observed today due to improved public health measures, they remain an important clinical clue in diagnosing lead poisoning, especially in individuals with poor oral hygiene. Early recognition and intervention are vital to preventing the irreversible effects of lead on multiple organ systems.

**Keywords:** Lead poisoning, Blood lead levels, Burtonian line.

**Received:** 22-03-2025; **Accepted:** 28-04-2025; **Available Online**: 29-04-2025



## 1. Introduction

Lead toxicity, or plumbism, is a significant public health issue arising from the accumulation of lead in the body. Though naturally occurring in the environment, lead's extensive industrial use has made it a pervasive toxin, affecting populations globally. One of the classical clinical manifestations of chronic lead poisoning is the presence of Burtonian lines—bluish-gray pigmentation at the gum margin, indicative of prolonged exposure to this heavy metal.[1]

Understanding the pathophysiology, sources of exposure, and systemic manifestations of lead toxicity is critical for early diagnosis and prevention. This article explores the mechanisms of lead toxicity and the diagnostic importance of Burtonian lines, especially in clinical and occupational health settings.

## 2. Historical Background of Lead Use and Toxicity

Lead has been utilized for over six millennia due to its favourable properties such as malleability, low melting point, and corrosion resistance. The Roman Empire's extensive use of lead in plumbing and food preparation contributed to widespread, though unrecognized, toxicity among the population.[2] Dr. Henry Burton first described the blue lines on the gums—now known as Burtonian lines—in 1834, linking them to lead exposure in patients presenting with systemic symptoms.[3]

## 3. Sources of Lead Exposure

Lead exposure occurs primarily through inhalation or ingestion. Common sources include:

1. Occupational exposure—metal smelting, battery manufacturing, and construction work.[4]

*Corresponding author: Surbhi Priyadarshi
Email: surbhipriyadarshi02@gmail.com

https://doi.org/10.18231/j.ijohd.2025.004

2. Environmental exposure—lead-contaminated soil, water through old pipes, and deteriorating paint in older buildings.[5]
3. Consumer products—ceramics, traditional medicines, cosmetics like kohl, and imported toys.[6]
4. Drinking water—particularly from outdated plumbing systems, as seen in the Flint water crisis.[7]
5. Food contamination—via lead-soldered containers or crops grown in contaminated soil.[8]

Children are especially vulnerable due to greater gastrointestinal absorption and the impact on developing nervous systems.[9]

## 4. Pathophysiology of Lead Toxicity

Lead interferes with multiple physiological processes:

1. Hematopoietic system: Lead inhibits enzymes such as delta-aminolevulinic acid dehydratase (ALAD) and ferrochelatase, impairing heme synthesis and leading to anemia.[10]
2. Nervous system**:** Disrupts neurotransmitter release and myelination, causing cognitive deficits, especially in children.[11]
3. Renal system: Chronic exposure can lead to interstitial nephritis and impaired renal function.[12]
4. Skeletal system: Lead accumulates in bone and may be mobilized during physiological stress such as pregnancy or menopause.[13]

## 5. Clinical Manifestations

Symptoms of lead poisoning vary depending on the duration and level of exposure:

1. Neurological: Fatigue, headaches, irritability, peripheral neuropathy, cognitive impairment.[11]
2. Gastrointestinal: Abdominal pain (lead colic), constipation, anorexia.[14]
3. Hematologic: Microcytic anaemia with basophilic stippling.[10]
4. Renal: Proteinuria and decreased glomerular filtration rate.[12]
5. Reproductive: Infertility and pregnancy complications.[15]
6. Oral: The appearance of Burtonian lines at the gingival margin.[16]

## 6. Burtonian Lines: A Clinical Hallmark

### *6.1. Description*

Burtonian lines appear as blue-black pigmentation along the gingival margin, particularly where teeth and gums meet. These lines are not caused by direct deposition of lead, but rather by the formation of lead sulfide due to a reaction between circulating lead and hydrogen sulfide produced by oral bacteria.[16]

### *6.2. Pathogenesis*

The development of Burtonian lines involves:

1. Elevated blood lead levels.
2. Bacterial production of hydrogen sulfide in the oral cavity.
3. Deposition of insoluble lead sulfide in inflamed gingival tissues.[17]

### *6.3. Clinical relevance*

Though now rare due to improved public health measures, Burtonian lines still serve as a valuable clinical indicator in patients with poor dental hygiene and chronic exposure. Their identification can prompt further testing for lead levels and systemic involvement.[18]

## 7. Diagnosis of Lead Toxicity

A combination of history-taking, clinical examination, and laboratory tests is used to confirm lead toxicity:

1. Blood lead levels (BLLs): The most definitive test; levels >5 µg/dL in children and >10 µg/dL in adults are concerning.[19]
2. Complete blood count: May reveal anemia with basophilic stippling.[10]
3. Urinary ALA and coproporphyrin levels: Elevated in lead toxicity.[20]
4. Radiographic imaging: May reveal "lead lines" in metaphyses of long bones in children.[21]
5. Oral examination: Inspection for Burtonian lines as a visual clue.[16,18]

## 8. Treatment and Management

1. Elimination of exposure: Critical for preventing further accumulation.[22]
2. Chelation therapy:
   - Succimer (DMSA) for moderate poisoning.
   - Calcium disodium EDTA and dimercaprol (BAL) for severe toxicity.[23]
3. Supportive care: Management of anemia, hydration, and monitoring renal function.
4. Nutritional interventions: Calcium and iron supplementation reduce lead absorption.[24]
5. Oral hygiene: Reducing bacterial sulfide production can mitigate the appearance of Burtonian lines.[16]

### *8.1. Prevention*

Preventing lead exposure involves both community and policy-level strategies:

1. Regulatory control**:** Banning lead in gasoline, paints, and plumbing.[25]
2. Workplace safety**:** Personal protective equipment, periodic monitoring.[4]
3. Community awareness**:** Soil remediation, clean water infrastructure.[26]

4. Childhood screening: Particularly in high-risk areas.[27]

## 9. Burden and Public Health Impact

The World Health Organization (WHO) estimates that lead exposure accounts for approximately 1 million deaths annually.[28] In children, even low levels of lead exposure can result in irreversible neurodevelopmental deficits, reduced IQ, and behavioural problems.[29] The economic impact includes healthcare costs, loss of productivity, and long-term societal burdens.[30]

## 10. Conclusion

Lead poisoning remains a silent but significant threat to public health. Burtonian lines, though less commonly seen today, serve as a visible clue to systemic toxicity and underline the importance of oral examinations in medical diagnostics. Timely recognition, intervention, and public health initiatives are essential to combat the enduring legacy of lead exposure.

## 11. Source of Funding

None.

## 12. Conflict of Interest

None.

## References

1. Flora G, Gupta D, Tiwari A. Toxicity of lead: A review with recent updates. *Interdiscip Toxicol*. 2012;5(2):47–58
2. Nriagu JO. Lead poisoning of the Roman aristocracy. *N Engl J Med*. 1983;308(11):660–3.
3. Burton H. On a remarkable blue line as a diagnostic sign of lead poisoning. *Med Chir Trans.* 1834;19:303–8.
4. Kosnett MJ. Health effects of low dose lead exposure in adults and children, and preventable risk. *Public Health Rep*. 2007;122(2):129–33.
5. Landrigan PJ, Fuller R, Acosta NJ, Adeyi O, Arnold R, Basu N, et al. The Lancet Commission on pollution and health. Lancet. 2018;391(10119):462–512.
6. Centers for Disease Control and Prevention. Childhood lead poisoning prevention [Internet]. Atlanta: CDC; 2020 [cited 2025 Apr 6]. Available from: https://www.cdc.gov/nceh/lead/
7. Hanna-Attisha M, LaChance J, Sadler RC, Champney Schnepp A. Elevated Blood Lead Levels in Children Associated With the Flint Drinking Water Crisis: A Spatial Analysis of Risk and Public Health Response. *Am J Public Health.* 2016;106(2):283–90.
8. Gulson BL, Mizon KJ, Palmer JM, Korsch MJ, Taylor AJ. Mobilization of lead from the skeleton during pregnancy and lactation. *J Lab Clin Med.* 1998;131(4):324–9.
9. Canfield RL, Henderson CR, Cory-Slechta DA, Cox C, Jusko TA, Lanphear BP. Intellectual impairment in children with blood lead concentrations below 10 μg per deciliter. *N Engl J Med*. 2003;348(16):1517–26.
10. Patrick L. Lead toxicity, a review of the literature. Part 1: Exposure, evaluation, and treatment. *Altern Med Rev.* 2006;11(1):2–22.
11. Bellinger DC. Very low lead exposures and children's neurodevelopment. *Curr Opin Pediatr.* 2008;20(2):172–7.
12. Loghman-Adham M. Renal effects of environmental and occupational lead exposure. *Environ Health Perspect.* 1997;105(9):928–39.
13. Barbosa F Jr, Tanus-Santos JE, Gerlach RF, Parsons PJ. A critical review of biomarkers used for monitoring human exposure to lead: advantages, limitations, and future needs. *Environ Health Perspect.* 2005;113(12):1669–74.
14. Needleman HL. The removal of lead from gasoline: historical and personal reflections. *Environ Res*. 2000;84(1):20–35.
15. Henson MC, Chedrese PJ. Endocrine disruption by cadmium, a common environmental toxicant with paradoxical effects on reproduction. *Exp Biol Med.* 2004;229(5):383–92.
16. Goodman JR, Weber FN. The Burtonian line in lead intoxication. *J Am Dent Assoc.* 1975;91(4):806–10.
17. Lee BK, Schwartz BS. Lead and oxidative stress: a potential role in lead-induced hypertension. *Environ Health Perspect.* 1995;103(Suppl 3):433–8.
18. Piomelli S, Seaman C, Zullow D, Curran A, Davidow B. Threshold for lead damage to heme synthesis in urban children. *Proc Natl Acad Sci U S A*. 1982;79(11):3335–9.
19. CDC. Guidelines for the identification and management of lead exposure in pregnant and lactating women. Atlanta: US Department of Health and Human Services; 2010.
20. Moore MR, Goldberg A, Yeung-Laiwah AA. Lead effects on the heme biosynthetic pathway. Relationship to toxicity. *Ann N Y Acad Sci.* 1987;514:191-203
21. Kleinman RE. Pediatric Nutrition Handbook. 7th ed. Elk Grove Village: American Academy of Pediatrics; 2014.
22. Agency for Toxic Substances and Disease Registry. Toxicological profile for lead. Atlanta: US Department of Health and Human Services; 2007.
23. Mayans L. Lead Poisoning in Children. *Am Fam Physician*. 2019;100(1):24-30.
24. Mahaffey KR. Nutrition and lead: strategies for public health. *Environ Health Perspect*. 1995;103(Suppl 6):191–6.
25. Needleman HL. History of lead poisoning in the world. In: George AM, editor. Environmental Health Perspectives. Amsterdam; Elsevier; 1997.
26. Brown MJ, Margolis S. Lead in drinking water and human blood lead levels in the United States. MMWR Suppl. 2012;61(4):1–9.
27. Advisory Committee on Childhood Lead Poisoning Prevention. Low level lead exposure harms children: a renewed call for primary prevention. CDC; 2012.
28. World Health Organization. Lead poisoning and health [Internet]. Geneva: WHO; 2021 [cited 2025 Apr 6]. Available from: https://www.who.int/news-room/fact-sheets/detail/lead-poisoning-and-health
29. Lanphear BP, Hornung R, Khoury J, Yolton K, Baghurst P, Bellinger DC, et al. Low-level environmental lead exposure and children's intellectual function: an international pooled analysis. *Environ Health Perspect.* 2005;113(7):894–9.
30. Attina TM, Trasande L. Economic costs of childhood lead exposure in low- and middle-income countries. *Environ Health Perspect*. 2013;121(9):1097–102.

**Cite this article:** Priyadarshi S. Lead poisoning and oral manifestations: revisiting the significance of burtonian lines. *Int J Oral Health Dent*. 2025;11(1):22–24.