

Guest Editorial

Molar Hypomineralization: What is the U.S. Experience (Revisited)?

Just two years ago, Molar Hypomineralization (MH) had been the subject of more than 75 prevalence studies worldwide over the prior 30 years, yet none of those reports emanated from the USA.¹ That gap has since narrowed, but questions remain about why this oral health problem has received so little attention in the U.S. dental literature. Could it be because the nature of the condition and its cause remain unclear, or that the lingering epidemic of childhood tooth decay has preoccupied dentistry in the U.S.? Given that MH is a medico-dental condition with many complexities, is it not time to focus attention on this problem and to bolster American participation in an international campaign promoting the need for research into 'chalky teeth'?²⁻⁴

MH is the most common manifestation of what are popularly termed chalky teeth (i.e., developmental dental defects [D3s]).⁵ Specific concerns about MH involve not only the dental outcomes, but also the patchy awareness of this prevalent condition and allied lack of good science about its cause and pathogenesis. Given these three levels of the MH problem, effective combat will require education and advocacy across a broad range of stakeholders, plus collective effort to undertake research into better clinical management and ultimately medical prevention.³

Clinically, MH is defined at tooth level by enamel opacities that appear both discolored (white, cream, yellow or brown) and sharply bordered against normal enamel (demarcated), and also lack attributable causation (idiopathic). At mouth or case level, one or more molars must be affected, thereby excluding incisor-only cases arising from traumatic injury or infected primary predecessors. Most commonly only the first permanent (six-year) molars are affected, but second primary (two-year) and permanent (12-year) molars can also be affected alone or in combination. A perplexing diagnostic feature is that only one molar, or up to all four molars of each type may be involved in any child – this precludes any simple causal association with systemic disturbances. Sometimes contemporaneously developed teeth are also affected, which in the case of six-year molars underpins the oft-used but scientifically-weak term, molar-incisor hypomineralization. The above criteria distinguish MH from the classical D3s (fluorosis, enamel hypoplasia, amelogenesis imperfecta) and early decay in enamel (white spot lesions). It is easy clinically to confuse degraded opacities (post-eruptive breakdown) with true hypoplasia and to misdiagnose rampant decay in hypomineralized molars (comprising acid attack from caries and diet, plus disintegration under chewing forces) as regular caries.⁶

Already being the most caries-prone teeth, molars may face over 10-fold higher risk of decay when severely hypomineralized.⁷ MH therefore accounts for a substantial proportion of childhood decay due to its surprisingly high prevalence – notably,

one-in-five children have affected two-year and/or six-year molars on average worldwide.⁸ Dental pain is also common with MH, even in mild cases where the opacities appear intact. Pain-compromised toothbrushing can further reduce the effectiveness of standard preventive dental care, which often fails on hypomineralized molars – the widespread claim that childhood decay is preventable can be misleading in this regard. Moreover, discolored anterior teeth might cause cosmetic concern. MH often presents treatment challenges for dentist and young patient alike. Consequently, affected families may face substantial financial and quality-of-life costs over decades. Causes of MH are currently unknown despite more than 35 investigations at population and laboratory levels, but most findings implicate systemic illness or its treatment, specifically during infancy in the case of two-year and six-year molars. If a recent biochemical breakthrough continues to elucidate this conundrum, it seems plausible that MH and its associated decay burden may become preventable through medical intervention.^{3,9,10}

Two years ago, it seemed likely that MH would manifest similarly in North America as elsewhere around the globe.¹ Indeed, regarding prevalence of hypomineralized six-year molars, comprehensive studies from Wisconsin, Indiana, and Ontario have since revealed estimates (10 percent, 13 percent and 12 percent, respectively) near the worldwide average (15 percent).^{8,11-13} Demarcated opacities were found on two-year, six-year and 12-year molars in a case series from Pennsylvania that included a cleft palate individual, and the diagnostic challenge of distinguishing idiopathic from traumatic causation also confounded a cleft palate study from Indiana^{14,15} — consequently neither report can be equated with studies of genuine (idiopathic) MH. Regards professional awareness, a cutting-edge approach to MH management was reported from Arizona, but a survey of pediatric dentists in the Midwest revealed generally modest understanding about MH by international standards.^{16,17} Perhaps the strongest measure of regional progress is that the world-first international event on MH and chalky teeth was recently hosted in Toronto, Canada.⁴

It seems fair to say that there is gross ignorance about MH worldwide, numerous exceptions notwithstanding. Reasons will vary geographically (e.g., private versus socialized healthcare), but three contributing factors can be identified. First, the problem is diluted over a broad sector, which raises questions about who should own it academically. Besides pediatric dentists and orthodontists who see the worst cases, other health care professionals (dental, medical, pharmacy), allied industry, public health providers, scientists, and the at-risk public hold important stakes. Second, an educational deficit exists across the sector. MH receives scant attention at best in the educational resources of most professional organisations and companies and perhaps

in some dental schools too. Third, MH is clinically obscure for many. From the medical perspective, pathologic onset happens invisibly within the jaw long before tooth eruption. Orally, some see MH but misname it (usually as 'hypoplastic molars'), others look but erroneously see it as decay, and many others have little opportunity to look. In the United States, an estimated annual incidence of approximately 670,000 new cases that involve six-year molars is spread over approximately 400,000 dentists and hygienists. Given these challenges, it is unsurprising the problem remains poorly translated through to public health and research domains. Recent progress with dental erosion, another neglected problem, provides optimism however.¹⁸

The multifarious challenges noted above call for a translational approach to their solution. Such efforts should address educational, research and health care needs. The D3 Group (D3G) is an international translational network and educational resource that seeks better understanding and care of people with D3s and chalky teeth, focusing scientifically on prevention.¹⁹ D3G strives to develop flexible terminology and other tools (e.g., children's storybook²⁰) for messaging consistently across the sector. The Chalky Teeth Campaign informs about the link between childhood decay and MH and advocates for research into the cause and prevention of this and other D3s.² Already supported by numerous American stakeholders²¹, D3G welcomes participation from others interested in teaming up to fight the MH problem globally.³

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Sincerely,

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References

- Hubbard MJ. Molar hypomineralization: What is the US experience? *J Am Dent Assoc* 2018;149(5):329-30.
- The D3 Group. Chalky Teeth Campaign (homepage). Available at: "www.chalkyteeth.org". Accessed October 27, 2020.
- Hubbard MJ, Mangum JE, Perez VA, Nervo GJ, Hall RK. Molar hypomineralisation: A call to arms for enamel researchers. *Front Physiol* 2017;8:546.
- The D3 Group. Welcome to the world-first workshop on D3s. Available at: "www.thed3group.org/toronto2020.html". Accessed October 28, 2020.
- The D3 Group. What are chalky teeth? Available at: "www.thed3group.org/what-are-chalky-teeth.html". Accessed October 28, 2020.
- The D3 Group. The basics. Available at: "www.thed3group.org/the-basics.html". Accessed October 28, 2020.
- The D3 Group. Health risks of molar hypomineralisation. Available at: "www.thed3group.org/health-risks.html". Accessed October 28, 2020.
- The D3 Group. Prevalence of molar hypomineralisation. Available at: "www.thed3group.org/prevalence.html". Accessed October 28, 2020.
- Williams R, Perez VA, Mangum JE, Hubbard MJ. Pathogenesis of Molar Hypomineralisation: Hypomineralised 6-year molars contain traces of fetal serum albumin. *Front Physiol* 2020;11(Article 619):1-9.
- Perez VA, Mangum JE, Hubbard MJ. Pathogenesis of Molar Hypomineralisation: Aged albumin demarcates chalky regions of hypomineralised enamel. *Front Physiol* 2020;11(Article579015):1-8.
- Davenport M, Welles AD, Angelopoulou MV, et al. Prevalence of molar-incisor hypomineralization in Milwaukee, Wisconsin, USA: A pilot study. *Clin Cosmet Investig Dent* 2019;11:109-17.
- Sidhu N, Wang Y, Barrett E, Casas M. Prevalence and presentation patterns of enamel hypomineralisation (MIH and HSPM) among paediatric hospital dental patients in Toronto, Canada: A cross-sectional study. *Eur Arch Paediatr Dent* 2020;21(2):263-70.
- Tagelsir Ahmed A, Soto-Rojas AE, Dean JA, Eckert GJ, Martinez-Mier EA. Prevalence of molar-incisor hypomineralization and other enamel defects and associated sociodemographic determinants in Indiana. *J Am Dent Assoc* 2020;151(7):491-501.
- Hartsock LA, Burnheimer J, Modesto A, Vieira AR. A snapshot of the prevalence of molar incisor hypomineralization and fluorosis in Pittsburgh, Pennsylvania, USA. *Pediatr Dent* 2020;42(1):36-40.
- Allam E, Ghoneima A, Tholpady SS, Kula K. Enamel hypomineralization in children with clefts and the relationship to treatment: A cross-sectional retrospective study. *Ann Plast Surg* 2018;81(5):544-47.
- Tagelsir A, Dean JA, Eckert GJ, Martinez-Mier EA. U.S. pediatric dentists' perception of molar incisor hypomineralization. *Pediatr Dent* 2018;40(4):272-78.
- MacLean J. Minimally invasive treatment for molar incisor hypomineralization. *J Multidisciplinary Care* 2018;4(11):18-20, 22-23.
- American Dental Association. Dental Erosion. Available at: "<http://www.ada.org/en/member-center/oral-health-topics/dental-erosion>". Accessed October 28, 2020.
- The D3 Group. Homepage. Available at: "www.thed3group.org". Accessed October 28, 2020.
- The D3 Group. It's just one of those things Sam – A kid's guide to chalky molars. Available at: "www.thed3group.org/sam-has-molar-hypomin.html". Accessed October 28, 2020.
- The D3 Group. International friends of D3G. Available at: "www.thed3group.org/international.html". Accessed October 28, 2020.