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Introduction

Minimally invasive dentistry (MID) is defined as a holistic management philosophy that integrates carious lesion control and minimal operative intervention [1]. Advances in dental materials, a greater understanding of the caries process and remineralization, and changes in caries prevalence have catalyzed the evolution in caries management from G.V. Black's "extension for prevention" to a minimally invasive approach [2-3].

Minimally invasive dentistry was pioneered in 1917 when Howe used silver in the form of an ammoniacal silver nitrate solution to treat carious lesions in a formula known as "Howe's solution" [4-5]. This was followed by Nishino and Yamaga in Japan with the use of ammoniacal silver fluoride for the arrest of dental caries, leading to the approval of the first Silver Diamine Fluoride (SDF) in 1970 [6-8]. In 1977, MID continued to expand when Simonsen originated a conservative occlusal preparation and restoration, known as the Preventative Resin Restoration (PRR) [9]. MID continued to develop in the 1980s in Tanzania by Jo Frencken with the development of Atraumatic Restorative Treatment (ART) as a response to the need to find a method of preserving decayed teeth in underserved communities [10]. A modification of the ART was proposed in early 2000 by a team lead by Massara in Brazil to use a rotary instrument on only tooth enamel to remove unsupported enamel, known as the Modified Atraumatic Restorative Treatment (mART) [11]. Furthermore, the use of both SDF and the ART has been combined to emerge a new paradigm called the Silver Modified Atraumatic Restorative Technique (SMART) [4]. Also under the umbrella of minimally invasive dentistry is the Hall Technique (HT). The HT was first developed in 1997 by a Scottish general dental practitioner, Norna Hall as a response to a demand in treatment that was both quick and did not involve the utilization of local anesthesia [12].

The Commission on Dental Accreditation (CODA) accredits predoctoral dental education programs, advanced dental education programs and allied dental education programs in the United States [13]. CODA serves dental professions and the public by developing and implementing accreditation standards that promote and monitor the quality and improvement of dental education programs [13]. The document titled *Accreditation Standards for Advanced Dental Education Programs in Pediatric Dentistry* put forth by CODA outlines in sections 4-16 and 4-17 the didactic instruction and clinical experiences, respectively, which must be achieved in a pediatric dentistry program curriculum [14]. Despite the outlined curriculum within the document by the Commission, the guidelines are rather vague with regard to explicit inclusion of materials and techniques. This project aims to assess the consistency of pediatric dentistry advanced dental education programs in teaching the minimally invasive dentistry techniques discussed above.

Objective

This study aims to evaluate and compare the minimally invasive dentistry curriculum and practices of minimally invasive dentistry for primary molars in pediatric dentistry advanced dental education programs in the United States.

Study Design and Methods

This study was a cross-sectional questionnaire-based survey carried out from February 13, 2023 to March 31, 2023. The study population consisted of United States pediatric dental residency program directors. Program directors received a notification of the study via their email address, and a link to complete the 12-question survey using a web-based platform (Survey Monkey).

Data was collected regarding how MID techniques were included in the programs' curricula, and how essential/not essential the program director thought the technique to be. Participants were also able to respond if their pediatric dental residency program teaches (either didactically, clinically, or both) any other technique.

For purposes of standardization, the participants were provided with definitions of the MID techniques included in the survey (Table 1).

MID Technique	Definition
Silver Diamine Fluoride (SDF)	Arresting active carious lesions by virtue of the demineralizing effect of fluoride and the antibacterial properties of silver
Atraumatic Restorative Treatment (ART)	The removal of carious tooth tissue using exclusively hand instruments and restoring the cavitated lesion with an adhesive dental material [
Silver Modified Atraumatic Restorative Technique (SMART)	The placement of SDF followed by a glass ionomer cement (GIC) restoration
Modified Atraumatic Restorative Treatment (mART)	The removal of soft, active carious lesions using exclusively hand instruments and restoring the cavitated lesion with an adhesive dental material
Preventative Resin Restoration (PRR)	The removal of carious pits and fissures using small burs, leaving all sound tooth structure, then restoring the tooth with composite resin and finally placing pit and fissure sealants to protect the unprepared areas from secondary caries
Hall Technique (HT)	The placement of a preformed stainless steel crown on a carious primary molar without tooth preparation

Table 1: Defined MID techniques in the survey

Results

A total of 101 surveys were emailed to pediatric dentistry program directors in the United States. Twenty-one questionnaires were completed, resulting in a response rate of 20.8%. Not all participants completed each question in the survey.

Figure 1 reports how MID techniques were taught in the management of caries in primary molars. The most commonly taught techniques were SDF, ART, SMART, and HT, with 100% of programs partaking. These interventions were taught both didactically and clinically. Slightly fewer programs taught PRR, with 92.3% of participants indicating that it is taught both didactically and clinically. The least taught technique was mART, with 76.9% of participants indicating that it is taught both didactically and clinically, and 7.7% didactically only.

Results (continued)

Figure 2 reports whether program directors perceived these MID techniques as important in a programs' curricula. Overall, the majority of participants stated that they 'strongly agree' or 'agree' that all techniques should be taught.

Graphs

Figure 1. Teaching of MID techniques in pediatric dentistry residency programs

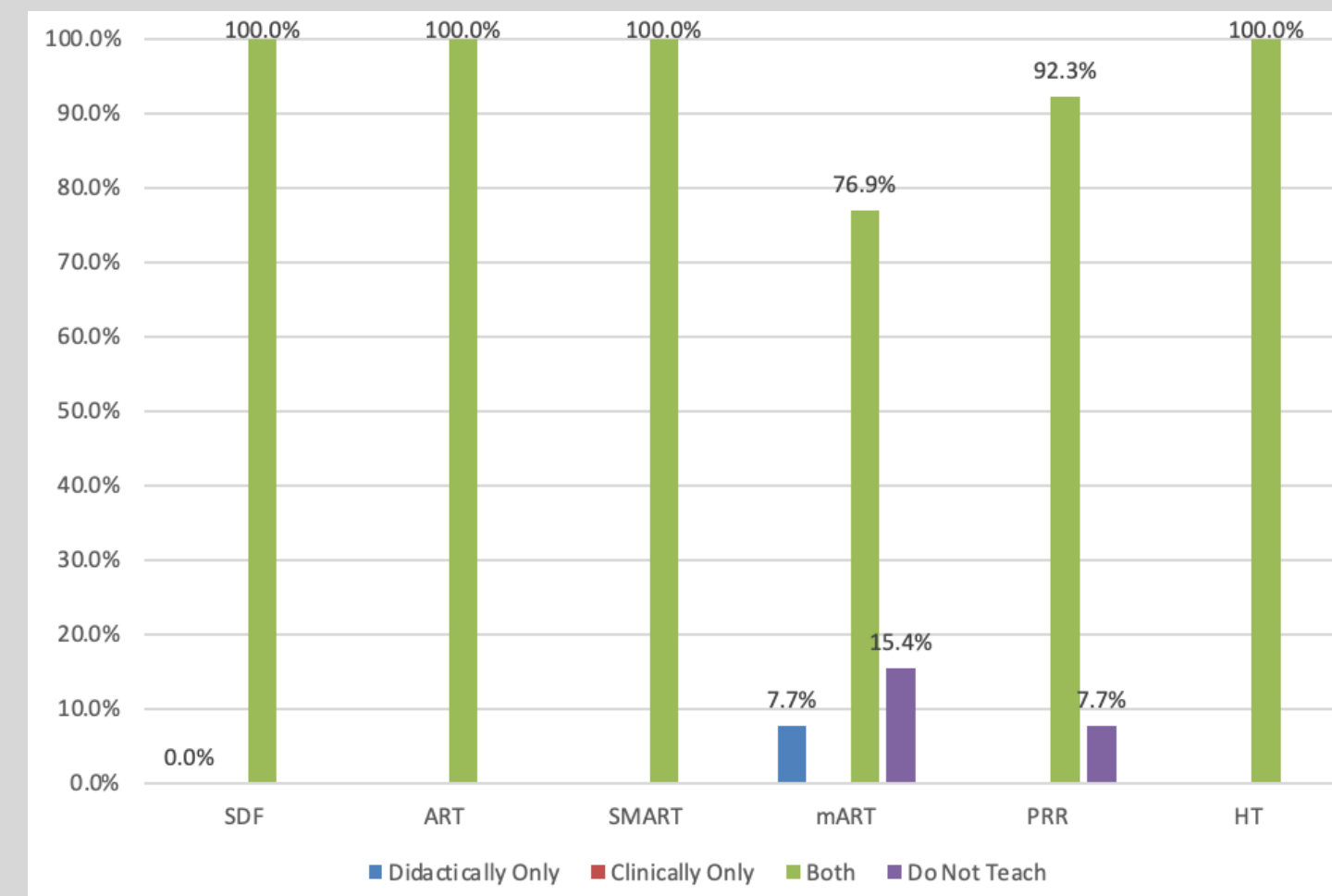
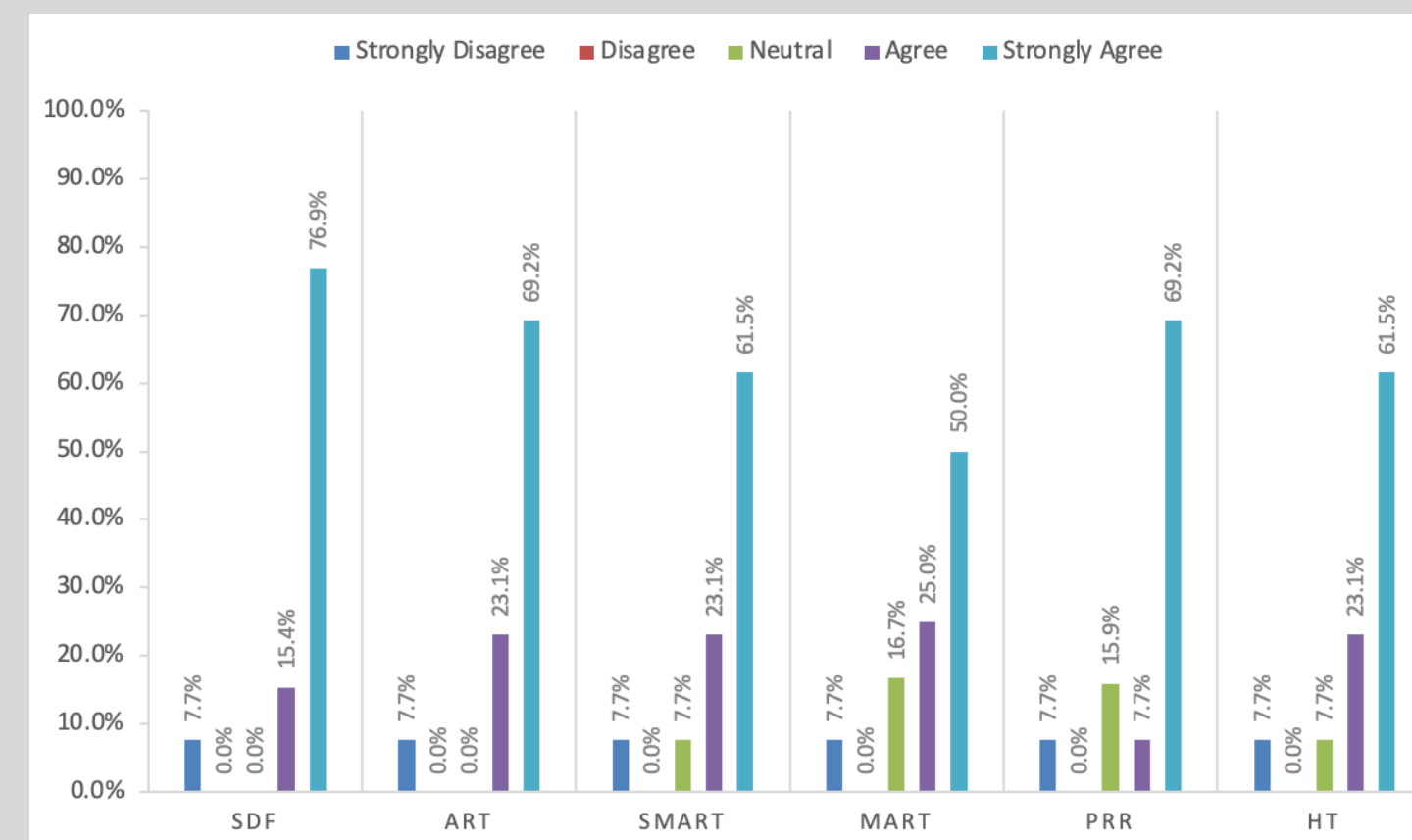


Figure 2. Program directors' perception of MID techniques that should be included in a pediatric dentistry curricula



Discussion

This study demonstrated that there was consistency in the teaching of minimally invasive interventions in pediatric dental residency programs. Education on MID can benefit the delivery of dental care domestically and globally. The World Health Organization's (WHO) Implementation Manual 'Ending Childhood Dental Caries' endorsed the use of non-invasive or minimally invasive treatment approaches because they are less resource-demanding, are more efficient and cost-effective, and cause less discomfort than other methods [15].

Program directors responded that other MID techniques were also included in their programs' curricula. These included: interproximal discing of small carious lesions to allow for better cleansability (particularly the maxillary primary incisors); periodic fluoride varnish applications; MI paste on trays (especially for patients with molar-incisor hypomineralization); and glass ionomer strip crowns in the knee-to-knee position.

The limitations of the study were the small sample size and unanswered questions in the survey, leading to incomplete data collection. Therefore, study results may not be generalizable to all pediatric dental residency programs in the U.S. Further research is needed to determine how pediatric dentists are being trained on MID.

Conclusions

The teaching of MID for the management of dental caries has a high penetrance in pediatric dentistry residency curricula in the United States.

References

1. S. Moradi, S. Sabbagh, L. Timms and V. Ravaghi, "Teaching Minimally Invasive Interventions in Paediatric Dentistry: A Cross-Sectional Survey of Dental Schools in Iran," vol. 21, no. 1, pp. 368-, 2021.
2. C. A. Murdoch-Kinch and M. E. McLean, "Minimally Invasive Dentistry," JADA, vol. 134, no. 1, pp. 87-95, January 2003.
3. K. R. Gujjar and N. Sumra, "Minimally Invasive Dentistry - A Review," International Journal of Clinical Preventive Dentistry, vol. 9, no. 2, pp. 109-120, June 2013.
4. D. Natarajan, "Silver Modified Atraumatic Restorative Technique: A Way towards "SMART" Pediatric Dentistry during the COVID-19 Pandemic," Front Dent, vol. 19, no. 12, 2022.
5. J. Greenwall-Cohen, L. Greenwall and S. Barry, "Silver Diamine Fluoride - An Overview of the Literature and Current Clinical Techniques," British Dental Journal, vol. 228, no. 11, pp. 831-838, 12 June 2020.
6. Y. O. Crystal and R. Niederman, "Evidence-Based Dentistry Update on Silver Diamine Fluoride," Dent Clin North Am, vol. 63, no. 1, pp. 45-68, January 2020.
7. E. Ballikaya, G. E. Unverdi and Z. C. Cehreli, "Management of initial carious lesions of hypomineralized molars (MIH) with silver diamine fluoride or silver-modified atraumatic restorative treatment (SMART): 1-year results of a prospective, randomized clinical trial," Clin Oral Investig, vol. 26, no. 2, pp. 2197-2205, 2022.
8. F. M. Zheng, I. G. Yan, D. Duangthip, S. S. Gao, E. C. Man Lo and C. H. Chu, "Silver Diamine Fluoride Therapy for Dental Care," Japanese Dental Science Review, vol. 58, no. 249-257, November 2022.
9. R. J. Simonsen, "Preventive Resin Restoration: Three-Year Results," JADA, vol. 100, no. 4, pp. 535-539, April 1980.
10. J. E. Frencken, "Evolution of the ART Approach: Highlights and Achievements," J Appl Oral Sci, vol. 17, no. spe, pp. 78-83, 2009.
11. M. d. L. D. A. Massara and M. Bonecker, "Modified ART: Why Not?," Brazilian Oral Research, vol. 26, no. 3, June 2012.
12. L. Ge, J. Wang, X. Wang, Y. Li, G. Song, W. Zhao, X. Chen, B. Jiang, Y. Mei, Y. Huang, S. Deng, H. Zhang, Y. Li and X. Zhou, "Expert Consensus on Early Childhood Caries Management," International Journal of Oral Science, vol. 14, no. 35, 14 July 2022.
13. "About CODA," [Online]. Available: <https://coda.ada.org/about-coda>.
14. Commission on Dental Accreditation, "Accreditation Standards for Advanced Dental Education Programs in Pediatric Dentistry," 2022. [Online]. Available: https://coda.ada.org/-/media/project-ada-organization/ada/coda/files/pediatric_dentistry_standards.pdf?rev=15ec4052d6a44c92bb49636c0845f422&hash=05D8F0B0E11A5606DA4A8233485254B
15. World Health Organization. Ending childhood dental caries: WHO implementation manual 2019. Available: <https://www.who.int/publications/item/ending-childhood-dental-caries-who-implementation-manual>.