

Review Article

Revolution in Pediatric Dentistry: A Review

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ABSTRACT:

Pediatric dentistry has witnessed tremendous advances in last few years. With these advances, the need for more precise diagnostic tools, specially imaging methods, have become mandatory. From the simple intra-oral periapical X-rays, advanced imaging techniques like computed tomography, cone beam computed tomography have also found place in modern dentistry. Therefore the aim of this review article focuses on the various revolutionary changes in pediatric dentistry and their clinical applications.

Keywords: Pediatric dentistry, Innovation, Revolution, Pediatric patient

Received: 18 September, 2021

Accepted: 22 October, 2021

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This article may be cited as: Vamshi NS, Agarwal A, Sachanandani H, Rajan M, Baddireddy SM, Najeeb A. Revolution in Pediatric Dentistry: A Review. J Adv Med Dent Scie Res 2021;9(11):47-51.

INTRODUCTION

When it comes to dentistry, there is no single definitive treatment to solve a problem. There are various evolutions like Virtual Reality, Smart Materials, Lasers etc., to boundless options that can be incorporated for the better delivery of the treatment. So it is a fundamental necessity for all the dentists to know the advancements in their field in order to incorporate them into their day-to-day practice.¹ Pediatric dentistry as a profession has reformed immensely, largely owing to advances in technology, materials, and disease knowledge. Indeed, pedodontics has come a long way from tried-and-tested behavioural management skills to the more tech-savvy virtual reality management. This specialty encompasses a variety of skills, disciplines, procedures and techniques that share a common origin

with other dental specialties however these have been modified and reformed to the distinctive requirements of infants, children, adolescents and special health care needs. The practice of dentistry experiences a new paradigm shift with the advent and use of new technology. New imaging devices, restorative procedures, internet and powerful electronic devices, laser dentistry and new materials are examples of advances impacting dentistry.² Therefore the aim of present literature is to brief the recent innovations in pediatric dentistry.

REVOLUTION IN CARIES DIAGNOSIS

DIFOTI

DIFOTI is the only dental diagnostic imaging instrument of its kind to be approved for the detection of incipient, frank, and recurrent caries. It can also be

used to detect fractures, cracks, and secondary caries around restorations. It is based on the principle that carious tooth tissue absorbs more light than surrounding healthy tissue and appears as darker area. DIFOTI system consists of two hand pieces (one for occlusal surface and one for smooth surface and inter proximal areas), a disposable mouthpiece, a foot pedal for selecting the image of interest and a computer system to capture and store the resulting image.³ Schneiderman et al. (1997); found that DIFOTI technique has superior sensitivity over conventional radiographic methods for the detection of approximal, occlusal, and smooth surface caries.⁴ Hae-Woong et al. (2004) observed that the DIFOTI diagnostic system is the most accurate means of detecting occlusal, buccal, and lingual surface carious lesions, while mesial and distal proximal carious lesions were most accurately assessed using bitewing radiography.⁵

REVOLUTION IN CARIES PREVENTION CARIES VACCINES

Another line of defence in human body that can be utilized against *S. mutans* colonization is the specific antibody production from adaptive immunity. Immune defence in dental caries is mediated mainly by secretory IgA (antibodies present in saliva and generated by the mucosal immune system. Mucosal immunization with *S. mutans* antigens at inductive sites, including gut-associated lymphoid tissue (GALT) and nasopharynx-associated lymphoid tissue (NALT), results in the migration of antigen-specific IgA-producing B cells to effector organs, such as the salivary glands. This is followed by the differentiation and maturation of these B cells and the secretion of IgA in the lamina propria, where it crosses the effector tissue ducts into the saliva. Results showed that vaccine or monoclonal antibody can effectively prevent *S. mutans* colonization. However, more clinical data regarding to caries experience are required before they can be proved effective against dental caries.⁶

REVOLUTION IN CARIES MANAGEMENT CHEMO-MECHANICAL METHODS FOR CARIES REMOVAL

The chemo-mechanical method of caries removal was developed to overcome these shortcomings. It is not only more comfortable for the patient but also able to better preserve the healthy tissue. The chemo-mechanical method is an effective alternative for caries removal because it brings together (i) atraumatic characteristics, (ii) bactericide & bacteriostatic action (iii) the active ingredient would soften the pre degraded collagen of the lesion without pain & undesirable effects to adjacent healthy tissues. The chemomechanically treated carious dentin becomes brittle, and is easily removed by curettage with hand instruments.^{7,8}

SMART BUR

One of the goals of conservative dentistry is to develop a method to remove caries infected dentin while preserving caries affected dentin. The smart prep bur appears to be the instrument to offer straight forward and efficient means of achieving this goal. Smart prep instrument is a medical grade polymer that safely and effectively removes decayed dentin leaving healthy dentin intact.

Polymer bur is a unique rotary instrument which is constructed from a medical-grade polyether-ketone-ketone, and it selectively removes decayed dentine without cutting the healthy dentine. This property is based on the hardness of the instrument being lower than the hardness of the healthy dentine. In addition, this minimally invasive excavation has the advantage of fewer dentin tubules being cut and thereby, less pain sensations being triggered compared to using conventional burs.⁹

REVOLUTION IN PATIENT EDUCATION 3D PRINTED MODELS

Marty et al. in the year 2019 developed 3D printed models with simulation of caries to perform pulpotomy and fabrication of stainless steel crown. As the models are actually made from patients radiographs dental students can visualize the factual pathology in terms of size, extent and deepness of the decayed lesion and in addition it will provide morphological complexities and specific tooth variation. Therefore, it will make possible to alter the models, by the teacher, as per the educational objectives.¹⁰

REVOLUTION IN RADIOGRAPHIC TECHNIQUES

CONE BEAM CT (CBCT)

CBCT also called as dental volumetric tomography, cone-beam volumetric tomography, dental CT, and cone beam imaging is a recent technology initially developed for angiography in 1982 and subsequently applied to maxillofacial imaging. It is only since the late 1980s that it has become possible to produce clinical systems that are both inexpensive and small enough to be used in the dental office. The principal feature of CBCT is that multiple planar projections are acquired by rational scan to produce a volumetric dataset from which inter-relational images can be generated.¹¹

CBCT can be used in pediatric patients having malocclusions and craniofacial anomalies, including cleft lip and palate. It is also proven to be helpful for the proper assessment and correct determination of the position of the unerupted teeth especially for the canines in upper arch and to determine the extent of root resorption. CBCT also provide a proper relationship between the dentition and for assessment of treatment planning and its outcome.¹²

**REVOLUTION IN PAIN MANAGEMENT
INTRANASAL SPRAYS**

These are a mixture of 3% tetracaine hydrochloride and 0.05% oxymetazoline. A metered device is used for infiltrating an anesthetic solution through the nostrils to anesthetize the maxillary anterior teeth, canines and premolars. It reduces the bleeding by inducing vasoconstriction of the regional blood vessels thus making the operational field favourable to operation.^{13,14}

COMPUTER CONTROLLED LOCAL ANESTHESIA DELIVERY

Computer controlled local anesthesia delivery systems enable the regulation of the rate of flow of the local anesthetic using computers and therefore minimizes pain by delivering the anesthesia slowly and at a constant speed.^{15,16} Many devices have been introduced that can inject local anesthetic into the tissues at a set speed. Collectively, these “painless anesthetic devices”, are termed “computer-controlled local anesthetic delivery” (CCLAD) devices. In 2018, November Septodont introduced the Dentapen at the Greater New York Dental Meeting, where it was well received. It is of lightweight and ergonomic design that enables the dentist to utilize standard dental anesthetic cartridges and needles. It is a self-contained, cordless, intuitive device that runs on disposable batteries. There are no foot pads, console, tubing or proprietary disposables. It can be held in 2 different ways—by the wings, like a manual syringe, or pen-like, for a precise injection during special procedures.^{13,15}

BUZZY SYSTEM

Buzzy is a hand-held device that naturally and quickly minimizes sharp pain from needle sticks like IV starts, blood draws, finger pricks and immunizations, through a combination of vibration, ice and distraction methods. Suohu T et al. (2020) conducted a study to evaluate the pain perception and comfort of patient during local anesthesia (LA) delivery using Buzzy system and conventional syringe and found that the external cold and vibration via Buzzy® can reduce pain and anxiety during local anesthetic delivery for various dental procedures.¹⁷

**REVOLUTION IN RESTORATIVE MATERIAL
SELF HEALING COMPOSITE**

Self-healing composites are composite materials capable of automatic recovery when damaged. They

are inspired by biological systems such as the human skin which are naturally able to heal themselves.⁷

The first self healing resin based synthetic material has been developed by White et al. The material was an epoxy system which contained resin filled microcapsule dicyclopentadiene, a highly stable monomer with excellent shelf life, encapsulated in thin shell made of urea formaldehyde. In response to environmental stimuli, some of the microcapsules rupture and release resin, which further reacts with Grubbs catalyst in epoxy composite, causing a polymerization reaction to take place and repair the crack. The main concern is the potential toxicity of the resins in the microcapsules and from the catalyst. However, their amount is relatively small, and the concentration may well be below the toxicity threshold.¹⁸

GOLDEN CROWN

Recently, Shinhung Co. Ltd. introduced titanium coated golden Stainless steel crown (Kids crown, Shinghung, Seoul; Korea) which has added advantage over conventional stainless steel crown. They are the SS crown having natural golden luster through titanium coating which provides high quality esthetic finish with easy maneuverability and reduce chair side time.¹⁹ Bamdadian Z et al. (2019) evaluated physical and mechanical properties of different brands of primary molar stainless steel crowns; the results showed that kids has satisfactory physical and mechanical properties.²⁰

FIGARO CROWN

Figaro Crowns are recently introduced crowns for primary teeth. These are said to be all white, metal (Bisphenol-A)-free, and are made from the highest safest, and time-tested products used in dentistry and medicine today. Figaro Crowns are made in the U.S.A. and possess all ISO Certifications required by Canada Health and the FDA.²¹

REVOLUTION IN PEDIATRIC ENDODONTICS

Rotary instrumentation has made a quantum leap in the field of Kedo file system is an exclusive pediatric rotary file system introduced by Jeevanandan G et al. in 2016. Kedo nickel-titanium rotary files are patented files exclusively used for root canal preparation of primary teeth. endodontics. These changes lead to the introduction of rotary endodontics in pediatric dentistry. There are four generations of Kedo-S rotary file system available.²²⁻²⁵

Generation	Specification
First-Generation	Kedo-S rotary file is a single NiTi rotary file system consisting of D1, E1, and U1 files, wherein U1 files are for upper and lower anterior primary teeth, D1 for mesiobuccal and mesiolingual canals, and E1 for distal and palatal canals of the primary molar teeth. They have a working length of 12 mm with a total length of 16 mm. The uniqueness of these files is the presence of variable taper (4%–8%) with varying tip diameter
Second Generation	Kedo-SG rotary files are heat-treated NiTi rotary files utilizing the M-Wire technology. These files result in better obturation quality due to its

	efficient preparation of primary root canals
Third Generation	The next generation is the Kedo-SG Blue consisting of three files D1, E1, and U1, which have greater cyclic fatigue resistance with its titanium oxide coating. These files are super flexible and have 75% of greater resistance to cyclic fatigue than its earlier generation
Fourth Generation	The newer generation Kedo-S Square consists of P1 file for molars and A1 file for anteriors. They also have variably variable cross section; that is, the apical 5 mm has triangular cross section with three-point contact to root canal, whereas the coronal 7 mm has teardrop cross section with two-point contact. This enables reduced apical dentin removal and less aggressive preparation

REVOLUTION IN BEHAVIOUR MANAGEMENT ARTIFICIAL INTELLIGENCE

Artificially Intelligent Methods in Behavioral Health Recent advancements in artificial intelligence have enabled real time human action performance, facial behavioral analysis, speech analysis, speech dissiliency detection, stereotypical motor movement from sensory data, many more. AI in combination with emerging technologies such as VR in the form of a digital learning platform can benefit more children and provide a personalized adoptive learning paradigm.¹⁶

In recent years, there has been an increase in behavioural research in virtual reality (VR) and virtual world. The VR refers to a human-computer interface that enables the user to interact dynamically with the computer generated environment. In contrast to the less complex audiovisual (A/V) distraction, VR uses sophisticated systems, such as head-mounted, wide field of view; three dimensional head-mount displays (HMDs) and motion sensing systems that measure the user's head and hand positions. This application may be superior to traditional distraction because it offers more immersive images due to the occlusive headsets that project the images right in front of the eyes of the user and, depending on the model used, block out real-world (visual, auditory, or both) stimuli. The VR even combines the audio, visual, and kinesthetic sensory modalities. Depending on how immersive the presented stimuli are, the person's attention will be more or less "drained" from the real world, leaving less attention available to real world processes, including painful stimuli. Immersion is particularly increased during VR, because the use of HMDs prevents patients from seeing what is happening in the real world, and directs the focus on what is going on in the virtual world. Therefore, the child's attention is focused on what is happening in the virtual world rather than on the surrounding environment.^{26, 27}

CONCLUSION

The upcoming trends in pediatric dental practice require an in-depth review of the entire spectrum of the specialty from the basic undergraduate and postgraduate level to the clinical practice of pedodontics. Pediatric dentistry as a profession has reformed immensely, largely owing to advances in

technology, materials, and disease knowledge. The field of Pediatric and preventive dentistry is boundless and yet to be explored.

REFERENCES

1. Velchamy S, Abinaya S, Moses J, Ravindran S. Recent Advancements in Pediatric Dentistry. *Ijdsir*;20203 (3):503 - 14
2. Shah S. Paediatric dentistry- novel evolvement. *Ann Med Surg (Lond)*. 2017 Dec 14;25:21-29.
3. Kidd EA. *Essentials of Dental Caries* (3rd ed). US: Oxford University Press; 2005. p. 42-44.
4. Schneiderman A, Elbaum M, Shultz T, Keem S, Greenbaum M, Driller J, et al. Assessment of dental caries with digital imaging fiber-optic transillumination (DIFOTI): In vitro study. *Caries Res*. 1997;31:103-10.
5. Hae-Woong Y, Seung-Hoon Y, Jong-Soo K. Early detection of initial dental caries using a DIFOTI. *J Korean Acad Paediatr Dent*. 2004;31:587-97.
6. Chen F and Wang D. Novel technologies for the prevention and treatment of dental caries: a patent survey. *Expert Opin Ther Pat*. 2010; 20: 681-694
7. Bussadori SK, Castro LC, Galvao AC. Papain Gel: a new chemomechanical caries removal agent. *J Clin Pediatr Dent* 2005;30(2):115-9.
8. Hadley J, Young DA, Eversole LR, Gornbein JA. A laser-powered hydrokinetic system For caries removal and cavity preparation. *J Am Dent Assoc* 2000;131(6):777-85.
9. Burman A, Nair VVR, Sistla GS, Choudhary T, Gupta S, Bothra S. Minimal Invasive Dentistry: An Update. *J Adv Med Dent Scie Res* 2021;9(10):67-71.
10. Marty M, Broutin A, Vergnes J-N, Vaysse F. Comparison of student's perceptions between 3D printed models versus series models in paediatric dentistry hands-on session. *Eur J Dent Educ*. 2019;23(1):68-72.
11. Goaz PW, White SC. *Extraoral examination in Oral Radiology. Principles and Interpretation*. 3rd ed. St. Louis: CV Mosby; 1994. p. 229-313.
12. American Academy of Oral and Maxillofacial Radiology. Clinical recommendations regarding use of cone beam computed tomography in orthodontics. Position statement by the American Academy of Oral and maxillofacial radiology. *Oral Surg Oral Med Oral Pathol Oral Radiol* 2013;116:238-57.
13. Kulkarni N. "Painless Anaesthesia in Pediatric Dentistry: An Updated Review." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*; 2019(18):4:67-71.
14. Saraghi M, Hersh EV. Intranasal tetracaine and oxymetazoline spray for maxillary local anesthesia without injections. *General dentistry* 2017;65:16-19.

15. Kwak EJ, Pang NS, Cho JH, Jung BY, Kim KD, Park W. Computer-controlled local anesthetic delivery for painless anesthesia: a literature review. *Journal of dental anesthesia and pain medicine* 2016;16:81-88.
16. Patini R, Staderini E, Cantiani M, Camodeca A, Guglielmi F, Gallenzi P. Dental anaesthesia for children - effects of a computer-controlled delivery system on pain and heart rate: a randomised clinical trial. *The British journal of oral & maxillofacial surgery* 2018;56:744-749.
17. Suohu T, Sharma S, Marwah N, et al. A Comparative Evaluation of Pain Perception and Comfort of a Patient Using Conventional Syringe and Buzzy System. *Int J Clin Pediatr Dent* 2020;13(1):27-30.
18. White, S. R. et al. Autonomic healing of polymer composites. *Nature* 409(6822), 794-7 (2001).
19. <https://www.facebook.com/1617218441631336/posts/perma-golden-crown-made-in-korea-stainless-steel-available-in-all-sizes/2815084811844687/>
20. Bamdadian Z, Pasdar N, Alhavaz A, Ghasemi S, Bijani A. Comparative Evaluation of Physical and Mechanical Properties of Different Brands of Primary Molar Stainless-Steel Crowns: An In Vitro Study. *Open Access Maced J Med Sci.* 2019 Dec 10;7(23):4120-4126.
21. Amrutha B. "Tooth coloured crowns in pediatric dentistry A review", *International Journal of Current Research.* 2019;11 (05):4098-4104.
22. Jeevanandan G. Kedo S paediatric rotary files for root canal preparation in primary teeth—case report. *J Clin Diagn Res* 2017;11(3):ZR03–ZR05.
23. Garg S, Kedo-SG pediatric rotary files: A boon for rotary endodontics in primary teeth. Garg S. Kedo-SG pediatric rotary files: A boon for rotary endodontics in primary teeth.
24. Thakkar TK. Advances in rotary endodontics in pediatric dentistry. *EC Dent Sci* 2019;18:1320–1330.
25. Pitchiah PA, Shivashankarappa PG. Rotary Files in Pediatric Dentistry: From Then Till Now. *J Sci Dent* 2020;10(2):55–57.
26. N. Bendre, N. Ebadi, J. J. Prevost, and P. Najafirad, "Human action performance using deep neuro-fuzzy recurrent attention model," *IEEE Access*, vol. 8, pp. 57 749–57 761, 2020.
27. Wismeijer AA, Vingerhoets AJ. The use of virtual reality and audiovisual eyeglasses system as adjunct analgesic techniques: a review of the literature. *Ann Behav Med* 2005 Dec;30(3):268-278.