

Recent Advancements in Pediatric Dentistry

¹Dr. Sharmili Velchamy , Post Graduate , Department of Pedodontics and Preventive Dentistry, MIG-412, New ASTC HUDCO, Hosur- 635109

²Dr .S. Abinaya , Post Graduate , Department of Pedodontics and Preventive Dentistry,

³Dr. Joyson Moses, Head of The Department , Department of Pedodontics and Preventive Dentistry

⁴Dr.Sharanya Ravindran , Senior Lecturer, Department of Pedodontics and Preventive Dentistry

Corresponding Author: Dr. Sharmili Velchamy , Post Graduate , Department of Pedodontics and Preventive Dentistry, MIG-412, New ASTC HUDCO, Hosur- 635109

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Abstract

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. So in this article we will be seeing various recent advancements in the field of Pediatric Dentistry that can aid the dentist to deliver better treatment and to obtain the patient's satisfaction.

Keywords: Recent advancements, Smart Materials, Virtual Reality, CCLAD.

Introduction

The history of dentistry is almost as ancient as the history of humanity and civilization with the earliest evidence dating from 7000 BC in the Indus Valley Civilization.

Researchers speculate that bead craftsmen used a drill made of flint heads to remove tooth enamel and rotting dental tissue. (1) Evidence suggests that this procedure was surprisingly effective. Dr.John M. Harris started the world's first dental school in Bainbridge, Ohio , on 21 February1828 and helped to establish dentistry as a health profession, and today it is a dental museum .It was between 1650 and 1800 that the science of modern dentistry developed and the French surgeon Pierre Fauchard became known as the "father of modern dentistry". (1) Fauchard was a highly skilled surgeon who made remarkable improvisations of dental instruments, often adapting tools from watchmakers, jewelers and even barbers that he thought could be used in dentistry. Major advances were made in the 19th century and dentistry evolved from a trade to a profession. The profession came under government regulation by the end of the 19thcentury. In the UK the Dentist Act was passed in

1878 and the British Dental Association formed in 1879. The Indian Dentist Act was passed in 1948. (2)The dental science that we practice as of today has evolved ever since, and it's still evolving to deliver dental treatment in a more efficient and comfortable way for the patient. The field of Pedodontics is even more delicate as we deal with kids who are prone to dental anxiety. So care should be taken to make the entire treatment stress free and comfortable and create a bond with the child so that they trust the dentist and cooperate with the procedure to make the treatment easier for them as well as us. In this article we are going to see the recent advancements in the field of pediatric dentistry that helps us to succeed in providing a better treatment for the patient in a more comfortable and effective way.

Virtual Reality

When it comes to Pediatric Dentistry the key is “pain and behavioural management”. Calm and a cooperative child is easy to treat and manage. People who are apprehensive about dental care often adopt a "cycle of avoidance" in which they consciously avoid visits to the dentist until they face a dental emergency, which can further strengthen their fear of dentistry. Approximately, 50% of individuals with extremely high dental fear report dental fear onset during childhood, 27% during adolescence, and 23% during adulthood. (3)There has been a surrealistic transformation in managing dental anxiety from using toys, cartoons, live models, television etc., to virtual reality in which the child can experience a completely different world that they have only dreamt off. Virtual Reality is defined as real-time interactive graphics with 3D models, it can be used for both distrational and educational purposes in the field of pediatric dentistry. When the child puts on a VR headset it takes the child to a simulated set-up making him/her completely aloof from the actual surroundings. (4) VR headset puts up a screen

one for each eye thus, eliminating any interaction with the real world. The visuals on the screen are rendered either by using a mobile phone or HDMI cable connected to a PC. Once the video is hit play on the device they start displaying in a three dimensional view on the screen of the VR headset. Many programs are available with children's favorite cartoon characters and educational storylines. It is always better to show familiar characters such as animals and cartoon figures instead of introducing them into an alien environment which can increase their dental anxiety. Showing them cartoon characters that they know and like would in turn help to hold the irattention for a longer period of time, because distraction works through the process of attention.



Figure 1: VR Glasses

In a study conducted by Naser Asl Aminabadi et al., 2012 on The Impact of Virtual Reality Distraction on Pain and Anxiety during Dental Treatment in 4-6 Year-Old Children: a Randomized Controlled Clinical Trial, he played a single episode of the cartoon series “Tomand Jerry” using (i-glasses 920HR Ilixco, Inc. Menlo Park, CA, USA) VR glass he concluded that study showed that virtual reality eyeglasses can successfully decrease pain perception and state anxiety during dental treatment. (5)Shetty v et al., in the year 2019 conducted a study on assessing the impact of Virtual Reality(VR) distraction technique on pain and anxiety in 5-8-year-old children, during short invasive dental procedures and concluded

that the Virtual Reality distraction can be used as a successful behavior modification method in children undergoing short invasive dental treatments. (6) A study conducted by Nansi López-Valverde et al., 2020 on Use of Virtual Reality for the Management of Anxiety and Pain in Dental Treatments: Systematic Review and Meta-Analysis he concluded that the findings of the meta-analysis show that VR is an effective distraction method to reduce pain and anxiety in patients undergoing a variety of dental treatments; however, further research on VR as a tool to prepare patients for dental treatment is required because of the scarcity of studies in this area. (7)

Local Anesthesia: Anesthesia has been a luxury to the branch of dentistry since it helps the dentist to carry out surgical procedures painlessly. Local anesthesia was discovered in the year 1884 by Karl Koller. The skill of administering local anesthesia plays a very important role in dental practice as it helps in pain control and patient management. Although the conventional needles and syringes is the commonly used method for delivering local anesthesia, there are some newer advances seen in the field of local anesthesia. Some of them include the computer-controlled local anesthesia delivery, vibrotactile systems, intraosseous anesthesia, jet injectors etc. (8)

Computer Controlled Local Anesthesia Delivery : In this method the local anesthesia is delivered at a controlled speed, this helps in depositing small amount of anesthesia at a slow speed which can reduce pain not only from resistance felt in the tissues, but also from anesthesia taking effect simultaneously with injection, which in turn allows the anesthetic to be injected into tissue that has already been anesthetized. (8)

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.

CCLAD also collectively refers to devices that not only slow and maintain the injection speed, but also maintain a constant speed while taking into account the anatomical characteristics of the tissues being injected. (9) The first CCLAD used was the Wand system (introduced in 1997) and some subsequent versions include Wand Plus and Compu Dent. Comfort Control Syringe (introduced in 2001). (8) Since their introduction, there have been a number of different systems developed with improved features aimed at addressing some of the shortcomings of the earlier 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.

1.) Local anesthetic can be delivered at 3 different speed levels:

- 1 mL in 30 seconds,
- 1 ml in 60 seconds,
- 1 ml in 100 seconds and

2.) These levels are categorised under 3 different modes:

- Full speed, which is the default;
- Ramped up (blue light), where the agent is initially delivered as a slow trickle; and
- Pressure mode (purple light), which is used for PDL injections.

3.) It comes with a 2 year warranty for the device and 3 month warranty for the cartridge holder and wings



Figure 2 : Dentapen

Figure 2a : Syringe grip

Figure 2b : Pen grip

For administration Local anesthetic cartridges are placed in a sterilize able clear cylinder called a cartridge holder that is attached to the device by a sterilize able finger grip. Then topical anesthesia is applied, the needle is passed through soft tissue in a traditional manner. At that point, the finger grip is activated and the CCLAD is advanced until it reaches its intended target, aspirating several times along the way. (10)



Figure 3: Dentapen Intuitive Buttons

There are clinical studies yet to be conducted on the dentapen but it projects to be a major asset if used properly in the field of pediatric dentistry.

Smart Materials: What is smart? According to the Cambridge dictionary smart means “intelligence or ability to think quickly” so does that means a material as the ability to think or have intelligence, in a literal sense, no but when put figuratively, yes. McCabe et al., (11) defined “Smart materials” as materials whose properties may be altered in a controlled fashion by stimuli, such as stress,

temperature, moisture, pH, and electric or magnetic fields. A key feature of smart behavior includes an ability to return to the original state after the stimulus has been removed. (12) Smartness of materials describes self-adaptability, self-sensing, memory, and multiple functionalities. So the materials which have the capacity to respond to environmental changes or external impacts, and are also known as “responsive materials.” When embedded in host materials and activated, they can compensate for faults or cracks produced, a phenomenon called the self-repairing effect and helps to keep the material in a “safe condition.” (12)

In Dentistry use of passive and inert materials has been ubiquitous, they were designed in such a way that they do not interact with body tissues and/or fluids for example materials such as amalgam are often judged on their ability to survive without reacting to the oral environment. But later came the materials which had the caliber to be “active” materials. Based on their interactions with the environment, dental materials are currently broadly categorized as Bio inert (passive), Bioactive, and Bio responsive or smart materials. The first active behavior noted in the field of dentistry was the release of “fluoride” from some dental

1. Active smart materials – They can sense a change in the environment and respond to them.
2. Passive smart materials – They can act as sensors but not as actuators or transducers. (13)

1. Restorative dentistry

- Smart glass ionomer cement (GIC)
- Smart composites
- Smart seal obturation system
- Self healing composites.

2. Prosthetic dentistry

- Smart ceramics
- Smart impression materials.

3. Orthodontics

- SMAs.

4. Preventive dentistry

- Amorphous calcium phosphate (ACP) releasing pit and fissure sealants.

5. Periodontics

- Smart antimicrobial peptide.

6. Endodontics

- NiTi rotary instruments.

7. Oral and maxillofacial surgery

- Smart sutures.

8. Smart fibers for laser dentistry

- Hollow core photonic fibers.

What are the smart materials that can be used in pediatric dentistry :

- Silver Diamine Fluoride
- Amorphous calcium phosphate
- Casein Phosphopeptide amorphous calcium phosphate

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- Casein phosphopeptide amorphous calcium phosphate.

Smart Glass Ionomer Cement : The term “glass-ionomer” was given in the earliest publication but is not so correct. The proper name for them, according to the International Organization for Standardization, ISO, is “glass polyalkenoate cement”, but the term “glass-ionomer” is recognised as an accepted name and is widely used in dental profession. (14) Davidson was the first to suggest the smart behavioural property of GIC. GICs has a coefficient of thermal expansion close to that of dental hard tissues, some samples of restorative materials were heated to determine their values of coefficient of the thermal expansion glass ionomer and, it was known that in wet conditions, little or no change in dimension was observed

when heating and cooling between 20°C and 50°C. In dry conditions, glass-ionomers showed a marked contraction when heated above 50°C. (16) Hence, the glass-ionomer materials can be said to be mimicking the behavior of human dentine through a type of smart behavior. Due to this smart behavior of GIC, it provides good marginal adaptation to the restorations. The other aspect of the smart behavior of GIC is the fluoride release and recharge capacity. (15)

Glass Advantage Glass Ionomer



Figure 4: Smart GIC

The story behind the invention is that it was invented to overcome the disadvantage caused by Silver Diamine Fluoride 38%, which was used in the beginning for preventing sensitivity on exposed root surfaces; but then it was discovered that it can be used to arrest caries, and now it is used as Silver Modified A traumatic Restorative Therapy (or SMART) treatments. But anterior aesthetics was a concern with SDF as it causes discoloration of decay and demineralization due to the silver penetration so it was then SMART Advantage™ Glass Ionomer Restorative was introduced. This is the first glass ionomer designed specifically to mask SDF treated and discolored surfaces. SMART Advantage is a self-cure, traditional fluoride-releasing glass ionomer. It is available in A1, A2 and mixed shade kits, SMART Advantage Glass Ionomer

is described as the go-to choice to cover SDF darkened sites. Gain control, without compromising color for your caries active patients.

Amorphous calcium phosphate: ACP was first described by Aaron S. Posner in 1963. When the PH in oral cavity drops below 5.8 (critical pH), ACP converts into crystalline Hydroxyapatite (HAP), and replaces the HAP crystal lost to the acid. Within 2 minutes these free ions get merged, forming gel like structures. This gel-like structure releases calcium and phosphate ions. These calcium and phosphate ions neutralize and buffer the pH. (15) Aegis® is a light-cured sealant that contains the “smart material” ACP. The ACP filler present in this has claimed to have a controlled flow ability along with being resilient and flexible, rendering a stronger and longer lasting sealant. (12)



Figure 5: Aegis light-cured sealant

Smart Composite: Smart composite is also one such material that has Amorphous calcium phosphate in it. Ariston pHc Alkaline Glass Restorative Material is an “intelligent” restorative material that releases calcium, fluoride, and hydroxyl ions when intraoral pH values drop below the critical pH of 5.5. It is a light-activated alkaline,

nano-filled glass restorative material recommended for the restoration of class I and II lesions in deciduous and permanent teeth. (16) The material relies on mechanical retention, requiring no etching and bonding agent and can be adequately cured in bulk thicknesses of up to 4 mm. The application is quick and easy. (12)



Self-healing composites: In dentistry all the materials that we use to restore the tooth are always acted upon by various factors like masticatory force, moisture, thermal expansion etc. all this eventually causes wear and tear of the material. This led to the evolution of self-healing polymers which was a major breakthrough. The first self-healing resin-based synthetic material has been developed by White et al. The epoxy matrix of the material was scattered with resin filled micro capsule dicyclopentadiene, a highly stable monomer with excellent shelf life, encapsulated in a 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. (17) 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. (12)

Shape memory alloys: shape memory alloys are the metals when subjected to the thermo mechanical load they have the ability to recover the original shape or length. (12) These alloys show exceptional properties such as super elasticity, shape memory, good resistance to fatigue and wear, and relatively good biocompatibility. Ex: Nickel-Titanium Nickel Titanium Alloy. NiTi alloys exist as different crystal structures at low and high temperature the low -temperature phase is called the martensitic or daughter phase (a body - centered cubic lattice) , and the high -temperature phase is called the austenitic or parent phase (hexagonal lattice).This lattice organization can be altered either by stress or temperature. (15)

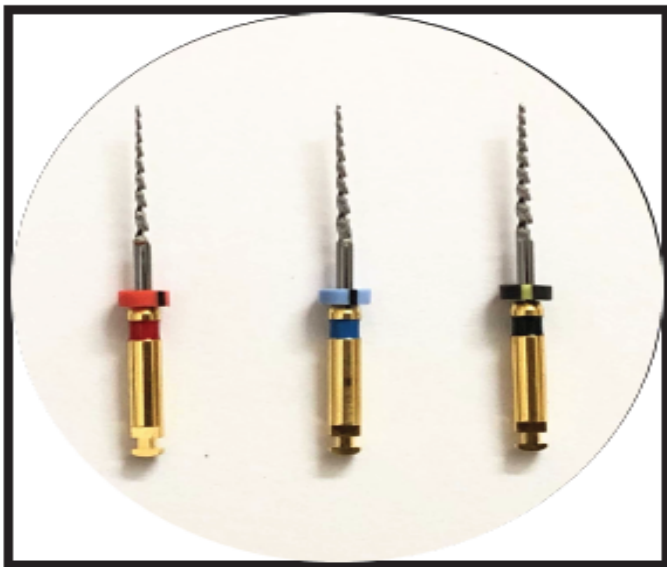


Figure 7: Kido files

Rotary instruments were introduced to pediatric endodontics by Barr. et al. in 2000. Manual stainless steel files provide excellent tactile control and sharp, long-lasting cutting surfaces. However, due to the inherent limited flexibility of stainless steel, manual preparation of curved canals is difficult. In the bygone decade, several rotary NiTi endodontic file systems have been launched to improve the shaping procedure. Recently, the concept of

single-file systems has been introduced and is currently being debated for its applicability in contemporary endodontics. Kedo-S pediatric rotary file system. The Kedo-S file system consists of three Ni-Ti rotary files. The total length of the files is 16 mm. The working length of the files is 12 mm. The files are named as D1, E1, U1, respectively. All the files have a variable taper corresponding to the use in primary teeth. (18)

Zirconia Crown



Figure 8 : Zirconia Crown They are made of zirconium, which is a silicate invented by a German chemist called M. H. Klaproth in 1789. Since the 1960s, zirconia has various medical uses. It is extremely durable and 100% biocompatible. It is a polycrystalline ceramic without glass and metal components. It is a polymorph that occurs in three forms (19) : Monoclinic - pure zirconia stable at 1107 °C

Tetragonal – above 1107 °C

Cubic form – at 2370 °C

The volume expansion caused by different forms of zirconia induces large stress which leads Zirconia to crack this can be avoided by adding a small amount of yttria which eliminates this phase change and produces a material with high compressive strength, high fracture resistance, corrosion. (20) Pediatric zirconia

crowns were first manufactured by EZ-Pedo Inc., and became commercially available in 2008. (21) They are recommended for both anterior and posterior cases. It has demonstrated high wear resistance, excellent biocompatibility, and superior corrosion resistance (Piconi, 1990). Recently dioxide ceramic prefabricated crown has been used in the treatment of primary teeth. (21)

Some of the commercially available zirconia crowns include:

- Nusmile Zr
- Kinder Zr
- EZ-Pedo

Zirconia is one of the strongest among the aesthetic crowns but it has two major drawbacks. One being the additional tooth reduction and the other being the difficulty in adjustment of the crown.

A study conducted on comparison of the amount of primary tooth reduction required for Anterior and Posterior Zirconia and Stainless Steel Crowns by Clark, Larkin et al., 2016 showed that Zirconia crowns required more tooth reduction than stainless steel crowns for primary anterior and posterior teeth. (22)

In another study on In vitro fracture resistance of three commercially available Zirconia Crowns for Primary Molars by Townsend et al., 2014 to measure the fracture resistance of primary mandibular first molar zirconia crowns from three different manufacturers—EZ Pedo (EzP), Nu Smile (NSZ), and Kinder Crowns (KK)—and compare it with the thickness of the zirconia crowns and the measured fracture resistance of Preveneered stainless steel crowns (SSCs). Statistically significant differences were found among the forces required to fracture Zirconia crowns by three different manufacturers. The increase in force correlated with crown thickness. The forces required to fracture the Preveneered stainless steel

crowns were greater than the forces required to fracture all manufacturers' zirconia crowns. (23)

Figaro Crowns



Figure 9: Figaro Crowns

Figaro Crowns are recently introduced crowns for primary teeth. These are said to be all white, metal-free and BPA (Bisphenol-A)-free, and are made from the highest quality 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. Figaro Crowns' materials are said to be: Biocompatible, Strong, Cost Effective and autoclavable. (7) Figaro crowns are radiolucent and allow the provider to monitor the pulp and interproximal surfaces of the adjacent teeth. Through extensive research and testing, our data proves that Figaro Crowns outperformed Stainless Steel Crowns (SSC) and Zirconia Crowns 2-2.5 times in ball bearing and compression tests. Reports show the average human bite yields 72 lbs. of force during chewing (ball bearing). Figaro crowns are relatively new to the field of pediatric dentistry and yet to be studied a lot to evaluate its clinical uses.

Ozone Therapy :The word ozone is derived from the Greek “ozein” meaning odorant. Ozone (O₃) is a gas with a characteristic, penetrating odor that is present in small amounts in atmospheric air. It is a triatomic molecule consisting of 1,2 three oxygen atoms with a molecular weight of 47.98g/mol. It is a blue gas, with a strong odor and absorbs the harmful ultraviolet rays present in the light spectrum from the sun and protects the living creatures from the ultraviolet rays. (24)Ozone therapy can be defined as a versatile bio-oxidative therapy in which oxygen/ozone is administered via gas or dissolved in water or oil base to obtain therapeutic benefits. Ozonized oils can also be used as a temporary root canal dressing in infected necrotic cases. In periapical lesions, ozone gas infiltration contributes in the nonsurgical management of these lesions. (24)Christian F. Schonbein(1840), a German chemist first discovered ozone and he is considered as the father of ozone therapy (25) and, Dr. E.A. Fisch, a German dentist in 1930, used ozone on a regular basis in his dental practice in Zurich, Switzerland and published numerous papers on the subject. (26)Ozone is one of the most powerful antimicrobial agents that is currently used in dentistry. Research has shown, application of ozone for a period of 10sec was capable of reducing the numbers of Streptococcus mutans and Streptococcus sobrinus in vitro due to the antimicrobial effectiveness of ozone, as a gas and in the form of ozonated water. (27)

Mode of Delivery of Ozone⁽²⁵⁾ : 1. Ozone gas application - ozone generating equipment converts oxygen to ozone. The ozone is thereafter led to a hand piece fitted with a silicone cup. The required time is 10 seconds. 2. Ozone aqueous solution - As an aqueous solution it can be used as disinfectant and sterilization agent, it accelerates wound healing, improves oxygen supply and support of metabolic processes. 3. Ozone oil - These are pure plant extract through which pure oxygen and ozone is passed. The

Ozonated NaOCl acts as a lubricant for instrumentation and flush loose debris from root canals clearing and dissolving both vital and non vital tissues. In pediatric dentistry Ozone is used as a chemo mechanical root canal disinfectant. Ozone has drastically shortened the time required, making single sitting root canal treatment an acceptable and feasible treatment technique. **MECHANISM OF ACTION:** When organic tissue comes in contact with ozonated NaOCl, hypochlorous acid is formed which reacts with insoluble proteins and produces soluble polypeptides, amino acids and other byproducts. (28)



Figure 10: Heal Ozone

Nagayoshi et al., tested the efficacy of Ozonated water on survival and permeability of oral microorganisms and dental plaque. They confirm that Ozonated water (0.5–4 mg/l) was highly effective in killing both gram positive and gram negative microorganisms. They stated, “Ozone is known to act as a strong antimicrobial agent against bacteria, fungi, and viruses. (29) Animi reddy Kishore et al., evaluated the antimicrobial efficacy of intra canal medicament in root canals charged with Enterococcus faecalis. Of the tested medicaments, Ozonated sesame oil was most effective for longer duration when compared to other groups and can be used as an alternative intra canal medicament. (30)

Laser: The first laser, or “maser” as it was initially called, was developed by Theodore H. Maiman of Hughes Aircraft Corporation in 1960. “Maser,” like the more familiar term “laser,” is an acronym for “microwave amplification by stimulated emission of radiation,” which describes the basic principle by which all lasers operate. The word LASER is an acronym for Light Amplification by Stimulated Emission of Radiation. (31) Treating a pediatric patient with a laser for oral and dental procedure is beneficial as it is less fearful to the child, children become more cooperative and it also enhances the treatment outcome and is better accepted by parents.

The most commonly used lasers in dentistry include (32) :

- Holmium Yttrium Aluminium Garnet (HO:YAG),
- Neodymium-doped Yttrium Aluminium Garnet (Nd:YAG),
- Carbon dioxide laser (CO₂),
- Erbium-doped Yttrium Aluminum Garnet (Er:YAG),
- Neodymium doped Yttrium Aluminum Perovskite (Nd:YAP),
- Gallium arsenide (GaAs) (diode),
- Erbium, Chromium doped Yttrium Scandium Gallium Garnet (Er-Cr:YSGG) and
- Argon lasers.

Laser Applications in Pediatric Dentistry These are broadly divided into hard and soft tissue applications. (33)

Hard tissue applications:

- Caries detection by laser induced fluorescence
- Prevention of enamel and dental caries
- Caries removal
- Cavity preparation
- Pit and fissure sealants
- Curing light activated resins
- Laser pediatric crowns
- Bleaching of vital and non-vital tooth

- Laser fusion of vertical root fracture
- Removal of old restorative materials
- Laser analgesia
- Orthodontic tooth movement
- Dental traumatology.

Soft tissue applications:

- Exposure of teeth to aid in tooth eruption
- Frenectomy
- Ankyloglossia
- Aphthous ulcers
- Herpes labialis lesions
- Dentigerous cyst
- Leukoplakia
- Treatment of mucocele
- Pediatric endodontics
- Gingival remodeling and Gingivectomy.

Lasers have grown in scope of treatment Although it has some cost- and training-related disadvantages, its use in pediatric dental procedure is well accepted by the patient and the irparents due to its minimal invasiveness.

Conclusion

In this article I have put forth the recent development in the field of pediatric dentistry and their wide rage of use in advantages. Pediatric dentists should be aware of these recent innovations to enable their use and utilize their optimal properties in day-to-day practice to provide quality and effective holistic treatment. The field of Pediatric and Preventive Dentistry is boundless and yet to be explored.

References

1. Hussain A, Khan FA. History of dentistry. Arch Med Health Sci 2014;2:106-10.
2. 3Dentists_Act_1948.pdf [Internet]. [cited 2020 May 15].
3. Kakkar, Mayank et al. “Prevalence of dental anxiety in 10-14 years old children andits implications.”

- Journal of dental anesthesia and pain medicine* vol. 16,3 (2016): 199-202. doi:10.17245/jdapm.2016.16.3.199
4. Cipresso P, Giglioli IAC, Raya MA and Riva G (2018) The Past, Present, and Future of Virtual and Augmented Reality Research: A Network and Cluster Analysis of the Literature. *Front. Psychol.* 9:2086. doi: 10.3389/fpsyg.2018.02086
 5. Asl Aminabadi, Naser et al. "The Impact of Virtual Reality Distraction on Pain and Anxiety during Dental Treatment in 4-6 Year-Old Children: a Randomized Controlled Clinical Trial." *Journal of dental research, dental clinics, dental prospects* vol. 6,4 (2012): 117-24. doi:10.5681/joddd.2012.025
 6. Shetty, V., Suresh, L. R., & Hegde, A. M. (2019). Effect of Virtual Reality Distraction on Pain and Anxiety During Dental Treatment in 5 to 8 Year Old Children. *Journal of Clinical Pediatric Dentistry.* doi:10.17796/1053-4625-43.2.5
 7. López-Valverde, N. & Muriel-Fernández, Jorge & López-Valverde, Antonio & Juan, Luis & Ramírez, Juan & Fraile, Javier & Payo, Julio & Antona, L. & Sousa, Bruno & Bravo, Manuel. (2020). Use of Virtual Reality for the Management of Anxiety and Pain in Dental Treatments: Systematic Review and Meta-Analysis. *Journal of Clinical Medicine.* 9. 1025. doi:10.3390/jcm9041025.
 8. Nupoor Kulkarni. "Painless Anaesthesia in Pediatric Dentistry: An Updated Review." *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)*, vol. 18, no. 4, 2019, pp 67-71.
 9. Kwak EJ, Pang NS, Cho JH, Jung BY, Kim KD, Park W. Computer-controlled local anesthetic delivery for painless anesthesia: a literature review. *J Dent Anesth Pain Med.* 2016; 16(2):81-88. doi:10.17245/jdapm.2016.16.2.81
 10. DDS RMP. Dentapen: The Next Generation CCLAD [Internet]. [cited 2020 May 15]
 11. F. McCABE, J., YAN, Z., T. AL NAIMI, O., MAHMOUD, G., & L. ROLLAND, S. (2009). Smart materials in dentistry-future prospects. *Dental Materials Journal*, 28(1), 37-43. doi:10.4012/dmj.28.37
 12. Jain P, Kaul R, Saha S, Sarkar S. Smart materials making pediatric dentistry bio-smart. *Int J Pedod Rehabil* 2017;2:55-9.
 13. Kamila S. Introduction, classification and applications of smart materials: An overview. *Am J Appl Sci* 2013;10:876-80
 14. Sonu Acharya and Sheetal Acharya. "Dental Materials used in Pediatric Dentistry – A Sneak Peek". *Acta Scientific Dental Sciences* 2.11 (2018)
 15. Padmawar N, Pawar N, Joshi S, Mopagar V, Pendyala G, Vadvadgi V . Biosmart Dental Materials: A New Era in Dentistry. *Int J Oral Health Med Res* 2016;3(1):171-176.
 16. Dhull KS, Dutta B, Verma T. Biosmart Materials in Dentistry: An Update. *Int J Oral Care Res* 2017;5(2):143-148.
 17. Lavnya D, Divya B, Mantena SR, Madhu Varma K, Bheemalingeswara Rao D, Chandrappa V. Recent Advances in Dental Composites: An Overview. *Int J Dent Mater* 2019;1(2): 48-54.
 18. Trushana K Thakkar., et al. "Advances in Rotary Endodontics in Pediatric Dentistry". *EC Dental Science* 18.6 (2019): 1320-1330.
 19. Tote JV, Godhane A, Das G, Soni S, Jaiswal K, Vidhale G. Posterior Esthetic Crowns in Pediatric Dentistry. *Int J Dent Med Res* 2015;1(6):197-201.
 20. Srinath S, Kanthaswamy AC. Different crown used for restoring anterior primary teeth: a review. *Journal*

- of Pharmaceutical Sciences and Research. 2017 Feb 1;9(2):190
21. Amrutha B, 2019. "Tooth coloured crowns in pediatric dentistry - A review ", *International Journal of Current Research*, Vol. 11, Issue, 05, pp. 4098-4104, May, 2019
 22. Clark, Larkin & Wells, Martha & Harris, Edward & Lou, Jennifer. (2016). Comparison of Amount of Primary Tooth Reduction Required for Anterior and Posterior Zirconia and Stainless Steel Crowns. *Pediatric dentistry*. 38. 42-46
 23. Townsend, Janice & Knoell, Patrick & Yu, Qingzhao & Zhang, Jian-Feng & Wang, Yapin & Zhu, Han & Beattie, Sean & Xu, Xiaoming. (2014). In Vitro Fracture Resistance of Three Commercially Available Zirconia Crowns for Primary Molars. *Pediatric Dentistry*. 36.
 24. Saha, Satabdi & Soni, Krunal & Soni, & Pandey, Niharika & Pal, Shubhabrata & Saha, Subrata. (2018). Ozone in pediatric dentistry-A miracle therapy.
 25. Katiyar A, Kohli A, Gupta K, Singh G, Katyayan R, Dwivedi A. As in Stratosphere: It is now in Dentalsphere- "Ozone in Paediatric Dentistry". *Rama Univ J Dent Sci* 2015 Sept.;2(3):32-34.
 26. Saini, Rajiv. "Ozone therapy in dentistry: A strategic review." *Journal of natural science, biology, and medicine* vol. 2,2 (2011): 151-3. doi:10.4103/0976-9668.92318
 27. S Khullar, A Mittal, M Kumar, E Perwez, A Kumar. *Ozone Therapy In Pediatric Dentistry: An Alternate Approach* . The Internet Journal of Dental Science. 2012 Volume 10 Number 2.
 28. Shakunthala P, Nandhini A, Kavitha M, Sharmila MS, Sabarigirinathan C, Vinayagavel K, Sriramaprabu G, Rupkumar P, Ranjani MS. Ozone in Clinical Dentistry. *Int J Oral Health Med Res* 2015;2(3):91-96.
 29. Nagayoshi, M., Fukuizumi, T., Kitamura, C., Yano, J., Terashita, M., & Nishihara, T. (2004). Efficacy of ozone on survival and permeability of oral microorganisms. *Oral Microbiology and Immunology*, 19(4), 240–246. doi:10.1111/j.1399-302x.2004.00146.
 30. Animireddy Kishore, G. Obulesu, Madhu Babu. Determination of Antimicrobial Efficacy of Calcium hydroxide, Ozonated sesame oil and their combination as intra canal medicament against *Enterococcus faecalis* – A Study in Fathima Institute of Medical Sciences, Kadapa. *IAIM*, 2016; 3(8): 219-227.
 31. I. E. Neena, P. Poornima, Ganesh Edagunji, K. B. Roopa, K. P. Bharath, "Lasers in pediatric dentistry: A review," *Int J Contemp Dent Med Rev*, Vol. 2015, Article ID: 030115, 2015. doi: 10.15713/ins.ijcdmr.29
 32. Nazemisalman B, Farsadeghi M, Sokhansanj M. Types of lasers and their applications in pediatric dentistry: a review. *J Lasers Med Sci*. 2015;6(3):96-101. doi:10.15171/jlms.2015.01.
 33. Shanthi M. Laser Prescience in Pediatric Dentistry. *Int J Sci Stud* 2015;3(2):197-203