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Review Article

Recent advances in non-pharmacological behavior management during dental treatment in pediatric patients - A review article

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Abstract

Behaviour management is a crucial aspect of paediatric dentistry, ensuring effective communication, cooperation, and a positive dental experience for children. Recent advancements in non-pharmacological behaviour management techniques have significantly improved patient compliance while reducing the need for sedation or general anaesthesia.

Techniques such as tell-show-do, positive reinforcement, and distraction remain fundamental, but newer innovations, including virtual reality (VR), augmented reality (AR), biofeedback, and artificial intelligence (AI)-driven behaviour prediction models, have enhanced patient engagement. As, paediatric dentistry continues to evolve, integrating these non-pharmacological techniques with traditional behaviour management methods enhances patient comfort and ensures better oral health outcomes.

Keywords: Behaviour management, Anxiety, Fear

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1. Introduction

Oral health care for young children can greatly impact their lives as well as their family's well-being however, dental fear and anxiety can be a serious obstacle preventing kids from getting dental care.[1] Current research indicates that dental anxiety and fear are psychological obstacles that have a detrimental impact on the patient's attendance frequency, leading to avoidant behaviour and a lower quality of life associated with oral health.[2]

Dental anxiety, dental fear and dental phobia have been used interchangeably in the literature. These three disorders are often referred to as "dental fear". However, there is a clear distinction between the terms by certain factors, among which dental anxiety is the mildest form.[3] The 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSMV-5) defines dental anxiety as a form of specific phobia. Dental anxiety is a conditioned response characterized by the anticipation of encountering a dental-related threat in the future[4]. In contrast, dental fear is a primitive emotion that elicits a fight or flight response, activated by an imminent and specific threat in a dental setting (e.g., dental drill, needle).[4-5] The most extreme form is dental phobia, which is defined as complete avoidance of dental care.[5] Dental anxiety is a complex condition that negatively affects dental patients and oral care providers.

The Global prevalence of early childhood dental fear and anxiety among 2-6 years children was found to be 30%. Children without dental visit experience and children with caries experience had higher odds of experiencing dental fear and anxiety compared to those with dental visit experience or caries-free status.[6]

Therefore, the first line of choice while treating the paediatric patient is always by using a non-pharmacological behaviour approach. It is the means through which the dental health team effectively and efficiently performs treatment for a child. The aim is to instil a positive dental attitude. Child management in dental office basically refers to methods of obtaining a child's approval of treatment in the dental chair

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and which is achieved through proper communication, patient/parent education with empathy, coaching and listening. The concept of behaviour management is to build and guide a child's behaviour towards the treatment rather than treating the tooth alone. Non-pharmacological approaches are much preferred in general clinical settings owing to their obvious benefits of being simpler, feasible, and less invasive without any physical adverse effects on the patient's body

There are a number of contemporary non-pharmacological techniques that aim to help manage a child's behaviour. Some strategies are meant to eliminate inappropriate behaviour or lessen anxiety, while others are meant to enhance the communication process. While the techniques are separate individually, they are often used in combination.

Few recommended Behaviour management techniques are Preparatory information, Non-verbal communication, Voice control, Tell-show-do (TSD), Enhancing control, Behaviour shaping and positive reinforcement, Euphemisms, Memory restructuring, Modelling, Distraction, Systematic desensitisation (SD), Negative reinforcement, empathy, coping strategies, Physical restraints, HOME, etc.[9]

2. Recent Advances in Non-Pharmacological Behaviour Management Techniques

2.1. Audio analgesia

Audio analgesia is a method of pain reduction. This technique involves providing a sound stimulus of such an intensity that the patient finds it difficult to be attentive to any other thing. This is the kind of stimulus distraction, displacement of attention and positive feeding in the part of dentist that can help.[10]

2.1.1. White noise

Lickliter described the procedure as one in which the patient wears earphones and controls his acoustic stimulus through a control box held in lap.it has two control knobs one for the music and one for rushing, roaring sound derived from "white noise". At the beginning of the session, the patient selects the music he wants to hear – a stereophonic tape recording and adjusts it to a volume suitable for ordinary listening.11[12]. When the dentist starts to work or when his work causes any discomfort, the patient turns up the volume of the music. As soon as there is trace or forewarning of pain the patient turns the voice knob on. It controls the level of rushing, roaring waterfall sound. The overall sound pressure of the noise may be set as high as 116 decibels.[12]

More types of noise have recently surfaced, including pink and brown noises; each has advantages of its own advantages and contributes differently to people's relaxation and tranquillity. Different frequencies correspond to different hues of noise.[14-15]

2.1.2. Brown noise

In addition to producing a deep, reassuring sound that ensures the outside noise is muffled, brown noise amplifies its lower frequencies more than pink noise does. Red noise, sometimes referred to as brown noise, is stronger and deeper than white noise and has higher energy at lower frequencies. Brown noise is mostly used by people to unwind, enhance their sleep, and alleviate tinnitus and other problems. Thunder, breaking waves, and torrential rain are a few examples.[14-15]

2.1.3. Pink noise

A softer kind of white noise is called pink noise. Each higher octave causes the power of pink noise frequencies to diminish, lowering the pitch. Higher frequencies, which are quieter, and lower frequencies, which are louder, are used in pink noise. This pattern can help you relax and feel more at ease by producing a pink sound that sounds like rain or rustling leaves.[14-15]

2.2. Audio tactile performance technique

Audio tactile performance technique is a specially designed health education method indicated especially for visually impaired children, to improve oral hygiene, including verbal information and tactile sense.[13]

Concept: It involves an audio-interactive session where a friendly environment is created and a good rapport is initially built. Once they have felt their teeth on a huge, tactile replica, they are instructed to brush the model with help. After that, they are requested to use their tongue to feel their own teeth for deposits, which are indicated by a scratchy feeling. After that, they receive instruction on how to wash their own teeth with help.[16]

There is a time restriction of health education, and the process is continued for each child individually until they can perform it independently, correctly and confidently. However, children under the age of six need extra encouragement to clean their teeth since they have different cognitive capacities and motor dexterity. Younger children require assistance to brush their teeth because it is a fine motor task.[17]

2.3. Applied behaviour analysis (ABA)

Applied behavior science is a science in which procedures are based on a principle of behavior through systematic experimentation. The ABA approach will involve studying perpetuating factors of a particular behavior, along with the accompanying response. ABA methods involve functional analysis to teach specific skills accordingly, for example, to teach oral hygiene habits to a child. Stepwise learning is done, followed by reinforcements. Mainly used in children with autism spectrum disorders.[18]

In ABA, emphasis is placed on the functional relationship between human behaviour and the environment,

the measurement of behaviour and a reliance on observable variables.

Concept: The shaping process is another tool that ABA-using caregivers can employ to help patients acquire appropriate behaviours that they do not yet display. Shape is the process of positively reinforcing repeated approximations of the behaviour chosen for change (the goal behaviour) until the individual does the behaviour on their own. When teaching patients the skills they need to accept in-office treatment, the dentist can benefit from using shaping techniques. They can be used, for instance, to educate a youngster how to sit in a dentist chair properly and on their own by rewarding the target behaviour—approximations of sitting in the chair—until the goal is achieved. The foundation for mastering other abilities needed for in-office treatments is sitting skills.[19,13]

2.4. Aromatherapy

Aromatherapy involves the use of essential oils. Essential oils alter the psychological states and reduce the anxiety in patients waiting in the dental office.[13]

2.4.1. Concept of aromatherapy

It includes inhaling fragrant oils, which contain volatile chemicals that quickly disperse into the bloodstream after entering the lungs and activating the brain through systemic circulation. But these compounds also attach to olfactory receptors, triggering an electrical reaction that travels to the brain. This reaction is predicted to trigger neocortex activation, which affects olfactory perception and travels to limbic system parts such as the amygdala and hypothalamus, which regulate hormone and emotion levels. Aromatherapy works both emotionally and physically.[20]

In aromatherapy, essential oils have long been used to assist patients feel less anxious before dental procedures. Various essential oils are used in aromatherapy, like Lavender scent, bergamot oil, apple odours, orange essential oil, lemongrass oil etc, which are effective in reducing anxiety and pain perception among children.[21-22]

2.5. Mobile dental games

Mobile games are appealing to kids of all ages. The dental operatory can make good use of this. These are active distraction techniques which have proven to significantly reduce anxiety. A joyful, kid-friendly environment is established as the kids voluntarily use the smartphone apps, and the dentist is no longer a scary stranger. In the mobile application, kids are manipulated to act like dentists and perform procedures like extraction, scaling, and restoration. Children are given pre-procedure information in a way that is suitable for their developmental stages. Therefore, the child's familiarisation with the treatment processes and their actual experience with them may contribute to the decrease in fear and quicker acceptance of treatment.[23-24]

Virtual instructional games known as dental simulations assist kids get more comfortable with various dental tools and procedures and foster a more positive attitude about treatment. For example, with the help of the smartphone app Baby Panda Dental Care, kids can play like dentists and carry out various dental operations like extraction, scaling, drilling, filling, bracket alignment, and much more.[25]

Various dental game apps are available for both iOS and Android, like My Little Dentist,[51] My Bright Smile by Colgate,[52] Brusheez-The Little Monsters Toothbrush Timer,[51] Disney Magic Timer,[51] Brush DJ, Chomper Chums,[53] etc.

2.6. Virtual reality based distraction

With the speed at which technology is developing, audiovisual spectacles have become a major advancement in distraction strategies. With the help of these spectacles, videos might be shown in two dimensions (2D), giving young patients a better visual experience. These developed into virtual reality glasses, which, in contrast to 2D glasses, allow interactive content to be displayed in three dimensions (3D).[13]

This development gives patients a greater sensation of presence and interaction during dental operations by immersing them in a more realistic and captivating virtual environment. Users can experience a different world using virtual reality, which generates an artificial environment that resembles the real one. Through synchronization between the head-mounted display helmet (which creates an image with depth and space), motion sensors, headphones, and joysticks, the virtual experience offers multi-sensory information for a completely immersive simulation.[26-28]

2.7. Writing in the air using leg technique (Witaul)

The 'writing in the air using leg' (WITAUL) technique is a simple and successful active distraction method. Ask the patient to use one leg to write the letters of their name while the injection is being administered. This has been demonstrated to be a successful diversionary strategy for pain management during the injection of local anaesthetic.[13]

Distraction tactics help divert the child's attention from the operation that causes fear. One such diversionary strategy is the WITAUL (Writing in the Air Using Leg) technique. The method, which is frequently employed in regular clinical practice, entails raising the right leg and writing in the air with it. To make it seem more unique, the author frequently instructs the youngster to write their name even though what is written with the leg is meaningless. In multiple cases, the method has been found to be effective in diverting children's attention.[30]

2.8. Modifications of tell-show do technique

2.8.1. Tell- play- do

It is based on Bandura's learning theory. This approach, which also includes letting the kid play with dental equipment, reduces the child's fear of the equipment.[31]

Concept: explain the procedure to the child by means of euphemism for customised dental instrument toys in the mouth of a cartoon model. The child is then allowed to hold the instrument imitating toys and perform the procedure in the mouth of the model following which the treatment is performed in the child.[45]

The dentist and the child exchange information in both directions when using the TPD approach. The youngster gains an understanding of the various dental operations after receiving dental care through dental imitation toys. Additionally, he is exposed to a variety of sights and sounds from dental practice equipment.[32] The TPD technique itself requires some amount of preparation prior to attending to the child as compared to other conventional technique which requires almost no pre-liminary preparations.

2.8.2. Tell – show – play – doh

In this technique the children are introduced to a Play-doh dental model and allowed to play with a battery-operated toy drill. They are shown how the suction, airotor, and air-water syringe felt and works in a playful way. This serves to familiarize them with the dental setup, helped reduce anxiety, built a bridge for future communication, and help them prepare for further treatment sessions.

2.8.3. Tell –touch – try - smell– do

This particular technique has been modified for visually impaired patients. Researchers advise that the instruments that we are going to use should be previously felt by the patient, while we describe them. The patient can be sensitive to particular scents which are very strong hence their preferences are to be taken in account. In such category of patients, the correct voice control is necessary for behaviour management.

2.8.4. Ask – tell – ask

In this technique, the child will be given importance before and after the intervention. First, "Ask" considers the child's requirements, then "Tell" small amounts of information in simple language, and next "Ask" about the child's understanding and concerns. Studies, reported that the Ask-Tell-Ask technique could address and support the emotional needs of patients, family members, and the health-care team across events of all severity.

2.9. Teach-back technique

The teach-back method, a technique for verifying patients' understanding of their health information, has been recommended by the Agency for Healthcare Research and Quality and the Institute for Healthcare Improvement as a strategy for taking universal precautions for health literacy. Patients are asked to repeat the instructions they receive from their health care professionals. In simpler terms, in this technique the child is involved in an active manner by the dentist first explaining the procedures to the child and then asking the child to teach back what he/she has learned. A systematic review by Yen and Leasure. Stated that teach-back is an effective method of reinforcing or delivering health education in children and adults.

2.10. Thaumaturgy

Thaumaturgy is a new technique that has been used in this study to manage strong-willed children. Thaumaturgy is a tool that distracts and relaxes child and helps the dentist to perform necessary treatment. The cognitive development of the children played a major role in the technique used. Brain is composed of two hemispheres, the left and the right, and specific functions have been attributed to each. The left hemisphere in right-handed people is characterized with verbal and voluntary skills. Language, speech analysis, and problem solving are mediated on this side. The right side can be associated with non-verbal skills and emotions. Skills, such as art and music, are right hemisphere activities. Imagination is also thought to be associated with right hemisphere. Thus, the right hemisphere of the brain plays a major role during the use of thaumaturgic techniques. Isaac Bonewit's defined thaumaturgy as "the use of magic for non-religious purposes; the art and science of wonder-working.[33]

2.10.1. Thaumaturgic techniques include[34]

Thumb and light trick: Two thumb sleeves incorporated with a lighting device is worn on the thumb of the operator, which could be activated/deactivated at the operator's will. Various creative hand movements are performed to sustain the subject's interest.

Book trick: A colouring book which could display blank pages, black and white images, and coloured images sequentially on the same leaf is displayed to the subject to sustain the subject's interest and negotiate with the subject's reasoning capability.

Item trick: Child safe toys are displayed in front of the subject. A cue card with the name of one of the items is given to subject before the game. Item elimination formula is used to periodically eliminate one of the items in every round of the game until one item remained, which is the same item as on the cue card.

Thaumaturgy is used as a definitive method of behaviour management in conventional paediatric care. These techniques can be employed for both invasive and non-invasive manoeuvres to control and convert negative behavioural patterns to more desirable behaviour patterns. Thaumaturgy has proven to be a novel behaviour shaping

technique carefully tailored to improve the clinical outcome of dental treatment irrespective of the child's attitude toward dental procedures.[13]

2.11. Animal Assisted Therapy (Aat)

This behaviour management therapy involves the use of trained animals for distraction during treatment. It has been shown that during treatment with AAT there has been a significant reduction in anxiety and related behaviours. AAT can elevate IgA levels, enhancing host defences. Various animals like Birds, cats, rabbits, fish and tortoise have been utilised for animal assisted therapy with the most common type being canine assisted therapy.[44]

Dogs are being increasingly used in animal assisted therapies in dental practices. Dog in particular are suitable for therapies as they have developed human like social skills through domestication that enable them to be sensitive to human posture, attentional states and emotions.[13] Use of a therapy dog as a part of an antianxiety therapy during dental treatment is an feasible and cost effective approach to alleviating dental anxiety and has the potential to improve the therapy of anxiety patients.[35] Precautions include that the pet should be vaccinated and the patient should not be phobic to the animals. It can be used specially in special-needs children, autism spectrum disorder and dementia.[35]

2.12. Accupressure

In addition to providing beneficial physical comfort, satisfaction, and economy, acupressure is described as "a pressure point, hand-mediated energy healing technique which is considered as a useful strategy for the management of multiple symptoms, and is a safe intervention that requires no sophisticated equipment, carries minimal cost, and can be used by physicians, nurses, and even patients.[36-37]

This method could be carried out using a variety of tools, such as wristbands, derma-rollers, or magnetic point stimulators, or by directly exerting pressure with the finger, either with or without creating a circular motion, or by placing a bead or pellet over the desired point at a somewhat constant pressure.[38]

2.13. Sensory adapted dental environment

Sensory adapted dental environment has been developed based on the Snoezelen environment and may be suitable in reducing dental anxiety and facilitating calming effect in the dental clinic among children. It is thoroughly effective in children with developmental disabilities.[39]

It uses a multisensory environment, a combination of mesmerizing sound, good lighting, vibration, tactile sensation and aroma. It regulates the response and reduces anxiety.

Modifications to integrate a multisensory environment include in variety of aspects.39[40]:

Visual Aspect: For children sensitive to visual stimuli, remove all the direct overhead fluorescent lighting, form adapted lighting, slow moving repetitive colors effects using solar projector and camouflaging of the dental instruments with toys.

Auditory Aspect: To camouflage the auditory stimulus due to dental equipment's a soft music a=can be played in the background, provide a white noise machine and minimize outside noise.

Tactile Aspect: A friendly immobilization wraps which envelopes and hugs the child when wrapped around can be used to comfort the child as it will ensure safety and a means of deep pressure.

Taste and Smell: he used gloves should be altered, refrain from using any kind of perfumes or using a strong shampoo with strong smell. Choose unscented soaps and air fresheners for the office. Modifying the sensory environment is believed to 'cushion' and thus 'protect' the subject from harsh stimuli, reducing aversive visual, auditory, and tactile intensity while offering soothing visual, auditory, and tactile stimuli. The modified sensory environment results in the subject's attention being focused intently on the positive stimuli, causing an 'altered state' with a concomitant reduced awareness of discomforting or nocuous stimuli.

2.14. Bubble breath play technique

The Bubble breath play technique is a straightforward, reasonably priced, highly captivating, and non-threatening method. Children are urged to blow large bubbles and exhale slowly when using this technique. They inhale deeply from the stomach in an effort to blow them away. This technique aids in teaching them how to breathe deliberately, which improves kids' ability to relax physiologically.[47]

Technique: The kids are taught a deep breathing exercise that involved taking deep breaths from their stomachs and slowly exhaling as though they were blowing out air until they were instructed to stop. Following multiple repetitions until the youngster became accustomed to the breathing exercise, the subjects are instructed to follow the same breathing pattern to blow a large bubble without shattering it using the bubble blower. By taking a deep breath and releasing it into bubbles ten times, the kids are encouraged to create large bubbles.[48]

Relaxation with timed deep breathing is an exercise that is thought to help nearly all patients who are afraid. In a variety of contexts, diaphragmatic breathing has been utilized to lessen anxiety and perceived discomfort. It is known that elevated anxiety levels are linked to heightened pain perception. Anxiety lowers the pain threshold by activating the sympathetic nervous system.[40]

By contracting the diaphragm, expanding the abdomen, and deepening the inhale and exhalation, diaphragmatic breathing lowers the frequency of respirations and increases the volume of blood gasses while lowering anxiety and stress levels. Research shows that even one breathing exercise dramatically lowers blood pressure while raising oxygenation, HRV.

Most children may be taught diaphragmatic breathing easily and affordably by verbal instructions, role modelling, and imitation. Increased sympathetic and decreased parasympathetic cardiac modulation are hallmarks of anxiety. By favouring a decrease in sympathetic nervous system dominance over parasympathetic nervous system dominance, diaphragmatic breathing proved successful in counteracting these effects.41[42]. A low-cost, simple-to-implement method that may be used in everyday dental care, diaphragmatic breathing shows promise in lowering negative effects and physiological distress in children with dental anxiety, leading to more cooperative behaviours and shorter visit times.

2.15. Magic Tricks

Children's dental fears are diverted by magic tricks, which are interactive humour and illusion-based therapy. Children can learn how to do these tricks, enjoy the interactive magic presentations, or do both as part of these therapies. Medical literature claims that children's anxiety has previously been reduced with the use of magic tricks or sessions. It is simple to learn a simple magic trick that doesn't require any particular abilities or knowledge. Dentists can employ these distraction strategies in accordance with the intellectual growth of the recipient based on the cognitive development of youngsters.**Error! Reference source not found.**-43

Magic Trick, a behaviour guiding tool that has been re-examined in the medical literature, has been shown to be just as successful in reducing children's fear during dental procedures as audiovisual aids. Magic tricks should be a part of dentists' behaviour management strategies.**Error! Reference source not found.**

2.15.1. Robots

In this they use humanoid robots to implement a techno-psychological distraction technique for children to reduce their anxiety and stress-related pain during their dental treatment.A company named Yujin robot company has developed humanoid robot named IrobiQ, which is equipped with a tablet computer and can play videos and animations on the front panel. It can move its head, arms, and wheels, but does not change its position. It has 3 DOFs (Degree of Freedom) on its head and 1 DOF on each arm. The robot has facial LEDS as a part of its own hardware system and can display five types of facial expressions: shy, disappointed, neutral, happy, and surprised. It can express various emotions with two LCD eyes and LED dot matrices on its mouth and cheeks, and react to human touch by five kinds of sensor.[47] The robot is programmed to motivate the patient during the treatment and support the interaction with the child by performing short-time movements such as face, head and arm gestures or using audio and videos. Irobi asks children questions, gets responses and allows them to make choices on LCD screen. The robot behaviours as well as dentistry animations and songs have been integrated to the robot for better interaction with the children. The multidisciplinary field of human-robot interaction (HRI) studies the "modelling, design, implementation, analysis, and evaluation of robots for human use" in public areas, workplaces, education, healthcare, and therapy.[50]

In the medical field, IRobiQ is utilized for vital sign monitoring, telepresence, communication, cognitive training, prescription reminders, and amusement. Children in early childhood educational settings also tolerate it well. Humanoid robots have the potential to lessen children's dental treatment-related discomfort and anxiety.[51] However, the most important disadvantage of the system we recommend is the high cost of the robot. One of the limitations of this technique, whether if the robot damaged on a hardware or software basis, they must be examined by a qualified specialist. Maintenance of comprehensive robotic systems also requires high budgets.[49]

3. Conclusion

Recent developments in pediatric dentistry's non-pharmacological behavior management techniques highlight how crucial it is to give kids a comfortable and stress-free dental treatment. The way dentists handle behavior management has been completely transformed by strategies like virtual reality distraction, interactive storytelling, cognitive behavioral therapy, and the use of digital tools. These techniques not only increase collaboration and lessen anxiety, but they also promote trust and a healthy attitude toward dental care that lasts a lifetime.

Reactions brought on by anxiety can be challenging to control and may lead to changes in the way oral care is delivered or less access to it. In order to complete the required dental work, these reactions may necessitate the use of sedative drugs, general anesthesia, or physical constraint. Since these methods frequently call for treatment to be done in a more specialized facility, like a hospital, rather than an outpatient dental clinic, management with them may be expensive. Paediatric dentistry is developing to address the particular psychological and emotional requirements of children by fusing technology innovation with evidence-based procedures, guaranteeing more efficient and compassionate treatment.

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5. Conflict of Interest

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