

AVANTGARDE IN PAEDIATRIC DENTISTRY

Beyond the Clinic: why new bioactive restorative materials have really changed Paediatric Dentistry

ABSTRACT

Background The aim of this paper is to remind how evidence-based paediatric dentistry should not only consider the best available scientific evidence relating to the patient's oral conditions but it should also consider the patient's needs beyond the clinic. In a child-family-oriented approach, the best restorative treatment for a primary tooth could not be the proper one for the child as a whole. Preservation of dental tissues as much as possible, without involving the pulp, is called minimal intervention dentistry (MID) and it is closely related to "selective caries removal" and "bioactive restorative materials". To preserve the vitality of a tooth as much as possible, many tools are available on the market (i.e. silver diamine fluoride, ozone) and this could play an important role in a "tailored fit treatment plan" mindset.

Clinical report This approach requires a huge paradigm shift in which carious lesion is no longer viewed as an infection to be eradicated, but as an illness that can be controlled in terms of slowing down or stopping it. This could be achieved through SCR (Selective Caries Removal) procedures that can be performed with low-speed drills, hand excavators, chemo-mechanical solutions and no need for local anaesthesia or absolute isolation. To maximise the chances of remineralisation of the carious lesion, the coronal seal of the restoration is crucial and the choice of bioactive restorative materials — that can be used in the not-absolutely-dry field — contributes to the success of these minimally invasive direct restorative procedures.

Conclusion Minimally invasive direct restorative strategies in paediatric dentistry, is a predictable evidence-based-restorative option for the treatment of vital primary teeth with no need of local anaesthesia and absolute isolation. Beyond the clinical aspect, the clinician expertise is crucial to evaluate the required materials and tools, not only to perform a minimal invasive paediatric dentistry in a safe, efficient and child-friendly way, but for the wellness of all parties involved. In this life-related paradigm new bioactive restorative materials are among the main protagonists.

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Introduction

Subjective well-being (SWB) is a positively oriented concept that encompasses how well life is going for a person [Diener et al., 1999]. There is evidence suggesting a link between paediatric SWB and health [Waters et al., 2008] in paediatric dentistry as well as in medicine in general. The patient reported outcomes (PROs) seems more important for the future than any other outcomes. Although symptoms and PROs seems to be similar, in the latter the symptoms are often considered only for behavioural objective but seldom for health-related quality of life (HRQL) [Deshpande et al., 2011]. One of the most challenging topics in paediatric dentistry is to be not only clinically effective but to reduce the risk of dental fear, considering how negative dental experiences reverberate in adulthood, presenting long-term effects [Thomson et al., 2009]. There is an ongoing commitment to improve the oral health and overall well-being of children, with a focus on minimising discomfort, anxiety, and long-term dental issues [Lo Giudice 2023]. In a child-centred restorative paediatric dentistry, the traditional clinical parameters to assess the clinical success of a restoration, as marginal integrity and wear surface, secondary decay, fracture and pulp inflammation [Amend et

al., 2022] are not enough to name a treatment as a success or a failure [Innes et al., 2013]. Outcomes such children and parental perception, discomfort, anxiety and pain complement all the previous parameters. Minimal intervention dentistry (MID) is a philosophy of care that aims to preserve tooth tissues through the patient's life [Wambier et al., 2023]; it is considered a friendly approach, reducing patient anxiety and offering health-oriented treatment options [Micknautsch et al., 2005]. Cavitated dentine lesions were usually considered to be the cut-off point for caries. If not controlled these lesions will progress, causing pain and negatively affecting both the child behaviour and the family quality of life [Leal et al., 2014]. In discussing the management of these kind of carious lesions in primary teeth, considering the concept of MID, the conventional restorative "needle, drill and fill" approach, in which all the carious tissue is removed, might not always be the best clinical option in terms of PRO. Needle and drill are the most fear-inducing aspects of dental treatment [Tani et al., 2005]. Regarding direct minimally invasive restorative techniques, a less invasive approach, in which both anaesthesia and drill can be avoided, was proposed. This technique, pioneered in the mid-eighties in Tanzania, is called atraumatic restorative treatment (ART). It is based on



FIG. 1a



FIG. 1b



FIG. 1c



FIG. 1d



FIG. 1e



FIG. 1f



FIG. 1g



FIG. 1h



FIG. 1i



FIG. 1l



FIG. 1m

Fig. 1 a-g: Restoration of the cavity of a vital 7.4 without caries excavation, with ozone application and a dual-cure glass ionomer cement without an adhesive procedure. **1 h:** The one year follow-up revealed the stability of the restoration. **1 i:** Signs of wear of the restoration after 2 years. **1 l:** The restoration has been repaired by partially removing it with a diamond bur mounted on a red handpiece, etching, use of universal adhesive and application of bioactive restorative material. **1 m:** Four years after the first visit the restoration is intact and the first phase of dental exchange is in progress.

the removal of the soft carious tissue using hand instruments, followed by restoration with a self-adhesive dental material that simultaneously seals any remaining pits and fissures still at risk [Frencken et al., 2012]. Many systematic reviews indicate that incomplete caries removal significantly reduced the risk of pulp exposure [Schwendicke et al., 2013]. Despite the ART technique is well codified, the term modified Atraumatic Restorative Treatment (mART) was first made known in the early 2000 and it consists in the principles mentioned above, using different tools alone or in combination in adaptation to the oral environment. The ART concept inspired restorative techniques probably could be better fitted in a 21st century SPA oral care mindset [Beretta et al., 2022], even if the principles must strictly be the same of the original ART approach. Relative analgesia for the patient comfort [Arcari et al., 2018], low speed burs specifically designed, hand excavators, ozone, silver diamine fluoride, chemo-mechanical caries removal compounds, new strategies of selective caries removal, high viscosity glass ionomer cements, bioactive restorative resin-based materials, are changing the way we look at child-family-

oriented restorative paediatric dentistry [Beretta et al., 2023].

Clinical reports

Proper timing for the first dental visit is crucial, but there is a huge heterogeneity in terms of indications. The Italian National Guidelines suggests a child's first dental visit at the age of 18 months [Italian National Guidelines, 2017]. The American national guidelines recommend a first dental visit within 6 months of eruption of the first primary tooth and no later than 12 months of age [ADA, 2023]. Some researchers [Furze and Basso, 2003; Paglia and Beretta, 2021] suggest that the first preventive dental counselling should take place during the intrauterine life to give information about caries and how to provide a proper oral care to the newborn?. In our opinion, an early dental counselling is strongly suggested as soon as possible in a setting in which paediatricians, dental hygienists and dentists cooperate in a synergic way. Here's some clinical cases in which an appropriate early parental counselling should have been done. We would remind the concept of child-oriented treatment plan in which the ideal treatment for the

tooth could not be the best choice for the child. For this reason, we decided to stress the extra-clinical background information.

Marta, 2.4 years old

Modified ART technique, carried out at the second visit after a preliminary behavioural approach [Tieri, Tripodi et al., 2023], "without caries excavation" of tooth 7.4 (vital and sensitive to chewing) in a young 28-month-old patient (referred to by the general dentist), by cleansing the cavity with a pH balancer containing fluoride and citric acid (alternatively chlorhexidine can be used), application of ozone [Beretta and Federici Canova, 2017] and restoration of the cavity with dual glass ionomer cement (self-photopolymerising) in a single session without local anaesthesia, absolute isolation and adhesive procedure, but employing only with a behavioural approach, in dad's arms and in conditions of absolute comfort and well-being (Fig. 1 a-g). At the one year follow-up, three paediatric oral hygiene sessions were carried out with a "no aerosol" protocol and fluoride applications, revealed the stability of the



FIG. 2a



FIG. 2b



FIG. 2c



FIG. 2d

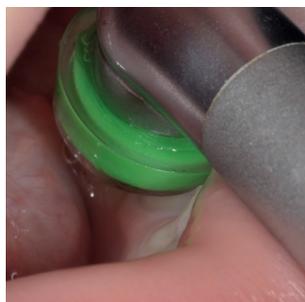


FIG. 2e



FIG. 2f

Fig. 2 a-f: Maria, 4 years old, subjected to MID for advanced carious lesion of lower left first primary molar (ICDAS 6), starting from fluoride applications in office till to chemo-mechanical manual caries removal (CMCR), ozone disinfection, and restoration using a direct bioactive restorative material (Activa™ BioACTIVE-RESTORATIVE™) without etching.

restoration (Fig. 1 h). After 24 months the restoration showed signs of wear at the edges (Fig. 1 i) and it was restored by partially removing it with a diamond bur mounted on a red handpiece, etching, use of universal adhesive and application of hydrophilic "smart and bioactive" resin-based restorative material (Activa™ PRESTO™) (Fig. 1 l). Four years after the first visit the restoration appears intact and the mouth and has maintained excellent health conditions for the arrival of the first permanent teeth (Fig. 1 m).

Maria, 4 years old

Maria came to our attention with her mother. She had never had an initial dental examination and no symptoms were reported. An advanced active carious lesion was diagnosed (ICDAS 5) [Pitts, 2004] in her lower left first primary molar. An immediate "drill and fill" surgical approach could have been risky for the loss of her cooperation [Cianetti et. Al 2017]. We decided to start with non-invasive procedures as oral habits modifications (in terms of fluoride exposition and diet) and topical fluoride varnish application. After only 2 weeks the compliance was good enough to perform a minimally invasive restorative procedure through chemo-mechanical selective caries removal [Reddy et al., 2019], ozone disinfection and restoration using a hydrophilic "smart and bioactive" resin-based restorative material [Lardani et al., 2022]. No local anaesthesia or absolute isolation were performed (Fig. 2 a-f).

Manuel, 4 years old

Manuel came to our attention with his father. He had a previous traumatic dental experience (due to the extension of the carious lesion, the previous dentist considered as

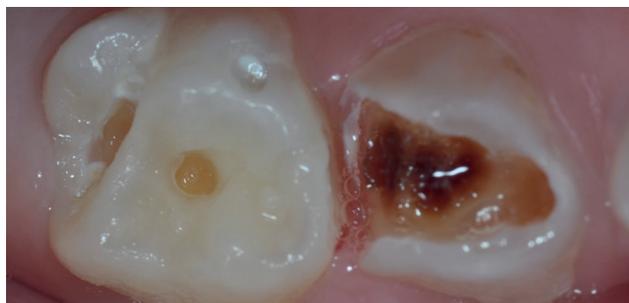


FIG. 3a



FIG. 3b

Fig. 3 a-b: Manuel, 4 years old, subjected to MID, starting from adequate behavioural approach to make the cavity preparation with selective caries removal on vital upper right first and second primary molars, until leathery dentine was reached, and subsequently restored using a bioactive hydrophilic restorative material (Activa™ BioACTIVE-RESTORATIVE™).



FIG. 4a



FIG. 4b



FIG. 4c

Fig. 4 a: Intraoral picture of the upper jaw 2 yrs after SDF 38% treatment of advanced carious lesions; presence of an abscess in left upper primary molars. 4 b: Intraoral picture of the upper jaw 3 yrs after. A rapid palatal expander was cemented after the extraction of left primary molar. 4 c: Intraoral picture of the upper jaw 4.5 yrs after. The RPE was removed. The upper primary molars exfoliated and the permanent teeth are healthy.

mandatory to perform immediately a local anaesthesia without any behavioural approach or comfort technique, like relative analgesia, quickly losing his collaboration). After two appointments of adequate behavioural approach, we perform a modification of the cavity design to expose the enamel's margins, with dedicated handpieces in 45 seconds and without local anaesthesia. Manuel seemed surprised to not feel any pain, so he decided to let us go ahead and performing a direct restoration with a hydrophilic "smart" resin-based restorative material without absolute isolation. The father previously knew nothing about modified atraumatic restorative treatment (Fig. 3 a-b).

Martina, 7 years old

Martina came to our attention with her mother. She presented nonspontaneous symptoms during chewing with no signs or symptoms of endodontic involvement. She was scared about the words pronounced by her grandmother regarding the requirement of dental extractions. Also, for this reason she always refused to go to the dentist. Taking initial pictures was not possible. She presented a DMFT of 4 with a high risk of pulpitis and or necrosis at the upper arch. We opted for a non-invasive therapy through habits modification and in-office fluoride varnish application every 3 months. The collaboration of the parents in terms of cavities cleansing was crucial. After two appointments of fluoride application, SDF 38% compound [Yan et al., 2022; Zaffarano, Cagetti et al., 2022] was applied every 6 months. After 2 years, one of the 4 advanced carious lesions led to an abscess; this was the major failure (Fig. 4 a). Only 2 years after the first visit Martina became ready for a restoration treatment, so we extracted the unsalvageable tooth 6.4 under relative analgesia and local anaesthesia and performed atraumatic restorations with a direct high viscosity glass ionomer cement on the other upper deciduous molars previously treated with SDF. Due to the need of palatal expansion, 3 years after the first visit, a CAD-CAT (Computer Aided Design-Computer Aided Technofacturing) rapid palatal expander [Federici Canova, Beretta et al., 2021; Beretta, Federici Canova, Gianolio and Zaffarano, 2022] was cemented on the first permanent molars, because the second deciduous molars were no longer usable as a primary anchorage [Quinzi, Federici Canova et al., 2021], to obtain correct palatal expansion, guiding the growth and dental exchange (Fig. 4 b, c).

Luca, 5.6 years old

Child-family-oriented paediatric dentistry does not mean "no

local anaesthesia" and "no absolute isolation". This approach is a level-up reasoning in terms of holistic care of the child. Luca was often looked after by his grandparents who gave him fruit juice. The mother knew that it was not appropriate, but family dynamics meant that the child was at home with his parents very little. Despite this, the cooperation was enough for a conventional restorative treatment but not for an endodontic treatment. A general anaesthesia option was carefully discussed. In our opinion, due to the high numbers of advanced carious lesions (the DMFT was 18) the risk to not have enough chairside time to restore the posterior teeth adopting a non-selective caries removal, bringing many of them to be extracted, was high (Fig.4 a-c). Indirect restorations, as stainless steel crowns and Hall technique were rejected. In agreement with the parents, considering the good compliance of the child, we opted for several appointment to restore at first the primary molars, using bioactive restorative materials (Activa™ BioACTIVE-RESTORATIVE™). With the aid of oral conscious sedation (relative analgesia), we administered local anaesthesia and achieved absolute isolation. A non-selective caries removal would have been probably led to a pulp exposure. Considering the absence of pulp involvement, we decided to perform a selective caries removal up to the leathery dentine with the aid of a manual excavator. Local anaesthesia was administered and absolute isolation was achieved (Fig.4 d-h). After 2 years the first permanent molars erupted, simplifying any future treatment decision (Fig. 4i). As you can notice, the key point should be to keep a proper plaque control, in this case the plaque control unfortunately was not good.

Discussion and Conclusion

Today the market offers to the paediatric dentist several tools to simplify the clinical procedures and make them more comfortable for the child and for the operator alike, but it is important to remind that these techniques are used only for minimal intervention (MI) caries management in order to preserve as much dental tissue as possible without involving the pulp, whenever possible. Without considering the complexity of paediatric dentistry, also a well-conducted minimal invasive treatment could lead to a failure in terms of relationship between the dentist, the child and his family. Sometimes parents are aware that some behaviours are wrong, but today's families' lives are complex, and this must also be taken into account before only clinical-based treatment plans. In this life-related paradigm, new bioactive restorative materials are among the key factors to consider for the next generation paediatric



FIG. 5a



FIG. 5b



FIG. 5c



FIG. 5d



FIG. 5e



FIG. 5f



FIG. 5g



FIG. 5h

Fig. 5 a-c: Luca, 5.6 years old, clinical conditions at the first visit.

Fig. 5 d, e: Advanced carious lesions, selective caries removal till leathery dentine and adhesive restoration with bioactive restorative material. 5 f, g: Immediate postoperative result. 5 h: Follow-up after 3 years. The upper left first permanent molar is fully erupted.

dentistry, that is, to make the correct clinical interventon, we must “think beyond the clinic itself”.

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