

# State-of-the-art on MIH. Part. 2 MIH clinical management using ozone

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## Abstract

### MIH: clinical management using ozone

MIH is still a challenge in paediatric dentistry, due to the high sensitivity caused to the first permanent molars, that can greatly reduce the cooperation either for home oral hygiene or for in-office treatment. In this contest the use of ozone emphasises the ART technique (Atraumatic Restorative Treatment) and introduces modern "no aerosol" concept.

**KEYWORDS** Enamel anomalies; Molar Incisor Hypomineralization; Ozone.

## Introduction

The continuous increase in the prevalence of enamel anomalies of permanent molars, including MIH, which is one of the most pressing issues in paediatric dentistry [Giuca et al., 2020], raises the question of defining new intervention protocols according to the technological advances that are revolutionising paediatric dentistry. The main clinical consequence for the teeth affected with MIH is represented by dental hypersensitivity [Alaluusua, 2010], with pain upon brushing and difficulties during feeding, generating a vicious circle that leads to a very rapid deterioration of cavitation [Lygidakis, 2010]. In this field, Ozone can be an important tool in the prevention and treatment of MIH. The aim of this work is to illustrate an operative protocol based on the use of ozone [Beretta and Federici Canova, 2017] for treatment of MIH.

## Ozone therapy

In recent years the use of new technologies for the treatment of tooth decay in young patients has revolutionised the world of paediatric dentistry. Ozone, a substance already known in medical practice for its high sterilising power, has been studied for its use in dentistry since the 1930s. Ozone is a powerful oxidizing agent occurring in nature as trivalent oxygen (O<sub>3</sub>); it is a colorless gas with a pungent odour. As stated above, it has a very high disinfecting power: indeed, it is able to effectively kill bacteria, viruses and spores in few seconds [Lynch, 2004].

After the early experiments, the use of ozone has been abandoned due to its relative toxicity and the difficulties to concentrate the gas without any waste. However, the studies have been resumed in the 1980s, when Dr. Edward Lynch of the Royal London Hospital Medical College was able to demonstrate how a carious lesion exposed to a single application of ozone could re-mineralise. In recent years, the introduction of new devices allowed the application of ozone directly on the tooth surfaces affected by caries, thanks to special single-patient silicon cups [Bayasan, 2000; Baysan and Lynch, 2006]. The first device for dental use was capable of delivering pure ozone starting from environmental air, after obtaining vacuum inside the cup, conveying it to the cavity, aspirating the gas and converting it back to O<sub>2</sub>. Recently, a new device on the market is able to produce ozone by withdrawing the oxygen from a special bottle and transforming it to a concentration of 32 g/m<sup>3</sup>, with much higher efficacy and power than the previous machines.

Ozone areas of application in paediatric dentistry are:

- caries on deciduous teeth;
- initial lesions on newly erupted permanent teeth, when it is not possible to make any type of restoration or seal;
- primary fissure caries;
- sterilisation of endodontic cavities.

Due to its ease of use and the absolute comfort, ozone is used for direct decontamination of dentin, especially in deciduous teeth of very young or not-collaborating patients, followed by the application of various products in order to obtain a remineralisation of the surface [Samuel et al., 2016; Safwat et al., 2017] or for decontamination after partial dentin excavation, that is effective, simple, safe and extremely conservative [Beretta and Federici Canova, 2017].



FIG. 1 Bioactive materials can be used for surface sealing following ozone application, and fluoroprophyllaxis, in order to increase the remineralising effect and reduce sensitivity.

**MIH and ozone**

According to Weerheijm criteria for diagnosis of MIH [2001], we can consider mild, moderate and severe forms of MIH. For the mild one, early diagnosis and prevention are crucial in order to preserve all the dental tissue and avoid cavitation or loss of substance. The tissue should be remineralised with fluoride gels or varnishes in-office with fluoroprophyllaxis sessions with a previous ozone application, that increases the remineralising effect and reduces sensitivity, so that the tooth can be sealed using a bioactive material (Fig. 1). In order to promote enamel remineralisation, phosphorus of amorphous calcium phosphate (CPP-ACP) can also be

used. It consists in a foam, suitable for application at home or in-office, that stabilizes calcium phosphate by binding to the amorphous calcium phosphate and thus forming CPP-ACP micelles. This process promotes remineralisation of the hypomineralised areas and prevents the adhesion of *Streptococcus mutans* to the enamel surface. In the moderate MIH form, the ART technique [Frencken, 2014] with glass ionomer cement can be modified using ozone in the case of newly erupted molars with small enamel fissures to avoid post-eruptive breakdown, allow proper oral hygiene and reduce sensitivity. Ozone is applied to the tooth for 60 seconds through a silicone cup to remove the biofilm, then a glass-ionomer cement is applied in order to fill the



FIG. 2 Ozone is applied on the tooth for 60 seconds using a silicone cup to remove the biofilm (a, b), then a glass-ionomer cement is applied (c, d) in order to fill the cavity and avoid bacterial contamination of the dentin (e); follow up after 24 months (f).



**FIG. 3** Composite resin restoration (a-f) and follow up after 18 (g, h) and 48 months (i, l).

cavity and avoid bacterial contamination of the dentin (Fig. 2). In severe forms of MIH, the tooth shows a post-eruptive breakdown, i.e. a post-eruptive structural collapse, frequently mistaken for a carious lesion. It is important to underline that the breakdown is always post-eruptive and should not be confused with enamel hypoplasia, which is a defect in the quantitative development of the enamel that can sometimes be appreciated even in a pre-eruptive stage. In severe MIHs, rapid structural collapse can compromise the integrity of the tooth and result in high risk of pulp damage [Willmot, 2008]. Therefore, the primary purpose of the treatment of severe forms is to maintain the vitality of the tooth, also in order to allow root development. With an early diagnosis, a glass ionomer material associated with ozone decontamination for 60 seconds can be used in the first instance, following the modified ART technique described above. In the severe forms this approach, due to its extreme simplicity and speed, can also be performed during the first visit, it is even more effective than in the medium forms, and can be associated to an orthodontic band, in order to improve the structure of the tooth (Fig. 3). By eliminating the sensitivity of the molars and sealing the cavity with glass ionomer cement the little patient is able to restart his/her normal oral hygiene practices, which are often compromised by the extreme sensitivity of these teeth. When a correct isolation of the affected area can

be obtained, it is possible to proceed with the restoration with composite resin using a minimally invasive technique by means of a previous application of ozone (Fig. 4).

It is important to take into account that the altered porosity of the demineralised enamel makes the adhesion less effective and increases the chances of fracture compared to a healthy enamel. This can greatly affect the duration of the restoration and parents should be informed about the need for constant and strict periodical checkups. In these cases, it is crucial to preserve the pulp to allow a correct root formation, because a traditional endodontic treatment would lead to the arrest of root formation. However, the clinical conditions should be: asymptomatic tooth (or only hypersensitivity but not spontaneous pain), absence of radiological signs of pulp involvement. In the ultra-conservative approach of dental tissue, the use of ozone could be crucial.

### Conclusions

Molar Incisor Hypomineralization (MIH) is a constantly increasing disease observed in paediatric dentistry. While in the mild and medium forms the preventive and restorative approach is simple, in the serious forms there is the problem of how to restore the tooth without compromising the



**FIG. 4** After ozone application restoration with composite resin can be performed using a minimally invasive technique (a-d); follow up after 24 months (e).

pulp. The clinical management of molars affected by MIH is conditioned by two factors that are not always directly related to each other: hypersensitivity to thermal stimuli and the degree of pulp involvement by carious or non-carious processes (rapid demineralisation of exposed dentin or breakdown). In all cases the first objective is always preservation of pulp vitality, as the long-term prognosis of these teeth is strongly influenced by root maturation.

In this scenario the use of ozone represents an effective and comfortable solution in the treatment of MIH. While in the mild forms it can promote remineralisation and increase the effectiveness of topical products, in the medium and severe forms the ozone therapy can be crucial to intercept early cavitated lesions that could not be treated otherwise. Furthermore, ozone appears to be crucial in serious dental breakdowns to preserve a layer of dentin above the pulp chamber, in order to maintain the vitality of the tooth and complete the root formation. Finally, the use of ozone either to prevent worsening of dental caries or for the treatment of decayed teeth, as well as MIH, can be considered an effective tool for the current “no aerosol concept” in dentistry, that will expand in the near future.

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