# MTA APPLICATIONS IN PEDIATRIC DENTISTRY

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**SUMMARY**

***MTA applications in pediatric dentistry.***

The aim of this paper is to show and asses the clinical applications of the Mineral Trioxide Aggregate (MTA) in pediatric dentistry, either on primary teeth or on immature apex permanent teeth. We have described the primary tooth pulpotomy technique using MTA, that is characterized by a superior biocompatibility and a sealing ability that make it a more suitable compound compared to other materials in terms of result prediction on a long-term basis. We have also reported the direct capping technique using MTA on immature apex teeth; in these particular cases, MTA is undoubtedly preferable to conventional materials, especially in what its sealing characteristics concern. Furthermore, we have explained the apexogenesis clinical procedure, in which after a chamber pulpotomy on incomplete root development teeth, MTA is used in direct contact with the pulpar stump in order to save the root pulp vitality, allowing the apex and relative canal walls physiological maturation to take place. In case of necrotic teeth with immature apex, we describe the possibility of using MTA as an apical barrier making the apexification treatment faster and predictable, taking profit from its biocompatibility quality, its sealing ability and setting characteristic in humid environments. In all described applications, MTA has demonstrated to be a very versatile and extremely trustworthy material. Either literature and results obtained from the present experience, show how the use of MTA in Pediatric Dentistry, compared to commonly used materials, translates into pulp or periapical tissues being less swollen and, thus, guaranteeing a higher prediction of the therapeutic result on a short-term basis and on a long-term one.

**Key words:** Mineral Trioxide Aggregate, Paediatric endodontics, Pulpotomy.

**RIASSUNTO**

***Utilizzo dell'MTA in odontoiatria pediatrica.***

Lo scopo di questo lavoro è illustrare e valutare le applicazioni cliniche di utilizzo del *Mineral Trioxide Aggregate* (MTA) in odontoiatria pediatrica, sia su denti decidui che su denti permanenti ad apice immaturo. Viene descritta la tecnica di pulpotomia dei denti decidui con MTA, la cui biocompatibilità ed il mantenimento del sigillo lo rendono più idoneo, rispetto ad altri materiali, in termini di predicibilità di risultato a lungo termine. Viene illustrata la procedura di incappucciamento diretto con MTA su denti con apice immaturo; in tali casi l'MTA è sicuramente da preferirsi alle tecniche convenzionali in particolare per le sue capacità sigillanti. Inoltre, viene riportata la procedura clinica di apicogenesi in cui, dopo pulpotomia camerale in dente ad incompleto sviluppo radicolare, viene utilizzato l'MTA a contatto del moncone pulpare al fine di preservare la vitalità della polpa radicolare, permettendo la fisiologica maturazione dell'apice e delle pareti canalari. Nel caso di denti necrotici ad apice immaturo, viene descritta la possibilità di utilizzare l'MTA come barriera apicale rendendo il trattamento di apecificazione molto più veloce e predicibile, sfruttando le doti di biocompatibilità, di sigillo e le capacità di indurimento in ambiente umido di questo materiale. In tutte le applicazioni descritte l'MTA si è dimostrato un materiale molto versatile ed estremamente affidabile. La letteratura ed i risultati ottenuti in seguito all'esperienza riportata, evidenziano come l'uso dell'MTA in odontoiatria pediatrica comporti una minore infiammazione dei tessuti pulpari o periapicali rispetto ai materiali comunemente utilizzati, garantendo una maggior predicibilità di risultato terapeutico sia a breve che a lungo termine.

**Parole chiave:** Mineral Trioxide Aggregate, Endodonzia pediatrica, Pulpotomia.



## Introduction

Pediatric endodontics deals with pulp therapy of deciduous teeth and immature apex permanent teeth.

The objective of *deciduous teeth* endodontic therapy is that of keeping, if possible, teeth active till their normal exfoliation time.

The objective of endodontic therapy of *immature permanent teeth* is that of ensuring root development

continuity and of keeping the tooth in its dental arch when pulp is compromised.
MTA is most helpful in these circumstances, allowing the operator to perform difficult therapies in a highly secure and predictive way compared to other materials (1).
The objective of this paper is to show and asses Pediatric Endodontics clinical procedures in which this material may be used.

## Clinical applications
## Deciduous element pulpotomy

Even if different techniques have been proposed (2), up to day there is no scientific evidence that makes clear which is the most appropriate material to be used in deciduous elements pulpotomy, only the MTA seems to have specific characteristics as to be considered as an appropriate material: its biocompatibility, its ability to harden in a humid environments and its sealing properties (3).
At the Pediatric Dentistry Unit of the Policlinico di Tor Vergata Hospital of Rome, we have studied a 7 years old child that reported pain during mastication at the lower right hemi-arch. The intraoral clinical examination revealed that the patient presented carious pathology on dental elements 8.4 and 8.5 (Fig. 1).
During excision of carious tissue of element 8.4 we noticed the coronal pulp exposure. After having evaluated the bleeding grade, the integrity of the root structure and the absence of radiotransparent periapical lesions (Fig. 2) we decided to perform a pulpotomy. After having opened the pulp chamber, the pulp content was removed and accurately sectioned from the canal entrance with a sterile excavator. Radicular pulp bleeding was controlled with sterile cotton pellets moistened with physiological solution. We used Mineral Trioxide Aggregate (MTA) (ProRoot MTA, Dentsply, Tulsa Dental, Tulsa, OK, USA) to cover the sectioned pulp. It was prepared according to manufacturer's indications and positioned on the canals entrance using an applicator. Finally, to improve the setting mechanism a sterile solution moistened cotton pellet was placed in direct contact with

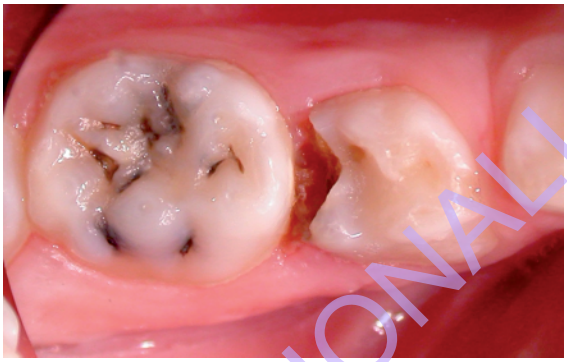

**Figure 1**
Carious pathology 8.4-8.5.

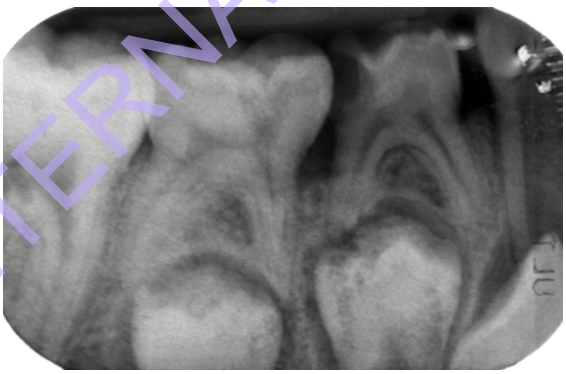

**Figure 2**
Periapical endoral radiography 8.4-8.5.

the MTA and the tooth was rebuilt with temporary material. Three days after, we made an endoral periapical radiography to check dental element 8.4 (Fig. 3). Once the temporary reconstruction was removed and MTA solidification was checked, the dental element was rebuilt with compomer material. After six months, we made another control radiography (Fig. 4)

## Permanent teeth capping

Nowadays, among available materials to perform a direct capping, for sure MTA is the material of choice (4). Direct capping is to be considered as an appropriate procedure in immature apex teeth and pulp exposure, without any signs of irreversible pulpitis. In such cases, MTA is absolutely preferable to calcium hydroxide (5). MTA stimulates the formation

**Figure 3**
MTA placement after cameral pulpotomy.

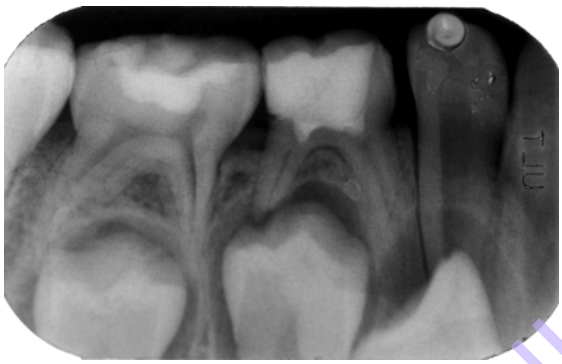

**Figure 4**
Control radiography (6 mths post-op).

of dentinal bridge in contact with dental pulp tissue. The dentinogenic effect of MTA may be a consequence of its sealing properties, its biocompatibility and its alkalinity (6).

The patient we have observed, an 11 years old child, presented a carious pathology on the lower left first molar. The decay was symptomless, non-aching to percussion or touch, with absence of any periradicular pathology visible on radiographic examination (Fig. 5) and had a positive response to the sensibility test.

Once the carious tissue was removed we noticed the exposure of the pulp horn at the mesio-lingual cusp (Fig. 6).

We proceeded cleansing the dental surface with a cotton pellet moistened in sodium hypochlorite 5.25%. In order to reach haemostasis of the pulp exposure, we used sterile cotton pellet moistened in physiological solution.

Afterwards, we applied the MTA cement (Pro-Root

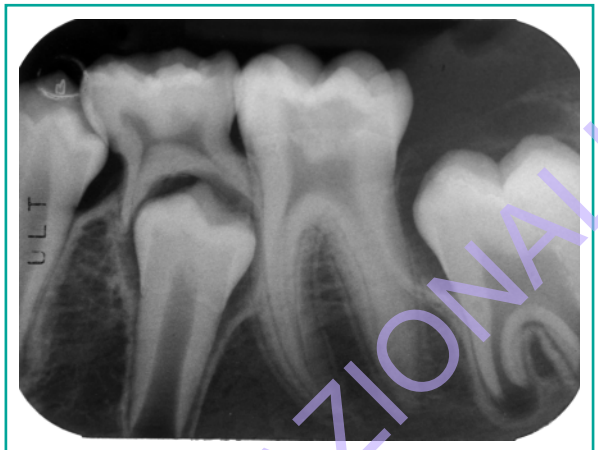

**Figure 5**
Periapical endoral radiography 3.6.

**Figure 6**
Element 3.6, mesio-lingual pulp corn exposure.

MTA, Dentsply, Tulsa Dental, Tulsa, OK, USA) in the exposed pulp area, and then, we placed a cotton pellet moistened in sterile water and a temporary filling and we performed a radiological control by means of periapical endoral radiography (Fig. 7). Three days after, we performed the pulp vitality test, obtaining a positive result, and we proceeded to remove the temporary filling, so as to be able to check the MTA solidification and to proceed with permanent reconstruction of the element with composite

**Figure 7**
MTA placement radiography.

**Figure 8**
Restored element radiography.

material (Fig. 8). We repeated vitality tests and control radiographies at 1, 3, 6 and 12 months (Fig. 9).

## Apexogenesis

Apexogenesis is the elective therapy in case of pulp exposures due to iatrogenic or carious trauma in dental elements that do not have complete root maturation yet. This procedure is performed with the goal of preserving pulp vitality and, thus, allowing the physiologic growth, the thickening of canal walls and the closure of root apex to follow their natural trend. MTA seems to have all requested characteristics that are normally asked to an ideal cement in order to be able to seal any existing communication between root canals and the oral cavity and, at the same time, it guarantees a high biocompatibility on the pulp stump (7).

We have observed a 10 years old girl that presented a contusive trauma on upper central incisors occurred more or less four days prior to the visit.

At oral examination we observed an enamel-dentin crown fracture of elements 1.1 and 2.1 with pulp exposure (Fig. 10, 11). Vitality test resulted positive for both elements; given the time passed from the trauma and the extent of the pulp exposure we did not considered appropriate to proceed with a direct pulp capping.

In the endoral radiography we observed that apices from elements 1.1 and 2.1 were not yet completely

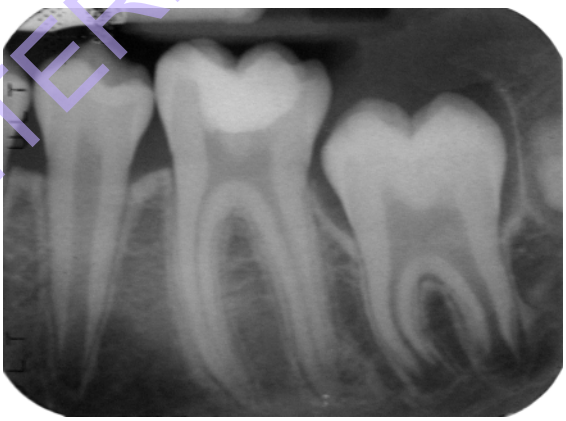

**Figure 9**
Control radiography (12 mths post-op).

**Figure 10**
Complicated crown fracture of 1.1 e 2.1, front view.

**Figure 11**
Complicated crown fracture of 1.1 e 2.1, occlusal view.

**Figure 12**
Periapical endoral radiography 1.1-2.1.

formed (Fig, 12). We, then, decided to preserve the root pulp in order for apexogenesis to take place.
After having administered local infiltration anesthesia and after having isolated the concerned elements with dental rubber dam we proceeded to clean the exposed pulp with sodium hypochlorite at 5.25%.
We opened the pulp chamber of 1.1 and 2.1 elements and amputated the pulp with a sterile excavator. In order to have bleeding under control we compressed a physiologic solution moistened cotton pellet into the canal for five minutes; once we checked whether haemostasis was taking place we used non-diluted, sterile, calcium hydroxide on element 1.1 and white MTA (Pro Root MTA - Dentsply, USA) on element 2.1.
The cavity of element 1.1 was filled with glass ionomer cement, while, on element 2.1, in order to stimulate setting reaction of MTA we placed a direct contact sterile water moistened cotton pellet, the cavity was filled with temporary material and we made a control radiography (Fig. 13). 72 hours after the intervention on element 2.1 we removed both, the temporary filling material and the cotton pellet. Once we had checked the setting reaction of MTA, the cavity was filled with glass ionomer cement. Then, we restored both elements with composite materials. We checked again the patient on months 3, 6, 9, 12 and 24 (Fig. 14). In all visits both elements resulted positive to vitality tests and no periardicular lesion radiographically visible was observed.

**Figure 13**
MTA placement .

**Figure 14**
Control radiography (24 mths post-op).

**Figure 15**
Complicated crown fracture of 2.1, front view.

## Apexification

The apexification technique with calcium hydroxide has always had a great success; nevertheless, it also has some disadvantages (8), as:
- time needed for the apex to mature is sometimes too long and cannot be programmed beforehand (9)
- we need to regularly replace the canal medication even if with this procedure we risk to loose the crown barrier and contaminate the root canal.

As a matter of fact, due to these reasons, it has become necessary to find a material that let you fill an immature apical teeth canal without having, first, to stimulate a natural apical barrier formation (10, 11).
We treated a 7 years old child that presented a crown fracture at element 2.1 with pulp exposure that took place three months before the visit (Fig. 15). We took a periapical endoral radiography of the element and did vitality tests that resulted negative. The periapical endoral radiography showed that root maturation and complete apex development of the concerned element were not yet complete, thus, we programmed an apical barrier by placement of MTA.
After having derided the canal, we cleansed it with sodium hypochlorite at 5.25% and proceeded with manual tools till 1 mm from the radiographic apex (Fig. 17). As the patient also presented previous abscessed events on the fractured element, we also did a mid medication with calcium hydroxide for a

**Figure 16**
Periapical endoral radiography 2.1.

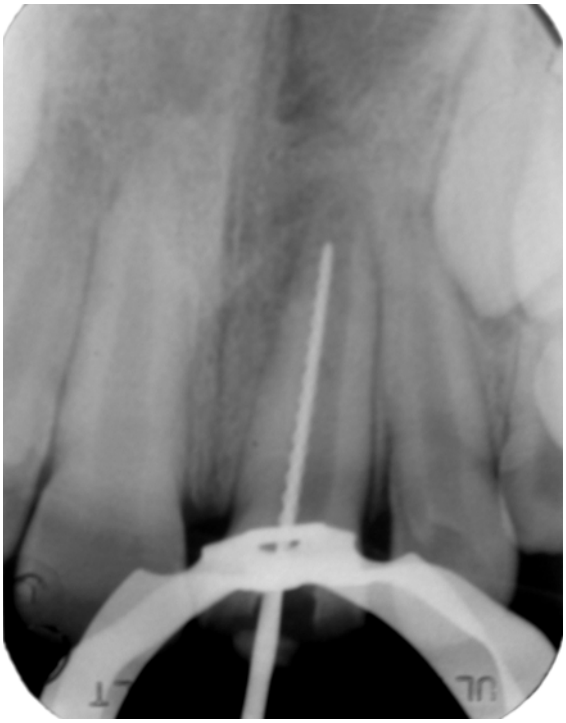

**Figure 17**
Exploratory radiography and length of intervention.

**Figure 18**
MTA placement radiography.

week time so as to neutralize the periapical acidity that could have impeded the MTA setting reaction (11).
Later on, after having removed the momentary filling and the calcium hydroxide using sodium hypochlorite at 5.25%, we dried the root canal with sterile paper cones. Then, we mixed MTA powder with sterile water and placed 4-5 mm of the material in the apex zone with the appropriate Dovgan carrier previously measured for this purpose. Finally, we made a control periapical endoral radiography (Fig. 18), placed in direct contact with the MTA a moistened paper cone and sealed the cavity with temporary materia. Three days after, we removed the temporary filling and the paper cone to check whether the material had, indeed, hardened. We then proceeded to complete therapy by filling the rest of the canal with warm gutta-percha according to classical methods and restoring element 2.1. Twelve months afterwards, we made a control radiography in which no periradicular radiographically visible lesion was observed (Fig. 19).

## Discussion and conclusion

MTA has demonstrated to be a very versatile and extremely reliable material (12, 13).
The elective indication of this material is in procedures that regard permanent teeth that have not yet reached complete maturation, in particular, in apexogenesis therapies and direct capping procedures as the material, thanks to its biocompatibility and stability on a long term basis, allows you to preserve interested elements vitality without having to perform further endodontic therapies.
In apexification cases, which imply the apical stop, it translates into an important time-saving procedure that lets you predict therapy in a secure way
Its applications in the deciduous teeth are still not yet widely used in daily clinical practice due to its high cost compared to commonly used materials. Literature (3, 7, 14, 15) as well as results from the present experience show how the use of MTA in pediatric dentistry means a smaller pulp or periapical tissues inflammation compared to commonly used

**Figure 19**
Control radiography (12 mths post-op).

materials guaranteeing a higher predictable therapeutic result on a short and long basis.

## References


1. Schmitt D, Bogen G. Multifaceted use of ProRoot MTA root canal repair material. Pediatr Dent 2001;23:326–30.
2. Holan G, Eidelman E, Fuks AB. Long-term evaluation of pulpotomy in primary molars using mineral trioxide aggregate or formocreosol. Pediatr Dent 2005;27:129–36.
3. Caicedo R, Abbott PV, Alongi DJ, Alarcon MY. Clinical, radiographic and histological analysis of the effects of mineral trioxide aggregate used in direct pulp capping and pulpotomies of primary teeth. Aust Dent J. 2006 Dec;51(4):297-305.
4. Iwamoto CE, Adachi E, Pameijer CH, Barnes D, Romberg EE, Jeffries S. Clinical and histological evaluation of whiteProRoot MTA in direct pulp capping. Am J Dent 2006;19:85–90.
5. Karabucak B, Li D, Lim J, Iqbal M. Vital pulp therapy with mineral trioxide aggregate. Dent Traumatol 2005;21: 240–3.
6. Tzias D, Pantelidou O, Alvanou A, Belibasakis G, Papadimitriou S. The dentinogenic effect of mineral trioxide aggregate (MTA) in short-term capping experiments. Int Endod J 2002;35:245–54.
7. Chacko V, Kurikose S. Human pulpal response to mineral trioxide aggregate (MTA): a histologic study. J Clin Pediatr Dent 2006;30:203–9.
8. Haglund R, He J, Safavi KE, Spangberg LSW, Zhu Q. Effects of root-end filling materials on fibroblasts and macrophages in vitro. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2003;95:739–45.
9. Johnson BR. Considerations in the selection of a root-end filling material. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1999;87:398–404.
10. Torabenejad M, Chivian N. Clinical applications of mineraltrioxide aggregate. J Endod 1999;25:197–205.
11. de Leimburg ML, Angeretti A, Ceruti P, Lendini M,Pasqualini D, Berutti E. MTA obturation of pulpless teeth with open apices: bacterial leakage as detected by polymerase chain reaction assay. J Endod 2004;30:883–6.
11. Lee YL, Lee BS, Lin FH, Lin AY, Lan WH, Lin CP. Effects of physiological environments on the hydration behavior of mineral trioxide aggregate. Biomaterials 2004;25:787–93.
12. Chacko V, Kurikose S. Human pulpal response to mineral trioxide aggregate (MTA): a histologic study. J Clin Pediatr Dent 2006;30:203–9.
13. Camilleri J, Monstein FE, Papaioannou S, McDonald F, Pitt Ford TR. Biocompatibility of two commercial forms of mineral trioxide aggregate. Int Endod J 2004;37:699–704.
14. Witherspoon DE, Small JC, Harris GZ. Mineral trioxide aggregate pulpotomies: a case series outcome assessment. J Am Dent Assoc 2006;137:610–8.
15. Felippe WT, Felippe MCS, Rocha MJC. The effect of mineral trioxide aggregate on the apexification and periapical healing of teeth with incomplete root formation. Int Endod J 2006;39:2–9.


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