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Biodentine® And Apexification: Practical Therapy for Necrosis of Immature Permanent Teeth

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INTRODUCTION:

The permanent tooth can be subjected to a variety of stresses during its formation, such as caries damage or trauma. In the short or long term, these aggressions can damage the pulp tissue, potentially leading to its necrosis, which in turn can cause infectious problems. The timing of the necrotizing event affects the state of development of the tooth, with roots still forming and residual thin walls, leading to root fragility. (1)

Management of these cases by conventional endodontic treatment then becomes difficult, not only because of the width of the apical diameter and the thinness of the root walls, but also because of their divergence, which makes complete debridement difficult, as well as problems of drying and apical sealing. (2)

For a long period, calcium hydroxide paste was employed to create a calcified barrier followed by root canal treatment. However, in 1993, mineral trioxide aggregate (MTA) became the preferred material due to its sealing properties and biocompatibility, good radiopacity, low solubility, high pH, expansion after setting and antimicrobial properties.

However, the long setting times, manipulation difficulties and risk of coronal discoloration associated with MTA led to the search for alternative materials, a new calcium silicate-based material, Biodentine® (Septodont), has been developed recently to maintain the beneficial properties and clinical applications of MTA without its negative characteristics.

(3)

Biodentine® can be employed to substitute dentin in coronal restorations, pulp linings, pulpotomies, repair of root perforations, internal and external resorptions and the construction of apical barriers in apexification treatments.(4)

These biological properties, together with the product's good color stability (16), lack of genotoxicity (17) and low cytotoxicity (18), make it ideal for endodontic practice and the material of choice for apexification treatments, especially in anterior teeth. On the other hand, one possible downside of Biodentine is its low radiopacity. (5)

The aim of this article is to illustrate, through a case study, the treatment of an immature permanent tooth with a Biodentine® apexification.

CLINICAL CASE:

A 19-year-old male patient presented with lateral dislocation of tooth 21 following trauma, who was treated in the pathological and surgical dentistry department, with a 4-week semi-regid contention from tooth 14 to 24. (Fig 1)

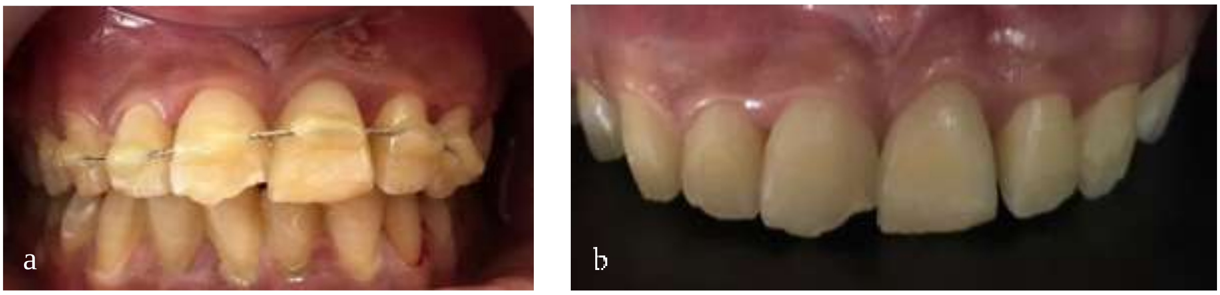
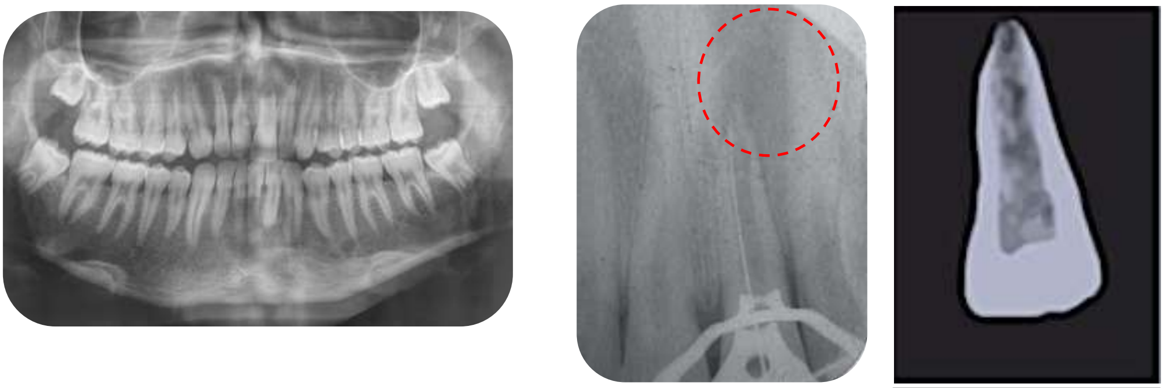


Figure 1: a. Initial state after tooth repositioning and placement of contention. b. Intra-oral photo after contention removal

Sensitivity tests revealed the absence of pulpal sensitivity on teeth 21 and 22.

Radiological examination showed that the root apex of 21 was not fully formed and was at NOLLA stage 9 (root edified, apex not closed), and LIPOE on teeth 21/22.(Fig 2)

It should be noted that the patient had already suffered trauma at the age of 8.



NOLLA stage 9

Figure 2: Panoramic and retroalveolar radiograhpy confirms the presence of a gaping apex (NOLLA stage 9) on tooth 21 and a radiolucent image on teeth 21 and 22

The treatment was carried out over two visits.

<u>The first visit:</u>

For tooth 21: creation of access cavity, pulpectomy, root canal shaping and calcium hydroxide obturation to working length

For tooth 22: root canal obturation by lateral condensation with gutta-percha. (Fig3)

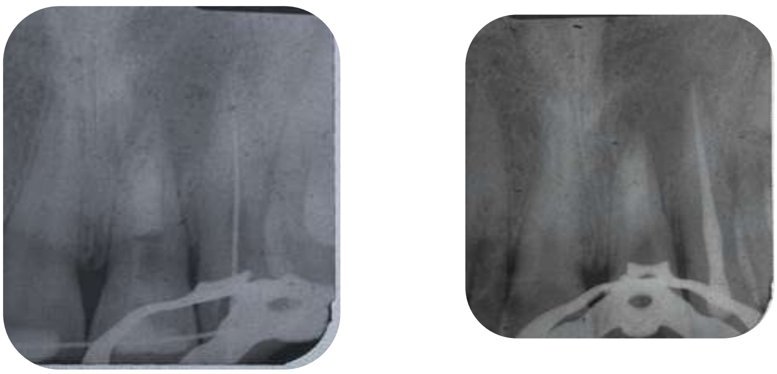


Figure 3: Tooth 21: Calcium hydroxide filling throughout the canal Tooth 22: final filling

Second visit: after 3 weeks

- Ca $(OH)_2$ was deposited with H files

- The irrigation protocol was as follows: the endodontic irrigation needle was placed at working length - 2mm, the concentration of the irrigation solution was decreased and the volume increased to avoid apical toxicity. (Fig. 4)

Figure 4: Irrigation to Working Length -2mm Endodontic needles recommended

- Drying with paper cones to working length

- Biodentine® was handled according to the manufacturer's instructions: The powder was combined with five drops of liquid and then activated in the dental triturator for 30 seconds.

- Adjustment of Machtou fullers to LT-4mm (Fig 5)

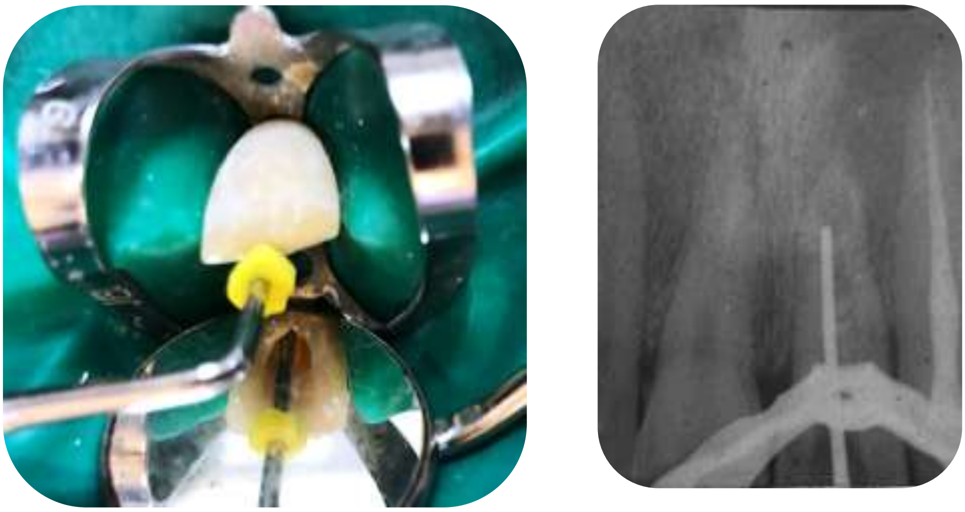


Figure 5: Choosing the Machtou fuller at LT - 4mm retroalveolar radiogaraphy with fuller in place

- Biodentine® was placed with an amalgam holder and compacted with the condenseurs spre/plug MACHTOU to the apex to create a 4mm apical plug, the excess material on the canal was cleaned with paper points.

- Control radiograph (Fig 6)

Figure 6: 4mm Biodentine ® apical plug

- After 12 minutes, the hardness of the Biodentine® was examined using a file to confirm setting

-The rest of the canal was filled with gutta percha using the warm vertical condensation technique (Fig 7) + Access cavity and the tooth was filled with composite resin. (Fig8)

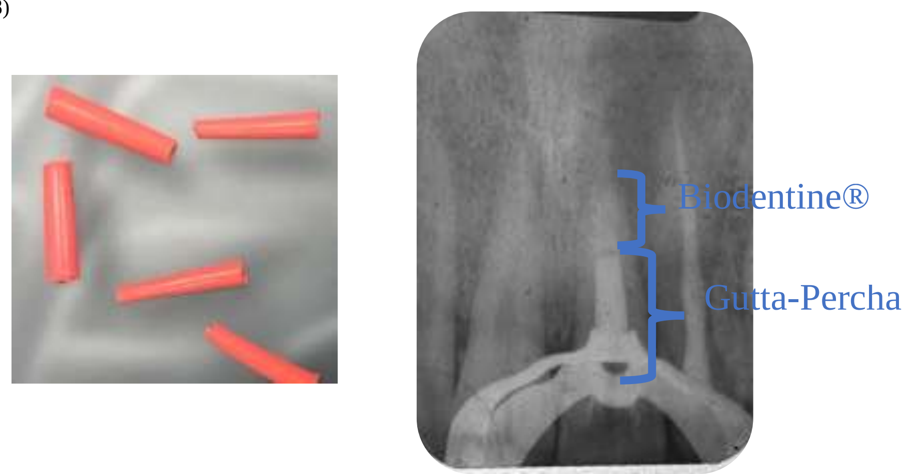


Figure 7: Postoperative radiograph

Figure 8: Final restoration with composite resin.

- One-year and two-year follow- up (Fig 9) showing complete disappearance of the periapical lesion and good bone healing

Figure 9: a: one-year follow-up; b: two-year follow-up

DISCUSSION:

Apexification is a method used to induce a calcified apical barrier or promote continued apical development in roots with necrotic pulp that are incompletely formed. Conventionally, this method requires the application of calcium hydroxide (CH) until the root apex is completely closed (6). Nevertheless, this long-term technique has several drawbacks, such as delayed treatment, difficulties in patient follow-up, unpredictable apical sealing and an increased risk of root fractures due to thin walls. Prolonged use of CH in root canals can also weaken tooth structure. (3)

MTA emerged by Torabinejad and collaborators as an excellent and predictable alternative to solve these problems by creating a biocompatible apical plug in a single visit as well as its good sealing capacity. (7)

MTA's mechanism of action is to liberate calcium ions that promote cell attachment and multiplication, while its high pH creates an antibacterial environment (8). In both clinical and radiographic success, MTA generates apical hard tissue formation with a much higher consistency than CH. (9)(13)

Despite the fact that MTA has shown to be a promising material for apexification, it has certain disadvantages, such as discoloration and weakening of the dentinal walls. (10)

to overcome these shortcomings, Biodentine® is introduced as a new bioactive dentin substitute cement, presented in capsule form with an ideal powder/liquid ratio. Powder composition: 80% tricalcium silicate, 15% calcium carbonate, 5% zirconium oxide (opacifier), Liquid: calcium chloride, a hydrosoluble polymer and water (11).

Based on the study conducted by Septodont in 2010, it can be stated that Biodentine® has a significantly shorter setting time compared to MTA materials. Biodentine® exhibits an initial setting time of 6 minutes and a final setting time of 10.1 minutes, in contrast to MTA, which have initial and final setting times of 70 minutes and 175 minutes, respectively. (12)

This shorter setting time was obtained by using a higher specific surface of the particles, adding a calcium chloride gas accelerant to the liquid phase, and reducing the liquid content. In apexification, a faster setting time avoids the need for two- step obturation, as is the case with MTA, and reduces the risk of bacterial contamination. (14)(15)

The marginal sealing capacity of calcium silicate-based materials is attributed to their potential to generate apatite crystals on the surface in contact with phosphates present in tissue fluids. These crystalline precipitates are produced by interactions between calcium and hydroxyl ions liberated by the hardened material and phosphate ions. Biodentine® exhibits apatite formation after immersion in a phosphate solution, demonstrating its bioactivity. (14)

It also, favors the survival and differentiation of apical papilla stem cells (SCAPs) and an increase in the odontoblastic marker DSPP, helping to fill open root canals and promote periapical healing. (16)

for its anti-bacterial properties, Biodentine® acts on certain facultative anaerobic bacteria such as Actinomyces naeslundii and lactobacillus casei(17)(19).

The physical properties are crucial when considering it as a material for crown restorations. Recent studies have demonstrated that teeth treated with

Biodentine® do not show crown discoloration. (18) (19).

However,the application of Biodentine as an apical plug is technique-sensitive. It is essential to contain the material within the limits of the root apex. Extruded sealing material in the periapical region can harden before decomposing and being resorbed, leading to persistent inflammation that can complicate or even inhibit tissue repair. To solve these problems, in 1992 Lemon developed the "internal matrix concept" for the treatment of root perforations. He proposed using amalgam to close the perforation, then be compacted against an outer matrix of hydroxyapatite, carefully pushed through the perforation to act as a barrier or outer matrix (20). Another approach is to use a sterile, resorbable collagen membrane as an external matrix to reconstruct the external shape of the root and facilitate adaptation of the sealing material. This material is highly moisture-absorbent, expands and has a haemostatic effect. The collagen membrane is completely absorbed within 10 to 14 days, permitting the new bone to gradually fill the defect. (21)

CONCLUSION

One-visit apexification using a new biocompatible material like Biodentine represents a significant advance in the effective management of open-apex teeth. the favorable clinical and radiological results obtained in this case study demonstrated that Biodentine can be an effective alternative to conventional apexification materials.

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