VPT and Restorative Dentistry on Permanent Teeth
How to Manage a Carious Exposition with a Reversible Pulpitis Status without Root Canal Therapy

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Abstract
Vital Pulp Therapy (VPT) is a biologic and conservative treatment modality to preserve the vitality and function of the coronal or remaining radicular pulp tissue in vital permanent teeth. The most important biological target of these therapeutic solutions is the dentinal bridge formation. Clinically, dentinal bridge formation is valued by Rx analysis where the pulp chamber is reduced after 3 - 6 months from VPT therapy. Usually, Clinical practice success on VPT procedure is made when no spontaneous pain is present. Clinical Parameters to achieve success in VPT are no encoded.

Aim of this paper is to show the clinical methodic to achieve clinical success in VPT cases on permanent teeth.

Keywords: Vital Pulp Therapy (VPT); Biodentine; Diagnosis; Direct Pulp Capping; Miniature Pulpotomy; Dentinal Bridge

Introduction
Vital pulp therapy (VPT) is a biological and conservative treatment modality to preserve the vitality and function of the coronal or remaining radicular pulp tissue in vital permanent teeth [1].

In modern endodontics, vital pulp therapy (VPT) is considered an ultra-conservative treatment modality [2].

VPT is composed by various techniques [2]:
1. Indirect pulp capping
2. Direct pulp capping
3. Miniature pulpotomy
4. Full pulpotomy

Indirect pulp capping is a procedure where a part of carious tissue is leaved in situ. Residual bacterial are walled in the capping material where them biological activity are stopped [3,4].

Direct pulp capping is a procedure where a part of residual pulp were exposed and covered by capping material that facilitate dentinal bridge formation and a pulpal vitality maintaining [5].

Miniature pulpotomy is a procedure where a part of residual pulp were removed and covered by capping material that facilitate dentinal bridge formation and a pulpal vitality maintaining [2,6].

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Full pulpotomy is a procedure in which all the pulp chamber has to be removed until to canals entrances; Full pulpotomy is useful when the pulp inflammation extends to the deepest anatomical roots levels [2].

The experts have the opinion that VPT success depends by [7]:

1. Residual pulp without inflammation
2. Bleeding management
3. Dental capping material to stimulate cellular proliferation
4. Marginal Seal to avoid bacterial infiltration

Some articles indicate that a VPT could be achieved:

1. On small pulp exposition of 1 mm of diameter maximum [7].
2. On traumatic or mechanical exposition due to carious removal [5].
3. Absence of pain before the treatment [5].
4. No apical radiologic signs of pathology [8].
5. No systemic diseases [9].
6. Adequate Bleeding management [10].

Clinically, if we refer to all of these points, root canal therapy should always be done because reversible pulpitis state depends by many factors.

To obtain success during VPT procedures, a correct clinical diagnosis and patients selection must be achieved.

Reversible Pulpitis and Clinical Diagnosis

To evidence reversible pulpitis an anatomopathological analysis is needed (Mejare 2012).

A correct clinical sequence is composed by:

1. **Cold test**: It is a subjective test and it is difficult to record [11]. The result of this test derived from the instantaneous intensity (a cotton pellet is positioned on the vestibular face of one or more teeth adjacent the interested element and the positioned on the teeth that has to be cured: if the stimulus is equal to the standard registration, the value will be “1”, while if it’s superior, there will be a numeric value that could be maximum “3”) and the period (the thermal stimulus must be about 1 minute more or less, for then disappearing completely, if instead the response is continuous overtime it’s contraindicated to do a VPT because we are probably in an irreversible pulpitis case).

2. **Electric test**: It was born as a numerical and objective test [11]. Clinically, when a numerical value is including between 10 and 18 it’s possible to do a VPT. When the value is between 8 and 9 we could face an irreversible pulpitis in 50% of the cases. If the value is inferior at 8 there is a high possibility of an irreversible pulpitis. When the value is between 50 and 60 there could be, with high probability, a necrosis state.

3. **Percussion test**: It's a subjective test and not sufficient alone to make a correct diagnosis [12]; if positive could indicate an apical necrosis (that must be confirmed radiologically with an intraoral radiograph).

4. **Rx analysis**: If the distance between the pulp and the carious process it's under 0.5 mm its present an inflammatory state of the pulp that can alter the good result of a VPT in 50% of the cases [13].

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Patient Selection

The VPT procedures provide a time period of about 30 - 40 days where a hypersensitivity to the thermal stimulus could be elevated but transitory. If the patient is not ready to face this period for any reason, a VPT is contraindicated and is mandatory to make a conventional RCT.

An element where has been make a VPT will necessitate an accurate monitoring of the symptoms through the clinical test mentioned before in the days 7-14-30-40 to comprehend the situation of the pulpal recovery; in this period, it must be performed cold test, electric test and percussion test, accurately recording the results in order to make a comparison with the initial data. If the patient doesn’t have this time frame it’s mandatory to do a conventional canal treatment to accelerate the recovery time of the patient.

In this article there will show a clinical case with a direct restoration marking the limit and the daily application of this procedure.

Material Selection

In this article will be presented two clinical case where has been used a biosilicate (Biodentine-Septodont) as a biomaterial. It’s provided by the producer in the form of a powder contained in a capsule and a liquid (7 drops) in a vial. To mix the two component, the cap of the capsule is removed, it’s positioned in the dedicated plastic base and then 5 drops of liquid are added. The capsule is then closed and mixed in a vibrator for 30 second. The biomaterial can be placed also on a mixing pad, and its adaptation in the dental cavity can be performed with a cylindrical obturator made of steel or plastic. After 20 minutes the procedure is completed and the dentin substitute is ready to be left in the site. The material must be kept in place for about 40 days for allowing it to gain mechanical proprieties before making of the final restoration.

Case Report

VPT Two stages technique: Direct Pulp Capping and direct restorative therapy

Male patient, 42 years old. Tooth number 34. Presence of a deep carious process on distal side (Figure 1, 2). No spontaneous pain.

Fig. 1
The cold test results twice in comparison to the adjacent teeth (value 2), the percussion test is negative and the electrical test results in the value of 11 (Meditester-Medical). Radiographically is not evidenced any signs of apical necrosis (Figure 2).

After retrieving the treatment consent of the patient, the local anesthesia is made with Articaine HCL 4% with adrenaline 1:200.000 (Septanest, Septodont), the dental dam is positioned and the decay elimination is done with diamond cylindrical bur and the with carbide bur on slow handpiece (Figure 3). It’s possible to notice a pulp exposure of a diameter of about 2 mm (Figure 4).
Bleeding after pulp exposition (Figure 5) becomes manageable after 30 seconds of waiting (Figure 6).

A sectional matrix was put in the distal side (Figure 7) and the biomaterial was prepared (Biodentine-Septodont), vibrating the capsule in vibrating device with a ratio of 1 capsule and 5 drops. The cavity has been filled with biomaterial, using a metal obturator (Figure 8).

Biomaterial setting time is of about 15 minutes (Figure 9, 10).
At 4 months from the procedure, Biodentine was structurally stable (Figure 11) and no signs of apical necrosis was detected during Rx analysis (Figure 12).
Through the follow-up VPT appointments the percussion was absent, cold test gave the value of 2 in the first 14 days, while from day 30 it stabilizes around the value of 1.5. The electric test gave the value of 17, longer than the first analysis.

After the retrieval of the consent from the patient, the local anesthesia was done using articaine HCL 4% with adrenaline 1:200.000 (Septanest, Septodont), the dental dam was positioned and a part of the biosilicate was removed by a steel matrix to protect adjacent tooth (Figure 13-15). Enamel layer was discovered to be able to improve adhesive procedures (Figure 16).

A teflon layer was positioned under the marginal side to protect the adjacent tooth (Figure 17) against the orthophosphoric acid (Figure 18). The acid can be positioned on biodentine and enamel layer to improve adhesive procedure.
After acid conditioning, surfaces (Figure 19-21) are ready to receive primer and bonding components.

After primer and bonding placement, a thin fluid composite layer was placed (Figure 22, 23) and the marginal crest was made by composite material (Figure 24). The direct restorative procedure was completed (Figure 25) after finishing and polishing (Figure 26, 27).

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**Rx Analysis:** Post restorative procedure (Figure 28), after follow up at 6 months (Figure 29), 18 months (Figure 30) and 24 months (Figure 31). Dentinal bridge formation is appreciable and no necrosis apical signs are present.

**Discussion**

The dental pulp can be exposed for mechanical causes during the prosthetic-restorative preparation of the tooth, for traumatic causes or for extended carious processes. The pulp result in an inflammation state when a carious process is present in a dental element. The possibility of doing or not a VPT on a permanent adults’ teeth was always a matter of discussion. The traditional way of clinical dentistry states that in a permanent tooth a root canal treatment is always indicated, considering the high predictability of this procedure, that is now studied and tested from decades. In reality, doesn’t exist a universal truth about the best therapy to do on a tooth with decay and pulp exposure.

For this reason, it’s important to consider also the VPT as an alternative therapy in the clinical practice. The goal in a VPT is to maintain throughout the time the vitality of the pulp tissue, that is clinically noticeable with the tooth that result asymptomatic and the formation of the dentinal bridge.

The selection of the material for doing a VPT is one of the fundamental parameter to obtain a good prognosis of the tooth treated. In the past year, the calcium hydroxide was the first material that gave satisfactory result, in case of pulp exposition, in order to maintain the vitality of the tooth and permit the formation of the dentinal bridge.

The pure calcium hydroxide, however, had also some limit on the mechanical aspect, that has to be filled with the use of other material added on the top, like IRM or zinc oxi-phosphate. The companies made an effort in the next decades in the development of materials that would have superior mechanical proprieties in comparison the calcium hydroxide, in terms of pulp biocompatibility, ease of use and adhesion to the restorative material. In the last years, MTA was in the center of many studies, with the result of an optimal material for pulp capping, but with some disadvantage like expensive cost of utilization and long setting time, that oblige the clinician to place a provisional restoration in the first 24 hours, and then make the final restoration.

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Another crucial factor for the good long term result of a VPT is the presence of an intimate contact between the dental residual layer and the restorative material. MTA and calcium hydroxide does not allow a mechanical and chemical bond. To accelerate the direct VPT procedure, allowing the clinician to make a final restoration in the same visit, some hybrid light-curing calcium-hydroxide base material were introduced, that however does not give satisfactory result in comparison with MTA, about the cytotoxicity of the biomaterial, that result increased.

Once is underlined the presence of a reversible pulpitis in the element to treat, the formation of the dentinal bridge depends by the biocompatibility of the material used and the release of calcium ions the influence the quantity and the quality of that.

One of the last material that was introduced on the market was Biodentine (Septodont), a bio-silicate that merges the high biocompatibility characteristics of MTA with the superior mechanical characteristics, similar to the human dentine. Its chemical composition is very similar to the MTA, where Biodentine results in superior mechanical proprieties and more easy bonding with the remaining dental tissue and the restorative material. The choice of adopting a Two stage technique instead of a one stage it’s dictated by the possibility of evaluating the interested tooth and, in case, intervene with a classic endodontic treatment, wasting only the VPT material and not the final restoration [14-21].

Conclusion
The VPT is a technique that the clinician can use, with a high success rate. The ability of making a correct VPT depends by many factors such as precision of the empiric diagnosis, the selection of the patient and the selection of a biomaterial, that has to be easy to use.

Bibliography

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