Dentinal bridge formation: clinical results after Biodentine™ removal

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Introduction

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 (Akhlaghi et al. 2015). In this conservative therapy group there are: indirect pulp capping, direct pulp capping, miniature pulpotomy and full pulpotomy (Ghoddusi et al. 2014). When one of these therapy modalities are performed, the most important biological target is dentinal bridge formation. Dentinal Bridge is a new reaction tissue that preserves pulp vitality and protects it from abnormal and continuous physical stimuli (cold, hot, percussion); it is due to a series of inflammatory responses leading to the formation of a hard-calcified dentin. This tissue was observed for the first time after calcium hydroxide application on a pulp exposure; owing to a high pH (12,5) calcium hydroxide causes liquefaction necrosis of the superficial pulp, removing up to 1,5 mm of the inflamed tissue. This is followed by neutralization of toxicity in the deep layers with coagulative necrosis. Clinically, dentinal bridge formation is valued by Rx analysis where the pulp chamber is reduced after 3-6 months from VPT therapy.

The aim of this article is to demonstrate a real dentinal bridge formation after complete Biodentine™ removal.

Clinical Case

A 29 year-old female patient with no systemic disease came to my office to restore 2.1 element where was a carious process on the mesial side (Fig. 1).

No spontaneous pain. Her dentist had made a conservative therapy two times in 4 months where the direct restoration had an incorrect adhesion. After a clinical analysis of Rx, cold, electric and percussion tests, a carious process close to the pulpal horn was detected (Fig.2 - 3).

After obtaining the patient's consent, local anaesthesia was performed (Articaine HCL 4% and 1:200000 adrenaline, Septanest, Septodont), the carious dentine was completely excavated and the pulp was exposed (fig 4-5-6-7).

A miniature pulpotomy by low speed handpiece was performed and Biodentine™ (Septodont) (Fig.8) was placed.

To improve hardness resistance a thin Equia Coat (GC) layer was applied on Biodentine™ restoration (Fig.9). Cold, Electric and Percussion Analysis were performed at 7,14,30,60,90, 180 and 360 days (table 1). After 360 days second restaurative step was performed (fig.10).

After obtaining the patient's consent, local anaesthesia was performed (Articaine HCL 4% and 1:200000 adrenaline, Septanest, Septodont), and the Biodentine™ restoration was completely removed to observe dentinal bridge type formation (Fig.11). In this case a complete Biodentine™ removal was performed only to value real dentinal bridge formation; clinically this procedure is absolutely unnecessary to achieve clinical success.

A composite direct restoration (ASTERIA) was performed on 2.1 and 1.1 elements (fig.12a, 12b, 12c).

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Figure 1: Preoperative clinical photograph of carious process on 2.1 and 1.1.

Figure 2: Preoperative Rx of carious process on 2.1 and 1.1; the pulpal horn was very close to the carious process.

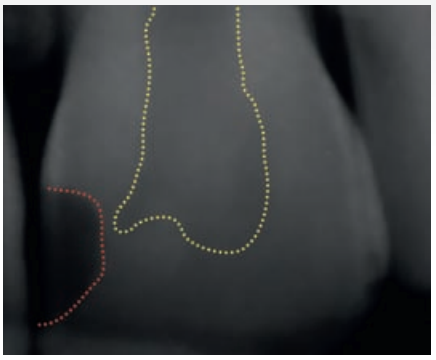

Figure 3: Magnification: yellow line is the pulp chamber contour; red line is the cavity contour. It shows that the carious process is 1mm close to the pulpal horn.

Figure 4: Preoperative clinical photograph. The carious process looks very small and simple to achieve restorative success.

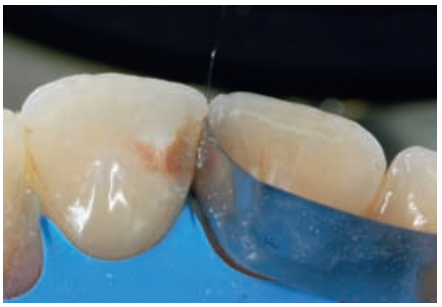

Figure 5: A steel matrix protect element 1.1 during carious excavation. Presence of deep carious process under the initial cavity.

Figure 6: Pulpal exposure (palatal view).

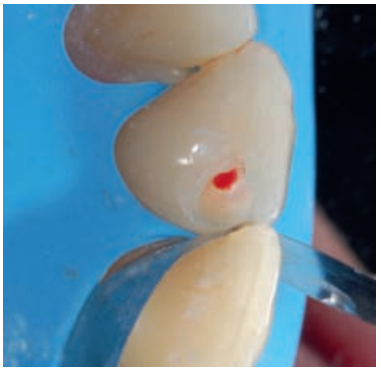

Figure 7: Pulpal exposure (occlusal view).

Figure 8: Biodentine™ in situ during VPT procedure.

No apical suffering signs were detected (Fig.13) and clinical tests were normal (Table 1).

Discussion

Clinical practice success on VPT procedure is made when no spontaneous pain is present. Dausch et al. (1952) demonstrated that, after a pulp amputation and calxyl application, clinical success was 98% while histologically only 76%. Dentinal bridge formation is an important Rx success parameter. In recent articles, dentine bridge formation was evaluated. Nowicka et al. (2015) performed on 44 third molars without carious process a voluntary pulp

Table 1: Clinical tests

Tooth 21	Electric	Cold	Persussion
pre op	17	+	-
7 days	17	++	-
14 days	11	++	-
30 days	18	++	-
60 days	10	++	-
90 days	10	+	-
180 days	15	+	-
360 days	15	+	-

Figure 9: Biodentine™ after equia coat layer application.

exposure and analysed dentinal bridge thickness and density after application of four types of materials. The results show that Biodentine™ and MTA resulted in the formation of bridges with a significantly higher average volume compared with Single Bond Universal.

Only The CBcT offers a correct volumetric Rx analysis of dentinal bridges, but in common practice a 2D evaluation had never been made. Dentinal Bridge is made of colliquative and/or liquefaction necrosis processes. This events create a hard tissue layer that protect the residual pulp tissue by chemical-physical stimulus. When a VPT is performed and a restoration is made, an empty space is present between a pulp capping material and a dentinal bridge caused by superficial pulp destruction (Franz et al. 1984). Dentine fragments, which are displaced into the pulp during cavity preparation, are acting as initial loci for mineralization or pulp stone formation (Mjor et al. 1991). Angiogenesis is essential for pulp wound-healing process because blood vessels play an important role in nutrition and oxygen supply, as a conduct for transport of metabolic waste, pulp homoeostasis and metabolism, and stem/progenitor cell migration (Nakashima et al. 2005). A correct material choice in VPT is very important to improve cells vitality. In recent research has been demonstrated that Biodentine™ caused a cytotoxic effect similar to MTA, suggesting that it may be considered an alternative in pulpcapping treatment (Poggio et al. 2015).

Dentinal Bridge formation time is 90 days (Hørsted et al. 1981). In my clinical practice, in Rx analysis the dentinal bridge presence is clear after 180-360 days. This observation highlights that a dentinal bridge is one of the parameters of a VPT follow up, but the clinical waiting period observation is about 1 year.

Matsuo et al. (1996) demonstrated that dentinal bridge formation was not clearly detected in Rx analysis and in his study, he did not include reparative dentine formation as a criterion for success and observational period was more variable (3 to 24 months).

Hyper-sensitivity after VPT procedure has neverbeen present in a period of about 30-40 days.This characteristic

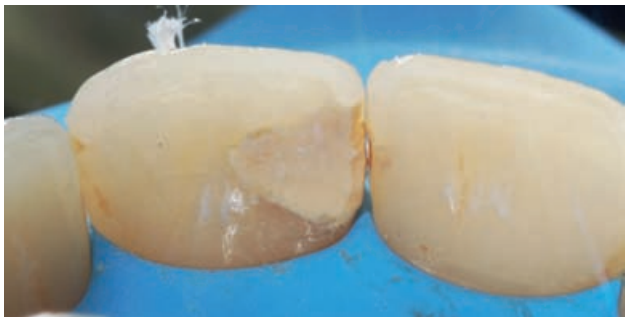

Figure 10: Biodentine™ after 13 months (palatal view).

Figure 11: Dentinal Bridge Formation after Biodentine™ removal.

Figure 12: Dentinal Bridge Formation after Biodentine™ removal (Fig. 11 magnification).

Figure 12a, 12 b: Direct composite restoration of 2.1 and 1.1.

Figure 12c: Direct composite restoration of 2.1 and 1.1.).

Figure 13: rx analysis post op.

is due to presence of theinflammation that is a prerequisite for tissuehealing and pulp regeneration (Goldberg et al.2015).

Conclusion

VPT success in clinical practice depends onmany factors. A correct material choice is helpfulto achieve pulp vitality and dentinal bridge formation after a pulp capping procedure.

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